Eversource Off-Peak Charging Offering for Tesla Owners Evaluation

Prepared for
Eversource
Study No.: MA-21-DR06-EV-OFFPEAK

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Reference No.:
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April 19, 2022

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Offering Overview

Offering Summary

Beginning in summer 2021, Eversource offered incentives for Eversource Tesla owners to encourage them to shift charging to off-peak hours of 11 p.m. and 7 a.m. Eversource initially provided this offering as a part of the ConnectedSolutions (CS) portfolio and branded it ConnectedSolutions Off-Peak Charging for Tesla Owners. Subsequently it is considered an offering outside of the ConnectedSolutions portfolio. In this report, the Eversource Off-Peak Charging Offering for Tesla Owners is referenced as "the offering", "the program", or "CS". The offering aimed to reduce peak demand of electric vehicle (EV) charging load by way of an off-peak charging rebate. The offering was open to Eversource residential customers in Massachusetts who owned a Tesla.

Participating customers received an incentive upon program enrollment, a rebate on electricity usage during off-peak hours, and a monthly bonus incentive for avoiding charging during the hours of 5 p.m. to 8 p.m. The primary objectives of this evaluation were to understand demand reductions and energy impacts resulting from rebates for off-peak charging, to understand customer charging patterns, and to assess the customer experience in the program. As a comparison group, Guidehouse assessed data from customers who were enrolled in Rolling Energy Resources (RER)[1] referred to as RER participants or nonparticipants for this evaluation. This evaluation covered Eversource's offering from July through September 2021.

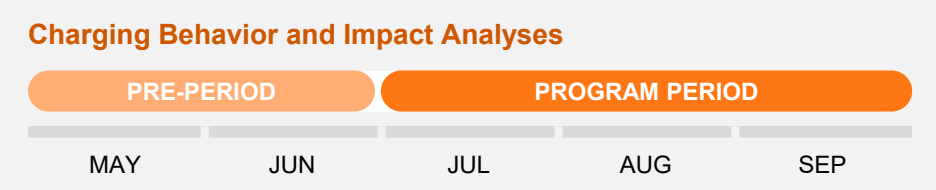
Table 1. Off-Peak Offering Summary Highlights

	Program Attributes	2021 Category		Program Attributes	2021 Category
Program Participants	**State**	Massachusetts	Key Vendors	**Technology Provider**	FleetCarma (Division of Geotab)
	Customer Segment	Residential customers		**Eligible manufacturers**	Tesla
	Target Enrollment	200[2]			
Program Design	**Program Attributes**	**2021 Category**			
	Demand Reduction	• Rebate on electricity costs for charging during off-peak hours (11 p.m.–7 a.m. EDT)			
	Rebate	• $50 enrollment incentive • Jun-Sep: $0.05/kWh ($0.03/kWh Oct-May) during off-peak hours • $10 monthly bonus for avoiding charging 5 p.m. to 8 p.m. • Applies to all locations within Eversource Massachusetts service territory			
	Communications/ Information	• FleetCarma app and dashboard informed and reminded participant to charge during off-peak periods and provided access to charging data for on- and off-peak charging • The SmartCharge Rewards Portal provided participants with information about and access to their rebate incentives			

Source: Guidehouse

Figure 1 shows the pre- and program periods for the Charging Behavior and Impact Analyses during the summer of 2021. These periods are the same for both CS and RER participants.

Figure 1. Data Periods Included in Analyses



Source: Guidehouse

[1] Rolling Energy Resources (RER) is a vendor of EV charging data derived from EV onboard computers, accessed via their native APIs. Guidehouse utilized data from battery EVs (BEVs) enrolled with RER and sharing data with RER to facilitate comparisons to CS participants.

[2] Four marketing emails from Eversource were sent on: April 1, 2021, April 20, 2021, May 18, 2021, and June 1, 2021.

Source for Figure: Guidehouse analysis of CS and RER EV telematics data

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Evaluation Methods

CS Off-Peak Charging Offering Evaluation Methods

PARTICIPANT SURVEYS

Guidehouse administered a survey to all offering participants (CS participants) enrolled as of July 1, 2021 in order to obtain information on how the offering influenced participant driving and charging behavior during the summer months. The survey ascertained participants' acceptance of program design and delivery features.

The survey was also administered to nonparticipants (RER participants). Responses from RER participants informed impact analysis methodology and served as a valuable source of information in comparing CS participants' self-reported feedback on program influence.

DATA MANAGEMENT

Guidehouse received raw interval telemetry and charging session data from FleetCarma. Guidehouse performed quality assurance/quality control (QA/QC) of the EV telematics data and other data sources at the outset of the offering. Guidehouse cleaned and formatted the EV telematics for the usage assessment and impact analysis.

ASSESSMENT OF CHARGING PROFILES

Guidehouse utilized EV telemetry collected from CS participants and RER participants to assess charging profiles. Guidehouse analyzed various metrics for CS participants and RER participants through the period spanning May to September 2021, which included the pre-program (May 1–June 30) and program (July 1–September 30) periods.

IMPACT ANALYSIS

Guidehouse estimated demand and energy impacts during both on- and off-peak hours across the evaluation period using a comparison group approach. Guidehouse modeled CS participants relative to RER participants using a difference-in-differences modeling approach to assess how much charging shifted from on- to off-peak periods.

REPORTING

Reporting included a draft presentation, a draft report, and a final report. Report contents include survey findings, assessment of charging profiles, and impact analysis results.

Source: Guidehouse

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Findings: Customer Experience Research

EV CHARACTERISTICS & CHARGING BEHAVIOR

- Most respondents have a Level 2 charger at home, with CS participants mainly using Tesla chargers.
- The majority of respondents were motivated to purchase an EV to help the environment.
- Fewer CS participants charged their EV until full and more connected their EV to their home charger (regardless of charging or not) during off-peak periods (11 p.m. to 7 a.m.) compared to RER participants.
- Most CS participants scheduled charging times using an app compared to only a small portion of RER participants.
  - 57% of CS and 13% of RER participants who own Teslas and use Tesla chargers scheduled charging times using an app.
  - Common scheduled start times for CS participants was at or after 11 p.m. on weekdays.
- Most CS participants reported location and availability of public chargers as barriers to public charging, and all respondents used workplace charging minimally.

Figure 2. Household Charging Device Usage

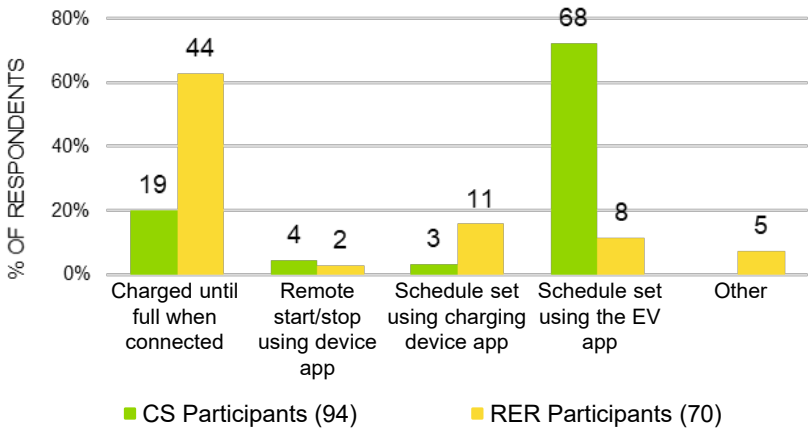
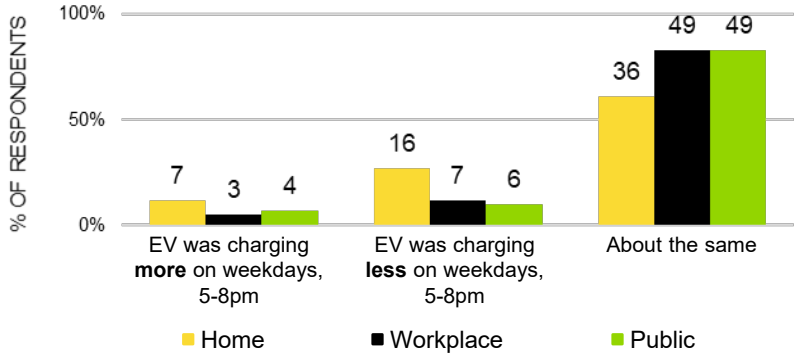


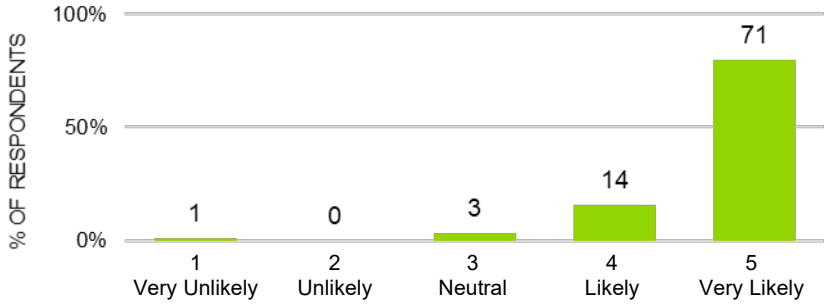
Figure 3. Typical EV Charging on Weekday On-Peak Hours



PROGRAM INFLUENCES

- Program incentives were most commonly cited as the top reason for CS participant enrollment.
- ~70% of CS participants viewed the SmartCharge Rewards Portal and found it valuable, and many said that the energy use information had an influence in determining their EV charging schedule for summer 2021.
- CS participants were more influenced by rewards and monthly bonuses than energy use information when determining their EV's charging schedule for summer 2021.

Figure 4. Likelihood of Continued Program Participation



PROGRAM SATISFACTION

- Almost all of the CS participants (96%) reported that they are likely to continue participating in the program in the future.
- 89% of CS participants were satisfied with the enrollment process
- Most CS participants were satisfied with the SmartCharge Rewards Portal, timing of on- and off-peak periods, and program communication and incentives.

Source for Figures: Guidehouse analysis of 2021 Off-Peak Charging Offering Post-Summer Survey

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Findings: Assessment of Charging Profiles

KEY FINDINGS

- **CS participants conducted most of their charging during off-peak hours (11 p.m.–7 a.m.).** This pattern was observed during the pre-period (May 1–June 30) and the program treatment period (July 1–September 30).
- **Many enrolled EVs appear to have shifted their charging from peak hours (7 a.m.–11 p.m.) to off-peak hours (11 p.m.–7 a.m.).** Despite CS participants conducting more of their charging during off-peak hours prior to program start, EVs appear to have shifted additional charging from peak hours to off-peak hours after the program began. (Note: From Customer Experience Research findings, 32% of CS participants and only 13% of RER participants charged more during off-peak hours in summer 2021 than in summer 2020).
- **30% of customers used scheduled charging in some capacity from May 2021–September 2021.** Nearly all scheduled charging occurred during off-peak hours (11 p.m.–7 p.m.), with most scheduled sessions beginning between 11 p.m. and 12 a.m. Among these customers, there was an increase in scheduled charging during off-peak hours during the program treatment period (July 1–September 30).

Figure 5. Percent of Energy Consumed by Hour, Pre- and Post-July 1 (CS Participants)

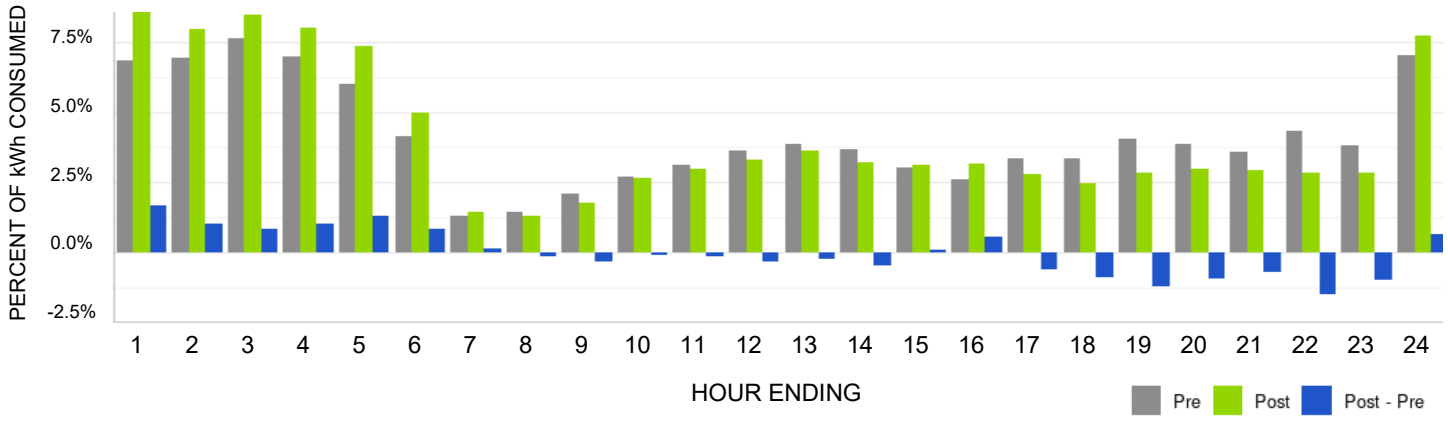
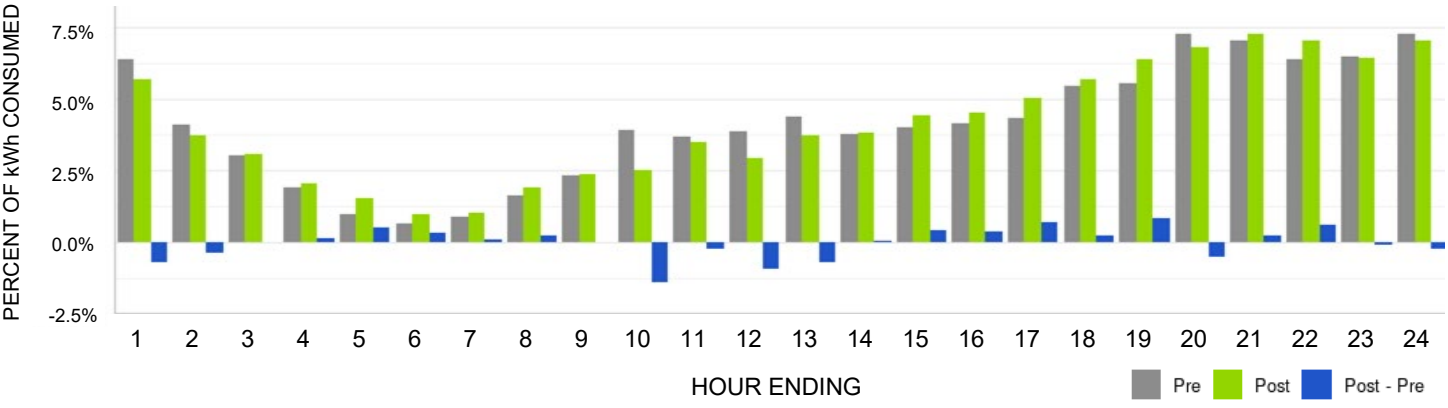


Figure 6. Percent of Energy Consumed by Hour, Pre- and Post-July 1 (RER Participants)



Source for Figures: Guidehouse analysis of CS EV telematics data

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Findings: Impact Analysis

PEAK AND OFF-PEAK PERIOD IMPACTS

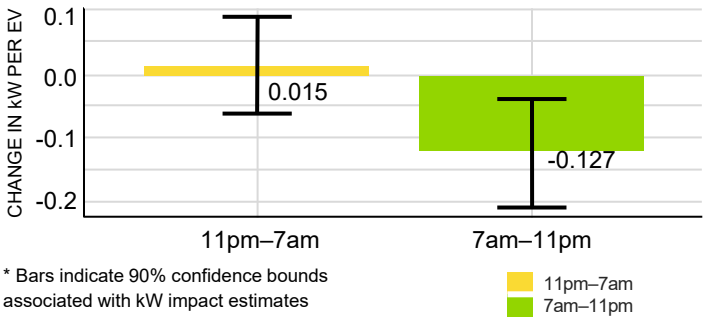
- **Average reductions in demand between the hours of 7 a.m. and 11 p.m. were 0.13 kW per EV.** Daily energy savings between the hours of 7 a.m. and 11 p.m. were 1.85 kWh per EV per day. There was not a statistically significant change in demand or energy between the hours of 11 p.m. and 7 a.m. Reductions in kW demand during peak hours is consistent with findings from charge profile analysis, which indicated that CS participants shifted charging downward during peak hours, particularly during super-peak hours (5 p.m. to 8 p.m.) that had an additional incentive for avoiding charging. This shift in charging from early-evening hours was not only a goal of the offering, but also a measured program impact.

Table 2. Demand Impacts per EV by Period

Impact Analysis Metric	Time Period	Est. Change
Average Half-Hourly kW Reduction per EV	7 a.m.–11 p.m.	-0.127 kW**
	11 p.m.–7 a.m.	0.015 kW
Average Daily kWh Savings per EV	7 a.m.–11 p.m.	-1.852 kWh**
	11 p.m.–7 a.m.	0.130 kWh

* Indicates significance at 90% confidence, ** Indicates significance at 95% confidence, *** Indicates significance at 99% confidence

Figure 7. Average kW Impact per EV by Period



* Bars indicate 90% confidence bounds associated with kW impact estimates

SUPER-PEAK PERIOD IMPACTS

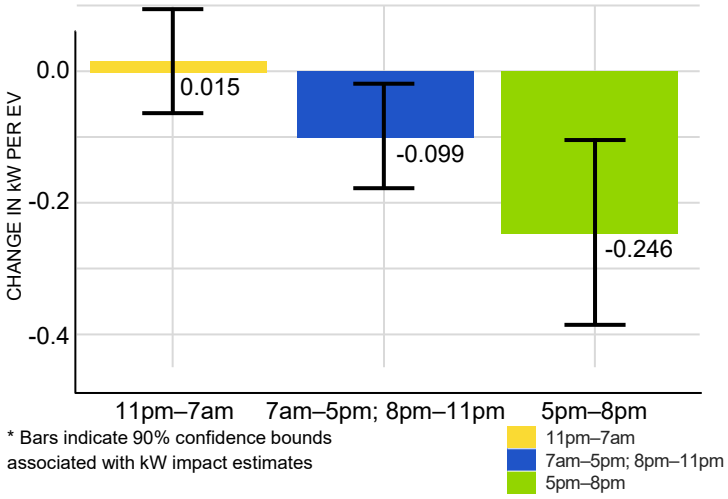
- **Average reductions in super-peak demand between the hours of 5 p.m. and 8 p.m. were 0.25 kW per EV.**[3] In addition to a $0.05/kWh rebate for charging during off-peak hours, CS participants were eligible for an additional $10/month bonus incentive if they avoided charging between the hours of 5 p.m. and 8 p.m. Daily energy savings during super-peak hours were 0.67 kWh per EV per day. For peak hours outside of the super-peak period, demand and energy impacts amounted to a 0.10 kW reduction in demand and 1.18 kWh in daily energy savings per EV. Changes in demand and energy for off-peak hours were not statistically different from zero. This suggests that much of the 0.13 kW per EV demand reduction assessed for 7 a.m.–11 p.m. could be attributed to super-peak demand reductions.

Table 3. Demand Impacts per EV by Period, Including Super-Peak

Impact Analysis Metric	Time Period	Est. Change
Average Half-Hourly kW Reduction per EV	7 a.m.–5 p.m.; 8 p.m.–11 p.m.	-0.099 kW**
	5 p.m.–8 p.m.	-0.246 kW***
	11 p.m.–7 a.m.	0.015 kW
Average Daily kWh Savings per EV	7 a.m.–5 p.m.; 8 p.m.–11 p.m.	-1.180 kWh**
	5 p.m.–8 p.m.	-0.673 kWh***
	11 p.m.–7 a.m.	0.130 kWh

* Indicates significance at 90% confidence, ** Indicates significance at 95% confidence, *** Indicates significance at 99% confidence

Figure 8. Average kW Impact per EV by Period, Including Super-Peak Hours



* Bars indicate 90% confidence bounds associated with kW impact estimates

[3] This finding is comparable to the 0.27 kW reduction per vehicle between 5 p.m. and 9 p.m. observed in the first year of National Grid's Rhode Island Off-Peak Charging Rebate Pilot. Notably, that program was implemented as a randomized control trial. Evaluation results for the pilot can be found linked here: http://www.ripuc.ri.gov/eventsactions/docket/4770-NGrid-RY2%20Transportation%20Initiative%20Annual%20Report%20Combined%20(10.30.2020).pdf

Source for Tables & Figures: Guidehouse analysis of CS and RER EV telematics data

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Final Considerations

Table 4. Key Considerations from the Offering

Research Category	Considerations
Program Design	**CONSIDERATION 1:** Consider creating a program guidebook that educates customers about the benefits of charging during off-peak hours and a monthly report that showcases results from the offering and participant efforts. Continue offering a modest incentive that follows the off-peak charging schedule, but also consider if there is potential to begin off-peak hours earlier than 11 p.m.
	CONSIDERATION 2: Consider implementing additional checks for customers that enroll in future cycles of this offering. For instance, ensure that the customer enrolling in the program meets eligibility requirements for the program, as Guidehouse identified several customers who did not qualify for the program due to living outside of the eligible geographic area but who had still enrolled in the program.
	CONSIDERATION 3: Consider creating a program component, educational tool/info, to teach participants & recruiting audience how to make participation easier – info on using scheduled charging & how to make that happen.
Impacts	**CONSIDERATION 4:** Consider adding a requirement of one calendar year of pre-period data from participants in order to participate in the program. Employing a broader time window of pre-period data – for instance, one calendar year prior to program start – will help improve the accuracy of impact estimates.
	CONSIDERATION 5: As the offering continues or a program based upon this offering is supported, consider tracking and measuring differences in charging behavior and impacts across seasons. Results for the summer season (July 1–September 30) may not be able to be extrapolated to other seasons due to differences in incentive structure and potential differences in driving behavior across seasons.
	CONSIDERATION 6: To more accurately assess how driving behavior changes across seasons, consider obtaining trip data for all enrolled CS participants.

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Final Report

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1. Introduction

Beginning in summer 2021, Eversource offered incentives for Eversource Tesla owners to encourage them to shift charging to off-peak hours between 11 p.m. and 7 a.m. Eversource initially provided this offering as a part of the ConnectedSolutions (CS) portfolio and branded it the ConnectedSolutions for Tesla Owners for Off-Peak Charging. Subsequently it is considered an offering outside of the ConnectedSolutions portfolio. Within this evaluation report, the Eversource Off-Peak Charging Offering for Tesla Owners is referenced as "the offering", "the program", or "CS".

The offering aimed to reduce peak demand of EV charging load by way of an off-peak charging rebate. The offering was open to Eversource residential customers in Massachusetts who owned a Tesla.[1] Participating customers received a rebate on electricity costs for charging during the hours of 11 p.m. to 7 a.m. and additional payments if they avoid charging during the super-peak period of 5 p.m. to 8 p.m.

This evaluation report describes Guidehouse's customer experience research, assessment of charging profiles, and analysis of impacts.[2] As a comparison group, Guidehouse compared data from CS nonparticipants who are currently enrolled in Rolling Energy Resources (RER).[3] This evaluation covers Eversource's offering implemented in Massachusetts from July 2021 through September 2021. Subsequent sections of this report detail Guidehouse's methodology, data sources used, and key findings. As part of this evaluation, Guidehouse developed an interim memorandum summarizing the results of the 2021 process evaluation, which included a participant survey and an impact analysis of charging profiles.

1.1 Offering Summary

Eversource's off-peak offering aimed to reduce EV charging during on-peak hours defined as 7 a.m. to 11 p.m. and especially during super-peak hours between 5 p.m. and 8 p.m. Participating customers received incentives upon program enrollment, a rebate on electricity usage during off-peak hours, and a monthly bonus incentive for avoiding charging during the hours of 5 p.m. to 8 p.m. Table 1-1 summarizes the characteristics of the offering.

Table 1-1. Off-Peak Charging Offering Summary

	Program Attributes	2021
Program Participants	**State**	Massachusetts
	Customer Segment	Residential customers who are Tesla owners
	Target Enrollment	200[4]

[1] This offering was limited to Tesla vehicles as it was not possible to enroll Tesla level 2 chargers in Eversource's other EV managed charging program. If this managed charging approach is offered in the future, Eversource does not intend to constrain future offerings strictly to Teslas.

[2] In a future comparison memo, Guidehouse will compare the kW impacts per EV associated with this offering to Eversource's Electric Vehicle Supply Equipment (EVSE) Direct Load Control offering and National Grid's Electric Vehicle Direct Load Control program.

[3] Rolling Energy Resources (RER) is a vendor of EV charging data derived from EV onboard computers, accessed via their native APIs. Guidehouse utilized data from battery EVs (BEVs) enrolled with RER and sharing data with RER to facilitate comparisons to CS participants.

[4] Four marketing emails from Eversource were sent on: April 1, 2021, April 20, 2021, May 18, 2021, and June 1, 2021.

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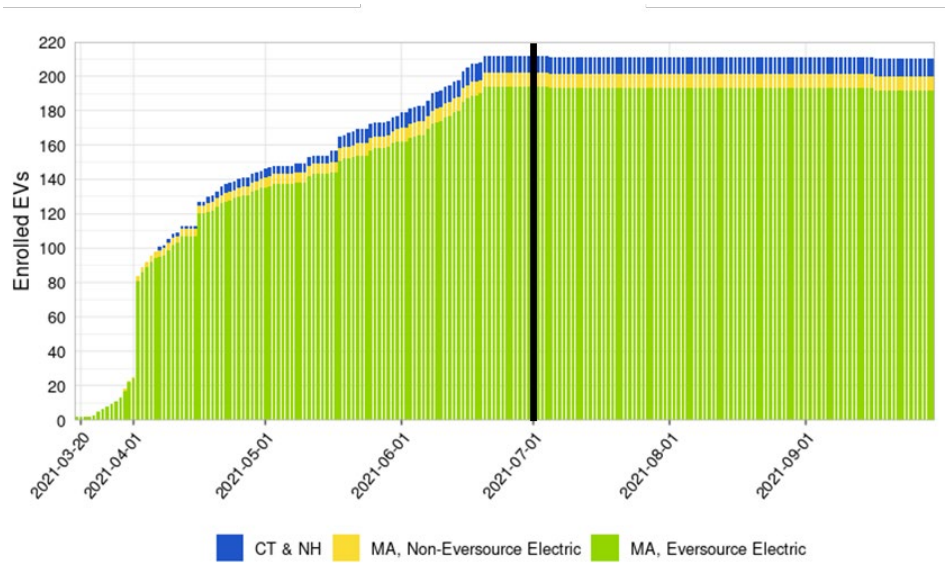
	Program Attributes	2021
Key Vendors	**Technology Provider**	FleetCarma (Division of Geotab)
	Eligible EV Manufacturers	Tesla
Program Design	**Demand Reduction Approach**	Rebate on electricity costs for charging during off-peak hours (11 p.m.–7 a.m. EST)
	Rebate	$50 enrollment incentive Jun-Sep: $0.05/kWh during off-peak hours Oct-May: $0.03/kWh during off-peak hours $10 monthly bonus incentive for avoiding charging between 5 p.m. and 8 p.m. EV can use any EVSE in Eversource's territory to receive the rebate
	Communications/ Information	Participants received information through FleetCarma app and dashboard reminding participants to charge during off-peak hours FleetCarma app and dashboard also provides access to charging data and indication of on-peak/off-peak charging The SmartCharge Rewards Portal provides participants with information about and access to their rebate incentives

Source: Guidehouse

Figure 1-1 shows enrollment in the offering from March through September 2021, with the treatment period start date denoted by a black vertical line. At the end of September, there were 199 customers and 210 EVs enrolled in the offering. Of these, 192 vehicles were associated with Eversource Electric Massachusetts customers. [5]

Figure 1-1. Off-Peak Offering Enrollment



[5] Guidehouse identified 19 ineligible customers that enrolled in the program. They were excluded from the charging profile analysis and impact analysis.

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Source: Guidehouse analysis of CS EV enrollment data

1.2 Evaluation Objectives

The primary objectives of this evaluation were to understand demand reductions and energy impacts resulting from rebates for off-peak charging, to understand customer charging patterns, and to assess the customer experience of the program. These objectives are achievable through the investigation of several research questions relating to 1) customer segments, 2) DR impacts, and 3) program design and scalability. Table 1-2 lists these research questions.

Table 1-2. Off-Peak Charging Offering Evaluation Research Questions

Category	Research Question
Customer Segments	• What participant characteristics impact charging patterns? E.g., type of EVSE used, access to and use of workplace EVSE
Impacts	• What are typical charging patterns during on-peak periods and off-peak periods? • How does the off-peak charging rebate influence charging behavior? • What are the demand and energy impacts of the program during specific peak periods?
Program Design Indicators	• Are customers satisfied with the amount and type of information they are provided about the program through the FleetCarma app and website dashboard? • How likely are customers to continue to participate in the program in the future? • How should program parameters be modified to achieve greater savings or increase customer acceptance of the solution?

Source: Guidehouse

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2. Evaluation Methods

The evaluation assessed the extent to which the offering achieves demand savings and customer acceptance. Table 2-1 summarizes the evaluation approach.

Table 2-1. Off-Peak Charging Offering Evaluation Methods

Task	Description
Participant Survey	Guidehouse administered a survey to all offering participants (hereinafter referred to as CS participants) enrolled as of July 1, 2021, to obtain information on how the program influenced participant driving and charging behavior during the summer months. The survey ascertained participants' acceptance of program design and delivery features. The survey was also administered to nonparticipants (hereinafter referred to as RER participants). Responses from RER participants informed impact analysis methodology and served as a valuable source of information in comparing CS participants' self-reported feedback and program influence. • Primary Data Collection: Post-summer survey • Data: Program participation
Data Management	Guidehouse received raw interval telemetry and charging session data from FleetCarma. Guidehouse performed quality assurance/quality control (QA/QC) of the EV telematics data and other data sources at the outset of the offering. Guidehouse cleaned and formatted the EV telematics for the usage assessment and impact analysis. • Primary Data Collection: N/A • Data: Program participation, EV telematics data, participant survey data
Assessment of Charging Profiles	Guidehouse utilized EV telemetry collected from CS participants and RER participants to assess charging profiles. Guidehouse analyzed various metrics for CS participants and RER participants through the period spanning May to September 2021, which included the pre-program (May 1–June 30) and program (July 1–September 30) periods. • Primary Date Collection: N/A • Data: Program participation, EV telematics data
Impact Analysis	Guidehouse estimated demand and energy impacts during both peak and off-peak hours across the evaluation period using a comparison group approach. Guidehouse modeled CS participants relative to RER participants using a difference-in-differences modeling approach to assess how much charging shifted from peak to off-peak periods. • Primary Data Collection: N/A • Data: Program participation, EV telematics data
Reporting	Reporting includes a draft presentation, a draft report, and a final report. The contents of reporting are: • Survey findings • Assessment of charging profiles • Impact analysis results

Source: Guidehouse

Table 2-2 displays the data periods included in the assessment of charging behavior and impact analyses.

1. Pre-program period (May 2021–June 2021)

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2. Program period (July 2021–September 2021)

For the charging behavior analysis and impact analysis, Guidehouse harnessed data spanning May 1 through September 30 covering the pre-treatment and during program treatment time periods. Most program impacts were assumed to have occurred during the program treatment time period.[6]

Table 2-2. Data Periods Included in Charging Behavior and Impact Analyses

Analysis	2021				
	May	Jun	Jul	Aug	Sep
Charging Behavior Analysis	**Pre-Period** May 1–June 30		**Program Period** July 1–September 30		
Impact Analysis					

Source: Guidehouse

The remainder of this section details the evaluation approach for each of the items Table 2-2 lists.

2.1 Customer Experience Research

Guidehouse administered two online surveys in November 2021. One survey was administered to the CS participants. The other survey was administered to nonparticipants enrolled in the RER EV Metering Study sample as part of the Massachusetts Residential Building Use and Equipment Characterization Study (RER participants). The results from the RER participants were used as a baseline comparison to the CS participants. Survey invitations were sent by email and reminders were sent to survey participants between 3 and 5 days after the initial invite was sent. Table 2-3 summarizes the time period covered by the surveys, the EV manufacturers included, and completion rates for each survey. The response rate for RER participants (73%) was higher than for CS participants (47%), while the total number of completes was higher for CS participants (94% vs. 72%).

The surveys were administered to Massachusetts CS and RER participants who enrolled prior to July 1, 2021. All respondents received a $10 e-gift card for completing the survey.

Table 2-3. 2021 Post-Summer Survey Summary

Survey Topics	CS Participants	RER Participants
Time Period Covered	2021 summer (June–August)	2021 summer (June–August)
Survey Fielded	November 3–15, 2021	November 3–15, 2021
EV Manufacturer	Tesla	Tesla, Chevrolet, Hyundai, Nissan, Volkswagen, BMW, Ford, Chrysler, and Audi
Invites Sent*	200	99
Completes	98	72

[6] There is a risk that program participants shifted charging behavior as soon as they enrolled in the program but before the off-peak charging rebate began on July 1. As such, some of the program impacts may be contained in the pre-period spanning May 1 – June 30.

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Survey Topics	CS Participants	RER Participants
Used Completes**	89 or 94†	72
Response Rate††	47%	73%

*Based on enrollment and incentives filed prior to 07/01/2021; counts include "Vehicle Connected" status only.
**Four CS participants were removed from the completes pool due to participation issues (3) or invalid data (1).
†Five CS participants were not presented with program-specific questions during the soft launch.
††Response rate is calculated as the ratio of completes used relative to invites sent.

Source: Guidehouse

Table 2-4 summarizes the topics covered in each survey. Certain topics were only included for CS participants (i.e., motivations for enrolling, program influence, and program satisfaction).

Table 2-4. 2021 Post-Summer Survey Topics

Survey Topics	Time Period Covered	CS Participants	RER Participants
Motivations and enrollment	2021 summer	All respondents	N/A
EV information	2020 and 2021 summer	All respondents	All respondents
EV characteristics and driving behavior	2021 summer	All respondents	All respondents
EVSE characteristics and charging behavior	2021 summer	All respondents	All respondents
Changes since summer 2020	Differences between summers 2021 and 2020	All respondents	All respondents
Program Influence	2021 summer	All respondents	N/A
Program Satisfaction	2021 summer	All respondents	N/A
Participant Demographics	N/A	All respondents	All respondents

Source: Guidehouse

Table 2-5 includes Guidehouse's activities for both the CS participant and RER participant surveys. Appendix A contains the survey instruments.

Table 2-5. Participant Survey Activities

Category	Activities
Survey Design and Programming	• Developed draft of survey instruments (maintain similarity in question structure across survey efforts) • Finalized survey instruments based on feedback from Eversource and EEAC Evaluation, Measurement, and Verification consultants • Programmed surveys • QA/QC of programmed surveys
Sample Preparation	• Received latest enrolled participant information (including contact information) • Prepared samples (e.g., remove those enrolled after July 1, 2021)

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Category	Activities
Survey Implementation	• Provided Eversource call center with information about the survey effort • Sent survey to CS participants and RER participants • Monitored survey completions • Sent reminder emails • Provided $10 e-gift cards for respondents who completed the survey
Data Cleaning and Analysis	• Cleaned/recoded data in preparation for analysis (including cleaning and coding of verbatim/open-ended responses) • Analyzed data using appropriate tool (e.g., SPSS, R)

Source: Guidehouse

2.2 Assessment of Charging Profiles

Understanding how customers used their EVs informed the impact analysis and clarified differences in behavior between CS participants and RER participants. The assessment of charging profiles includes breakouts by the following four time periods and data combinations to distinguish the potential changes in behavior caused by program participation:

1. Pre-program period (May 2021–June 2021) for CS participants
2. Program period (July 2021–September 2021) for CS participants
3. Pre-program period (May 2021–June 2021) for RER participants
4. Program period (July 2021–September 2021) for RER participants

For this analysis, Guidehouse assessed metrics including average energy consumption by hour and period, average daily energy consumption, scheduled charging frequency, and the prevalence of Level 1 and Level 2 chargers.

2.3 Impact Analysis

Guidehouse estimated demand and energy impacts of program participation during off-peak hours (11 p.m. to 7 a.m.) and peak hours (7 a.m. to 11 p.m.) that occurred between July 1 and September 30 using a difference-in-differences regression approach.

2.3.1 Difference-in-Differences Regression Approach

The difference-in-differences regression approach employs a regression that estimates average demand or energy usage, which varies based on time of day (i.e., off-peak or peak hours), time period (i.e., prior to CS program or following beginning of CS program), and program participation status (i.e., CS participant or RER participant).

To estimate impacts, Guidehouse regressed demand on a set of time-specific fixed effects (e.g., day of week), an indicator for the time period of the day, an indicator of program participation status (e.g., treatment), and an indicator of whether the time is prior to or within the program treatment period. Equation 2-1 shows the model specification.

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Equation 2-1. Model Specification

$$kW_{it} = \lambda_t + \beta_0 + \beta_1 Peak_t + \beta_2 Post_t + \beta_3 Treatment_i + \beta_4 Post_t\ Treatment_i + \beta_5 Post_t\ Peak_t + \beta_6 Peak_t\ Treatment_i + \beta_7 Peak_t\ Post_t\ Treatment_i + e_{it}$$

Where,

kW_{it}	is the demand for EV *i* during period *t*
λ_t	is a series of time-specific fixed effects for period *t;* these pick up temporal differences, such as day of week
$Post_t$	is a binary variable taking a value of 1 when *t* is in the post-period spanning July 1 through September 30 and 0 otherwise
$Peak_t$	is a binary variable taking a value of 1 when *t* is in the period not eligible for the off-peak rebate (i.e., *t* is in 7 a.m. to 11 p.m.) and 0 otherwise
$Treatment_i$	is a binary variable taking a value of 1 when EV *i* is enrolled in the off-peak offering and 0 when EV *i* is enrolled in the RER demonstration
ε_{it}	is the cluster-robust error term for EV *i* during period *t;* cluster-robust errors account for heteroskedasticity and autocorrelation at the household level

In this difference-in-differences specification, the change in kW attributed to program participation during off-peak hours is estimated via β_4, while the change in kW attributed to program participation during peak hours is estimated via $\beta_4 + \beta_7$

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3. Data Sources and Data Review

This section describes the data sources used for this evaluation and the steps taken to prepare the data for analysis. The data sources used included survey data (described in Section 2.1), and data from Eversource, Geotab/FleetCarma, and RER.

3.1 Data from Eversource, Geotab/FleetCarma, and RER

- **CS EV enrollment data:** This data identified each vehicle enrolled in off-peak offering and provided key information about the vehicle's enrollment, including the date(s) the vehicle was accepted to the program, the date the vehicle unenrolled from the program (if applicable), the year, make, and model of the vehicle, and customer contact information. The program was limited to Tesla owners, so the CS enrollment data includes only Tesla vehicles.
- **RER EV enrollment data:** Like CS enrollment data, RER enrollment data identified each vehicle contained in its respective interval data. This data also included the year, make, and model of the vehicle, as well as customer information. RER data included nine different EV manufacturers.
- **CS EV telematics interval data:** This data contained energy and demand associated with times when a vehicle was plugged-in and charging. It was provided in 15-minute intervals for each EV enrolled in the program.
- **RER EV telematics interval data:** RER data contained similar information as CS data, including energy and demand. However, RER data was provided in 30-minute intervals.

Guidehouse used the interval, session, and telemetry data for the assessment of charging behavior and impact analyses. Prior to the analysis, the interval data was cleaned using the following steps:

- **Verify CS interval data covers analysis period:** Data was limited to analysis periods when an EV was enrolled. It was also limited to May 1-September 30 to allow for accurate comparisons between the periods before and after the July 1 program start date.
- **Flag and remove low quality or anomalous data points:** Interval data was modified to remove observations with erroneous data, such as observations where interval start was equal to interval end, or where start state of charge was greater than end state of charge.
- **Convert data to 30-minute interval data:** CS and RER data was provided in two different time interval durations. To allow for accurate charge profile analysis and impacts analysis, CS data was converted to 30-minute intervals to match the RER interval data format.

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4. Analysis and Results

This section summarizes findings from the customer experience research, the assessment of charging profiles, and the impact analysis.

4.1 Customer Experience Research

The following subsection summarizes key findings related to customer experience research. As part of this evaluation, Guidehouse developed an interim memorandum summarizing the results of the 2021 post-summer survey for the CS participants and RER participants. This section includes the findings from the 2021 post-summer survey. In the figures in this section, the percent of respondents is on the y-axis and the respondent counts are above each bar.

4.1.1 Key Findings

- Helping the environment was the most commonly cited primary motivator to purchase an EV, while program incentives was most commonly cited as the top reason for enrolling in the program for CS participants.
- The majority of CS participants (89%) were satisfied with the enrollment process.
- Most respondents (88%) have a Level 2 charger at home, with 11% of CS participants and 77% of RER participants using ChargePoint, Enel X, Leviton, or Siemens chargers. Notably, proportionally fewer RER respondents with Teslas used 'Other' chargers (including Tesla chargers; 45%) than CS participants (89%).
- About half of both CS and RER participants reported their weekly mileage did not change from summer 2020 to 2021, and RER participants reported driving slightly fewer miles overall on weekdays in summer 2021.
- Fewer CS participants (20%) charged their EV until full and on average more (71%) connected their EV to their home charger (regardless of whether they were charging) during off-peak periods (11 p.m. to 7 a.m.) compared to RER participants (63% and 54%, respectively)
- Most CS participants (76%) scheduled charging times using an app compared to only a small portion of RER participants (27%). The most common scheduled start time for CS participants was at or after 11 p.m. on weekdays. Of the respondents who own Teslas and use 'Other' chargers (including Tesla chargers), 57% of CS participants scheduled charging times using an app compared to 13% of RER participants.
- Most CS participants reported location and availability of public chargers as barriers to public charging, and all respondents used workplace charging minimally.
- About 70% of CS participants viewed the SmartCharge Rewards Portal and found it valuable, and many reported a high score for the influence that energy use information had on determining their EV charging schedule for summer 2021.
- CS participants were more influenced by rewards and monthly bonuses than energy use information when determining their EV's charging schedule for summer 2021.
- Almost all (96%) of CS participants reported that they are likely to continue participating in the program in the future.

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- Most CS participants were satisfied with the SmartCharge Rewards Portal, timing of on- and off-peak periods, and program communication and incentives.

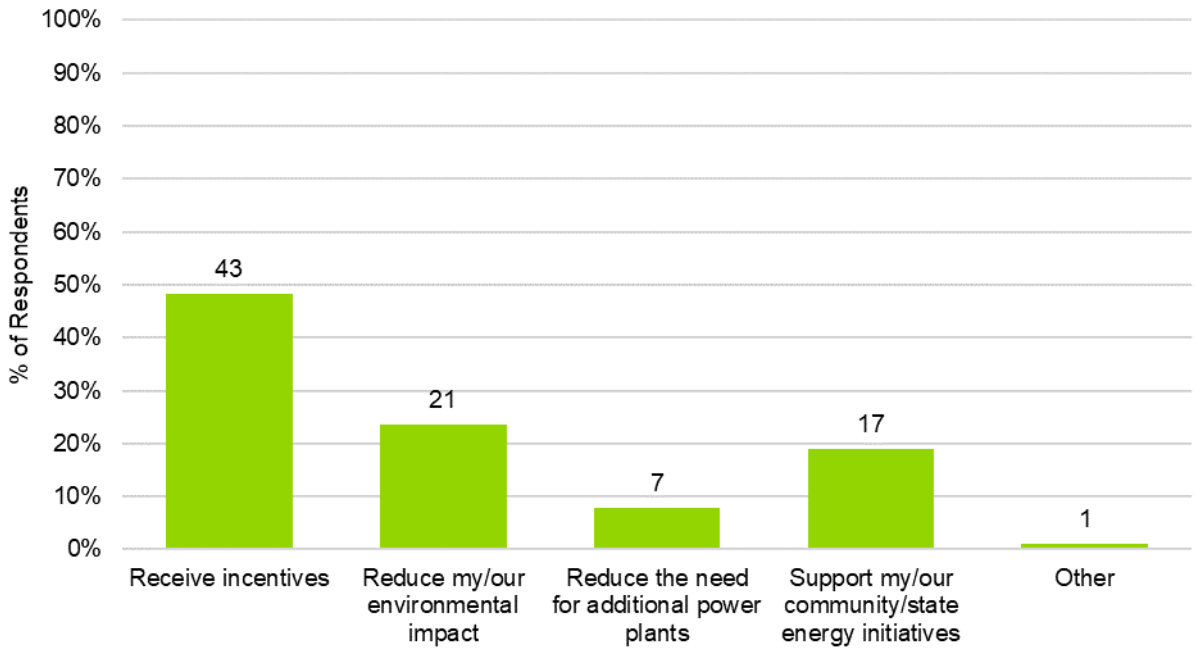
4.1.2 Participant Survey Results

The Key Findings summary above is based on the following sections that present an analysis of the 2021 post-summer survey (conducted in November 2021) data. As mentioned previously, certain survey topics were only presented to CS participants (i.e., motivations for enrolling, program influence, and program satisfaction). Appendix B includes the aggregated responses for every survey question.

4.1.2.1 Motivations and Enrollment

Guidehouse asked CS participants about their motivations as well as their experience enrolling in the program. Figure 4-1 shows these respondents cited receiving the program incentives as their top reason for enrolling in the program (43 respondents, 48%).

Figure 4-1. Top Motivation for Enrolling (n=89)



M1. What was your top motivation for enrolling in Eversource's ConnectedSolutions SmartCharge Rewards Program?

Note: Five out of the 94 CS participants were not presented with program-specific questions during the soft launch.

Source: Guidehouse analysis of 2021 Off-Peak Charging Offering Post-Summer Survey

The majority of CS participants (89%) were satisfied with the enrollment process (Figure 4-2). A few respondents encountered the following challenges in the enrollment process:

- Delays in successful enrollment and unclear guidelines (six)
- Difficulties connecting Tesla to rewards account (five)
- Difficulties creating rewards account (two)

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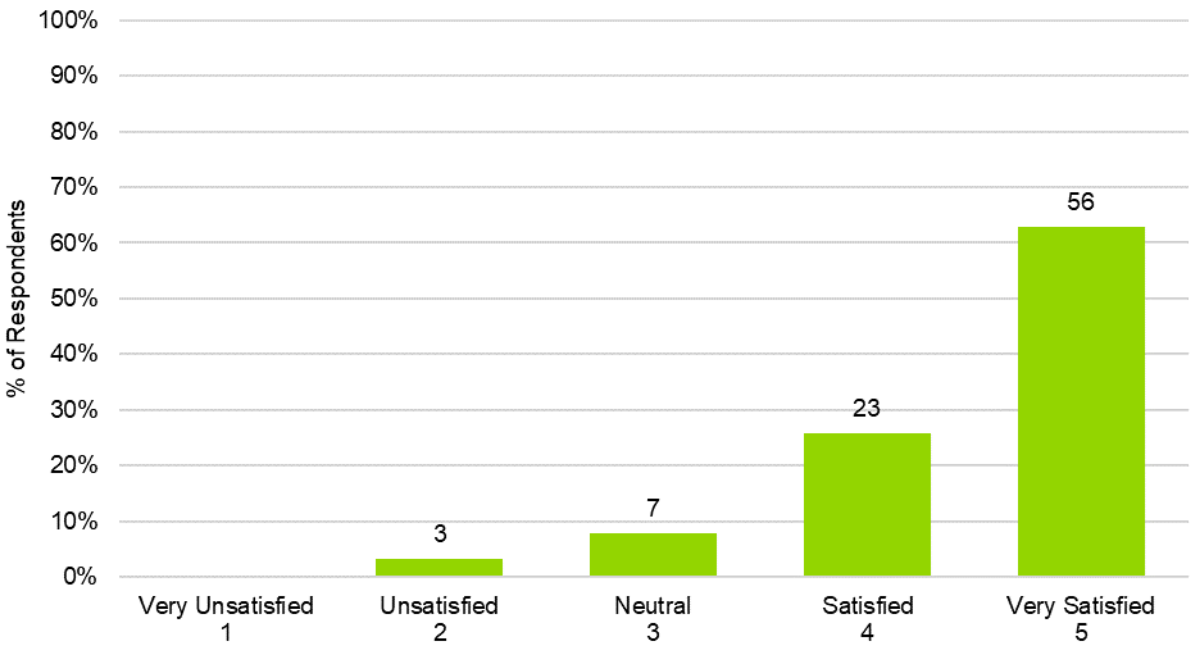
- Issues installing or connecting to EVSE (two)

Figure 4-2. Satisfaction with the Enrollment Process (n=89)



M3. On a scale of 1 to 5, where 1 indicates "Very Unsatisfied" and 5 indicates "Very Satisfied," how satisfied were you with the process of enrolling in the program?

Note: Five out of the 94 respondents were not presented with program-specific questions during the soft launch.

Source: Guidehouse analysis of 2021 Off-Peak Charging Offering Post-Summer Survey

4.1.2.2 EV Characteristics and Driving Behavior

When asked to identify their top motivation for purchasing their EV(s), CS participants (50 participants, 53%) and RER participants (33 participants, 46%) most commonly cited that their motivation was to help the environment (Figure 4-3). The next-most commonly cited reasons for both participants were a desire for the latest technology and fuel independence.

Despite the environment being a primary motivator to purchase an EV, CS participants cited program incentives as their top reason for enrolling in the program (as Figure 4-1 shows).

Out of both CS participants and RER participants, 10 respondents own an additional BEV and nine respondents own an additional PHEV that was not enrolled in the program or RER study. Most of the CS participants (92 participants, 98%) and RER participants (67 participants, 93%) reported that their enrolled EV functioned as their primary form of transportation.

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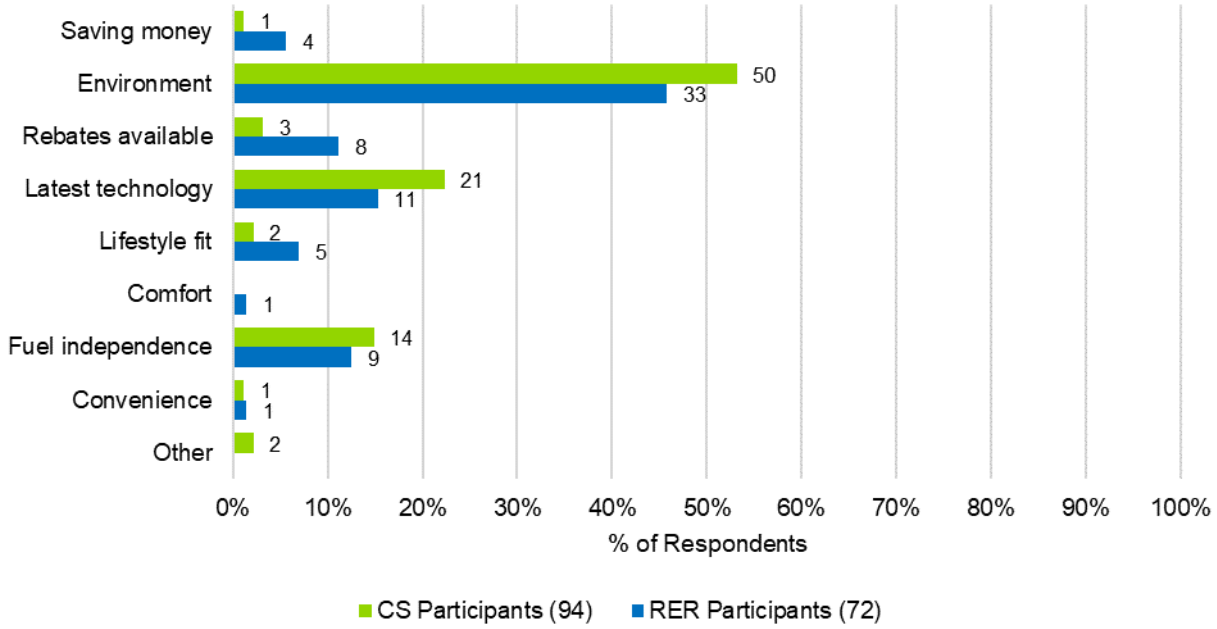
Figure 4-3. EV Purchase Motivation (n=166)



EV17. What was your household's top motivation for buying the EV?

Source: Guidehouse analysis of 2021 Off-Peak Charging Offering Post-Summer Survey

In terms of daily mileage driven in their EV, a majority of CS participants (60 participants, 64%) and RER participants (52 participants, 72%) drove their EV 30 miles or less per day on average during typical summer 2021 weekdays, as Figure 4-4 demonstrates. Approximately half of the CS participants (45 participants, 48%) and RER participants (36 participants, 50%) stated that their weekday EV mileage did not significantly change from summer 2020 to summer 2021.

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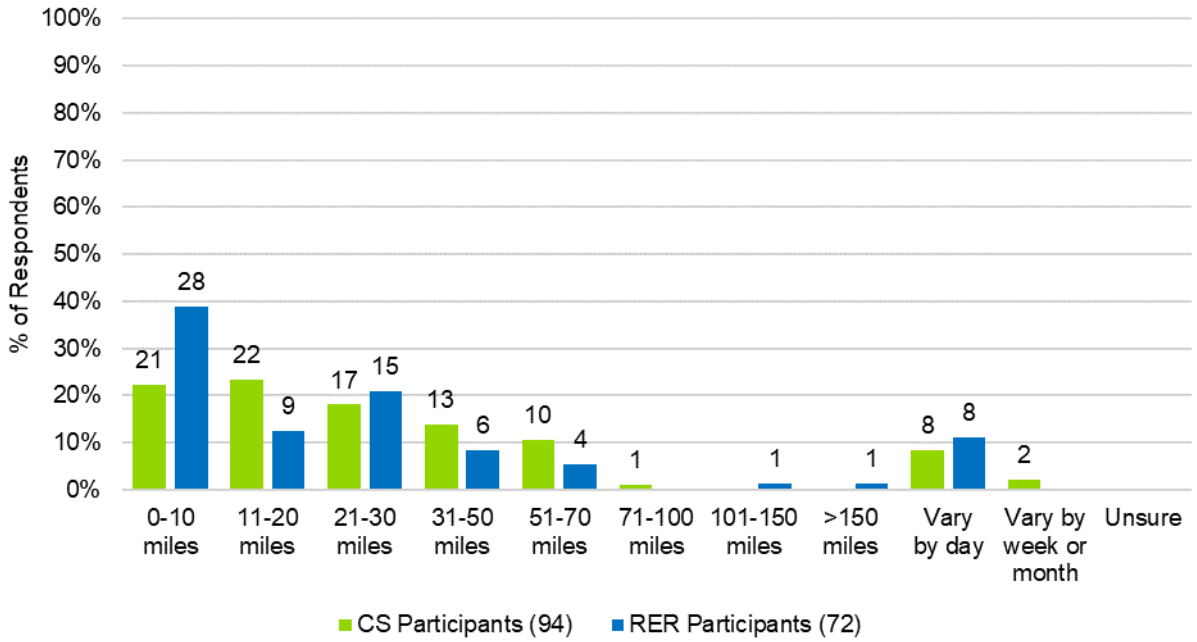
Figure 4-4. Average Miles Driven in EV on Typical Weekday in Summer 2021 (n=166)



EV19. On a typical summer 2021 weekday (Monday, Tuesday, etc.), on average, how many miles was this EV driven by you and other members of your household?

Note: Respondents with more than one EV were asked to answer questions about the EV whose driving and charging patterns they were most familiar with.

Source: Guidehouse analysis of 2021 Off-Peak Charging Offering Post-Summer Survey

4.1.2.3 EVSE Characteristics

Most CS participants (81 participants, 86%) and RER participants (65 participants, 90%) own a Level 2 charger at home. Figure 4-5 shows the distribution of these Level 2 chargers. Half of RER participants (33 participants, 51%) reported having a ChargePoint device at home, whereas CS participants (72 participants, 89%) reported owning a Level 2 charger that did not fit the list of brands in the survey. Since CS participants are by requirement all Tesla owners, it can be assumed that the majority of these 'Other' responses correspond to OEM-specific charging devices, namely Tesla.

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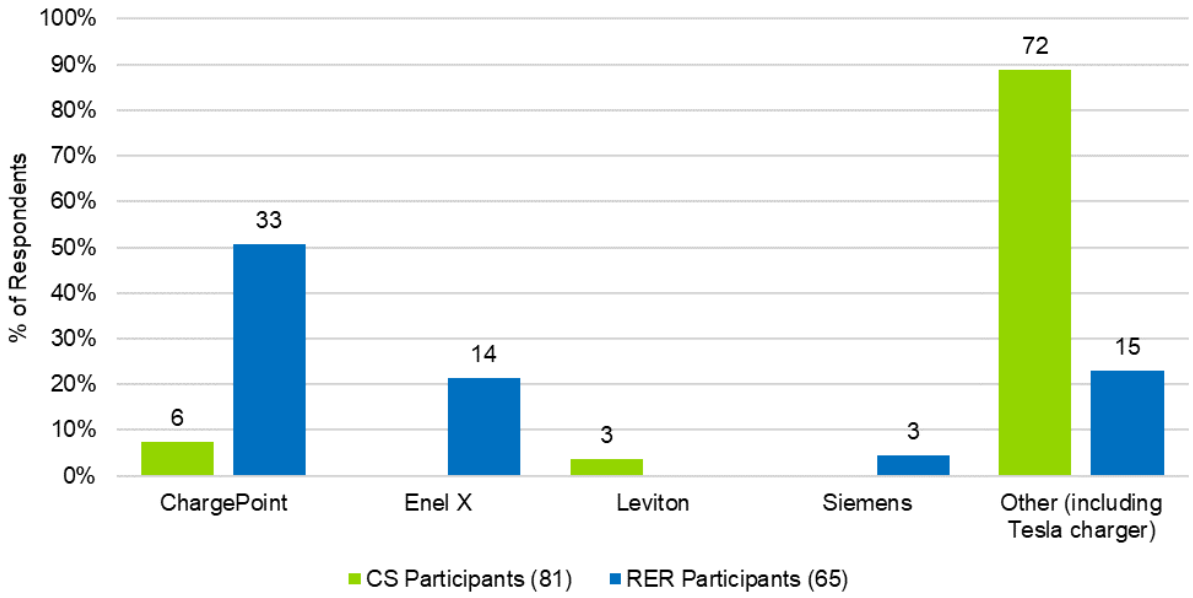
Figure 4-5. Make of Level 2 Charger (n=146)



CB3. Please select the make of your Level 2 charger.

Source: Guidehouse analysis of 2021 Off-Peak Charging Offering Post-Summer Survey

Per Figure 4-6, RER participants (30 participants, 42%) have a higher proportional frequency of storing their home charging device compared to CS participants (24 participants, 26%). Mainly CS participants (12, 13%) use a heated garage to store their home charging device in comparison to RER participants (1 participants, 1%). Most CS (46 participants, 49%) and RER participants (35 participants, 49%) store their home charging device in an unheated attached garage.

Although not a major factor in the summer, cold winter temperatures can affect charging in unheated garages and outdoors. Furthermore, prolonged exposure to extremely low or high temperatures can influence how effectively the Lithium-ion (Li) battery charges and reduce its longevity. The optimal charging temperature range for Li-batteries is between 15°C to 35°C (59°F to 95°F) even though Li-battery manufacturers usually list the charging temperature range as 0°C to 45°C (32°F to 113°F).[7,8]

[7]Aqwu, Daberechi, F. K. Opara, Nkwachukwu Chuwuchekwa, D. O. Dike, and L. Uzoechi. 2017. "Review of comparative battery energy storage systems (Bess) for energy storage applications in tropical environments." *IEE NIGERCON* 1000-1005.

[8]Motoaki, Yutaka, Wenqi Yi, and Shawn Salisbury. 2018. "Empirical analysis of electric vehicle fast charging under cold temperatures." *Energy Policy* 162-168.

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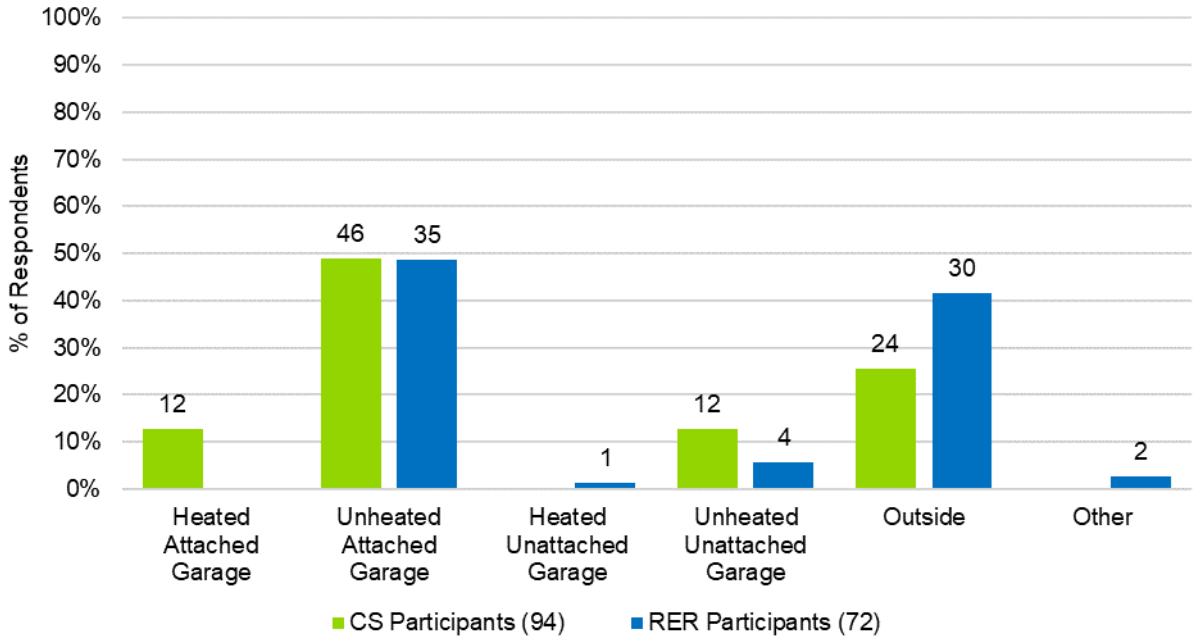
Figure 4-6. Location of Home Charging Device (n=166)



D2. Which of the following best describes the location of your home charging device?

Source: Guidehouse analysis of 2021 Off-Peak Charging Offering Post-Summer Survey

4.1.2.4 Charging Behavior and Changes Since Summer 2020

As shown in Figure 4-7, about 76% of CS participants (71) scheduled charging times using an app, compared to only 27% of RER participants (19). Of the respondents who own Teslas and use 'Other' chargers (including Tesla chargers), 57% of CS participants (54) scheduled charging times using an app compared to 13% of RER participants (3). Thus, Tesla owners in the RER participant group described less scheduling behavior in comparison to CS participants. This is possibly because the potential to receive incentives from the offering influences customers to schedule charging around peak-demand hours.

Approximately 20% of CS participants (19) reported connecting their EV to their home charging device whenever it is not in use and charging until full compared to 63% of RER participants (44). Of the 23 RER participants who own Teslas, 52% (12) connected their EV to their home charging device whenever it was not in use and charged until full. Although, this is not a significant difference compared to non-Tesla owners in the RER group.

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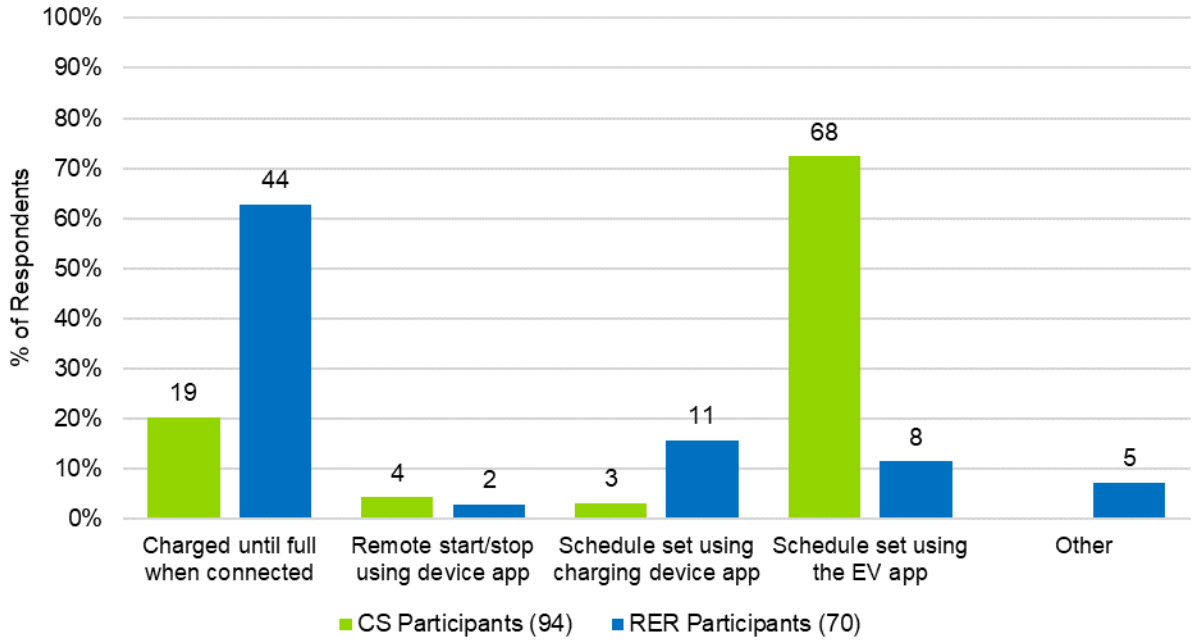
Figure 4-7. Household Charging Device Usage (n=164)



CB5. During summer 2021, which of the following best described your household's use of your home charging device for your EV?

Note: Two RER participants cited that they do not have a home charging device

Source: Guidehouse analysis of 2021 Off-Peak Charging Offering Post-Summer Survey

The most common times for respondents' EVs to be connected to their home charging device, regardless of if the EV was charging or not, on a typical summer weekday in 2021 was between the hours of 6 p.m. and 8 a.m. As Figure 4-8 shows, CS participants (71%) on average reported connecting their EV to their home charger more during off-peak hours (11 p.m. to 7 a.m.) compared to RER participants (54%). Additionally, RER participants (42%) on average reported connecting their EV to their home charger during super peak hours (5 p.m. to 8 p.m.) more than CS participants (26%).

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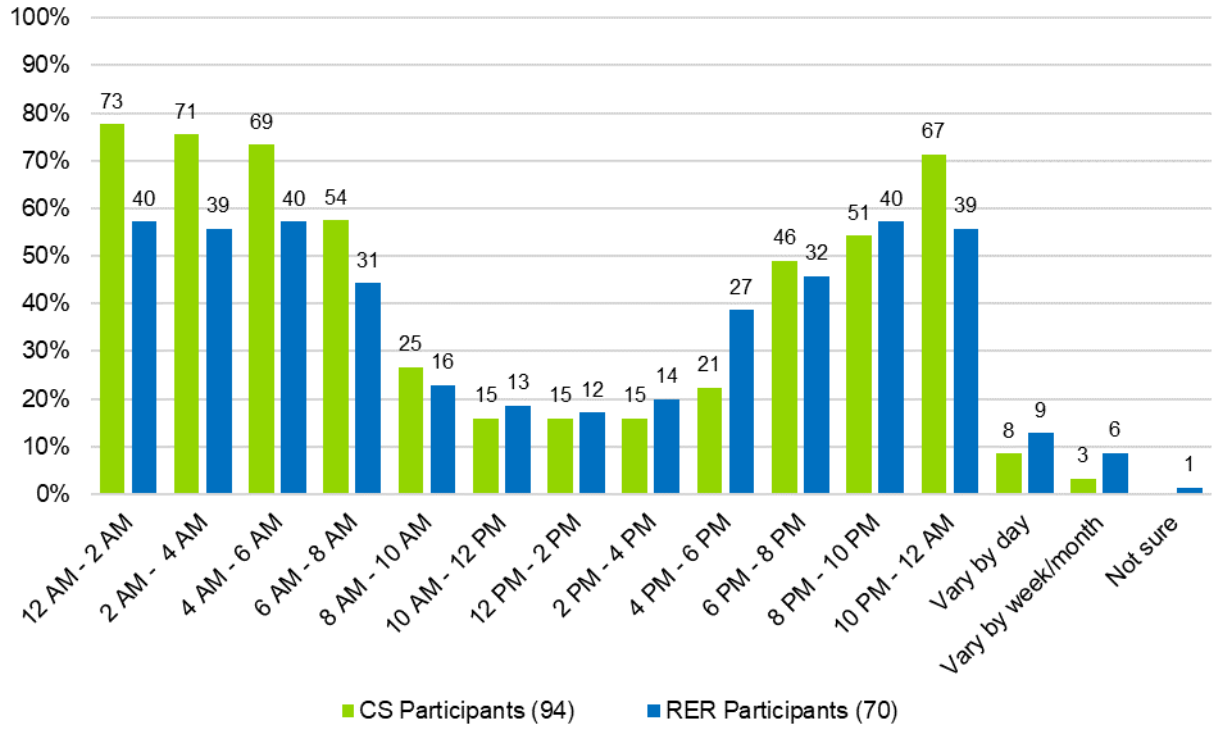
Figure 4-8. Typical Weekday Connection Times for Home Charging Device (n=164)



CB6. Please indicate the time ranges during which the EV was typically connected (regardless of charging or not) to your home charging device on weekdays (Monday–Friday) during summer 2021 (June–August).

Note: Two RER participants cited that they do not have a home charging device.

Source: Guidehouse analysis of 2021 Off-Peak Charging Offering Post-Summer Survey

A greater proportion of CS participants (19 participants, 32%) described an increase in off-peak (11 p.m. to 7 a.m.) charging during weekdays from summer 2020 to summer 2021 than RER participants (7 participants, 13%). This is likely because CS participants charge their EV around peak-demand hours to receive incentives through the offering. Workplace and public charging do not show the same disparity in usage across 2020 and 2021 between each participant type. Figure 4-9 details the full distribution in reported changes to weekday off-peak charging by charger location in summer 2021 compared to summer 2020.

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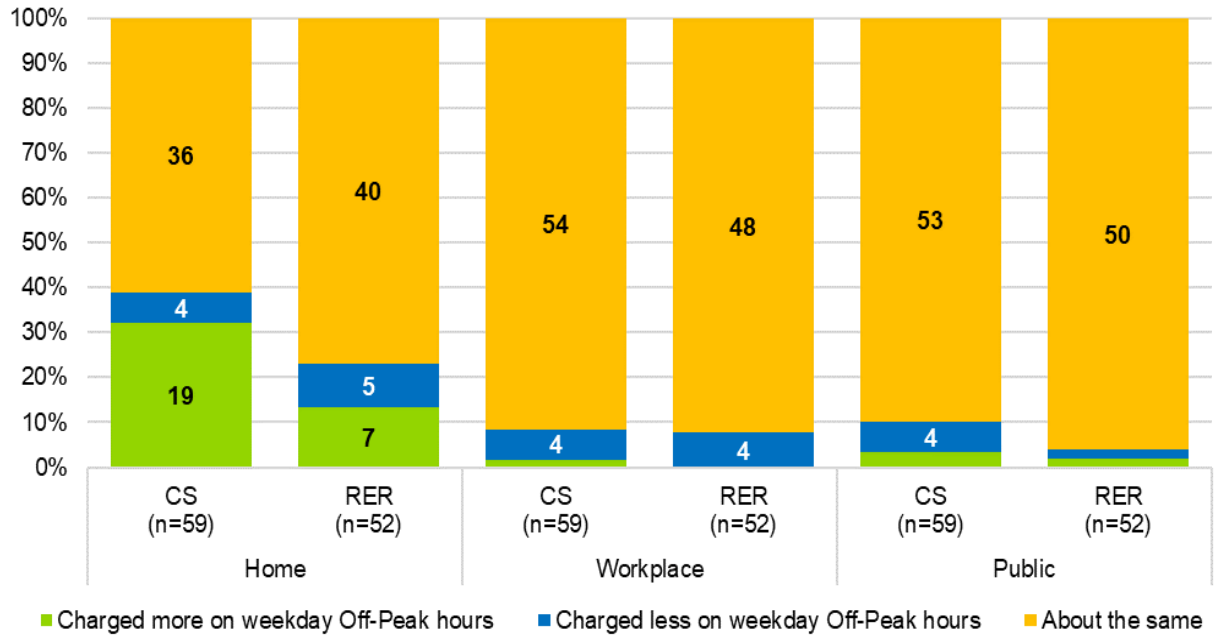
Figure 4-9. Change in EV Charging for Weekday Off-Peak Hours in Summer 2021 Compared to Summer 2020 (n=111)



CS5. Compared to summer 2020, was this EV typically charging more, less, or the same amount in summer 2021 during the weekday hours of 11 p.m. to 7 a.m. relative to other hours? Please indicate how this varied by charging location.

Source: Guidehouse analysis of 2021 Off-Peak Charging Offering Post-Summer Survey

Per Figure 4-10, most CS participants charged their EV the same amount in summer 2020 compared to summer 2021 for all locations (Home: 26 participants, 61%; Workplace: 49 participants, 83%; Public: 49 participants, 83%) on weekdays from 5 p.m. to 8 p.m. (super-peak period). Thus, more CS participants reported changes to their charging behavior at home than at their workplace or public charging stations. More specifically, 27% of CS participants (16) charged at home less on weekdays from 5 p.m. to 8 p.m. in summer 2021 than they did in summer 2020. This is possibly because the potential to receive incentives from the offering influenced customers to charge around super-peak-demand hours.

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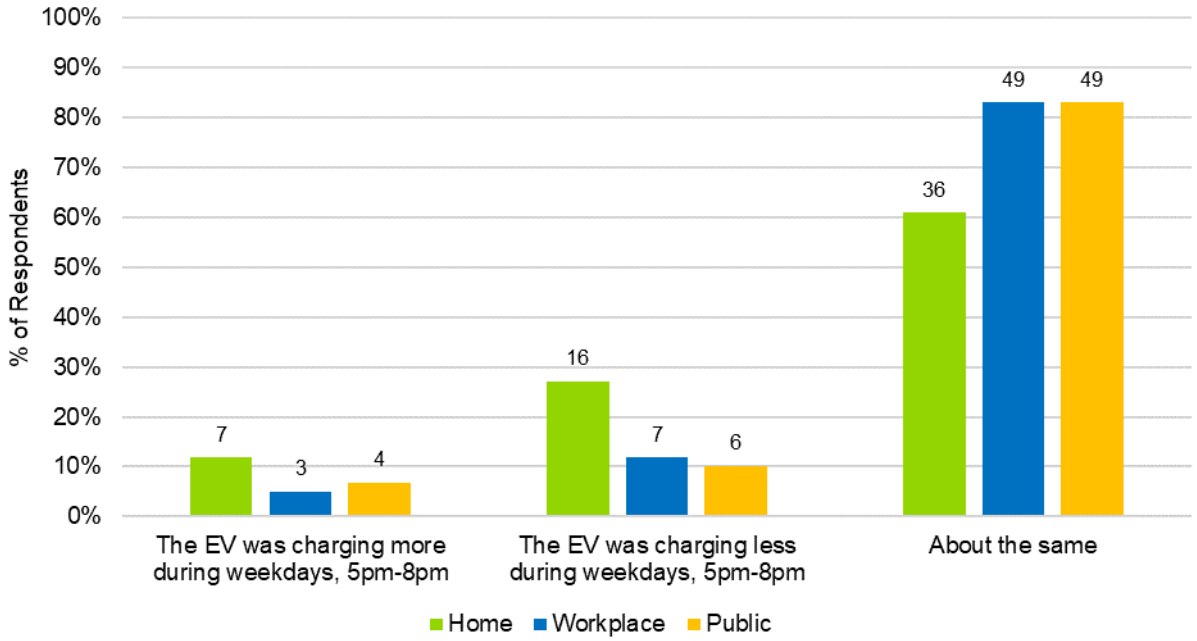
Figure 4-10. Typical EV Charging on Weekday On-Peak hours (n=59)



CS6. Compared to the summer 2020, was this EV typically charging more, less, or the same amount in summer 2021 during weekday hours of 5 p.m.–8 p.m. relative to other hours? Please indicate how this varied by charging location.

Note: Only participants were asked this question in the offering survey.

Source: Guidehouse analysis of 2021 Off-Peak Charging Offering Post-Summer Survey

Few respondents reported using workplace charging during the summer of 2021 (only 18 CS participants and eight RER participants). Most of these CS participants (15 participants, or 83%) are motivated to use workplace charging as it is free for them, as Figure 4-11 shows. On average, the majority of CS participants (76%) and RER participants (63%) charged at their workplace charging station between the hours of 8 a.m. and 2 p.m. on weekdays in summer 2021. Only 19% of CS participants and 6% of RER participants, on average, charged their EV at their workplace charging station between the hours of 4 p.m. and 8 p.m.

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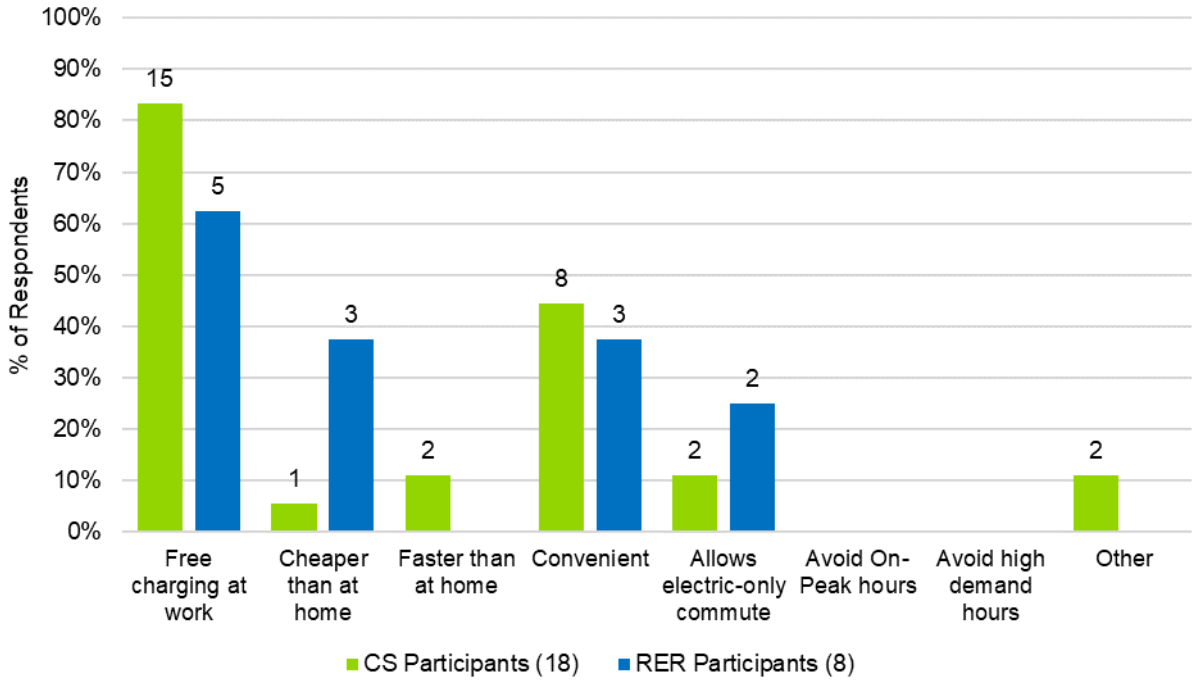
Figure 4-11. Motivations for Using Workplace Charging Stations (n=26)



CB14. What are your main motivations for using workplace charging stations? Select all that apply.

Source: Guidehouse analysis of 2021 Off-Peak Charging Offering Post-Summer Survey

4.1.2.5 Program Influences

Most CS participants (62 participants, 70%) stated that they use the SmartCharge Rewards Portal, with many viewing it on occasion (Figure 4-12). Of the respondents who viewed the portal, 30% of them had suggestions for improvement. These suggestions follow:

- Twelve CS participants want greater clarity on data and rewards as well as how or if electricity costs and savings change during on- and off-peak periods
- Four CS participants wish to view data outside of Eversource territory and other charging locations
- Three CS participants would like to receive emails or notifications of monthly data reports

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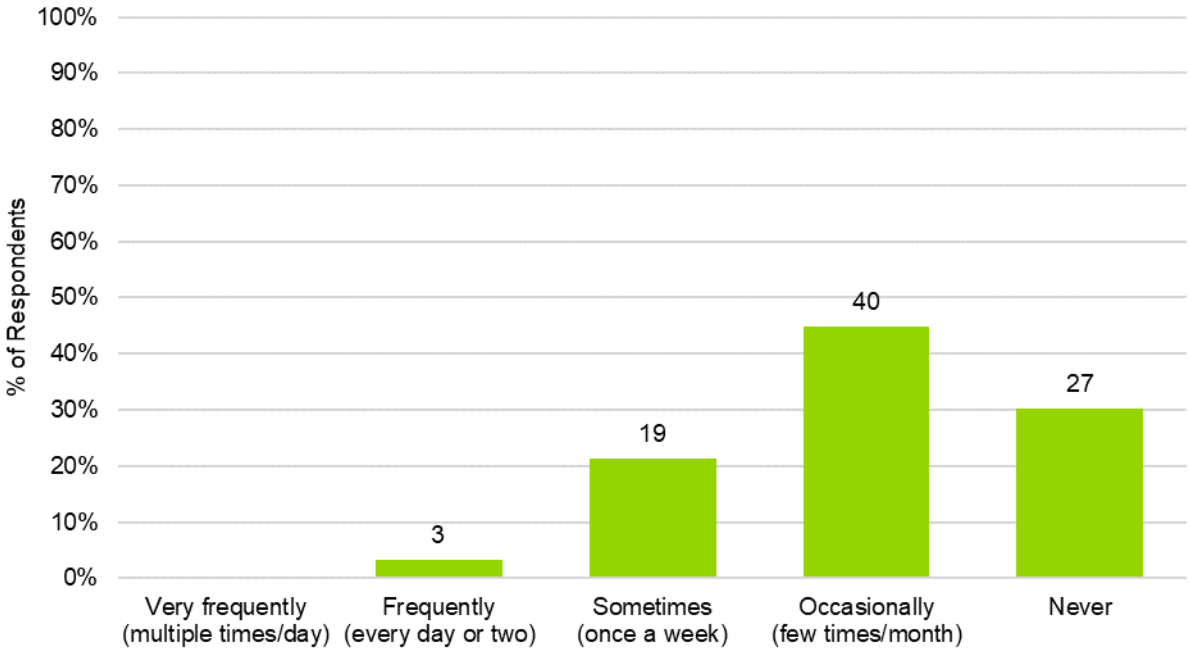
Figure 4-12. Frequency of Viewing the SmartCharge Rewards Portal (n=89)



I1. Which of the following best describes how often you view the SmartCharge Rewards Portal provided by Geotab (FleetCarma)?

Note: Five out of the 94 respondents were not presented with program-specific questions during the soft launch. This question was only presented to participants of the offering survey.

Source: Guidehouse analysis of 2021 Off-Peak Charging Offering Post-Summer Survey

The more that CS participants viewed and engaged with the SmartCharge Rewards portal, the higher they scored the influence of energy use information on their EV charging schedule for summer 2021. In Figure 4-13, it appears that more CS participants reported that they were “not influenced at all” by the energy use information in determining their summer 2021 EV charging schedule. However, 12 of these 21 respondents also answered that they had never viewed the portal. Of the remaining nine respondents who were “not influenced at all” by the energy use information, one viewed the SmartCharge Rewards portal frequently, three viewed it sometimes, and five viewed it occasionally.

CS participants scored energy use information an average of three out of five. This average score increased to 3.4 for the CS participants who reported they use the portal (62 participants, or 70%) and increased to 3.5 for the CS participants who used the portal ‘Occasionally’ (40 participants, or 45%).

On average, CS participants rated rewards and monthly bonuses as more influential than energy use information in determining their EV’s charging schedule for summer 2021 (Figure 4-13). Regardless of portal use, it appears that the CS participants perceived the financial incentives to be more instrumental in changing their charging behavior than the energy use information.

Further, about 70% of CS participants reported that they were at least influenced by rewards and monthly bonuses in determining their EV’s charging schedule for the summer of 2021. On average, CS participants rated both the rewards and monthly bonuses a 4.1 out of five.

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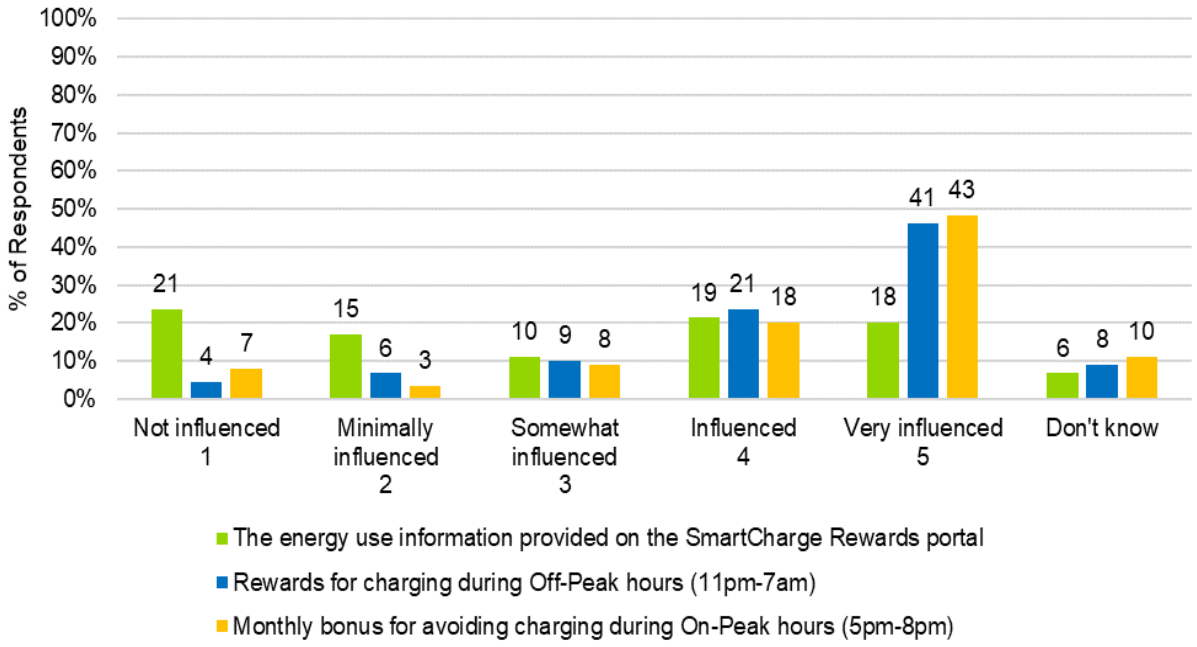
Figure 4-13. Program Influences on Charging Schedule (n=89)



I6. On a scale of 1 to 5, where 1 is "Not influenced at all" and 5 is "Very influenced," how influenced was your EV's charging schedule in summer 2021 by the following aspects of Eversource's ConnectedSolutions SmartCharge Rewards Program?

Note: Five out of the 94 respondents were not presented with program-specific questions during the soft launch. This question was only presented to participants of the offering survey.

Source: Guidehouse analysis of 2021 Off-Peak Charging Offering Post-Summer Survey

4.1.2.6 Program Satisfaction

Satisfaction with the program is very high, with 96% of participants reporting that they are likely to continue participating in the future (Figure 4-14).

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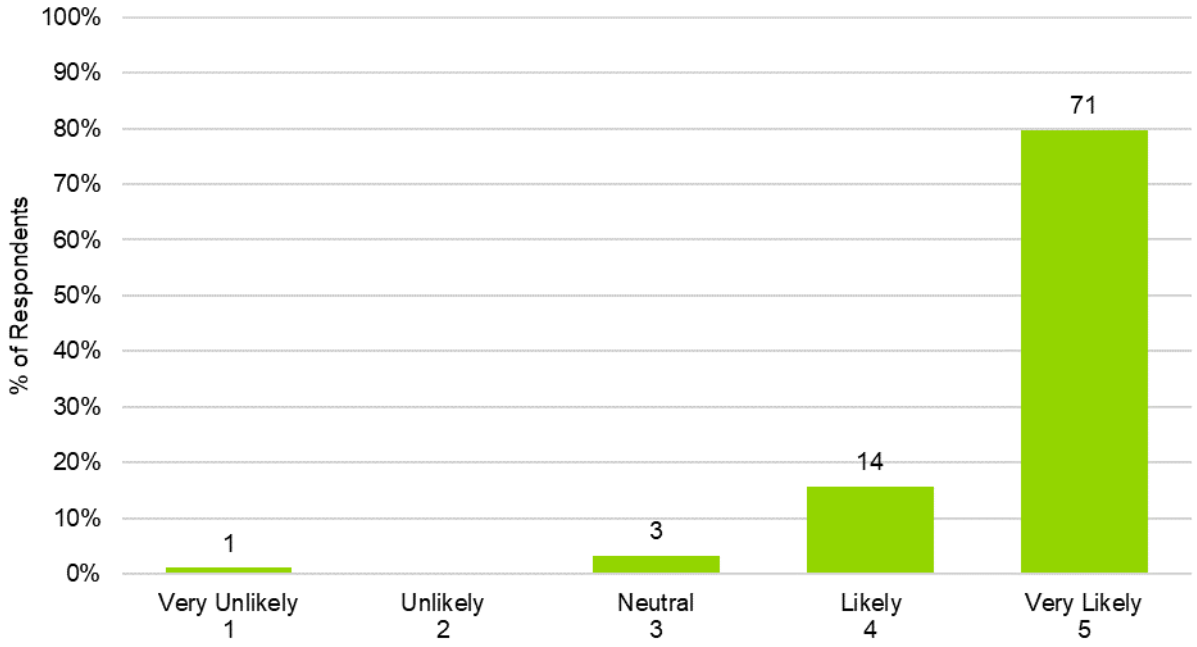
Figure 4-14. Likelihood of Continued Program Participation (n=89)



S7. On a scale of 1 to 5, where 1 is "Very Unlikely" and 5 is "Very Likely," how likely are you to continue to participate in Eversource's ConnectedSolutions SmartCharge Rewards Program?

Note: Five out of the 94 respondents were not presented with program-specific questions during the soft launch. This question was only presented to participants of the offering survey.

Source: Guidehouse analysis of 2021 Off-Peak Charging Offering Post-Summer Survey

Participants provided the following open-ended feedback about their experiences with the program:

- Twelve respondents recommended improving the incentive amount or changing the incentive structure.
- Six respondents suggested including clearer guidelines and data for the program.
- Other responses included partnering with more OEMs, securing personal information (i.e., ensuring that information gathered from the EV is not used for tracking or personal identification purposes), and offering other payment options.

Most participants were satisfied with the program portal, program communications, incentives, and the timing of on- and off-peak periods (Figure 4-15). Additionally, most participants were motivated by program incentives, and this may contribute to high participant satisfaction with program incentives.

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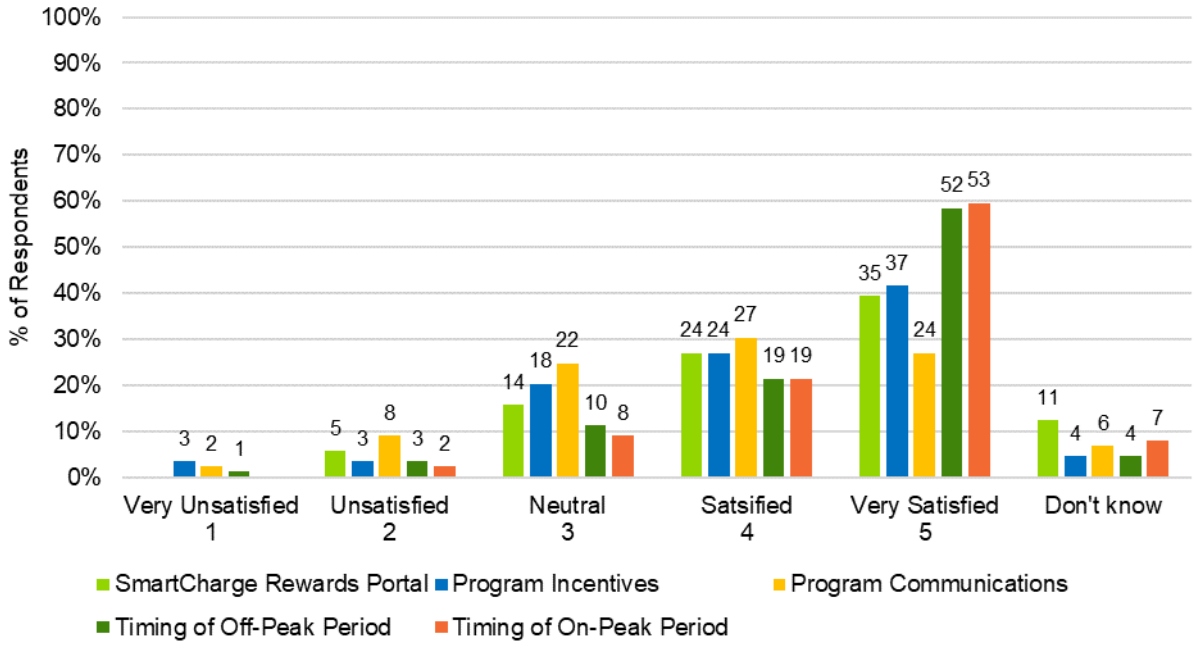
Figure 4-15. Satisfaction with the Program Components (n=89)



S1. On a scale of 1 to 5, where 1 is "Very unsatisfied" and 5 is "Very satisfied," how would you rate your satisfaction with the following aspects of Eversource's ConnectedSolutions SmartCharge Rewards Program to-date?

Note: Five out of the 94 respondents were not presented with program-specific questions during the soft launch. This question was only presented to participants of the offering survey.

Source: Guidehouse analysis of 2021 Off-Peak Charging Offering Post-Summer Survey

In open-ended feedback about their experiences with the various components of the program, participants reported the following:

- **Program Incentives:** Extend off-peak hours and reduce strike restrictions
- **Program Portal:** Separate energy use by EV and charging location
- **Program Communications:** Clarify program objectives and send out monthly reports
- **Timing of On- and Off-Peak Periods:** Start off-peak periods earlier than 11 p.m. and offer reminders or educational content on how to avoid charging during on-peak periods

4.2 Assessment of Charging Profiles

This section consists of an assessment of CS participants' and RER participants' charging behavior during the May–September 2021 analysis period.

4.2.1 Key Findings

- **CS participants conducted most of their charging during off-peak hours (11 p.m.–7 a.m.).** This pattern was observed during the pre-period (May 1–June 30) and the program treatment period (July 1–September 30).
- **Many enrolled EVs appear to have shifted their charging from peak hours (7 a.m.–11 p.m.) to off-peak hours (11 p.m.–7 a.m.).** Despite CS participants conducting more

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of their charging during off-peak hours prior to program start, EVs appear to have shifted additional charging from peak hours to off-peak hours after the program began. (Note in Figure 4-9 that 32% of CS participants charged more off-peak in summer 2021 than in summer 2020, while just 13% of RER customers charged more off-peak in summer 2021 than in 2020.)

- **30% of customers used scheduled charging in some capacity from May 2021–September 2021.** Nearly all scheduled charging occurred during off-peak hours (11 p.m.–7 p.m.), with most scheduled sessions beginning between 11 p.m. and 12 a.m. Among these customers, there was an increase in scheduled charging during off-peak hours during the program treatment period (July 1–September 30).

4.2.2 Charging Profile Analysis Results

Guidehouse's experience with EV data has shown that numerous metrics are helpful in characterizing charging behavior. Guidehouse investigated the charging behavior of enrolled devices over one impact analysis period, which included a pre-period and program treatment period. The pre-treatment period is defined as May–June 2021, and the program treatment period is defined as July–September 2021, as participants began receiving off-peak incentives on July 1.

CS EV interval data contained primarily Eversource electric customers in Massachusetts. However, some customers residing outside of Massachusetts or in non-Eversource territory enrolled in the offering. The assessment of charging profiles only included EVs in Eversource territory and in Massachusetts. Table 4-1 shows the number of EVs in each group.

Table 4-1. Enrolled EVs with Data by Customer Segment

Customer Segment	Enrolled EVS with Data	Eligible for Program?
Massachusetts Customer with Eversource Electric Service	192	Yes
Massachusetts Customer with Other Electric Service	8	No
Connecticut or New Hampshire Customer with Eversource Electric Service	10	No

Source: Guidehouse analysis of CS EV enrollment data

Figure 4-16 shows the percentage of energy consumed by hour for CS EVs pre- and post-July 1 treatment, with blue bars showing the change in percentage from pre to post. This plot highlights two key findings. First, that CS participants charged much more during the off-peak period than the on-peak period as compared to RER participants; second, that CS participants shifted even more of their consumption to the off-peak period after July 1 treatment. Much of the shifted energy also came from the super-peak period between 5 p.m. and 8 p.m. (hour ending 18–20).

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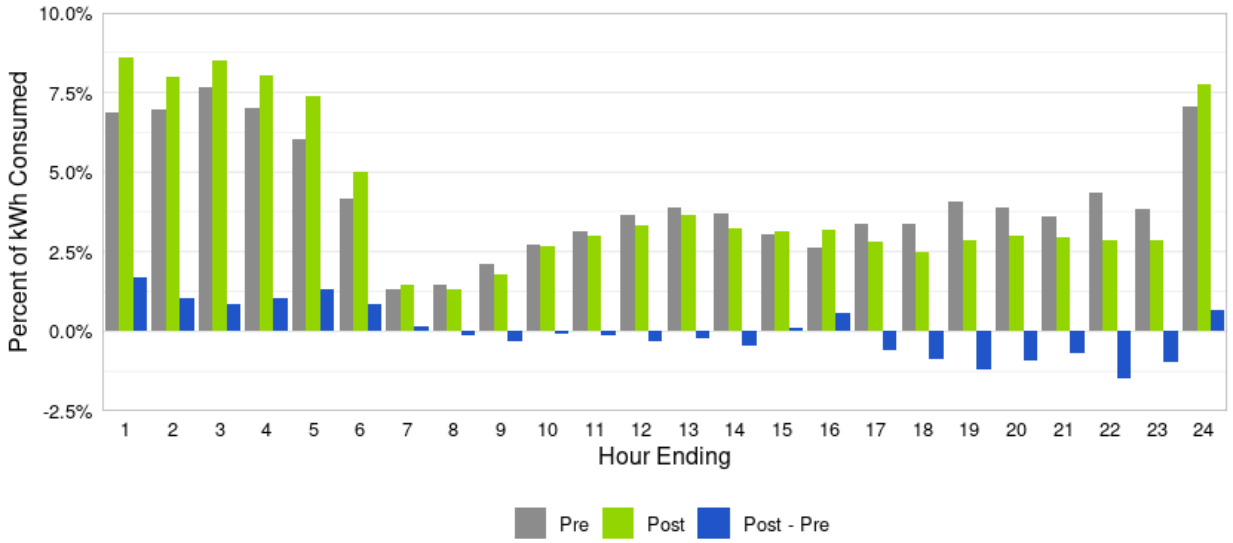
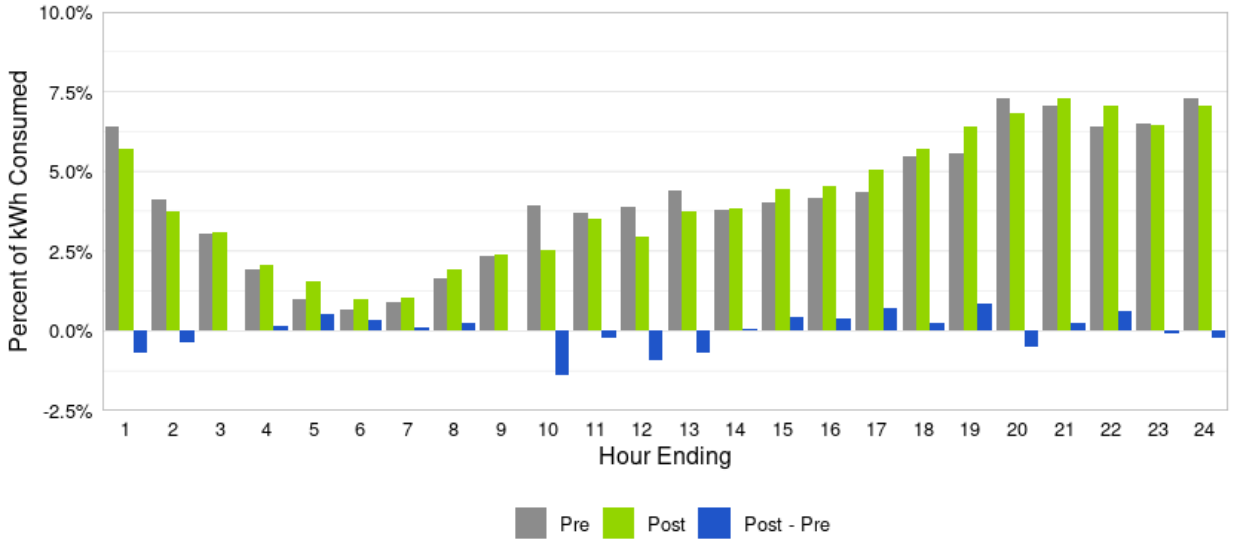
Figure 4-16. Percent of Energy Consumed by Hour, Pre- and Post-July 1 (CS Participants)



Source: Guidehouse analysis of CS EV telematics data

Figure 4-17 shows the percentage of energy consumed by hour for RER participants, with blue bars showing the change in percentage from pre to post. The single hour with the highest energy consumption across the full analysis period for RER participants was hour ending 21 (8 p.m.–9 p.m.). This compares to the highest energy consumption for CS participants being 1 a.m. – 2 a.m. There is also no clear trend between energy consumed pre- and post-July 1 treatment for RER participants. The breakdown of energy consumption for the RER participants shows marked differences in behavior between them and CS participants.

Figure 4-17. Percent of Energy Consumed by Hour, Pre- and Post-July 1 (RER Participants)



Source: Guidehouse analysis of RER EV telematics interval data

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CS participants were limited to Tesla owners, while RER participants included multiple manufacturers. Given this, it is possible that differences in ease of scheduling between manufacturers played a role in the timing of energy consumption. Figure 4-18 shows RER energy consumption by hour for only participants with a Tesla, and illustrates that RER Tesla owners behaved in a manner more similar to other RER participants (Figure 4-17) than to CS participants (Figure 4-16).

Figure 4-18. Percent of Energy Consumed by Hour, Pre- and Post-July 1 (RER Participants, Tesla Only)

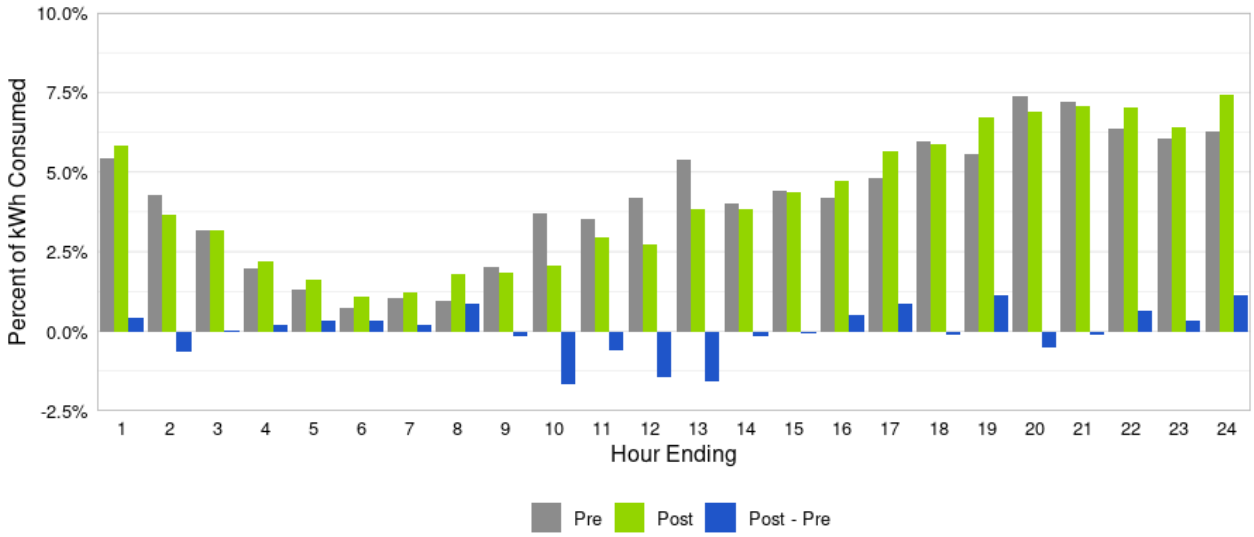

Table 4-2 examines differences in kWh consumption between the CS and RER participants across the pre-treatment and program treatment periods. The table lists the percentage of energy consumed in the peak and off-peak periods for each group across all months of the analysis. CS participants show an existing propensity for off-peak charging in the pre-period (46% of total kWh) compared to RER (25% of total kWh). CS participants also increased the percentage of kWh consumed during off-peak hours from the pre- to post-period by 8%, while RER participants showed no sizeable difference from pre to post.

Table 4-2. Percent of kWh Consumed in Off-Peak and Peak Periods

Period	Month	CS			RER			Difference *(CS Off – RER Off)**
		EVs	Off-Peak *11pm-7am*	Peak *7am-11pm*	EVs	Off-Peak *11pm-7am*	Peak *7am-11pm*	
Pre	May	149	*41%*	*59%*	69	*25%*	*75%*	*16%*
	June	188	*51%*	*49%*	78	*25%*	*75%*	*26%*
Post	July	183	*53%*	*47%*	77	*27%*	*73%*	*26%*
	August	181	*53%*	*47%*	75	*27%*	*73%*	*26%*
	September	188	*55%*	*45%*	74	*23%*	*77%*	*32%*
Pre	May– June	189	*46%*	*54%*	78	*25%*	*75%*	*21%*

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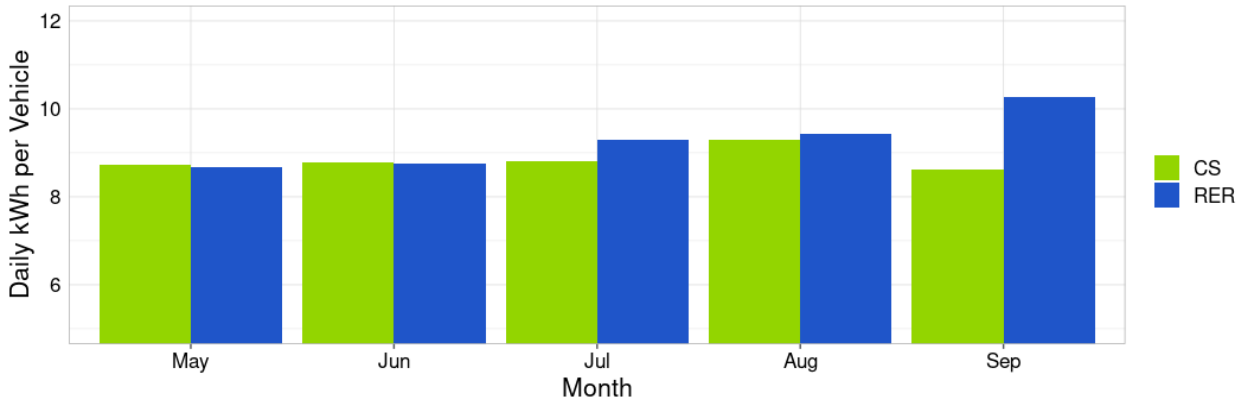
Period	Month	CS			RER			Difference *(CS Off – RER Off)**
Post	July–September	191	*54%*	*46%*	77	*26%*	*74%*	*28%*

Note: Calculations shown in the Difference column may appear inaccurate due to rounding error.

Source: Guidehouse analysis of CS and RER EV telematics data

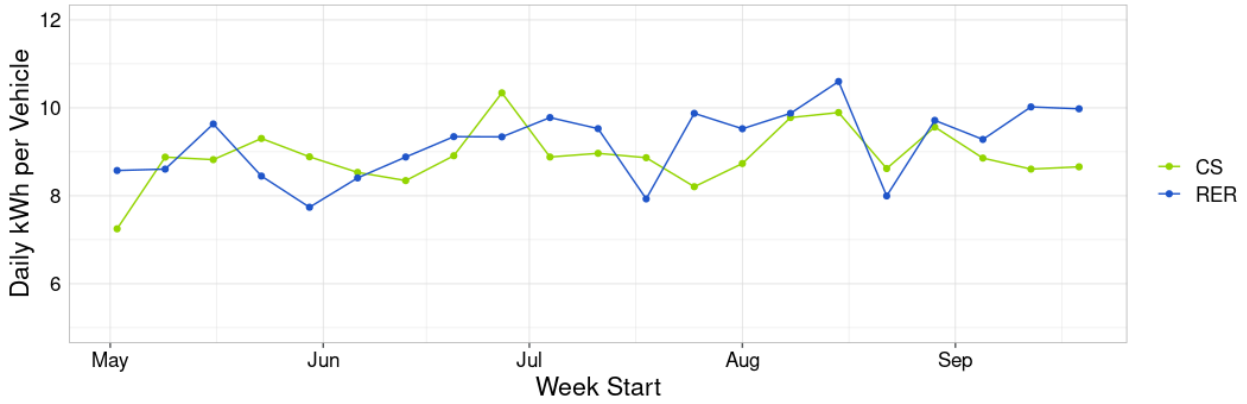
Figure 4-19 and Figure 4-20 show the average daily kWh consumed by month and by week across all enrolled CS participants and RER participants. CS and RER EVs showed a slow and steady increase in average daily kWh by vehicle across the analysis period.

Figure 4-19. Average Daily kWh by Month



Source: Guidehouse analysis of CS and RER EV telematics data

Figure 4-20. Average Daily kWh by Week*



*The first and last weeks of the analysis were removed from this figure as they only contained data from 1 and 4 days, respectively

Source: Guidehouse analysis of CS and RER EV telematics data

Table 4-3 details the average daily kWh by month. The table shows again that CS and RER participants increased daily kWh from the pre-treatment to program treatment period. Results also indicate that there is a notable decrease in CS participants' peak consumption, while off-peak consumption increased.

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Table 4-3. Average Daily kWh, Off-Peak and Peak

Period	Month	CS			RER			Difference *(CS Off – RER Off)*
		Off-Peak *11pm-7am*	Peak *7am-11pm*	*Total*	Off-Peak *11pm-7am*	Peak *7am-11pm*	*Total*	
Pre	May	3.84	4.87	8.71	2.15	6.52	8.67	1.69
	June	4.47	4.31	8.78	2.21	6.55	8.76	2.26
Post	July	4.68	4.13	8.81	2.46	6.82	9.28	2.22
	August	4.99	4.30	9.29	2.57	6.85	9.42	2.42
	September	4.81	3.81	8.62	2.36	7.90	10.26	2.45
Pre	May–June	4.17	4.58	8.75	2.19	6.53	8.72	1.98
Post	July–September	4.82	4.07	8.89	2.47	7.17	9.64	2.35

Source: Guidehouse analysis of CS and RER EV telematics data

4.3 Impact Analysis

This section summarizes key findings related to the impact analysis conducted for this evaluation. Guidehouse assessed impacts of program participation for CS program participants during off-peak (11 p.m. to 7 a.m.) and peak hours (7 a.m. to 11 p.m.) using the difference-in-differences regression specification Section 2.3 summarizes.

4.3.1 Key Findings

- **Average reductions in demand between the hours of 7 a.m. and 11 p.m. were 0.13 kW per EV.** Daily energy savings between the hours of 7 a.m. and 11 p.m. were 1.85 kWh per EV per day. There was not a statistically significant change in demand or energy between the hours of 11 p.m. and 7 a.m. This is despite observed increases in the share of charging conducted during the hours of 11 p.m. to 7 a.m. between the pre-period and program treatment period.
- **Average reductions in super-peak demand between the hours of 5 p.m. and 8 p.m. were 0.25 kW per EV.**[9] Daily energy savings during super-peak hours were 0.67 kWh per EV per day. For peak hours outside of the super-peak period, demand and energy impacts amounted to a 0.10 kW reduction in demand and 1.18 kWh in daily energy savings per EV. Changes in demand and energy for off-peak hours were not statistically different from zero. This suggests that much of the 0.13 kW per EV demand reduction assessed for 7 a.m.–11 p.m. could be attributed to super-peak demand reductions.

[9] This finding is comparable to the 0.27 kW reduction per vehicle between 5 p.m. and 9 p.m. observed in the first year of National Grid's Rhode Island Off-Peak Charging Rebate Pilot. Notably, that program was implemented as a randomized control trial. Evaluation results for the pilot can be found linked here: http://www.ripuc.ri.gov/eventsactions/docket/4770-NGrid-RY2%20Transportation%20Initiative%20Annual%20Report%20Combined%20(10.30.2020).pdf

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4.3.2 Impact Results

Table 4-4 shows the demand and energy impacts per enrolled EV by time period. The impact of program participation during off-peak hours spanning 11 p.m. to 7 a.m. was statistically insignificant. However, the impact of program participation during peak hours spanning 7 a.m. to 11 p.m. was a 0.13 kW reduction in demand and a 1.85 kWh daily energy savings per EV. Reductions in kW demand during peak hours is consistent with findings from charge profile analysis, which indicated that CS participants shifted charging downward during peak hours, particularly during super-peak hours (5 p.m. to 8 p.m.) that had an additional incentive for avoiding charging. This shift in charging from early-evening hours was not only a goal of the offering, but also a measured program impact.

Table 4-4. Demand Impacts per EV by Period

Impact Analysis Metric	Time Period	Estimated Change	Pre-Period Average	Percent Change
Average Half-Hourly kW Reduction per EV	7 a.m.–11 p.m.	-0.127 kW**	0.362 kW	-35.03%*
	11 p.m.–7 a.m.	0.015 kW	0.562 kW	2.68%
Average Daily kWh Savings per EV	7 a.m.–11 p.m.	-1.852 kWh**	4.982 kWh	-37.18%**
	11 p.m.–7 a.m.	0.130 kWh	4.232 kWh	3.07%

* Indicates significance at 90% confidence

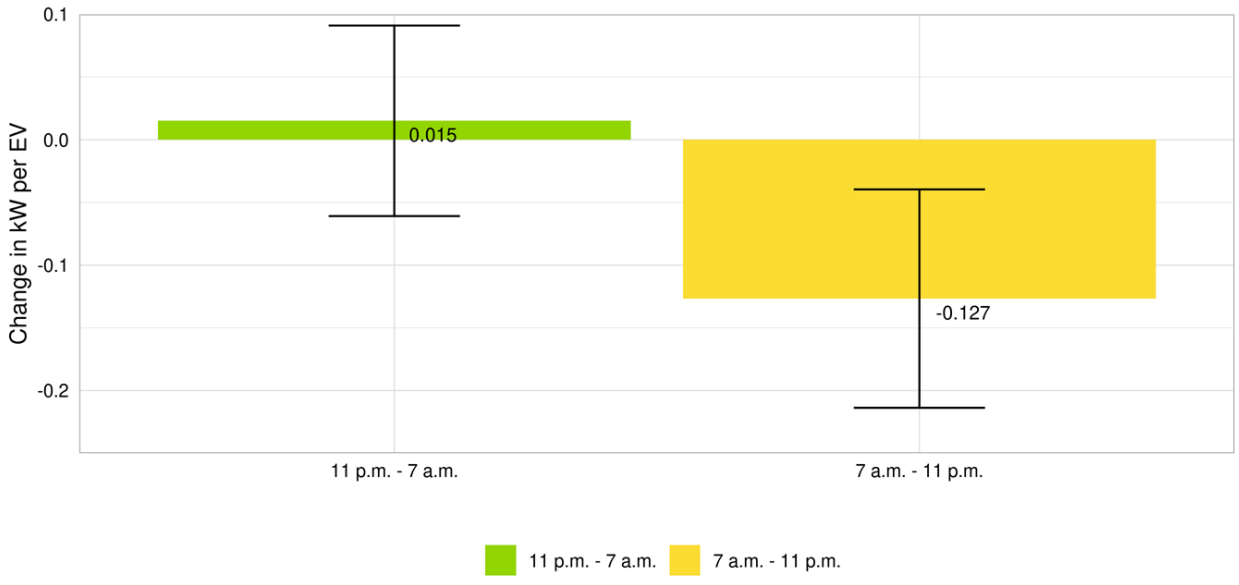
** Indicates significance at 95% confidence

*** Indicates significance at 99% confidence

Source: Guidehouse analysis of EV interval data

Figure 4-21 illustrates the kW impact per EV that participated in the off-peak offering during the period spanning July 1 through September 30 with 90% confidence bounds overlaid. Although off-peak period demand impacts of program participation were statistically insignificant, peak period demand impacts amounted to a 0.13 kW reduction in demand per participating EV.

Figure 4-21. Average kW Impact per EV by Period



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Source: Guidehouse analysis of CS and RER EV telematics data

In addition to a $0.05/kWh rebate for charging during off-peak hours, CS participants are eligible for an additional $10/month bonus incentive if they avoided charging between the hours of 5 p.m. and 8 p.m. To explore the impact of this bonus incentive, Guidehouse split the peak period defined as 7 a.m. to 11 p.m. into two periods. The first period comprises peak hours spanning 7 a.m. to 5 p.m. and 8 p.m. to 11 p.m. The second period comprises super-peak hours spanning 5 p.m. to 8 p.m. Guidehouse then estimated demand and energy impacts of program participation within each off-peak, peak, and super-peak hours using a modified version of the regression summarized in Equation 2-1.

Table 4-5 shows the demand and energy impacts per enrolled EV by time period, this time including super-peak hours spanning 5 p.m. to 8 p.m. As was the case in results summarized above, the impact of program participation during off-peak hours spanning 11 p.m. to 7 a.m. was statistically insignificant. However, splitting the peak hours into two separate periods reveals that much of the demand reductions observed between 7 a.m. to 11 p.m. were observed between 5 p.m. to 8 p.m. More specifically, during super-peak hours there was a 0.25 kW reduction in demand and a 0.67 kWh daily energy savings per EV. For peak hours outside of the super-peak period, demand and energy impacts amounted to a 0.10 kW reduction in demand and 1.18 kWh in daily energy savings per EV.

Table 4-5. Demand Impacts per EV by Period, Including Super-Peak Hours

Impact Analysis Metric	Time Period	Estimated Change	Pre-Period Average	Percent Change
Average Half-Hourly kW Reduction per EV	7 a.m.–5 p.m.; 8 p.m.–11 p.m.	-0.099 kW**	0.348 kW	-28.49%**
	5 p.m.–8 p.m.	-0.246 kW***	0.422 kW	-58.36%***
	11 p.m.–7 a.m.	0.015 kW	0.562 kW	2.66%
Average Daily kWh Savings per EV	7 a.m.–5 p.m.; 8 p.m.–11 p.m.	-1.180 kWh**	3.893 kWh	-30.30%**
	5 p.m.–8 p.m.	-0.673 kWh***	1.089 kWh	-61.78%***
	11 p.m.–7 a.m.	0.130 kWh	4.232 kWh	3.07%

* Indicates significance at 90% confidence

** Indicates significance at 95% confidence

*** Indicates significance at 99% confidence

Source: Guidehouse analysis of CS and RER EV telematics data

Figure 4-22 illustrates the kW impact per EV that participated in the off-peak offering during the period spanning July 1 through September 30 with 90% confidence bounds overlaid. Demand impacts of program participation were identified to fall primarily within the super-peak period spanning 5 p.m. to 8 p.m.

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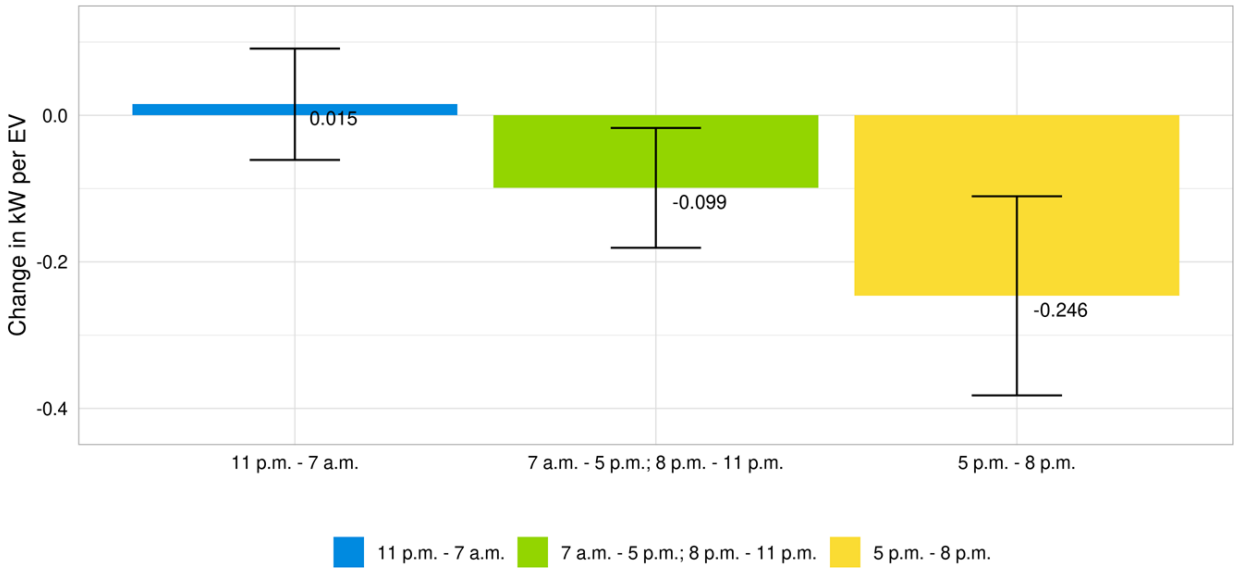
Figure 4-22. Average kW Impact per EV by Period, Including Super-Peak Hours



Source: Guidehouse analysis of CS and RER EV telematics data

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5. Findings and Considerations

The following tables summarize key findings from each research activity, along with key considerations for the program.

Table 5-1. Key Findings – Customer Experience Research

Research Category	Findings
Motivations and Enrollment	Helping the environment was the most commonly cited primary motivator to purchase an EV, while program incentives was most commonly cited as the top reason for enrolling in the program.
	The majority of respondents (89%) were satisfied with the enrollment process.
EVSE Characteristics	Most CS (86%) and RER (90%) participants own a Level 2 charger at home, with the majority being OEM-specific chargers, especially for CS participants.
	RER participants have a higher proportional frequency of storing their home charging device outside, while mainly CS participants use a heated garage.
EV Characteristics and Driving Behavior	Out of both participant types, 10 own an additional BEV and nine own an additional PHEV that was not enrolled in the program or RER study.
	About half of both CS and RER participants reported that their weekly milage did not change from summer 2020 to 2021, and RER participants reported driving slightly fewer miles overall on weekdays in summer 2021.
Charging Behavior and Changes Since Summer 2020	Compared to only 27% of RER participants, 76% of CS participants scheduled charging times through an app. Common scheduled start times for CS participants was at or after 11 p.m. on weekdays in summer 2021.
	The most common times for respondents to have their EVs connected to chargers was on weekdays between 6 p.m. and 8 a.m.
	A smaller proportion of CS participants (20%) charged their EV until full, and a larger proportion (32%) charged their EV during off-peak hours (11 p.m. to 7 a.m.) compared to RER participants (62% and 13%, respectively).
	CS participants (31%) reported experiencing less barriers to public charging compared to RER participants (15%), and there was no significant difference between RER Tesla and non-Tesla owners. All respondents used workplace charging minimally during summer 2021 weekdays.
Program Influences	Most CS participants (70%) viewed the SmartCharge Rewards portal and of those who viewed the portal, 30% provided suggestions for improvement.
	CS participants were more influenced by rewards and monthly bonuses than energy use information in determining their EV's charging schedule for summer 2021.
Program Satisfaction	Most CS participants were, at least, satisfied with the SmartCharge Rewards portal (66%), timing of on- and off-peak periods (81% and 78%, respectively), and program communications (57%) and incentives (69%).
	Almost all (96%) of CS participants reported that they are likely to participate in the program again in the future.

Source: Guidehouse

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Table 5-2. Key Findings – Charging Profile Analysis

Research Category	Findings
Charging Profile Analysis	**CS participants conducted most of their charging during off-peak hours (11 p.m.–7 a.m.).** This pattern was observed during the pre-period (May 1–June 30) and the program treatment period (July 1–September 30).
	Many enrolled EVs appear to have shifted their charging from peak hours (7 a.m.–11 p.m.) to off-peak hours (11 p.m.–7 a.m.). Despite CS participants conducting more of their charging during off-peak hours prior to program start, EVs appear to have shifted additional charging from peak hours to off-peak hours after the program began.
	30% of customers used scheduled charging in some capacity from May 2021–September 2021. Nearly all scheduled charging occurred during off-peak hours (11 p.m.–7 p.m.), with most scheduled sessions beginning between 11 p.m. and 12 a.m. Among these customers, there was an increase in scheduled charging during off-peak hours during the program treatment period (July 1–September 30).
	Across the full analysis period, **the single hour with the most energy consumed, on average, was 2 a.m.–3 a.m.** The 5 hours with the most energy consumed all fell between 11 p.m.–4 a.m., both pre- and post-treatment, primarily due to a concentration of scheduled charging sessions starting at 11 p.m.

Source: Guidehouse

Table 5-3. Key Findings – Impacts

Research Category	Findings
Impacts	**Average reductions in demand between the hours of 7 a.m. and 11 p.m. were a statistically significant 0.13 kW per EV.** Daily energy savings between the hours of 7 a.m. and 11 p.m. were a statistically significant 1.85 kWh per EV per day. There was not a statistically significant change in demand or energy between the hours of 11 p.m. and 7 a.m. This is despite observed increases in the share of charging conducted during the hours of 11 p.m. to 7 a.m. between the pre-period and program treatment period.
	Average reductions in super-peak demand between the hours of 5 p.m. and 8 p.m. were a statistically significant 0.25 kW per EV. Daily energy savings during super-peak hours were a statistically significant 0.67 kWh per EV per day. For peak hours outside of the super-peak period, demand and energy impacts amounted to a statistically significant 0.10 kW reduction in demand and a statistically significant 1.18 kWh reduction in daily energy savings per EV. This suggests that much of the 0.13 kW per EV demand reduction assessed for 7 a.m.–11 p.m. could be attributed to super-peak demand reductions.

Source: Guidehouse

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Table 5-4. Key Findings – Considerations

Research Category	Considerations
Program Design	**Consideration 1:** Consider creating a program guidebook that educates customers about the benefits of charging during off-peak hours and a monthly report that showcases results from the offering and participant efforts. Continue offering a modest incentive that follows the off-peak charging schedule, but also consider if there is potential to begin off-peak hours earlier than 11 p.m.
Program Design	**Consideration 2:** Consider implementing additional checks for customers that enroll in future cycles of this offering. For instance, ensure that the customer enrolling in the program meets eligibility requirements for the program, as Guidehouse identified several customers who did not qualify for the program due to living outside of the eligible geographic area but who had still enrolled in the program.
Program Design	**Consideration 3:** Consider creating a program component, educational tool/info, to teach participants & recruiting audience how to make participation easier – info on using scheduled charging & how to make that happen.
Impacts	**Consideration 4:** Consider adding a requirement of one calendar year of pre-period data from participants to participate in the program. Employing a broader time window of pre-period data – for instance, one calendar year prior to program start – will help improve the accuracy of impact estimates.
Impacts	**Consideration 5:** As the offering continues or a program based upon this offering is supported, consider tracking and measuring differences in charging behavior and impacts across seasons. Results for the summer season (July 1–September 30) may not be able to be extrapolated to other seasons due to differences in incentive structure and potential differences in driving behavior across seasons.
Impacts	**Consideration 6:** To assess how driving behavior changes more accurately across seasons, consider obtaining trip data for all enrolled CS participants.

Source: Guidehouse

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Appendix A. Participant Survey Instruments

A.1 2021 Participant Survey Instrument

[If CS Participant, display] Eversource thanks you for participating in ConnectedSolutions SmartCharge Rewards Program this year. In an effort to improve the program and its ability to reduce strain on the electricity grid during periods of peak demand, we have some questions related to your experiences in the program and your household's charging and driving behavior in general.

If you cannot complete the survey all at one time or if you accidentally exit the survey mid-course, you can resume the survey where you left off by clicking on the link from the email you received.

[If RER Participant, display] The Massachusetts Program Administrators thank you for participating in the Rolling Energy Resources study this year. In an effort to better plan for updates needed to the electric grid to continue to encourage electric vehicles in Massachusetts, we have some questions related to your household's charging and driving behavior.

If you cannot complete the survey all at one time or if you accidentally exit the survey mid-course, you can resume the survey where you left off by clicking on the link from the email you received.

A.1.1 Motivations

M1. What was your top motivation for enrolling in Eversource's ConnectedSolutions SmartCharge Rewards Program?

[Response option order is randomized for each respondent]

a. Receive incentives
b. Reduce my/our environmental impact
c. Reduce the need for additional power plants
d. Support my/our community and/or state's energy initiatives
e. Other (Specify) **[Open ended]**

M2. How did you learn about Eversource's ConnectedSolutions SmartCharge Rewards Program? Select all that apply.

a. Eversource email
b. Eversource website
c. Eversource other (Specify) **[Open ended]**
d. Tesla email
e. Tesla website
f. Tesla app
g. Friend/family/neighbor
h. Other (Specify) **[Open ended]**
i. Not sure **[Mutually exclusive response]**

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M3. On a scale of 1 to 5, where 1 indicates “Very Unsatisfied” and 5 indicates “Very Satisfied,” how satisfied were you with the process of enrolling in the program?

a. Very Unsatisfied – 1	**b.** 2	**c.** 3	**d.** 4	**e.** Very Satisfied – 5

M4. Did you encounter any challenges or difficulties during the enrollment process?

a. Yes, I encountered challenges during the enrollment process
b. No, I did not encounter any challenges during the enrollment process

[If M4 = a, continue; otherwise, skip to M6]

M5. During which enrollment step did you encounter challenges or difficulties? Select all that apply.

a. Entering my name and contact information to prove I am an Eversource customer
b. Entering the Model and Model Year of my Tesla
c. Creating a SmartCharge Rewards account
d. Connecting my Tesla account to my SmartCharge Rewards account
e. Other (Specify) **[Open ended]**

M6. How could the ConnectedSolutions SmartCharge Rewards Program enrollment process be improved?

a. **[Open ended]**
b. No improvements needed
c. Not sure

A.1.2 EV Characteristics and Driving Behavior

EV1. How many licensed drivers are there in your household? **[Numeric value prompt]**

EV2. According to our records, you currently have the following EV(s) enrolled in **[Display program name]**.

[Display make, model, and year of EV #1 from record]
[Display make, model, and year of EV #2 from record, if applicable]

Is this accurate?

a. Yes
b. No

[If EV2 = b, continue; otherwise, skip to EV4]

EV2_0. How many EVs do you have enrolled in **[Display program name]**?

a. 1
b. 2

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[If EV2_0 = a, continue; otherwise, skip to EV3_2]

EV3. Please provide the make, model, and year of your enrolled EV. **[Make, model, and year of EV #1 are updated based on these selections]**

	Make and Model	**Year**
Enrolled EV #1	**[Dropdown]**	**[Dropdown]**

[If EV2_0 = b, continue; otherwise, skip to EV4]

EV3_2. Please provide the make, model, and year of your enrolled EV. **[Make, model, and year of EV #1 and EV #2 to be updated based on these selections]**

	Make and Model	**Year**
Enrolled EV #1	**[Dropdown]**	**[Dropdown]**
Enrolled EV #2	**[Dropdown]**	**[Dropdown]**

EV4. Does your household own any other EVs (that are not enrolled in **[Display program name]**)? This includes other all-battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs). It does NOT include pure hybrid vehicles (i.e., those that do not require the battery to be charged via charging equipment). (Select all that apply)

a. Yes, our household owns an additional BEV(s) that is not enrolled in the program
b. Yes, our household owns an additional PHEV(s) that is not enrolled in the program
c. No, our household does not own any BEVs or PHEVs beyond what is enrolled **[Mutually exclusive response]**

[If EV4 = a, continue; otherwise, skip to EV10]

EV5. How many additional BEVs does your household own? **[Dropdown w/ values 0-4]**

[If EV4 = b, continue; otherwise, skip to EV15]

EV10. How many additional PHEVs does your household own? **[Dropdown w/ values 0-4]**

[If # of enrolled EVs = 2, continue; otherwise, skip to EV16]

EV15. Of the electric vehicles enrolled in **[Display program name]**, please identify the electric vehicle whose driving and charging schedule you are most familiar with.

a. **[Display make, model, and year of EV#1]**
b. **[Display make, model, and year of EV#2]**

[If # of enrolled EVs = 1, display] *Please answer the remaining questions thinking about the electric vehicle that is enrolled in the program.*

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[If # of enrolled EVs = 2, display] Please answer the remaining questions thinking about this electric vehicle.

EV16. Did this electric vehicle serve as the primary form of transportation for at least one member of the household on weekdays during summer 2021 (June through August)?

a. Yes
b. No

EV17. What was your household's top motivation for buying the electric vehicle?

[Response option order is randomized for each respondent]

a. We/I wanted to save money
b. We/I wanted to help the environment
c. There were rebates available (Specify) **[Open ended]**
d. We/I wanted the latest technology
e. It fits with my/our lifestyle
f. For comfort reasons
g. Fuel independence
h. Convenience (not having to stop at gas station)
i. Other (Specify) **[Open ended]**

We now have some questions about how your household used the electric vehicle during the summer. Please answer the questions thinking about ***this past summer – i.e., June 2021 through August 2021.***

EV18. Which of the following best describes how your household *typically* used this electric vehicle on weekdays (Monday through Friday) during the summer of 2021 (June through August)?

a. I or another member of my household used it on a regular schedule (e.g., to and from work)
b. I or another member of my household used it as needed (e.g., to complete errands)
c. No one from my household used it on weekdays
d. Other (Please describe how your vehicle was typically used on weekdays) **[Open ended]**

EV19. On a *typical* summer 2021 weekday (Monday, Tuesday, etc.), on average, how many miles was this electric vehicle driven by you and other members of your household? Don't worry about being exact – just provide your best estimate for the total miles driven on a typical summer weekday for 2021.

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a. 0-10 miles
b. 11-20 miles
c. 21-30 miles
d. 31-50 miles
e. 51-70 miles
f. 71-100 miles
g. 101-150 miles
h. >150 miles
i. It varied significantly day-to-day or depending on the day of the week (Please describe) **[Open ended]**
j. It varied significantly depending on the week or month (Please describe) **[Open ended]**
k. Not sure

A.1.3 EVSE Characteristics and Charging Behavior

[If # of enrolled EVs = 1, display] Still thinking about the enrolled electric vehicle (**[Display make, model and year of EV #1]**), we now have some questions about how your household *charged* this electric vehicle during this past summer. Please answer the questions thinking about **this past summer – i.e., June – August 2021.**

[If # of enrolled EVs = 2 AND EV15 = a, display] Still thinking about the enrolled electric vehicle whose driving and charging schedule you are most familiar with (**[Display make, model and year of EV #1]**), we now have some questions about how your household *charged* this electric vehicle during this past summer. Please answer the questions thinking about **this past summer – i.e., June – August 2021.**

[If # of enrolled EVs = 2 AND EV15 = b, display] Still thinking about the enrolled electric vehicle whose driving and charging schedule you are most familiar with (**[Display make, model, and year of EV #2]**), we now have some questions about how your household *charged* this electric vehicle during this past summer. Please answer the questions thinking about **this past summer – i.e., June – August 2021.**

CB1. Approximately what percentage of your EV's charging this past summer took place at your home, work, public, or other charging stations? Don't worry about being precise, just take your best guess.

Charging Location	**% of EV charging**
CB1_1. My home charger	**[Numeric]** %
CB1_2. Workplace charger	**[Numeric]** %
CB1_3. Public charger	**[Numeric]** %
CB1_4. Other (Specify) **[Open ended]**	**[Numeric]** %

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CB2. Which of the following best describes the electric vehicle charging device that you have at home?

a. Level 1 charger (i.e., a charger that plugs into a standard 120-volt outlet)
b. Level 2 charger (i.e., a charger that plugs into a high-output 220/240-volt outlet)
c. I do not have a charger for use at home

[If CB2 = b, continue; otherwise, skip to CB4]

CB3. Please select the make of your Level 2 charger. **[Dropdown]**

[If CB1_1 > 0%, continue; else, skip to CB11]

CB4. During summer 2021, when your electric vehicle was not being used and at home, was it typically connected to your home charging device?

a. Yes, I/we typically always had the EV connected to home charging device when not using the EV
b. No, I/we only connected the EV to home charging device at select times; please describe (e.g., when the EV battery had a certain % charge remaining) **[Open ended]**
c. Other (Specify) **[Open ended]**
d. Not sure

CB5. During summer 2021, which of the following best describes your household's use of your home charging device for your electric vehicle?

a. Whenever the EV was connected to our home charging device, it charged until it was fully charged
b. I/We used the home charging device app to remotely start and stop charging of the EV
c. I/We followed a charging schedule that I/we set using the home charging device app
d. I/We followed a charging schedule that I/we set using the EV's app
e. Other (Specify) **[Open ended]**

[If CB5 = c OR d, continue; otherwise, skip to CB6]

CB5_b. How was your electric vehicle's charging schedule determined?

a. I/We selected it
b. It is the default schedule
c. Other (Specify) **[Open ended]**
d. Don't know

CB6. Below, please indicate the time ranges during which the electric vehicle was ***typically connected (regardless of charging or not) to your home charging device*** on weekdays (Monday through Friday) during summer 2021 (June through August). Select all the time ranges that apply.

As an example, if you typically disconnected the electric vehicle at 7:30 AM to go to work and then you connected this electric vehicle again when you returned home at 5:30 PM (leaving it connected until the following morning), you would select all ranges between 12 AM and 8 AM, and between 4 PM and 12 AM.

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a. 12 AM – 2 AM
b. 2 AM – 4 AM
c. 4 AM – 6 AM
d. 6 AM – 8 AM
e. 8 AM – 10 AM
f. 10 AM – 12 PM
g. 12 PM – 2 PM
h. 2 PM – 4 PM
i. 4 PM – 6 PM
j. 6 PM – 8 PM
k. 8 PM – 10 PM
l. 10 PM – 12 AM
m. It varied significantly day-to-day or depending on the day of the week (M-F). (Please describe) **[Open ended]**
n. It varied significantly depending on the week or month. (Please describe) **[Open ended]**
o. Not sure **[Mutually exclusive response]**

[If CB5 = b, continue; otherwise, skip to CB8]

CB7. At approximately what time did you typically start and stop charging your electric vehicle with your home charging device on weekdays in summer 2021? **[Open ended]**

[If CB5 = c or d, continue; otherwise, skip to CB9]

CB8. At approximately what time was your electric vehicle's charging typically scheduled to start and end on weekdays in summer 2021? **[Open ended]**

CB9. Compared to your household's use of your home charging device on weekdays, was the amount of time this electric vehicle was ***typically connected to your home charging device*** in summer 2021 different on weekends?

a. Yes, the EV was connected more on weekends
b. Yes, the EV was connected less on weekends
c. No / Not significantly

CB10. Compared to your household's use of your home charging device on weekdays, was the timing of when this electric vehicle was ***typically connected to your home charging device*** in summer 2021 different on weekends (e.g., shifted from being connected early evening through early morning to being connected all day when not in use)?

a. Yes (Please describe) **[Open ended]**
b. No or not significantly

CB11. Is this electric vehicle driven to a workplace that has workplace charging available? Please answer this question based on whether or not charging is available at a workplace, regardless of whether you or other household members go into work regularly and/or use it.

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a. Yes
b. No
c. Not applicable (e.g., full-time remote, retired)

[If CB1_2 > 0%, continue; otherwise, skip to CB15]

CB13. Below, please indicate when this electric vehicle was ***typically connected to a workplace charging station*** on weekdays (Monday through Friday) during the summer 2021 (June through August). Select all the time ranges that apply.

As an example, if you typically connected this electric vehicle to a workplace charging station around 3 PM and disconnected when you left to return home at 5:30 PM, you would select ranges 2 PM – 4 PM and 4 PM – 6 PM.

a. 12 AM – 2 AM
b. 2 AM – 4 AM
c. 4 AM – 6 AM
d. 6 AM – 8 AM
e. 8 AM – 10 AM
f. 10 AM – 12 PM
g. 12 PM – 2 PM
h. 2 PM – 4 PM
i. 4 PM – 6 PM
j. 6 PM – 8 PM
k. 8 PM – 10 PM
l. 10 PM – 12 AM
m. It varied significantly day-to-day or depending on the day of the week (Please describe) **[Open ended]**
n. It varied significantly depending on the week or month (Please describe) **[Open ended]**
o. Not sure **[Mutually exclusive response]**

CB14. What are your main motivations for using ***workplace charging stations***? Select all that apply**.**

a. My workplace charging is free
b. My workplace charging is cheaper than charging at home
c. My workplace charging is faster than charging at home
d. Workplace charging is convenient
e. Workplace charging allows me to commute fully in electric mode
f. **[If CS Participant, display]** I charge at workplace public charging stations to avoid charging during On-Peak hours (5PM - 8PM)
g. **[If RER Participant, display]** I charge at public charging stations to avoid charging during hours when electricity demand on the grid is the highest (“peak” hours)
h. Other (Specify) **[Open ended]**

[If CB11 = a, continue; otherwise, skip to CB16]

CB15. Are there are any barriers for you or your household members to use ***workplace charging stations*** to charge this electric vehicle? (select all that apply)

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a. There is limited availability of workplace chargers
b. Workplace charging station time limits are a barrier
c. Workplace charging stations are not compatible with my EV
d. I have not experienced any barriers to using workplace charging stations **[Mutually exclusive response]**
e. Other (Specify) **[Open ended]**

[If CB1_3 > 0%, continue; otherwise, skip to CB17]

CB16. What are your main motivations for using ***public charging stations***? (select all that apply)

a. Public charging is cheaper than charging at home
b. Public charging is faster than charging at home
c. Public charging is convenient
d. Public charging allows me to commute fully in electric mode
e. **[If CS Participant, display]** I charge at public charging stations to avoid charging during On-Peak hours (5PM - 8PM)
f. **[If RER Participant, display]** I charge at public charging stations to avoid charging during hours when electricity demand on the grid is the highest ("peak" hours)
g. Other (Specify) **[Open ended]**

CB17. Are there are any barriers for you or your household members to use ***public charging stations*** to charge this electric vehicle? Select all that apply.

a. Public charging is more expensive than charging at home
b. There is limited availability of public chargers
c. Public charging stations are not always located near where I am going
d. Public charging station time limits are a barrier
e. Public charging stations are not always compatible with my EV
f. I have not experienced any barriers to using public charging stations **[Mutually exclusive response]**
g. I have not tried to use public charging stations **[Mutually exclusive response]**
h. Other (Specify) **[Open ended]**

A.1.4 Changes Since Summer 2020

Now we have some questions about how driving and charging changed, if at all, for the electric vehicle ***since summer of 2020***.

CS1. Compared to your household's use of your electric vehicle in the summer 2020, did the typical ***miles per day*** that this electric vehicle was driven on weekdays change in summer 2021?

a. Yes, we drove the EV more on weekdays in summer 2021
b. Yes, we drove the EV less on weekdays in summer 2021
c. No or not significantly
d. We bought the EV after the summer of 2020

[If CS1 ≠ d, continue; otherwise, skip to A1]

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CS2. Compared to your household's use of this electric vehicle in the summer of 2020, did the ***timing*** of when this electric vehicle was typically driven on weekdays change in summer 2021?

a. Yes
b. No / Not significantly

[If CS2 = a, continue; otherwise; skip to CS3]

CS2a. Please describe how the timing of when this electric vehicle was typically driven on weekdays changed in summer 2021 compared to summer 2020 **[Open ended]**

CS3. Compared to the summer of 2020, was this EV typically charging more, less, or the same amount ***on weekdays*** in summer 2021? Please indicate how this varied by charging location.

	a. The EV was charging ***more on weekdays*** in summer 2021	**b.** The EV was charging ***less on weekdays*** in summer 2021	**c.** About the same
CS3_1. My home charger			
CS3_2. Workplace charger			
CS3_3. Public charger			

[If CS3_1 ≠ c OR CS3_2 ≠ c OR CS3_3 ≠ c, continue; otherwise, skip to CS5]

CS4. What accounts for the change in the amount of ***charging on weekdays*** between summer 2020 and summer 2021? **[Open ended]**

CS5. Compared to summer of 2020, was this EV typically charging more, less, or the same amount in summer 2021 ***during the weekday hours of 11 PM to 7 AM*** **[If CS Participant, display parenthetical]** ("Off-Peak" hours) relative to other hours? Please indicate how this varied by charging location.

	a. The EV was charging ***more*** during the weekday hours of 11 PM – 7 AM than during other hours in summer 2021	**b.** The EV was charging ***less*** during the weekday hours of 11 PM – 7 AM than during other hours in summer 2021	**c.** About the same
CS5_1. My home charger			
CS5_2. Workplace charger			
CS5_3. Public charger			

[If CS5_1 ≠ c OR CS5_2 ≠ c OR CS5_3 ≠ c, continue; otherwise, skip to CS6]

CS5a. What accounts for the change in the amount of ***charging on weekdays from 11 PM – 7 AM*** between summer 2020 and summer 2021? **[Open ended]**

[If CS Participant, continue; otherwise, skip to CS7]

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CS6. Compared to the summer of 2020, was this EV typically charging more, less, or the same amount in summer 2021 ***during the weekday hours of 5 PM – 8 PM*** ("On-Peak" hours) relative to other hours? Please indicate how this varied by charging location.

	a. The EV was charging ***more*** during the weekday hours of 5 PM – 8 PM than during other hours in summer 2021	**b.** The EV was charging ***less*** during the weekday hours of 5 PM – 8 PM than during other hours in summer 2021	**c.** About the same
CS6_1. My home charger			
CS6_2. Workplace charger			
CS6_3. Public charger			

[If CS6_1 ≠ c OR CS6_2 ≠ c OR CS6_3 ≠ c, continue; otherwise, skip to CS7]

CS6a. What accounts for the change in the amount of ***charging on weekdays from 5 PM – 8 PM*** between summer 2020 and summer 2021? **[Open ended]**

CS7. What, if any, additional observations do you have to share related to how your household's use of this electric vehicle and/or charging stations changed between summer 2020 and summer 2021?

a. **[Open ended]**
b. No additional observations

A.1.5 Additional EVs in Household

[If # of enrolled EVs = 2 OR EV4 = a, continue; otherwise, skip to I1]

A1. Thank you for answering the previous questions thinking about the enrolled electric vehicle whose driving and charging schedule you are most familiar with.

You indicated that your household has more than one EV. Please describe how your household used the additional electric vehicle(s) in summer 2021 (e.g., driven approximately 5 miles per weekday, on average, mostly after 4 pm). **[Open ended, optional]**

A2. Additionally, please describe how your household charges the additional electric vehicle(s). How do you manage home charging between EVs? **[Open ended, optional]**

A.1.6 Program Influences

[If CS Participant, continue; otherwise, skip to D1]

I1. Which of the following best describes how often you view the SmartCharge Rewards Portal (pictured) provided by Geotab (FleetCarma)?

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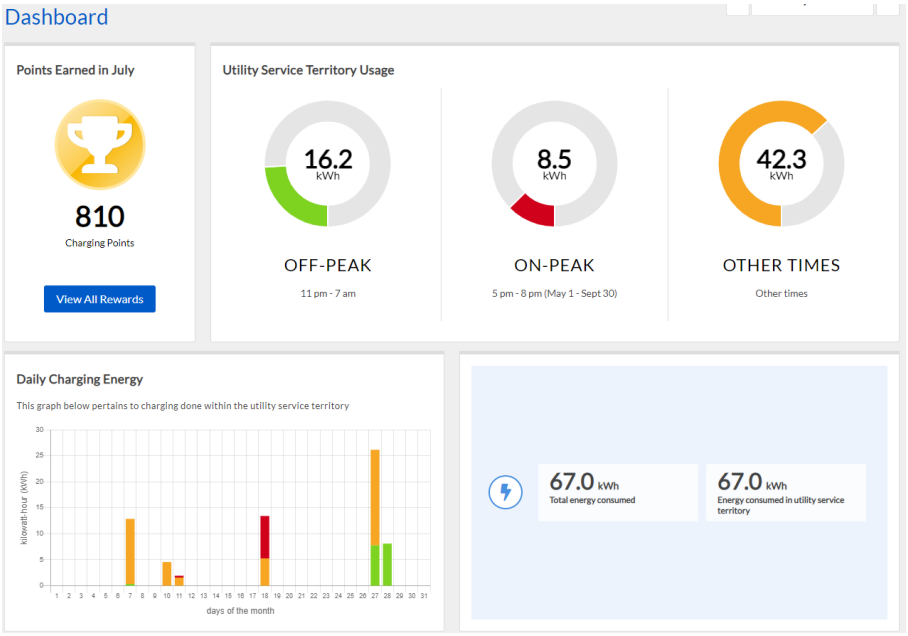
a. Very frequently (multiple times a day)
b. Frequently (every day or two)
c. Sometimes (once a week)
d. Occasionally (once or twice a month)
e. Never



[If I1 ≠ e, continue; otherwise, skip to I5]

I2. On a scale of 1 to 5, where 1 is “Not at all valuable” and 5 is “Very valuable”, how valuable is the following information provided on the portal?

	a. Not at all valuable	**b.** Minimally valuable	**c.** Somewhat valuable	**d.** Valuable	**e.** Very valuable	**f.** Don’t know
	1	**2**	**3**	**4**	**5**	
I2a. Summary of rewards earned						
I2b. Overall energy (kWh) consumed when charging my EV in Eversource territory during Off-Peak, On-Peak, and Other Times						
I2c. Energy (kWh) consumed when charging my EV in Eversource territory during Off-Peak, On-Peak, and Other Times by day of the month						

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	a. Not at all valuable	**b.** Minimally valuable	**c.** Somewhat valuable	**d.** Valuable	**e.** Very valuable	**f.** Don't know
I2d. Total energy (kWh) consumed when charging my EV vs. total energy (kWh) consumed when charging my EV in Eversource territory						

[If I2a = c-e OR I2b = c-e OR I2c = c-e OR I2d = c-e, continue; otherwise, skip to I4]

I3. Please describe what you find valuable about the information provided on the SmartCharge Rewards portal. **[Open ended]**

I4. Are there ways that the information provided on the SmartCharge Rewards portal could be improved?

a. Yes (Specify) **[Open ended]**
b. No

I5. Which of the following program incentives did you receive in the summer of 2021? Select all that you earned or benefited from at least once.

a. $50 incentive for enrolling in the program
b. $0.05/kWh for charging during Off-Peak hours (11 PM – 7 AM)
c. $10 monthly bonus for avoiding charging during On-Peak hours (5 PM – 8 PM)

I6. On a scale of 1 to 5, where 1 is "Not influenced at all" and 5 is "Very influenced", how influenced was your EV's charging schedule in summer 2021 by the following aspects of Eversource's ConnectedSolutions SmartCharge Rewards Program?

	a. Not influenced at all	**b.** Minimally influenced	**c.** Somewhat influenced	**d.** Influenced	**e.** Very influenced or Primary motivation	**f.** Don't know
	1	**2**	**3**	**4**	**5**	
I6a. The energy use information provided on the SmartCharge Rewards portal						
I6b. Rewards for charging during Off-Peak hours ($0.05/kWh)						
I6c. Monthly bonus for avoiding charging during On-Peak hours ($10/month)						

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[IF QI6a = c, d, or e, CONTINUE. ELSE SKIP TO QI8]

I7. Please indicate how the ***energy use information provided on the SmartCharge Rewards portal*** affected your charging behavior during summer 2021 relative to what it would have been if the information was not provided.

Without the usage information, I would have… (select all that apply) **[Responses a and b are mutually exclusive; responses c and d are mutually exclusive; responses e and f are mutually exclusive.]**

a. Charged more during Off-Peak hours (11 PM – 7 AM)
b. Charged less during Off-Peak hours (11 PM – 7 AM)
c. Charged more during On-Peak hours (5 PM – 8 PM)
d. Charged less during On-Peak hours (5 PM – 8 PM)
e. I would have charged my EV more *outside* of Eversource's territory
f. I would have charged my EV more *within* Eversource's territory
g. Don't know

[If I6b = c-e, continue; otherwise, skip to I9]

I8. Please indicate how the ***$0.05/kWh reward for charging during Off-Peak hours*** affected your charging behavior during summer 2021 relative to what it would have been if rewards were not provided.

Without the Off-Peak Rewards, I would have… (select all that apply) **[Responses a and b are mutually exclusive; responses c and d are mutually exclusive; responses e and f are mutually exclusive]**

a. Charged more during Off-Peak hours (11 PM – 7 AM)
b. Charged less during Off-Peak hours (11 PM – 7 AM)
c. Charged more during On-Peak hours (5 PM – 8 PM)
d. Charged less during On-Peak hours (5 PM – 8 PM)
e. I would have charged my EV more *outside* of Eversource's territory
f. I would have charged my EV more *within* Eversource's territory
g. Don't know

[If I6c = c-e, continue; otherwise, skip to S1]

I9. Please indicate how the ***$10 monthly bonus for avoiding charging during On-Peak hours*** affected your charging behavior during summer 2021 relative to what it would have been if the bonus was not provided.

Without the bonus for avoiding charging during On-Peak hours, I would have… (select all that apply) **[Responses a and b are mutually exclusive; responses c and d are mutually exclusive; responses e and f are mutually exclusive]**

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a. Charged more during Off-Peak hours (11 PM – 7 AM)
b. Charged less during Off-Peak hours (11 PM – 7 AM)
c. Charged more during On-Peak hours (5 PM – 8 PM)
d. Charged less during On-Peak hours (5 PM – 8 PM)
e. I would have charged my EV more *outside* of Eversource's territory
f. I would have charged my EV more *within* Eversource's territory
g. Don't know

A.1.7 Program Satisfaction

S1. On a scale of 1 to 5, where 1 is "Very unsatisfied" and 5 is "Very satisfied", how would you rate your satisfaction with the following aspects of Eversource's ConnectedSolutions SmartCharge Rewards Program to-date?

	a. Very Unsatisfied	**b.**	**c.**	**d.**	**e.** Very Satisfied	**f.** Don't know
	1	**2**	**3**	**4**	**5**	
S1a. The SmartCharge Rewards Portal						
S1b. Program incentives						
S1c. Program communications						
S1d. Timing of Off-Peak period (11 PM – 7 AM)						
S1e. Timing of On-Peak period (5 PM – 8 PM)						

[If S1a ≠ f, continue; otherwise, skip to S3]

S2. How could the ***SmartCharge Rewards Portal*** be improved?

a. **[Open ended]**
b. No improvements needed
c. Not sure

[If S1b ≠ f, continue; otherwise, skip to S4]

S3. How could ***program incentives*** be improved?

d. **[Open ended]**
e. No improvements needed
f. Not sure

[If S1c ≠ f, continue; otherwise, skip to S5]

S4. How could ***program communications*** be improved?

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a. **[Open ended]**
b. No improvements needed
c. Not sure

[If S1d ≠ f, continue; otherwise, skip to S6]

S5. How could the ***timing of the Off-Peak period*** be improved?

a. **[Open ended]**
b. No improvements needed
c. Not sure

[If S1e ≠ f, continue; otherwise, skip to S7]

S6. How could the ***timing of the On-Peak period*** be improved?

a. **[Open ended]**
b. No improvements needed
c. Not sure

S7. On a scale of 1 to 5, where 1 is "Very Unlikely" and 5 is "Very Likely", how likely are you to continue to participate in Eversource's ConnectedSolutions SmartCharge Rewards Program?

a. Very Unlikely – 1	**b.** 2	**c.** 3	**d.** 4	**e.** Very Likely – 5

[If S7 = a or b, continue; otherwise, skip to S9]

S8. What change(s) to Eversource's ConnectedSolutions SmartCharge Rewards Program, if any, would encourage you to continue participating? **[Open ended, optional]**

[IF S7 = c-e, continue; otherwise, skip to D1]

S9. What recommendations would you make, if any, to help improve Eversource's ConnectedSolutions SmartCharge Rewards Program going forward? **[Open ended, optional]**

A.1.8 Demographics

You're almost done! We just have a few more questions.

D1. Which of the following best describes the property type where your home charging device is located?

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a. Single family home
b. Multi-family home (2-4 units)
c. Multi-family home (5+ units)
d. Mobile home
e. Not a residence (business, workshop or other)
f. Other (Specify) **[Open ended]**

D2. Which of the following best describes the location of your home charging device?

a. In an attached heated garage
b. In an attached garage with no heat
c. In an unattached heated garage
d. In an unattached garage with no heat
e. Outside
f. Other (Specify) **[Open ended]**

D3. Which of the following age categories do you fall into?

a. 18-24
b. 25-34
c. 35-44
d. 45-54
e. 55-64
f. 65 or over
g. Prefer not to provide

D4. What is the last grade of school you completed?

a. Grade school or less (1-8)
b. Some high school (9-11)
c. Graduated high school (12)
d. Vocational/technical school
e. Some college (1-3 years)
f. Graduated college (4 years)
g. Post-graduate education
h. Prefer not to provide

D5. Which category best describes your gender?

a. Male
b. Female
c. Other
d. Prefer not to provide

D6. How many people occupied your home this summer 2021? Enter zero where appropriate. **[Responses are restricted to two digits]**

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Occupant Type	Number
D6_1. Children, under 18	**[Numeric]**
D6_2. Adults, 18 to 65	**[Numeric]**
D6_3. Adults, 65 and older	**[Numeric]**

D7. **[PIPE VLAUES FOR D7 BASED ON RESPONSE TO D6]** What was your estimated total annual household income in 2021 before taxes (in other words, your gross household income)? **[Example choices shown below are for if sum of D6 values = 1]**

a. Less than $19,600
b. $19,601 - $39,100
c. $39,101 - $45,600
d. $45,601 - $52,100
e. $52,101 - $58,700
f. $58,701 - $65,200
g. $65,201 - $71,700
h. $71,701 - $78,200
i. $78,201 - $97,800
j. $97,801 - $130,400
k. Greater than $130,400
l. Prefer not to answer

A.1.9 Closing

C1. We have reached the end of the survey. Do you have any additional comments regarding the Eversource ConnectedSolutions SmartCharge Rewards Program?

a. **[Open ended]**
b. None

C2. Thank you for taking the time to fill out this survey for the **[Display program name]**! Please provide your email address so we may email you a $10 eGift Card redeemable at a number of retailers including Amazon.com and Visa (to see your options, visit https://www.rewardsgenius.com/reward-catalog).

a. Enter email address **[Open ended]**
b. I prefer not to provide my email address

[Survey close] We thank you for your time spent taking this survey. Your response has been recorded.

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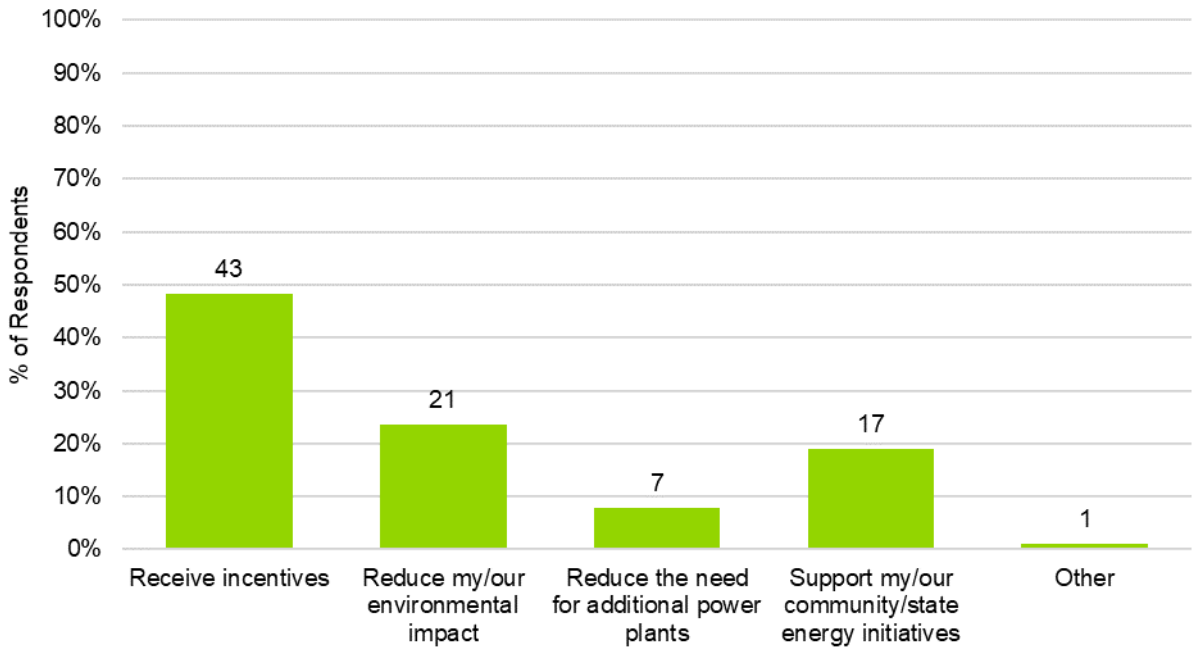
Appendix B. Participant Survey Output

B.1 2021 Participant Survey Output

B.1.1 Motivations

M1. What was your top motivation for enrolling in Eversource's ConnectedSolutions SmartCharge Rewards Program? (n=89)



Source: Guidehouse

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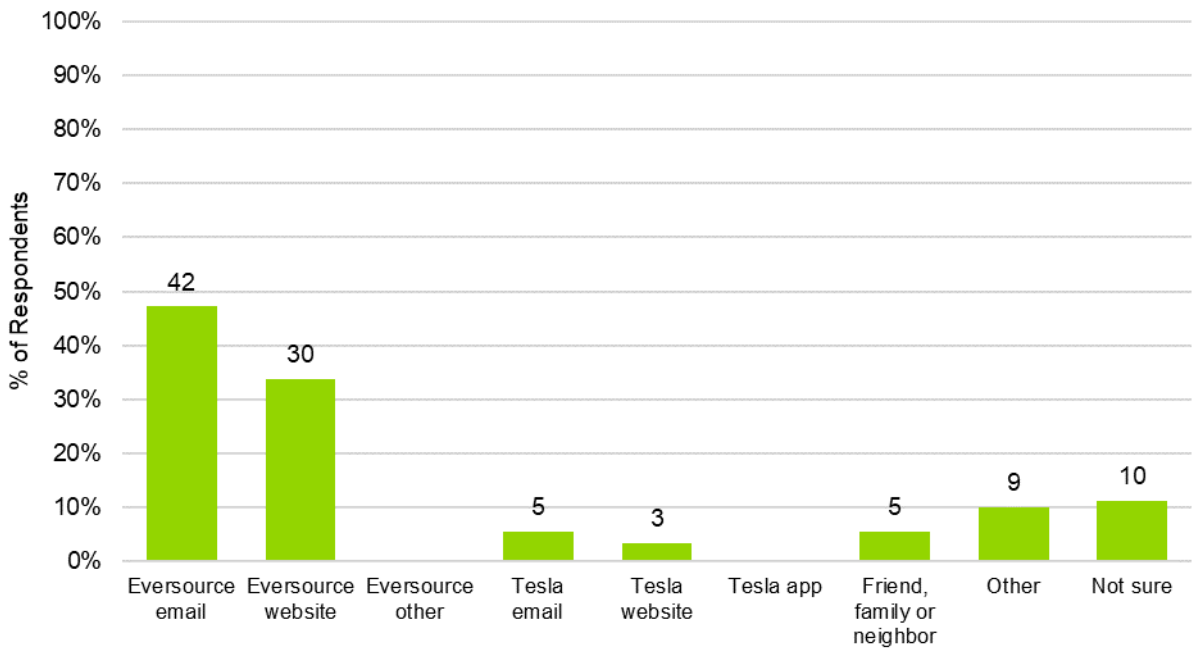
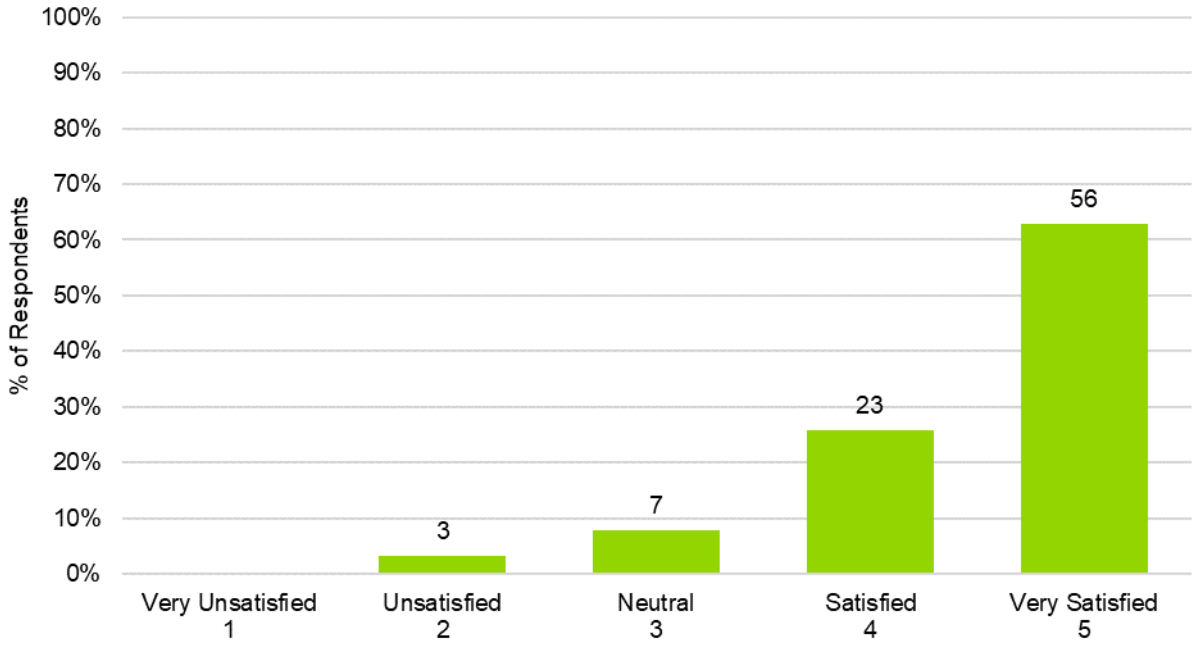
M2. How did you learn about Eversource's ConnectedSolutions SmartCharge Rewards Program? Select all that apply. (n=89)



Source: Guidehouse

M3. On a scale of 1 to 5, where 1 indicates "Very Unsatisfied" and 5 indicates "Very Satisfied," how satisfied were you with the process of enrolling in the program? (n=89)



Source: Guidehouse

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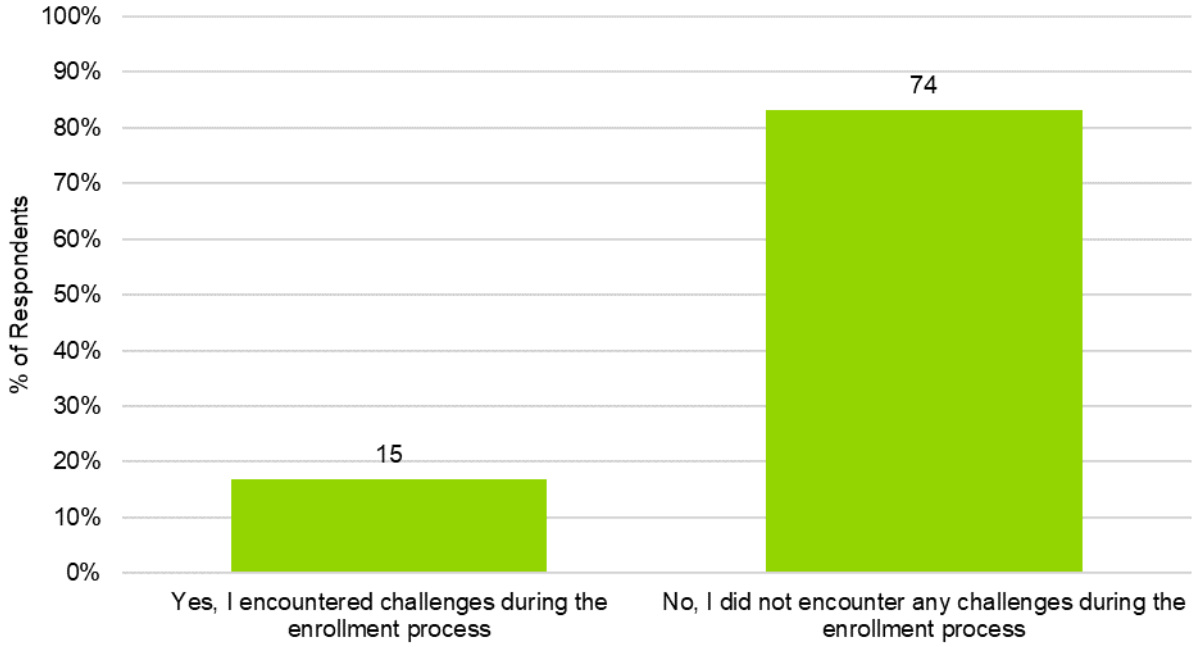
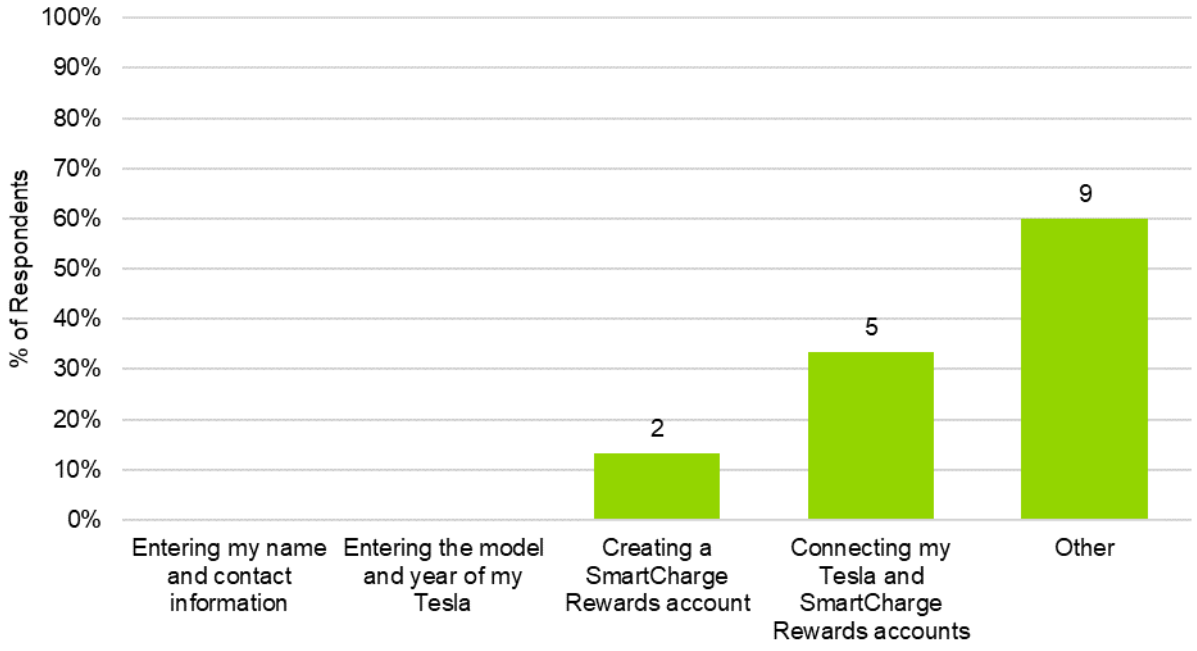
M4. Did you encounter any challenges or difficulties during the enrollment process? (n=89)



Source: Guidehouse

M5. During which enrollment step(s) did you encounter challenges or difficulties? Select all that apply. (n=15)



Source: Guidehouse

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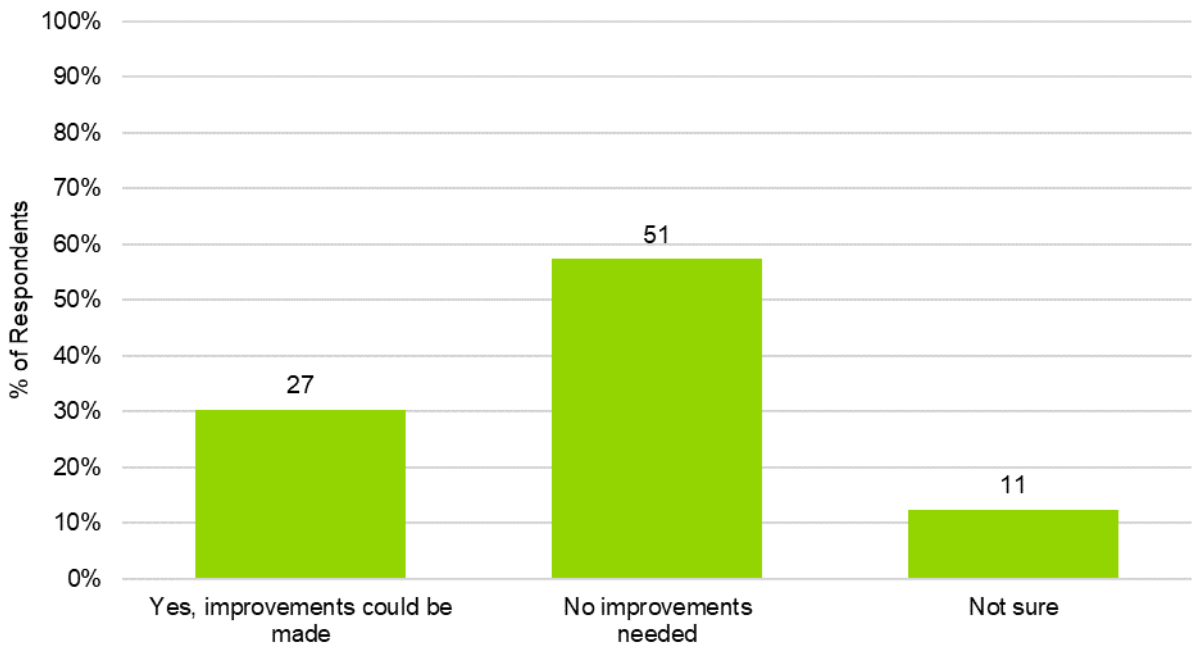
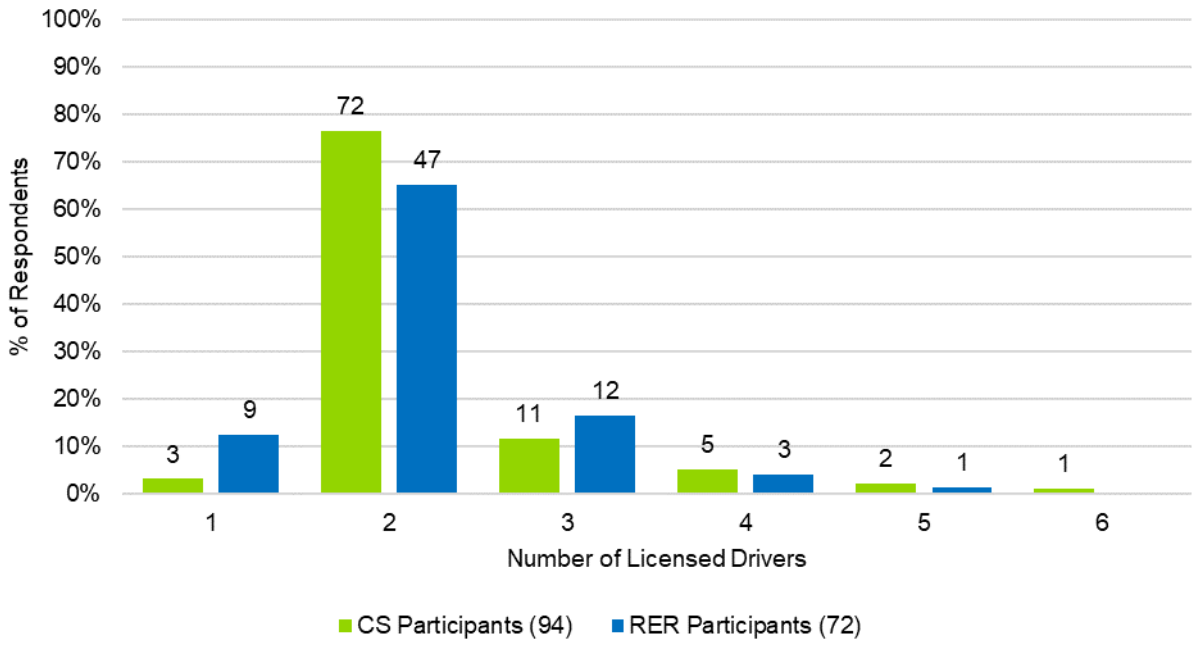
M6. How could the ConnectedSolutions SmartCharge Rewards Program enrollment process be improved? (n=89)



Source: Guidehouse

B.1.2 EV Characteristics and Driving Behavior

EV1. How many licensed drivers are there in your household? (n=166)



Source: Guidehouse

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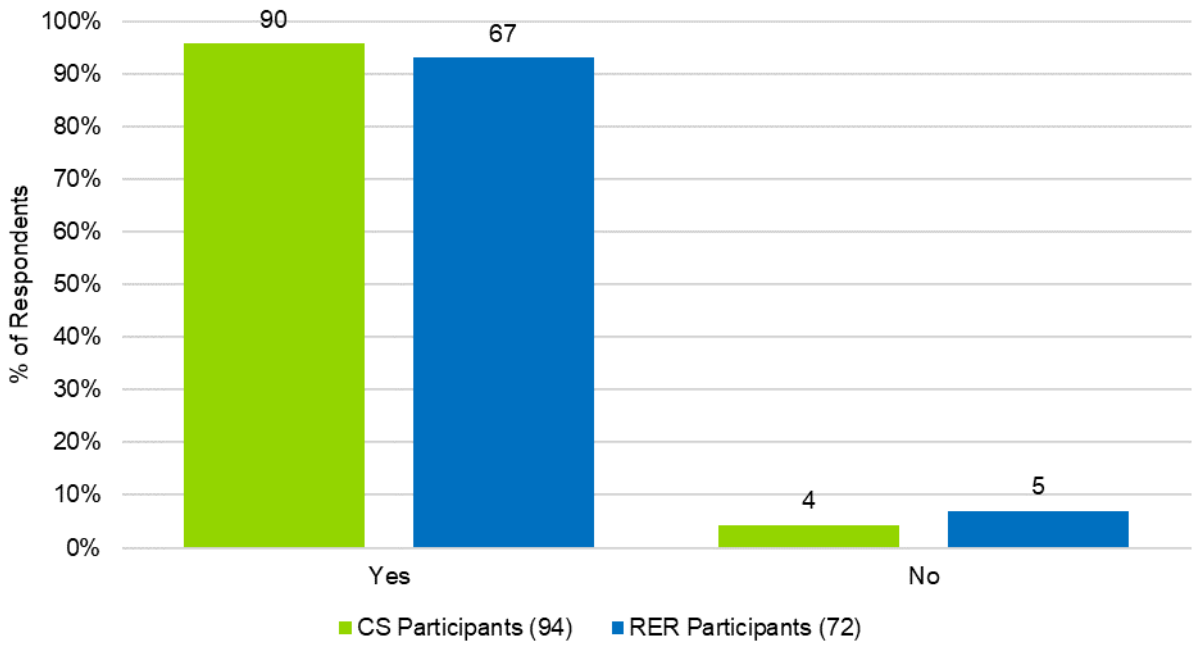
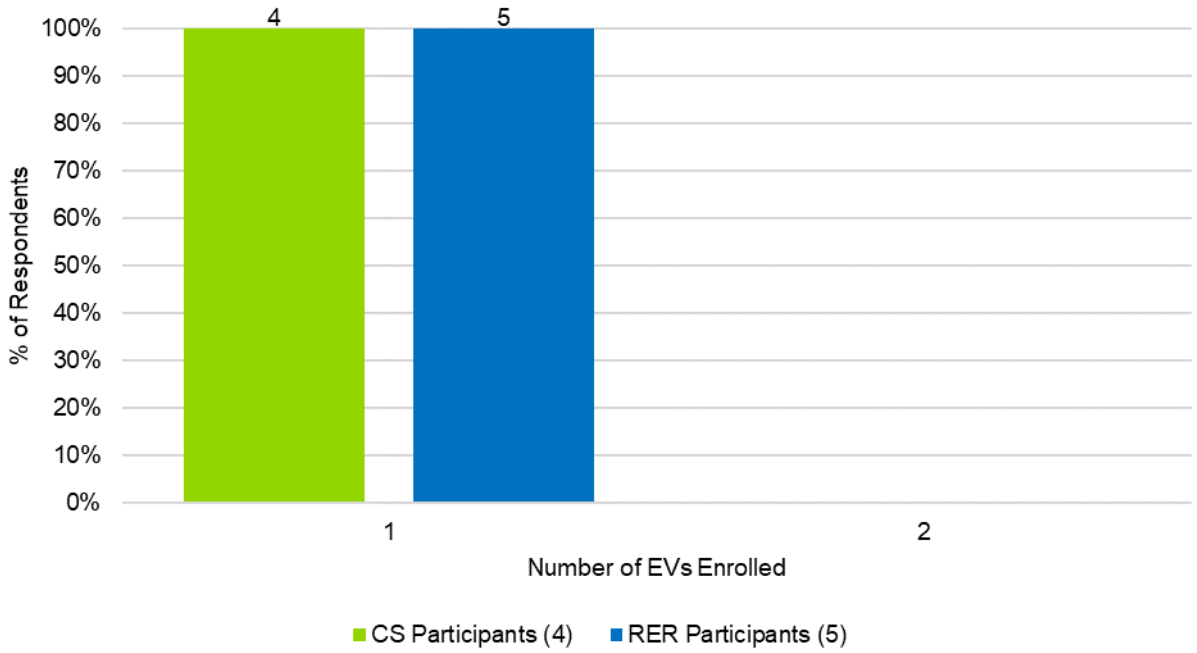
EV2. According to our records, you currently have the following EV(s) enrolled in **[Display program name]**. Is this accurate? (n=166)



Source: Guidehouse

EV2_0. How many EVs do you have enrolled in **[Display program name]**? (n=9)



Source: Guidehouse

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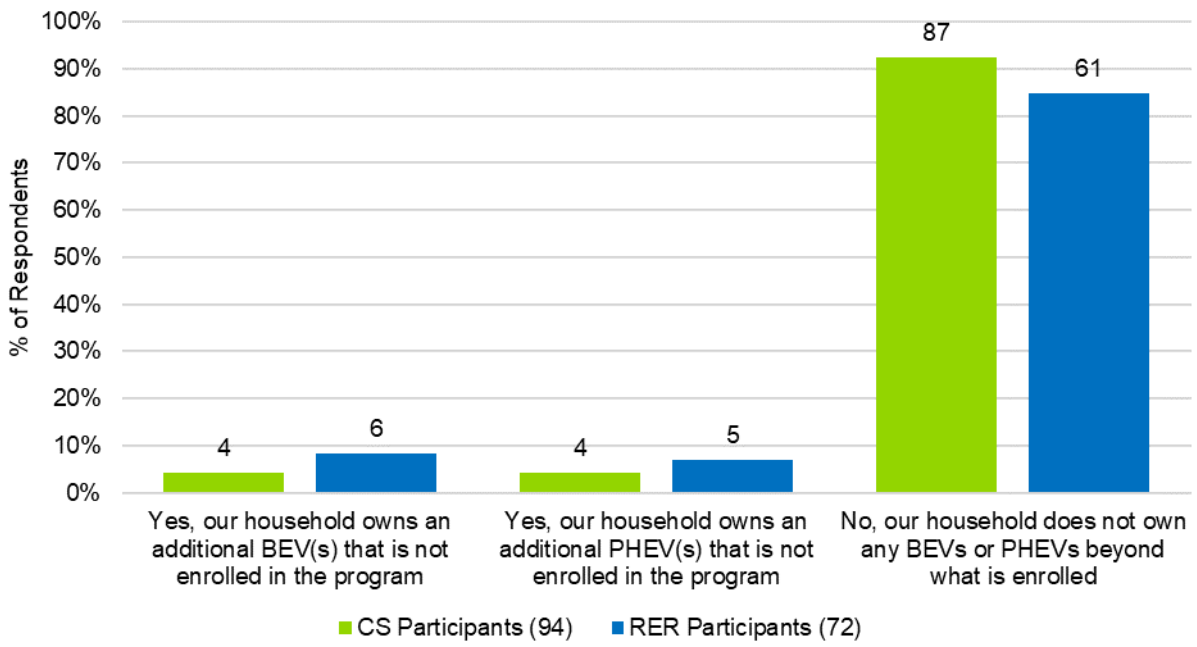
EV4. Does your household own any other EVs (that are not enrolled **in [Display program name]**)? (n=166)



Source: Guidehouse

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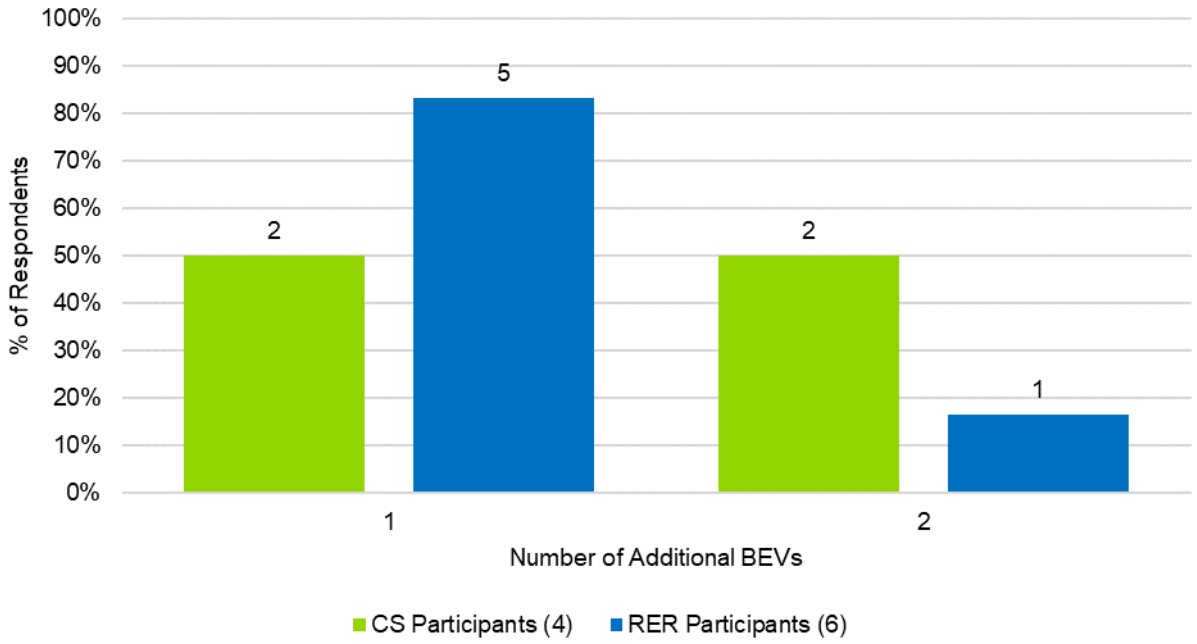
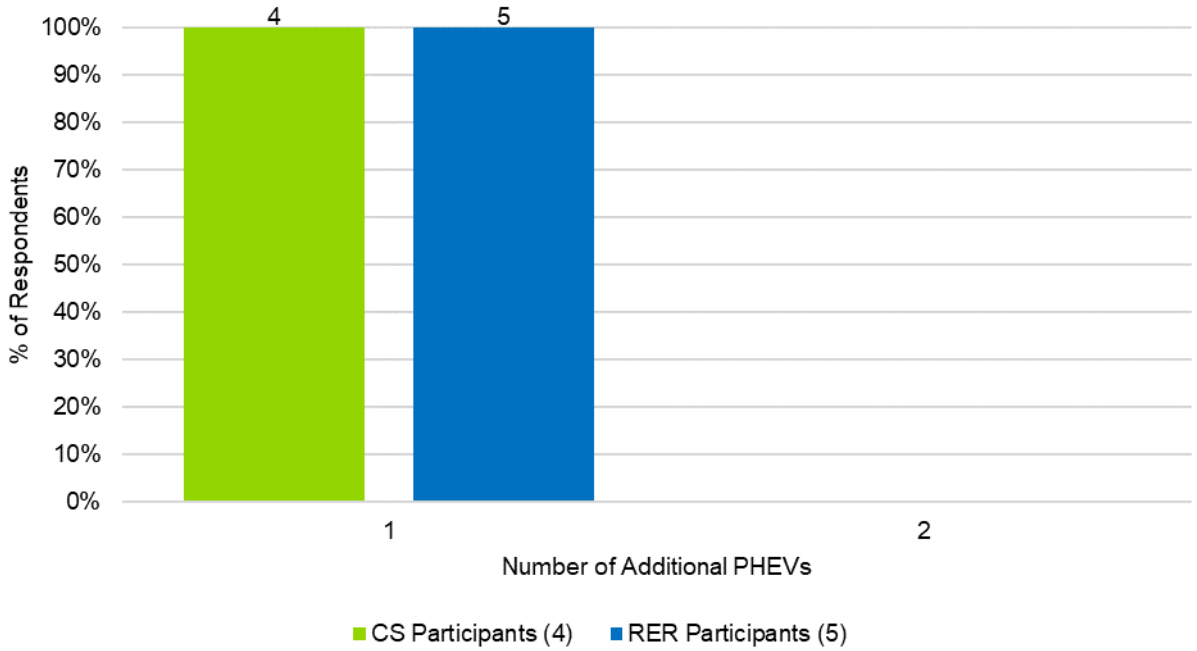
EV5. How many additional BEVs does your household own? (n=10)



Source: Guidehouse

EV10. How many additional PHEVs does your household own (n=9)



Source: Guidehouse

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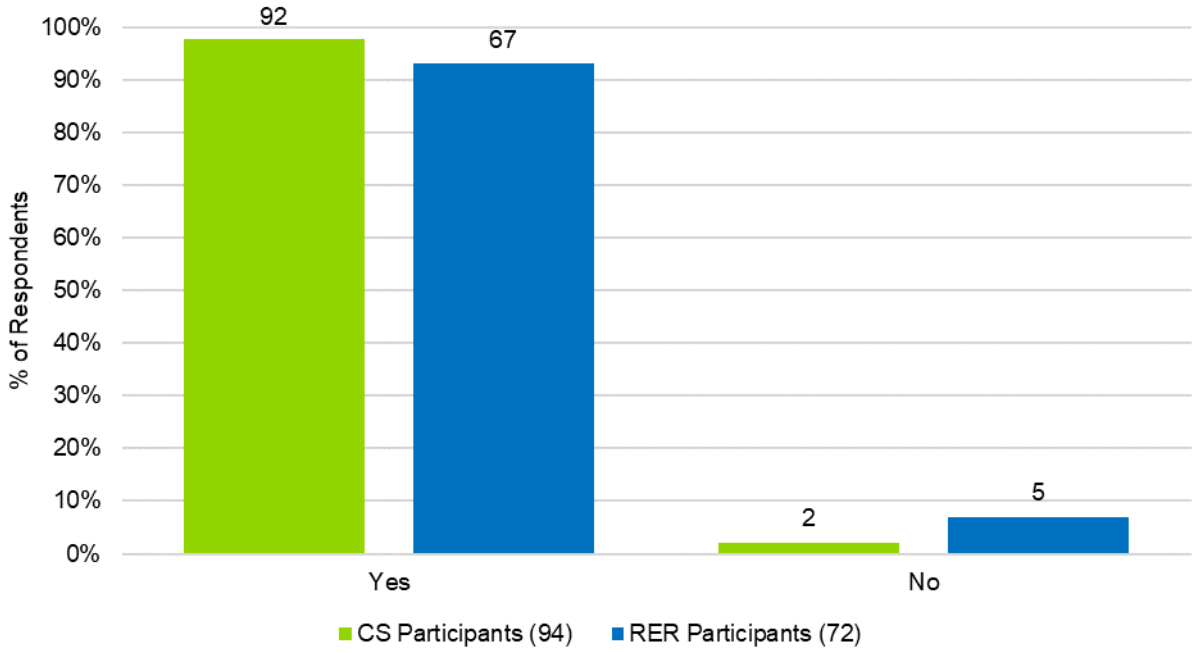
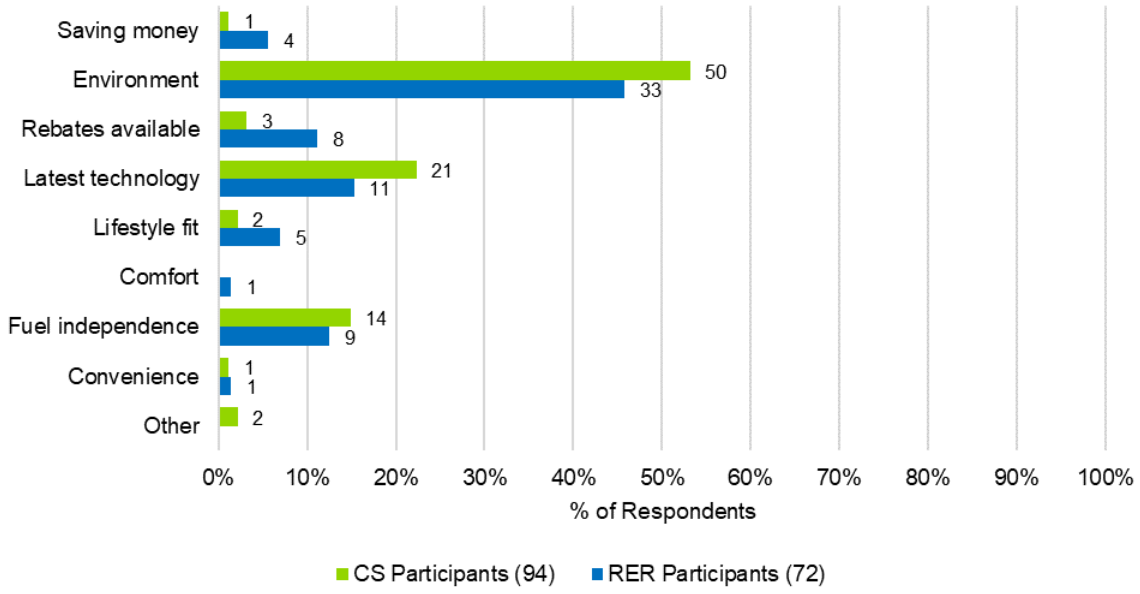
EV16. Did this electric vehicle serve as the primary form of transportation for at least one member of the household on weekdays during summer 2021 (June through August)? (n=166)



Source: Guidehouse

EV17. What was your household's top motivation for buying the electric vehicle? (n=166)



Source: Guidehouse

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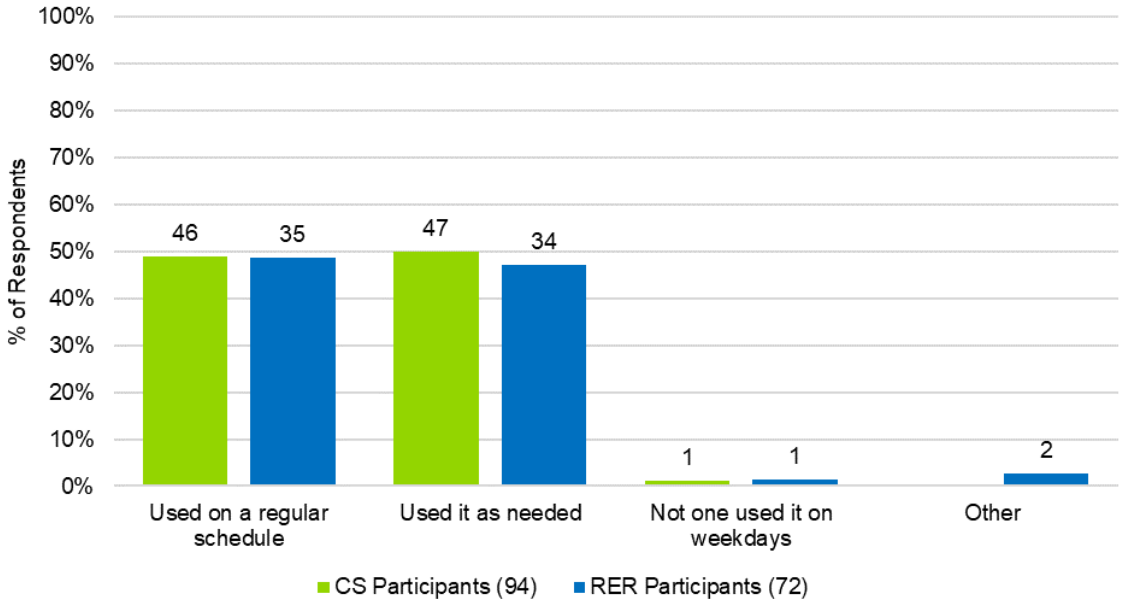
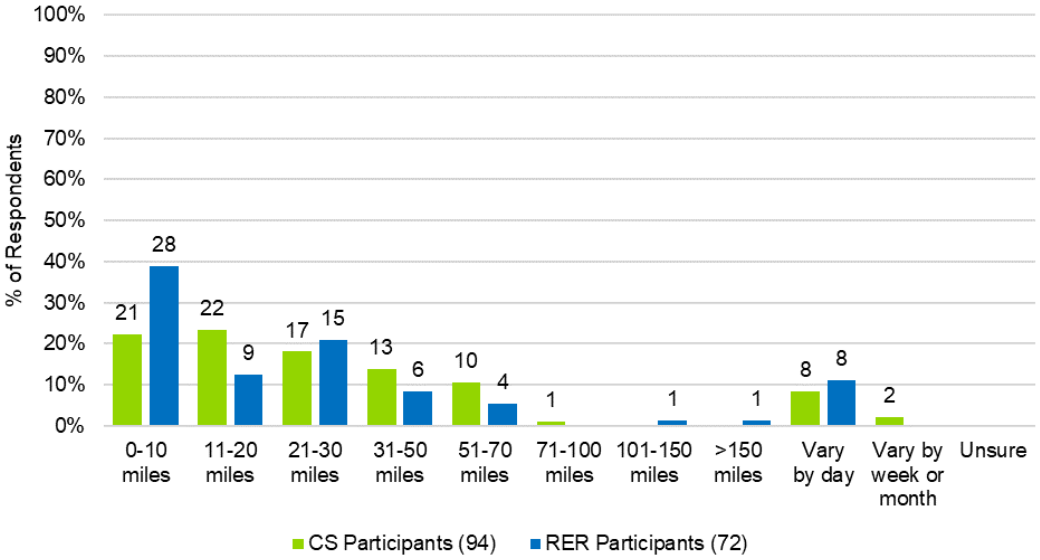
EV18. Which of the following best describes how your household typically used this electric vehicle on weekdays (Monday through Friday) during the summer of 2021 (June through August)? (n=166)



Source: Guidehouse

EV19. On a typical summer 2021 weekday (Monday, Tuesday, etc.), on average, how many miles was this electric vehicle driven by you and other members of your household? Don't worry about being exact – just provide your best estimate for the total miles driven on a typical summer weekday for 2021. (n=166)



Source: Guidehouse

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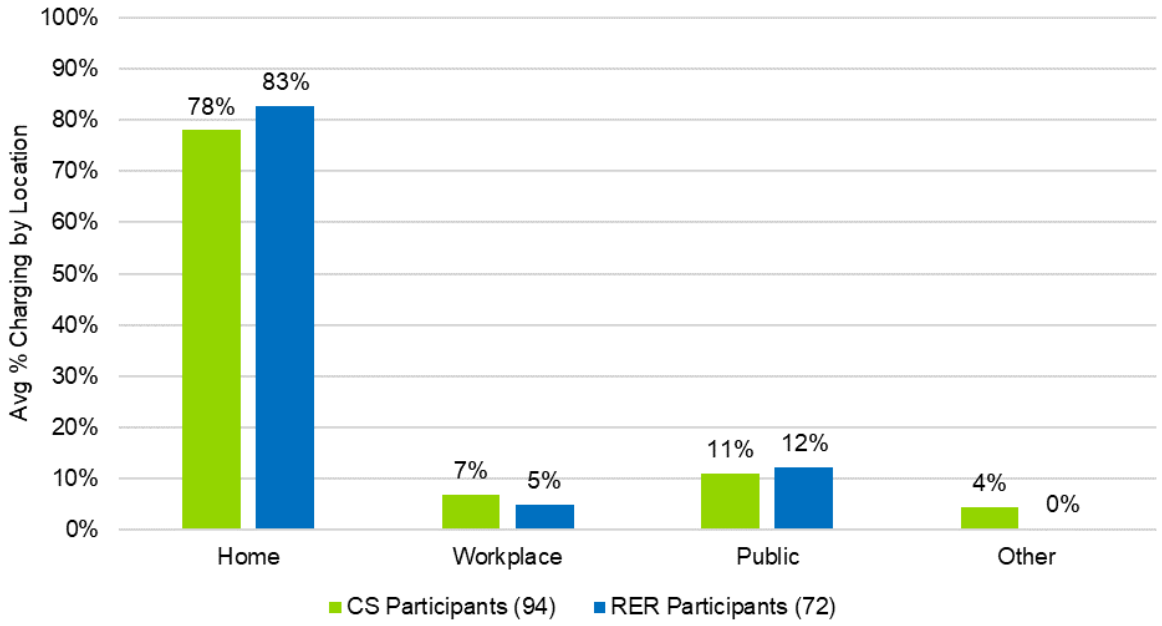
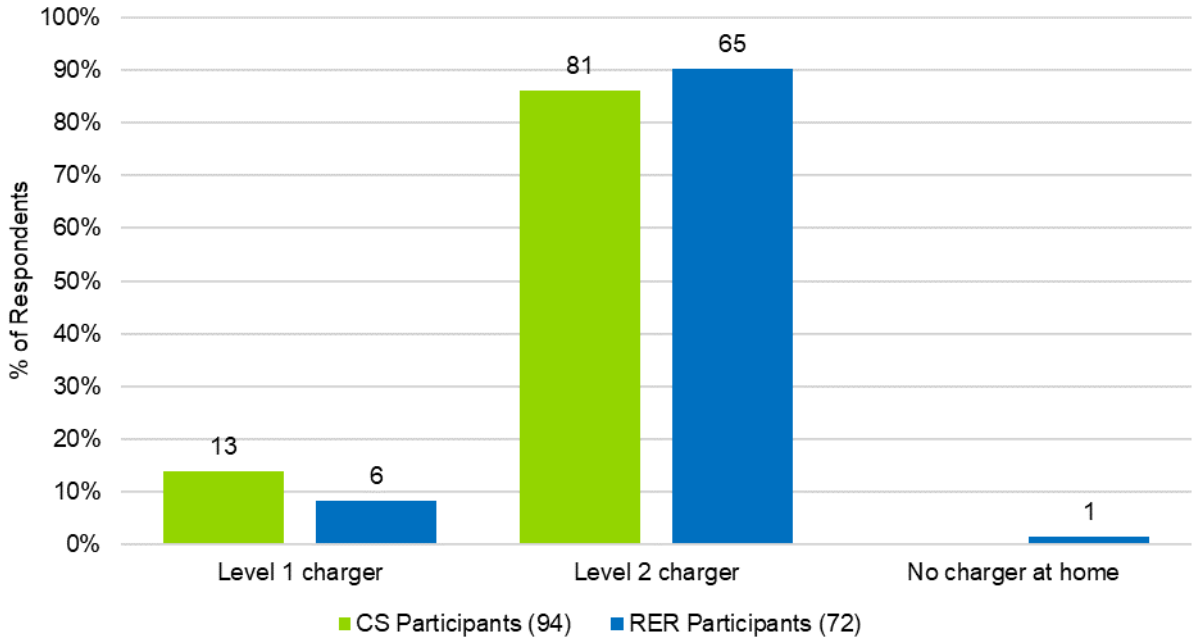
B.1.3 EVSE Characteristics and Charging Behavior

CB1. Approximately what percentage of your EV's charging this past summer took place at your home, work, public, or other charging stations? (n=166)



Source: Guidehouse

CB2. Which of the following best describes the electric vehicle charging device that you have at home? (n=166)



Source: Guidehouse

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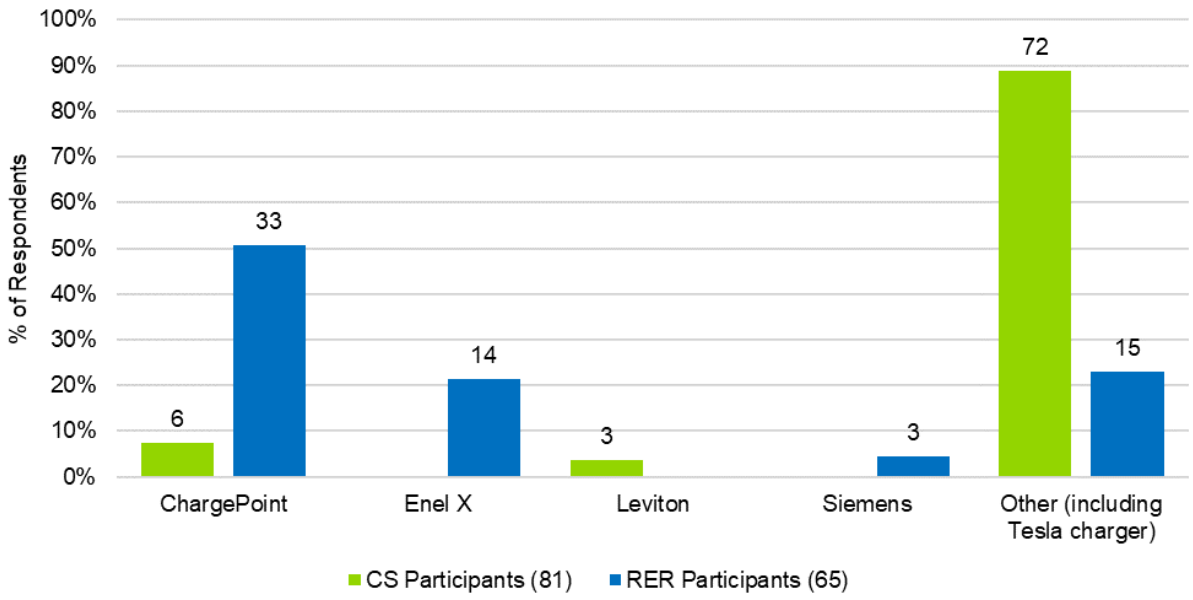
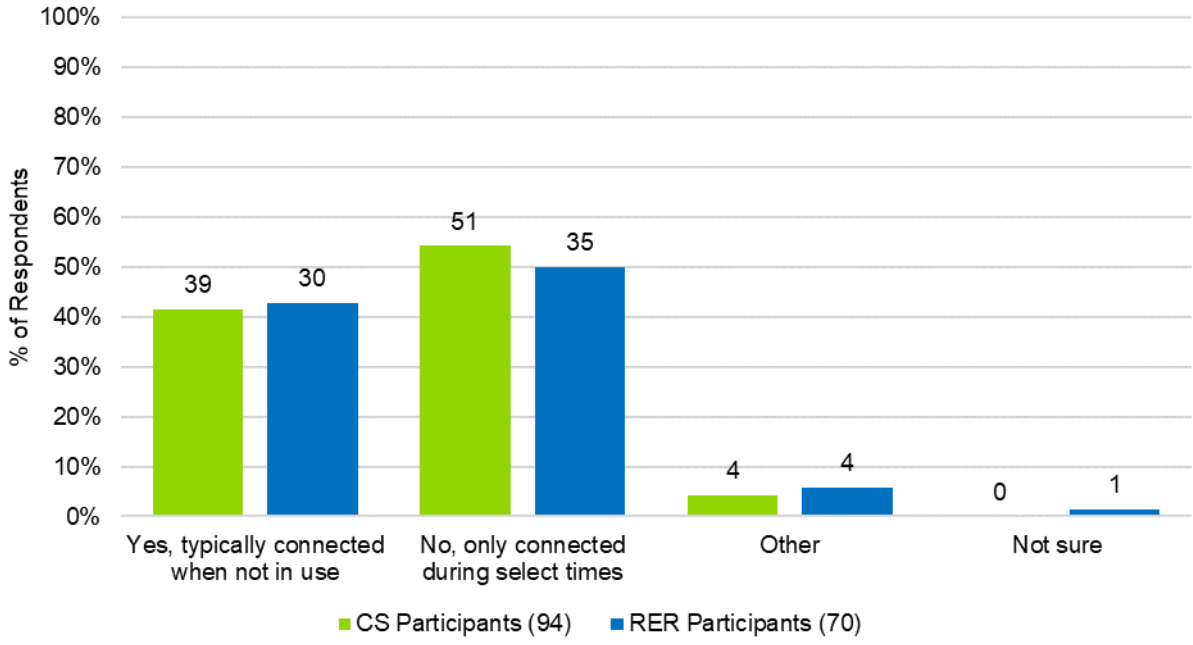
CB3. Please select the make of your Level 2 charger. (n=146)



Source: Guidehouse

CB4. During summer 2021, when your electric vehicle was not being used and at home, was it typically connected to your home charging device? (n=164)



Source: Guidehouse

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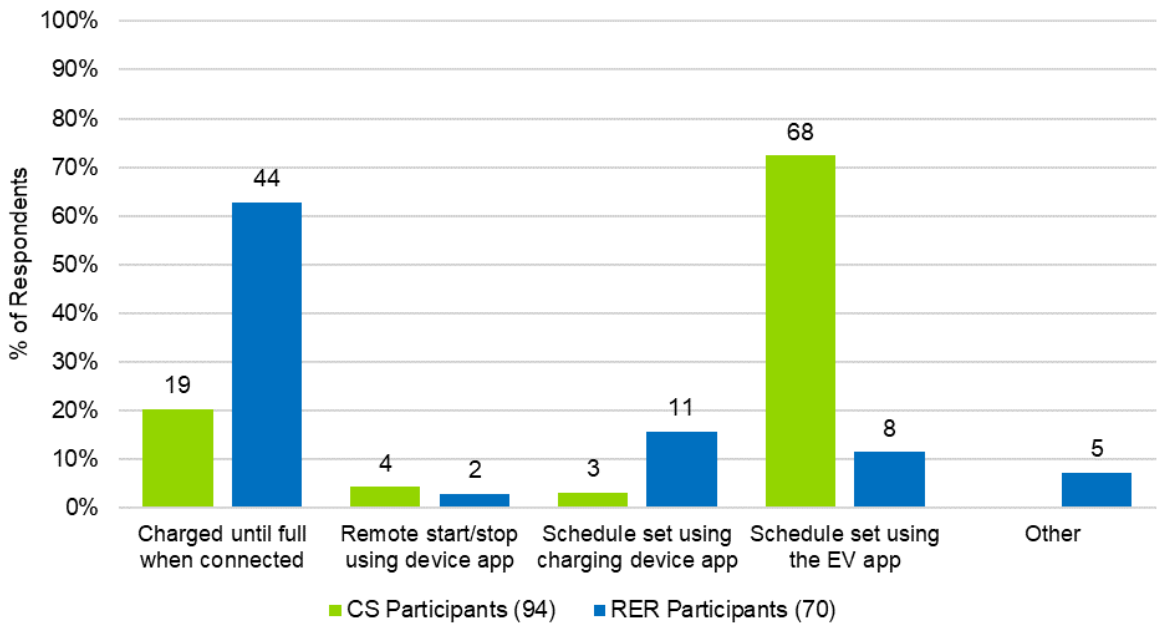
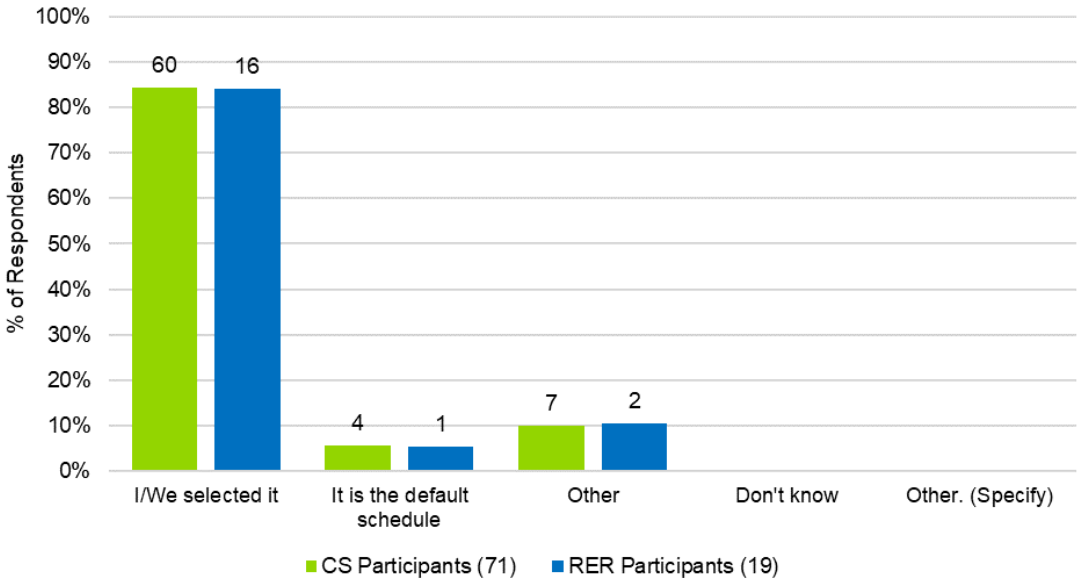
CB5. During summer 2021, which of the following best describes your household's use of your home charging device for your electric vehicle? (n=164)



Source: Guidehouse

CB5_b. How was your electric vehicle's home charging schedule determined? (n=90)



Source: Guidehouse

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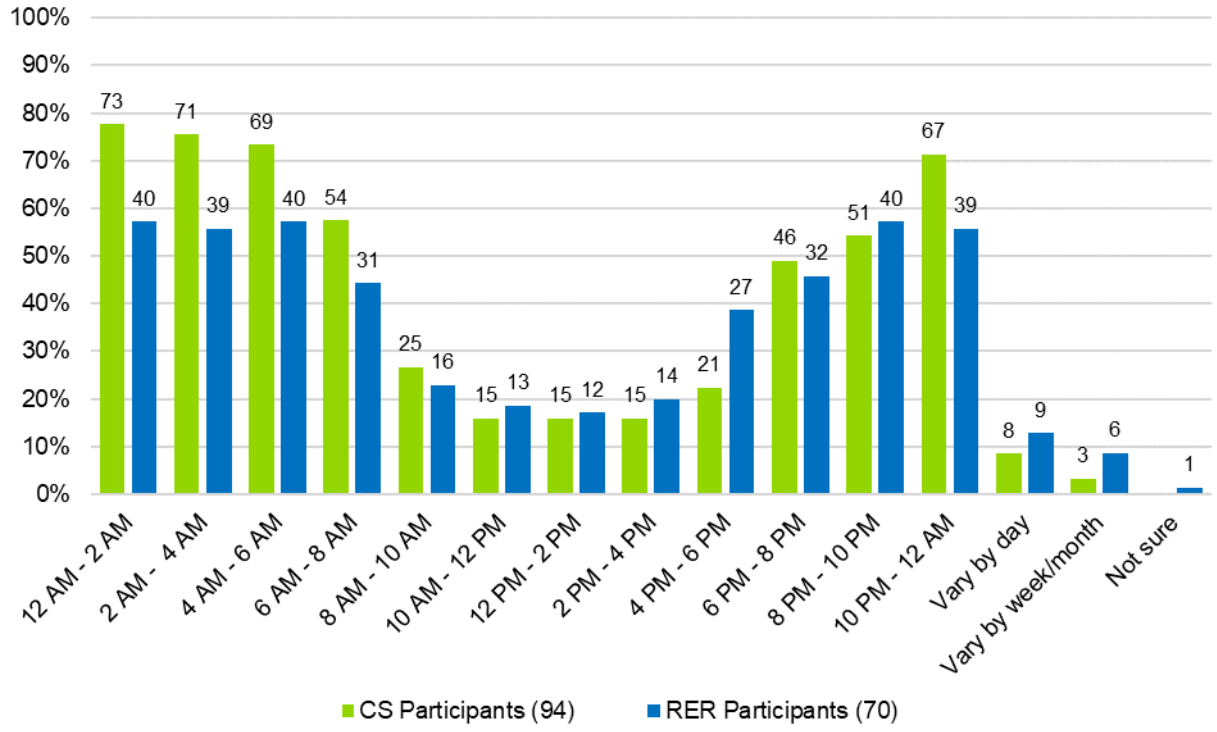
CB6. Indicate the time ranges during which the electric vehicle was typically connected to your home charging device on weekdays (Monday – Friday) during summer 2021 (June – August). Select all the time ranges that apply. (n=164)



Source: Guidehouse

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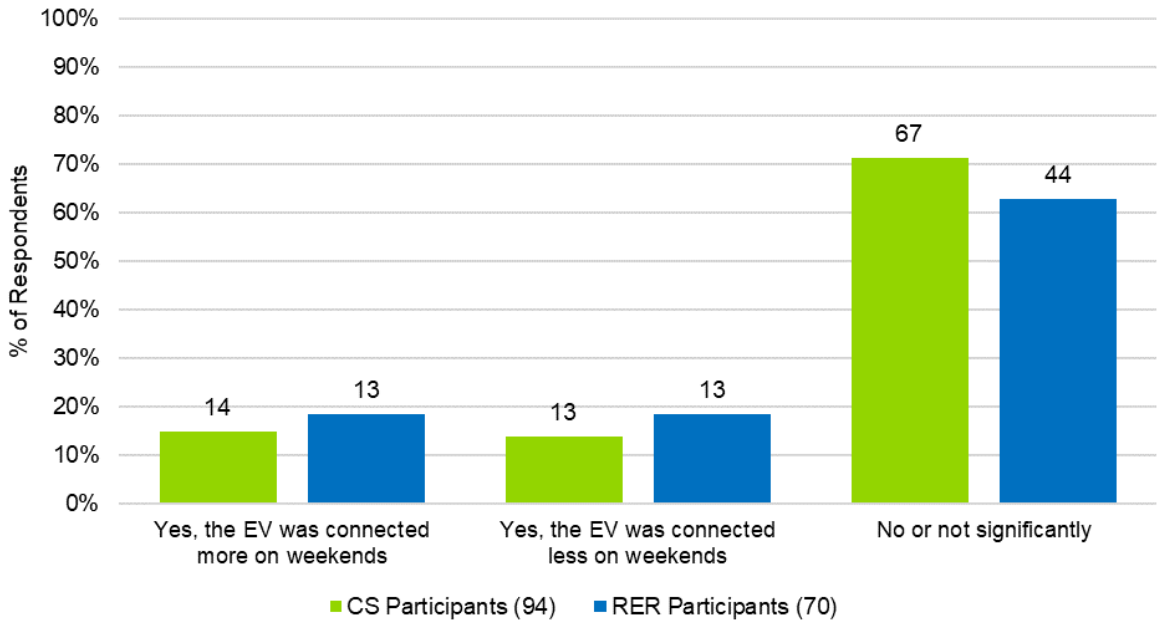
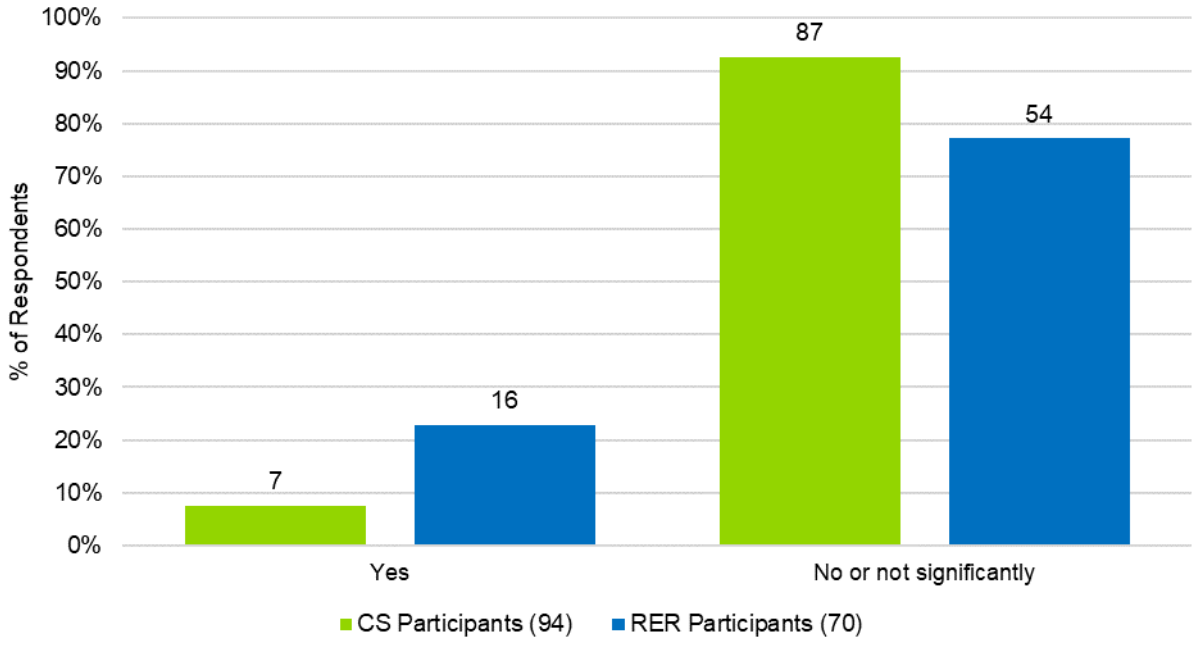
CB9. Compared to your household's use of your home charging device on weekdays, was the amount of time this electric vehicle was typically connected to your home charging device in summer 2021 different on weekends? (n=164)



Source: Guidehouse

CB10. Compared to your household's use of your home charging device on weekdays, was the timing of when this electric vehicle was typically connected to your home charging device in summer 2021 different on weekends? (n=164)



Source: Guidehouse

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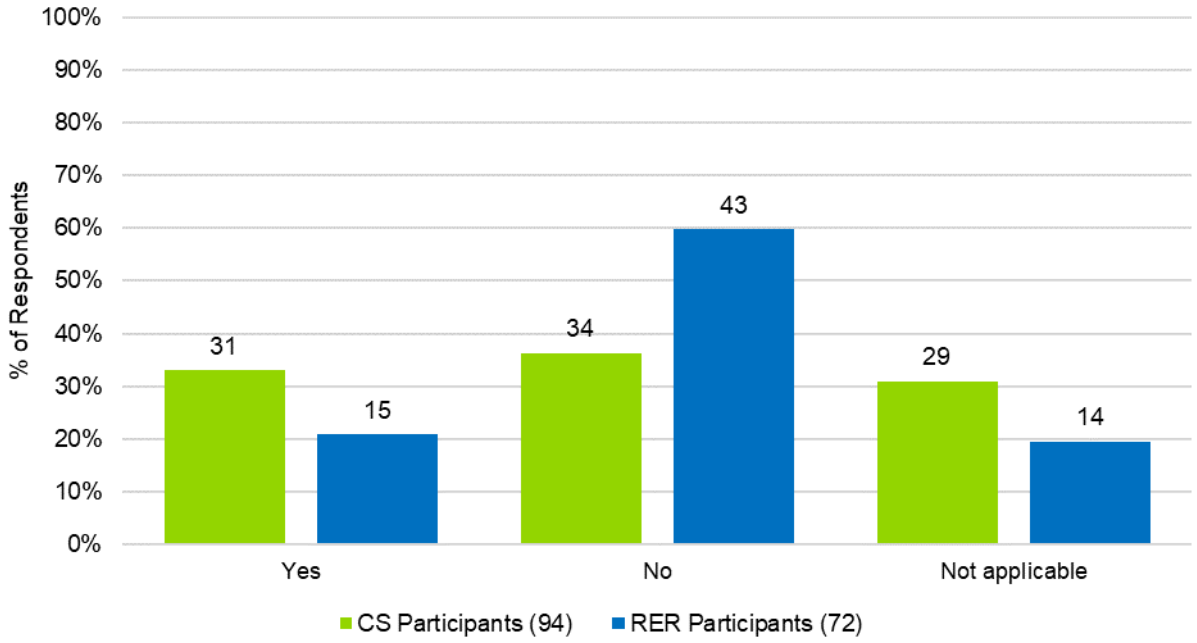
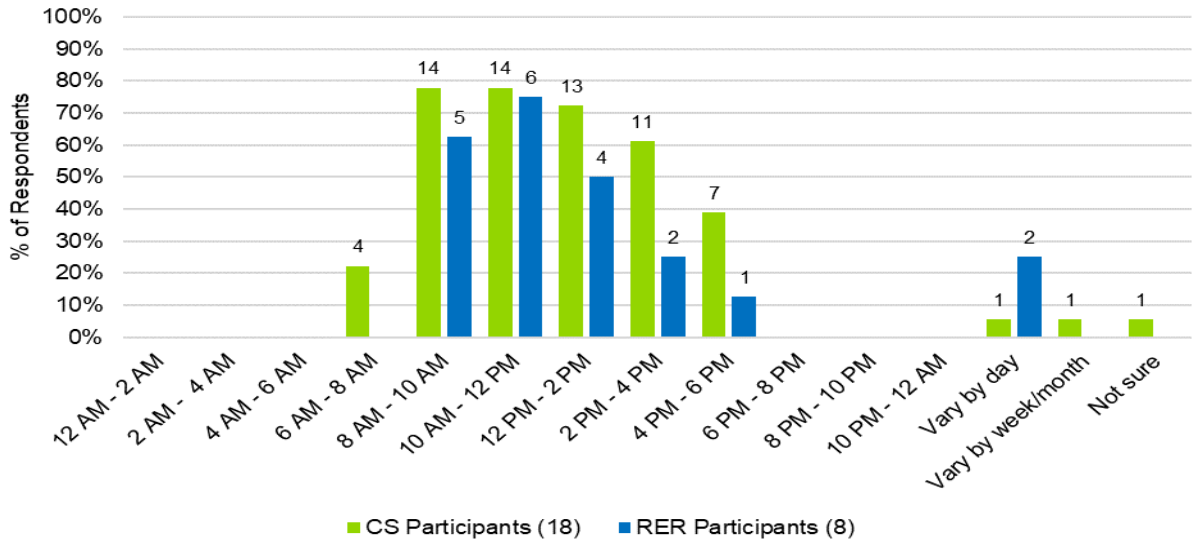
CB11. Is this electric vehicle driven to a workplace that has workplace charging available?

Answer this question based on whether or not charging is available at a workplace, regardless of whether you or other household members go into work regularly and/or use it. (n=166)



Source: Guidehouse

CB13. Below, please indicate when this electric vehicle was typically connected to a workplace charging station on weekdays (Monday – Friday) during the summer 2021 (June – August). Select all the time ranges that apply. (n=26)



Source: Guidehouse

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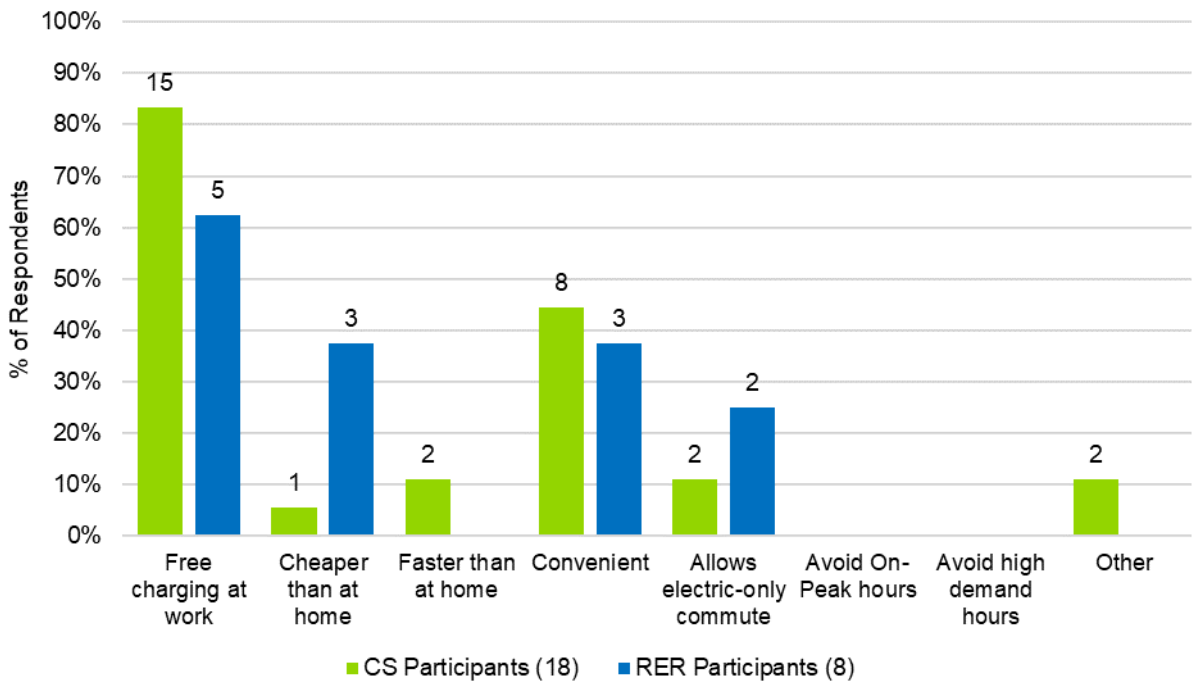
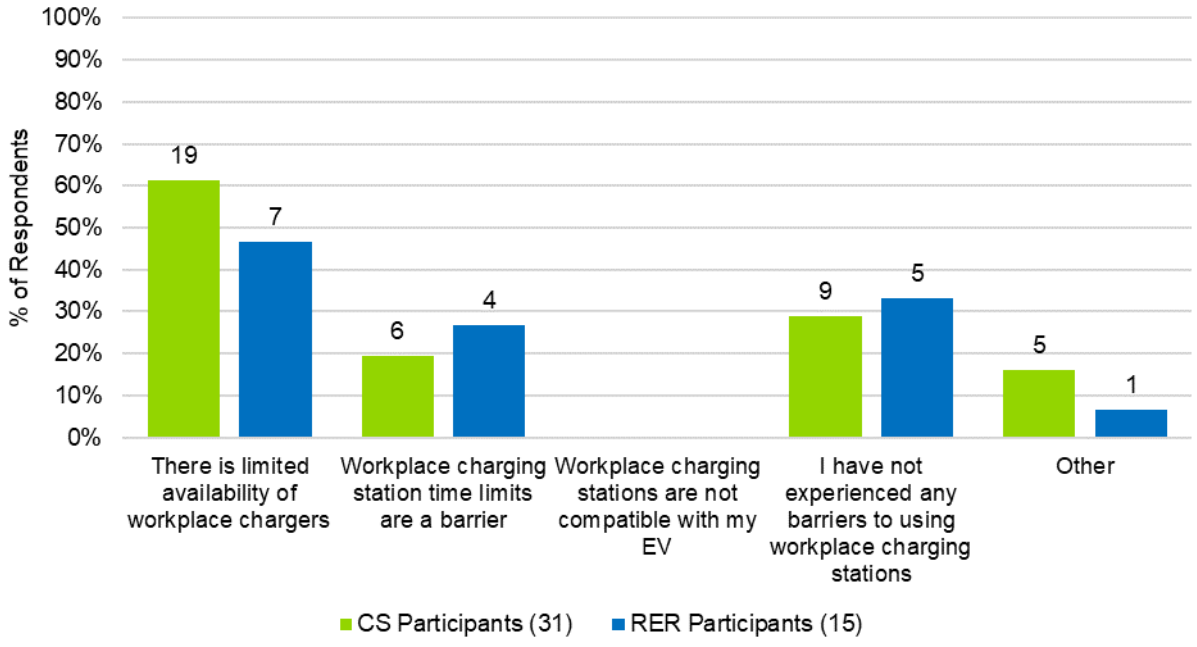
CB14. What are your main motivations for using workplace charging stations? Select all that apply. (n=26)



Source: Guidehouse

CB15. Are there are any barriers for you or your household members to use workplace charging stations to charge this electric vehicle? Select all that apply. (n=46)



Source: Guidehouse

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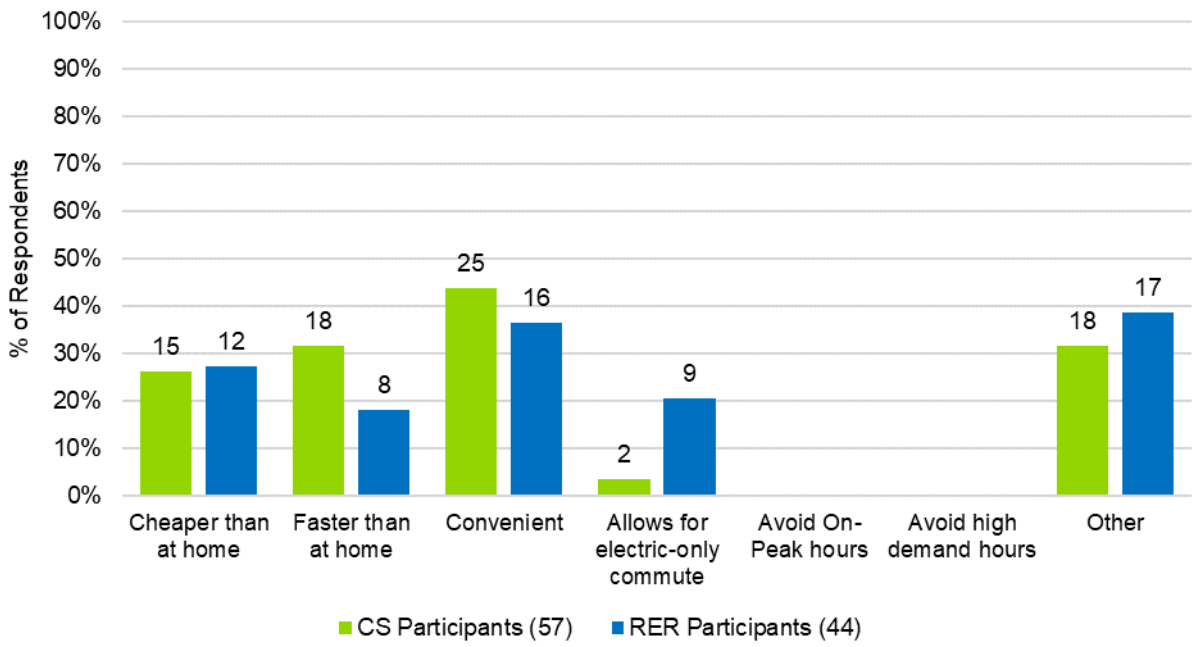
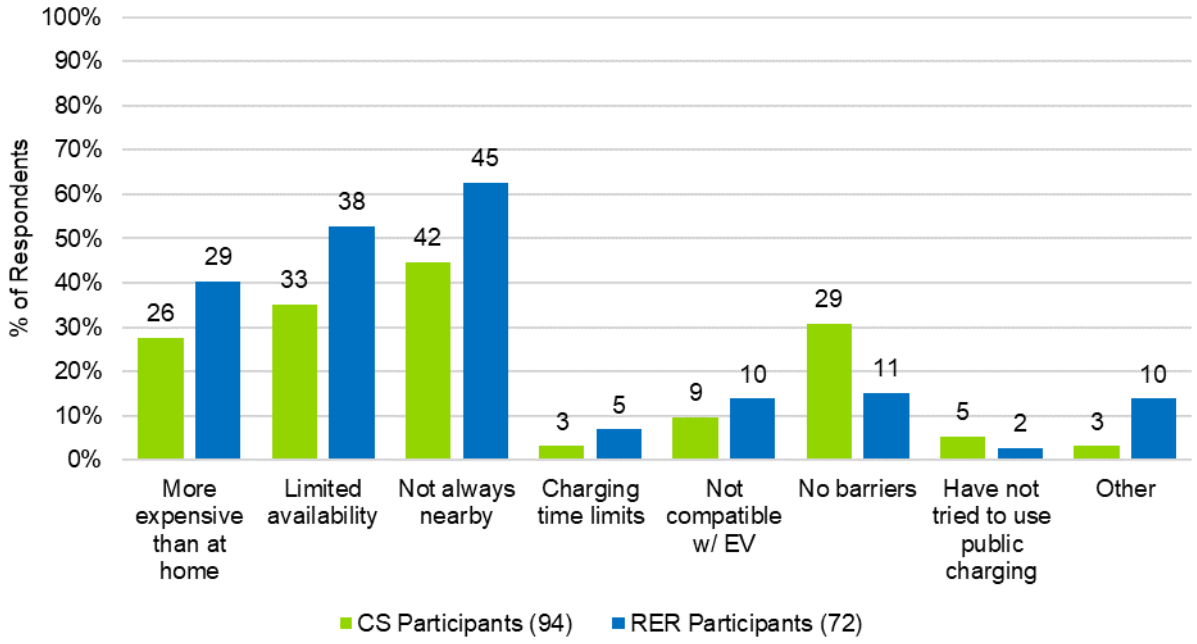
CB16. What are your main motivations for using ***public charging stations***? Select all that apply. (n=101)



Source: Guidehouse

CB17. Are there are any barriers for you or your household members to use **public charging stations** to charge this electric vehicle? Select all that apply. (n=166)



Source: Guidehouse

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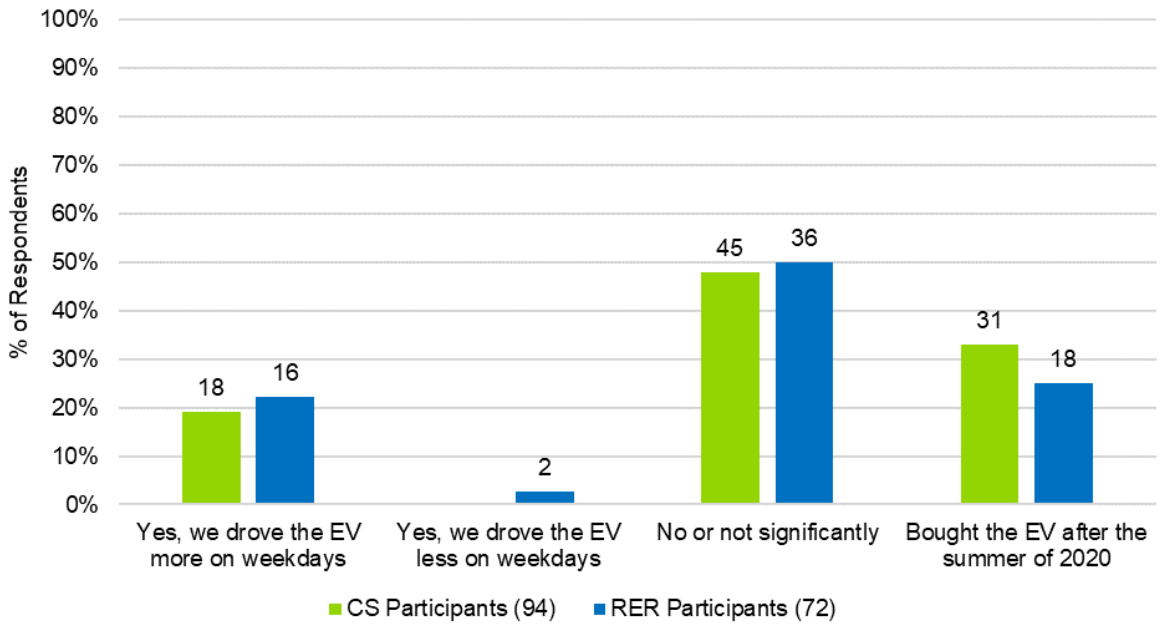
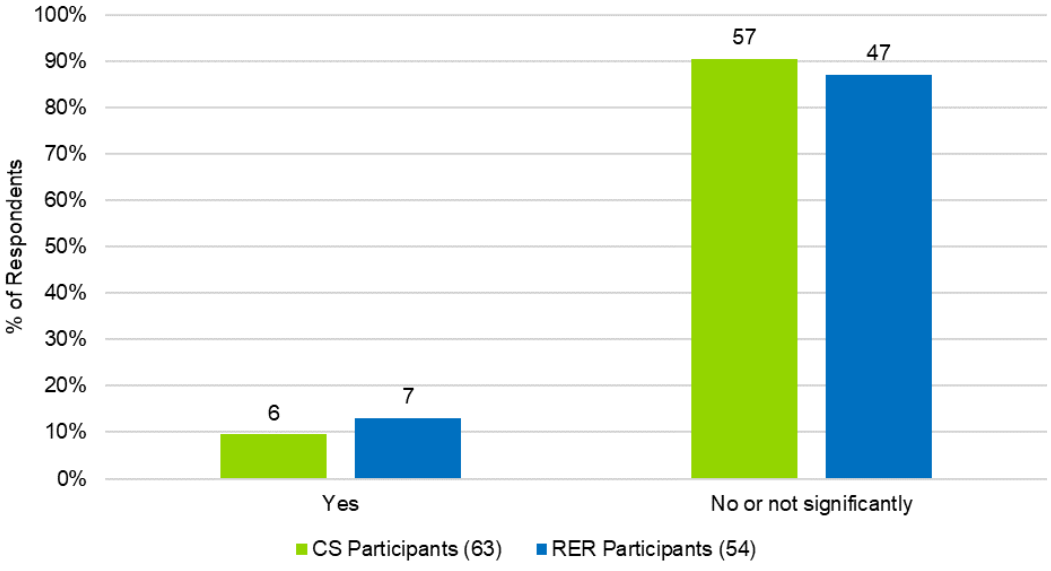
B.1.4 Changes Since Summer 2020

CS1. Compared to your household's use of your electric vehicle in the summer 2020, did the typical ***miles per day*** that this electric vehicle was driven on weekdays change in summer 2021? (n=166)



Source: Guidehouse

CS2. Compared to your household's use of this electric vehicle in the summer of 2020, did the ***timing*** of when this electric vehicle was typically driven on weekdays change in summer 2021? (n=117)



Source: Guidehouse

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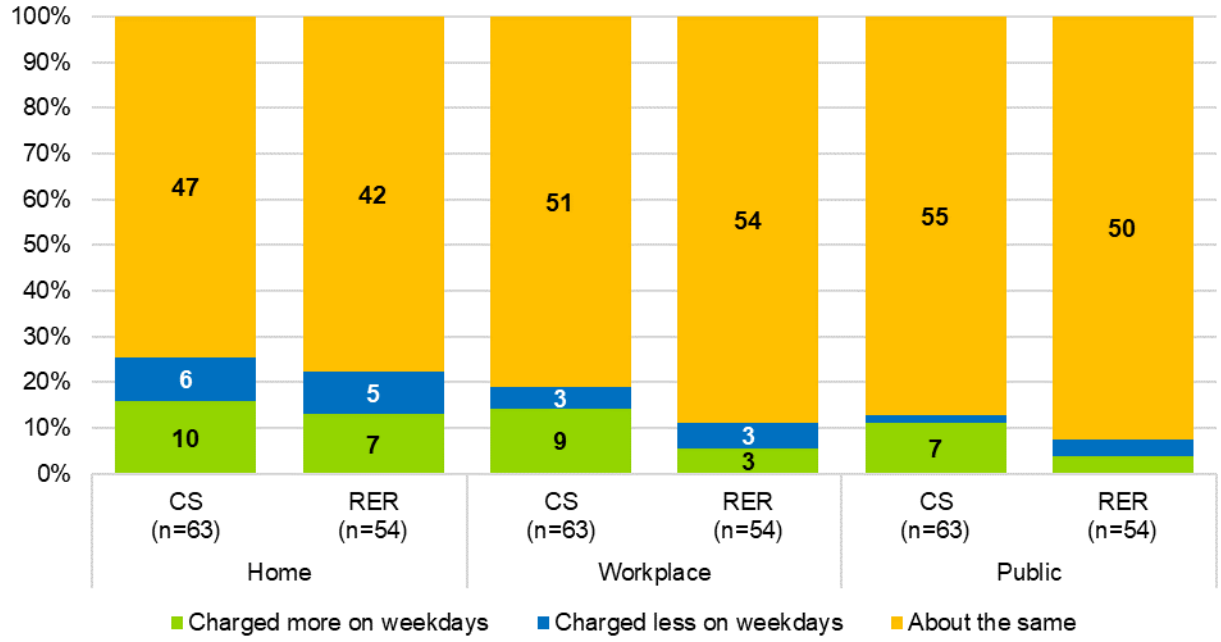
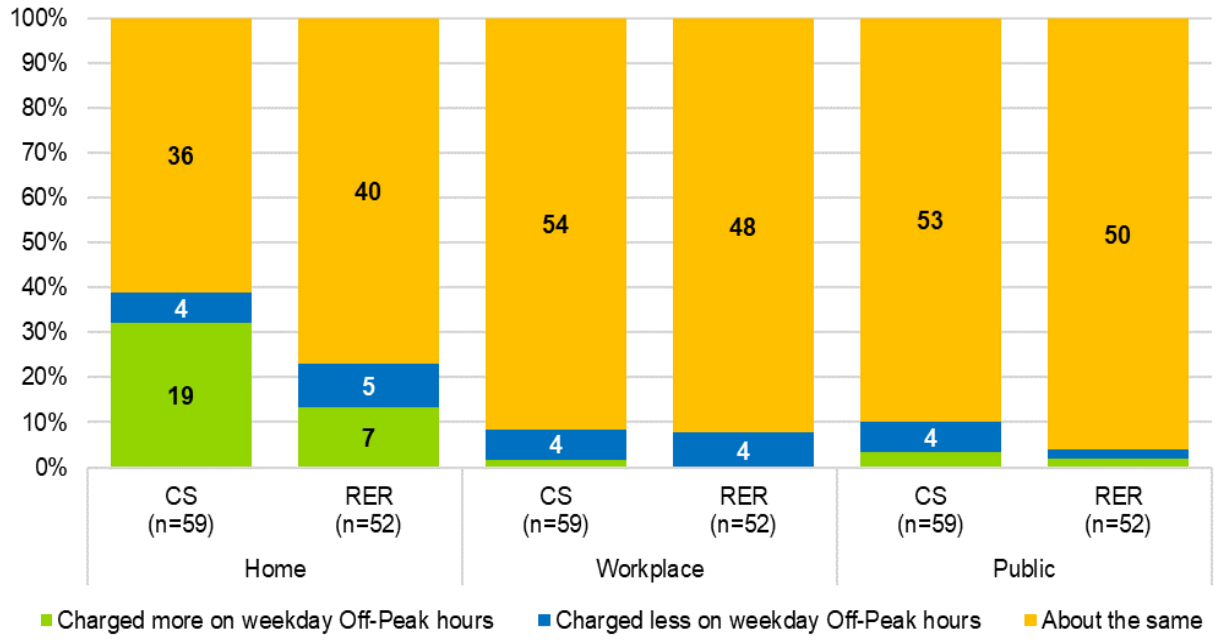
CS3. Compared to the summer of 2020, was this EV typically charging more, less, or the same amount ***on weekdays*** in summer 2021? Indicate how this varied by charging location. (n=117)



Source: Guidehouse

CS5. Compared to the summer of 2020, was this EV typically charging more, less, or the same amount in summer 2021 during the weekday hours of 11 PM to 7 AM ("Off-Peak" hours) relative to other hours? Please indicate how this varied by charging location. (n=111)



Source: Guidehouse

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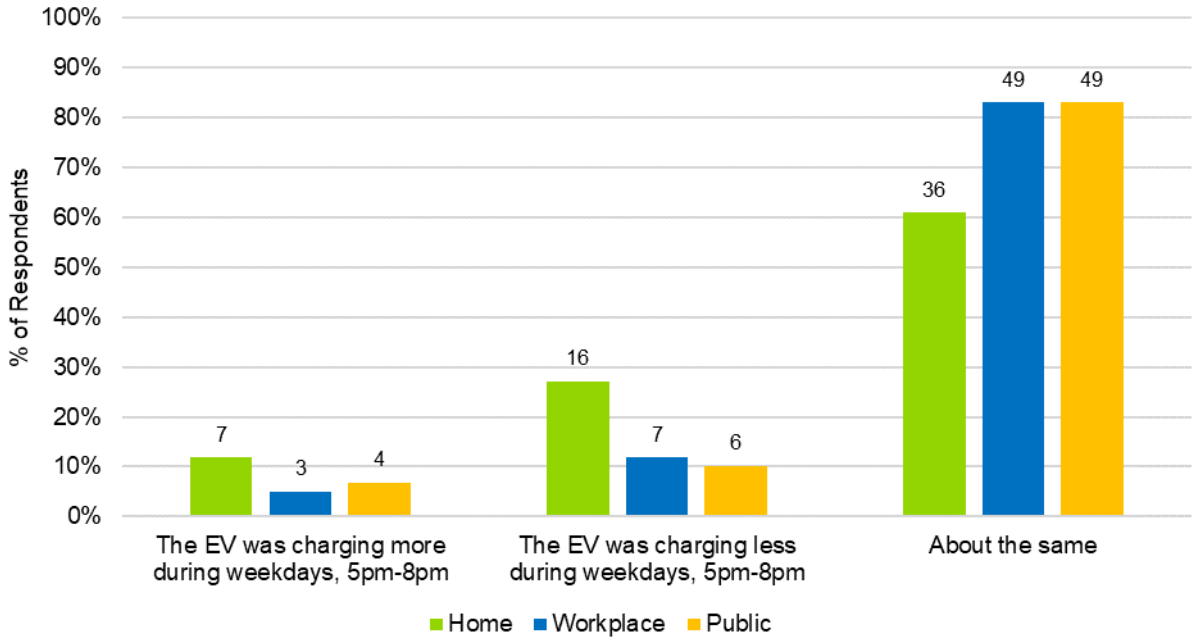
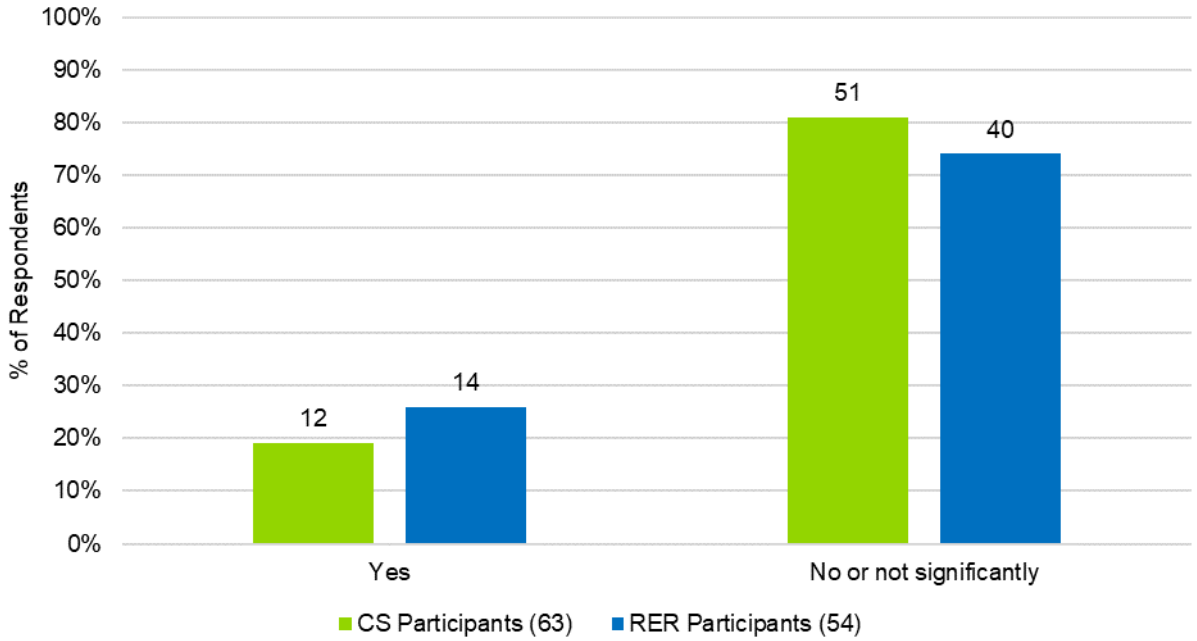
CS6. Compared to the summer of 2020, was this EV typically charging more, less, or the same amount in summer 2021 ***during the weekday hours of 5 PM – 8 PM*** ("On-Peak" hours) relative to other hours? Please indicate how this varied by charging location. (n=59)



Source: Guidehouse

CS7. What, if any, additional observations do you have to share related to how your household's use of this electric vehicle and/or charging stations changed between summer 2020 and summer 2021? (n=117)



Source: Guidehouse

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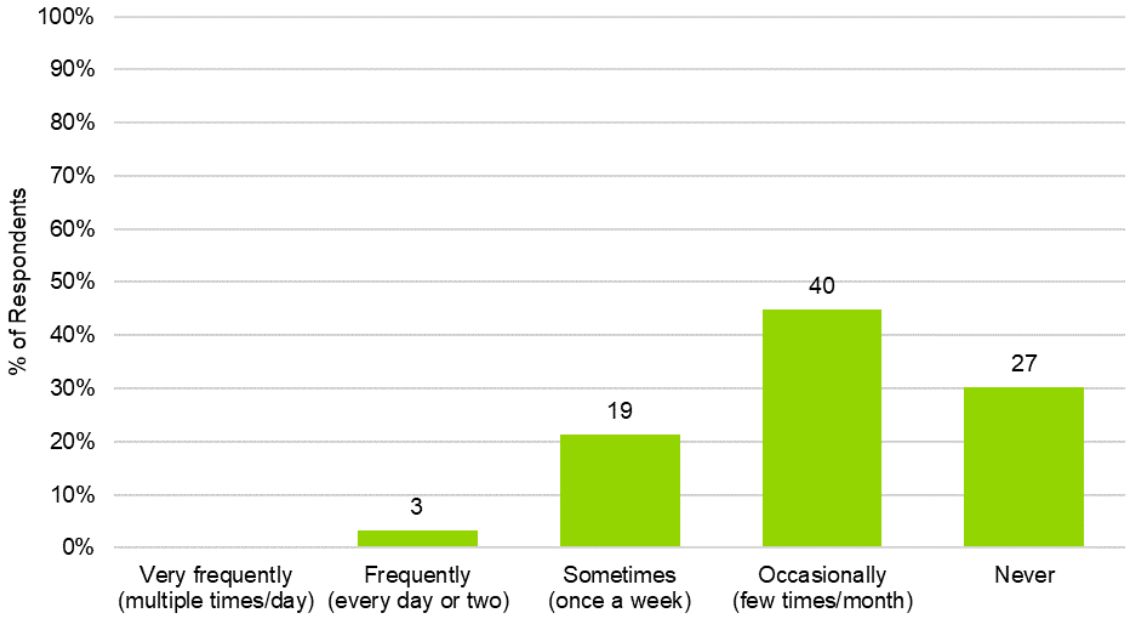
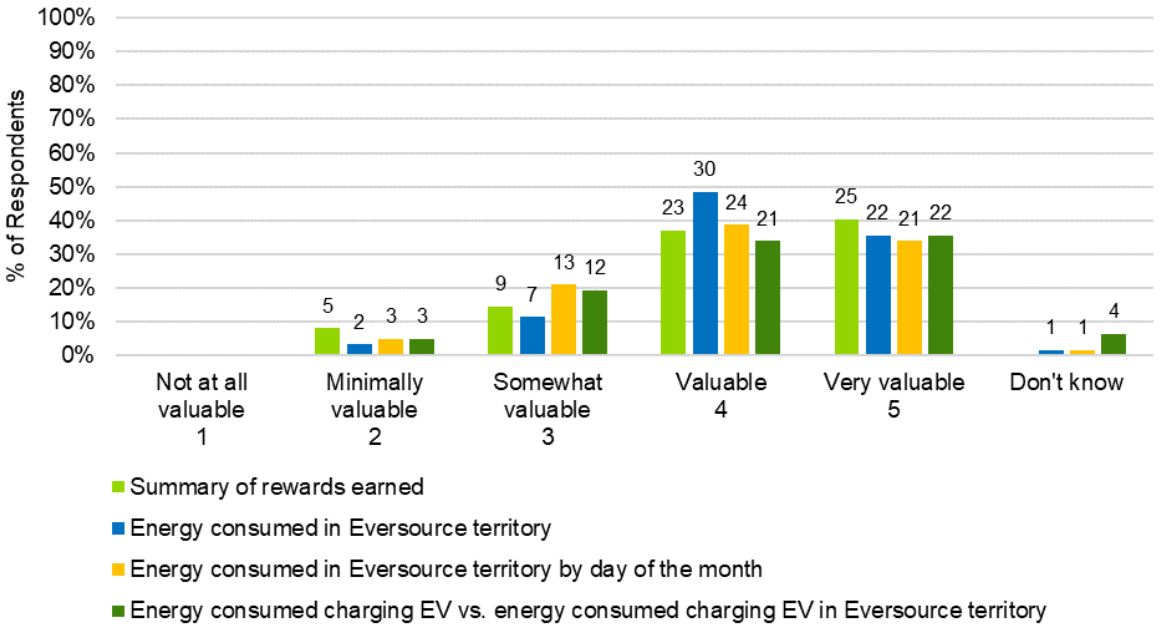
B.1.5 Program Influences

I1. Which of the following best describes how often you view the SmartCharge Rewards Portal provided by Geotab (FleetCarma)? (n=89)



Source: Guidehouse

I2. On a scale of 1 to 5, where 1 is “Not at all valuable” and 5 is “Very valuable”, how valuable is the following information provided on the portal? (n=62)



Source: Guidehouse

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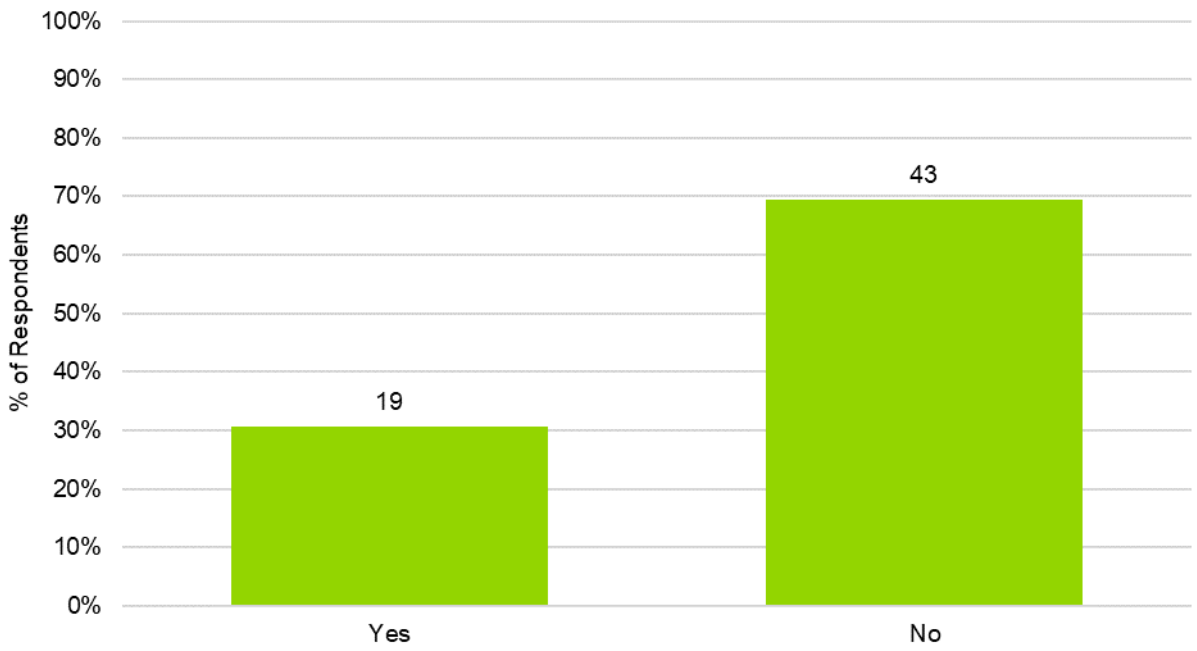
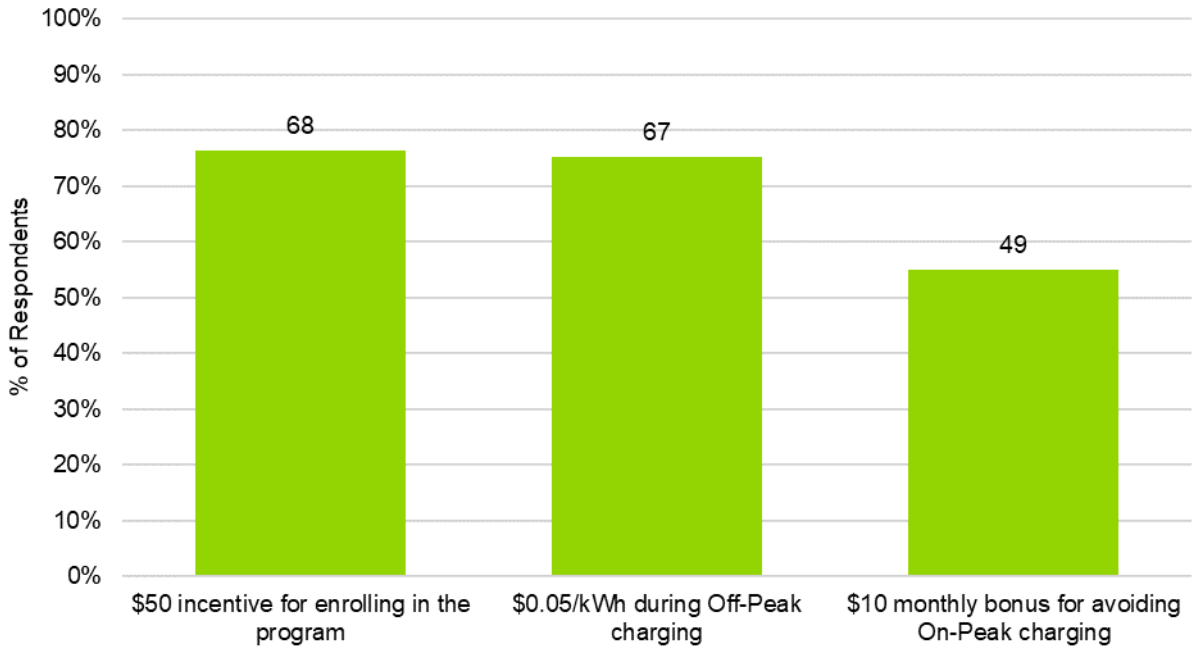
I4. Are there ways that the information provided on the SmartCharge Rewards portal could be improved? (n=62)



Source: Guidehouse

I5. Which of the following program incentives did you receive in the summer of 2021? Select all that you earned or benefited from at least once. (n=89)



Source: Guidehouse

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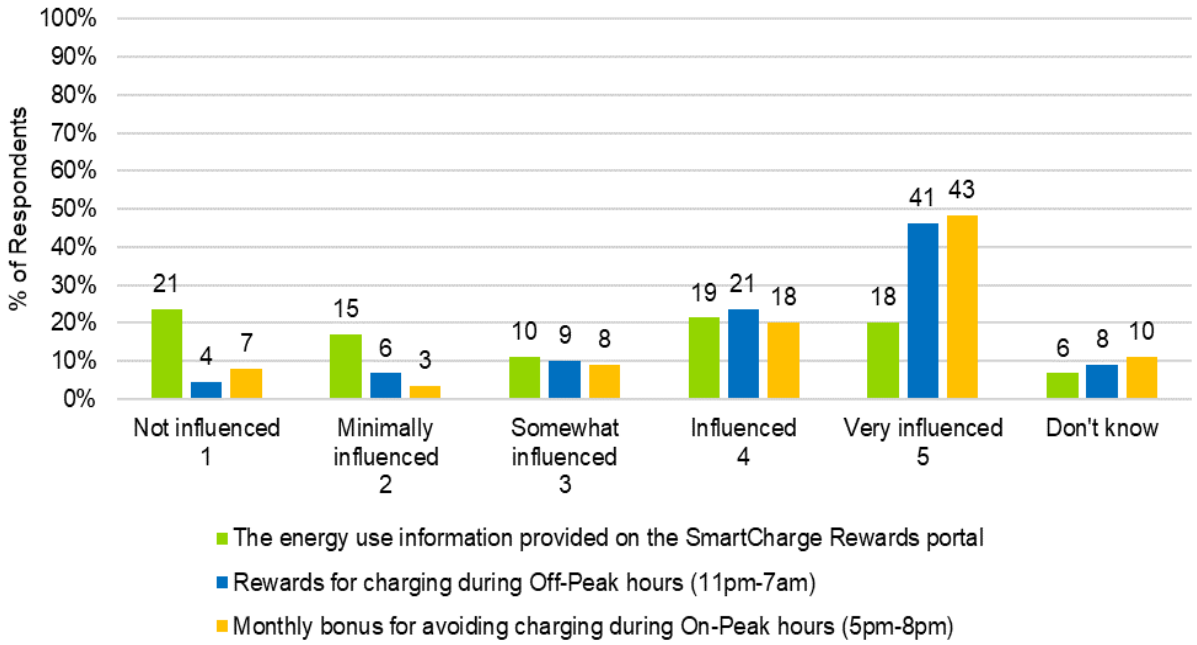
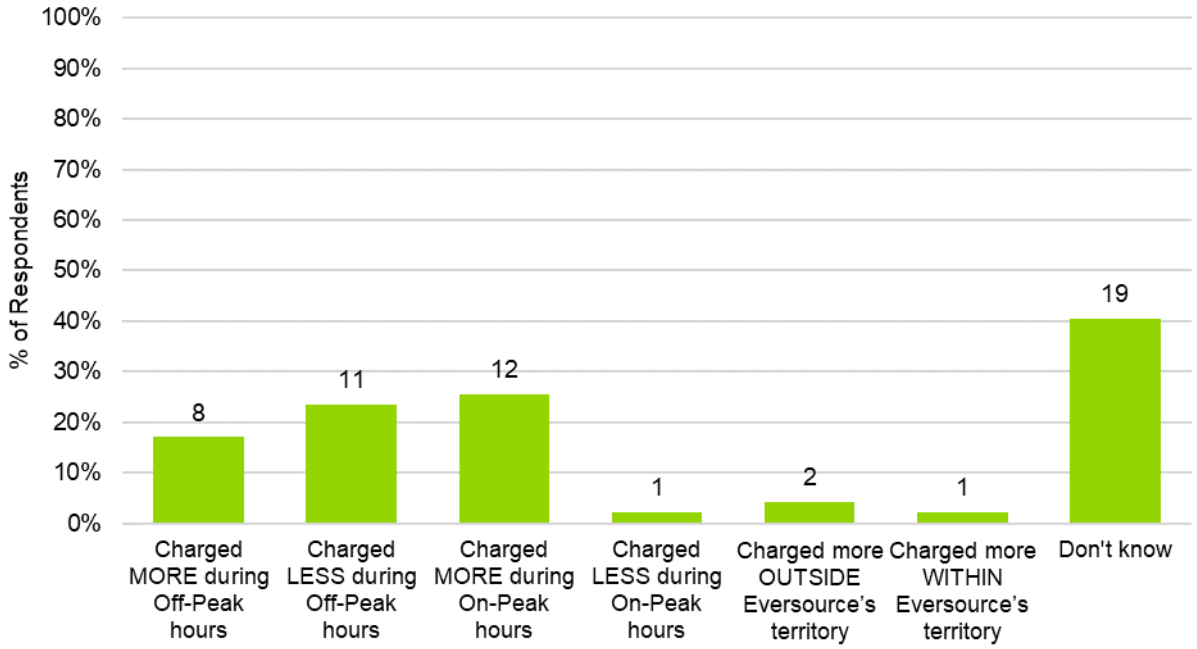
I6. On a scale of 1 to 5, where 1 is “Not influenced at all” and 5 is “Very influenced”, how influenced was your EV’s charging schedule in summer 2021 by the following aspects of Eversource’s ConnectedSolutions SmartCharge Rewards Program? (n=89)



Source: Guidehouse

I7. Please indicate how the ***energy use information provided on the SmartCharge Rewards portal*** affected your charging behavior during summer 2021 relative to what it would have been if the information was not provided. (n=47)



Source: Guidehouse

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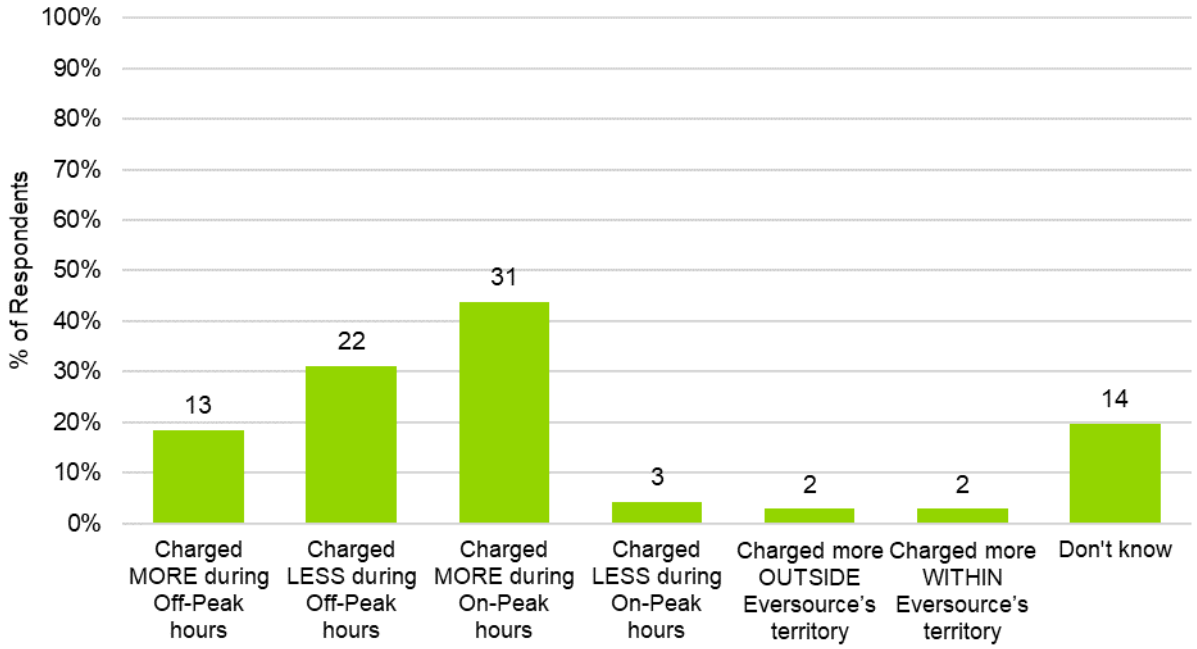
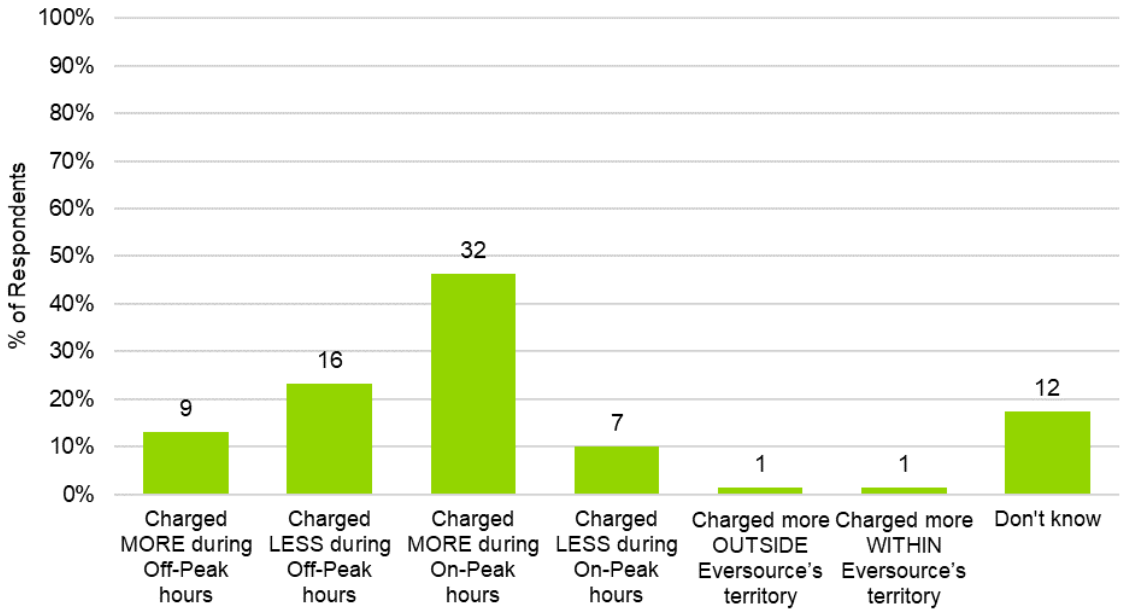
I8. Please indicate how the ***$0.05/kWh reward for charging during Off-Peak hours*** affected your charging behavior during summer 2021 relative to what it would have been if rewards were not provided. (n=71)



Source: Guidehouse

I9. Please indicate how the ***$10 monthly bonus for avoiding charging during On-Peak hours*** affected your charging behavior during summer 2021 relative to what it would have been if the bonus was not provided. (n=69)



Source: Guidehouse

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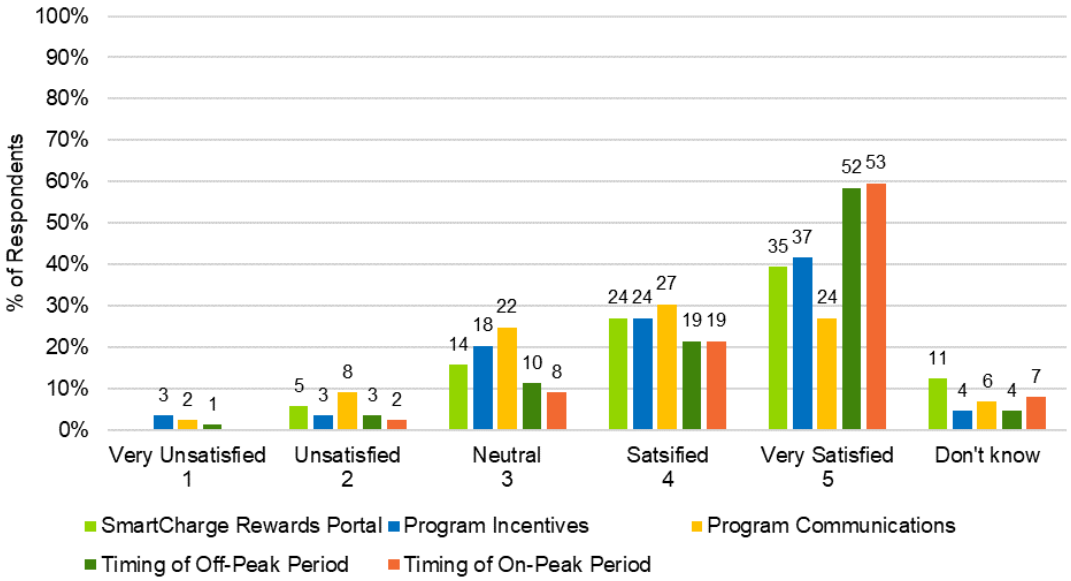
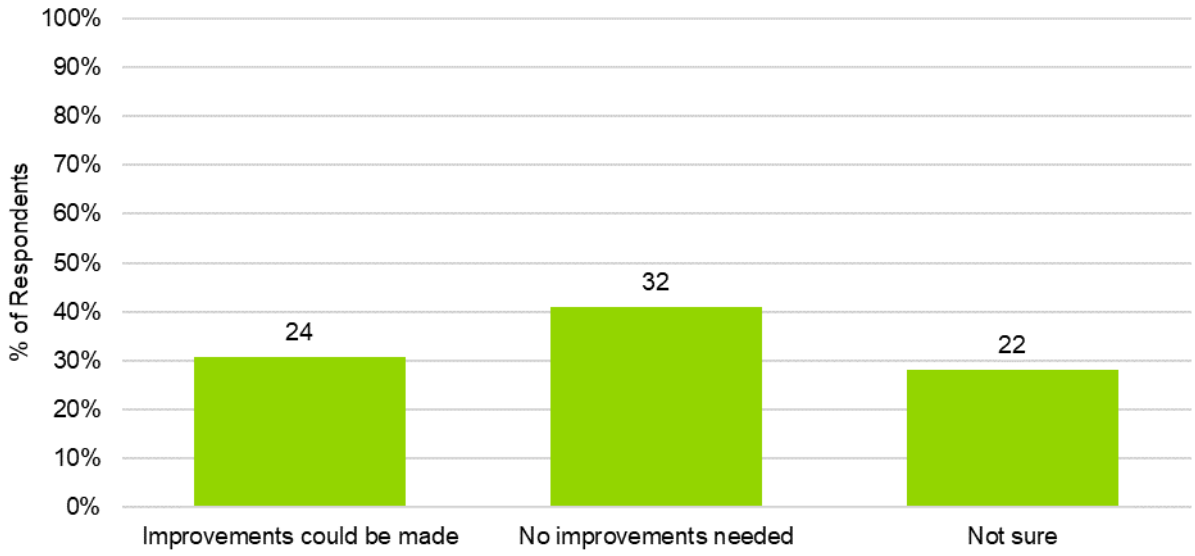
B.1.6 Program Satisfaction

S1. On a scale of 1 to 5, where 1 is “Very unsatisfied” and 5 is “Very satisfied”, how would you rate your satisfaction with the following aspects of Eversource’s ConnectedSolutions SmartCharge Rewards Program to-date? (n=89)



Source: Guidehouse

S2. How could the ***SmartCharge Rewards Portal*** be improved? (n=78)



Source: Guidehouse

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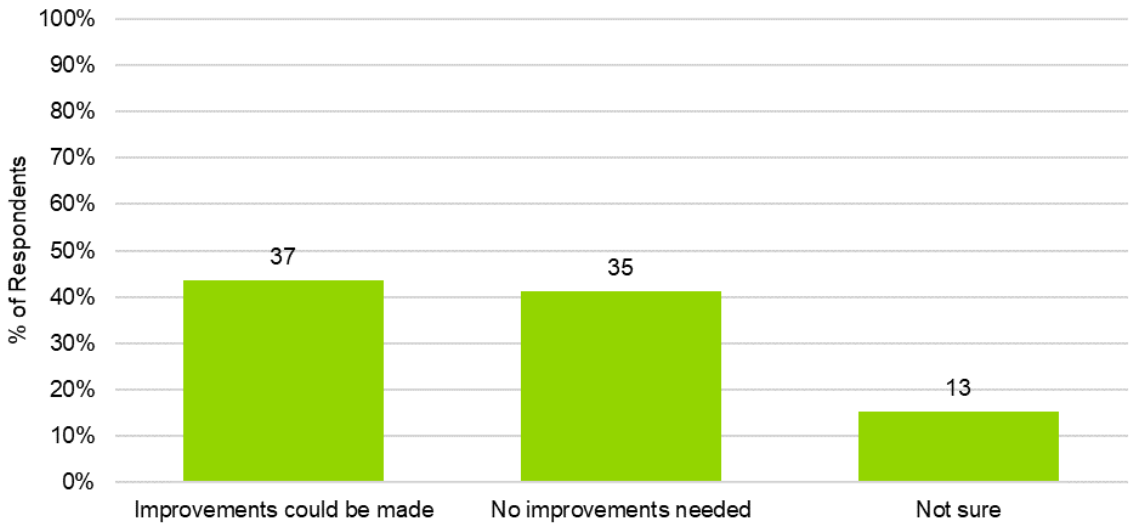
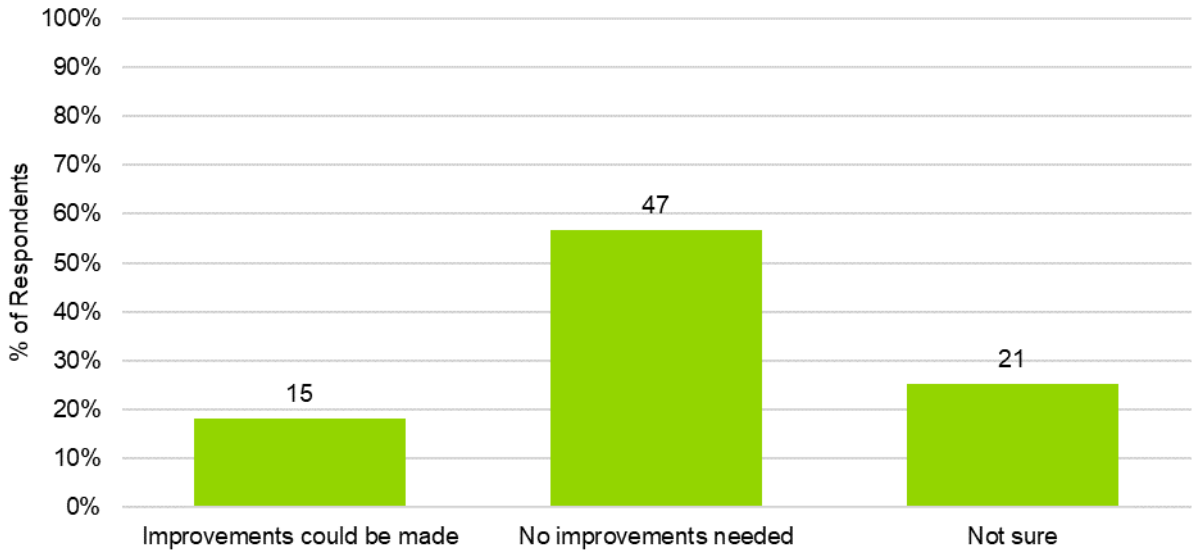
S3. How could ***program incentives*** be improved? (n=85)



Source: Guidehouse

S4. How could program ***communications*** be improved? (n=83)



Source: Guidehouse

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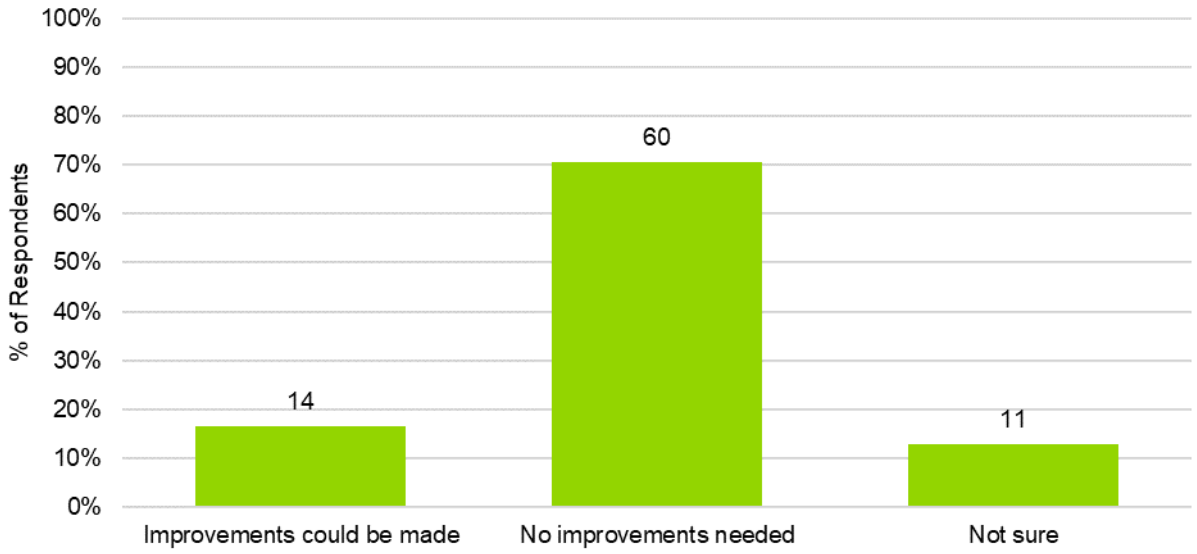
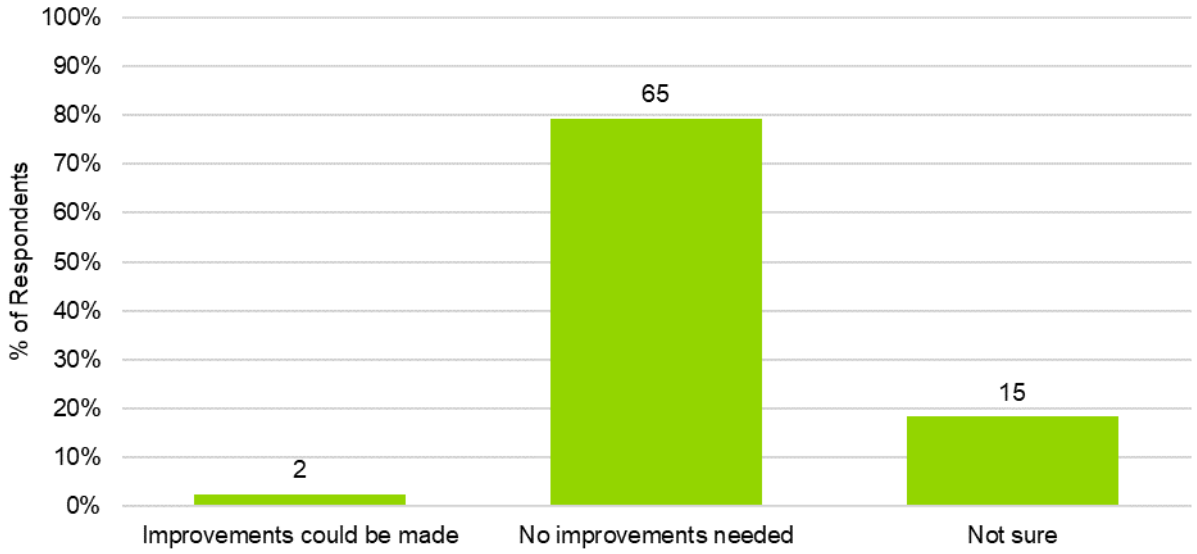
S5. How could the ***timing of the Off-Peak period*** be improved? (n=85)



Source: Guidehouse

S6. How could the ***timing of the On-Peak period*** be improved? (n=82)



Source: Guidehouse

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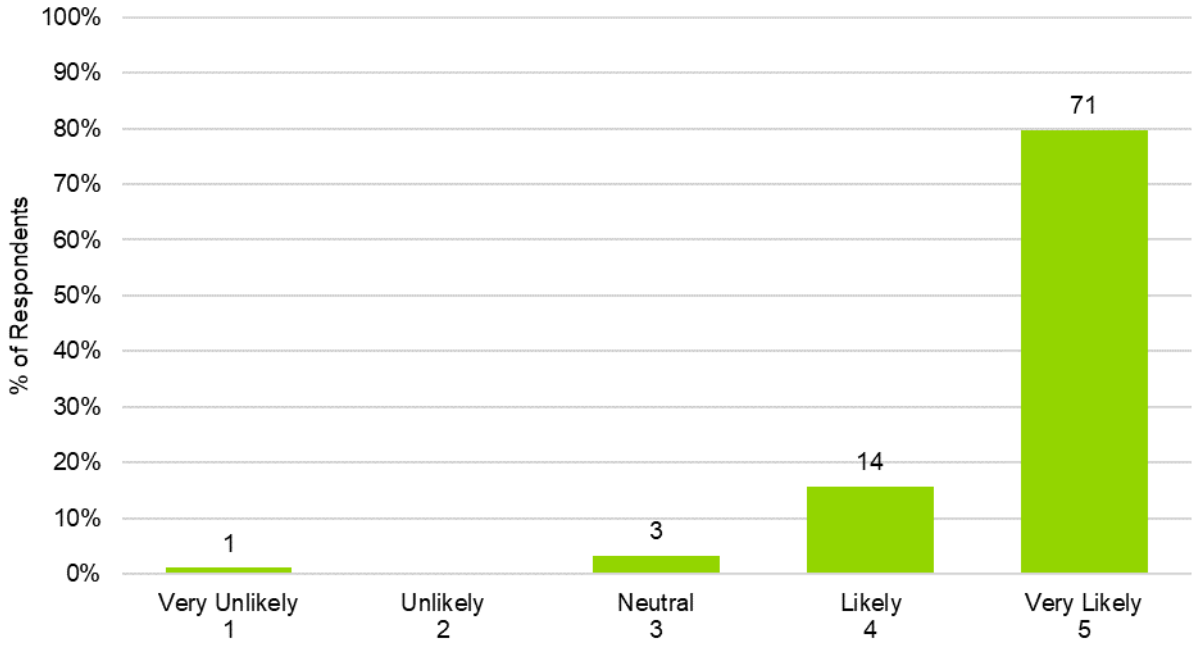
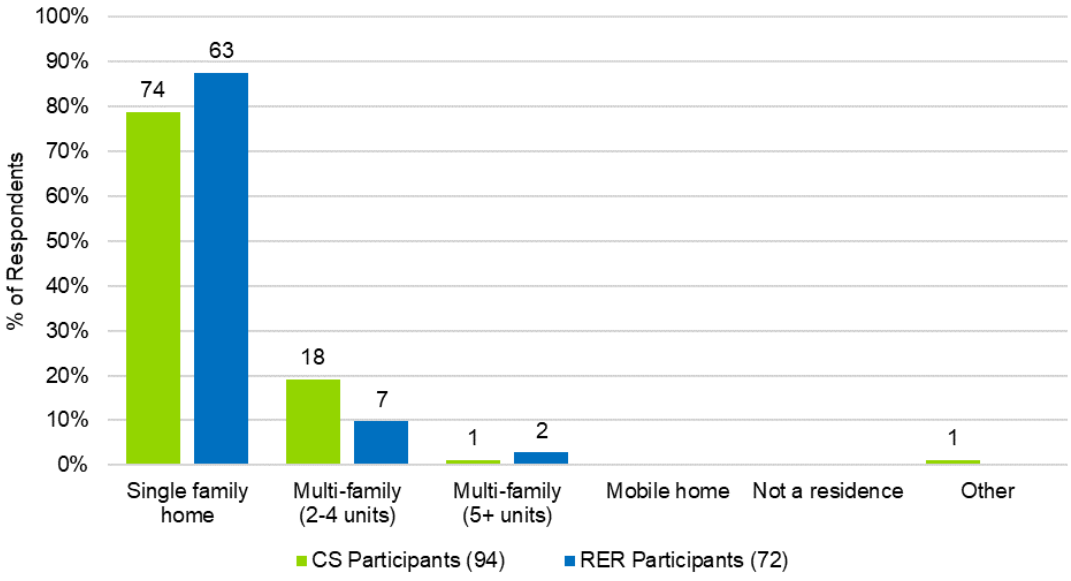
S7. On a scale of 1 to 5, where 1 is “Very Unlikely” and 5 is “Very Likely”, how likely are you to continue to participate in Eversource’s ConnectedSolutions SmartCharge Rewards Program? (n=89)



Source: Guidehouse

B.1.7 Demographics

D1. Which of the following best describes the property type where your home charging station is located? (n=166)



Source: Guidehouse

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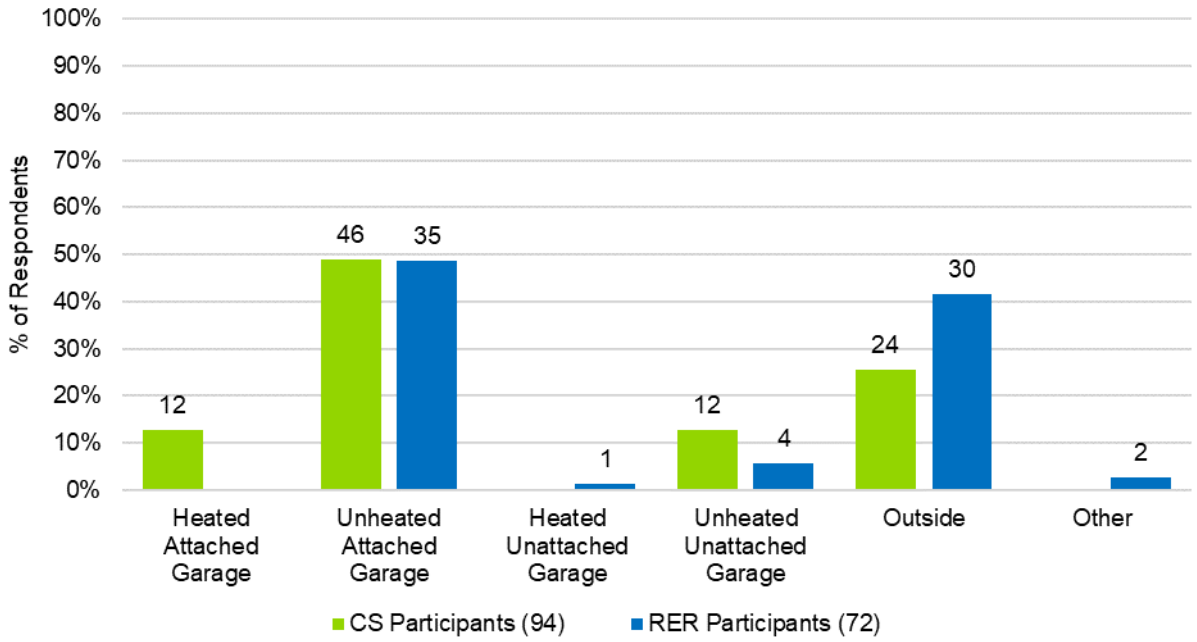
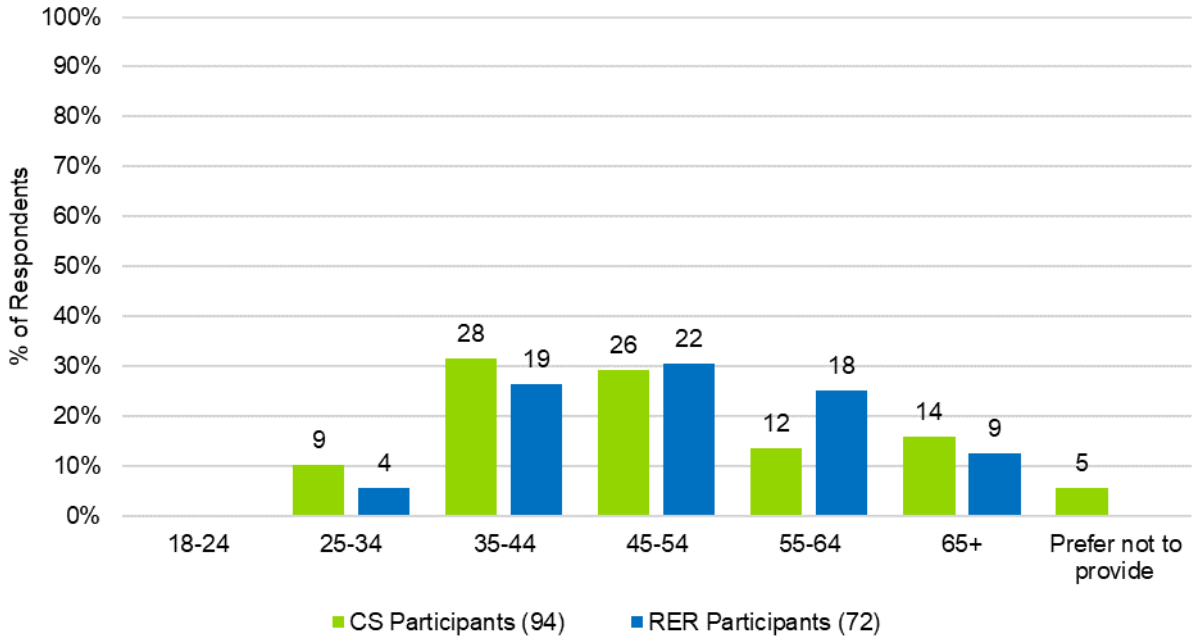
D2. Which of the following best describes the location of your home charging device? (n=166)



Source: Guidehouse

D3. Which of the following age categories do you fall into? (n=166)



Source: Guidehouse

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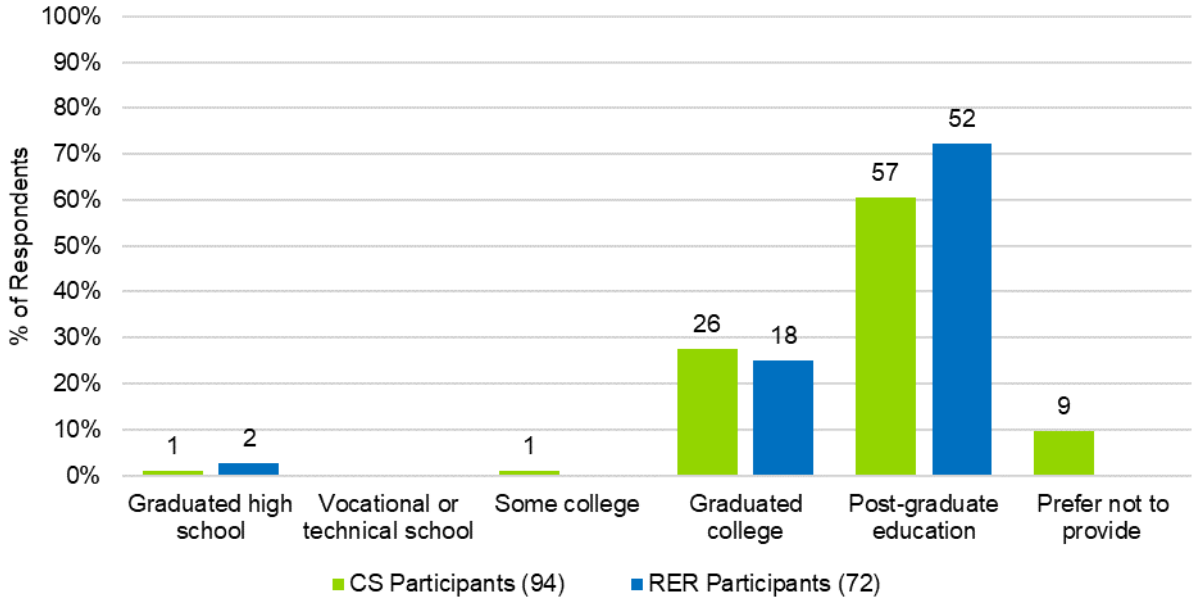
D4. What is the last grade of school you completed? (n=166)



Source: Guidehouse

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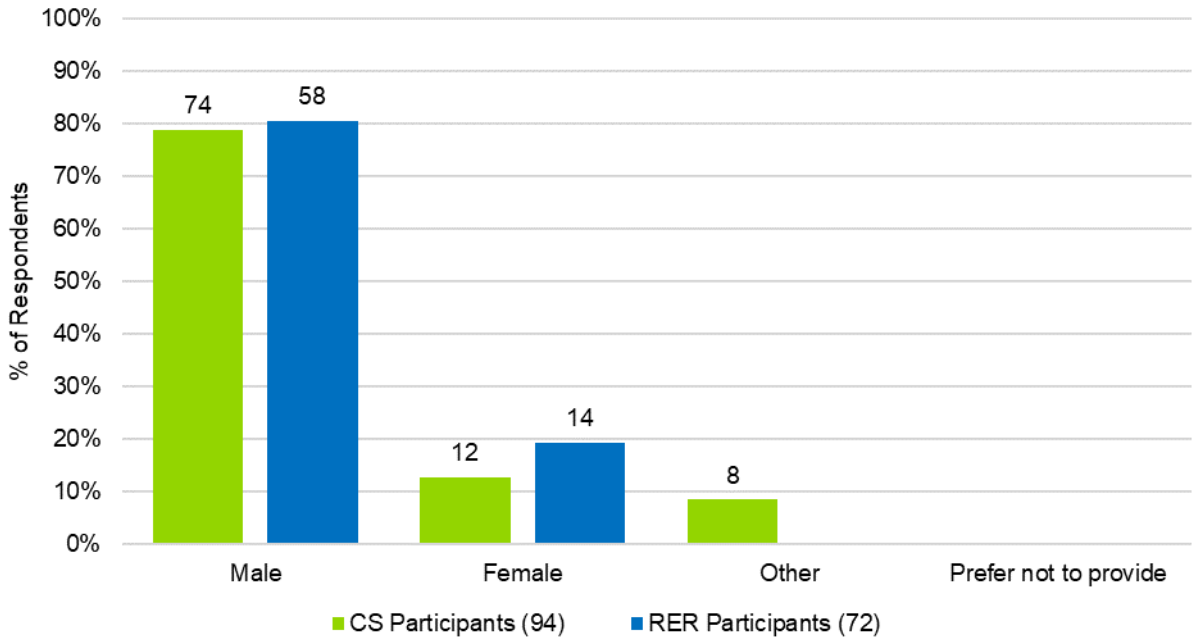
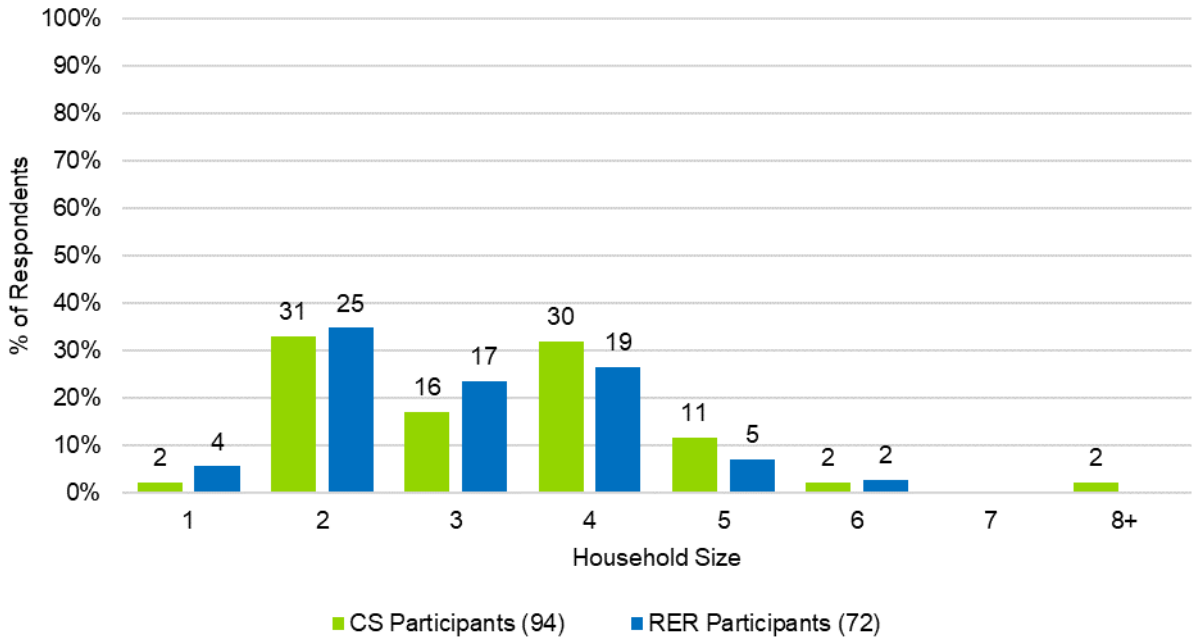
D5. Which category best describes your gender? (n=166)



Source: Guidehouse

D6. How many people occupied your home this summer 2021? (n=166)



Source: Guidehouse

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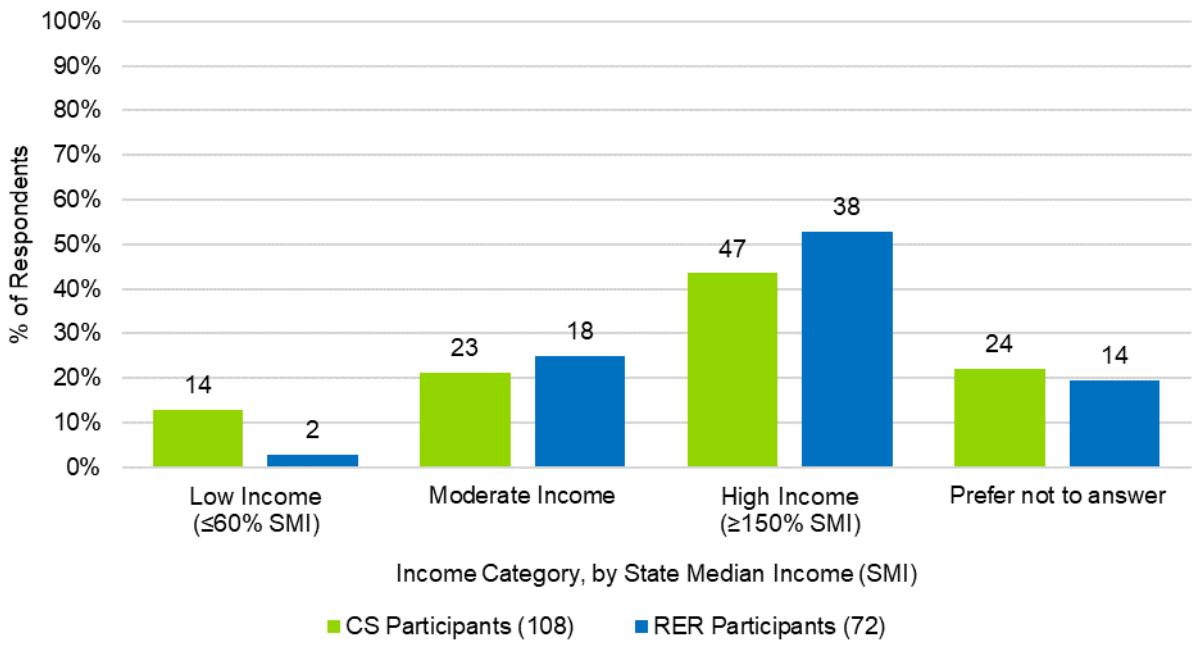
D7. What will be your estimated total annual household income in 2021 before taxes (in other words, your gross household income)? (n=166)



Source: Guidehouse

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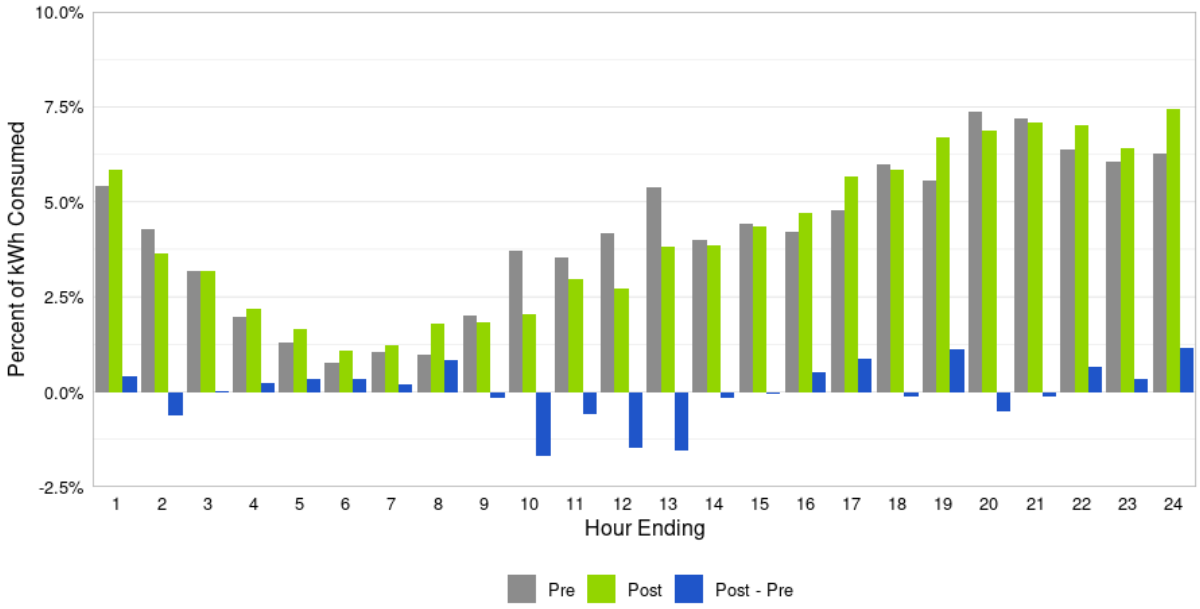
Appendix C. Assessment of Charging Profiles – Supplemental Results

This section contains a variety of supplementary plots and tables that assess the charging behavior of CS and RER participants.

C.1 Energy Consumption

Figure C-1. Percent of Energy Consumed by Hour and Period- RER Participants, Tesla Only



Source: Guidehouse analysis of RER EV telematics data

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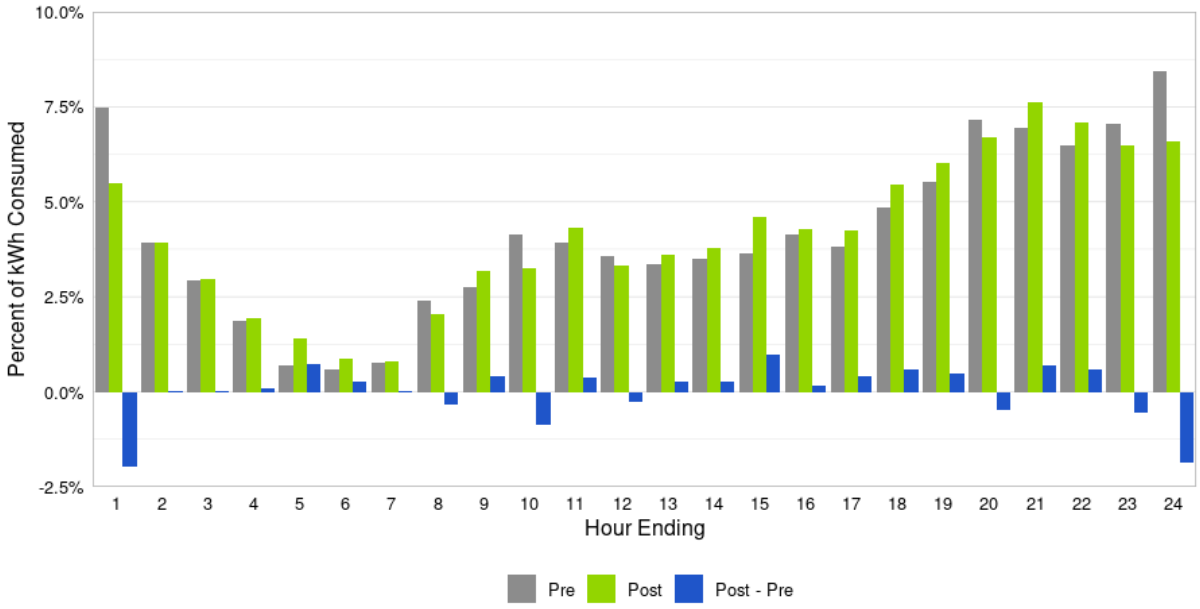
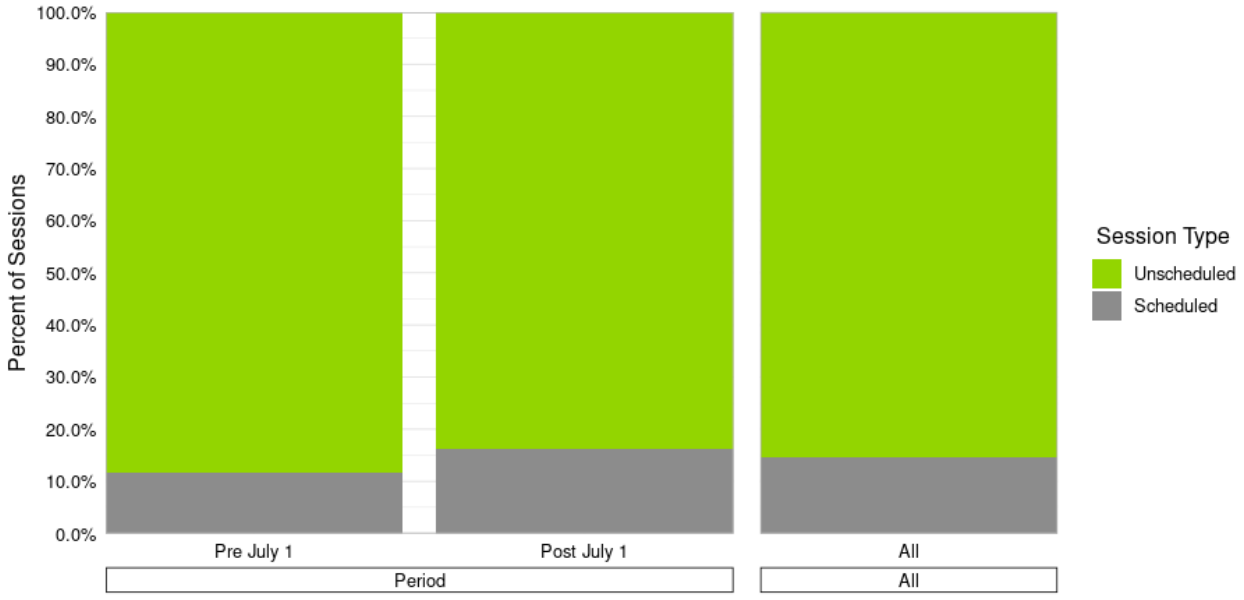
Figure C-2. Percent of Energy Consumed by Hour and Period- RER Participants, No Tesla



Source: Guidehouse analysis of RER EV telematics data

C.2 Scheduled Charging

Figure C-3. Percent of Sessions by Type and Period, CS Participants



Source: Guidehouse analysis of CS EV telematics data

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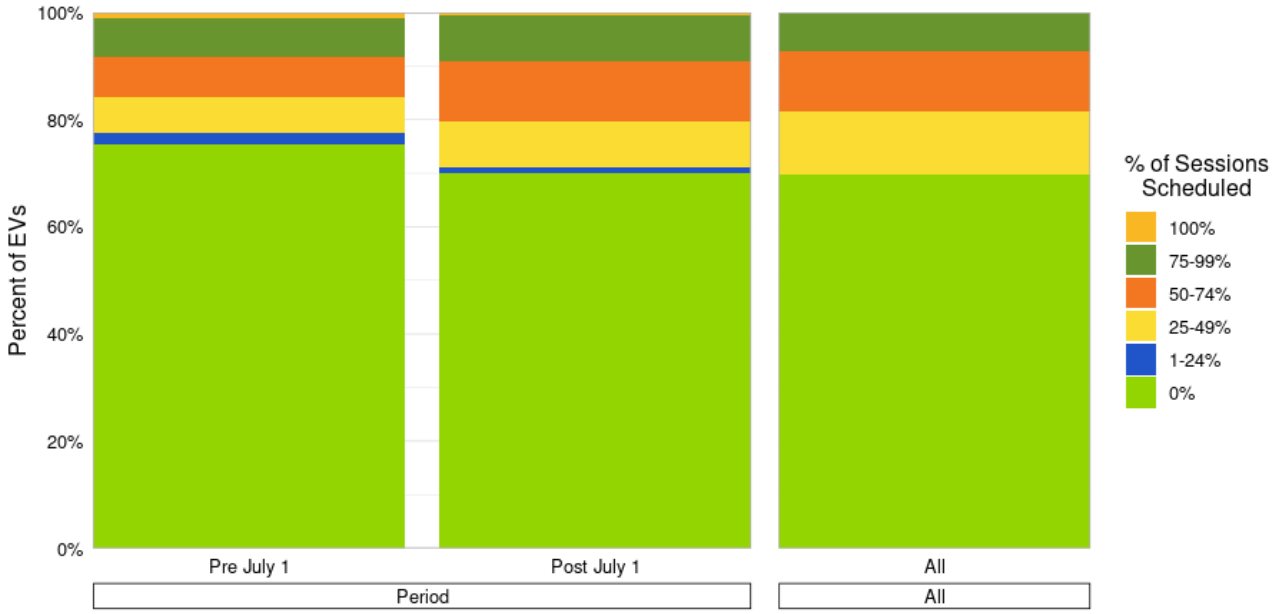
Figure C-4. Percent of EVs by Scheduled Session Frequency, CS Participants



Source: Guidehouse analysis of CS EV telematics data

Table C-1. Comparison of Scheduled Charging and EVSE Level, CS Participants

Scheduling	EVSE Level					
	Level 1	%	Level 2	%	Unknown	%
Use Scheduled Charging	6	18%	54	34%	0	0
Do Not Use Scheduled Charging	28	82%	104	66%	1	100%
Total	**34**	**100%**	**158**	**100%**	**1**	**100%**

Source: Guidehouse analysis of CS EV telematics data

Table C-2. Comparison of Scheduled Charging

Scheduling	CS		RER	
	n	%	n	%
Use Scheduled Charging	59	30.0%	18	22.8%
Do Not Use Scheduled Charging	134	70.0%	61	77.2%
Total	**193**	**100%**	**79**	**100%**

Source: Guidehouse analysis of CS and RER EV telematics data

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Appendix D. Impact Analysis – Supplemental Results

For the calculation of impacts, Guidehouse considered two core regression specifications. The first and primary regression specification used for the impact analysis was the difference-in-differences regression using CS participant and RER participant charging data during the periods prior to and following the beginning of the program. The second regression specification considered for the impact analysis was a participant-only (CS-only) regression, using charging data of only participants during the periods prior to and following the beginning of the program.

Table D-1 summarizes the two models considered for impact analysis. Guidehouse ultimately opted to use the difference-in-differences specification to quantify impacts associated with program participation. The model can difference away underlying differences between CS and RER participants.[10] In addition, the model can difference away changes in charging associated with seasonality, which reduces the risk of seasonality contaminating the assessed kW and kWh treatment effects.

Table D-1. Models Considered for Impact Analysis

Model	Difference-in-Differences	Participant-Only
Description	• Regression model that quantifies changes in charge energy and demand between pre-period and program treatment period, CS and RER participants. • Develops a counterfactual using CS EVs and RER EVs, pre-period and program treatment period kW and kWh. • Differences between groups over time are controlled for via a series of dummy variables.	• Regression model that quantifies changes in charge energy and demand between pre-period and program treatment period for CS participants only. • Counterfactual is pre-period kW and kWh.
Sample	• CS and RER participants	• CS participants only
Pros	• Differences away seasonal changes in charging behavior, reducing risk of seasonality contaminating in savings estimates	• Omitting RER EVs reduces risk of differences between CS and RER contaminating savings estimates
Cons	• Savings estimates of kW and kWh may be contaminated by CS and RER's underlying differences	• Savings estimates will include kW and kWh changes attributed to seasonality and program treatment

[10] This requires a parallel trends assumption for the modeled dependent variable to be met during the pre-treatment period. Guidehouse has verified that pre-treatment period differences in measured kW and kWh are comparable during the pre-treatment period.

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Source: Guidehouse

Guidehouse estimated a participant-only model to serve as a sensitivity check. Results of the difference-in-differences and participant-only models are compared in Table D-2. The impact of program participation during off-peak hours was statistically insignificant in both model specifications. However, the impact of program participation during peak hours was a 0.13 kW reduction in demand and a 1.85 kWh daily energy savings per EV in the difference-in-differences model. The impact of program participation during peak hours was a 0.09 kW reduction in demand and a 1.18 kWh daily energy savings per EV in the participant-only model.

Table D-2. Difference-in-Differences and Participant-Only Impacts per EV by Period

Impact Analysis Metric	Time Period	Difference-in-Differences Impact Estimate	Participant-Only Impact Estimate
Average Half-Hourly kW Reduction per EV	7 a.m.–11 p.m.	-0.127 kW**	-0.089 kW*
	11 p.m.–7 a.m.	0.015 kW	0.040 kW
Average Daily kWh Savings per EV	7 a.m.–11 p.m.	-1.852 kWh**	-1.18 kWh**
	11 p.m.–7 a.m.	0.130 kWh	0.363 kWh

* Indicates significance at 90% confidence

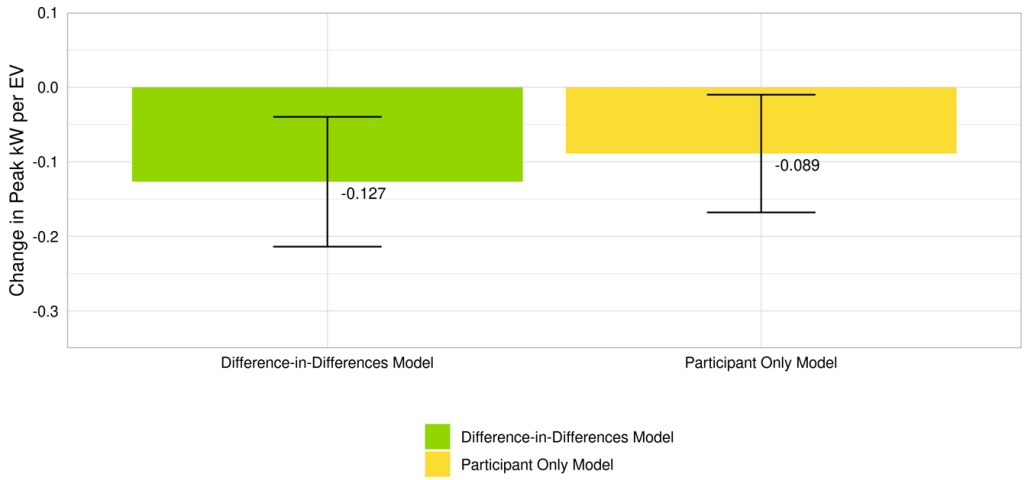
** Indicates significance at 95% confidence

*** Indicates significance at 99% confidence

Source: Guidehouse analysis of EV interval data

Figure D-1 compares the kW impact per EV during peak hours during the period spanning July 1 through September 30 with 90% confidence bounds overlaid.

Figure D-1. Difference-in-Differences and Participant-Only Impacts on kW in Peak Hours



Source: Guidehouse analysis of EV interval data

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In the charging profile analysis, Guidehouse identified that CS participants underwent an overall reduction in charge kW and kWh from May through September. Without a group upon which to compare charge kW and kWh between May and September, kW and kWh reduction estimates will include kW and kWh changes attributed to program treatment as well as unobservable factors unrelated to the program that led to reductions in charge kW and kWh between May and September. Therefore, Guidehouse recommends the use of the difference-in-differences impact estimate.

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