Electric Vehicle Managed Charging Offering Comparison Study

MA22-DR02-E-Res EV Comp

Final Report

Prepared for:

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1. Introduction

National Grid and Eversource offered three different residential electric vehicle (EV) managed charging offerings in Massachusetts as part of the energy efficiency portfolio between summer 2019 and summer 2021. The three EV managed charging offerings aimed to curtail EV charging during times of high electric demand. This was accomplished via use of direct load control (DLC) or an off-peak rebate.

In this document, Guidehouse provides a comparison of the three EV managed charging offerings to improve understanding of the offerings and their associated outcomes. Information used in this comparison study was drawn from prior evaluations of the three EV offerings. It is important to note that prior evaluations assessed each offering at a point in time, and offerings have since evolved. Also, evaluations of National Grid's EV DLC offering and Eversource's Off-Peak Charging offering occurred in the first year of implementation. In contrast, Guidehouse evaluated Eversource's EVSE DLC offering from 2019 to 2021, during which time implementation improvements were made based on prior-year's learnings.

Note that National Grid also provided an off-peak rebate offering to its customers through its EV Market Development Program. However, since the offering is not part of the Three-Year Energy Efficiency Program it is not included in this comparison study.

1.1 Summary of Offerings

In this section, Guidehouse provides a brief overview of the three EV managed charging offerings evaluated for the Massachusetts program administrators (PAs) and the Massachusetts Energy Efficiency Advisory Council's (EEAC) consultant team between summer 2019 and summer 2021. Additional detail on each of the offerings may be found in Section 4, where Guidehouse provides in-depth comparisons of each of the offerings.

1.1.1 Eversource Electric Vehicle Supply Equipment (EVSE) DLC Offering

Eversource launched an electric vehicle supply equipment (EVSE) DLC offering beginning August 2019 to residential Eversource electric customers that were EV owners with a qualifying networked Level 2[1] EVSE manufactured by ChargePoint, Enel X, or SolarEdge. The offering aimed to reduce EV charging load during demand reduction events via DLC of enrolled EVSEs. Demand reduction events could be called on non-holiday weekdays between the hours of 4 p.m. and 8 p.m. Participating customers were provided incentives for the right to throttle their EVSE from Level 2 to Level 1, as well as for access to their charging data. Through September 2021, the program enrolled 487 EVSEs in Massachusetts. Additional details on the design of this offering may be found in Section 4.1.

[1] For reference, Level 1 charging use a 120-volt and 20-amp service from a standard household outlet, which typically provides approximately 5 miles of range per 1 hour of charging (assuming 1.9 kW charging power). Level 2 equipment connects to a high-output 240-volt and 40-amp power source enabling approximately 25 miles of range per hour of charging (assuming 6.6 kW charging power). Direct-current (DC) fast charging (Level 3) provides 100 to 200+ miles of range per 30 minutes of charging (depending on the vehicle and battery state of charge). Source: https://afdc.energy.gov/fuels/electricity_infrastructure.html

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1.1.2 National Grid EV DLC Offering

National Grid provided an EV DLC offering to owners of eligible EVs from OEMs (Original Equipment Manufacturer) – BMW, Chevrolet, Ford, and Honda – in Massachusetts beginning May 2021.[2] The offering aimed to reduce EV charging load during demand reduction events via DLC of enrolled EVs. Demand reduction events could be called between 2 p.m. and 7 p.m. on non-holiday weekdays and weekends from June to September 2021. Participating customers received an incentive upon program enrollment, and a per-event rebate based on level of charging or a flat annual incentive that was distributed if customers did not participate in any peak events.[3] Through September 2021, there were 105 EVs (53 BEVs (Battery-powered Electric Vehicles) and 52 PHEVs (Plug-In Hybrid Electric Vehicles) enrolled. Additional details on the design of this offering may be found in Section 4.1.

1.1.3 Eversource Off-Peak Charging Offering

Eversource first introduced an off-peak charging offering in March 2021 and tested it from July through September 2021 to Eversource electric customers with a qualifying EV.[4] The offering aimed to reduce EV charging load between the hours of 7 a.m. and 11 p.m. on weekdays and weekends by way of an off-peak charging rebate. An additional bonus incentive was provided to customers that reduced charging between 5 p.m. and 8 p.m. Through September 2021, 192 vehicles were enrolled in the offering. Additional details on the design of this offering may be found in Section 4.1.

1.2 Objectives of Comparison Study

The goal of this study is to provide a comparison of the designs, impacts, and customer acceptance and satisfaction between the EV managed charging offerings. The key research questions are as follows:

- What are the key program design differences between Eversource's and National Grid's EV managed charging offerings – Eversource EVSE DLC Offering, National Grid EV DLC Offering, and Eversource Off-Peak Charging Offering?
- How do customer acceptance and satisfaction compare between Eversource's and National Grid's DLC offerings?
- How do event impacts compare between Eversource's and National Grid's DLC offerings for the summer 2021 period?
- How do the impacts of the three EV managed charging offering compare during overlapping event hours in summer 2021?

[2] Tesla was added as a fifth OEM ahead of the summer 2022 season. However, given Guidehouse does not have data to support comparisons using data from enrolled Tesla vehicles, Tesla owners and their associated EVs are not included in any analysis of participant satisfaction, charge profiles, event participation, or impacts.

[3] After the June-September 2021 offering, National Grid changed the incentive structure to include only an initial enrollment incentive and a flat annual incentive, rather than an incentive based on annual performance.

[4] National Grid also provided a similar offering to its customers through its EV Market Development Program. However, since the offering is not part of the Three-Year Energy Efficiency Program it is not included in this comparison study.

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- What are the factors causing differences in impacts between the two DLC offerings?
- How do the Eversource and National Grid EV/EVSE offerings address segments of the overall EV market?
- Considering the three approaches, what insights can be provided as to the benefits to transmission and distribution from managed EV charging?

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2. Data Sources and Data Review

In this section Guidehouse provides a summary of the data used from the prior evaluations and this comparison study. The information used in this comparison study was drawn from prior evaluations of the three EV managed charging offerings. The specific evaluations are the

- *2019 Electric Vehicle Supply Equipment Direct Load Control Demonstration – Process Evaluation Findings, July 6, 2020,*[5]
- *Eversource EVSE Direct Load Control Demonstration Evaluation Final Report, September 21, 2021*,[6]
- *Eversource Off-Peak Charging for Tesla Owners Demonstration Evaluation Final Report, April 19, 2022*,[7] and
- *National Grid EV and PHEV Demand Response Offering Evaluation Final Report, July 11, 2022.*[8]

First, Guidehouse provides a brief overview of the types of data from each of the three evaluations that were used in this comparison study. Then, Guidehouse provides a summary of additional data used for this study to support additional analysis not included in the evaluations.

2.1 Data from Prior Evaluations

To inform a comparison of customer acceptance and satisfaction, Guidehouse utilized participant survey data collected during evaluations of each of the three offerings. Survey topics included:

- Motivations and Enrollment Process
- EV/EVSE Information
- Charging Behavior
- Charging Behavior During Events (DLC Offerings Only)
- Program Satisfaction
- Program Influences
- Participant Demographics

[5] https://ma-eeac.org/wp-content/uploads/2019-Eversource-EVSE-DLC-Process-Evaluation-Memo-2020-07-06-FOR-PUBLICATION.pdf

[6] https://ma-eeac.org/wp-content/uploads/Eversource-EVSE-DLC-Evaluation-Infographic-and-Report-2021-09-21.pdf

[7] https://ma-eeac.org/wp-content/uploads/Eversource-Off-Peak-Evaluation-Report-2022-04-19-FINAL-with-Infographic-2.pdf

[8] https://ma-eeac.org/wp-content/uploads/MA21-DR04-E-Res-EV-National-Grid-EV-and-PHEV-Demand-Response-Evaluation-Report-2022-07-11-FINAL-wInfographic.pdf

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Table 2-1 summarizes the primary periods covered by the surveys for each offering.

Table 2-1. Participant Survey Periods Used for Comparison Study

EV Offering	2019				2020				2021			
	Spr.	Sum.	Fall	Win.	Spr.	Sum.	Fall	Win.	Spr.	Sum.	Fall	Win.
Eversource EVSE DLC Summer 2019												
Eversource EVSE DLC Summer 2020												
Eversource EVSE DLC Winter 2021												
National Grid EV DLC Summer 2021												
Eversource Off-Peak*												

Note: Spring, summer, fall, and winter span March through May, June through August, September through November, and December through February, respectively.

*In addition to Off-Peak offering participants, the Off-Peak survey was administered to control group participants.
Source: Guidehouse

Table 2-2 provides an overview of the data used to compare impacts, charging profiles, and event participation across the three offerings for summer 2021, and Table 2-3 summarizes the time periods covered by the data across the three offerings. Where possible, Guidehouse drew from impact estimates (i.e., kW reductions) summarized in each of the program evaluations to conduct comparisons. In some instances, for this memo, Guidehouse utilized telemetry, session, event summary, and enrollment data from each of the evaluations to conduct additional analysis.

Table 2-2. Types of Data Used for the Comparison Study

Data Source	Eversource EVSE DLC	National Grid EV DLC	Eversource Off-Peak
Impact Estimates (kW reductions)	✓	✓	✓
EV/EVSE Interval Data	✓		✓
EV/EVSE Session Data	✓	✓[9]	
Event Summary Data	✓	✓	
Program Enrollment Data	✓	✓	✓

Source: Guidehouse

[9] EV/EVSE session data was converted into 15-minute intervals, which always started and ended on a quarter-hour mark. Total session energy consumption was equally spread across the duration of each charging session.

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Table 2-3. Periods with EV or EVSE Telemetry Used for Comparison Study

EV Offering	2019				2020				2021			
	Spr.	Sum.	Fall	Win.	Spr.	Sum.	Fall	Win.	Spr.	Sum.	Fall	Win.
Eversource EVSE DLC Summer 2019												
Eversource EVSE DLC Summer 2020												
Eversource EVSE DLC Winter 2021												
Eversource EVSE DLC Summer 2021												
National Grid EV DLC Summer 2021												
Eversource Off-Peak												

Note: Spring, summer, fall, and winter span March through May, June through August, September through November, and December through February, respectively.

Source: Guidehouse

Of note, analysis and results included in this report related to Eversource's EVSE DLC offering in 2020 and 2021 include both MA and CT participating EVSEs.[10] MA and CT had the same program design and event parameters in 2020 and 2021. Additionally, investigation into how charging profiles compared between the two states did not show notable differences. For this reason, the evaluation of the EVSE DLC offering ultimately combined analysis and results across states related to participant surveys, charging profile analysis, event participation analysis, and impact analysis. Accordingly, consistent with the evaluation, results shown throughout this memo also reflect the combination of MA and CT participating EVSEs. The proportion of participating EVSEs in MA and CT for each evaluation period was as follows:

- Summer 2019 – 100% MA, 0% CT
- Summer 2020 – 84% MA, 16% CT
- Winter 2020/2021 – 81% MA, 19% CT
- Summer 2021 – 73% MA, 27% CT

2.2 Additional Data Used for Comparison Study

In addition to data summarized in Section 2.1, Guidehouse utilized data on EVs and the EV charging infrastructure in Massachusetts. Table 2-4 summarizes the data sources used for this comparison study, as well as the key inputs used from each data source.

[10] Connecticut did not have a demonstration in 2019.

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Table 2-4. Additional Data Used for Comparison Study

Data Source	Key Inputs Used
IHS Markit (as of April 2022)	• EV make, model, and year for non-Fleet EVs in Massachusetts
U.S. Department of Energy Alternative Fuels Data Center (as of October 2022)	• Latitude and longitude of public EV charging stations • Charge rate (e.g., Level 1, Level 2, DCFC) • Restrictions on public charging access (e.g., restricted hours)
Phase 6 Survey for New and Existing Customers, part of the Massachusetts RES 1 Phase 6 Panel Study (as of July 2022)	• Type of EVSE installed at the home (e.g., Level 1, Level 2)
National Grid and Eversource EV Managed Charging Program Managers (as of October 2022)	• Capabilities and limitations of certain EV/EVSE makes and models • Potential for future offering to cover additional makes and models

Source: Guidehouse

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3. Evaluation Methods

This section describes the methods pertaining to this comparison study. First, Guidehouse provides a brief summary of how each data source was used to inform analysis findings provided in Section 4, Section 5, and Section 6. To provide context for comparisons of impact and process findings provided in Section 4, Guidehouse also provides a brief summary of the impact evaluation methods and process evaluation methods used for each of the EV managed charging program evaluations.

3.1 Comparison Study Methods

To conduct this comparison study, Guidehouse first compiled and organized all data collected during evaluations of the three EV managed charging offerings. Data used from each of the evaluations is summarized in detail in Section 2.1 and included data collected through participant surveys as well as impact estimates and the data underlying impact estimates. In addition, for this study, Guidehouse collected data from other sources summarized in Section 2.2 to understand the composition of EVs and the charging infrastructure in Massachusetts.

Once all data were compiled and organized, Guidehouse conducted in-depth comparisons of offering designs, impacts, charging profiles, event participation, and customer acceptance and satisfaction. In some cases, such as in the comparison of impacts and charging profiles, new analysis of data previously received was required. Findings from all comparisons may be found in Section 4.

In addition to comparisons of the EV managed charging offerings, Guidehouse conducted analysis of customers served by the offerings by examining demographic information gathered during participant surveys. Findings from this analysis may be found in Section 5. Lastly, to understand the ability of the offerings to serve EV customers in Massachusetts, Guidehouse summarized data on EV charging infrastructure and EV characteristics highlighted in Section 2.2. Findings from this analysis may be found in Section 6.

3.2 Impact Evaluation Methods Review

For the respective evaluations, Guidehouse estimated impacts using an engineering approach for the DLC offerings and a regression approach for the off-peak charging offering. Guidehouse summarizes the two approaches in more detail in Table 3-1 below. Using these approaches, Guidehouse estimated a counterfactual or baseline condition that would have been observed in the absence of the offering and compares this counterfactual condition to actual observed data under the offering. The estimated difference between the counterfactual condition and the actual observed data is the estimated impact of the offering.

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Table 3-1. Impact Evaluation Methods

Impact Evaluation Method	Method Description
Engineering Approach[11]	For the DLC offerings, Guidehouse estimated kW impacts associated with each event by calculating the difference between actual observed and counterfactual charging had no event been called. The counterfactual for each EV/EVSE was typically estimated using some of the following data: total energy consumption during and after the event, the EV's state of charge during the event, power draw observed during the plug session, charging rate, and the available line power of the plug session.
Regression Approach	For the off-peak charging offering, using data observed prior to the start of the program and after the start of the program for participants and non-participants,[12] Guidehouse employed a difference-in-difference regression model to estimate the average kW difference between the participants and non-participants over time. Results from the difference-in-differences approach were used to inform estimates of program-induced reductions in charging during peak hours (7 a.m. through 11 p.m.).

Source: Guidehouse

3.3 Process Evaluation Methods Review

To facilitate a process evaluation of the three EV managed charging offerings, Guidehouse administered online participant surveys to enrolled participants and, in the case of the Eversource Off-Peak offering, non-participants enrolled in the RER study. Topics covered by participant surveys were previously summarized in Section 2.1. For each of the evaluations, surveys were administered to all Massachusetts offering participants.[13,14] Respondents were provided $10 for completing the survey.

After data collection was complete, Guidehouse assessed the representativeness of each survey respondent population (those who completed the survey) compared to the overall population (enrolled offering participants) for each survey. Guidehouse then conducted analysis on collected data, which included visualizing responses to each of the survey questions. Full survey results are provided in each of the three evaluation reports. All three evaluation reports can be found cited in Section 2.

[11] Guidehouse's engineering approach assumes all charging sessions are fixed and do not capture any behavioral effects on charging resulting from the event.
[12] Non-participants used in the evaluation of the Eversource Off-Peak offering are EVs that were enrolled in the RER EV Metering Study as part of the Massachusetts Residential Building Use and Equipment Characterization Study
[13] In the summer 2020 and winter 2021 evaluations of the Eversource EVSE DLC offering, Guidehouse surveyed participants in both Connecticut and Massachusetts.
[14] Eversource EVSE DLC participant surveys were administered to all Massachusetts and Connecticut program participants, including those who previously responded to a survey. National Grid EV DLC participants received a survey invitation if they had enrollment and incentives filed prior to 08/31/2021 and had a status of "Accepted". Eversource Off-Peak participants received a survey invitation if they had enrollment and incentives filed prior to 07/01/2021 and had a status of "Vehicle Connected".

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4. Analysis and Results

In this section, Guidehouse provides a comparison of the three EV managed charging offerings across the following chapter sections:

- **Comparison of Offering Design.** This section provides a comparison of design characteristics, such as customers served, incentive structures, load reduction strategies, and event characteristics.
- **Comparison of Charging Profiles.** This section provides comparisons of charging profiles between the three EV managed offerings. This includes an assessment of charging profiles across non-holiday, non-event weekdays for each offering, as well as an assessment of profiles for non-holiday, non-event weekdays that were shared between the two DLC offerings.
- **Comparison of Customer Acceptance and Satisfaction.** This section provides comparisons of key metrics related to customer acceptance of and satisfaction with the three EV managed charging offerings.
- **Comparison of Event Participation.** This section provides a comparison of event participation status for the two DLC offerings, with emphasis on understanding how participants used their EVs during the time of an event.
- **Comparison of Impacts.** This section provides a comparison of estimated impacts from each of the three EV managed charging offerings. This includes an assessment of overall impact estimates previously provided by Guidehouse, as well as new impact estimates for hours shared by all three EV offerings.

4.1 Comparison of Offering Design

In this section, Guidehouse details the designs of the three EV managed charging offerings. This includes a comparison across the three EV offerings for summer 2021 (June – September), as well as a review of how Eversource's EVSE DLC offering evolved from summer 2019 through summer 2021.

Table 4-1 summarizes the design of each of the three offerings as of September 30, 2021. The National Grid EV DLC offering and the Eversource EVSE DLC offering were similar, in that they were both DLC programs that could directly curtail/throttle EV charging. On the other hand, the Eversource Off-Peak offering yielded demand reductions via a rebate on electricity consumption during off-peak hours (defined in the offering as 11 p.m. through 7 a.m.).

Note that, in some cases, offerings as implemented differed from what was intended. Differences between actual implementation and intended design are common in the first few cycles of an offering. As the DLC offerings continue to evolve, and the PAs are working with EV/EVSE OEMs to align offering implementation with intended design.

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Table 4-1. MA EV Managed Charging Offerings Summary as of September 30, 2021[15]

Program Attributes	Eversource EVSE DLC	National Grid EV DLC	Eversource Off-Peak
Program Administrator	Eversource	National Grid	Eversource
State	Massachusetts & Connecticut[16]	Massachusetts	Massachusetts
Customer Segment	Residential	Residential	Residential
Customer Subsegments	Customers buying a new Level 2 charger Customers that have an existing Level 2 charger	Owners of eligible battery electric vehicles (BEVs) or plug-in hybrid electric vehicles (PHEVs)	Owners of eligible BEVs
Demand Response Management System (DRMS) or Technology Provider	EnergyHub	EnergyHub	FleetCarma (Division of Geotab)
Types of Equipment Enrolled and Eligible	ChargePoint, Enel X or SolarEdge Level 2 EVSEs	BMW, Chevrolet, Ford, and Honda BEVs and PHEVs[17]	Tesla BEVs
Targeted Load	Level 2 EV charging via enrolled EVSE	Home or away Level 1 or Level 2 charging	Charging during peak hours (7 a.m. – 11 p.m.)
Demand Reduction Approach	Direct load control Throttling of Level 2 charging to Level 1 or full curtailment during events, depending on OEM[18]	Direct load control Full curtailment of charging during events	Rebate on electricity costs for charging during off-peak hours (11 p.m. – 7 a.m.) Bonus incentive for avoiding charging between 5 p.m. and 8 p.m.
DLC Event Window	Between 2 p.m. and 7 p.m. on non-holiday weekdays and weekends	Between 4 p.m. and 8 p.m. on non-holiday weekdays	N/A

Source: Guidehouse analysis of offering design as detailed in the Eversource EVSE DLC Demonstration Evaluation Final Report, the Eversource Off-Peak Charging for Tesla Owners Demonstration Evaluation Final Report, and the National EV and PHEV Demand Response Offering Evaluation Final Report.

[15] National Grid also provided a similar offering to its customers through its EV Market Development Program. However, since the offering is not part of the Three-Year Energy Efficiency Program it is not included in this comparison study.

[16] This evaluation only covers the Massachusetts participants.

[17] Four OEMs were able to participate in the National Grid EV DLC in summer 2021. Tesla was added as a fifth OEM for the summer 2022 season. Therefore, Tesla owners and their associated EVs are not included in any analysis of participant satisfaction, charge profiles, event participation, or impacts.

[18] Eversource's intended curtailment strategy was throttling for all participating charging stations. However, ultimately, one EVSE OEM, accounting for 37% of enrolled EVSE by September 30, 2021 could not throttle, and, instead fully curtailed charging during events.

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One key difference between the two DLC offerings was in the controlled load. The National Grid offering targeted Level 1 and Level 2 charging of EVs, and this charging could be curtailed while the EV was connected to an EVSE at home or away from home. On the other hand, while charging load was also directly controlled in the Eversource DLC offering, the offering was for Level 2 home charging.

All offerings had differences in equipment enrolled and eligible for program participation. For the National Grid EV DLC offering, EVs from four OEMs could enroll in the offering, and enrolled EVs could be either a BEV or a PHEV.[19] For the Eversource EVSE DLC offering, any EV could participate in the offering, provided they were plugged into an enrolled ChargePoint, Enel X, or SolarEdge EVSE at home. Lastly, for the Eversource Off-Peak offering, enrollment was limited to Tesla BEVs.

Table 4-2 summarizes incentive structures of the three EV managed charging offerings as of September 30, 2021. All three offerings provided both one-time enrollment and ongoing participant incentives to eligible customers in varying amounts.

Participation, or ongoing, incentives varied considerably between the three offerings. For the DLC offerings, incentives varied from a per-event incentive to a flat incentive. The National Grid EV DLC offering offered a range of incentives from a flat $20 annual incentive to a $20 per event incentive for Level 2 charging events. The Eversource EVSE DLC offering provided a $50 annual incentive for those customers that enrolled with existing equipment (those customers buying a new Level 2 charger were not provided an annual incentive since their upfront enrollment incentive was higher). The Eversource Off-Peak offering provided a rebate on electricity costs incurred between 11 p.m. and 7 a.m. In addition to a rebate on electricity costs, participants would receive a $10 bonus incentive for reduced charging during the period of highest demand spanning 5 p.m. through 8 p.m.

[19] Four OEMs were able to participate in the National Grid EV DLC in summer 2021. Tesla was added as a fifth OEM for the summer 2022 season. The 2021 summer participants were evaluated and compared in this study. Therefore, Tesla owners and their associated EVs are not included in any analysis of participant satisfaction, charge profiles, event participation, or impacts.

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Table 4-2. MA EV Managed Charging Offerings Incentives as of September 30, 2021

Program Attributes	Eversource EVSE DLC[20]	National Grid EV DLC[21]	Eversource Off-Peak
Enrollment Incentive	• $300[22] for residential customers buying a new Level 2 charger • $150 for residential customers that have an existing Level 2 charger	• $25	• $50
Participation (Ongoing) Incentive	• For customers that have an existing Level 2 charger, annual participation incentive of $50 for up to three years	• $20 per event for Level 2 charging events[23] • $10 per event for Level 1 events (incl. for charging that takes place outside of National Grid's territory) • Customers need to participate for at least 50% of an event to earn the per-event incentive • $20 annual incentive, if customer participates in no events	• 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

Source: Guidehouse analysis of offering design as detailed in the Eversource EVSE DLC Demonstration Evaluation Final Report, the Eversource Off-Peak Charging for Tesla Owners Demonstration Evaluation Final Report, and the National EV and PHEV Demand Response Offering Evaluation Final Report.

Figure 4-1 below provides a comparison of events called during summer 2021 for the DLC offerings. The National Grid EV DLC offering called 26 total events as compared to the Eversource EVSE DLC offering's six events. Eversource EVSE DLC offering events had a longer duration during the summer period, with all events having a duration of three hours. The National Grid EV DLC events had a duration of either two hours or three hours. Two events overlapped in June and four events overlapped in August.

[20] As of the time of this study, Eversource's incentive structure has changed to $50 for enrolling and $20 at the end of each summer for participating.

[21] After the June-September 2021 offering, National Grid changed the incentive structure to include only an initial enrollment incentive ($50) and a flat annual incentive ($20), rather than an incentive based on annual performance.

[22] Based on agreement to participate in the program for the remainder of the three-year offering period.

[23] Level 1 charging is defined by National Grid as any session below 1.8 kW. Level 2 charging is defined as any session above 1.8 kW.

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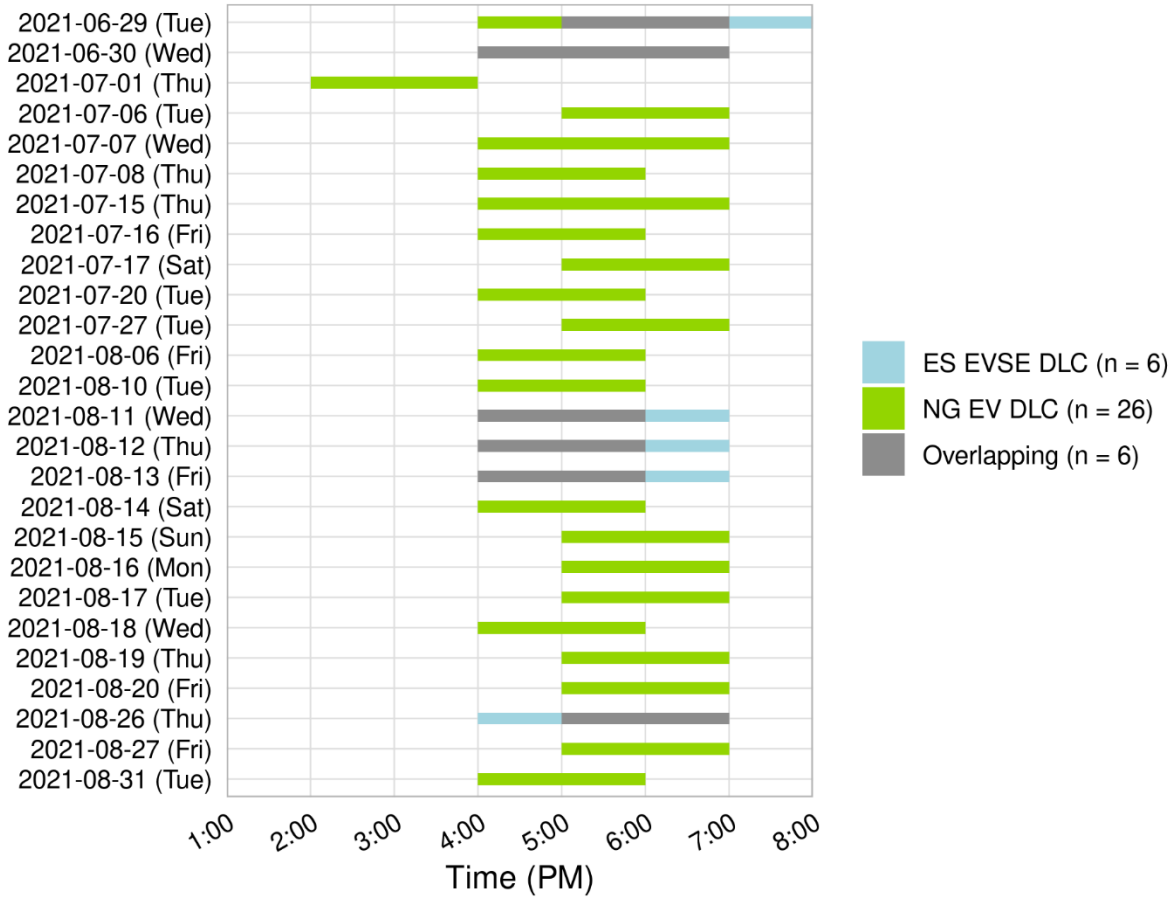
Figure 4-1. Summary of Summer 2021 DR Events



Note: In addition to the six events called in summer 2021, Eversource called a total of three events across summer and fall 2019, five events in summer 2020, and four events in winter 2021.

Source: Guidehouse analysis of event schedules as detailed in the Eversource EVSE DLC Demonstration Evaluation Final Report, and the National EV and PHEV Demand Response Offering Evaluation Final Report.

Table 4-3 provides a summary of the overlapping events with more than 15 EVs/EVSEs.[24] Overlapping events occurred on three consecutive days in mid-August and for one day at the end of August. All overlapping events overlapped for two hours, either overlapping between 4 p.m. and 6 p.m. or between 5 p.m. and 7 p.m. Guidehouse provides a comparison of curtailment outcomes estimated for these overlapping hours in Section 4.5.

[24] Guidehouse does not provide a summary of the June 29 or June 30, 2021 overlapping events, as there were fewer than 15 EVs enrolled in the National Grid DLC offering at the time of those events.

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Table 4-3. DLC Offering Overlapping Event Summary as of September 30, 2021

Date	Day of Week	Eversource EVSE DLC Event Hours	National Grid EV DLC Event Hours	Period of Overlapping Event Hours
8/11/2021	Wednesday	4:00 - 7:00 p.m.	4:00 - 6:00 p.m.	4:00 - 6:00 p.m.
8/12/2021	Thursday	4:00 - 7:00 p.m.	4:00 - 6:00 p.m.	4:00 - 6:00 p.m.
8/13/2021	Friday	4:00 - 7:00 p.m.	4:00 - 6:00 p.m.	4:00 - 6:00 p.m.
8/26/2021	Thursday	4:00 - 7:00 p.m.	5:00 - 7:00 p.m.	5:00 - 7:00 p.m.

Note: There were two additional overlapping events called on June 29 and June 30, 2021. However, given fewer than 15 EVs were participating in the National Grid DLC offering at the time of those events, Guidehouse does not provide a summary of the events.

Source: Guidehouse analysis of event schedules as detailed in the Eversource EVSE DLC Demonstration Evaluation Final Report and the National EV and PHEV Demand Response Offering Evaluation Final Report.

Table 4-4 provides a summary of event characteristics for the DLC offerings. National Grid DLC participants were able to participate in a DR event if they were plugged into and charging from a Level 1 or Level 2 EVSE at home or away from home. Eversource DLC participants could participate in a DR event if they were plugged into and charging from an enrolled Level 2 EVSE at home. As such, during a DR event, the National Grid DLC offering called on a wider variety of charging loads (Level 1 and Level 2) and a wider array of charging locations (home and away).

Table 4-4. DLC Offering Event Characteristics Summary as of September 30, 2021

Program Attributes	Eversource EVSE DLC	National Grid EV DLC
Event Eligibility	Plugged into and charging from enrolled Level 2 EVSE	Plugged into and charging from a Level 1 or Level 2 EVSE[25]
Direct Load Control Approach	Throttling of Level 2 charging to Level 1 or full curtailment during events, depending on OEM	Full curtailment of charging during events
Event Notification	Varies by OEM[26]	Varies by OEM[27]
Opting Out	Customers can opt out of events anytime	Customers can opt out of events in one of the following ways depending on the EV original equipment manufacturer (OEM): pushing a button in the car, opting out in the app, responding to a text message, and/or unplugging and re-plugging in the EV during the event

Source: Guidehouse analysis of offering design as detailed in the Eversource EVSE DLC Demonstration Evaluation Final Report, the Eversource Off-Peak Charging for Tesla Owners Demonstration Evaluation Final Report, and the National EV and PHEV Demand Response Offering Evaluation Final Report.

[25] EV charging with Direct Current (DC) Fast Chargers was not signaled for events.
[26] One OEM provided in-app notifications, email notifications, and/or SMS text messages the day before a DR event. The other OEM provided no notification in advance of an event.
[27] One OEM sent notifications upon plug-in to customers if plug session time intersects with a DR event. Another OEM sent event notifications 24+ hours in advance, again at the start of the event, and at the end of the event to indicate charging will resume. Another OEM sent notifications to all customers at the start of events, regardless of whether the EV is plugged in. The last OEM did not send event notifications; however, DR events were shown on the main app screen, in the customer's charging schedule.

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Event notifications varied for participants in both DLC offerings, with participants receiving anything from a day-ahead notification to no advance notification at all depending on their EV/EVSE OEM. During events, National Grid DLC offering participants experienced full curtailment during the event window. Eversource DLC offering participants either experienced throttling of charging from Level 2 to Level 1 or fully curtailed charging during an event, depending on the EVSE OEM.

Eversource DLC offering has evolved since it was introduced in 2019, which is summarized in Table 4-5. When the offering was first rolled out, ChargePoint EVSEs in Massachusetts could participate in events, and events spanned 7 p.m. to 10 p.m. on non-holiday weekdays.[28] By summer 2020, offering eligibility was expanded to include customers in Connecticut and owners of Enel X and SolarEdge EVSEs. Since summer 2020, enrollment has steadily increased from 339 EVSEs to 687 EVSEs by September 30, 2021.

Table 4-5. Eversource EVSE DLC Design Changes over Time

Program Attributes	Summer 2019	Summer 2020	Winter 2020/2021	Summer 2021
States	Massachusetts	Massachusetts and Connecticut	Massachusetts and Connecticut	Massachusetts and Connecticut
Enrolled EVSEs[29]	96 (through Dec. 2019)	284 (through Dec. 2020)	328 (through Mar. 2021)	487 (through Sep. 2021)
Eligible EVSEs	ChargePoint	ChargePoint, Enel X, and SolarEdge	ChargePoint, Enel X, and SolarEdge	ChargePoint, Enel X, and SolarEdge
Direct Load Control Approach	Throttling of Level 2 charging to Level 1 during events	Throttling of Level 2 charging to Level 1 or full curtailment during events, depending on OEM	Throttling of Level 2 charging to Level 1 or full curtailment during events, depending on OEM	Throttling of Level 2 charging to Level 1 or full curtailment during events, depending on OEM
Event Timing	Between 7 p.m. and 10 p.m. on non-holiday weekdays[30]	Between 4 p.m. and 7 p.m. on non-holiday weekdays	Between 5 p.m. and 8 p.m. on non-holiday weekdays	Between 4 p.m. and 8 p.m. on non-holiday weekdays

Source: Guidehouse analysis of offering design as detailed in the Eversource EVSE DLC Demonstration Evaluation Final Report.

[28] In 2019, Eversource called the three events to begin at either 3 p.m. or 4 p.m. Due to an issue with time zones, event throttling initiated 4 hours later than intended. This had no impact on the evaluation and the issue was corrected for subsequent events.

[29] Enrolled EVSE counts in the table represent MA participants. Of note, analysis and results included in this report related to Eversource's EVSE DLC offering include both MA and CT participating EVSEs. The proportion of participating EVSEs in MA and CT for each evaluation period was as follows: Summer 2019 – 100% MA, 0% CT, Summer 2020 – 84% MA, 16% CT, Winter 2020/2021 – 81% MA, 19% CT, Summer 2021 – 73% MA, 27% CT.

[30] In 2019, Eversource called the three events to begin at either 3 p.m. or 4 p.m. Due to an issue with time zones, event throttling initiated 4 hours later than intended. This had no impact on the evaluation and the issue was corrected for subsequent events.

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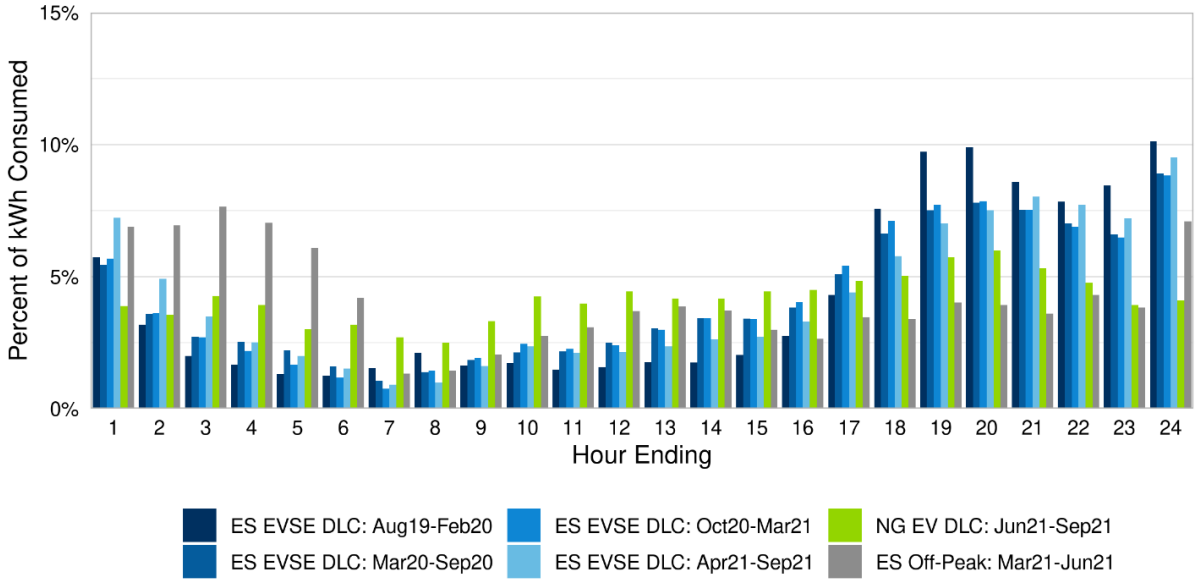
4.2 Comparison of Charging Profiles

This section Guidehouse provides a comparison of charge profiles between the three EV offerings. First, we provide a summary of the percentage of energy consumed by hour on non-holiday, non-event weekdays for each offering's evaluation period. We then provide a summary of the percentage of energy consumed by hour on overlapping non-holiday, non-event weekdays in summer 2021.

Figure 4-2 provides a comparison of charge profiles for each offering's non-holiday, non-event weekdays, and Table 4-6 provides the peak energy hour for each offering's non-holiday, non-event weekdays. Much of the differences in charge profiles between offerings are likely due to differences in program design. The Eversource EVSE DLC offering targeted home charging, whereas the National Grid EV DLC and Eversource Off-Peak offering targeted charging both at and away from home. Relative to the Eversource DLC offering, National Grid DLC and Eversource Off-Peak participants appear to charge more from 8 a.m. through 4 p.m. This is likely because we can observe home and away charging via EV telemetry. Since we have access to only the home EVSE telemetry, Eversource EVSE DLC participants appear to have charged more than participants in the other offerings from 5 p.m. through 11 p.m. We have not attempted to estimate how the Eversource EVSE participants charge their vehicles away from their residence as we are comparing the potential demand the PAs could shift when calling a DR event. Further, the participants in each program tend to utilize different capacity EVSEs at home (see Section 4.3), which can lead to lower charge energy consumption for the National Grid DLC and Eversource Off-Peak offerings compared to the Eversource DLC offering.

Figure 4-2. Percent of Energy Consumed by Hour and Period on Non-Holiday, Non-Event Weekdays



Note: Data used for the Eversource Off-Peak offering include non-holiday weekdays during the period leading up to program treatment, from March through June. This most accurately captures the observed charge profiles under the offering's baseline condition (i.e., no off-peak incentive), the parallel condition to DLC offerings' non-event days.

Note: Except for the Aug19-Feb20 evaluation period, results for Eversource EVSE DLC reflect the combination of MA and CT participating EVSEs. MA and CT had the same program design and event parameters in 2020 and 2021.

Source: Guidehouse analysis of telemetry for the three evaluated EV managed charging offerings

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Table 4-6. Peak Energy Hour by Period on Non-Holiday, Non-Event Weekdays

EV Offering	Time Period	Peak Energy Hour
Eversource EVSE DLC	Aug 2019 – Feb 2020	11 p.m. – 12 a.m.
	Mar 2020 – Sep 2020	11 p.m. – 12 a.m.
	Oct 2020 – Mar 2021	11 p.m. – 12 a.m.
	Apr 2021 – Sep 2021	11 p.m. – 12 a.m.
National Grid EV DLC	Jun 2021 – Sep 2021	7 p.m. – 8 p.m.
Eversource Off-Peak*	Mar 2021 – Sep 2021	2 a.m. – 3 a.m.

* Data used for the Eversource Off-Peak offering include non-holiday weekdays during the period leading up to program treatment, which spanned March through June. This most accurately captures the observed charge profiles under the offering's baseline condition (i.e., no off-peak incentive), the parallel condition to DLC offerings' non-event days.

Note: Except for the Aug19-Feb20 evaluation period, results for Eversource EVSE DLC reflect the combination of MA and CT participating EVSEs. MA and CT had the same program design and event parameters in 2020 and 2021.
Source: Guidehouse analysis of telemetry for the three evaluated EV managed charging offerings

Eversource EVSE DLC participant charge profiles have evolved over time. A greater share of daily charging was occurring between 5 p.m. and 11 p.m. during the first evaluation period relative to subsequent periods. These changes are likely tied to a combination of changes over the four EVSE DLC evaluation periods, including changes in the participant mix, changes in participant behavior, differences in seasons covered, and evolution of the COVID-19 pandemic.

There are also differences in how offering participants charge during overnight hours (11 p.m. to 7 a.m.). Prior to receiving rebates for charging during the off-peak hours (i.e., prior to program treatment), Eversource Off-Peak participants charged the most during overnight hours relative to DLC participants, where charging peaked between 11 p.m. and 5 a.m. This finding is consistent with 76% of Off-Peak respondents indicating use of scheduled charging, shown in Figure 4-3 below. Further differences in overnight charging between Eversource EVSE DLC and National Grid EV DLC participants are provided with language supporting Figure 4-4 below.

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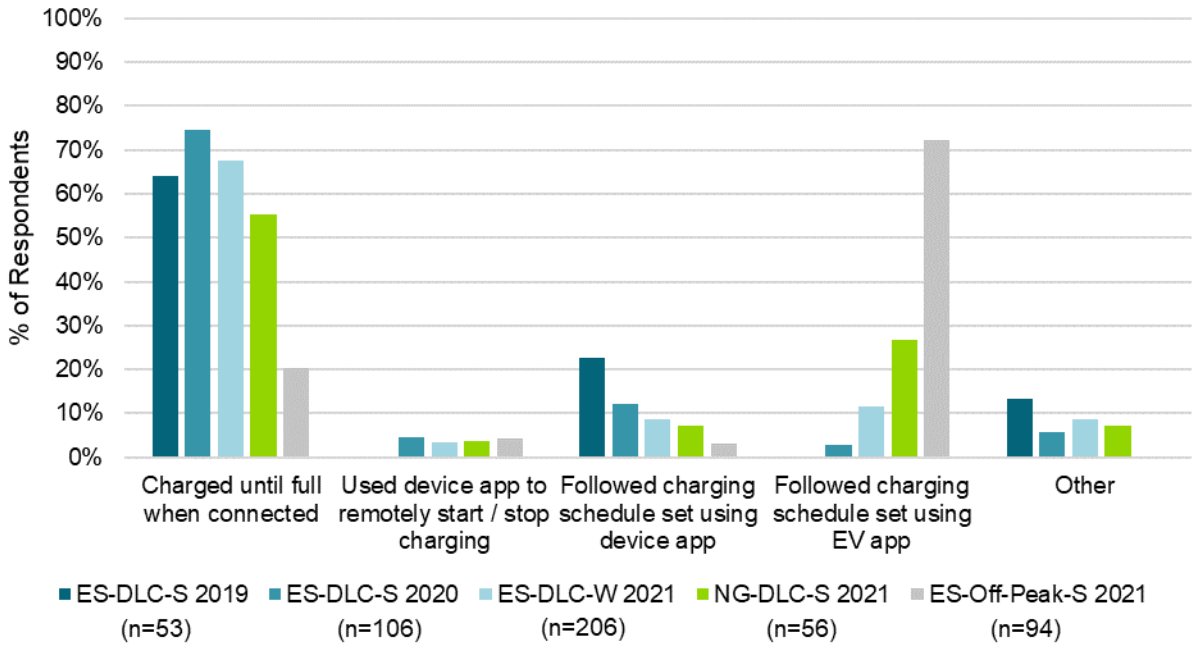
Figure 4-3. Use of Home Charging Device by EV Offering



Question: Which of the following best describes your household's use of your home charging device for your EV?

Note: Except for the Aug19-Feb20 evaluation period, results for Eversource EVSE DLC reflect the combination of MA and CT participating EVSEs. MA and CT had the same program design and event parameters in 2020 and 2021.

Source: Guidehouse analysis of survey data as detailed in the Eversource EVSE DLC Demonstration Evaluation Final Report, the Eversource Off-Peak Charging for Tesla Owners Demonstration Evaluation Final Report, and the National EV and PHEV Demand Response Offering Evaluation Final Report.

Figure 4-4 provides a comparison of charge profiles for overlapping non-holiday, non-event weekdays between the two DLC offerings.[31] In addition to charging more between 8 a.m. and 4 p.m. relative to Eversource EVSE DLC participants (summarized above), National Grid EV DLC participants charged more between 3 a.m. and 8 a.m. relative to Eversource DLC participants. One OEM in the offering scheduled charging set to occur during hours with a lower environmental impact, typically coinciding with early morning hours spanning 3 a.m. through 7 a.m. Additionally, National Grid EV DLC participants conducted Level 1 charging, with some sessions coinciding with overnight hours. Participants likely charged for more time to reach a desired level of charge as compared to Level 2 sessions observed in the Eversource EVSE DLC offering. Both of these factors likely contributed to a larger share of charge energy consumption occurring between 3 a.m. and 8 a.m. relative to Eversource EVSE DLC participants.

[31] For the DLC offerings, there are 43 overlapping non-holiday, non-event weekdays when there are more than 15 vehicles or EVSEs enrolled in each program.

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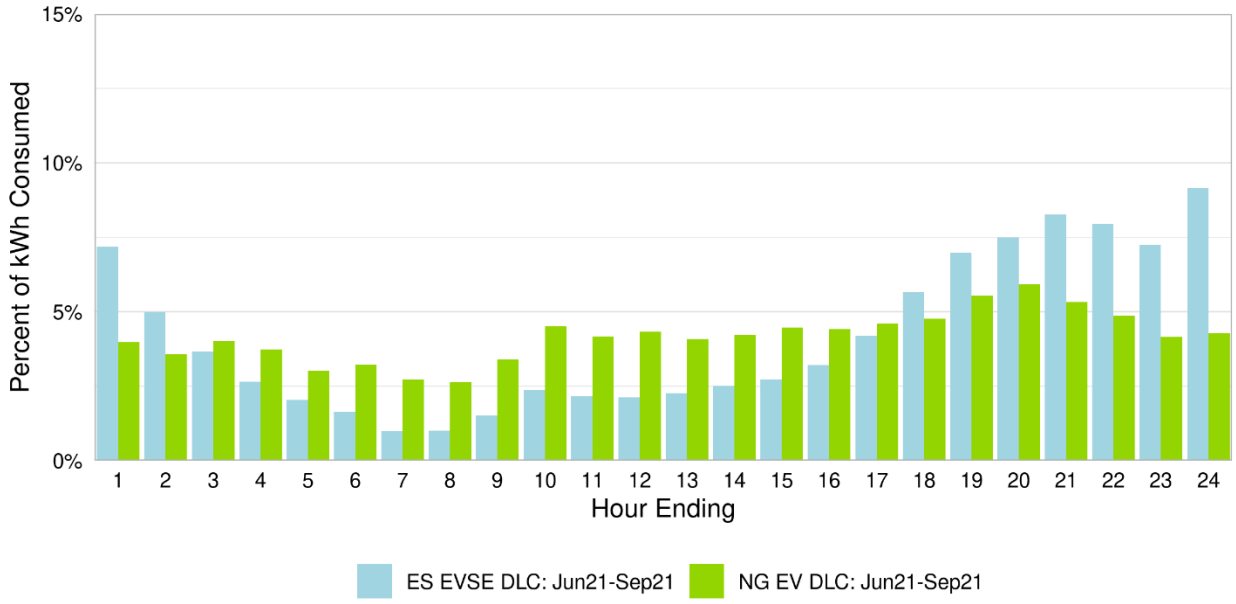
Figure 4-4. Percent of Energy Consumed by Hour and Period on Overlapping Non-Holiday, Non-Event Weekdays



Note: Data included for the DLC offerings include 43 overlapping non-holiday, non-event weekdays spanning July through September 2021 when there are more than 15 EVs or EVSEs enrolled in each offering. The Eversource Off-Peak offering was not included in this chart, as the offering had no data spanning the baseline condition (i.e., no off-peak incentive) with which to compare to the DLC offerings (the Off-Peak offering was providing incentives to customers from July through September, the comparison window for the DLC offerings).

Note: Except for the Aug19-Feb20 evaluation period, results for Eversource EVSE DLC reflect the combination of MA and CT participating EVSEs. MA and CT had the same program design and event parameters in 2020 and 2021.

Source: Guidehouse analysis of telemetry for the three evaluated EV managed charging offerings

4.3 Comparison of Customer Acceptance and Satisfaction

To facilitate a comparison of customer acceptance and satisfaction, Guidehouse identified key metrics that are common to the evaluation of the National Grid EV DLC offering, the Eversource EVSE DLC offering, and the Eversource Off-Peak offering. The selected customer acceptance and satisfaction metrics compared are listed in Table 4-7, below. Event participation based on analysis of telemetry data is discussed separately in Section 4.4. This task leverages customer surveys conducted for the EV program evaluations. It is important to note that, at the time National Grid EV DLC participants were surveyed (fall 2021), National Grid had not yet administered incentives for participation in demand response events during summer 2021. This ultimately may have negatively biased survey responses related to program satisfaction.

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Table 4-7. Customer Acceptance and Satisfaction Metrics

Metric	Source Data
• Motivations for enrolling • Recollection of events (DLC Offerings Only) • Self-reported rate of opt out (DLC Offerings Only) • Feedback on the degree to which program was viewed as an inconvenience or required behavior change • Satisfaction with event characteristics (i.e., length, frequency, timing) (DLC Offerings Only) • Self-reported changes in customer behavior as a function of program participation • Likelihood of continued participation • Feedback on ways to improve the offering	• National Grid EV DLC 2021 Post-Summer Survey • Eversource EVSE DLC 2021 Post-Winter Survey • Eversource EVSE DLC 2020 Post-Summer Survey • Eversource EVSE DLC 2019 Post-Summer/Fall Survey • Eversource Off-Peak Charging 2021 Post-Summer Survey

Source: Guidehouse

Table 4-8 summarizes participants' top motivation for enrollment in the DLC and Off-Peak offerings. Across the offerings, receiving incentives and reducing environmental impact were primary motivators for participants. For National Grid, reducing environmental impact was the most common top motivator for enrolling. By contrast, for the Eversource DLC and Off-Peak offerings, receiving incentives was the most commonly selected top motivator. Supporting community or state energy initiatives was the third most common top motivator for all programs except Eversource DLC 2021. Across the three years of Eversource DLC offering, there has been a steady decline in respondents selecting supporting community or state energy initiatives as a top motivator for enrolling.

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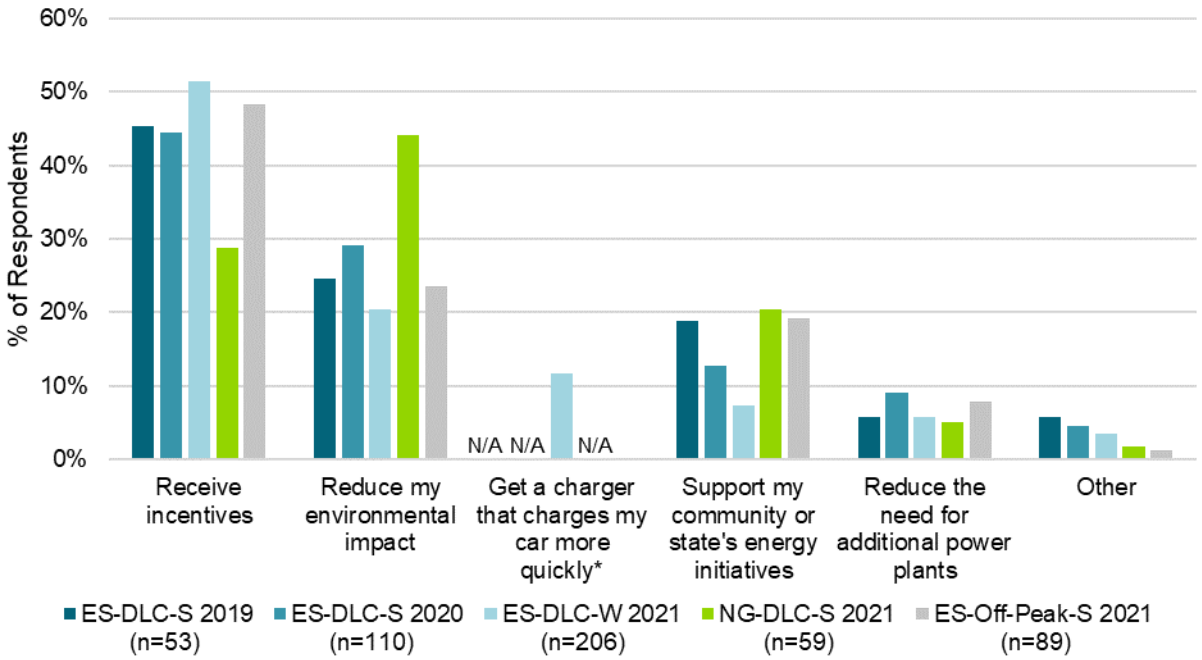
Figure 4-5. Top Motivation for Enrollment



Question: What was your top motivation for enrolling in Eversource's ConnectedSolutions EV Home Charger Demand Response Program?

*Response option was only included in EVSE DLC Winter 2021 Survey.

Note: Except for the summer 2019 survey, results for Eversource EVSE DLC reflect the combination of MA and CT participating EVSEs. MA and CT had the same program design and event parameters in 2020 and 2021.
Source: Guidehouse analysis of survey data as detailed in the Eversource EVSE DLC Demonstration Evaluation Final Report, the Eversource Off-Peak Charging for Tesla Owners Demonstration Evaluation Final Report, and the National EV and PHEV Demand Response Offering Evaluation Final Report.

Table 4-8 provides a summary of event recollection and reported impacts of events on respondents' charging behavior for the two DLC offerings. Additionally, the table includes the number of events called during each analysis period for the offerings.

Although National Grid called far more events than Eversource did during any of the analysis periods, National Grid also had the least number of respondents recalling at least one event (64%) over the season. This may relate to when and how participants were notified of events by the two offerings.[32] Relatedly, depending on the EV OEM, National Grid participants may never have received event notifications if they were never plugged-in during event hours. Similarly, one of the two primary EVSE OEMs in Eversource's DLC offering sent event notifications to all enrolled EVSE owners before every event, the other sent no notification.

The share of respondents who reported being connected to a charger for at least some event hours was greatest for the Eversource DLC Summer 2019 survey and the National Grid DLC Summer 2021 survey. In the case of Eversource, the decrease in the share connected during at least some event hours likely relates to the event timing in the summer 2019 analysis period

[32] For example, in the National Grid offering, one OEM sent notifications to customers upon plug-in if plug session time intersected with a DR event, while another OEM sent event notifications 24+ hours in advance of an event, at the start of the event, and at the end of the event. One OEM in the National Grid program did not send any event notifications.

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versus subsequent analysis periods (i.e., people are more frequently connected to home charging later at night). For National Grid, this may relate to the fact that participants could be charging anywhere (home or away) and still be curtailed for events.

Importantly, National Grid Summer 2021 survey respondents were more likely than Eversource survey respondents (across all analysis periods) to report that events required them to adjust their behavior (e.g., by deferring or rescheduling activities or modifying charging schedule) or that they opted out of at least one event. This likely relates to the number of events National Grid called relative to Eversource, the control strategy employed (full curtailment rather than throttling to reduced rate of charge, depending on the EVSE OEM), and the relatively higher share of respondents who were connected to charging during event periods. Although the share of those connected to charging for at least some event hours was equally high for Eversource's summer 2019 season, events were called later at night, and, thus, were likely viewed as less disruptive.

Table 4-8. DLC Offerings – Event Recollection and Reported Impact Metrics

	Eversource EVSE DLC (Summer 2019)	Eversource EVSE DLC (Summer 2020)	Eversource EVSE DLC (Winter 2021)	National Grid EV DLC (Summer 2021)
Number of events	3	5	4	26
Length of events	3 hrs.	2-3 hrs.	2 hrs.	2 hrs.^
Timing of events	7 – 11 p.m.	4 – 7 p.m.	5 – 8 p.m.	2 – 7 p.m.
Recalled at least one event (of all respondents)	80% (41 of 51)	92% (101 of 110)	70% (144 of 206)	64% (38 of 59)
Recalled receiving notifications (of those who recalled at least one event)*	93% (38 of 41)	93% (94 of 101)	93% (134 of 144)	89% (34 of 38)
Reported being connected to charging for at least some event hours (of those who recalled at least one event)	78% (32 of 41)	71% (72 of 101)	65% (94 of 144)	79% (30 of 38)
Reported impacts (of those who recalled at least one event)	5% (2 of 41)	9% (9 of 101)	6% (8 of 144)	26% (10 of 38)
Reported opting out at least once (of those who recalled at least one event)	0% (0 of 41)	5% (5 of 101)	2% (3 of 144)	16% (6 of 38)

*It is not surprising that the vast majority of participants across the two DLC offerings who were aware of at least one event also recalled receiving notifications. Relatedly, most of the Eversource DLC Winter 2021 survey respondents and about half of the National Grid Summer 2021 survey respondents who were not aware of any events had EVSEs/EVs that did not provide any notification of events.

^ Except the two June and two July events which were each 3 hours long.

Note: Except for the summer 2019 survey, results for Eversource EVSE DLC reflect the combination of MA and CT participating EVSEs. MA and CT had the same program design and event parameters in 2020 and 2021.

Source: Guidehouse analysis of survey data as detailed in the Eversource EVSE DLC Demonstration Evaluation Final Report, the Eversource Off-Peak Charging for Tesla Owners Demonstration Evaluation Final Report, and the National EV and PHEV Demand Response Offering Evaluation Final Report.

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Table 4-9 summarizes the average satisfaction scores of Eversource and National Grid DLC offering survey respondents related to number, length, and timing of events. On average, respondents were satisfied with events across all analysis periods and both offerings. That said, respondents to the Eversource DLC Summer 2019 survey were the most satisfied and respondents to the National Grid DLC Summer 2021 survey were the least satisfied. Again, this is likely a reflection of the later event timing for Eversource DLC participant during summer 2019 and the sheer number of events called by National Grid.

Table 4-9. DLC Offerings – Event Satisfaction Metrics (Average score on a 1-5 scale where 1=Very Dissatisfied, 5=Very Satisfied)

	Eversource EVSE DLC (Summer 2019)	Eversource EVSE DLC (Summer 2020)	Eversource EVSE DLC (Winter 2021)	National Grid EV DLC (Summer 2021)
Number of events	3	5	4	26
Length of events	3 hrs.	2-3 hrs.	2 hrs.	2-3 hrs.
Timing of events	7 – 11 p.m.	4 – 7 p.m.	5 – 8 p.m.	2 – 7 p.m.
Satisfaction w/ number of events	4.7	4.5	4.6	3.9
Satisfaction w/ length of events	4.8	4.4	4.6	4.0
Satisfaction w/ timing of events	4.7	4.4	4.5	4.0

Note: Except for the summer 2019 survey, results for Eversource EVSE DLC reflect the combination of MA and CT participating EVSEs. MA and CT had the same program design and event parameters in 2020 and 2021.
Source: Guidehouse analysis of survey data as detailed in the Eversource EVSE DLC Demonstration Evaluation Final Report, the Eversource Off-Peak Charging for Tesla Owners Demonstration Evaluation Final Report, and the National EV and PHEV Demand Response Offering Evaluation Final Report.

Figure 4-6 illustrates respondents' perception of how their charging behavior, generally, was affected by their participation in the DLC offering. This question was only included in the Eversource DLC Summer 2021 and National Grid DLC Summer 2021 surveys. When comparing the two offerings, there is no notable difference in reported program influence on home charging schedules. For both the Eversource and National Grid 2021 DLC offerings, roughly 20% of respondents reported that the offering had impacted their charging schedule in some way (e.g., to shift charging to overnight hours to align with program goals).

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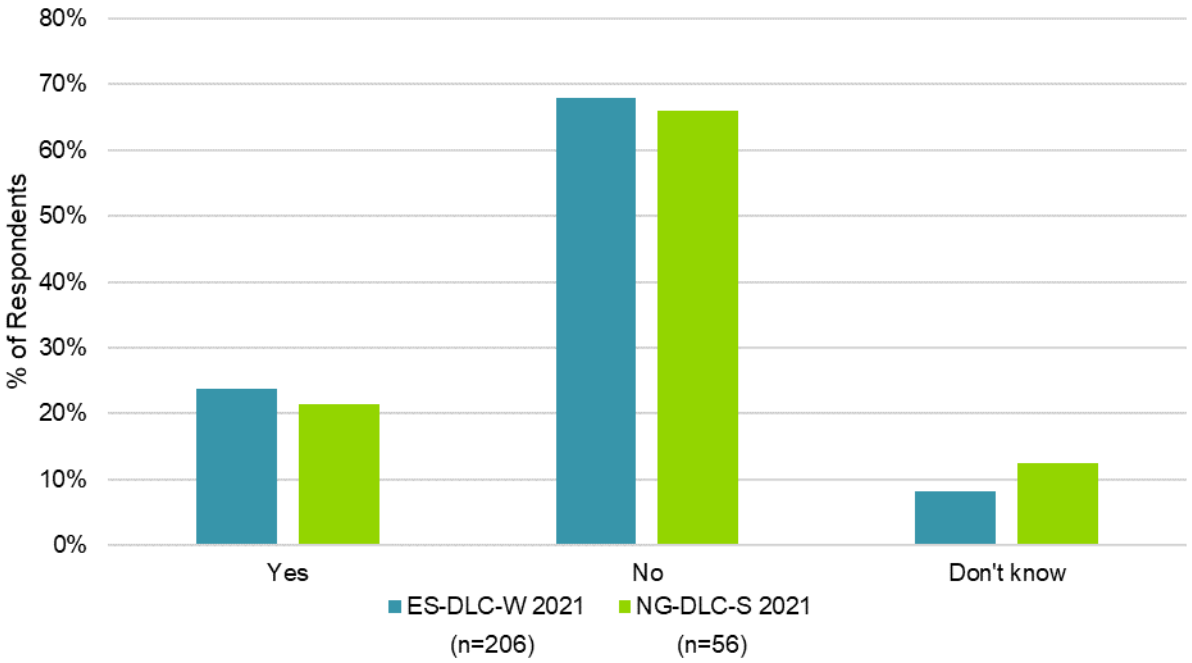
Figure 4-6. DLC Program Impacts on Home Charging Schedule



Question -
Eversource: Did the program influence your choice of charging schedule at all? (n=206)
National Grid: Did National Grid's ConnectedSolutions EV and PHEV Demand Response Program influence your choice of home charging schedule at all? (n=56)

Note: Results for Eversource EVSE DLC reflect the combination of MA and CT participating EVSEs. MA and CT had the same program design and event parameters in 2020 and 2021.
Source: Guidehouse analysis of survey data as detailed in the Eversource EVSE DLC Demonstration Evaluation Final Report, the Eversource Off-Peak Charging for Tesla Owners Demonstration Evaluation Final Report, and the National EV and PHEV Demand Response Offering Evaluation Final Report.

Figure 4-7 summarizes respondents' likelihood of continuing to participate in their given offering. Across all offerings, a majority of participants indicated they were likely to continue participating in the future. However, while 80 to 95% of Eversource DLC and Off-Peak respondents were *very* likely to continue participating, only 58% of National Grid respondents responded that they were *very* likely to continue. National Grid also had the highest percentages of respondents indicate they were very unlikely (5%), unlikely (3%), or neutrally likely (12%) to continue participating. Based on survey feedback, it is reasonable to assume that this hesitance towards continued participation is at least somewhat attributable to some dissatisfaction and confusion around participation incentives, how one can earn them, and when they would be received. The finding may also be linked to the significantly higher number of events for the National Grid DLC program compared to the Eversource DLC programs, as well as differences in control strategies during events (full curtailment rather than reducing the rate of charge).

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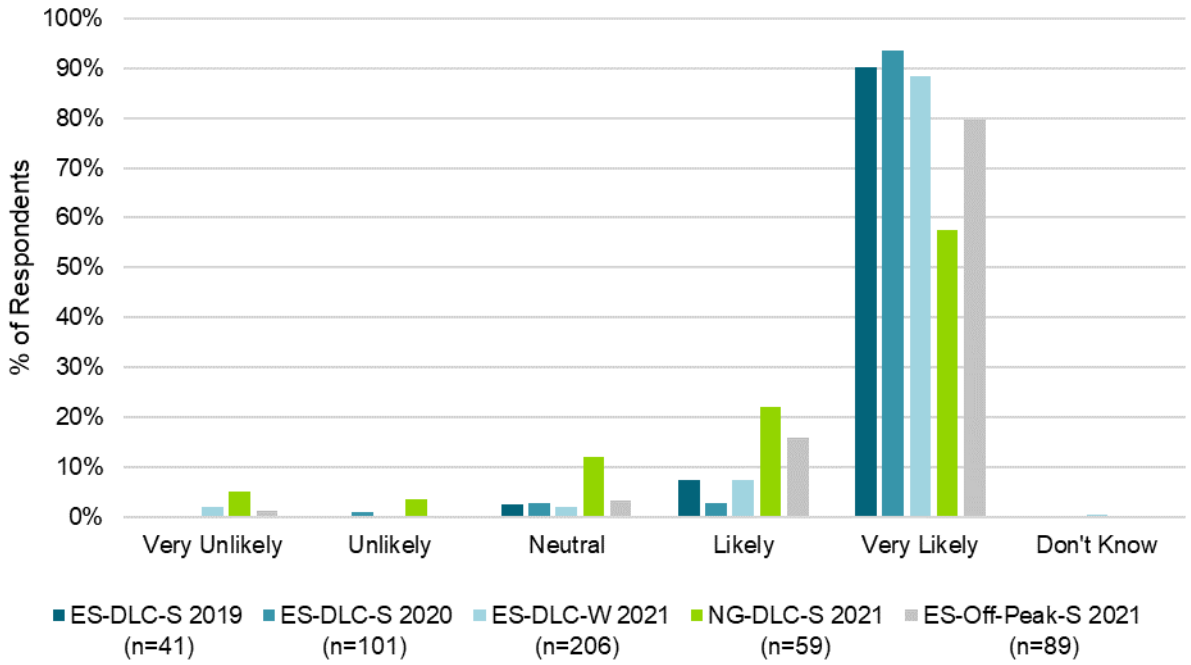
Figure 4-7. Likelihood of Continued Program Participation



Question: How likely are you to continue to participate in the given program?

Note: Except for the summer 2019 survey, results for Eversource EVSE DLC reflect the combination of MA and CT participating EVSEs. MA and CT had the same program design and event parameters in 2020 and 2021.
Source: Guidehouse analysis of survey data as detailed in the Eversource EVSE DLC Demonstration Evaluation Final Report, the Eversource Off-Peak Charging for Tesla Owners Demonstration Evaluation Final Report, and the National EV and PHEV Demand Response Offering Evaluation Final Report.

Each offering's evaluation report includes a summary of survey respondents' open-ended feedback about their experiences with the offering and how it could be improved. These are synthesized below.

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Table 4-10. Open-Ended Feedback Related To How Offerings Could Be Improved

Eversource EVSE DLC	National Grid EV DLC	Eversource Off-Peak Charging
• 7 respondents with EVSEs from vendor B expressed confusion around events and event timing due to a lack of notifications. • 10 respondents recommended additional advertising or awareness to improve the program. • 17 respondents wanted the program to be coupled with pricing changes—i.e., time-of-use (TOU) pricing (9) or low off-peak rates (8).	• Communicate about how incentives are earned, what the status is of incentives earned over the course of the summer, and when participants should expect to receive incentives (8) • Offer more events or raise incentives (6) • Send payments to customers faster (5)	• On the program portal, separate energy use by EV and charging location • Improve communications by clarifying program objectives and sending out monthly reports • Start off-peak periods earlier than 11 p.m. and offer reminders or educational content on how to avoid charging during on-peak periods

Source: Guidehouse analysis of survey data as detailed in the Eversource EVSE DLC Demonstration Evaluation Final Report, the Eversource Off-Peak Charging for Tesla Owners Demonstration Evaluation Final Report, and the National EV and PHEV Demand Response Offering Evaluation Final Report.

4.4 Comparison of Event Participation

In this section, Guidehouse continues the discussion of customer acceptance with a comparison of event participation between the two DLC offerings.

Figure 4-8 provides a summary of plug status during DLC events by DLC offering. Compared to the Eversource EVSE DLC offering, National Grid EV DLC offering experienced a greater share of non-participation (on average across events, 93% of enrolled EVs were non-participants). This may be attributed to the high number of events for the National Grid EV DLC offering (26 events in summer 2021) as compared to the Eversource EVSE DLC offering (6 events in summer 2021), which can increase customer fatigue with event participation and, in turn, increase opt-outs. This higher rate of non-participation may be a contributor to slightly lower average impacts for the National Grid EV DLC offering relative to the Eversource EVSE DLC offering, covered in further detail in Section 4.5.

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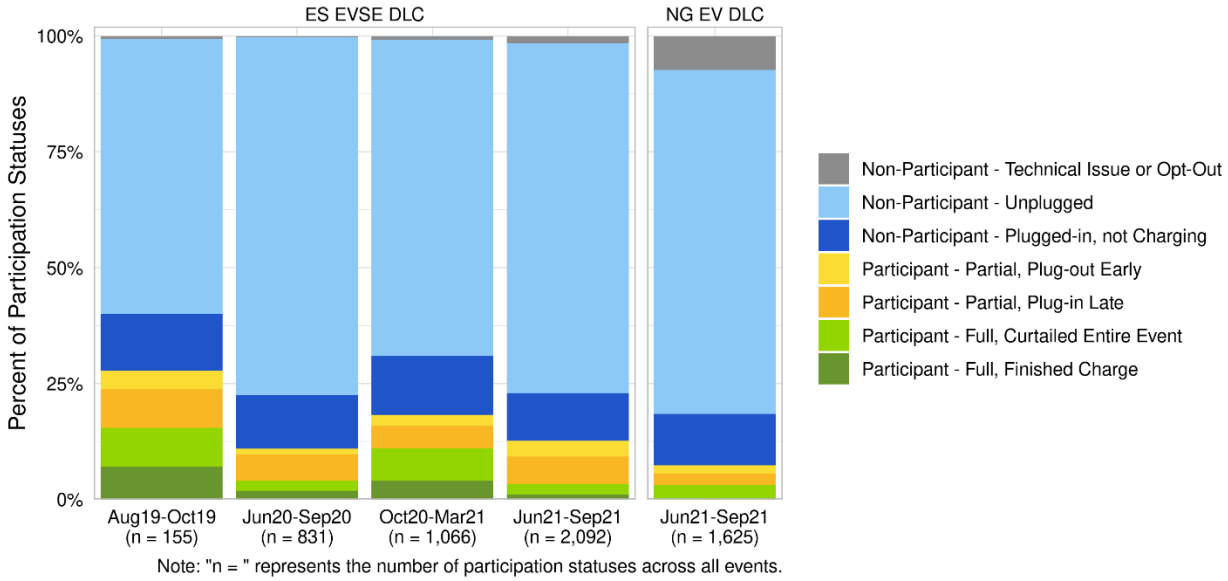
Figure 4-8. Plug Status During DLC Events by DLC Offering



Note: Except for the Aug19-Oct19 evaluation period, results for Eversource EVSE DLC reflect the combination of MA and CT participating EVSEs. MA and CT had the same program design and event parameters in 2020 and 2021.

Source: Guidehouse analysis of telemetry for the three evaluated EV managed charging offerings

Figure 4-9 summarizes the distribution of events that devices participated in across the two DLC offerings. National Grid EV DLC participants had the greatest rate of participation in at least one event, with 50% of enrolled EVs participating in at least one event. For the Eversource DLC offering, 30-48% of enrolled EVSEs participated in at least one event. This finding may be tied to the large number of events called in the National Grid DLC offering's summer 2021 period relative to the Eversource EVSE DLC evaluation periods, increasing the likelihood of a participant participating in at least one event.

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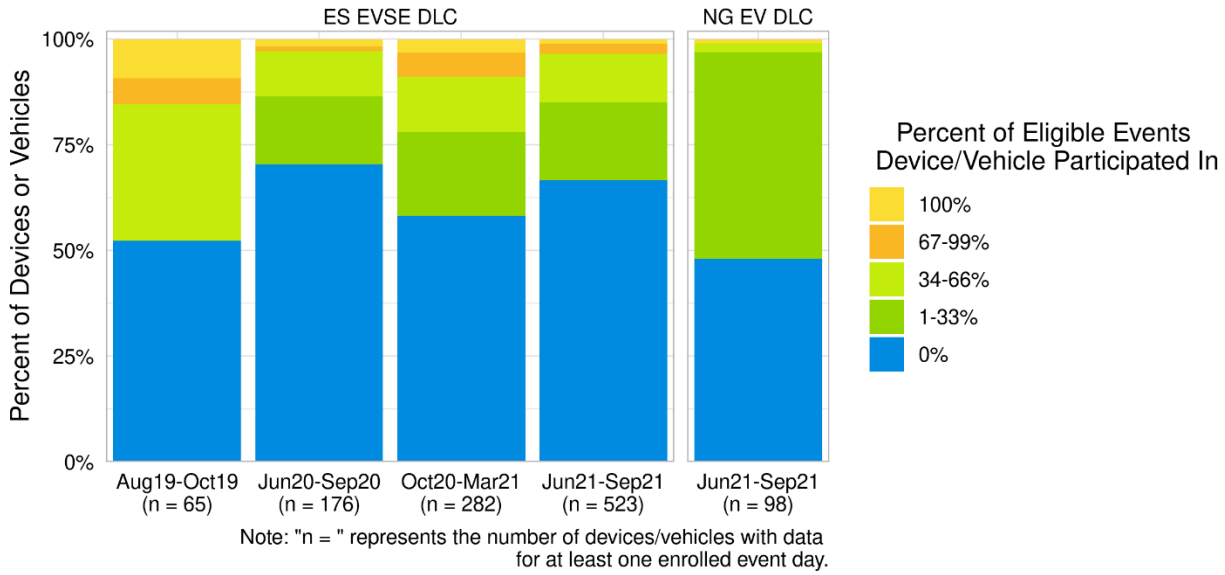
Figure 4-9. EV Event Participation by DLC Offering



Note: Except for the Aug19-Oct19 evaluation period, results for Eversource EVSE DLC reflect the combination of MA and CT participating EVSEs. MA and CT had the same program design and event parameters in 2020 and 2021.

Source: Guidehouse analysis of telemetry for the three evaluated EV managed charging offerings

4.5 Comparison of Impacts

In this section, Guidehouse provides a comparison of impact estimates for the managed charging offerings. First, Guidehouse presents a comparison of estimated impacts across event hours that were shared by the two DLC offerings and the Off-Peak offering (i.e., overlapping event hours). After this, Guidehouse presents a comparison of estimated impacts for each offering for all applicable event hours.

To estimate impacts across event hours shared by the two DLC offerings, Guidehouse limited the analysis period to the hours when DLC events were called (as shown in Table 4-11below). Guidehouse estimated impacts for the DLC offerings via engineering analysis for overlapping event hours. Guidehouse estimated impacts for the Off-Peak offering via a difference-in-differences regression for 4 p.m. to 7 p.m. window during non-holiday weekdays in the program's post-period (July 1 through September 30).[33]

[33] For the Off-Peak offering, Guidehouse also explored estimating impacts for only the four overlapping event hours; however, statistical precision did not yield a reliable estimate. Guidehouse believes that applying estimates gathered for the 4 p.m. to 7 p.m. window during non-holiday weekdays to overlapping event hours is a valid approach, as there is no reason to believe there would be differences in participant behavior on the four overlapping event days and participant behavior from 4 p.m. to 7 p.m. on all other non-holiday weekdays during the offering's post-period.

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Table 4-11. Overlapping Event Hours

Date	Day of Week	Eversource EVSE DLC Event Hours	National Grid EV DLC Event Hours	Period of Overlapping Event Hours
8/11/2021	Wednesday	4:00 - 7:00 p.m.	4:00 - 6:00 p.m.	4:00 - 6:00 p.m.
8/12/2021	Thursday	4:00 - 7:00 p.m.	4:00 - 6:00 p.m.	4:00 - 6:00 p.m.
8/13/2021	Friday	4:00 - 7:00 p.m.	4:00 - 6:00 p.m.	4:00 - 6:00 p.m.
8/26/2021	Thursday	4:00 - 7:00 p.m.	5:00 - 7:00 p.m.	5:00 - 7:00 p.m.

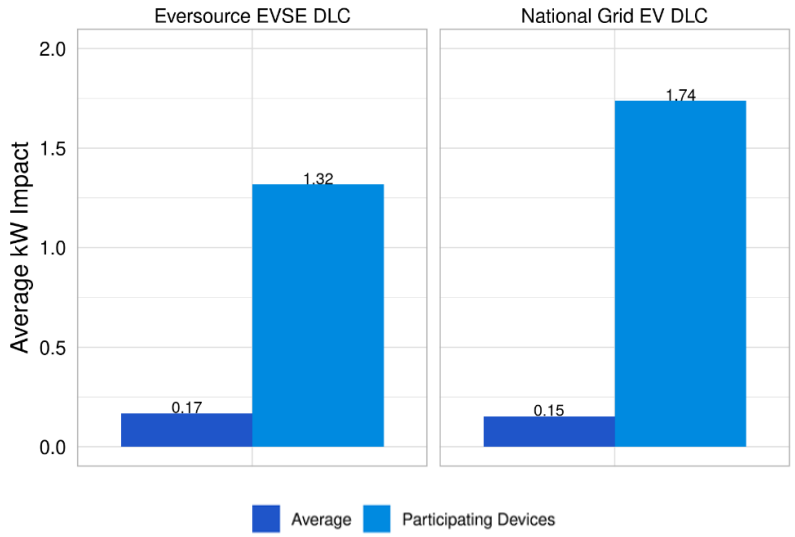
Note: The two offerings also called overlapping event hours on June 29, 2021 and June 30, 2021. However, these two event days were not included in the analysis for National Grid's offering due to low sample sizes (<15 enrolled vehicles).

Note: Results for Eversource EVSE DLC reflect the combination of MA and CT participating EVSEs. MA and CT had the same program design and event parameters in 2020 and 2021.

Source: Guidehouse analysis of event schedules as detailed in the Eversource EVSE DLC Demonstration Evaluation Final Report and the National EV and PHEV Demand Response Offering Evaluation Final Report.

Figure 4-10 provides impact estimates for overlapping hours for the DLC managed charging offerings. Comparing the DLC offerings, kW impact estimates for participating devices were greater for the National Grid EV DLC offering. The National Grid EV DLC offering fully curtailed participating EVs, while the Eversource EVSE DLC offering either throttled customers from Level 2 to Level 1 charging or fully curtailed charging. As such, curtailment potential during the event windows was likely higher for the National Grid EV DLC offering, which could lead to a greater impact across participating devices.

Figure 4-10. Offering Impact Estimates for Overlapping Event Hours in Summer 2021



Note: Participating devices includes full participants plugged in for the entirety of the event, as well as partial participants that plugged in late, plugged out early, or cut off their session early.

The comparison for the DLC events are for the specific overlapping event hours as identified in Table 4-10.

Behavior changes may also be present in the DLC offerings but were not able to be quantified and are therefore unobserved. Other factors contributing to differences are summarized in Section 3.2 and Section 4.1, respectively).

Note: Results for Eversource EVSE DLC reflect the combination of MA and CT participating EVSEs. MA and CT had the same program design and event parameters in 2020 and 2021.

Source: Guidehouse analysis of telemetry for the three evaluated EV managed charging offerings

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In addition to differences in curtailment strategies, all Eversource EVSE DLC participants received day-ahead notifications for day-ahead events, while a small subset of National Grid EV DLC participants received a day-ahead notification Eversource EVSE DLC participants may have therefore modified their charge behavior (e.g., by conducting charging before or after an event) at a greater rate than National Grid DLC participants.

Despite differences in participating device impacts, average kW impact estimates across all devices (i.e., including non-participants) are comparable between the two DLC offerings. As summarized in Section 4.4, the National Grid EV DLC offering participants had lower event participation than Eversource EVSE DLC participants. As such, the comparability of average estimated kW impacts is likely to be a function of relatively low event participation amongst National Grid EV DLC participants.

For the Off-Peak offering, Guidehouse estimated impacts for the 4 p.m. to 7 p.m. window during all non-holiday weekdays in the program's post-period (July 1 through September 30, 2021) using a difference-in-differences regression. Guidehouse also explored estimating impacts for only the four periods aligning with DLC offering events, however statistical precision did not yield a reliable estimate. Comparing DLC impact estimates and the Eversource Off-Peak impact estimate (0.25 kW), Off-Peak offering has a slightly greater average estimated kW impact. Off-Peak offering impacts capture behavior changes (e.g., shifting charging to off-peak hours). Behavior changes may also be present in the DLC offerings but were not able to be quantified and are therefore unobserved.[34] Other factors contributing to differences and, making comparison difficult, include differences in estimation approaches, and differences in the participant pool (summarized in Section 3.2 and Section 4.1, respectively).

Figure 4-11 provides average estimated kW reductions for each offering for all applicable event hours. For the DLC offerings, the kW impact estimates shown correspond with average kW (Eversource EVSE DLC) or weighted average[35] (National Grid EV DLC) reductions using an engineering approach for all called events in each applicable analysis period. Information about events called in the DLC offerings may be found in Section 4.1. For the Off-Peak offering, the kW impact estimate (0.13 kW) corresponds with the estimated reduction in kW using a difference-in-differences regression. This estimate represents the average per-participant kW reduction for the period spanning 7 a.m. through 11 p.m. on weekdays and weekends[36], defined as the peak period for the offering.[37]

[34] To estimate a behavior change, Guidehouse would require interval data spanning a period prior to enrolling in the program for participants and non-participants. As such, Guidehouse did not estimate additional kW impacts associated with behavior changes for the DLC offerings.

[35] In order to control for rolling enrollment, Guidehouse weighted National Grid event impacts by the number of enrolled EVs when calculating the monthly and season averages.

[36] Eversource Off-Peak offering incentivized customers for charging occurring during off-peak energy hours (i.e., 11 p.m. through 7 a.m.). As such, the estimated demand reductions used in this comparison are for the ISO-NE summer energy peak period (i.e., 7 a.m. through 11 p.m.).

[37] Holidays were ultimately removed from the analysis dataset, as charging conducted on holidays was not representative of usual conditions and often coincided with large spikes or drops in charging.

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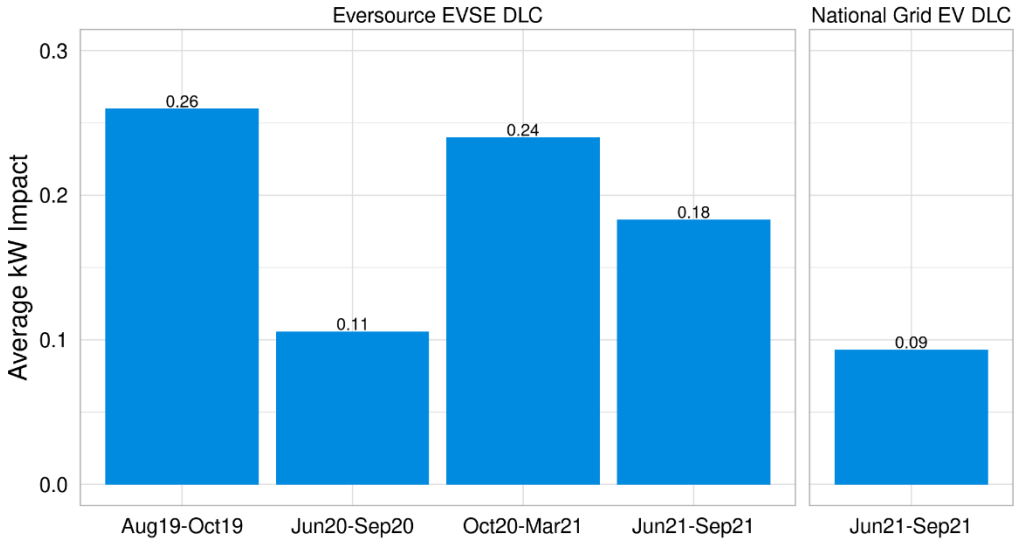
Figure 4-11. Average Impact Estimates for each Evaluation Period



Note: More information on event periods for DLC offerings may be found in Section 4.1.

Behavior changes may also be present in the DLC offerings but were not able to be quantified and are therefore unobserved. Other factors contributing to differences are summarized in Section 3.2 and Section 4.1, respectively.

Note: Except for the Aug19-Oct19 evaluation period, results for Eversource EVSE DLC reflect the combination of MA and CT participating EVSEs. MA and CT had the same program design and event parameters in 2020 and 2021.

Source: Guidehouse analysis of telemetry for the three evaluated EV managed charging offerings

Comparing estimates between all event hours (Figure 4-11) and the subset of hours shown in Figure 4-10, the Eversource DLC offering has roughly identical average estimated kW reductions. On the other hand, the National Grid EV DLC offering has slightly lower estimated kW impacts across all devices when considering all event hours. The National Grid EV DLC offering featured rolling enrollment, and many EVs that were enrolled in the July time period had a lower available line power (measured in kW) as compared to the pool of EVs that participated in overlapping August events. As such, EVs that participated in events in July had a lower curtailment capability as compared to EVs that participated in the overlapping August events. Additionally, event participation across all events was lower than observed for overlapping event hours, particularly in the month of July, which further reduced the average impacts relative to the overlapping hours.[38]

During summer 2021, impact estimates across all event hours are slightly lower for the National Grid EV DLC offering compared to the Eversource EVSE DLC offering. As summarized in Section 4.4, there was a greater rate of event non-participation amongst National Grid EV DLC participants relative to Eversource DLC participants. This ultimately drives down average estimated kW impacts across all customers.

Estimates for the Eversource Off-Peak offering are slightly lower when considering the 7 a.m. to 11 p.m. window (0.13 kW) relative to the 4 p.m. to 7 p.m. window (0.25 kW). The 4 p.m. to 7

[38] In its National Grid EV and PHEV Demand Response Offering evaluation, Guidehouse provided event participation estimates on a per-event basis. Findings indicated a greater rate of non-participation for events in the month of July relative to the month of August.

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p.m. window overlapped with the $10 monthly bonus incentive available to participants that reduced charging between 5 p.m. and 8 p.m. Analysis results provided in the evaluation of the Eversource Off-Peak offering indicated that much of the estimated average kW reduction between 7 a.m. and 11 p.m. (0.13 kW) occurred between 5 p.m. and 8 p.m. (0.25 kW) rather than during the other peak energy hours (0.10 kW). If the PAs provide an off-peak offering in the future and wish to realize greater curtailment during peak demand hours (e.g., 1 p.m. to 5 p.m.), the PAs should consider shifting the bonus incentive to a coincident period, which may lead to greater reductions during peak demand hours.

Lastly, Eversource's Off-Peak offering has a greater estimated kW impact than the National Grid DLC offering and a lower estimated kW impact than the Eversource DLC offering. Factors contributing to these differences are likely similar to the ones previously summarized (i.e., uncaptured behavior changes in DLC offerings, differences in estimation approach, and differences in the participant pool).

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5. Offering Participants

This section summarizes the customers served by the three EV managed charging offerings provided to Massachusetts customers. Guidehouse first provides a review of the locations served by each of the three offerings. After this, Guidehouse reviews select characteristics of participants where data are available, including information on household demographics, home charging, and site characteristics.

Offering participants could be found across Massachusetts, with the majority within Middlesex, Norfolk, and Suffolk Counties. This is consistent with the overall population of Massachusetts, with much of the Commonwealth's population found within these counties. Note that Eversource and National Grid electric service areas each cover a larger percentage of some counties than others. For reference, Table 7-1 in the Appendix lists counts of Massachusetts electric customers by county for Cape Light Compact, Eversource, National Grid, and Unitil.

Table 5-1. EV Managed Participation by County as September 30, 2021

County	Eversource EVSE DLC Participation	National Grid EV DLC Participation	Eversource Off-Peak Charging Participation	Combined Participation
Barnstable	6	0	9	15
Berkshire	6	3	2	11
Bristol	6	7	7	20
Dukes	0	0	1	1
Essex	0	23	1	24
Franklin	21	0	1	22
Hampden	8	1	2	11
Hampshire	8	4	1	13
Middlesex	296	29	114	439
Nantucket	0	0	0	0
Norfolk	98	15	39	152
Plymouth	12	6	4	22
Suffolk	26	2	8	36
Worcester	0	15	3	18
Total	**487**	**105**	**192**	**784**

Source: *Guidehouse analysis of program tracking data for the three evaluated EV managed charging offerings*

Figure 5-1 summarizes the level of charging capable for EVSEs installed at participants' homes. For the Eversource DLC offering, participants were required to have an existing or purchase a new eligible Level 2 EVSE, and therefore all participants had Level 2 charging available at their homes. National Grid DLC offering and Eversource Off-Peak offering participants were enrolled with an eligible EV and therefore could have Level 1 or Level 2 EVSEs at their home. When asked about the level of charging their home EVSE was capable of, 44% of National Grid DLC survey respondents indicated having Level 1 charging as compared to 14% of Eversource Off-Peak offering participants. These differences in EVSEs at home are likely attributed to differences in the participant pool. Numerous National Grid DLC offering participants enrolled with a PHEV, which requires less time to charge to full and has a backup system to rely on in

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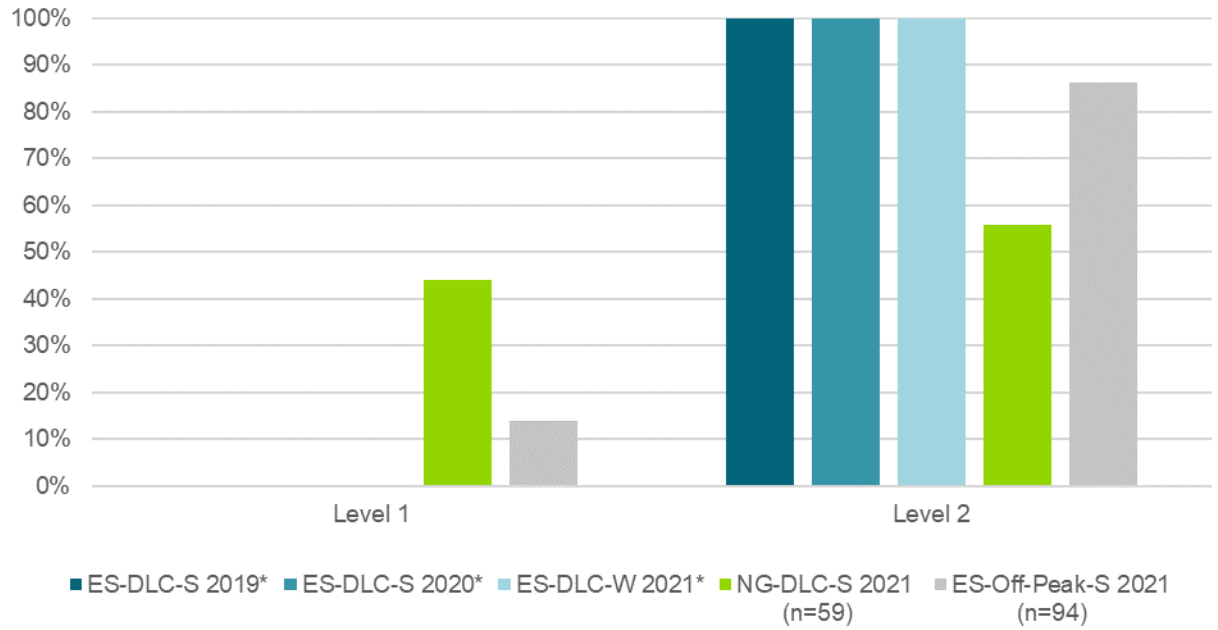
the case of low charge. On the other hand, Eversource Off-Peak participation was limited to Tesla BEVs, which would take a much longer time to charge from low to full when connected to a Level 1 EVSE.

Figure 5-1. Level of EVSEs Represented as of September 30, 2021



* Note: Since all EVSE participants were required to have a Level 2 EVSE, Eversource EVSE DLC participants were not asked about what level of charging their EVSE was capable of. As such, Guidehouse has represented all EVSE DLC participants as having a Level 2 EVSE.
Source: Guidehouse analysis of survey data as detailed in the Eversource EVSE DLC Demonstration Evaluation Final Report, the Eversource Off-Peak Charging for Tesla Owners Demonstration Evaluation Final Report, and the National EV and PHEV Demand Response Offering Evaluation Final Report.

Figure 5-2 summarizes income segments covered by EV managed charging offerings as of September 30, 2021. When survey respondents were asked to report their household income, a greater proportion (41%) of National Grid DLC offering respondents indicated a moderate income than Eversource DLC or Eversource Off-Peak respondents. A greater proportion (70%) of Eversource DLC respondents indicated high income as compared to the National Grid DLC and Eversource Off-Peak respondents.

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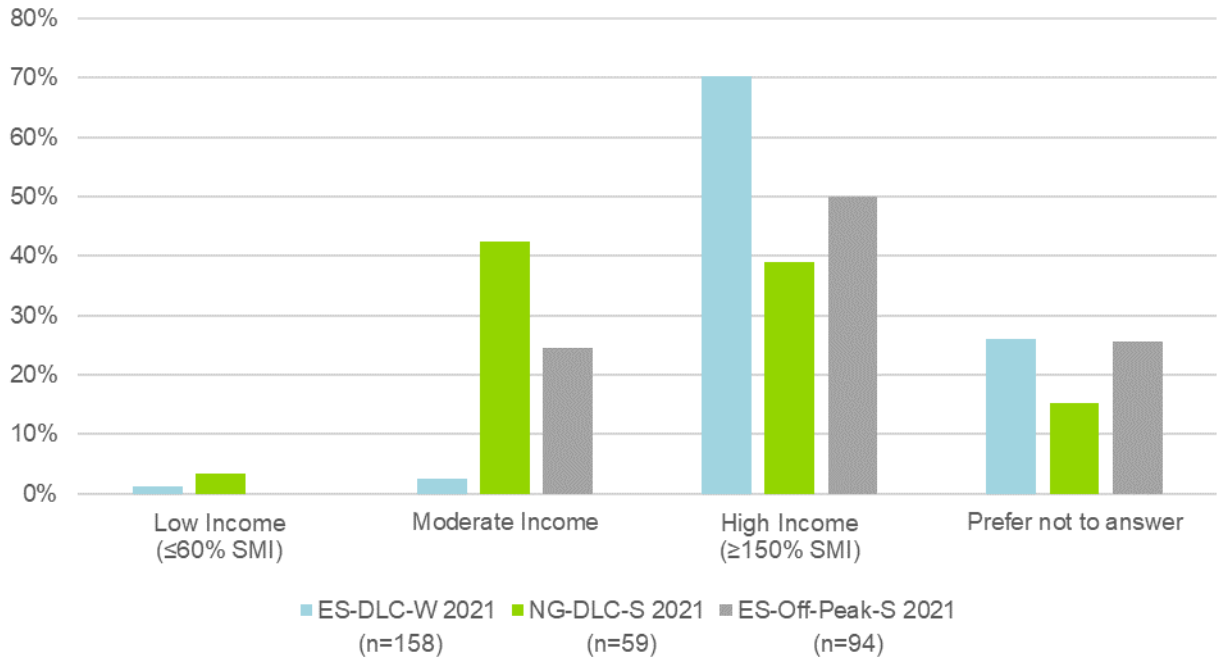
Figure 5-2. Income Segments Represented as of September 30, 2021



Source: Guidehouse analysis of survey data as detailed in the Eversource EVSE DLC Demonstration Evaluation Final Report, the Eversource Off-Peak Charging for Tesla Owners Demonstration Evaluation Final Report, and the National EV and PHEV Demand Response Offering Evaluation Final Report.

Figure 5-3 summarizes the property types where respondents' home charging devices were located. The distribution of property types is similar between all three EV offerings, with the vast majority of participants indicating that their home charging occurred at a single-family home. Multi-family homes comprised the remainder of responses, most of which were small multi-family homes.

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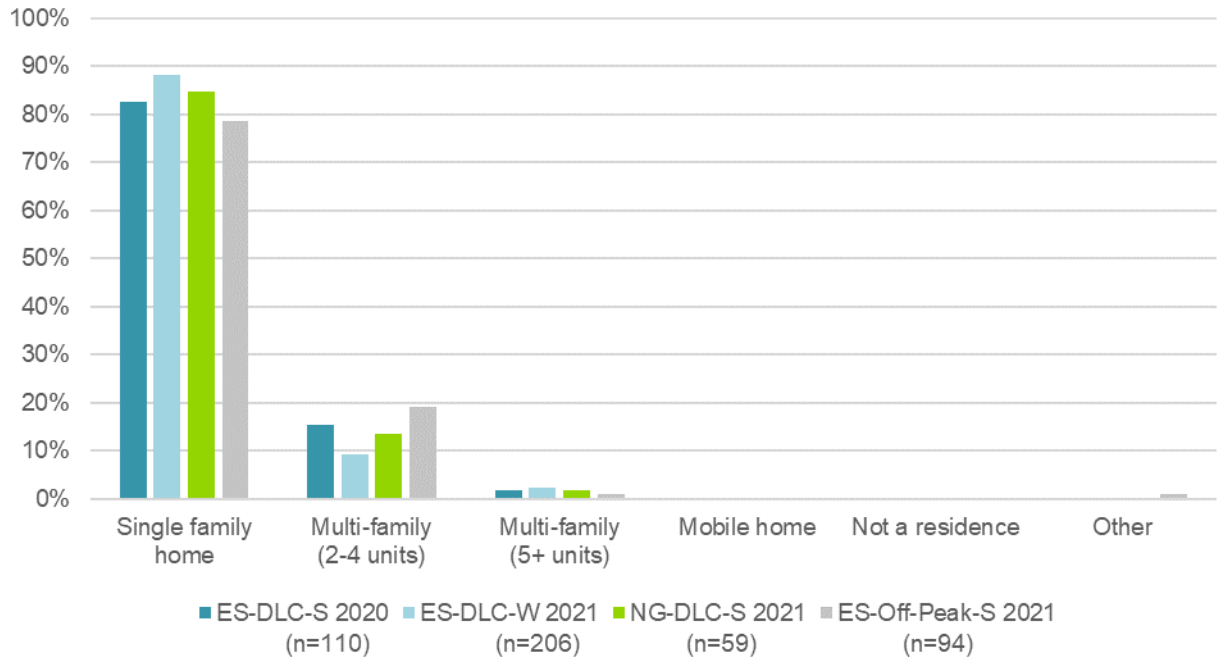
Figure 5-3. Property Types Represented as of September 30, 2021



Source: Guidehouse analysis of survey data as detailed in the Eversource EVSE DLC Demonstration Evaluation Final Report, the Eversource Off-Peak Charging for Tesla Owners Demonstration Evaluation Final Report, and the National EV and PHEV Demand Response Offering Evaluation Final Report.

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6. Strengths and Weaknesses, Ability to Serve EV/EVSE Types and Circumstances

Table 6-1 summarizes EV ownership and managed charging participation in Massachusetts by county. The five Massachusetts counties with highest EV adoption per 100,000 people include Dukes, Middlesex, Hampshire, Franklin, and Norfolk. The managed charging offerings cover most counties in Massachusetts, with Franklin, Middlesex, Norfolk, and Suffolk counties having the highest percentage of EVs enrolled in the offerings.

In terms of the distribution in managed charging participants by county relative to all EVs in Massachusetts, Middlesex, Norfolk, and Suffolk counties are overrepresented, while other counties are underrepresented, particularly Essex and Worcester counties, which is likely because of the share of municipally-owned electric companies in those counties. For reference, Table 7-1 in the Appendix lists counts of Massachusetts electric customers by county for Cape Light Compact, Eversource, National Grid, and Unitil.

Table 6-1. EVs and Managed Charging Participation by Massachusetts County

County	Non-Fleet EVs Owned	Non-Fleet EVs per 100,000 people	Managed Charging Participants*	Percentage of Non-Fleet EVs Enrolled in Offerings	Non-Fleet EVs Owned (% of total)	Managed Charging Participants (% of total)
Barnstable	1,695	740	15	0.88%	3%	2%
Berkshire	833	647	11	1.32%	2%	1%
Bristol	1,914	330	20	1.04%	4%	3%
Dukes	306	1,487	1	0.33%	1%	0%
Essex	4,981	616	24	0.48%	10%	3%
Franklin	729	1,027	22	3.02%	1%	3%
Hampden	1,430	308	11	0.77%	3%	1%
Hampshire	1,735	1,071	13	0.75%	3%	2%
Middlesex	20,562	1,262	439	2.14%	39%	56%
Nantucket	119	835	0	0.00%	0%	0%
Norfolk	7,119	981	152	2.14%	14%	19%
Plymouth	2,473	466	22	0.89%	5%	3%
Suffolk	3,838	483	36	0.94%	7%	5%
Worcester	4,565	530	18	0.39%	9%	2%
MA Total / Average	**52,299**	**745**	**784**	**1.50%**	**100%**	**100%**

* Reflects the count of EVs/EVSEs enrolled across the three offerings as of September 30, 2021.
Source: Guidehouse analysis of U.S. Department of Energy Alternative Fuels Database, 2020 U.S. Census data, IHS Markit data (April 1, 2022), and EV program tracking data (September 30, 2021)

Table 6-2 summarizes the most prevalent EV OEMs in Massachusetts, as well as eligibility of each EV OEM in the three EV managed charging offerings. As of April 2022, approximately 52,300 non-fleet EVs were registered to vehicle owners in Massachusetts. Of the registered EVs, nearly 40% were manufactured by Tesla. The four next most popular EV OEMs were Toyota, Chevrolet, Ford, and BMW, together comprising approximately 36% of registered EVs.

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A remaining 33 EV OEMs comprised the remaining approximately 25% of registered EVs. The National Grid DLC offering currently covers four of the top five EV OEMs, while the Eversource Off-Peak offering covered Tesla EVs. Since the Eversource EVSE DLC offering comprises eligible ChargePoint, Enel X, and SolarEdge EVSEs, any EV is eligible for the offering.

Table 6-2. Top EV OEMs in Massachusetts and Eligibility by EV Offering

EV OEM	Registered Non-Fleet EVs	Percentage of Registered Non-Fleet EVs	EV OEM Eligibility		
			Eversource EVSE DLC*	National Grid EV DLC	Eversource Off-Peak
Tesla	20,439	39.1%	✓	✓	✓
Toyota	8,723	16.7%	✓		
Chevrolet	4,789	9.2%	✓	✓	
Ford	2,684	5.1%	✓	✓	
BMW	2,418	4.6%	✓	✓	
Nissan	2,031	3.9%	✓		
Hyundai	1,876	3.6%	✓		
Volvo	1,408	2.7%	✓		
Audi	1,016	1.9%	✓		
Honda	998	1.9%	✓	✓	
Other	5,917	11.3%	✓		
MA Total / Average	**52,299**	**100%**			

*Note: All EV OEMs can participate in the Eversource EVSE DLC offering, provided the EV is plugged into an enrolled Level 2 EVSE.

Source: Guidehouse analysis of IHS Markit data (April 1, 2022) and offering design as detailed in the Eversource EVSE DLC Demonstration Evaluation Final Report, the Eversource Off-Peak Charging for Tesla Owners Demonstration Evaluation Final Report, and the National EV and PHEV Demand Response Offering Evaluation Final Report

Table 6-3 summarizes home EVSE OEM eligibility by offering. The Eversource EVSE DLC offering included ChargePoint, Enel X, and SolarEdge. Anecdotal evidence gathered from discussions with Eversource indicate that ChargePoint and Enel X capture much of the home EVSE market. The National Grid DLC and Eversource Off-Peak offerings determine eligibility by EV type, and therefore it is possible for EV owners to use any EVSE at home.

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Table 6-3. EVSE OEMs and Eligibility by EV Offering

EVSE OEM	EVSE OEM Eligibility		
	Eversource EVSE DLC	National Grid EV DLC*	Eversource Off-Peak*
ChargePoint	✓	✓	✓
Enel X	✓	✓	✓
SolarEdge	✓	✓	✓
Other		✓	✓

*Note: All EVSE OEMs can be included as a part of the National Grid DLC and Eversource Off-Peak offerings, provided an enrolled EV is plugged into one of the EVSEs manufactured by that OEM.

Source: Guidehouse analysis of offering design as detailed in the Eversource EVSE DLC Demonstration Evaluation Final Report, the Eversource Off-Peak Charging for Tesla Owners Demonstration Evaluation Final Report, and the National EV and PHEV Demand Response Offering Evaluation Final Report.

Table 6-4 summarizes the estimated distribution of home charging stations in Massachusetts by level, as well as home EVSE level eligibility by offering. The Eversource EVSE DLC offering captures networked Level 2 home charging (a subset of the 53%), while the National Grid EV DLC and Eversource Off-Peak offerings are inclusive of the population of EV owners that charge with Level 2 or Level 1 charging stations at home or do not charge at home. Note that the estimated distribution of home charging stations in Massachusetts by level is based on survey responses to the Phase 6 Survey for New and Existing Customers, part of the Massachusetts RES 1 Phase 6 Panel Study, from July 2022.

Table 6-4. Level of EVSEs in Homes in Massachusetts

Level of Home Charger	Estimated Percentage of Home EVSEs*	EVSE Level Eligibility		
		Eversource EVSE DLC	National Grid EV DLC	Eversource Off-Peak
Level 1	42%		✓	✓
Level 2	53%	✓	✓	✓
No Home Charger	5%		✓	✓

* Estimated distribution of home charging stations in Massachusetts by level is based on survey responses to the Phase 6 Survey for New and Existing Customers, part of the Massachusetts RES 1 Phase 6 Panel Study, from July 2022.

Source: Guidehouse analysis of offering design as detailed in the Eversource EVSE DLC Demonstration Evaluation Final Report, the Eversource Off-Peak Charging for Tesla Owners Demonstration Evaluation Final Report, and the National EV and PHEV Demand Response Offering Evaluation Final Report.

Based on the above information, Table 6-5 provides a summary of the remaining gap in customers served by the Eversource and National Grid EV managed charging offerings in their current form (and for Off-Peak, as it was in 2021). The table provides a description of the gap for each offering and if combined, along with a rough estimate of the percentage of population of EVs in Massachusetts that are ineligible.

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Table 6-5. Current Offerings - Summary of Gaps

	Eversource EVSE DLC	National Grid EV DLC	Eversource Off-Peak	All three offerings	DLC offerings only
Description of gap	EV owners with non-networked Level 2, Level 1 or no charger at home	EV OEMs other than BMW, Chevrolet, Ford, Honda, and Tesla[39]	EV OEMs other than Tesla	EV owners with non-networked Level 2, Level 1 or no charger at home who have EVs other than BMW, Chevrolet, Ford, Honda, and Tesla	EV owners with non-networked Level 2, Level 1 or no charger at home who have EVs other than BMW, Chevrolet, Ford, Honda, and Tesla
Estimated % of MA EVs ineligible	>47%	40%	61%	>19%	>19%

Source: Guidehouse analysis of U.S. Department of Energy Alternative Fuels Database, 2020 U.S. Census data, IHS Markit data (April 1, 2022), EV program tracking data (September 30, 2021), and offering design as detailed in the Eversource EVSE DLC Demonstration Evaluation Final Report, the Eversource Off-Peak Charging for Tesla Owners Demonstration Evaluation Final Report, and the National EV and PHEV Demand Response Offering Evaluation Final Report.

In terms of the ability of the 2021 offerings to reduce EV charging load during ISO-NE peak hours, 14 of the 62 ISO-NE peak hours (including 3 of the top 4 hours) overlapped National Grid's event periods in summer 2021. For Eversource EVSE DLC, 4 of the 62 ISO-NE peak hours (including all of the top 4 hours) overlapped Eversource's event periods in summer 2021. Eversource's Off-Peak offering, with an off-peak period of 11 p.m. ET to 7 a.m. ET, fully avoided the 62 ISO-NE peak hours. Additionally, 23 of the 62 ISO-NE peak hours (none of the top 4 hours) fell within the offering's 5-8 p.m. ET bonus incentive period.

Table 6-6. Alignment of Offerings with ISO-NE Peak Hours in 2021

	Eversource EVSE DLC	National Grid EV DLC	Eversource Off-Peak Charging
Number of events called in summer 2021	6	26	N/A*
Number of the 62 ISO-NE peak hours with intervention	4	14	62

*Off-peak charging rebate applied to every day.

Source: Guidehouse analysis of event schedules as detailed in the Eversource EVSE DLC Demonstration Evaluation Final Report and the National EV and PHEV Demand Response Offering Evaluation Final Report.

As part of the Eversource EVSE DLC evaluation, Guidehouse conducted a literature review of other managed charging programs around the country, including both direct load control and pricing-based programs. Utilities across the US are experimenting with a variety of managed charging solutions (including direct load control and pricing-based solutions) for electric vehicles to achieve goals for peak load reduction or load shifting. As of early 2021 (the time of the literature review), no single program design or technology platform had been identified as the model that will ultimately become the industry favorite.

[39] Tesla was added as a fifth OEM ahead of the summer 2022 season. Tesla was not eligible in 2021.

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The literature review included interviews with five program administrators about their programs: Austin Energy, Pepco, GMP, MMWEC, and PG&E.[40] Peak load reduction and renewables absorption are some of the primary use cases for managed charging programs among the utilities interviewed. Several of these utilities offer customers a choice between TOU and DLC channels for EV DR participation. All of the utilities mentioned the importance of educating the customer regardless of program design.

[40] Interviews with managed charging program managers that took place in December 2020 and January 2021.

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7. Considerations

Based on the findings described above, Guidehouse provides some considerations below:

- The EV DLC and EVSE DLC are complementary offerings that achieve peak load reduction as none presently addresses all EV owners/vehicles.

- If both programs are offered, ensure program rules are created to encourage EV DLC participation because it addresses charging that takes place both at home and away from home.

- If one DLC offering needs to be prioritized, the EV DLC offering should be prioritized as it has a broader reach and therefore greater potential to reduce transportation related charging during peak periods. With the current partner EV manufacturers (Tesla, Ford, BMW, Honda, Chevrolet/GM), the EV DLC offering potentially enables peak load reductions for >50% of EVs in Massachusetts, and addresses charging that takes place at home and away from home and reduces both Level 1 and Level 2 charging. The reach of the offering will grow as more EV manufacturers are added. That said, if the EV DLC offering is prioritized, continued efforts should be made to achieve uniformity in program delivery across participating OEMs (e.g., event notification methods and timing).

- Although the PAs explain the goals of the program to customers, which causes some customers to adjust their charging schedule, the potential peak reduction benefits from the DLC offerings likely can be greater if the PAs introduce behavioral messaging to encourage off-peak charging (e.g., encourage the use of a charging schedule for the EV and/or EVSE).

- An additional offering that can complement the DLC offerings is an off-peak charging rebate offering. The off-peak rebate provides a monetary incentive to encourage the behavior change to charge outside of peak hours.

- Although not previously quantified because a customer could only participate in one offering, the PAs could assess how the DLC and off-peak offerings can complement each other and additional behavioral messaging that is introduced.

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Appendix A. Massachusetts Electric Customers by County

Table 7-1. MA Electric Customers by County

County	Cape Light Compact Customers	Eversource Customers	National Grid Customers	Unitil Customers
Barnstable	199,071	0	0	0
Berkshire	0	37,213	33,953	0
Bristol	0	87,894	115,233	0
Essex	0	0	263,456	0
Franklin	0	25,699	7,711	0
Hampden	0	117,545	27,269	0
Hampshire	0	36,381	30,695	0
Middlesex	0	395,913	259,112	5,402
Nantucket	0	0	13,852	0
Norfolk	0	87,553	144,232	0
Plymouth	0	95,845	118,332	0
Suffolk	0	310,815	26,645	0
Worcester	0	0	298,094	24,953
MA Total	**199,071**	**1,194,858**	**1,338,584**	**30,355**

Source: The city/town source data is from the Eversource, National Grid and Unitil Appendix 1 filings in the MA Grid Mod docket.[41] Note: This sums feeder-level data. Summing customer-level data likely would arrive at a somewhat different result. Also, Dukes County feeders and associated customers are included with Barnstable County as the substation serving Martha's Vineyard is located in Barnstable County

[41] Massachusetts Electric Company and Nantucket Electric Company d/b/a National Grid, Grid Modernization Plan Annual Report 2022. Submitted to Massachusetts DPU on April 1, 2021 as part of DPU 22-41; NSTAR Electric Company d/b/a Eversource Energy, Grid Modernization Plan Annual Report 2021. Submitted to Massachusetts DPU on April 1, 2022 as part of DPU 22-40; Fitchburg Gas and Electric Light Company d/b/a Unitil, Grid Modernization Plan Annual Report 2021. Submitted to Massachusetts DPU on April 1, 2022 as part of DPU 22-42.

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