PACIFIC POWER
A DIVISION OF PACIFICORP

825 NE Multnomah, Suite 2000
Portland, Oregon 97232

June 29, 2021

***VIA ELECTRONIC FILING***

Public Utility Commission of Oregon
Attn: Filing Center
201 High Street SE, Suite 100
Salem, OR 97301-3398

**RE: UM 1810—PacifiCorp's Transportation Electrification Pilot Final Report**

In accordance with Order No. 18-075 as modified by Order No. 19-087, PacifiCorp d/b/a Pacific Power encloses for filing in the above-referenced docket its final transportation electrification pilot update and evaluation.

It is respectfully requested that all formal data requests to the company regarding this filing be addressed to the following:

By e-mail (preferred): datarequest@pacificorp.com

By regular mail: Data Request Response Center
PacifiCorp
825 NE Multnomah Street, Suite 2000
Portland, OR 97232

Please direct any informal inquiries to Cathie Allen, Manager, Regulatory Affairs, at (503) 813-5934.

Sincerely,

Shelley McCoy
Director, Regulation

Enclosure

# *Pacific Power*

# *Transportation Electrification Pilot Program*

## *Final Report*
## *June 30, 2021*

# Background

In accordance with Senate Bill 1547, PacifiCorp (PacifiCorp or Company) filed its initial transportation electrification application on December 27, 2016, proposing three pilot programs anticipated to accelerate transportation electrification in the Company's Oregon service territory. In February 2017, Public Utility Commission of Oregon (Commission) staff requested additional information to expedite the review process. In response, PacifiCorp filed a supplemental application on April 12, 2017. On May 31, 2017, PacifiCorp hosted a settlement conference where intervening parties expressed support for, concerns with, and suggestions for improvement of various aspects of PacifiCorp's proposed pilot programs. This resulted in a stipulation that was filed on August 11, 2017, that resolved all matters in the proceeding (Stipulation). All but one intervening party agreed to the terms of the Stipulation. The Commission modified, adopted, and approved the Stipulation on February 27, 2018.

The lengthy proceeding resulted in the Stipulation and order naming specific dates that did not align with the proposed three-year period of implementation. To align timing expectations, PacifiCorp filed a motion to amend Order No. 18-075 on February 25, 2019. On March 14, 2019, the Commission published Order 19-087, amending Order 18-075 to modify the dates included in the Stipulation. The amended language also modified the Stipulation to require progress updates to the Commission by March 31, 2019, and March 31, 2020[1], with a final report on pilot activities due by June 30, 2021.

Additionally, as part of Senate Bill 1547 and articulated under docket AR 609 PacifiCorp filed the Company's Transportation Electrification Plan on February 3, 2020. The Transportation Electrification Plan has additional information on all transportation electrification activities undertaken by PacifiCorp in the Company's Oregon service area. The Transportation Electrification Plan is an active regulatory proceeding (docket UM 2056).

On March 8, 2020, Oregon Governor Kate Brown declared a state of emergency in response to the COVID-19 virus outbreak. Since that time, the COVID-19 virus has not only become a global health crisis, but a social and economic one as well, as social distancing is enforced, and businesses closed to stop the spread of infection. The pilot programs experienced challenges associated with COVID-19 but the pandemic did not greatly alter the course of the pilot programs. This information is discussed in detail in the attached Appendix A.

[1] On March 14, 2019, the Commission issued Order No. 20-096 providing a new due date of May 29, 2020 for the second progress update due to COVID-19 delays.

# Contents

# 1. Key Findings and Results

In late 2018, Pacific Power selected Guidehouse (formerly known as Navigant) to evaluate the success of the three programs in achieving their stated objectives. These pilot programs included: 1) a public charging pilot, 2) an outreach and education pilot, and 3) a demonstration and development pilot. Key findings in the evaluation include:

Public Charging Pilot: Pacific Power installed five charging pods that are owned and operated by Pacific Power and accessible by the public. The pods include a combination of direct current fast charging (DCFC) ports and Level 2 (L2) ports. Construction of the Public Charging Pilot sites began in a site in Madras in 2019. All the remaining project sites: Otis, Bend, Klamath Falls and Mill City were completed as of April 2021. Although there were some limitations in data availability, Guidehouse found that the Public Charging program successfully achieved many of the key objectives sought by Pacific Power. The program appears to be serving key market segments and increasing overall access to and confidence in the availability of charging options.

Outreach and Education Pilot: Pacific Power promoted various electric vehicle (EV) marketing campaigns designed to bring awareness to EV technology, infrastructure and promote Pacific Power's efforts in transportation electrification. The pilot consisted of four components: customer communications, self-service resources, community events, and technical assistance. Guidehouse assessed customer exposure to various sources of information and created a composite measure of exposure to outreach and education. Survey findings revealed that outreach and education activities were successful in reaching approximately 30 percent of respondents.

Demonstration and Development Pilot: Pacific Power provided grant funding toward nonresidential customer EV charging infrastructure projects. This included awarding 49 grants with a total of 34 projects completed to date. A number of projects were delayed due to COVID and those projects are expected to be completed throughout 2021. Overall the pilot expanded access to electric vehicle supply equipment (EVSE) in Pacific Power's service territory, and appear to have enabled more or earlier deployment of EVSE than would have otherwise occurred even with delays caused by COVID-19.

These pilots saw significant success as further described below and in detail in Appendix A: Pacific Power Transportation Electrification Pilot Programs Evaluation Report for Oregon and described in further detail in Section II: Pilot Programs Summary. Table 1, below, highlights in more detail the key findings and results found after completion of the pilot programs.

**Table 1: Transportation Electrification Pilot Key Evaluation Findings**

| Program | Key Evaluation Findings |
|---|---|
| Public Charging Pilot Program | Pacific Power's public charging pods have expanded the availability and access to public charging. The pods receive regular use by EV drivers, although the utilization remains well-below the full capacity of the pods. This means the pods will be capable of meeting future market need as EV penetration expands. |
| | EV drivers have a strong preference for public fast charging. Significantly more charging sessions occurred at DCFC ports than L2 ports, and nearly twice as much energy was delivered per DCFC session. |

| | |
|---|---|
| | Most public charging occurred during daytime hours, but it appears the pricing structure was effective at managing use to off-peak hours. Nearly 85% of the total energy dispersed occurred during off-peak hours. |
| | Feedback from users suggests the public chargers serve a mix of EV drivers who both are and are not Pacific Power customers, while they are traveling longer distances between towns or cities. |
| | Pacific Power's charging pods reduced EV driver concerns about the driving distance of their EV (i.e. range anxiety), and increased EV driver confidence in their ability to find charging when needed. |
| Outreach and Education Pilot Program | Outreach activities were effective at reaching the general population, but exposure depth was limited. |
| | Exposure to outreach and education activities appears to be associated with better impressions of BEVs, increased interest in BEVs, and increased likelihood (intention) to purchase a BEV among those who were not already considering a BEV purchase. These results did not apply to PHEVs. |
| | More than half of the surveyed general population was aware of at least one public EV charging location in close proximity to their home, and this awareness increased between 2019 and 2020. There was little change in most measures of EV knowledge between 2019 and 2020, with a small increase in customer understanding of lower maintenance costs and emissions from PEVs compared to conventional vehicles. |
| | Participants of the technical assistance offering were highly satisfied with their experience, and the most valuable component appears to be information about project costs, siting guidance, and expected usage. Participants would appreciate more information about vendor and equipment selection, pricing and fee models, and equipment maintenance. |
| Demonstration and Development Pilot Program | The program expanded access to EVSE in Pacific Power's service territory, and appears to have enabled more or earlier deployment of EVSE than would have otherwise occurred. Most program-funded EVSE is available for public charging, and workplace charging was also a leading use case. |
| | The program appears to be most effective at reaching customers who had already considered installing EVSE at their businesses, although many were in the early stages of planning. About one-quarter of grant recipients had not considered installing EV charging infrastructure before participating in the program. |
| | Even though many customers had already considered installing EVSE, only a small portion would have installed the same equipment at the same time without the program. Participant feedback suggests that program accelerated the timing of EVSE deployment by 1-2 years, even for those who may have installed EVSE without the program. Findings indicate that program experience may stimulate the market by influencing some participants to install additional EVSE beyond that funded by the program. |
| | Most charging occurred during daytime hours, following a similar profile as Pacific Power's public pods. A considerable portion of charging sessions were completed by a relatively small number of individual users. |

*Source: Guidehouse Pacific Power Transportation Electrification Pilot Programs Evaluation Report for Oregon*

Guidehouse utilized a number of key activities to evaluate the pilot. Key activities included the following:

- General population surveys with Pacific Power customers
- Focused surveys with pilot program participants who received technical assistance or grant funding from Pacific Power
- Surveys with EV drivers who used Pacific Power's public EV charging stations
- Analysis of EV charging data from Pacific Power's public EV charging stations and those owned by customers who received grant funding
- Cost-effectiveness analysis of each pilot program

# 2. Pilot Program Summary

Section II provides in summary and details of the operations and results from each pilot offered to Pacific Power customers from 2018 until 2021.

## *2.1 Public Charging Pilot*

Through the Public Charging Pilot, PacifiCorp was authorized to construct, own, and operate public electric vehicle charging stations at up to seven locations in its Oregon service territory. The Company planned to build five locations with the approved pilot program budget. This pilot aimed to accelerate consumer adoption of transportation electrification by increasing customer awareness and understanding of transportation electrification alternatives and supporting equitable access to charging infrastructure. Given the rural nature of PacifiCorp's service territory—and the relatively long distance between public fast chargers (compared to urban areas)—increasing the availability of charging infrastructure is crucial to long-term market development.

The Company began looking for potential locations in March 2018, paying particular attention to areas currently underserved by existing charging infrastructure. An initial list of nine potential sites was shared in June 2018 with Commission staff based on the criteria of convenience and anticipated use, visibility, availability of necessary electrical service, future-proofing, and permitting. Communities were engaged through PacifiCorp's Regional Business Managers to identify suitable locations to site charging stations. Potential sites were identified within seven communities. To ensure projects are completed without exceeding the approved budget, the number of locations was narrowed to five locations. The location and completion date of each of the five sites is listed in Table 2 below.

**Table 2: Charging Station Completion Dates**

| Location | Date of Completion |
|---|---|
| Mill City | 04/28/2021 |
| Bend | 09/08/2020 |
| Klamath Falls | 09/04/2020 |
| Otis | 08/26/2020 |
| Madras | 01/07/2020 |

Construction of the Public Charging Pilot sites began in the Madras location in 2019. The remaining project sites in Otis, Bend, Klamath Falls and Mill City were completed as of April 2021. Each location operates with four DC Fast Chargers and one dual-port L2 Charger. The Company had planned to support an opening celebration along with a community ride and drive in conjunction with the launch of each charging station. However, in response to state and federal guidance on suspending large events due to COVID- 19 concerns, large events have been replaced with smaller ribbon cutting ceremonies along with local media coverage.

Through the fast charging stations, the Company is collecting data on energy usage, number of charging sessions, revenue collected, unique drivers, and average session length. If drivers have opted in, we are also collecting driver zip codes and session details, including session start time, end time, time spent charging, time spent connected, kilowatt-hours dispensed, port used, fee paid, beginning state of charge, end state of charge.

Figures 1 through 3 below demonstrate social media posts promoting the Madras station opening and contain public reviews on the popular EV station locator app, PlugShare.

**Figure 1: Social Media for Mill City Charging Event**

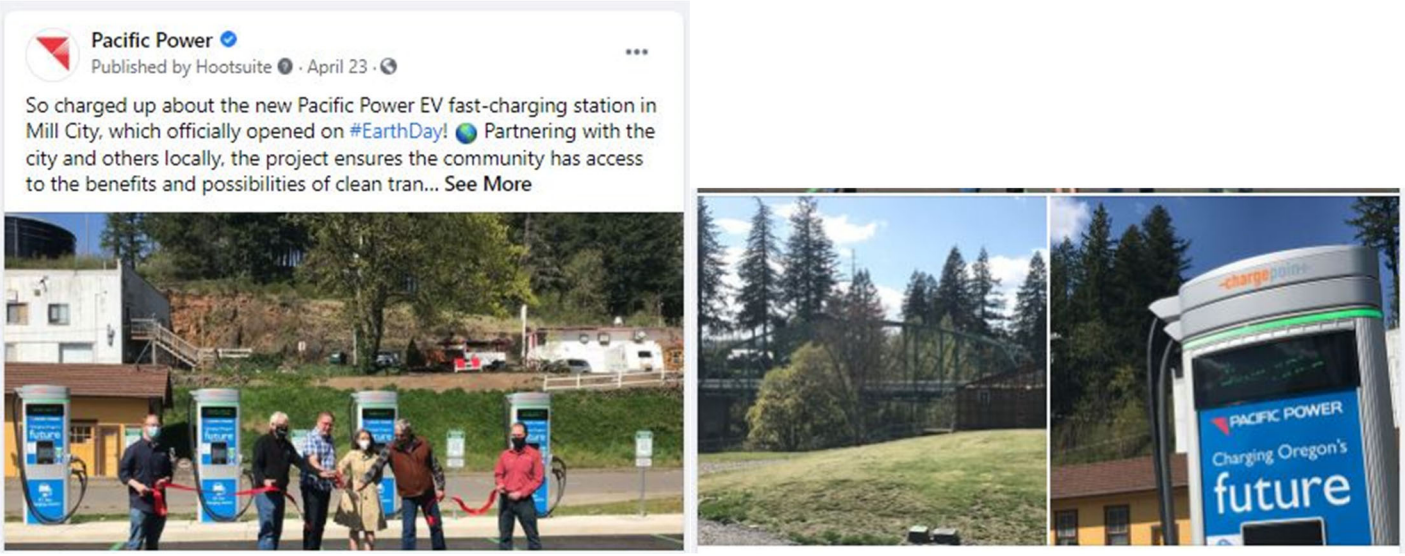


**Figure 2: Klamath Falls PlugShare Checkins**

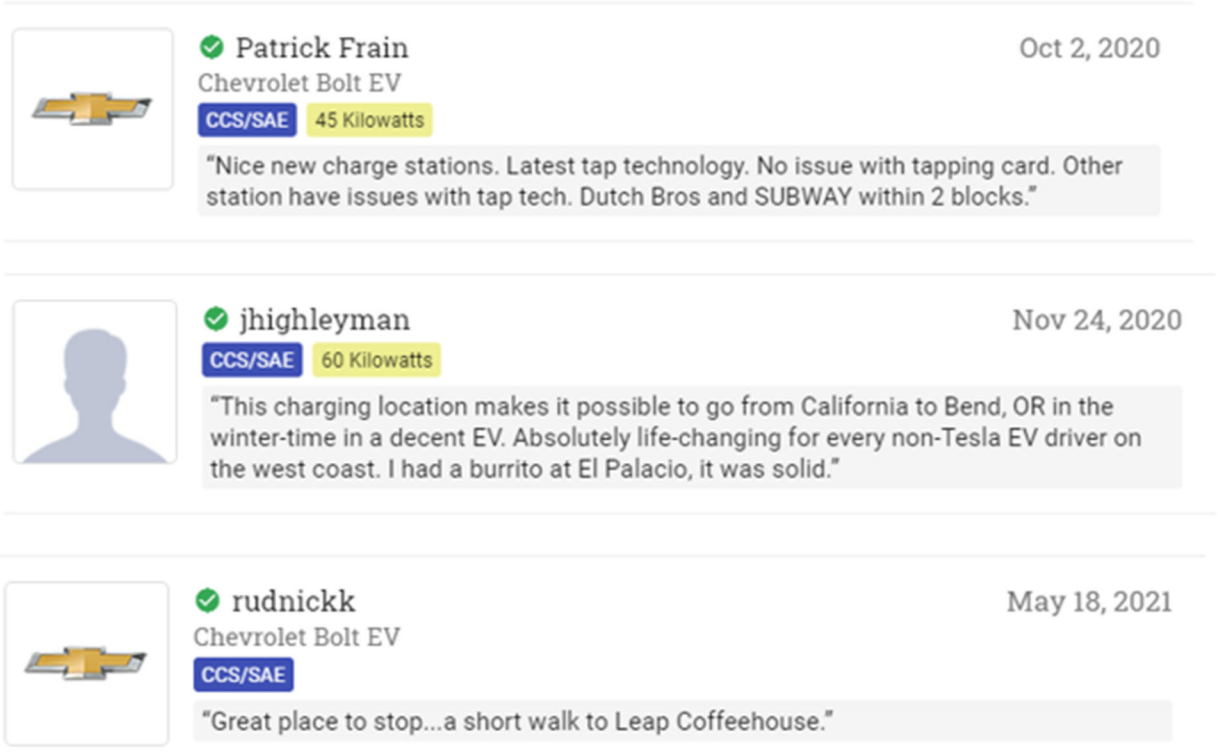
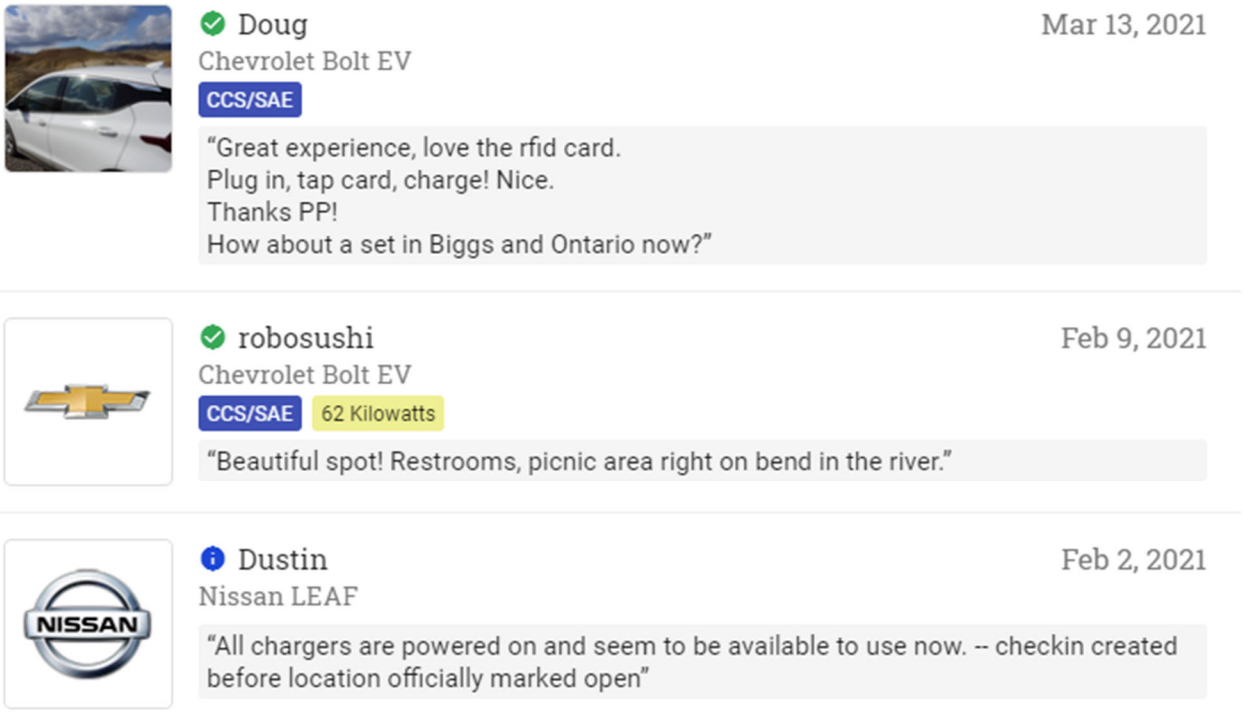



**Figure 3: Mill City PlugShare Checkins**



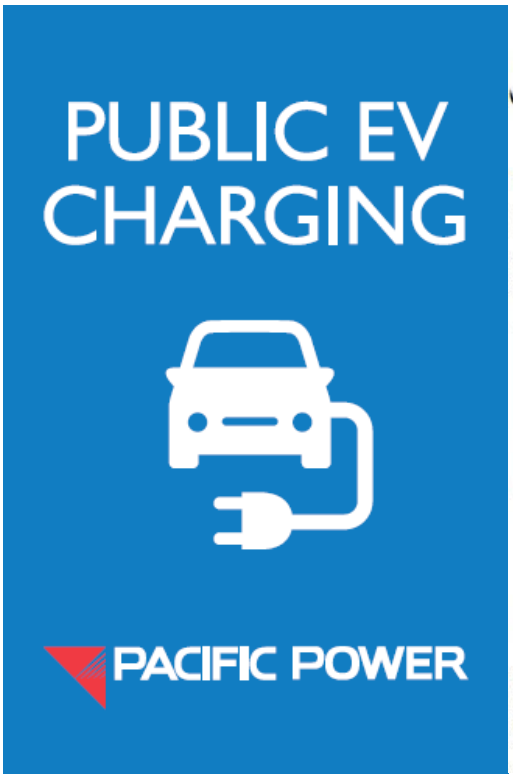
## *2.3 Outreach and Education Pilot*

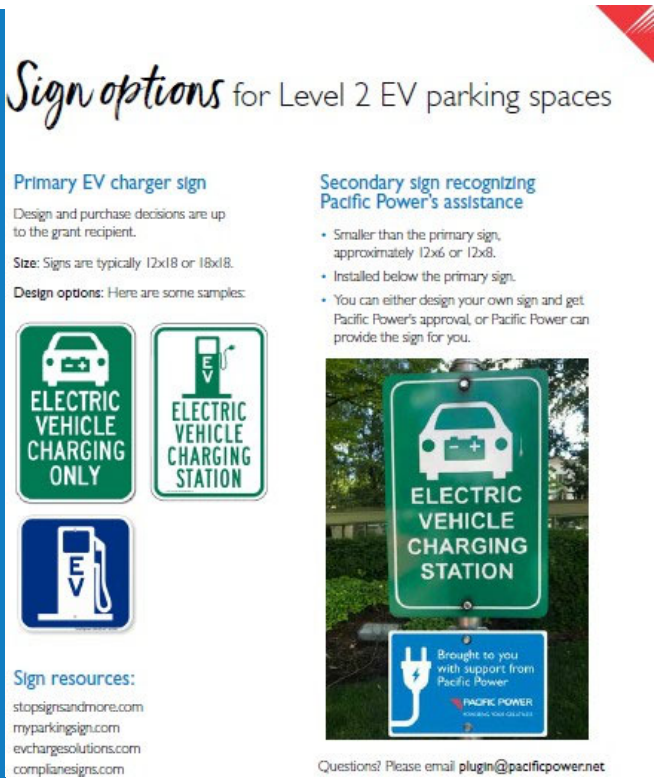
The Outreach and Education Pilot primarily consists of four components: customer communications, self-service resources, community events, and technical assistance. Final results on each component are provided below.

### Customer Communications

As required in docket UM 1810, PacifiCorp focused customer communications expenses, to the extent practical, on promoting and supporting the success of its Transportation Electrification Pilot Programs.[2] The majority of communications have focused on publicizing and soliciting applications for the demonstration and development grants, along with increasing awareness of technical assistance, encouraging customers to use self-service resources, and driving participation in customer events. The Company has also used the communications program to fund highly visible signage for PacifiCorp owned chargers as well as chargers installed through the Grant program. Examples of this signage are shown in Figure 4.

**Figure 4: Signage for PacifiCorp & Grant Funded Charging Stations**

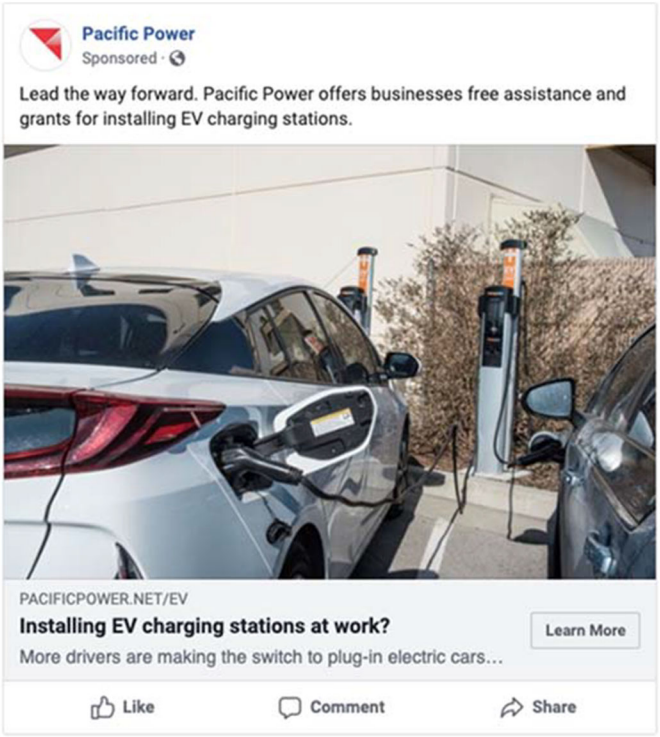


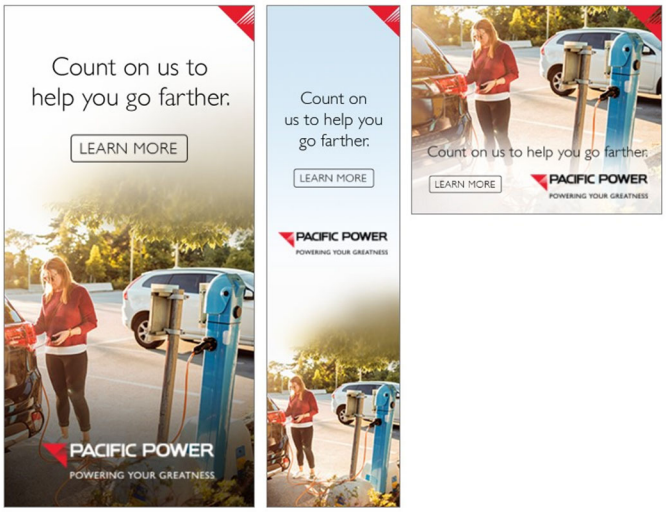




[2] *In the Matter of PacifiCorp d/b/a PacifiCorp, Application for Transportation Electrification Program*, Docket No. UM 1810, PacifiCorp's Supplemental Application (April 12, 2017).

Driven by outreach and communication efforts, the related EV pilot programs have received solid participation as reflected in the amount of grant applications received and inquiries for technical assistance. Figure 5 through Figure 9 below are examples of a PacifiCorp social media posts and communications promoting programs to customers.

**Figure 5: Sample Communications**



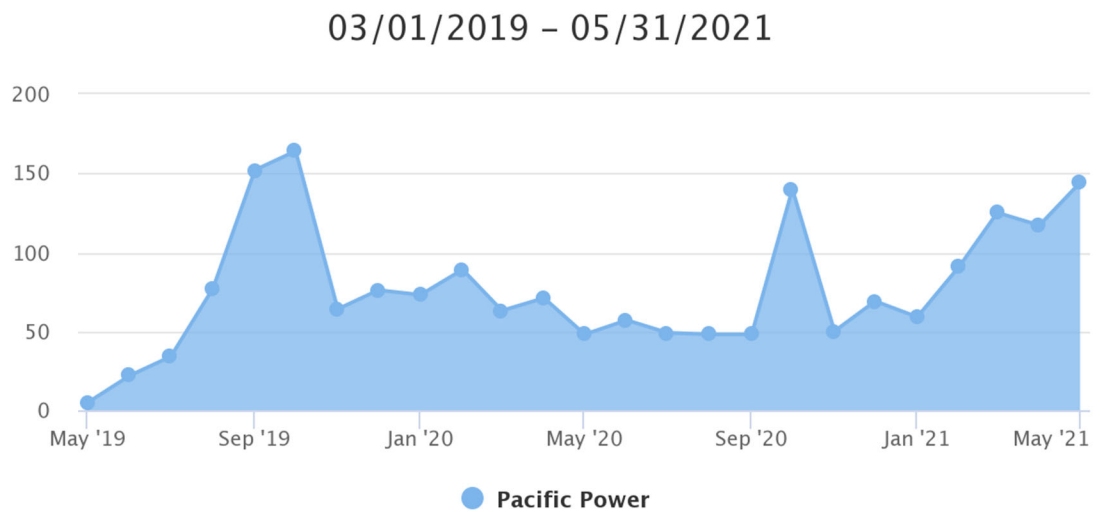


## Self Service Resources

Through a competitive request for proposal process, the Company selected Clean Power Research's WattPlan tool. WattPlan performs detailed electric vehicle and home load modeling, electric utility bill, vehicle total cost of ownership and environmental impact estimates. This tool assists customers interested in electric vehicles in better understanding total lifecycle costs through comprehensive vehicle options, utility bill impacts, and incentive calculations.

WattPlan went live on PacifiCorp's website in May 2019. To date, WattPlan has produced cost comparison estimates for customers 1,935 times. The tool was marketed to residential customers through email and social media channels as part of the Company's website relaunch in August 2019, as part of National Drive Electric Week during the month of September, and through paid social media advertisements in February 2020. Figure 6 below shows the usage of WattPlan increased when actively promoted.

**Figure 6: Monthly Usage of Watt Plan**




The Company has also contracted with Chargeway to install another self-service tool, three Chargeway Beacons in dealerships within the Company's service area. Though the Beacons are located in car dealerships, the end users are PacifiCorp residential customers who frequent the dealerships.

Chargeway is a system that uses colors to identify plug types and numbers for power levels. The higher the number, the faster a driver is able to charge at a charging station. This label system is communicated via colorful stickers on charging stations and in the Chageway app. The Beacons make it easier for customers to differentiate the correct charging standard for their vehicle. The Chargeway app is free to download for all PacifiCorp customers and shows the simple color and number icons on the station finder map to identify all charging options available for every electric vehicle a user adds to their account. The beacon is a six foot interactive touch screen that shows charging locations and aides salespeople in communicating about electric fuel.

These Beacons were installed in the fourth quarter of 2019 at TC Chevy in Medford/Ashland, Team Kia in Bend and Ware Chevy in North Bend/Coos Bay. Locations were chosen in coordination with the Oregon Auto Dealers Association using metrics of geographic location, participation in the state rebate program, EV inventory and dealer interest. Data on the number of EVs sold pre- and post-Beacon installation have been gathered showing a slight uptick in sales after the Beacons were deployed.

## Community Events

PacifiCorp coordinated six electric transportation community events to date, which were primarily electric vehicle ride-and-drive events. The Company was originally planning for additional ride-and-drive events throughout Oregon unfortunately due to the restriction during the COVID-19 pandemic all in person events were canceled for the rest of 2020.

The Company implemented diverse types of event participation and sponsorships alongside the PacifiCorp's event manager, Forth. Some ride-and-drives have been organized as a part of larger community events not specifically focused on electric vehicles, while others where stand-alone events with the sole focus on electric transportation. Most event participation included a ride-and-drive element with either Forth, local dealerships, or local owners associations supplying the vehicles for test drives. Some events did not have a ride-and-drive element but electric vehicles were available to see and touch and information about EVs and utility programs was available from PacifiCorp or Forth staff. Table 3 summarizes the Oregon events to date.

**Table 3: PacifiCorp Community Events**

| Event Name | Location | Date | Ride and/or Drives | Number of Customer Interactions |
|---|---|---|---|---|
| Touch-a-truck | Independence | 5/11/2019 | 18 | 82 |
| Da Vinci Days | Corvallis | 7/20/2019 | 24 | 85 |
| National Drive Electric Week-Lincoln City | Lincoln City | 9/14/2019 | 53 | 106 |
| National Drive Electric Week-Coos Bay/ North Bend | North Bend | 9/21/2019 | N/A | 67 |
| Talent EV Pop-up | Talent | 01/18/2020 | 11 | 62 |
| Portland Auto Show | Portland | 2/10/2020 | 194 | 1,000+ |
| Total | 6 | N/A | 300 | 1402 |

In 2020 there were two additional ride-and-drive events in Oregon along with other “pop up” and educational events that were scheduled.

Given the state and federal guidance on suspending large events due to COVID-19 these events were suspended. The Company plans to host a number of upcoming events as restrictions have lifted with the COVID-19 pandemic. Smaller events such as ribbon cutting celebrations are slated for 2021 to further the outreach and education program efforts. Effects of the pandemic are summarized in the attached Guidehouse report.

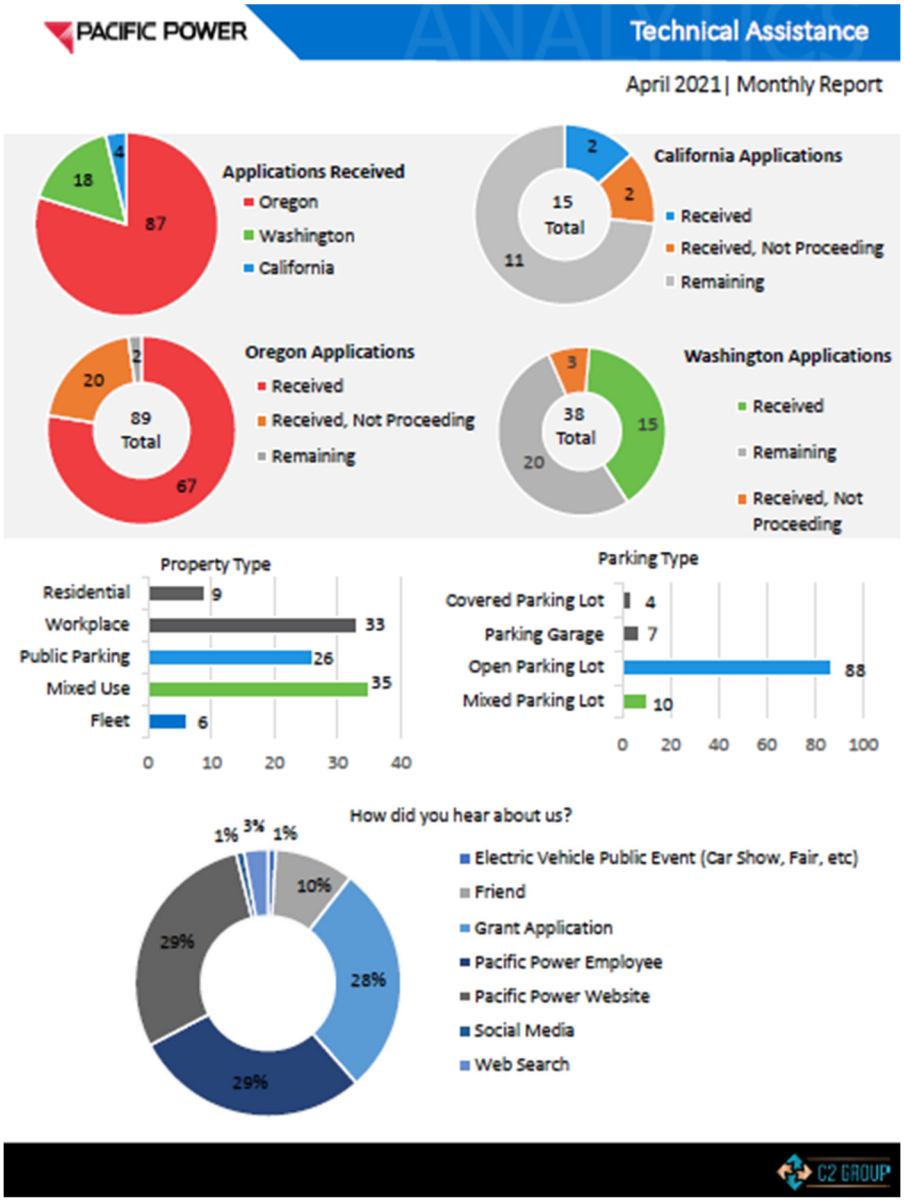
## Technical Assistance

PacifiCorp provided on-site technical assistance to non-residential customers interested in installing charging infrastructure. The Company has contracted with C2 Group to provide this service at no cost to customers. The pilot program conducted or received an application to conduct onsite technical assistance for 87 total Oregon applications received. Customers apply via an online application on the Company’s website. A desktop review and phone conversation follows to understand the customer’s EVSE needs, followed by an in-person site walk. Within a few weeks after the site walk, the customer receives their customized assessment and is given the option of a final 30- minute review session.

Figure 7 Technical Assistance April Monthly Report below provides a summary of technical assistance applications and reports through April 2021.

Technical assistance site visits were temporarily paused due to safety concerns related to COVID-19. Site visits have resumed starting in May of 2021, customer as provided the option of an in-person meeting or remote depending on the customer’s preference.

**Figure 7: Technical Assistance April Monthly Report**



# 3. Demonstration and Development Pilot

The Demonstration and Development Pilot provides grant funding to non-residential customers to help offset the upfront costs of installing electric vehicle charging infrastructure. To make the program more easily understood by customers, PacifiCorp branded the Demonstration and Development Pilot program as the Electric Vehicle Charging Station Grant Program. Nexant has provided the scoring and recommendations for funding as the third-party independent evaluator.

**Table 4: Grants Awarded**

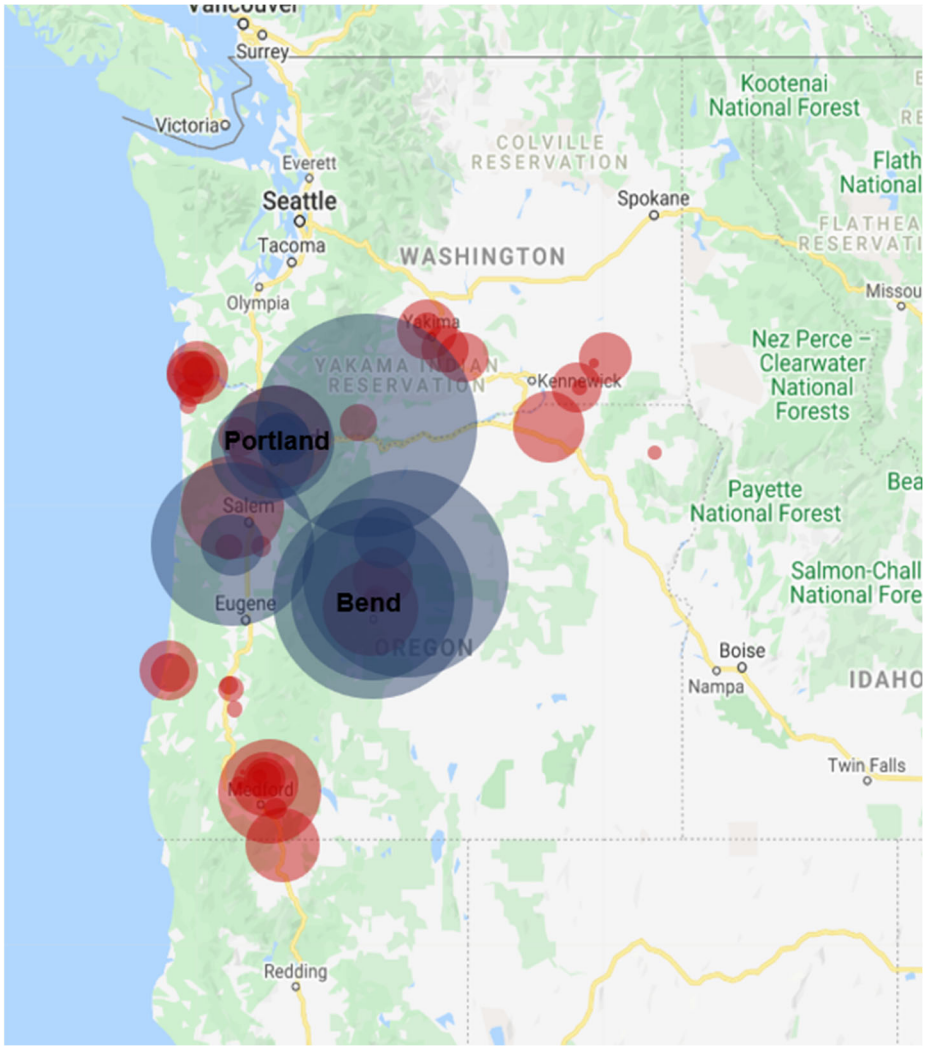
| Total Number of Applications | Awarded Applications | Projects Completed | Total Ports Installed |
|---|---|---|---|
| 80 | 49 | 34 | 109 |

The first quarterly grant cycle opened to non-residential customers on October 15, 2018, with applications due November 15, 2018. As of the first quarter of 2021, the Company has received 70 applications to the grant. Five full grant cycles have been completed with $1,513,488.13 awarded to 49 grant recipients. If a grant recipient decides to not complete a project, the funds awarded to them will be redistributed to assist other potential projects.

The final quarterly cycle opened on January 15, 2020, with applications due on February 15, 2020. Thirty-four applications were reviewed by the independent evaluator. The Company observed an uptick in the number of applications received in the fourth quarter of 2019 with 32 applications. Other quarterly grant cycles averaged 10 applications per quarter. The grant application was refined each cycle based on applicant feedback.

Most grant recipients plan to install Level 2 charging stations representing an estimated total 163 charging ports, with three recipients planning to install DC Fast chargers. Grants have been awarded to diverse types of organizations across PacifiCorp's service area (Figure 8 Charging Locations Enabled Through PacifiCorp Pilot Programs) including cities, multiunit residential housing, small businesses, hotels, a hospital, community colleges, and nonprofits.

**Figure 8: Charging Locations Enabled by PacifiCorp Pilot Programs**




# 4. Conclusions

In conclusion, these pilot programs enabled programs throughout Pacific Power territory over the last three years. The public chargers served a diverse set of customers as well EV drivers who were outside of company's service territory. Allowing EV drivers to travel longer distances between cities primarily located in rural areas of Oregon. The pricing structure was effective at managing use to off-peak hours and nearly 85 percent of the total energy dispersed occurred during off-peak hours. Feedback collected from charging users indicate that EV drivers were empowered to drive longer distances while minimizing concerns with range anxiety and charging availability.

Outreach and education efforts were effective in reaching the general population but was limited due to COVID- 19 restrictions. The company is planning on having additional community events in the Summer and Fall of 2021. Awareness of public charging locations increased between

2019 and 2020. Most notably there was a high rate of customer satisfaction in the technical assistance program with siting guidance and outlining project costs.

Deployment of the EVSE charging program provided wider access to public and workplace charging. The program was effective in incentivizing customers who had already considered installing charging. Feedback from program participants suggests an accelerated timeline of 1-2 years. While COVID-19 and other challenges appeared, the breadth of the pilot ensured that customers could either implement projects that were stalled or accelerate projects that may have taken years to come to fruition.

# Pacific Power Transportation Electrification Pilot Programs

## Evaluation Report for Oregon

**Prepared for:**

**Pacific Power**

**Submitted by:**

Guidehouse Inc.
1375 Walnut St
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Boulder, CO 80302

Reference No.: 207864
December 23, 2020

**Key Contributing Authors:**

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# Executive Summary

In 2016, Pacific Power filed initial plans for several transportation electrification pilot programs with the Oregon Public Utility Commission (Commission) in response to Oregon Senate Bill 1547. This bill directed utilities to pursue efforts to reduce greenhouse gas (GHG) emissions from the transportation sector. After iterating with the Commission and stakeholders, Pacific Power received approval to offer several pilot programs.

In late 2018, Pacific Power selected Guidehouse (formerly known as Navigant) to evaluate three programs:

- **Public Charging pilot:** Deployment of electric vehicle (EV)[1] charging pods owned by Pacific Power and accessible by the public for use. The pods include a combination of direct current fast charging (DCFC) ports and Level 2 (L2) ports.
- **Outreach and Education pilot:** Marketing campaigns, EV-related website tools, educational and awareness activities, and technical assistance services to promote general awareness of electric transportation technologies and services to Pacific Power customers.
- **Demonstration and Development pilot:** Grant fund awarding to eligible applicants for installation of EV charging infrastructure at nonresidential customer sites.

The intent of this evaluation was to understand how Pacific Power's pilot programs were addressing certain market barriers to EV adoption, how program EV charging infrastructure was being used by consumers, and whether key findings could be used to inform future program offerings. Guidehouse conducted a series of evaluation activities in 2019 and 2020 to accomplish the evaluation objectives. Key activities included the following:

- General population surveys with Pacific Power customers
- Focused surveys with pilot program participants who received technical assistance or grant funding from Pacific Power
- Surveys with EV drivers who used Pacific Power's public EV charging stations
- Analysis of EV charging data from Pacific Power's public EV charging stations and those owned by customers who received grant funding
- Cost-effectiveness analysis of each pilot program

[1] In this report, EV is synonymous with PEV (plug-in electric vehicle). PEVs can include battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs)

## Key Evaluation Findings

Guidehouse's primary evaluation findings are summarized in Table 1-1.

**Table 1-1. Key Evaluation Findings for Each Pilot Program**

| Program | Key Evaluation Findings |
|---|---|
| Public Charging Program | Pacific Power's public charging pods have expanded the availability and access to public charging. The pods receive regular use by EV drivers, although the utilization remains well-below the full capacity of the pods. This means the pods will be capable of meeting future market need as EV penetration expands. |
| | EV drivers have a strong preference for public fast charging. Significantly more charging sessions occurred at DCFC ports than L2 ports, and nearly twice as much energy was delivered per DCFC session. |
| | Most public charging occurred during daytime hours, but it appears the pricing structure was effective at managing use to off-peak hours. Nearly 85% of the total energy dispersed occurred during off-peak hours. |
| | Feedback from users suggests the public chargers serve a mix of EV drivers who both are and are not Pacific Power customers, while they are traveling longer distances between towns or cities. |
| | Pacific Power's charging pods reduced EV driver concerns about the driving distance of their EV (i.e. range anxiety), and increased EV driver confidence in their ability to find charging when needed. |
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| | Exposure to outreach and education activities appears to be associated with better impressions of BEVs, increased interest in BEVs, and increased likelihood (intention) to purchase a BEV among those who were not already considering a BEV purchase. These results did not apply to PHEVs. |
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| Demonstration and Development Program | The program expanded access to EVSE in Pacific Power's service territory, and appears to have enabled more or earlier deployment of EVSE than would have otherwise occurred. Most program-funded EVSE is available for public charging, and workplace charging was also a leading use case. |
| | The program appears to be most effective at reaching customers who had already considered installing EVSE at their businesses, although many were in the early stages of planning. About one-quarter of grant recipients had not considered installing EV charging infrastructure before participating in the program. |
| | Even though many customers had already considered installing EVSE, only a small portion would have installed the same equipment at the same time without the program. Participant feedback suggests that program accelerated the timing of EVSE deployment by 1-2 years, even for those who may have installed EVSE without the program. Findings indicate that program experience may stimulate the market by influencing some participants to install additional EVSE beyond that funded by the program. |
| | Most charging occurred during daytime hours, following a similar profile as Pacific Power's public pods. A considerable portion of charging sessions were completed by a relatively small number of individual users. |

*Source: Guidehouse*

## Effects of COVID-19 Pandemic

The timing of this evaluation coincided with the coronavirus outbreak. Although the evaluation began in early 2019, many of the significant evaluation activities occurred in the spring and summer of 2020 when the pandemic was significantly affecting the US economy and normal way of life. Most of the charging data Guidehouse analyzed for this evaluation was from charging sessions that occurred during the pandemic period. The first Public Charging pilot station became operational in December 2019, and subsequent Public Charging pilot stations were installed throughout 2020. Several of the Demonstration and Development pilot chargers became operational in late Q3 or Q4 of 2019, but the timing of this evaluation report is such that comparing seasonal trends from pre-pandemic and pandemic times was not possible.[2] Guidehouse did perform some analysis of charging data in close proximity to key dates from the pandemic period, which is presented later in this report.

Guidehouse advises readers of this report to acknowledge that results pertaining to charging station usage and charging profiles may not be reflective of what would have occurred in the absence of the pandemic. The economic impacts, dramatic shift to working from home, and reduced business and leisure travel may have affected charging station usage and the normal charging habits of EV drivers. Furthermore, Pacific Power indicated that some participants of the Demonstration and Development program experienced permitting challenges, staff turnover, and supply chain issues that likely delayed the commissioning of their projects, and ultimately usage of the program charging infrastructure.

[2] A monthly comparison would be important to capture seasonality of charging behavior.

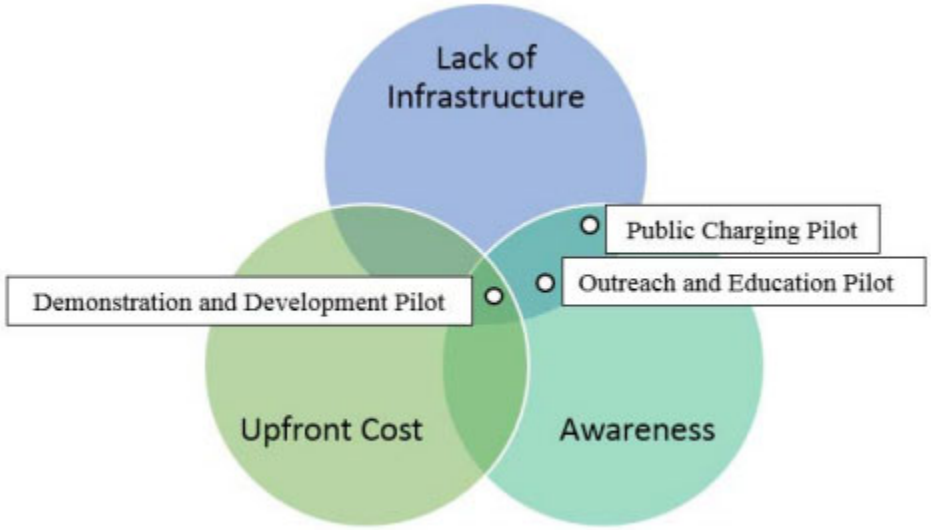
# 1. Introduction and Evaluation Objectives

Oregon's Senate Bill 1547 directed electric utilities to propose program offerings that would support reduced transportation sector GHG emissions through electrification. In late 2016, Pacific Power filed plans with the Oregon Public Utility Commission (Commission) to offer several transportation electrification programs and received approval in 2018.

Pacific Power serves about 600,000 retail customers in the Oregon service territory, which is predominately made up of smaller municipalities and rural communities. Although Oregon has consistently ranked as one of the top US states for EV sales in recent years, much of the EV adoption activity is focused in the greater Portland metro area, which largely falls outside of Pacific Power's territory.

In the pilot program filings, Pacific Power identified several key barriers to transportation electrification, including consumer attitudes toward EVs, high upfront costs of EVs, lack of awareness of the technology solutions and benefits of EVs, and lack of available EV charging infrastructure. Pacific Power designed its pilot programs to address these barriers. Figure 1 shows an excerpt from the filings that illustrates how each program was envisioned to address the barriers.

**Figure 1. Intended Barriers to be Addressed by Pacific Power's EV Pilot Programs**




*Source: Pacific Power's Application for Transportation Electrification Programs, April 12, 2017, https://www.pacificpower.net/content/dam/pcorp/documents/en/pacificpower/rates-regulation/oregon/filings/docket-um-1810/4-12-17_supplement/04_Supplemental_Application_REDACTED.pdf*

## 1.1 Report Terminology

Given the emerging nature of the EV and EV charging market, Guidehouse defines some terminology used in this report:

- **Electric vehicle supply equipment (EVSE):** Broadly used term to describe EV charging infrastructure. Generally, the term EVSE can refer to charging equipment of different makes and models and is agnostic to charging level.

- **Charging level:** Refers to the industry-accepted naming convention for the rated kilowatt (kW) capacity of a charging station. The charging levels are usually known as Level 1 (L1), Level 2 (L2), and direct current fast charging (DCFC, also sometimes known as Level 3).
- **Charging station:** Refers to the charging device hardware, which may be a pedestal mount, wall mount, or other configuration. It is often used interchangeably with EVSE, although generally it refers to singular or plural charging devices.
- **Charging port:** Refers to the plug that connects to an EV. A charging station may contain multiple charging ports.
- **Charging pod:** Used by Pacific Power to describe the sites where utility-owned charging infrastructure was deployed. The term pod is used to describe a particular site, which in this case includes several DCFC and L2 stations.

## 1.2 Evaluation Objectives

At a high level, this evaluation was intended to assess how Pacific Power's EV pilot programs addressed certain transportation electrification market barriers, how program charging infrastructure is being used by EV drivers, and how customers perceived their experience participating in the programs or being exposed to outreach activities. This report contains a dedicated section for each pilot program that elaborates further on the specific evaluation objectives for that program.

## 1.3 Evaluation Activities

Guidehouse evaluated the pilot programs by reviewing program materials and tracking data, analyzing utilization and interval data from the charging stations, and collecting feedback from participating customers and the general population through various survey activities. Table 1-1 provides an overview of the key evaluation activities. The subsequent sections of this report contain a more complete description of each activity

**Table 1-1. Overview of Key Evaluation Activities**

| Project Element | Major Evaluation Activities |
|---|---|
| **Public Charging Pilot** | • Survey EV drivers who used Pacific Power's public charging stations.<br>• Develop load profiles, utilization metrics, and timeline comparing trends in pod use to Pacific Power's outreach and media efforts using charging pod data. |
| **Outreach and Education Pilot** | • Survey the general population as a baseline in the summer of 2019 and again during the summer of 2020 using a panel of the same survey respondents.<br>• Survey participants of the technical assistance offering electronically and via phone. |
| **Demonstration and Development Pilot** | • Survey grant funding recipients electronically and via phone.<br>• Analyze participant EVSE data.<br>• Assess pilot impacts on enabling expanded or more advanced EVSE deployment.<br>• Develop summary of private EVSE characteristics and effects of grant recipient education and awareness activities. |
| **Cost-Effectiveness** | • Review the cost-effectiveness methodology that Pacific Power and other stakeholders developed for transportation programs in Oregon and apply the methodology to assess cost-effectiveness of the pilot programs. |
| **Other Evaluation Activities** | • Synthesize data and findings from pilot participation, survey research, and cost-effectiveness analysis. |

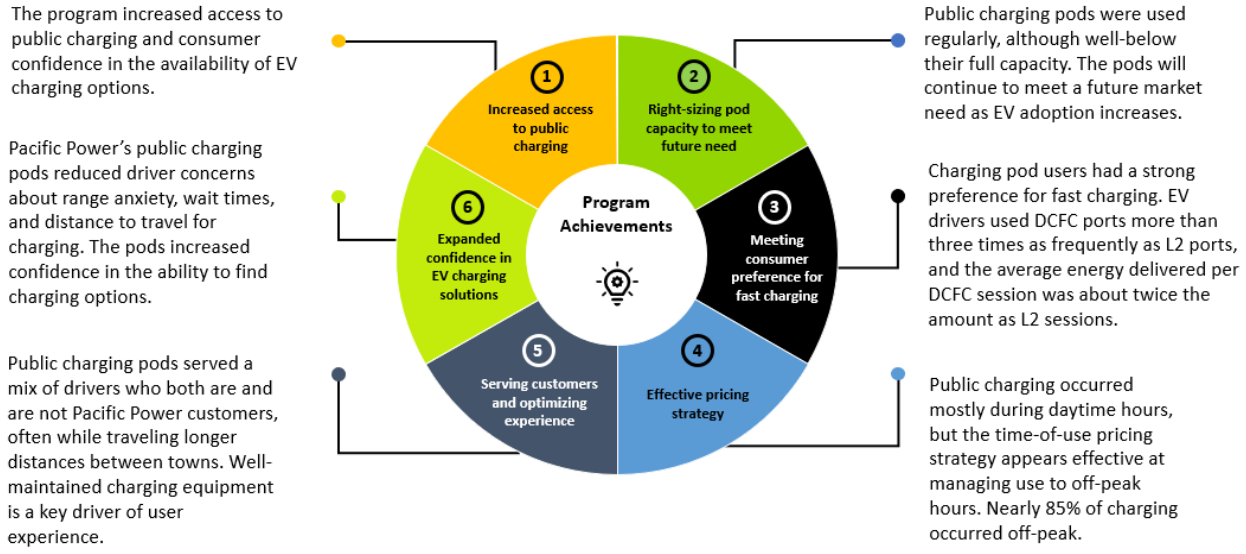
*Source: Guidehouse*

# 2. Public Charging Pilot Program

## 2.1 Key Findings – Public Charging Program

Although there were some limitations in data availability, Guidehouse found that the Public Charging program successfully achieved many of the key objectives sought by Pacific Power. **The program appears to be serving key market segments and increasing overall access to, and confidence in the availability of charging options.** Figure 2 summarizes key findings.

**Figure 2. Public Charging Program Achievements**




*Source: Guidehouse*

Guidehouse found that Pacific Power's charging pods are receiving regular use by EV drivers, although the total capacity of the pods (i.e. number of ports) is likely overbuilt to serve the current number of EVs. Pod utilization and load factors were well-below the full capability, which means that charging ports were sitting idle much of the time. **This does suggest the pods will be capable of meeting future market need as EV penetration expands, and that Pacific Power has successfully expanded availability and access to public charging.**

Guidehouse also found that **EV drivers have a strong preference for public fast charging**, as the DCFC ports received significantly more use than the L2 ports. On average, about twice as much energy was delivered per DCFC session compared to L2 session.

The public charging pods were primarily used during daytime hours, but it appears that **the pricing structure was effective at managing use to off-peak hours**. Nearly 85% of the total energy dispersed at the charging pods occurred during off-peak hours. It also appears that the time-based charging rates (i.e. $/minute) were effective at minimizing the idle time that EVs occupied a charging port when no energy was being delivered.

Feedback from users suggests the public chargers serve a mix of EV drivers who both are and are not Pacific Power customers, while they are traveling longer distances between towns or cities. Most pod users reported that they usually charge at home and overnight. **Well-maintained charging equipment is a key driver of positive user experience.** Users consider

public charging stations to be most convenient when placed along major interstates or highways, and ensuring that charging ports are in good working order is a key driver of user experience and satisfaction.

Charging pod users overwhelmingly indicated that Pacific Power's public charging pods **reduced their concern about the driving distance of their EV (i.e. range anxiety)**. A majority of survey respondents reported Pacific Power's public charging pods gave them **greater confidence in their ability to find EV charging when needed**, reduced the distance they needed to travel for charging, and reduced the wait time upon arrival.

## 2.2 Public Charging Program Summary

Pacific Power designed the Public Charging pilot program to increase public access to EV charging stations and to contribute to consumer awareness via strategic placement of the charging stations in areas with high visibility and consumer traffic. The 2017 pilot program application indicated that Pacific Power aimed to install seven charging pods in 2018 and 2019, with the first three in 2018 and the remaining four in 2019. Each pod was to include multiple DCFC ports and at least one L2 port. When Guidehouse began evaluating the program in early 2019, Pacific Power indicated that plans had changed and only five public charging pods were anticipated.

Installation of the public charging pods took longer than expected. Guidehouse was aware of some delays due to finding site hosts, site permitting, construction, the coronavirus outbreak, and equipment procurement but was generally not involved in the deployment process. As Table 2-1 shows, the first pod was installed in late 2019 and subsequent pods were installed throughout 2020. The final pod was not operational at the time of this evaluation report.

**Table 2-1. Public Charging Pod Locations and Operational Dates**

| Location | Operational Date | Site Characteristics |
|---|---|---|
| Madras | December 2019 | Located at Chamber of Commerce building central to Madras, near the intersection of Hwy 26 and Hwy 97. |
| Bend | February 2020 | Located in the central business district of Bend, near the intersection of Hwy 97 and Hwy 20. |
| Otis | May 2020 | Located near several businesses in proximity to the junction of Hwy 18 and the Oregon Coast Hwy 101. |
| Klamath Falls | September 2020 | Located in the central business district of Klamath Falls, near the junction of Hwy 97 and Hwy 39. |

*Source: Guidehouse analysis of charging pod data*

### Charging Pod Configuration

Pacific Power selected ChargePoint as the charging network service provider and hardware provider for the public charging pods. The pods were developed with consistent equipment specifications and allow up to six EVs to charge simultaneously. Whenever possible, sites were future proofed to allow for additional charging capacity as vehicle technology becomes capable of faster charging times. The charging stations are configured with connectors compatible with all makes and models of EVs. Each charging pod includes the following:

- Four DCFC charging stations, rated at 62.5 kW each, with both Combined Charging System (CCS) and CHAdeMO connectors

- One, dual-port L2 charging station rated at 7.2 kW per port
- Total rating of 264.4 kW for each pod when including all stations and ports

**Pricing and Payment**

The public charging pods are subject to Pacific Power's Oregon Schedule 60 pricing structure, which is a time-of-use (TOU) rate with on-peak and off-peak periods that change by season. Note that certain major holidays are also considered off-peak. Table 2-2 lists the rate structure. EV drivers who use the public charging stations have the option to pay by tapping a credit card, using Google Pay or Apple Pay, creating a ChargePoint account and paying via the ChargePoint app or by calling a toll-free number to pay via credit card.

**Table 2-2. Public Charging Rate Schedule**

| Period | Definition | DCFC Rate (Per Minute) | L2 Rate (Per Minute) |
|---|---|---|---|
| Summer (April 1-October 31) | On-peak (4 p.m.-8 p.m., Monday-Friday) | $0.283 | $0.014 |
| | Off-peak | $0.177 | $0.006 |
| Winter (November 1-March 31) | On-peak (6 a.m.-10 a.m., 5 p.m.-8 p.m., Monday-Friday) | $0.283 | $0.014 |
| | Off-peak | $0.177 | $0.006 |

*Source: Pacific Power, "Find charging stations," https://www.pacificpower.net/savings-energy-choices/electric-vehicles/find-charging-stations.html*

## 2.3 Public Charging Evaluation Objectives and Activities

### 2.3.1 Objectives

The evaluation objectives for the Public Charging program were guided by a collaborative stakeholder process that included Pacific Power, Commission staff, and other stakeholders. The outcome of that process was a set of learning objectives used to develop the evaluation scope and methodology.[3] The learning objectives can be broadly grouped into several categories:

- Charging station usage trends: load profiles, charging patterns, session characteristics
- Customer trends: characteristics of charging station users, reception to pricing models, effects on charging habits

Pacific Power also wanted to understand how the program addressed key market barriers:

[3] Pacific Power, a division of PacifiCorp, "Re: UM 1810—PacifiCorp's Public Charging Pilot Program—Data Collection Learning Objectives," October 2, 2018, https://www.pacificpower.net/content/dam/pcorp/documents/en/pacificpower/rates-regulation/oregon/filings/docket-um-1810/10-2-18_public_charging_pilot_program_data_collection_and_learning_objectives/PacifiCorp_Public_Charging_Pilot_Program_Data_Collect.pdf

- **Lack of publicly accessible EVSE:** The program's effectiveness at expanding the availability of reliable and convenient EV charging with seamless interoperability and a reasonable pricing structure.
- **Lack of awareness of electric transportation options and benefits:** The program's effectiveness at increasing consumer comfort with transportation electrification and off-peak pricing, while expanding consumer ability to choose a charging location, technology level, and service provider.

### 2.3.2 Activities

Guidehouse performed two primary activities to address the evaluation objectives:

- **Charging pod utilization analysis:** Guidehouse analyzed all available data from the public charging pods to develop metrics that characterize how the pods are being used and impacting the grid. The available data included session-level information unique to each charging event, and hourly and 15-minute interval data for energy (kWh) and demand (kW) impacts.
- **Surveys with charging pod users:** Guidehouse coordinated with Pacific Power to administer surveys with charging pod users. Each charging station was outfitted with a Pacific Power-branded sign that encouraged users to provide feedback about their experience by completing a survey. The signs enabled a user to scan a QR code with their smartphone and complete an electronic survey while waiting for their EV to charge. Ultimately, Guidehouse received a small number of completed surveys, in part due to the limited number of people who used the stations during the evaluation period. In an effort to gather more completed surveys, Guidehouse attempted to coordinate with Pacific Power and ChargePoint to send email invitations with the survey link directly to people who had used the charging stations at least one time, but ultimately this did not occur.

## 2.4 Public Charging Results and Findings

The extended deployment timeline for the public charging pods created some limitations in Guidehouse's ability to arrive at certain findings according to the original evaluation plan. At the time data collection was finalized for this report, the first charging pod had been operational for only about 9 months, the second for 6 months, the third for 3 months, and the fourth for only a few weeks. This resulted in a condensed amount of time for charger usage data to accumulate and for surveys to be deployed. Furthermore, it is unclear how the timing of the COVID-19 pandemic and the 2020 Oregon wildfires relative to the charging pod deployment schedule may have affected usage of the charging stations during this analysis period.[4]

### 2.4.1 Charging Pod Utilization Analysis

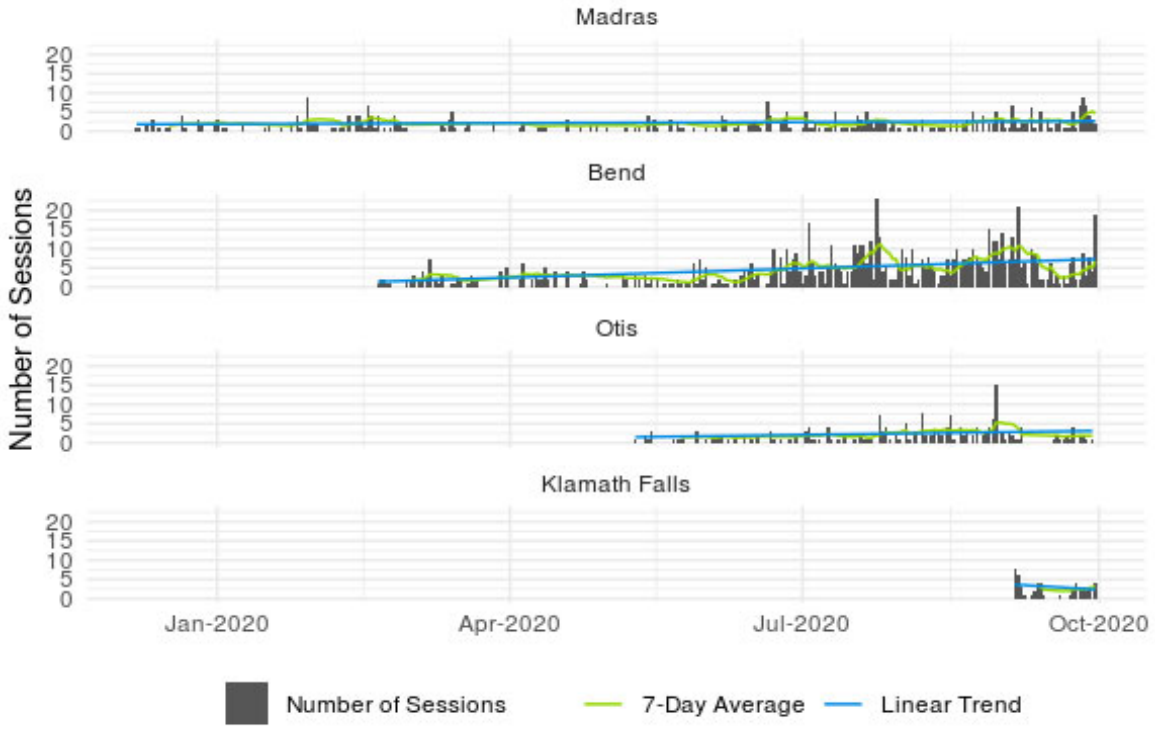
Guidehouse analyzed the charging data from program inception through October 1, 2020. This section presents key findings from the data analysis, which demonstrates how the public charging stations are being used. The values presented are subject to rounding.

[4] At least three of the public sites were located in communities heavily impacted by wildfires in the summer of 2020.

### *2.4.1.1 Charging Activity*

Figure 3 shows the utilization of Pacific Power's public charging pods as a visual timeseries. The graphic displays the number of daily charging sessions that occurred at each pod since it became operational. The blue line represents a linear trend in pod usage, which demonstrates increasing utilization of the Bend and Otis sites over time and relatively flat or consistent utilization at the Madras site. Limited data was available for the Klamath Falls site. This figure demonstrates that the public charging pods are being used consistently by EV drivers, but results presented later in this section show that the pods have sufficient capacity to serve more customers as EV penetration increases.

**Figure 3. Timeline of Charging Activity by Pod**




*Source: Guidehouse analysis*

Table 2-3 shows that over 1,000 unique charging sessions occurred at the time of this report, resulting in an average of about 3.4 charging sessions per day across all pods.

**Table 2-3. Summary of Charging Activity Across All Public Charging Pods**

| Station | Day of First Event | Ending Date | Total Sessions | Average Sessions per Day | Average Sessions per Month |
|---|---|---|---|---|---|
| All Pods | 2019-12-07 | 2020-10-01 | 1,030 | 3.43 | 105 |

*Source: Guidehouse analysis*

Table 2-4 summarizes charging activity by pod. During the evaluation period, the Bend location experienced the most usage, with about 2.5 times the number of daily charging sessions as the other pods. On average, each pod was used about once per day.

**Table 2-4. Summary of Charging Activity by Pod**

| Pod | Day of First Event | Ending Date | Days in Operation | Total Sessions | Average Sessions per Day | Average Sessions per Month |
|---|---|---|---|---|---|---|
| Madras | 2019-12-07 | 2020-10-01 | 300 | 286 | 0.95 | 29 |
| Bend | 2020-02-18 | 2020-10-01 | 226 | 572 | 2.53 | 77 |
| Otis | 2020-05-05 | 2020-10-01 | 149 | 142 | 0.95 | 29 |
| Klamath Falls | 2020-09-02 | 2020-10-01 | 29 | 30 | 1.03 | 31 |

*Source: Guidehouse analysis*

As Table 2-5 shows, drivers predominantly charged their EVs with the DCFC ports, which experienced over three times as many charging sessions as the L2 ports. This trend was consistent across all charging pods, as Table 2-6 shows. This finding suggests a strong customer preference for public fast charging.

**Table 2-5. Summary of Charging Activity by Charging Level**

| Port Type | Total Sessions | Average Sessions per Day | Average Sessions per Month |
|---|---|---|---|
| DCFC | 788 | 2.63 | 80 |
| L2 | 242 | 0.81 | 25 |

*Source: Guidehouse analysis*

**Table 2-6. Charging Activity by Charging Level for Each Pod**

| Pod | Port Type | Total Sessions | Average Sessions per Day | Average Sessions per Month |
|---|---|---|---|---|
| Madras | DCFC | 220 | 0.73 | 22 |
| Madras | L2 | 66 | 0.22 | 7 |
| Bend | DCFC | 407 | 1.80 | 55 |
| Bend | L2 | 165 | 0.73 | 22 |
| Otis | DCFC | 140 | 0.94 | 29 |
| Otis | L2 | 2 | 0.01 | <1 |
| Klamath Falls | DCFC | 21 | 0.72 | 22 |
| Klamath Falls | L2 | 9 | 0.31 | 9 |

*Source: Guidehouse analysis*

Table 2-7 shows some additional characteristics of typical charging sessions. A total of 308 unique EV drivers used the DCFC ports. On average, an EV was plugged in for about 41 minutes during a DCFC session and was charging for 38 minutes. This finding suggests that drivers are generally unplugging vehicles from DCFC ports when charging is complete, which indicates the per-minute pricing structure may be effective at minimizing idle time (i.e., EVs plugged in for extended periods of time after charging has completed). About 24 kWh were delivered during the average DCFC session.

Table 2-7 also shows that drivers charged their vehicles for longer times using the L2 ports, but that only about half as much energy was delivered during an average L2 charging session compared to a DCFC session. Drivers also left EVs plugged in for about 28 minutes per session, on average, after charging was complete. This finding suggests that the per-minute pricing was less effective at deterring L2 users from leaving EVs to occupy a charging port when no energy was being delivered.

**Table 2-7. Characteristics of Charging Sessions by Charging Level**

| Port Type | Average Total Time per Session (Minutes) | Average Charging Time per Session (Minutes) | Average Energy per Charge per Session (kWh) | Number of Distinct Users |
|---|---|---|---|---|
| DCFC | 41 | 38 | 23.89 | 308 |
| L2 | 149 | 122 | 11.30 | 111 |

*Source: Guidehouse analysis*

Table 2-8 shows the variation in charging session characteristics by pod location. Although the duration of session time varied, the average energy delivered per session was more closely grouped across pods, ranging from about 19 kWh to 24 kWh per session. The total number of distinct users in Table 2-8 is 464, which indicates that up to 64 distinct users have charged at more than one location.

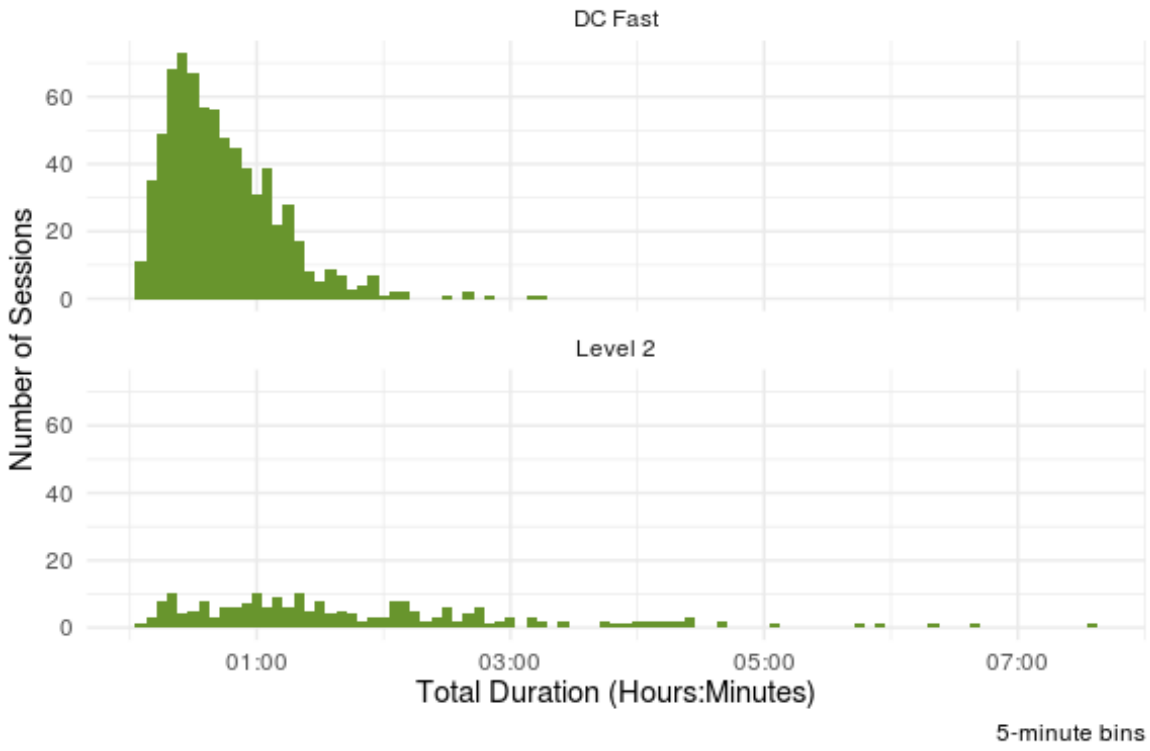
**Table 2-8. Characteristics of Charging Sessions by Pod**

| Pod | Number of Sessions | Average Total Time per Session (Minutes) | Average Charging Time per Session (Minutes) | Average Energy per Charge per Session (kWh) | Number of Distinct Users |
|---|---|---|---|---|---|
| Madras | 286 | 52 | 51 | 18.83 | 147 |
| Bend | 572 | 80 | 67 | 21.61 | 211 |
| Otis | 142 | 33 | 32 | 21.74 | 91 |
| Klamath Falls | 30 | 106 | 73 | 24.28 | 15 |

*Source: Guidehouse analysis*

Figure 4 shows a histogram of charging session duration for each charging level, which illustrates the variation in session length.

**Figure 4. Histogram of Charging Session Duration by Charging Level**

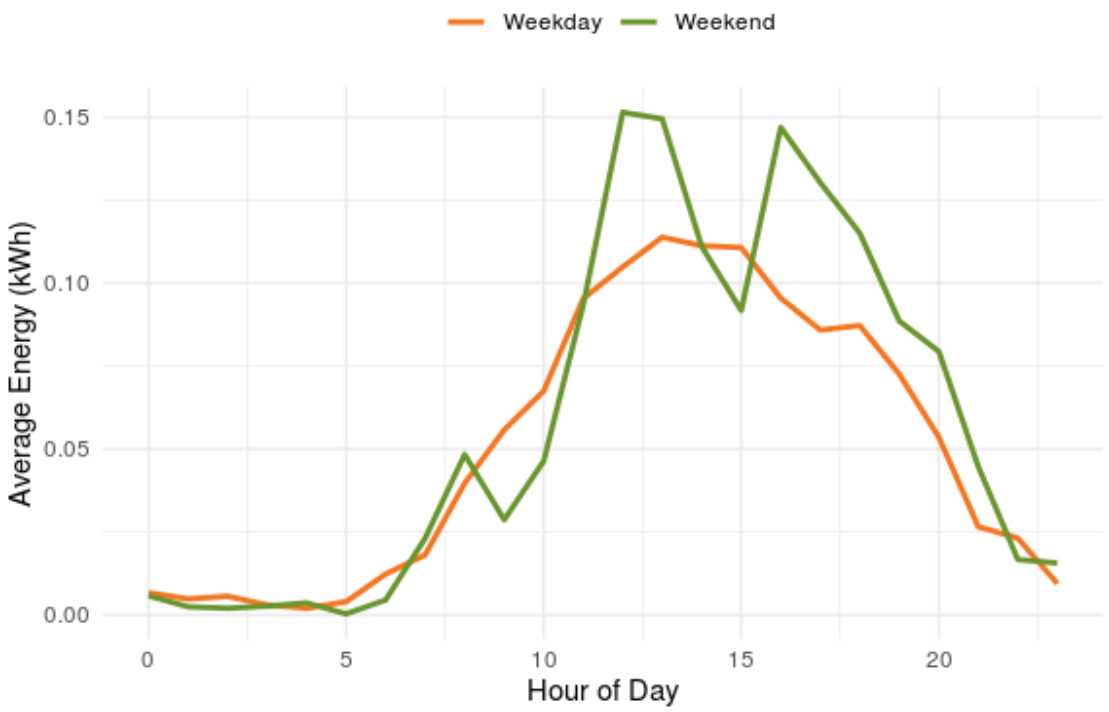



*Source: Guidehouse analysis*

### *2.4.1.2 Charging Load Profiles*

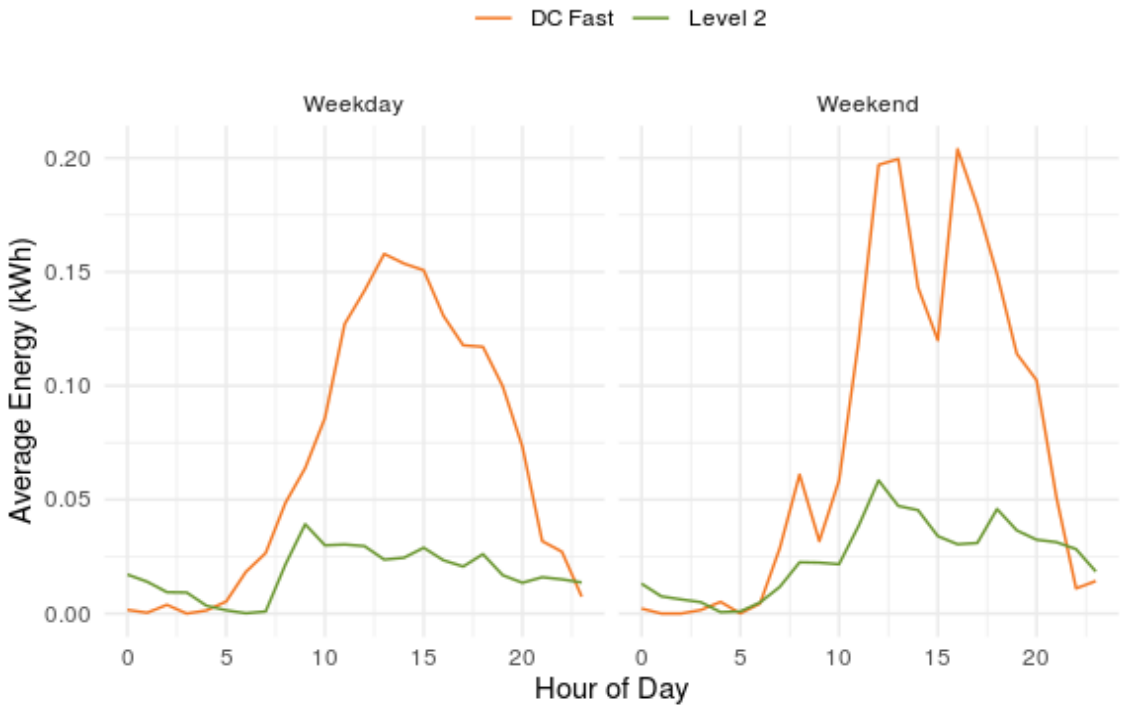
Guidehouse developed charging load profiles to visualize trends in charging behavior. Figure 5 shows the aggregate charging profiles for all pods, demonstrating that most charging occurred during the daytime hours, with a weekday peak between 11:00 a.m. and 3:00 p.m. Figure 6 shows the aggregate charging profiles separated by DCFC and L2 ports.

**Figure 5. Aggregate Charging Profile for All Pods**




*Source: Guidehouse analysis*

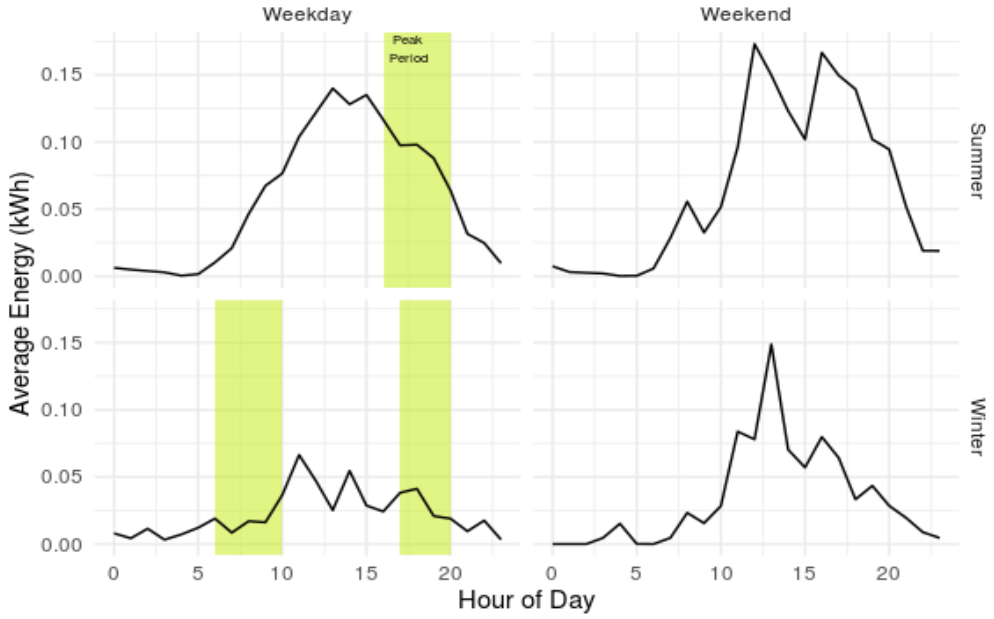
**Figure 6. Aggregate Charging Profiles by Charging Level**




*Source: Guidehouse analysis*

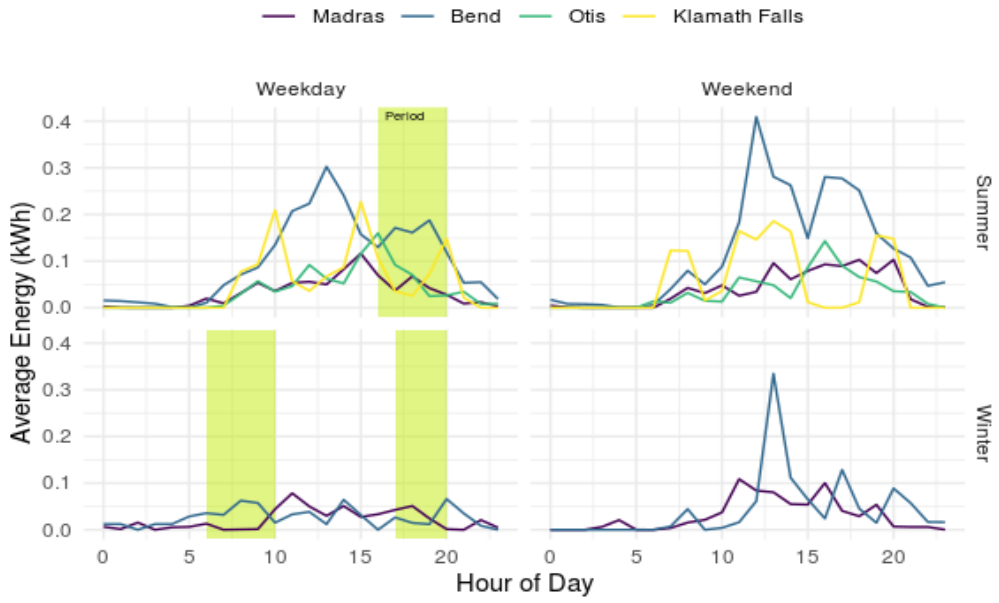
Guidehouse also developed charging profiles to illustrate how charging behavior differed during the seasonal on-peak and off-peak periods as defined by the Schedule 60 charging rate structure. Figure 7 shows these profiles, with the green bars indicating the period of time that is considered on-peak for each season. Figure 8 shows the corresponding profiles for each charging pod. The total dispersed energy and revenue generation between on-peak and off-peak pricing periods is discussed later in this section.

**Figure 7. Aggregate Charging Profiles during Peak Period**




*Source: Guidehouse analysis*

**Figure 8. Charging Profiles by Pod**



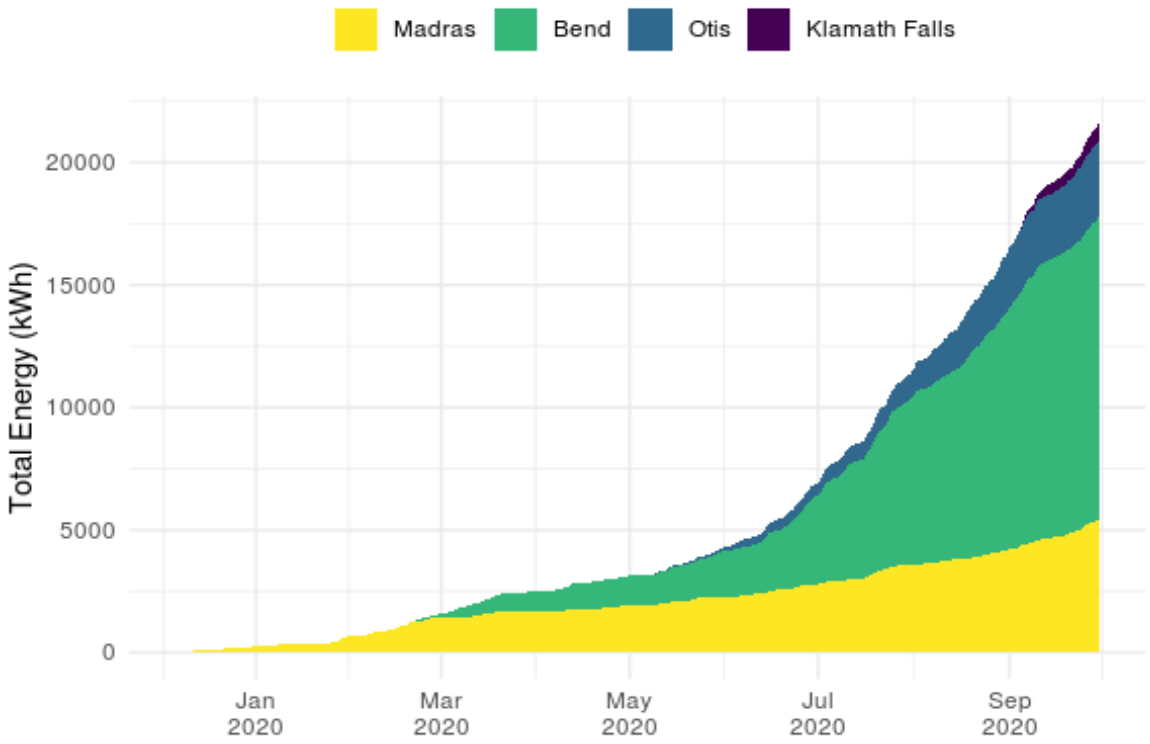

*Source: Guidehouse analysis*

### *2.4.1.3 Energy and Power Impacts*

Guidehouse analyzed the charging data to evaluate the energy and power (i.e., demand) impacts of the public charging pods. The energy delivered during a charging session can depend on several factors, including EV driver intentions, EV make and model, battery state of charge, and other considerations.

Figure 9 illustrates the cumulative energy delivered by the charging pods since the Public Charging pilot began. The Bend and Madras sites were the leading users of energy.

**Figure 9. Cumulative Energy Delivered by Charging Pods Since Program Inception**




*Source: Guidehouse analysis*

Since the first pod was installed in December 2019 and through October 1, 2020, the charging pods delivered approximately 21.6 MWh of energy over the course of about 1,000 hours, as Table 2-9 shows. For this analysis, Guidehouse calculated the total available time by treating each port separately, and defined the percentage of time a charging port was in use as the time that any port was in use divided by the total time that all ports could have been delivering energy. Also shown in Table 2-9, the maximum power that occurred simultaneously across all charging pods during a 15-minute interval was 175.9 kW.[5]

[5] The rated capacity of all pods combined is 1,058 kW, meaning the total power could be as high as 1,058 kW if all ports at all pods were being used simultaneously.

**Table 2-9. Summary of Charging Time and Energy Delivered for All Pods**

| Pod | Total Time Available (Hours) | Total Time with EV Plugged In (Hours) | Idle Time (EV Plugged In but Not Charging) (Hours) | Energy Delivered (kWh) | Max Power (kW) | Percentage of Time Charging Port in Use |
|---|---|---|---|---|---|---|
| All Pods | 100,342 | 1,088 | 103 | 21,561 | 175.9 | 0.98 % |

*Source: Guidehouse analysis*

Table 2-10 shows a breakdown of charging time and energy delivered for each pod. Nearly 60% of the total energy delivered was at the Bend pod. This table also shows the maximum power that occurred at each pod, which is an indicator of multiple ports being used at the same time.[6]

**Table 2-10. Charging Time and Energy Delivered by Charging Pod**

| Pod | Total Time Available (Hours) | Cumulative Charging Port Use (Hours) | Energy Delivered (kWh) | Max Power (kW) | Percentage of Time Charging Port in Use |
|---|---|---|---|---|---|
| Madras | 43,087 | 242.2 | 5,386 | 127.8 | 0.56 % |
| Bend | 32,460 | 632.1 | 12,360 | 159.2 | 1.95 % |
| Otis | 21,362 | 74.4 | 3,087 | 119.1 | 0.35 % |
| Klamath Falls | 3,416 | 36.5 | 729 | 63.7 | 1.07 % |

*Source: Guidehouse analysis*

Table 2-11 shows the breakdown of charging time and energy delivered by charging level. About 87% of the total energy was delivered through DCFC ports, even though only 77% of the charging sessions occurred at DCFC ports (Table 2-5).

**Table 2-11. Charging Time and Energy Delivered by Charging Level**

| Port Type | Total Time Available (Hours) | Cumulative Charging Port Use (Hours) | Energy Delivered (kWh) | Percentage of Time Charging Port in Use |
|---|---|---|---|---|
| DCFC | 67,338 | 501.0 | 18,827 | 0.74 % |
| L2 | 32,986 | 484.2 | 2,734 | 1.47 % |

*Source: Guidehouse analysis*

#### *2.4.1.4 Monthly and Seasonal Analysis*

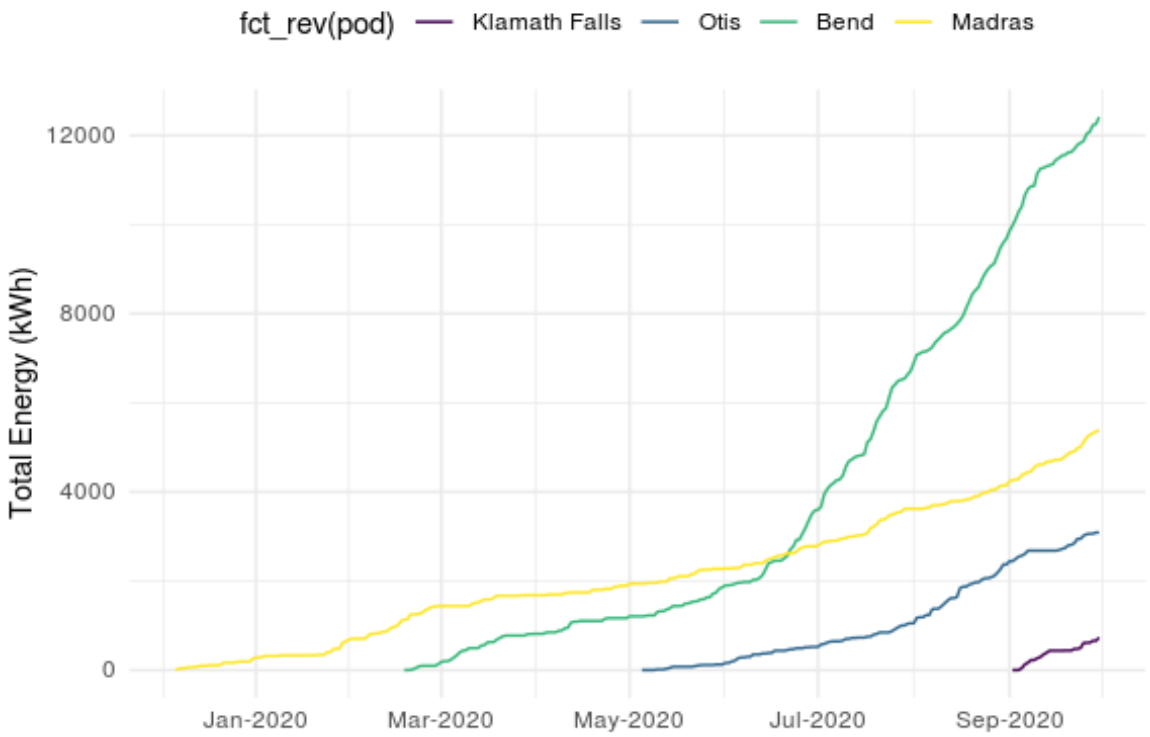
Guidehouse also calculated the charging usage on a monthly and seasonal basis to explore trends in charging behavior. This analysis should be considered in the context of the pilot program—the charging pods came online at different times over a 10-month period and the pilot took place during the COVID-19 pandemic; drawing longer-term conclusions may not be accurate.

One way to visualize the trends in charging pod usage is to display cumulative energy use as a timeseries, as Figure 10 shows. The slope of each line is an indicator of how the usage varies

[6] Each pod has four 62.5 kW DCFC ports and two 7.2 kW L2 ports for a total capacity of 264.4 kW per pod.

throughout the year. The most striking feature is the steep increase in energy use at the Bend site, beginning in June of 2020. This could suggest the charging use will be higher during the summer months as result of leisure travel or other factors, although a longer period of data is needed to draw firm conclusions about seasonal trends.

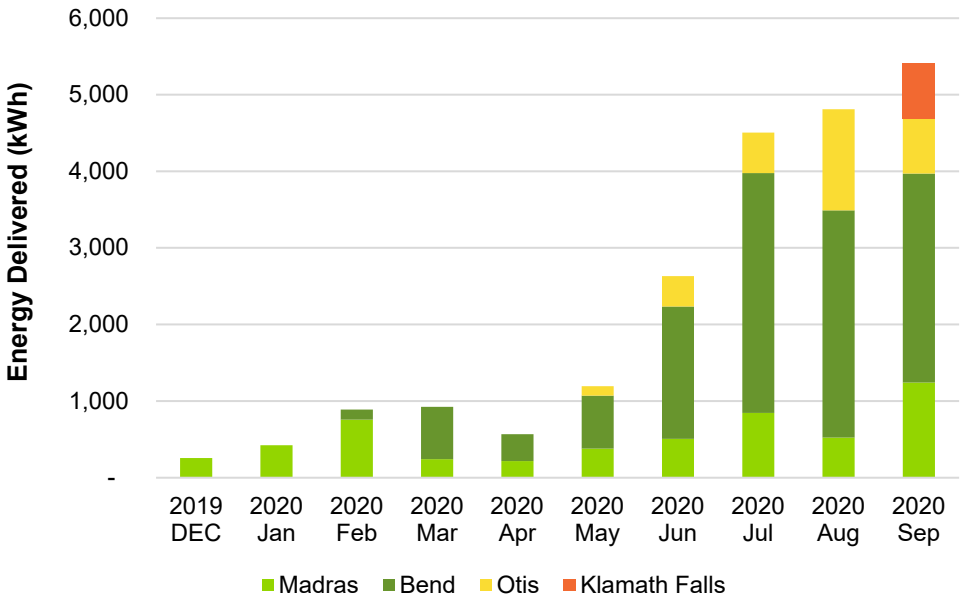
**Figure 10. Cumulative Energy Trends by Pod**




*Source: Guidehouse analysis*

Figure 11 shows the monthly energy delivered by each pod since becoming operational. Focusing on Madras and Bend, it is evident that the summer months were the leading contributors to energy use, although longer-term trends may look different for a variety of reasons.

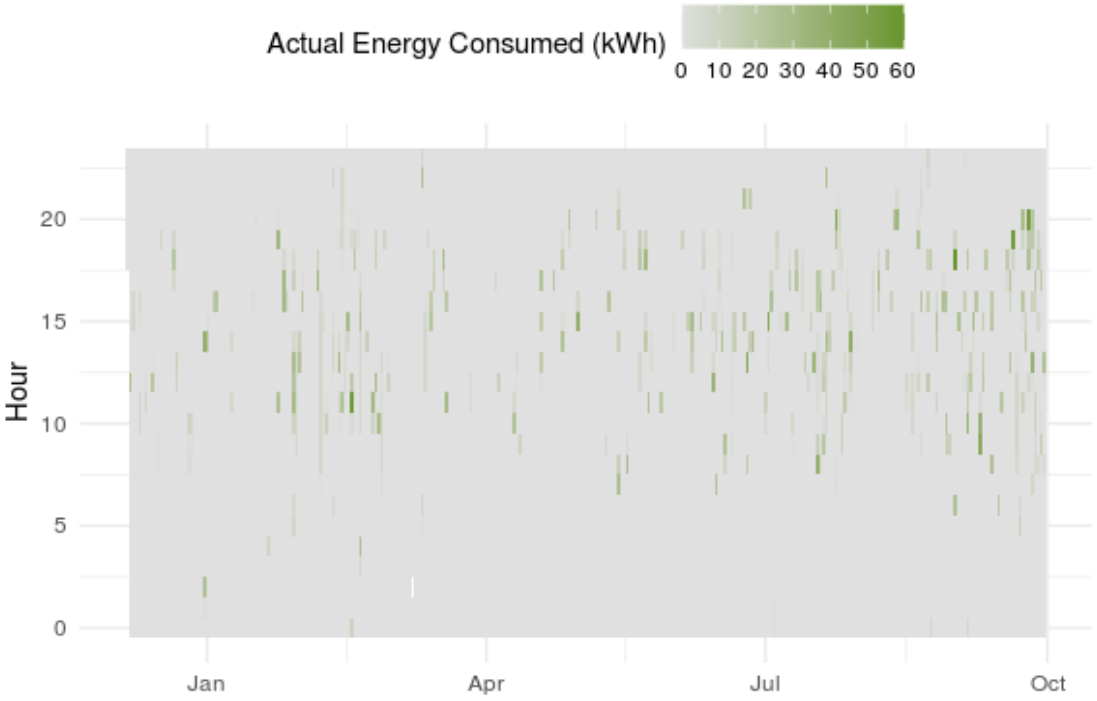
**Figure 11. Monthly Energy Delivered by Each Pod**




*Source: Guidehouse analysis*

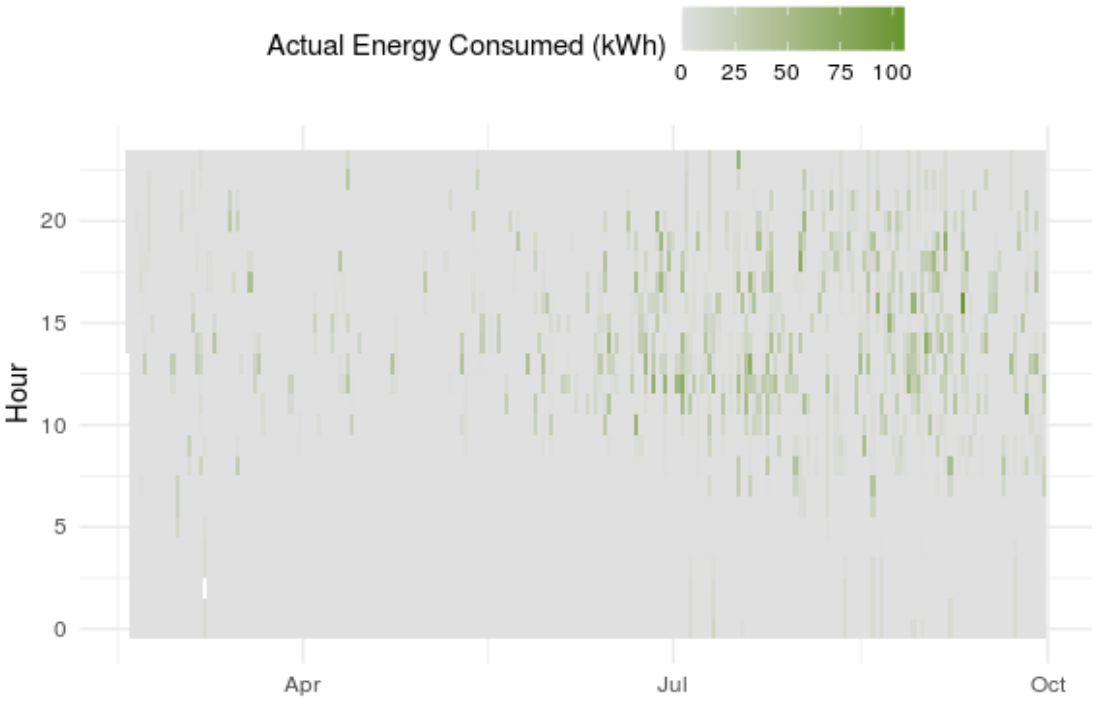
Figure 12 through Figure 15 provide visual heatmaps of the charging use and energy delivered by each pod location. The horizontal axis is a timeseries beginning when the station came online, and vertical axis is the hour of the day. The shading scale represents the energy delivered. Generally, charging activity occurs mostly in the daytime hours and seems to be heavier during summer months.

**Figure 12. Heatmap of Charging Use (Madras)**



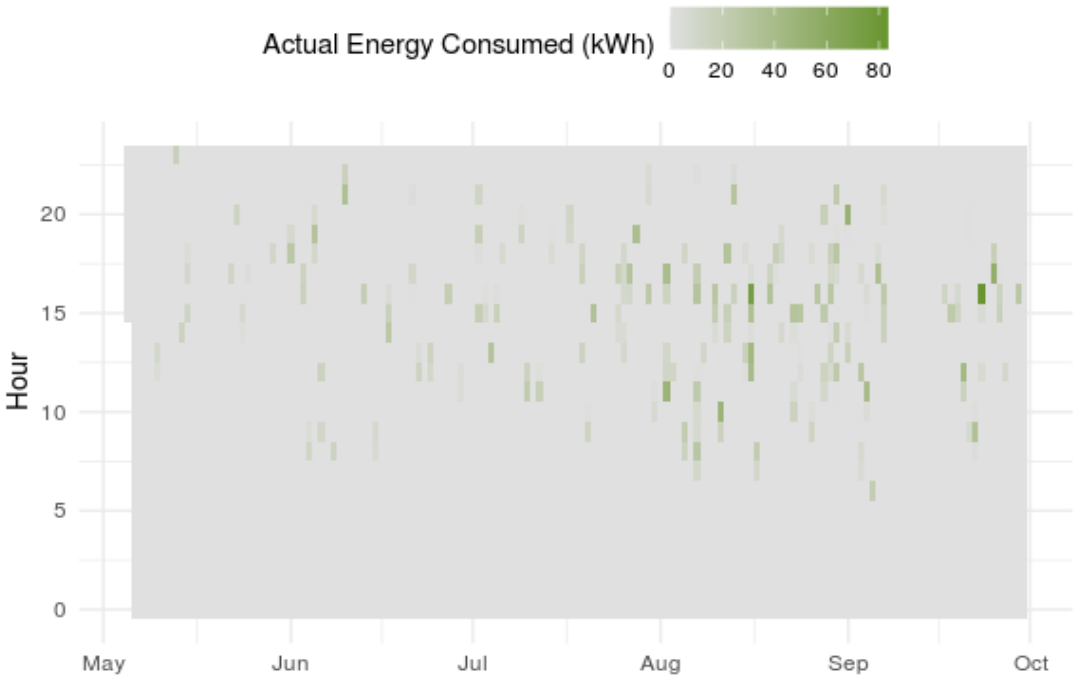

*Source: Guidehouse analysis*

**Figure 13. Heatmap of Charging Use (Bend)**



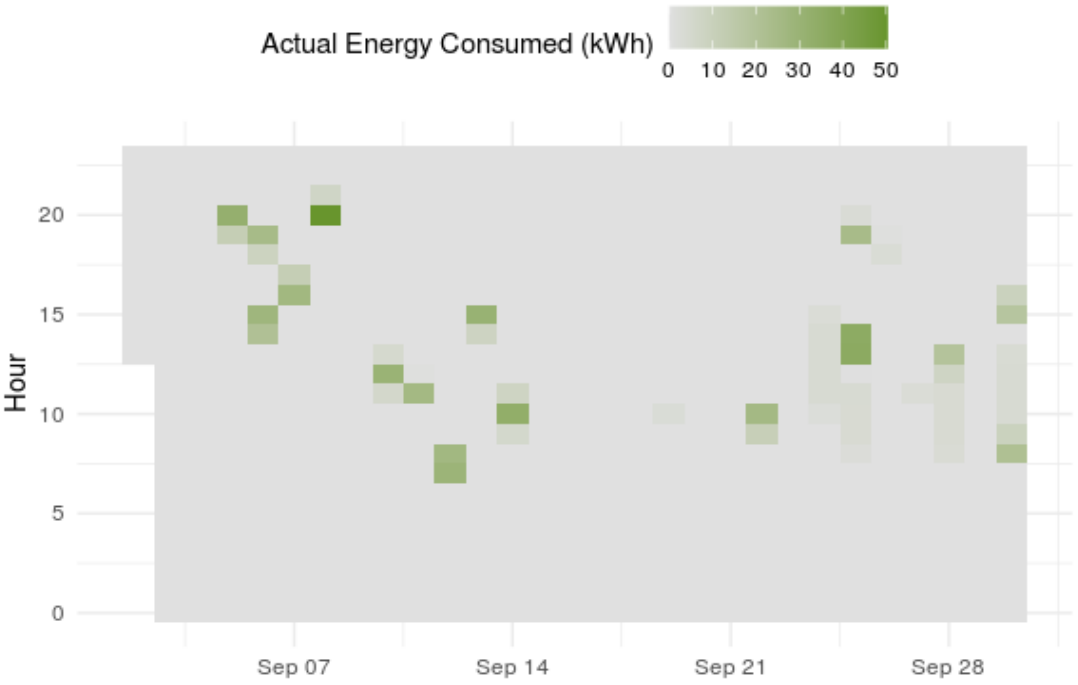

*Source: Guidehouse analysis*

**Figure 14. Heatmap of Charging Use (Otis)**




*Source: Guidehouse analysis*

**Figure 15. Heatmap of Charging Use (Klamath Falls)**




*Source: Guidehouse analysis*

Table 2-12 contains tabulated results of charging utilization by pod for each month since operation.

**Table 2-12. Monthly Charging Characteristics**

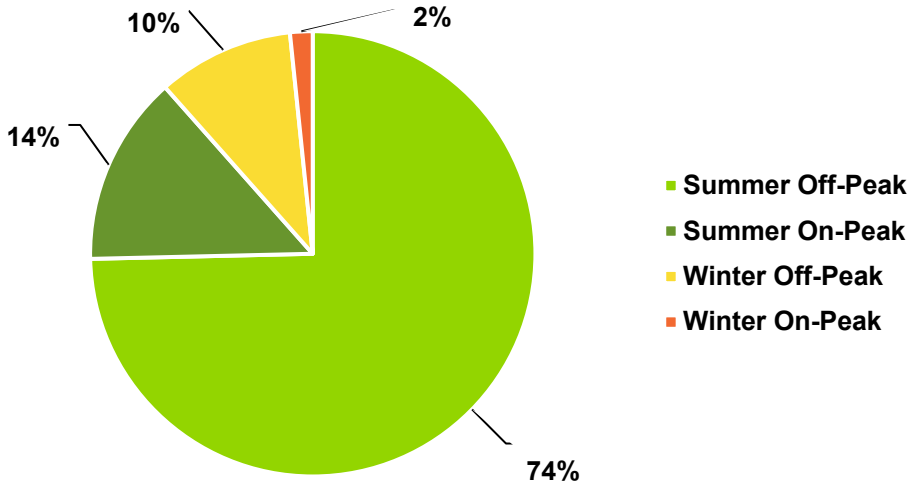
| Pod | Month | Number of Days | Energy (kWh) | Max Hourly Power (kW) | Load Factor (%) |
|---|---|---|---|---|---|
| Madras | Jan | 31 | 423.0 | 73.21 | 0.78% |
| Madras | Feb | 29 | 757.6 | 90.59 | 1.20% |
| Madras | Mar | 31 | 241.5 | 64.40 | 0.50% |
| Madras | Apr | 30 | 214.9 | 62.35 | 0.48% |
| Madras | May | 31 | 378.0 | 127.82 | 0.40% |
| Madras | Jun | 30 | 505.8 | 116.62 | 0.60% |
| Madras | Jul | 31 | 845.4 | 115.61 | 0.98% |
| Madras | Aug | 31 | 522.2 | 57.19 | 1.23% |
| Madras | Sep | 30 | 1,241.7 | 113.69 | 1.52% |
| Madras | Dec | 26 | 255.7 | 49.88 | 0.85% |
| Bend | Feb | 12 | 130.3 | 47.39 | 1.00% |
| Bend | Mar | 31 | 681.9 | 83.09 | 1.10% |
| Bend | Apr | 30 | 352.5 | 63.29 | 0.77% |
| Bend | May | 31 | 691.6 | 109.92 | 0.85% |
| Bend | Jun | 30 | 1,728.4 | 159.21 | 1.51% |
| Bend | Jul | 31 | 3,131.3 | 131.79 | 3.19% |
| Bend | Aug | 31 | 2,967.4 | 114.06 | 3.50% |
| Bend | Sep | 30 | 2,728.0 | 130.22 | 2.91% |
| Otis | May | 27 | 123.7 | 62.87 | 0.31% |
| Otis | Jun | 30 | 396.3 | 63.80 | 0.86% |
| Otis | Jul | 31 | 528.5 | 81.59 | 0.87% |
| Otis | Aug | 31 | 1,319.1 | 119.10 | 1.49% |
| Otis | Sep | 30 | 719.6 | 115.47 | 0.87% |
| Klamath Falls | Sep | 29 | 728.5 | 63.69 | 1.67% |

*Source: Guidehouse analysis*

#### *2.4.1.5 Peak Pricing and Charging Revenue Analysis*

Guidehouse analyzed the charging activity during on-peak and off-peak periods as defined by the Schedule 60 rate plan to explore customer behavior relative to TOU pricing. The evaluation team also calculated the charging revenue that accrued in each of the pricing categories defined in the Schedule 60 rate plan. Figure 16 shows that nearly 85% of all energy dispersed at the public charging pods occurred during off-peak hours, which suggests the pricing structure may have been effective at encouraging customers to charge off-peak. Table 2-13 shows a more detailed breakdown of charging activity by pricing category.

**Figure 16. Energy Delivered by Pricing Period**




*Source: Guidehouse analysis*

**Table 2-13. Charging Use by Pricing Period Category**

| Season | Peak Period | Total Time Available (Hours) | Time Charging Port in Use (Hours) | Energy (kWh) | Max Power (kW) |
|---|---|---|---|---|---|
| Summer | Off-Peak | 70,044 | 747.5 | 16,092 | 175.9 |
| Summer | On-Peak | 7,445 | 105.3 | 2,979 | 163.3 |
| Winter | Off-Peak | 18,995 | 118.5 | 2,136 | 83.1 |
| Winter | On-Peak | 3,840 | 13.9 | 354 | 90.6 |

*Source: Guidehouse analysis*

The total revenue amounted to just under $6,000, with about two-thirds of that occurring at DCFC ports in the summer off-peak period as shown in Table 2-14. Although about 85% of energy was dispersed during off-peak hours, only about 78% of the revenue was generated during off-peak hours because of the pricing differential. The revenue presented in Table 2-14 was calculated by applying the charging activity to the Schedule 60 pricing structure, and does not account for payments to the charging vendor or franchise fees which would deduct from the revenue ultimately received by Pacific Power.

**Table 2-14. Charging Revenue Accrued During Schedule 60 Pricing Categories**

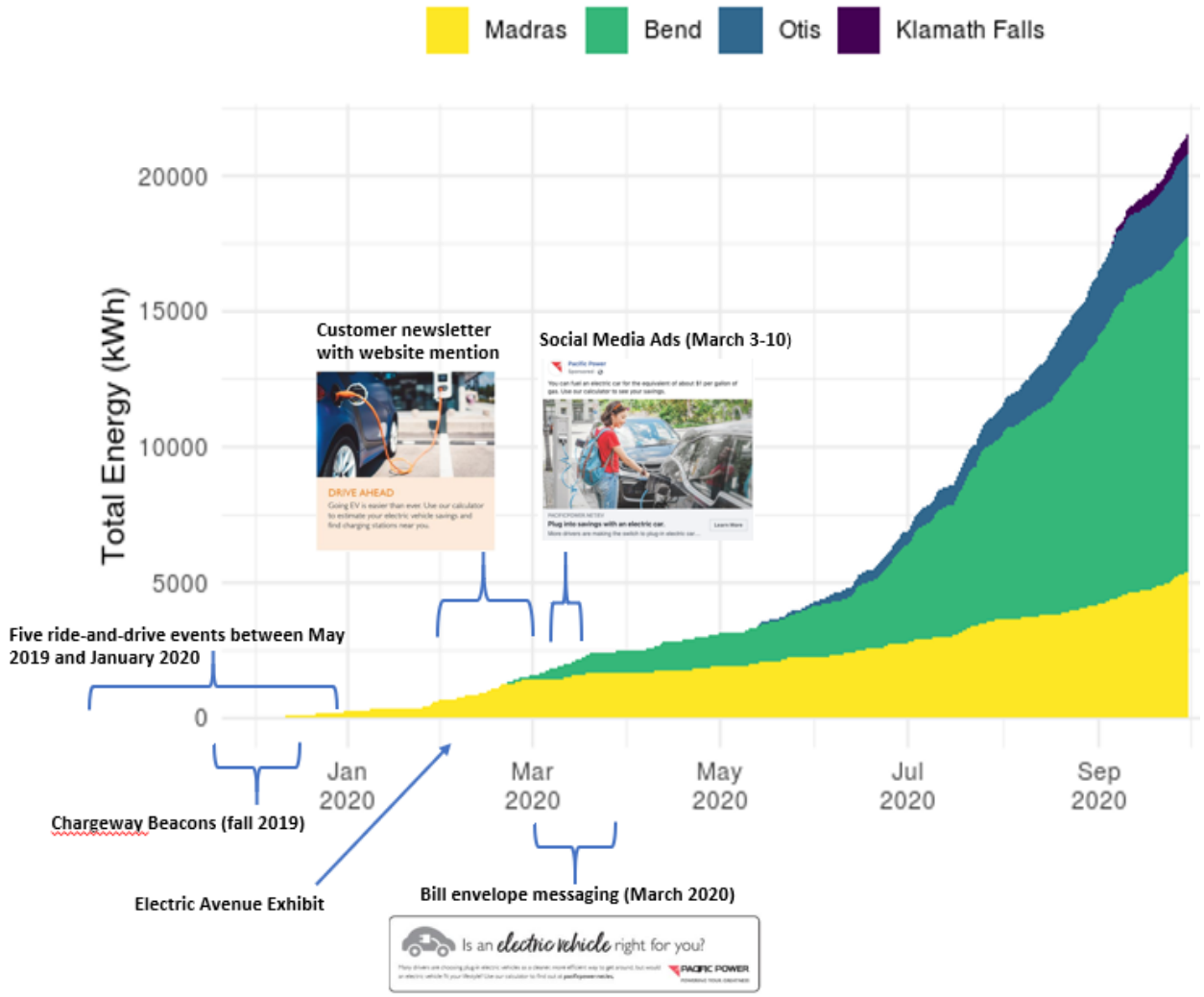
| Port Type | Season | Peak Period | Energy (kWh) | Time Charging Port in use (Minutes) | Charging Revenue ($) | Percent of Total Revenue |
|---|---|---|---|---|---|---|
| DCFC | Summer | Off-Peak | 14,079 | 22,222 | $3,933.38 | 65.6% |
| DCFC | Summer | On-Peak | 2,749 | 3,962 | $1,121.29 | 18.5% |
| DCFC | Winter | Off-Peak | 1,697 | 3,415 | $604.47 | 10.1% |
| DCFC | Winter | On-Peak | 314 | 520 | $147.18 | 2.5% |
| L2 | Summer | Off-Peak | 2,025 | 22,664 | $135.98 | 2.3% |
| L2 | Summer | On-Peak | 230 | 2,486 | $34.81 | 0.6% |
| L2 | Winter | Off-Peak | 439 | 3,695 | $22.17 | 0.4% |
| L2 | Winter | On-Peak | 40 | 311 | $4.36 | 0.1% |
| **Total** | | | **21,561** | **59,111** | **$5,987** | **100%** |

*Source: Guidehouse analysis*

#### *2.4.1.6 Alignment with Outreach Activities and COVID-19 Pandemic*

Guidehouse compared the usage data from public charging pods with the timing of Pacific Power's Outreach and Education activities to visualize changes in charging use that may have coincided with the activities. Figure 17 shows a timeseries of outreach activities along with the corresponding charging use at each pod. Pacific Power conducted most outreach activities during the second half of 2019 and the first quarter of 2020. As previously mentioned, the deployment of charging pods occurred later than originally intended, and therefore minimal charging data was available during the timing of most outreach activities making it infeasible to determine whether the activities had a short-term effect on pod usage. It is also worth noting that Pacific Power's Wattplan EV website experienced a spike in user traffic between August and October of 2019.

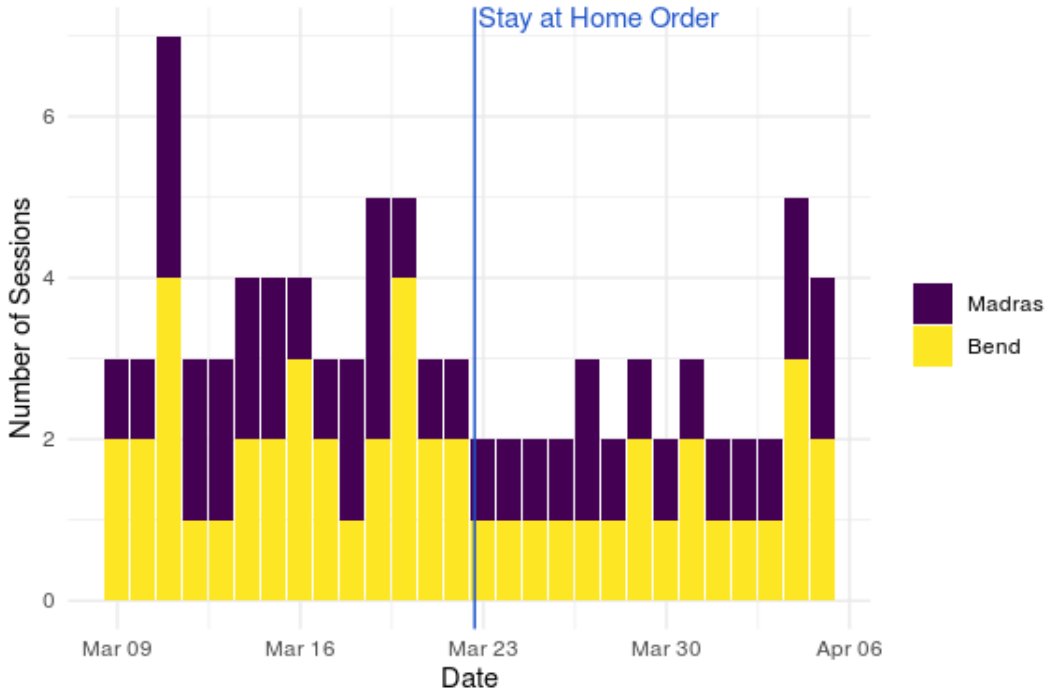
**Figure 17. Timeseries of Outreach Activities and Public Charging Use**




*Source: Guidehouse*

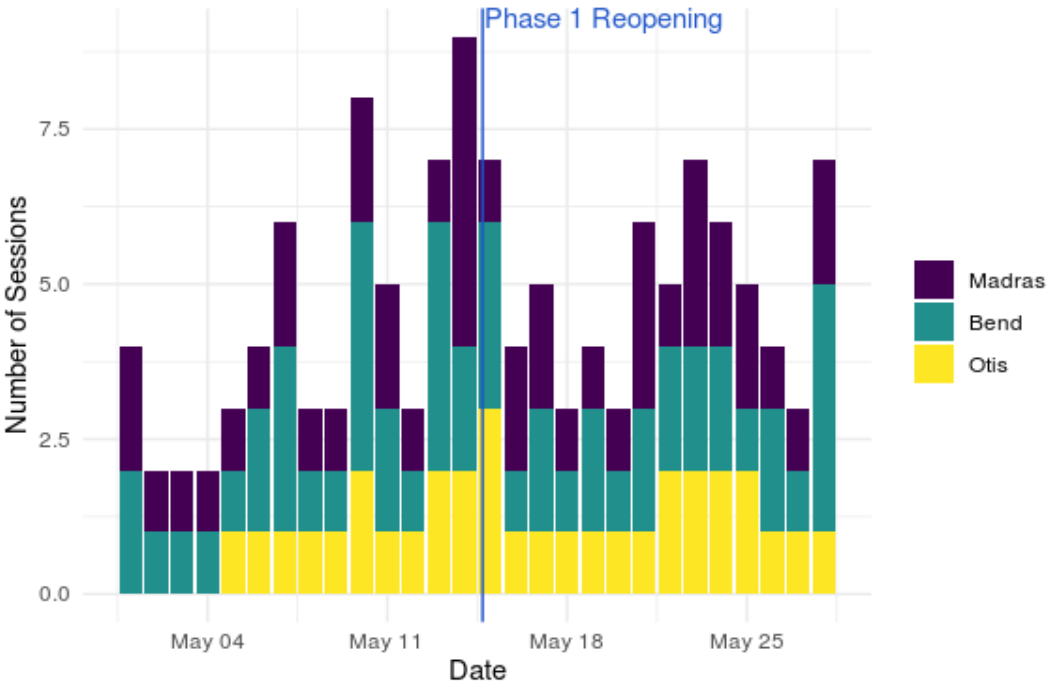
Guidehouse also analyzed charging pod data in proximity to key Oregon dates related to the coronavirus pandemic. The charging pods had not been operational for long enough to perform a year-over-year comparison, so Guidehouse analyzed data for two weeks before and after the key dates. Figure 18 shows the pod usage before and after Oregon's stay at home order. There does appear to be a drop in pod use, but data are too limited to quantify the impact. Similarly, Figure 19 shows pod use before and after the phase one reopening. By this time, the Otis pod was operational, but the data show no conclusive changes in charging use.

**Figure 18. Charging Pod Use in Proximity to Oregon's Stay at Home Order (2020)**




*Source: Guidehouse analysis*

**Figure 19. Charging Pod Use in Proximity to Oregon's Phase 1 Reopening (2020)**

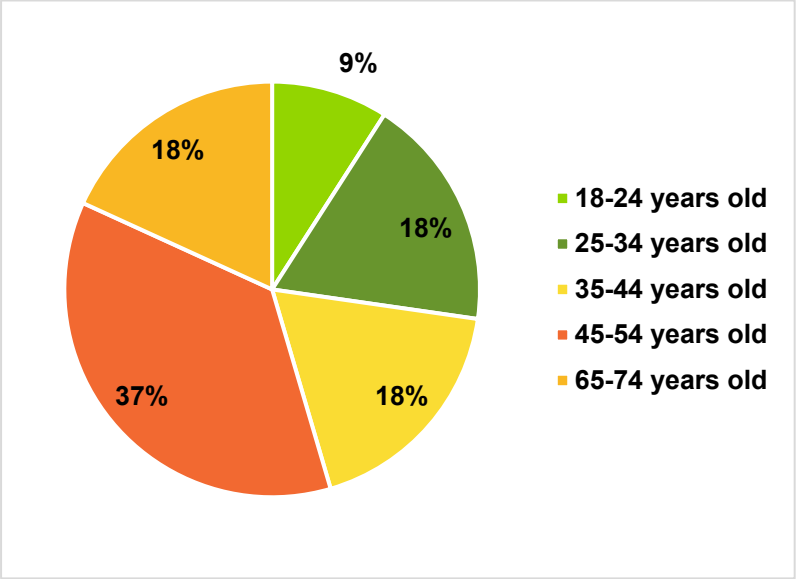



*Source: Guidehouse analysis*

### 2.4.2 Surveys with Charging Pod Users

A total of 11 people completed the electronic surveys while onsite at the public charging pods between February and October 2020. Five (46%) of the 11 respondents completed the survey at the Bend location, 4 (36%) at the Otis location, and 2 (18%) at the Madras location. As shown in Figure 20, the reported age of respondents was generally distributed across a wide range of age categories. Six (55%) of the 11 respondents reported that Pacific Power was not their current electricity provider, which indicates that the public charging pods were serving EV drivers who resided both within and outside of Pacific Power's service territory.

**Figure 20. Age of Survey Respondents (n=11)**

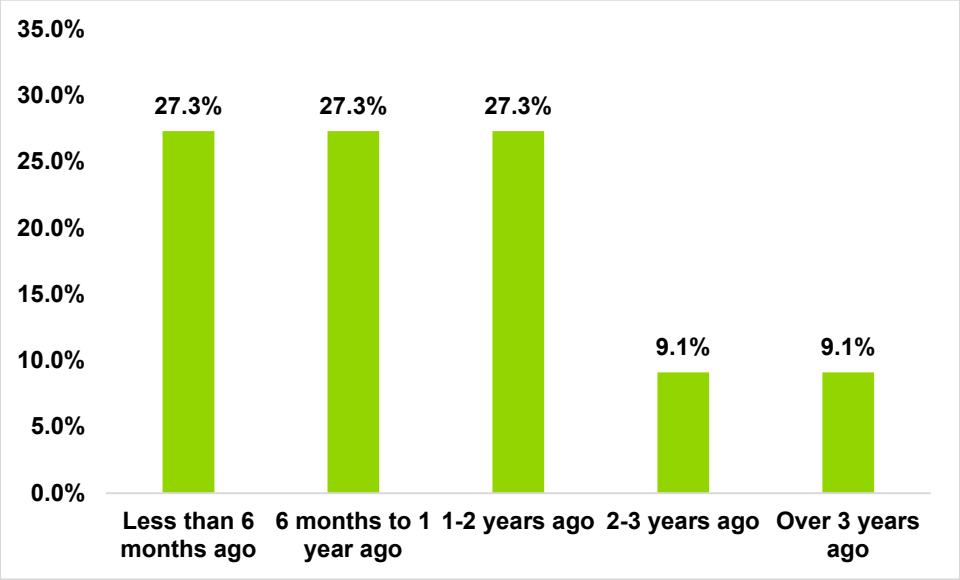



Question: "Please indicate your current age"

*Source: Guidehouse analysis*

More than half of respondents had acquired their current EV within one year prior to completing the survey, as shown in Figure 21. About one-third of responded also reported that they purchased or leased their first EV more than three years before completing the survey. This suggests that the survey responses reflect insight from drivers with a range of experience with EVs.

**Figure 21. Timeline of Current PEV Purchase (n=11)**

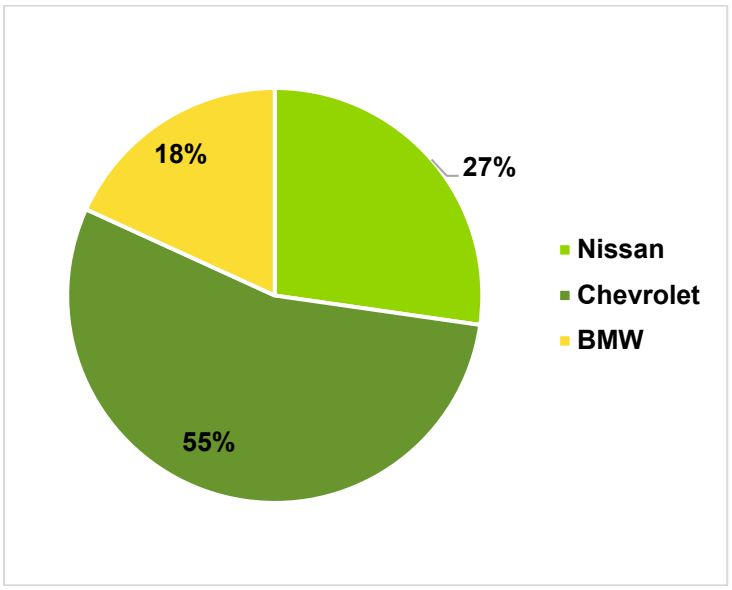



Question: "When did you purchase or lease your current PEV?"

*Source: Guidehouse analysis*

Respondents owned three makes of EV, with 2019 being the most common model year as shown in Figure 22 and Figure 23, respectively. This suggests that the survey responses reflect the experience of users with a variety of vehicle types and ages.

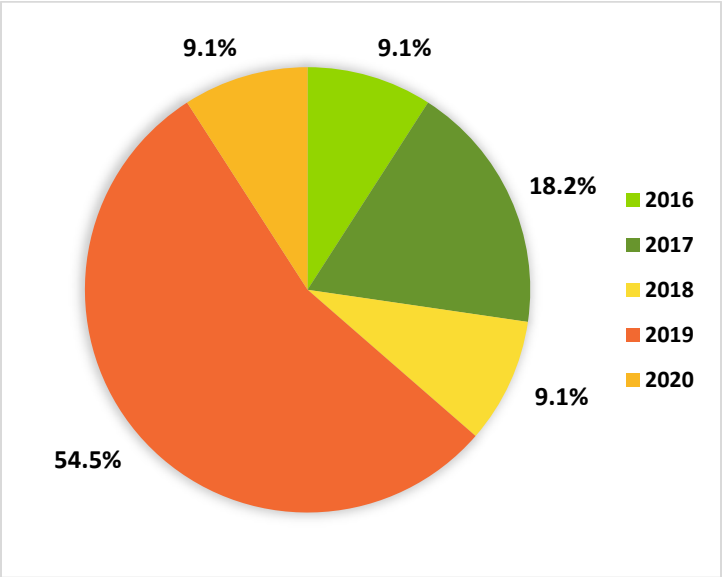
**Figure 22. Make of Current EV (n=11)**




Question: "What type of battery electric vehicle (BEV) or plug-in hybrid electric vehicle (PHEV) do you currently own or lease?"

*Source: Guidehouse analysis*

**Figure 23. Model Year of Current EV (n=11)**

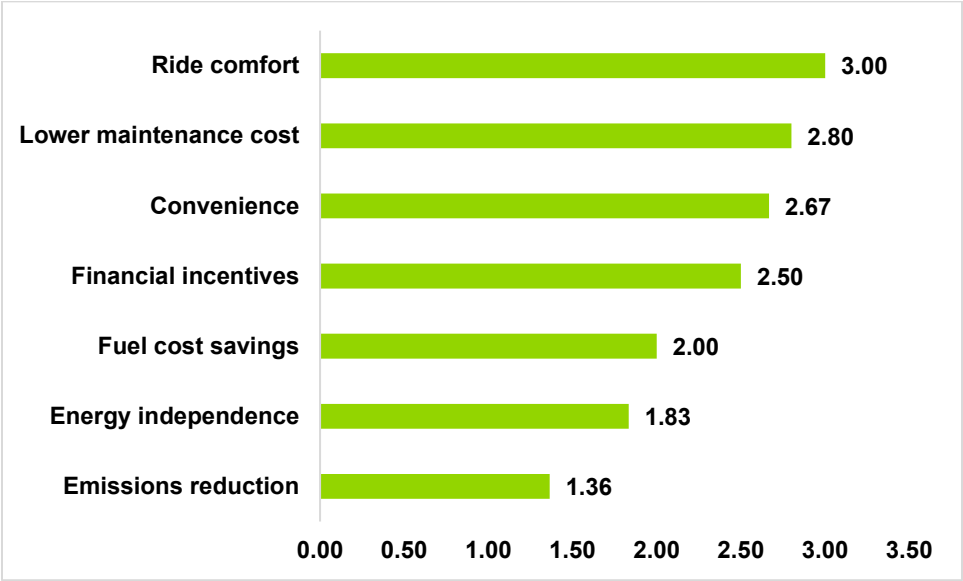



Question: "What year is your battery electric vehicle (BEV) or plug-in hybrid electric vehicle (PHEV)?"

*Source: Guidehouse analysis*

Respondents cited ride comfort, lower maintenance costs, and convenience as the top three factors that motivated their decision to purchase an EV. Figure 24 shows a ranking of purchase motivators, with a higher score indicating that more respondents selected the option as a motivating factor.

**Figure 24. Purchase Motivators for Current EV (n=11)**




Question: "Please rank the importance of the top 3 factors that motivated your choice to purchase or lease your current battery electric vehicle (BEV) or plug-in hybrid electric vehicle (PHEV), using 1 to indicate the factor that motivated you the most"

*Source: Guidehouse analysis*

#### *2.4.2.1 Respondent Awareness of Public Pods and Pricing Structure*

About two-thirds of respondents were aware that Pacific Power offered other similar charging pods in Oregon. The survey asked respondents to indicate how they had learned about Pacific Power's charging pods. Of the 11 total respondents, 4 (36%) indicated they had learned about the pods through a variety of apps that help EV drivers locate charging stations. One respondent learned of the charging pods through Pacific Power branded signage near the pod, and one respondent learned about the charging pods through a web browser search. The remaining 5 respondents did not report how they had become aware of the pods.

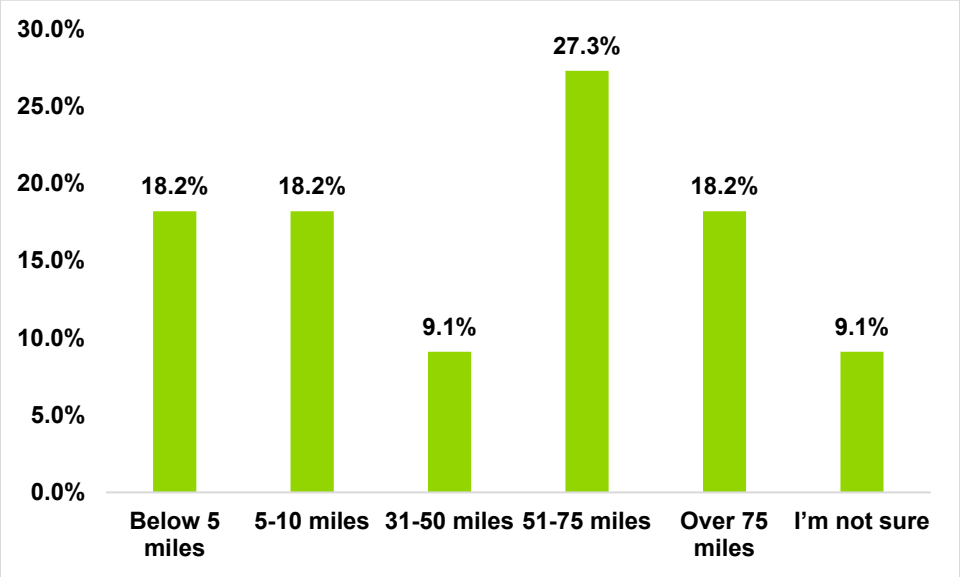
About two-thirds of respondents were aware that Pacific Power's charging pods had a variable pricing structure that was based on the time of day when the charging occurred. Of the 7 respondents who were aware, only 3 (46%) reported that they considered the varying rates when deciding to charge their EV at the time of the survey. When those who were aware of the time-of-using pricing were asked to describe how the rates influenced their decision to charge, respondents gave the following responses:

- I noticed there were cheaper rates in the afternoon so I decided to charge during that time using my charging app.
- I want to avoid on-peak charges. I also presume that off-peak is lower carbon content electricity.
- Since we are traveling at the moment, we need to charge now regardless of rate. If I was at a location, or staying overnight, I would utilize non-prime hours to charge.
- They do not [influence my decision]. It's the only one available.
- We normally charge at home at night.
- We stop to charge on the way to our property, and when we get there depends on traffic. If the rate was much higher, we would try to charge elsewhere.
- No response

#### *2.4.2.2 Accessibility and Convenience*

The surveys included a number of questions to collect feedback about the accessibility and convenience of Pacific Power's charging pods. Nearly half of respondents had driven more than 50 miles before using the charging pod, as shown in Figure 25. The distribution of reported driving distance is an indicator that pods are serving drivers across a wide geographic distribution, or for a variety of use cases such as travel.

**Figure 25. Distance Traveled to Use Charging Pod (n=11)**

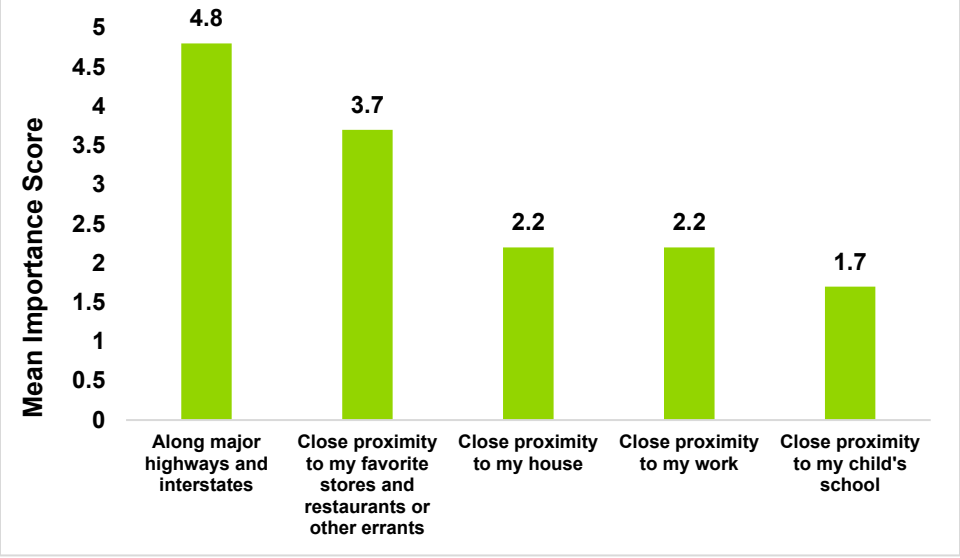



Question: "Approximately how many miles did you drive to use this charging location?"

*Source: Guidehouse analysis*

When asked to rate the convenience of the charging pod location with regards to EV charging needs, nearly two-thirds (n=7) of respondents rated the convenience as 5 (very convenient) on a scale from 1 to 5. Respondents were further asked to indicate the importance of certain locational features when deciding what makes a charging pod location convenient to them. On a scale from 1 to 5, with 1 being "not convenient at all" and 5 being "very convenient", respondents indicated that pod placement along major highways and interstates as their top choice. Figure 26 shows the average convenience rating of each locational characteristic.

**Figure 26. Factors of Charging Location Convenience**




Question: "On a scale of 1-5, indicate the importance of each of the following factors for what makes a charging station convenient for you. [Scale 1-5: 1=not at all important, 5=extremely important]"

*Source: Guidehouse analysis*

Respondents also provided open-ended feedback regarding factors that they perceive as contributing to the convenience of a charging pod location. Some responses included:

- Two respondents noted that station functionality is a key factor in station convenience (i.e. charging ports in working order)
- Two respondents indicated that vacation destinations and hotels were desired factors
- One respondent indicated that charging locations should be within 150 miles in any direction
- One respondent indicated that kWh-based charging fees were more convenient than time-based charging fees

Guidehouse also asked respondents to suggest specific locations within Oregon that they would like to see additional Pacific Power charging pods. Nine respondents provided suggestions, which included:

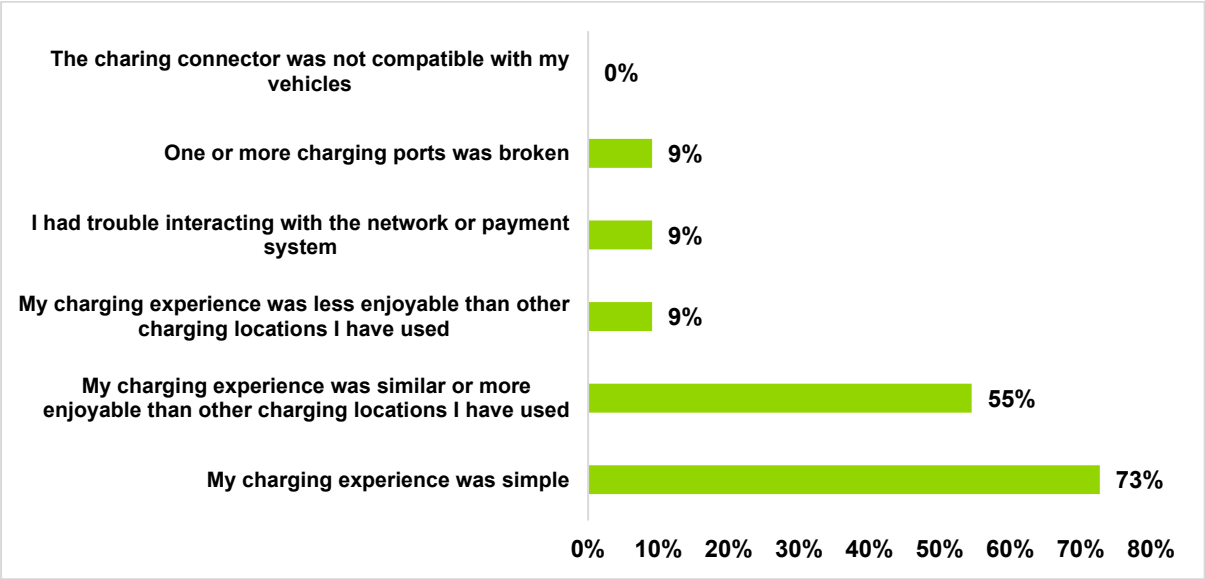
- 97 south of Bend, hwy 20 east of bend, and mountain passes
- All of Oregon east of the I-5 corridor is very underserved. I would like to be able to more easily travel to and through central and eastern Oregon. Bend doesn't seem to have any fast charge stations.
- Astoria, Eugene, Newport
- Bend, Sisters, Salem, Klamath Falls, Ashland, Detroit Lake, Rosenberg
- Government Camp
- Major and secondary highway corridors.  Near state parks and other recreation areas.
- Near shopping or parks
- Seaside, Hood River, Rhododendron, Central Point, Grants Pass, I-5 in Portland
- Within 150 in any direction of current fast charger

#### *2.4.2.3 Charging Pod User Experience*

EV drivers generally reported a favorable experience while using Pacific Power's public charging pods. However, a key factor in user experience is whether all charging ports at a given location are in good working order, enabling a streamlined experience and mitigating wait times. Respondents were asked to select from a number of options to describe their experience with the charging equipment (multiple selections were permitted). As shown in Figure 27, most respondents reported a simple charging experience that was similar to other locations they had used. No respondents reported compatibility issues with the charging port connectors, although in a separate question one respondent indicated that the DCFC cord was too short to reach the side charging port on a Chevrolet Bolt.

Two other respondents noted that three of the four DCFC ports at the Bend site were not working. The surveys were collected about two weeks apart, and the earlier response seems to indicate that this had been an ongoing issue and was also causing persistent wait times at the charging pod. One of these respondents reported waiting 15-20 minutes for the charging port to be unoccupied, and the other reported waiting more than 20 minutes. All other respondents were able to charge immediately upon arrival at the charging pod.

**Figure 27. User Experience with Charging Pods (n=11)**




*Question: "How would you describe your experience with using the charging equipment today?"*
*Source: Guidehouse analysis*

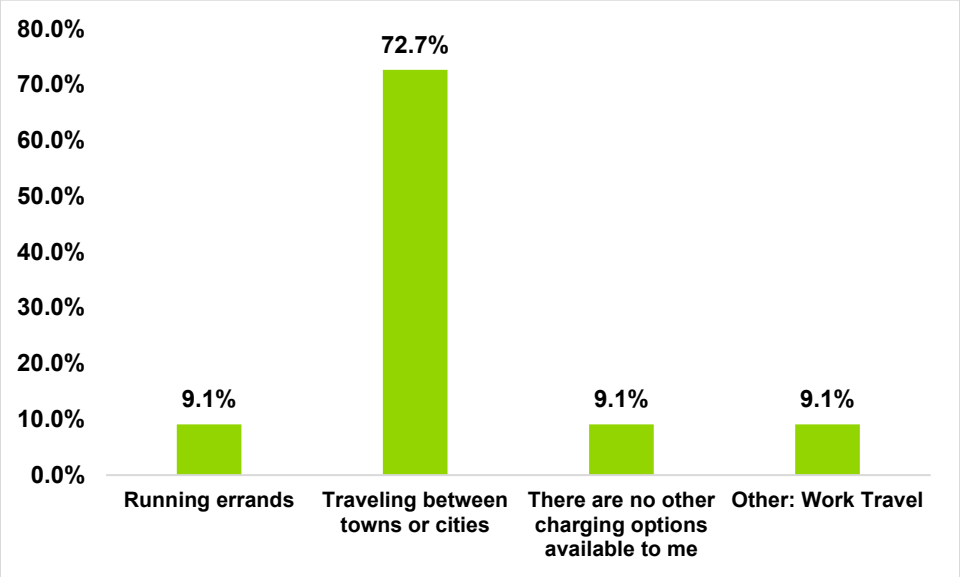
Individual feedback about charging experience included:

- Charger #2 is at the wrong location in the ChargePoint app, and I had to search quite a bit to find it (Reported from the Otis location, during the first month of pod operation).
- Conveniently located. Was clean and safe. (Otis location)
- The ability to pay with a contact list credit card is amazing! I can't begin to tell you how nice of a future this will be in making me feel like I won't get stuck with a dead phone or forgetting my card
- This was the first time I charged my car away from my home and it was very simple and easy (Otis location)
- We need more CCE/SAE stations!!

### *2.4.2.4 Charging Behavior*

Guidehouse designed the surveys to collect information about how EV drivers are using Pacific Power's charging pods, along with their typical charging habits. As shown in Figure 28, nearly three-quarters of respondents were using the public charging pods while traveling between towns or cities. This suggests that, at least in the early phase of operation, the public pods are filling the charging need for EV drivers traveling longer distances versus more localized use cases.

**Figure 28. Charging Pod Use Cases (n=11)**

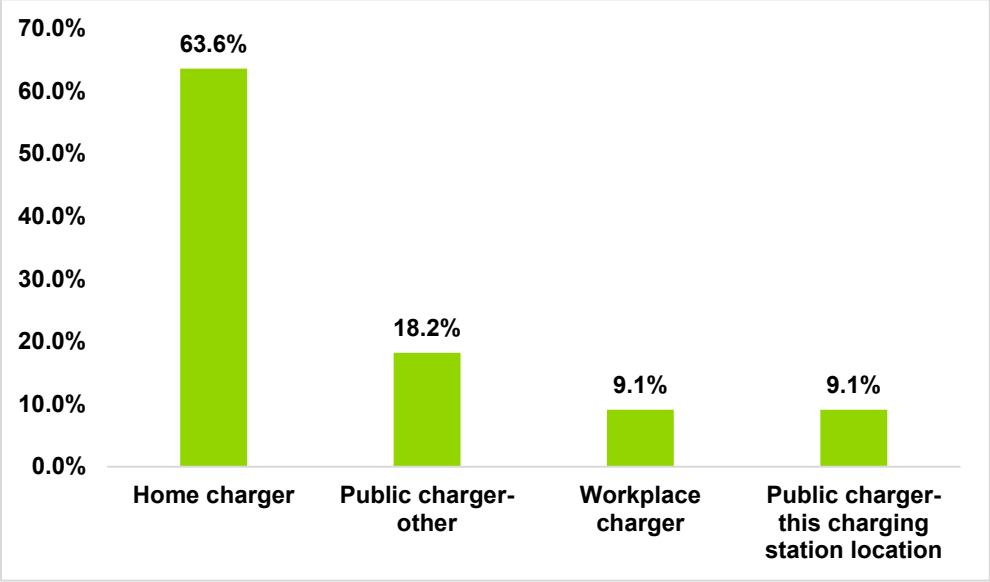



Question: "What term best describes your reason for using this charging station today?"

*Source: Guidehouse analysis*

Figure 29 shows nearly two-thirds of respondents typically charge their EVs at home, which is consistent with known trends that have been observed in other studies. About the same portion of respondents charge about 2-3 times per week, as shown in Figure 30.

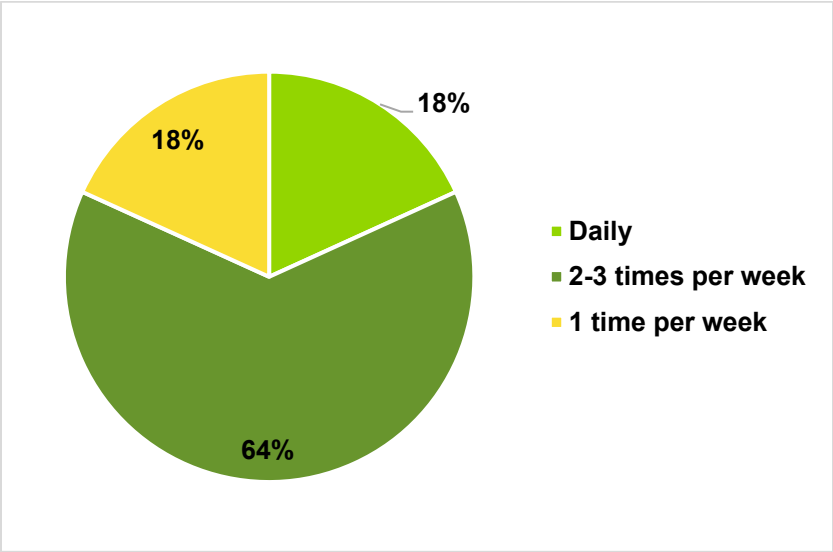
**Figure 29. Locations Where Drivers Typically Charge their EVs (n=11)**




Question: "Where do you typically charge your battery electric vehicle (BEV) or plug-in hybrid electric vehicle (PHEV)?"

*Source: Guidehouse analysis*

**Figure 30. Frequency of Typical EV Charging (n=11)**

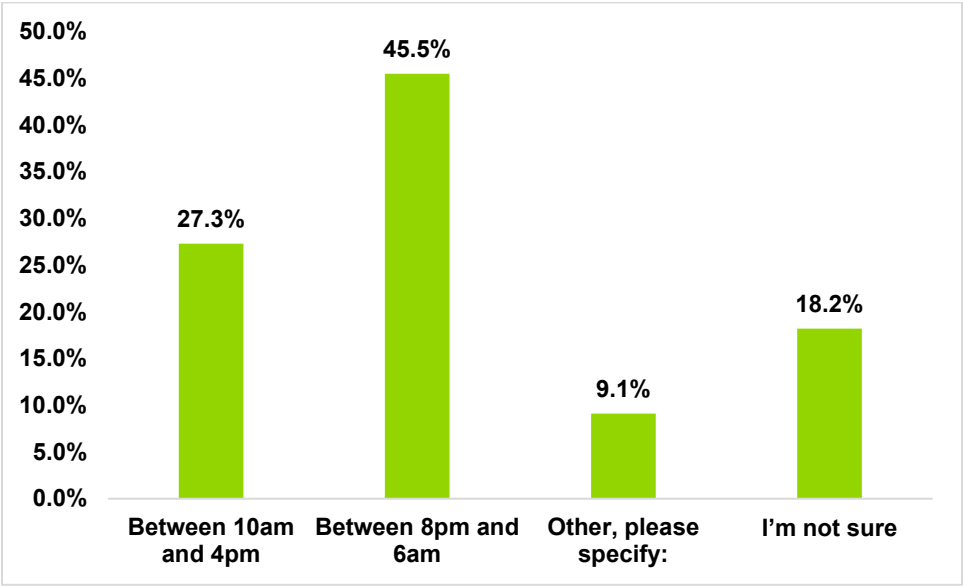



Question: "How often do you typically charge your battery electric vehicle (BEV) or plug-in hybrid electric vehicle (PHEV)?"

*Source: Guidehouse analysis*

About half of the respondents typically charge their EVs between 8 p.m. and 6 a.m., as shown in Figure 31. The respondent who selected "other" provided additional information that typical charging is set to finish at 6 a.m. in order to use off-peak energy. This further supports the finding that most respondents typically charge overnight, and there was almost complete overlap between those who reported charging overnight and those who reported using a home charger for their typical charging needs.

**Figure 31. Times When Drivers Typically Charge their EVs (n=11)**

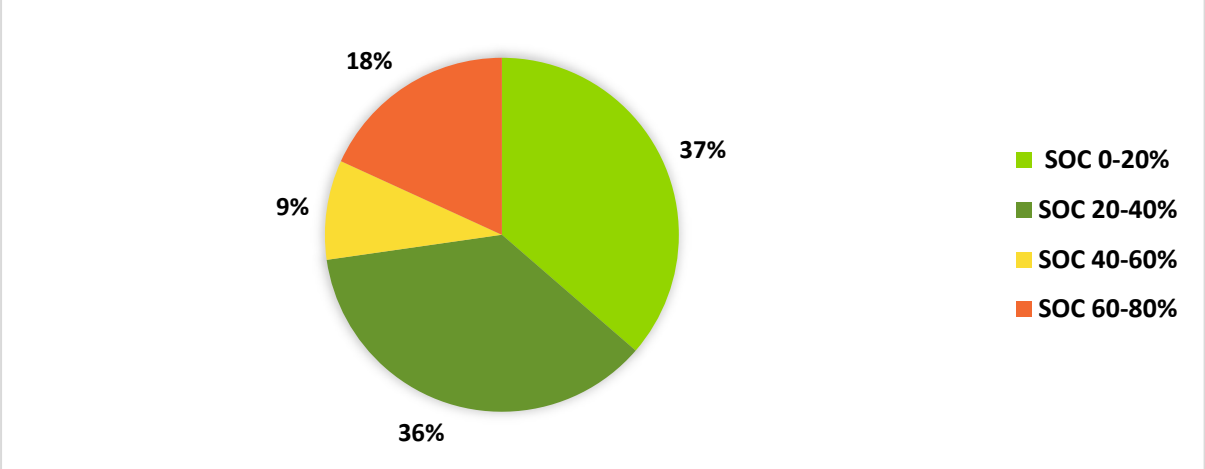



Question: "What time of day do you typically charge your battery electric vehicle (BEV) or plug-in hybrid electric vehicle (PHEV)?"

*Source: Guidehouse analysis*

Figure 32 shows the EV battery state-of-charge (SOC) reported by respondents at arrival to the charging pod. About one-third of respondents reported an SOC of 20% or less when they arrived at the charging pod, and about one-third reported an SOC between 20% and 40%. No respondents indicated their SOC was greater than 80%. This suggests that most respondents were using the pods for a significant charging event, and not simply to top off their charge.

**Figure 32. Battery State-of-Charge at Arrival to Charging Pod (n=11)**

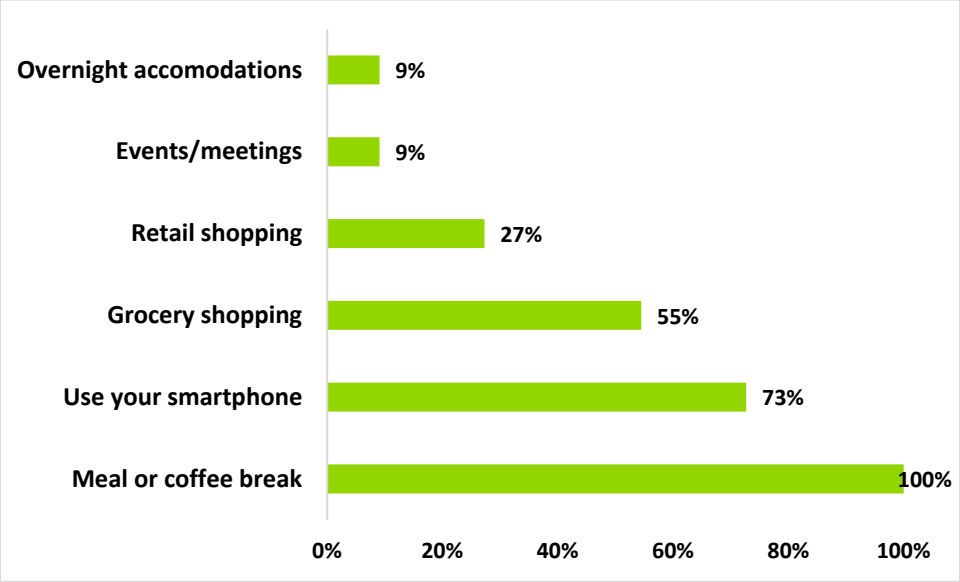



Question: "What percentage of charge did you have when you arrived at the station?"

*Source: Guidehouse analysis*

Respondents were asked to select from a list of activities they prefer to do while waiting for their EVs to charge, and Figure 33 shows the responses. All 11 respondents indicated they prefer to have a meal or coffee while waiting, and about three-quarters use a smartphone while waiting. These responses may help Pacific Power identify locations for future public charging that may be more attractive to drivers.

**Figure 33. Activities Preferred by Drivers while EVs are Charging (n=11)**



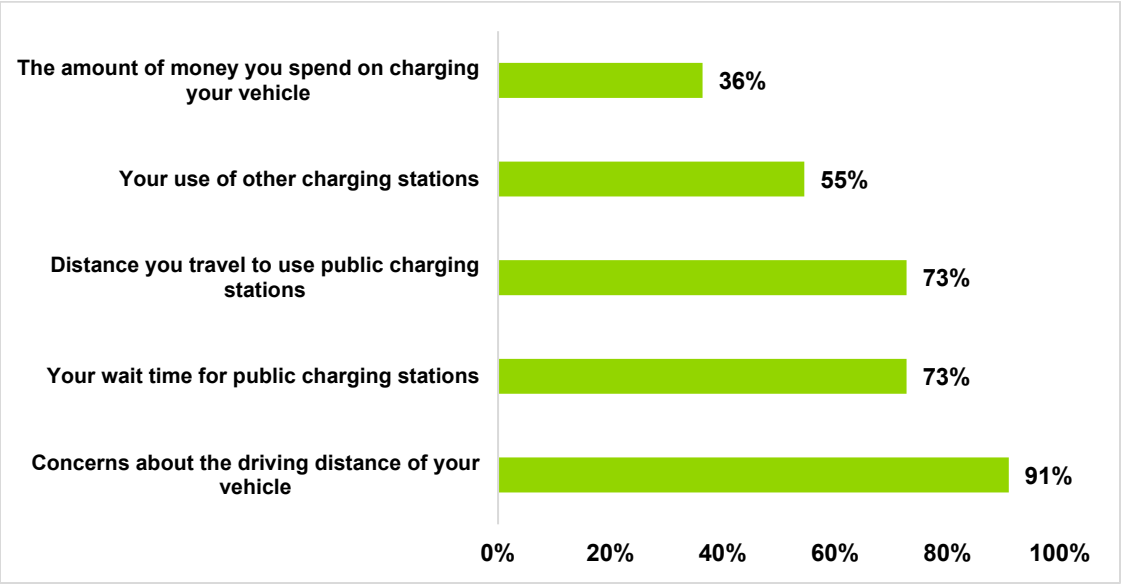

Question: "What activities do you prefer to do while your car is charging at a public charger?"

*Source: Guidehouse analysis*

### *2.4.2.5 Program Influence*

It appears that Pacific Power's public charging pods successfully addressed certain barriers regarding the prevalence and accessibility of charging options among survey respondents. As shown in Figure 34, 10 of the 11 (91%) of respondents indicated that Pacific Power's infrastructure reduced their concern about the driving distance of their EV (i.e. range anxiety). About two-thirds of respondents indicated that the public pods reduced the distance they needed to travel for charging, and reduced the wait time upon arrival. Additionally, 7 of the 11 (64%) of respondents reported Pacific Power's public charging pods gave them greater confidence in their ability to find EV charging when needed. These findings are encouraging indicators that the program is achieving success at meeting key objectives.

**Figure 34. Influence of Charging Pods on Reducing Barriers (n=11)**




Question: “Has the installation of this station, or any other Pacific Power public charging station, reduced any of the following?”

*Source: Guidehouse analysis*

# 3. Outreach and Education Pilot Program

## 3.1 Key Findings – Outreach and Education

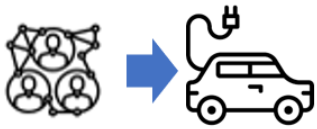
Pacific Power's outreach activities appeared effective at reaching the general population, with about 30% of the surveyed general population recalling exposure to one or more activities. The depth of exposure was limited, with most respondents recalling exposure to only one item. Pacific Power indicated that implementation of some activities was limited by the inability to conduct in-person events after March of 2020 due to the pandemic.

The evaluation findings suggest a set of positive and significant associations between outreach and education activities and desired program outcomes such as favorable impressions, interest, consideration, and purchasing intentions for BEVs. Interestingly, the same relationships do not appear to exist for PHEVs. The lack of significance for PHEVs may be due to higher levels of familiarity with PHEV technologies, lower levels of perceived risk associated with PHEVs, or other factors associate with the use of bivariate analysis.

> Outreach and education activities appear to support desired program outcomes such as favorable impressions, interest, consideration, and purchasing intentions for BEVs.

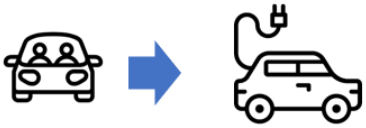
Figure 35 summarizes how outreach and education activities associate with customer interest, consideration, and intention to purchase EVs. Figure 36 elaborates on additional findings from the customer surveys.

**Figure 35. The Influence of Outreach and Education**



**Exposure to outreach and education appears to be associated with…**

- ***better impressions*** of BEVs (but not PHEVs) and ***greater intentions*** to purchase both types of vehicles
- Increased interest in BEVs when exposure is moderate (but no significant change in interest in PHEVs)
- No significant change in consideration of either a PHEV or a BEV.
- ***A significant influence on the likelihood (intention) to purchase a BEV*** among those who were NOT already considering a purchase.
  - O&E make the biggest difference in the likelihood of purchasing a BEV among those people who were not already interested and considering BEVs



**Influence of In-Car Experience on Perceptions and Plans to Purchase***

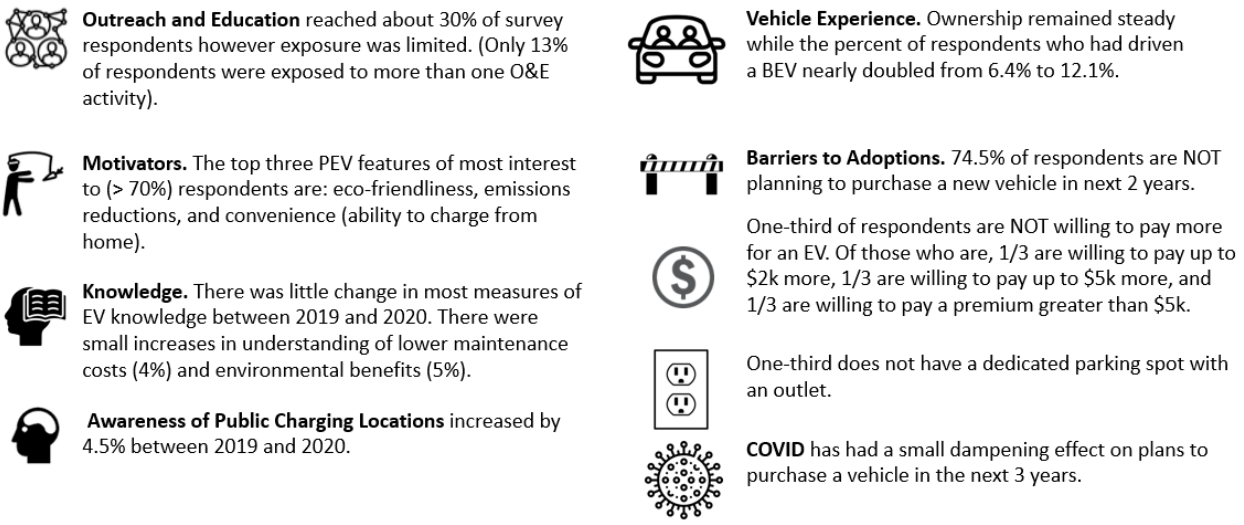
For BEVs – Higher levels of interest, consideration and intentions are associated with both types of in-car experiences. Impressions seem to exist independently of in-car experiences.

For PHEVs – Higher levels of interest and consideration of PHEVs are associated with having ridden in a PEV. Respondents' intention to purchase a PHEV is positively associated with both riding and driving experience.

*The influence of outreach and education and experience is assessed using bivariate analysis only.

*Source: Guidehouse*

**Figure 36. Summary of General Population Survey Findings**




*Source: Guidehouse*

**Overall impressions of PHEVs are more favorable than BEVs**, however BEV impressions appear to be improving. About a third of people would *consider* a PEV as their next vehicle, but they report that the likelihood of PEV purchase remains relatively low.

**More than half of the surveyed general population was aware of at least one public EV charging location in close proximity to their home**, and this awareness increased between 2019 and 2020. There was little change in most measures of EV knowledge between 2019 and 2020, with a small increase in customer understanding of lower maintenance costs and emissions from PEVs as compared to conventional vehicles.

Participants of the **technical assistance** offering were highly satisfied with their experience, and **the most valuable component appears to be information about project costs, siting guidance, and expected usage**. Participants would appreciate more information about vendor and equipment selection, pricing and fee models, and equipment maintenance.

## 3.2 Outreach and Education Program Summary

Pacific Power developed the Outreach and Education pilot program to address the perceived lack of customer awareness concerning electric transportation options and benefits. This lack of awareness was recognized as a primary barrier to the adoption of EVs. To address this barrier, outreach and education activities were designed to increase customer exposure and access to reliable information to provide customers with a higher level of comfort and acceptance of electric transportation.

The program included a series of marketing campaigns, public events, customer-facing online tools, and technical assistance. The efforts were intended to increase exposure to EVs, increase access to reliable information, increase knowledge of the benefits and capabilities of EVs and EVSE, and encourage EV drivers to charge during off-peak hours. Pacific Power's strategy employed a diverse set of messaging tactics within four primary categories:

- Customer communications

- Community events
- Self-service resources (i.e. website enhancements)
- Technical assistance

Pacific Power conducted several outreach or marketing campaigns to provide customers with information about EVs. Some activities included social media posts in March 2020, informational pamphlets to commercial customers, notification on bill envelopes directing customers to Pacific Power's EV website, and informational newsletters distributed in February 2020.

Pacific Power sponsored a series of community events to engage with the public regarding EVs:

- Held five ride and drive events between May 2019 and January 2020. These events allowed customers to view, ride in, or test drive EVs and engage with Pacific Power representatives for information. Pacific Power reported that these events resulted in 106 ride/drives and 402 customer interactions.
- Hosted Electric Avenue Exhibit at the Portland International Auto Show in February 2020.
- Deployed three Chargeway beacons in Medford/Ashland, Bend, North Bend, and Coos Bay/North Bend in the fall of 2019. The beacons are interactive electronic screen displays located at vehicle dealerships that allow customers and dealers to explore EV and charging options.

Pacific Power also added several enhancements to its website to help customers evaluate EV technologies and charging options. These enhancements included the following:

- Calculator to estimate the cost and emissions savings associated with EVs
- Links to several Mapping tools that allow customers to find nearby EV charging stations
- Information about EV savings and incentives
- Information about charging levels and whether electrical upgrades would be needed

Finally, Pacific Power offered technical assistance to organizations interested in evaluating options and the costs of installing EV charging infrastructure at their location. The technical assistance included a customized site assessment report to serve as initial plans for EVSE development.

## 3.3 Outreach and Education Evaluation Objectives and Activities

### 3.3.1 Objectives

This evaluation sought to determine the efficacy of Pacific Power's ability to reduce barriers to transportation electrification and improve customer awareness of PEVs and EVSE. Guidehouse developed an evaluation approach to characterize the existing state of awareness and perceptions among Pacific Power's customers, and to measure changes that may have occurred during the duration of the pilot program.

### 3.3.2 Activities

Guidehouse performed two primary activities to address the evaluation objectives:

- **General population panel survey:** Guidehouse performed two online surveys of the general population to assess customer willingness to purchase an EV, determine customers' understanding of the pricing model, and investigate the exposure to and effectiveness of Pacific Power's outreach and communications campaigns. An initial survey was conducted in June 2019 to establish a baseline; a second survey was fielded in June 2020 to only those customers who completed the first survey in 2019 (i.e., panel approach). More specifically, evaluation activities were used to measure and evaluate changes in:
  - Customer understanding of the technology, its features, and its readiness
  - Customer understanding of the economics of ownership
  - Customer concern about charging logistics, including access to EVSE
  - Customer awareness of environmental and community benefits
  - Market drivers, consumer interests, and barriers to adoption
- **Surveys with technical assistance recipients:** Guidehouse performed two online surveys with Pacific Power customers who participated in the technical assistance offering. The first survey, performed in December 2019, gathered customer insights following the onsite field assessment. The second survey, performed in August 2020, gathered customer feedback near the end of their project.

## 3.4 Outreach and Education Results and Findings

### 3.4.1 General Population Surveys

Guidehouse fielded the baseline survey in June 2019. Invitations were sent to 10,000 Pacific Power customers; 1,482 customers completed the baseline survey, a response rate of 14.8%. The follow-up survey was fielded 1 year later in June 2020, when invitations were sent to all customers who completed the baseline survey. A total of 631 customers completed the follow-up survey, a response rate of 42.6%. The survey findings reported as follows are based on the panel of 631 customers who completed both surveys and tracks their responses over time. A summary discussion for each of the following topics is provided:[7]

- Respondent demographics
- Perceptions of PEVs and customers' intentions to purchase
- Exposure to outreach and education activities
- Experience with EVs, motivations, and barriers to adoption
- Customer understanding of the technology and economics of ownership
- Customer awareness of environmental and social benefits
- Influence of outreach and education and experience on perceptions of PEVs and intention to purchase

[7] Please refer to Appendix A for a more complete set of survey results.

### *3.4.1.1 Respondent Demographics*

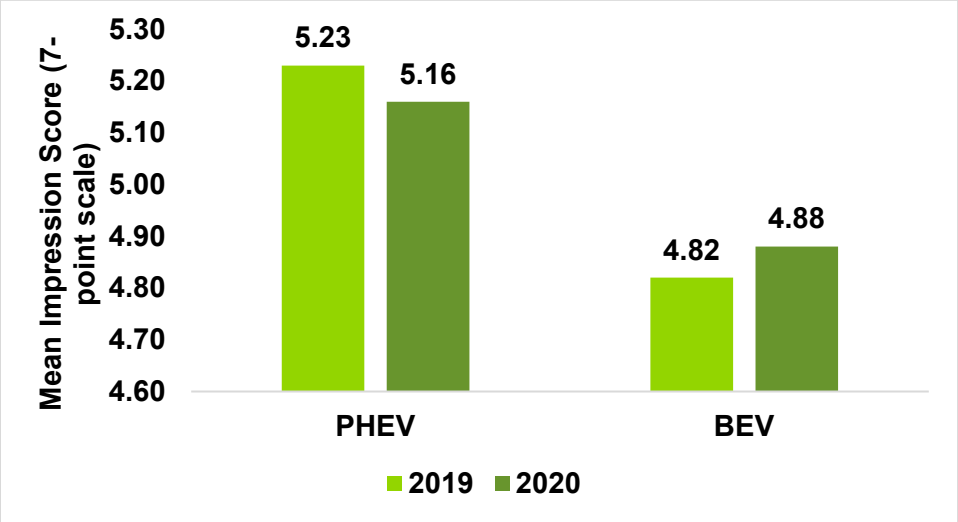
**Age and education:** The panel was composed of older customers, with 63% of respondents at 50 or more years old. Fifteen percent were between 40 and 49 years old, and 19% were between 18 and 39. Three percent chose not to disclose their age. Respondents tended to be educated—56% had at least a 4-year college degree, while 34% had gone to technical school, had some college, or held a 2-year college degree. Eleven percent had a high school degree or less.

**Housing type and ownership:** Of respondents, 80% live in a single-family home,10% live in an apartment, 7% live in a condo or townhouse, and 3% live in some other type of housing. Eighty percent of respondents indicated they own their home while 20% rent.

### *3.4.1.2 Perceptions of PEVs and Customers' Intentions to Purchase*

**Impressions.** As Figure 37 shows, customers' overall impressions of plug-in hybrid EVs (PHEVs) are more favorable than battery EVs (BEVs); however, BEV impressions appear to be improving. Between 2019 and 2020, impressions of BEVs increased slightly while impressions of PHEVs declined slightly.

**Figure 37. General Impressions of PHEVs and BEVs (n=631)**

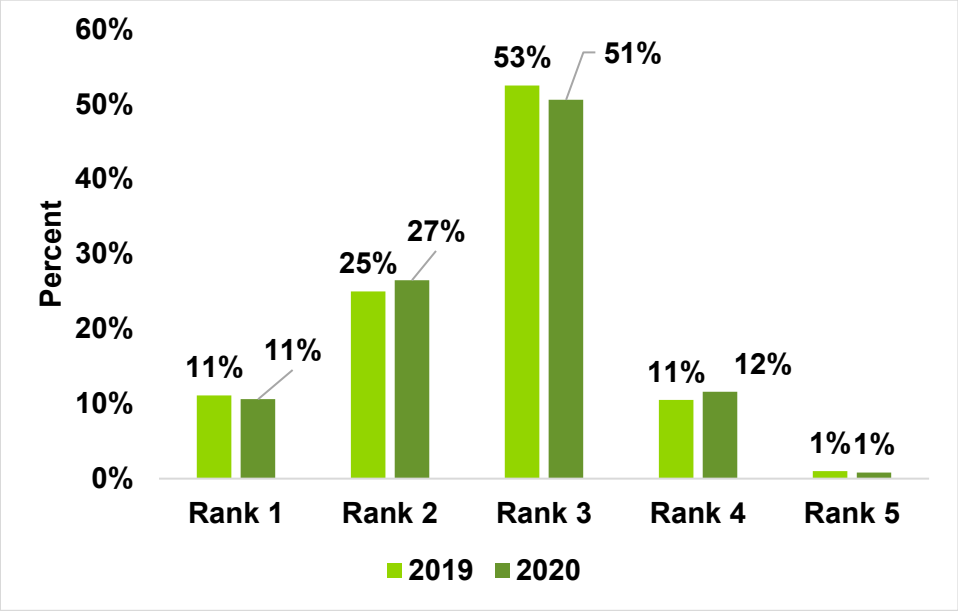



Question: "What is your general impression of the following vehicle types?"

*Source: Guidehouse analysis*

**Interest.** Respondents expressed interest in a PHEV or a BEV by ranking these vehicle types as either their first or second vehicle type choice. As Figure 38 and Figure 39 show, more customers expressed an interest in PHEVs—38% of respondents indicated an interest in a PHEV compared to 23% in a BEV. The level of interest for both remained steady between 2019 and 2020.

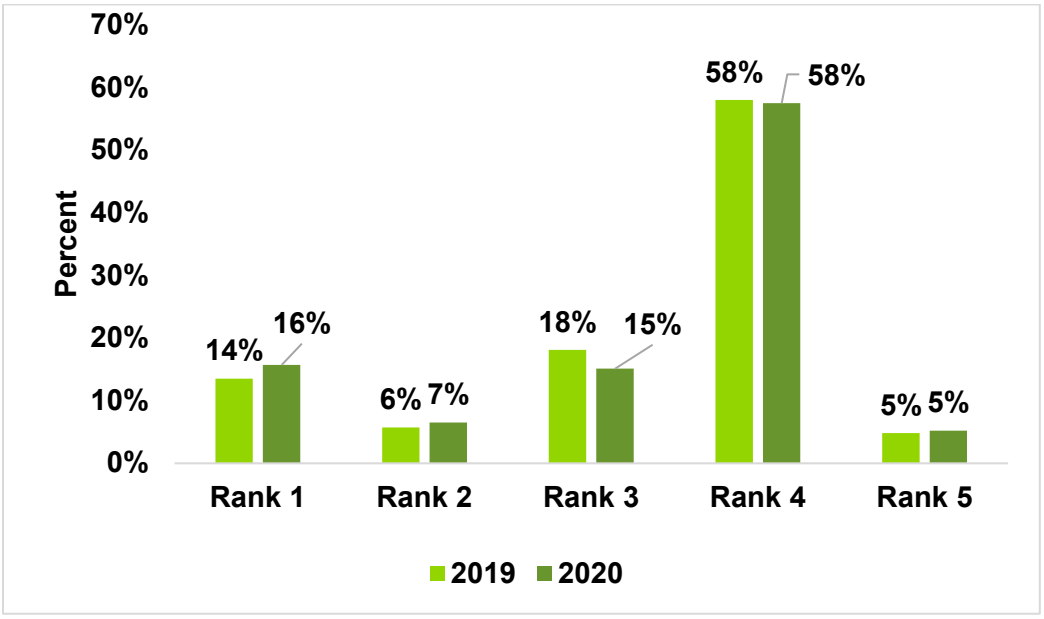
**Figure 38. Expressed Interest/Ranking for PHEVs (n=631)**




Question: "Please rank your preferences for each of the following vehicle types, using #1 to indicate the vehicle type of most interested and #5 to indicate the vehicle type of least interest?"

*Source: Guidehouse analysis*

**Figure 39. Expressed Interest/Ranking for BEVs (n=631)**

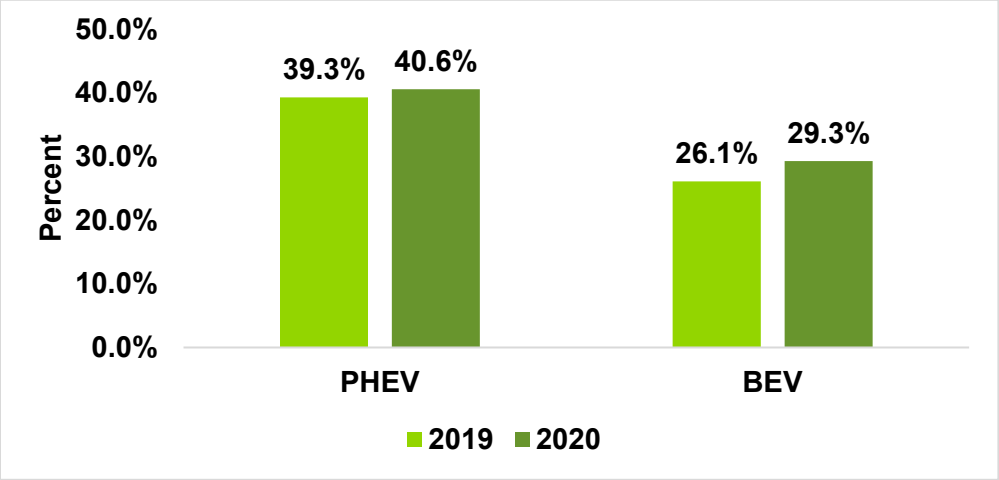



Question: "Please rank your preferences for each of the following vehicle types, using #1 to indicate the vehicle type of most interested and #5 to indicate the vehicle type of least interest?"

*Source: Guidehouse analysis*

**Considerations.** When asked if they are considering a PHEV or BEV for their next vehicle purchase, 41% of respondents said they were considering a PHEV and 29% a BEV. The proportion of respondents considering a purchase remained steady between 2019 and 2020, as Figure 40 shows.

**Figure 40. Respondents Considering a PHEV or BEV for Purchase (n=631)**

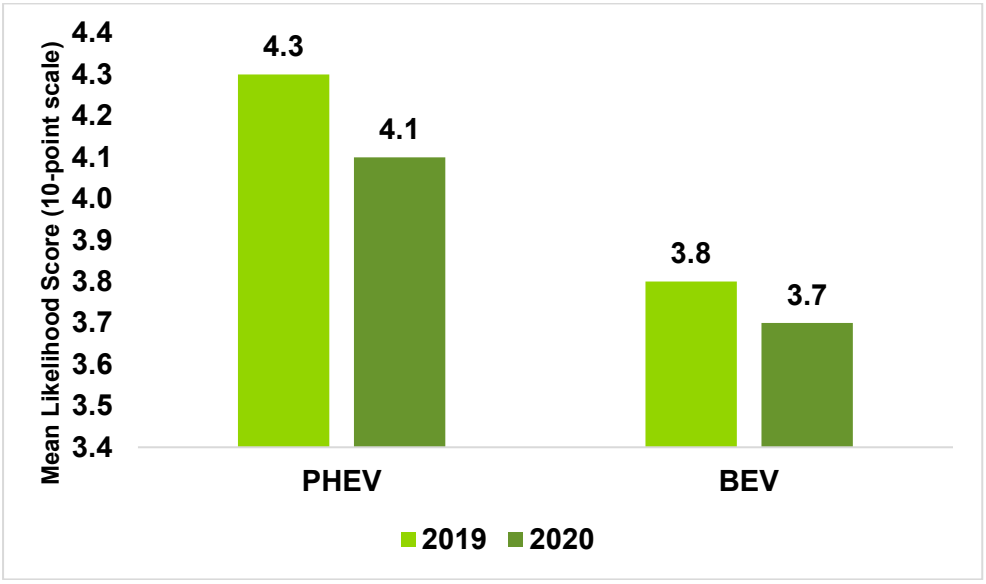



Question: "Are you considering a plug-in hybrid electric vehicle or battery electric vehicle for your next vehicle purchase?"

*Source: Guidehouse analysis*

**Intentions.** When asked to rate their likelihood of purchase (on a 10-point scale), the average score across customers for both PHEVs and BEVs was relatively low (4.1 and 3.7, respectively). Between 2019 and 2020, intentions to purchase a PHEV declined by 4.7% and remained steady for BEVs. These findings are illustrated in Figure 41.

**Figure 41. Likelihood of Purchase by Vehicle Type (n=631)**




Question: "Please indicate how likely or unlikely are you to select each of the following vehicle types as your next vehicle (1-10 scale) "

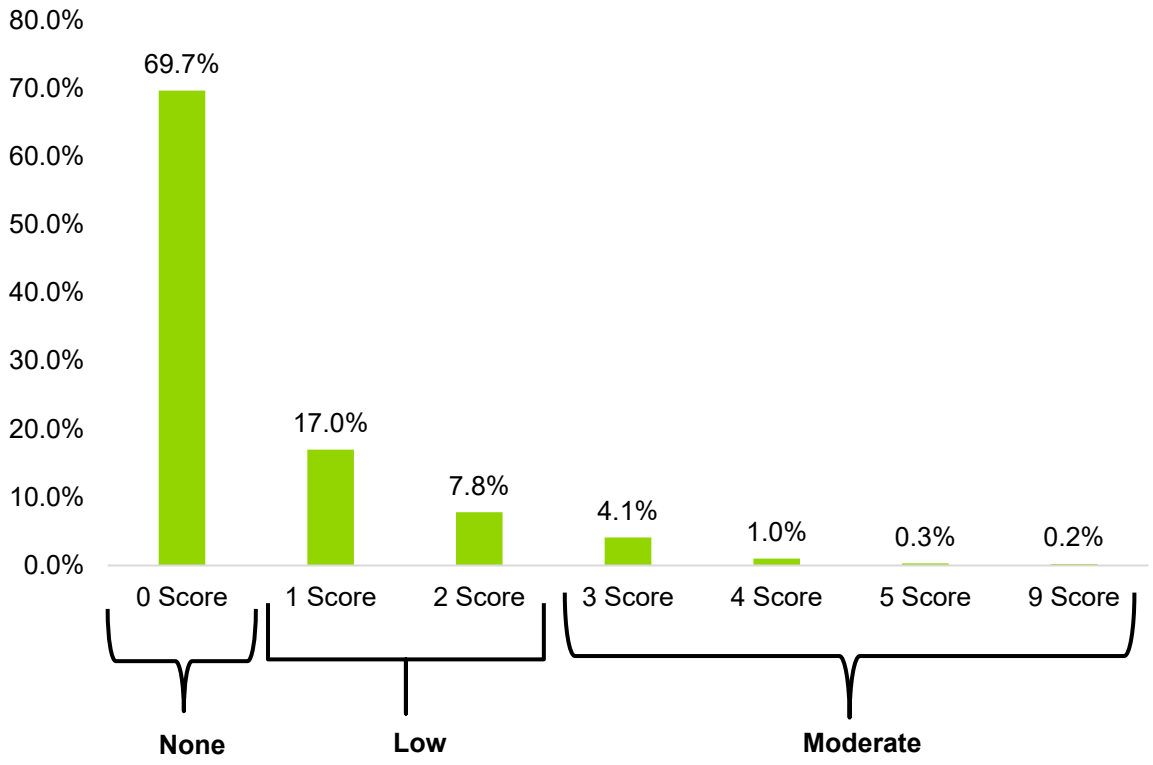
*Source: Guidehouse analysis*

### *3.4.1.3 Exposure to Outreach and Education Activities*

Pacific Power engaged in a wide variety of outreach and education activities designed to provide customers with more information about PHEVs and BEVs. These activities included providing information about EVs on the Pacific Power website, the Pacific Power newsletter, and the customer billing envelope; sharing information at community events; holding ride and drive events; and placing advertisements across a variety of media including TV, paper mailings, online social media, internet search engines, radio, and on streaming services.

Respondents were asked whether they recalled being exposed to these various sources of information. Guidehouse assessed customer exposure to various sources of information and created a composite measure of exposure to outreach and education. Survey findings revealed that outreach and education activities were successful in reaching approximately 30% of respondents. The level of exposure was fairly shallow, with only 13% of respondents reporting being exposed to more than one outreach/education activity.

**Figure 42. Exposure to Pacific Power Outreach and Education Activities (n=631)**




*Source: Guidehouse analysis*

### *3.4.1.4 Experience with EVs, Motivations, and Barriers to Adoption*

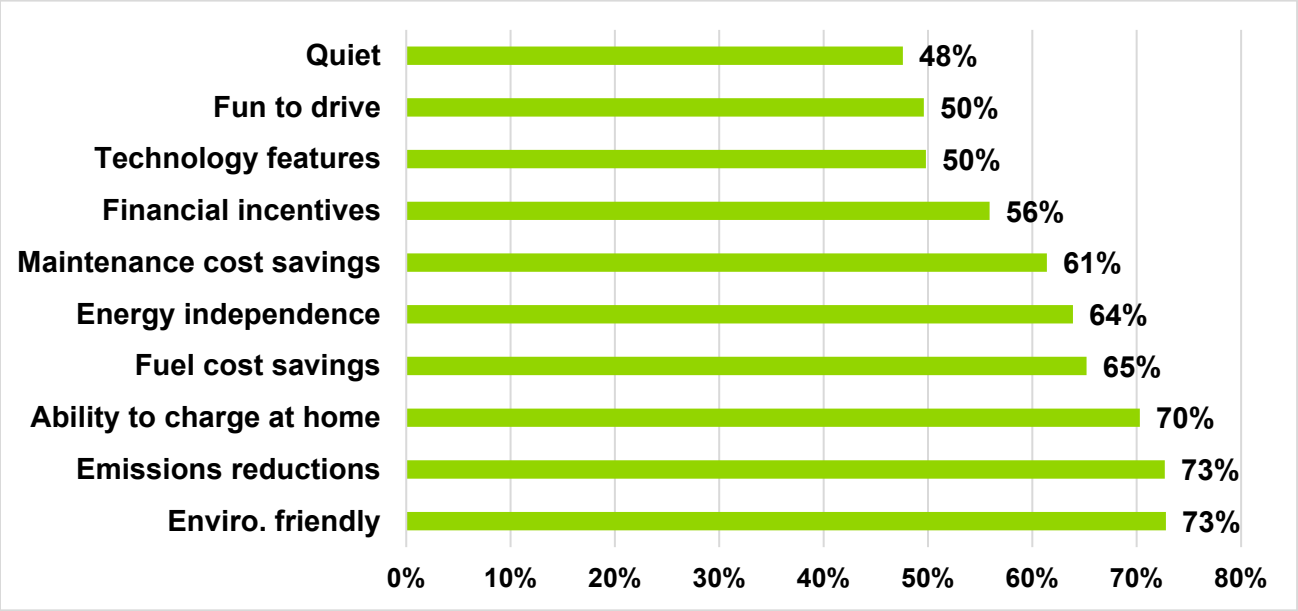
In 2020, approximately 10% of respondents reported that they owned some type of EV (including hybrid EVs). Of respondents, 28% reported having ridden in a PHEV, while nearly 14% had driven a PHEV. Fewer respondents reported having ridden in or driven a BEV, 23% and 12%, respectively. Direct experience is important in establishing greater comfort with new technologies and potentially increasing adoption rates. As Figure 43 shows, when asked to

specify the importance of 10 EV-related factors in shaping their interest in PHEVs and BEVs, respondents reported being most motivated by three factors:

- Environmental friendliness of EV technology (73%)
- Emissions reductions achieved by EV technology (73%)
- Convenience of charging from home (70%)

Four additional factors were identified as important by more than 50% of respondents: fuel cost savings (65%), energy independence (64%), maintenance cost savings (61%), and financial incentives (56%).

**Figure 43. Customer Motivations to Purchase a PEV (n=631)**




Question: "Please indicate the importance of the following factors in determining your interest in purchasing/leasing a PHEV/BEV (1-7 scale)"

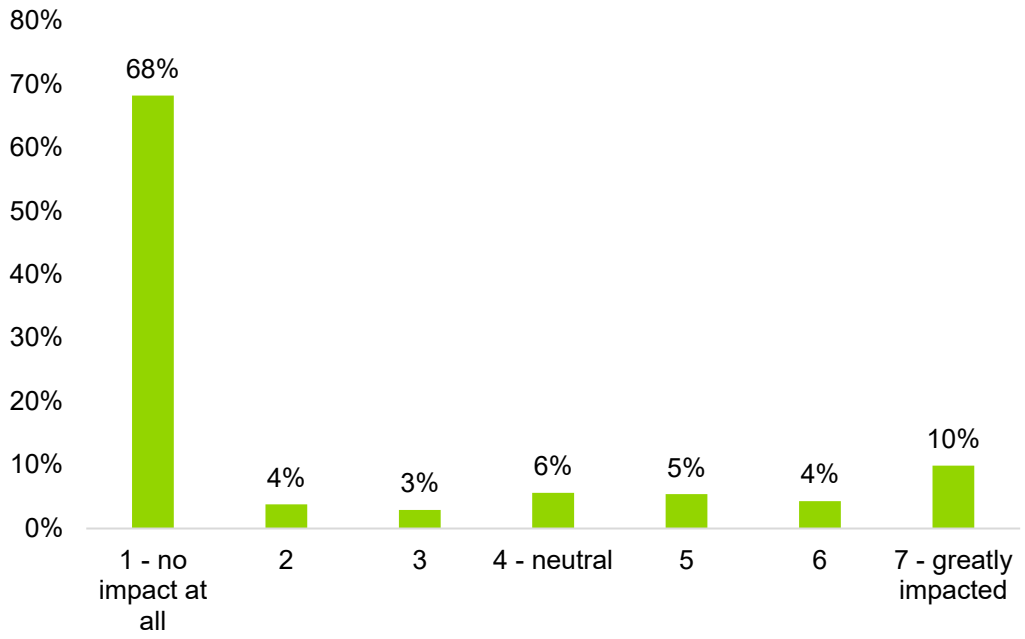
*Source: Guidehouse analysis*

Customer experience and motivations were offset by several potential barriers to adoption. Among the barriers, short-term purchasing plans were dampened between 2019 and 2020, as were the proportion of respondents indicating a high likelihood of purchasing a PHEV or BEV. This dampening may reflect the influence of the coronavirus outbreak. As Figure 44 shows, when respondents were asked whether the pandemic had impacted their vehicle purchasing plans, nearly 20% indicated some impact. Of those respondents whose purchasing plans were impacted, respondents reported a lower likelihood of a PEV purchase.

Other notable barriers include respondents' willingness to pay more for a PEV, limited access to an electrical outlet at home, and limited availability of workplace charging. Approximately one-third (34%) of respondents reported they were not willing to pay more for a PEV, while another 22% indicated they would only be willing to pay an additional $2,000, an insufficient amount to cover the true cost difference between internal combustion engine (ICE) vehicles and PEVs. While most respondents (91%) indicated they did have a dedicated parking space,

approximately one-third of respondents with dedicated parking did not have access to an electrical outlet. Finally, while nearly 52% of respondents reported they work away from home either some or all of the time, only 11% of those working away from home reported having access to workplace charging.

**Figure 44. Self-Reported Impact of Coronavirus Outbreak on Vehicle Purchasing Plans (n=631)**




Question: "Please indicate the extent that the corona virus outbreak has had on your plans to purchase your next vehicle (1-7 scale)"

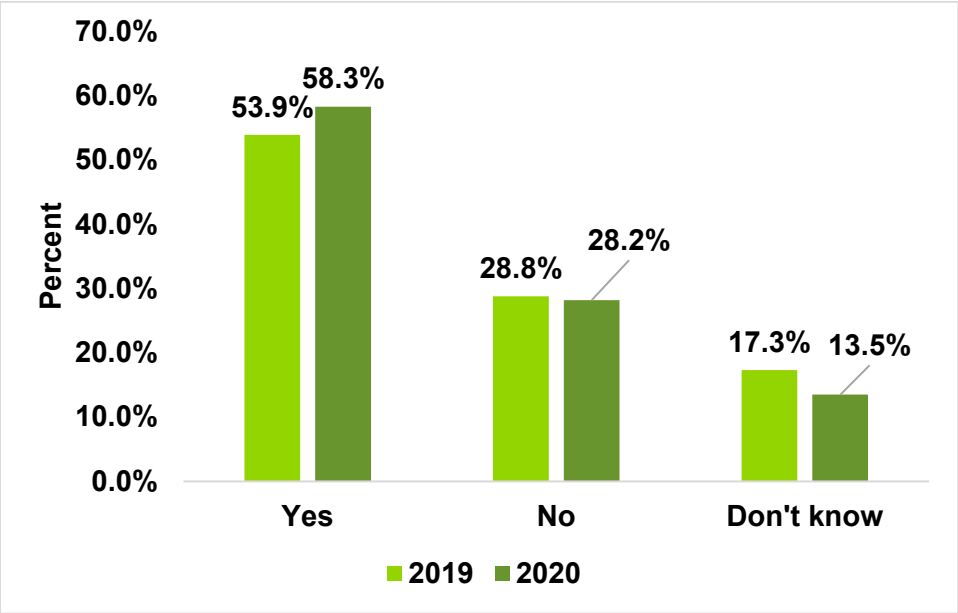
*Source: Guidehouse analysis*

### *3.4.1.5 Customer Understanding of the Technology and the Economics of Ownership*

Survey responses revealed low-to-moderate levels of technology knowledge and the economics of ownership, with little change in knowledge between 2019 and 2020. Survey data indicated that approximately 31% of respondents were knowledgeable of DCFC charge time, while 37% of respondents could correctly identify the drivable range of a typical sedan-style BEV. Similarly, 37% of respondents were aware of the lower maintenance costs associated with BEVs when compared to traditional vehicles with ICEs. Forty-two percent of respondents were able to correctly identify the general cost of a standard BEV, such as a Chevrolet Bolt or Nissan Leaf. When asked about charging availability, 58% of respondents indicated they were aware of at least one public EV charging location within 25 miles of their home; however, only 21% were aware of any sources of free information that could help them locate the nearest publicly available EV charging stations.[8]

[8] The statistical significance of the mean difference in awareness between years was not tested.

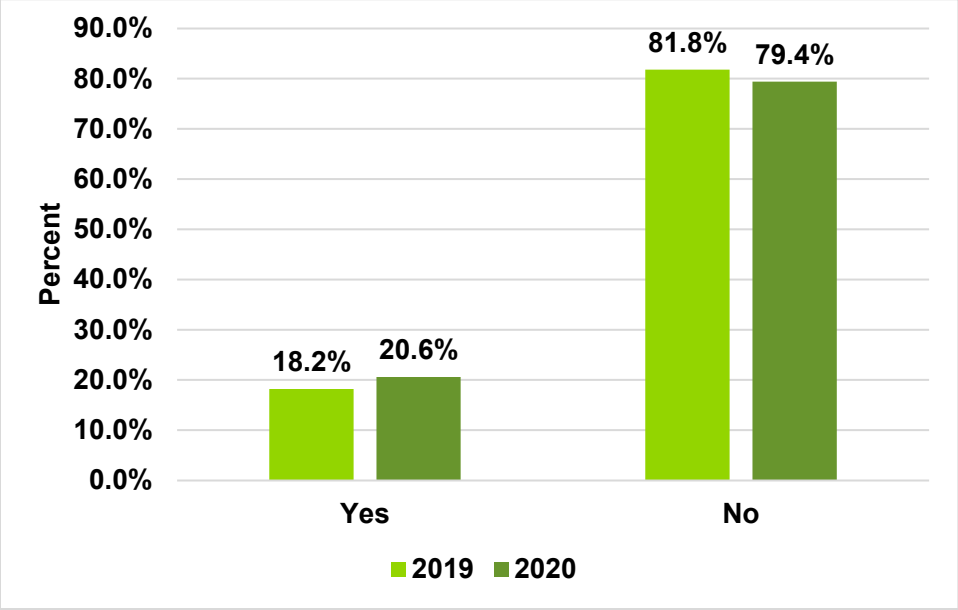
**Figure 45. Public Charging Awareness (n=631)**




Question: "Are you aware of any public electric vehicle charging locations within 25 miles of your home?"

*Source: Guidehouse analysis*

**Figure 46. Charging Location Information Awareness (n=631)**



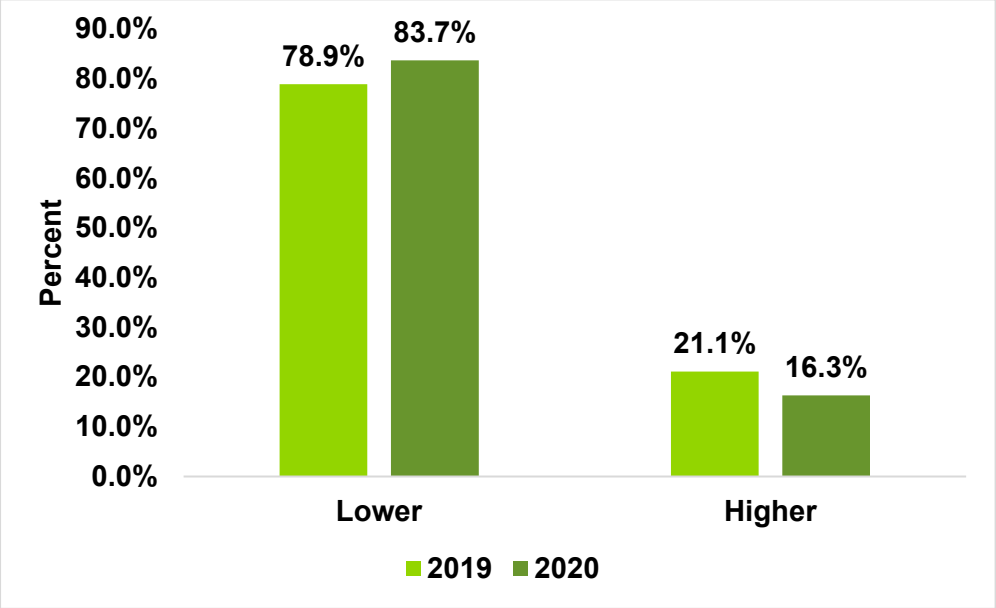

Question: "Are you aware of any source of information to help you locate the nearest publicly available electric vehicle charging station?"

*Source: Guidehouse analysis*

### *3.4.1.6 Customer Awareness of Environmental and Social Benefits*

Respondents were highly aware of the climate benefits of driving BEVs. In 2020, 84% of customers correctly indicated that the GHG emissions from BEVs are lower than emissions from vehicles that use gasoline or diesel fuel. As Figure 47 shows, customer awareness of the environmental benefits of BEVs slightly increased in 2020.[9]

**Figure 47. Awareness of GHG Emissions Associated with BEVs (n=631)**




Question: "Has the installation of this station, or any other Pacific Power public charging station, reduced any of the following?"

*Source: Guidehouse analysis*

### *3.4.1.7 Influence of Outreach and Education Activities and Vehicle Experience on Perceptions of PEVs and Intention to Purchase*

Guidehouse used bivariate analysis[10] to consider the potential influence of Pacific Power's outreach and education activities on a set of four particular program outcomes:

- Customer impressions of PHEVs and BEVs
- Customer interest in the potential purchase of PHEVs and BEVs
- Customer consideration of PHEVs and BEVs for next purchase
- Customer likelihood of purchasing a PHEV or BEV

[9] The statistical significance of the mean difference between years was not tested.

[10] Guidehouse used a t-test to determine the significance of the differences between mean scores for respondents exposed to Pacific Power's outreach and education activities to those respondents not exposed to outreach and education activities.

The influence of vehicle experience on the same outcome variables was also assessed using bivariate analysis. Both sets of bivariate findings are presented in this section.

The first set of bivariate analyses used survey data to assess the relationship between customer exposure to Pacific Power's outreach and education activities and various measures of customer interest in PEVs. Guidehouse expected that respondents exposed to outreach and education activities would have more favorable impressions of PEVs, greater interest, be more likely to consider a PHEV or BEV, and would express a higher likelihood of purchase. As mentioned earlier in this report, exposure to a range of different outreach and education activities was captured in a composite outreach and education measure.

Survey results show that respondents had limited levels of exposure to outreach and education activities. These low levels of exposure may limit the measurable relationship between exposure to outreach and education activities and program outcomes and should be kept in mind when considering the bivariate results. Notwithstanding the limited duration of outreach and education activities, the use of bivariate analysis indicates that respondents' exposure to even low levels of outreach and education activities is positively associated with more favorable impressions of BEVs and to respondents' consideration of BEVs for purchase. Exposure to moderate levels of outreach and education is associated with higher levels of interest in BEVs; however, low levels of exposure to outreach and education activities did not have a significant relationship with respondent interest. Finally, outreach and education efforts were found to have a significant, positive relationship with BEV purchasing intentions, particularly among those respondents who indicated they were not considering the purchase BEV.

These findings suggest a set of positive and significant associations between outreach and education activities and desired program outcomes such as favorable impressions, interest, consideration, and purchasing intentions for BEVs. Interestingly, the same relationships do not appear to exist for PHEVs. The lack of significance for PHEVs may be due to higher levels of familiarity with PHEV technologies, lower levels of perceived risk associated with PHEVs, or other factors associate with the use of bivariate analysis.

#### *3.4.1.8 Influence of Vehicle Experience on Perceptions of PEVs and Intention to Purchase*

Guidehouse's analysis of survey data also assessed the bivariate relationship between vehicle experience and various measures of customer interest in PEVs. The evaluation team expected that respondents who had the benefit of in-car experiences would have more favorable impressions of PEVs, greater interest, be more likely to consider a PHEV or BEV, and would express a higher likelihood of purchase. Respondent experience with PEVs was measured as having either ridden in or driven in a PHEV or BEV.[11] Survey findings indicate that having ridden in either a PHEV or BEV is associated with more favorable impressions, greater consideration of purchase, and a greater likelihood of purchasing either a PHEV or BEV. Riding in a PEV does not seem to be associated with higher levels of interest.

Having driven a BEV is associated with greater interest, greater consideration, and a higher likelihood of purchasing a BEV but not more favorable impressions of BEVs. These findings may indicate that favorable impressions of BEVs tend to precede a person's decision to seek

[11] Guidehouse used a t-test to determine the significance of the differences between mean scores for respondents reporting having ridden or driven a PHEV or BEV to those respondents who had not ridden or driven the same vehicles.

out driving opportunities. The relationship between driving a PHEV and customer perceptions and intentions appears to be limited to the likelihood of purchase. In other words, PHEV driving experience does not appear to be associated with favorable impressions, interest, or consideration, but it does appear to be linked with a greater likelihood of purchase. These findings may indicate a greater level of familiarity with PHEVs or lower perceptions of risk associated with PHEVs given the option of using conventional fuels. Table 3-1 summarizes these findings.

**Table 3-1. Influence of Experience on Perceptions and Intentions**

| Measure | Ridden In | Driven |
|---|---|---|
| **Impression** | Better impressions of PHEVs but not BEVs | No change in impressions for either BEVs or PHEVs |
| **Interest** | Higher levels of interest for both PHEVs and BEVs | Increased interest in BEVs but not PHEVs |
| **Consideration** | Increased consideration of both PHEVs and BEVs | Increased consideration of BEVs but not PHEVs |
| **Intention to Purchase** | Increased intention to purchase both PHEVs and BEVs | Increased intention to purchase both PHEVs and BEVs |

*Source: Guidehouse analysis*

### 3.4.2 Technical Assistance Evaluation Findings

Guidehouse performed two surveys to gather insights from recipients of Pacific Power's EVSE technical assistance activities. The first, a post-assessment survey, was performed in December 2019, shortly after some of the first customers completed participation in the initial site assessment. The post-assessment survey was designed to collect information about participant motivations, concerns, experiences, and satisfaction with the assessment, as well as the impact of the assessment on their thinking and decision to move forward. The second survey, an end-of-project survey, was performed in August 2020 after technical assistance participants had made decisions about the EVSE installation and had progressed toward the installation of charging stations or even completed installation. The end-of-project survey was designed to identify the barriers and challenges that participants faced, whether their implementation plans had changed, and, if they had changed, how. It also assessed overall satisfaction with the initiative and gathered recommendations for improvements. Post-assessment survey data was collected for five participants. End-of-project survey data was collected for 22 participants.

#### *3.4.2.1 Post-Assessment Survey Results*

The most common sources of motivation reported by participants included environmental concerns and recognition that there were not enough chargers in southern Oregon. Participants were motivated to apply for assistance because they recognized the need for and value of technical expertise or needed financing to pursue the project. Despite their motivation, some participants expressed concerns about the availability of funding, the cost of installation, finding the right vendors, the need for ongoing maintenance, and how the power would be paid for.

Participants reported high levels of satisfaction with their experiences with the application process, the assessment, and follow-up communications. Using a 5-point scale ranging from

very dissatisfied (1) to very satisfied (5), participant satisfaction scores in eight out of 10 categories averaged a score of 4 or above. Participants were most satisfied with the knowledge of the assessor (5) and least satisfied with the follow-up contact (3.2) and the time required to provide assessment results (3.8). Table 3-2 summarizes the satisfaction measures for the remaining assessment activities.

**Table 3-2. Post-Assessment Satisfaction Scores**

| Satisfaction Topic | Average Satisfaction Score |
|---|---|
| Ease of application process | 4.0 |
| Application response time | 4.2 |
| Clarity of application response | 4.2 |
| Ease of scheduling onsite assessment | 4.8 |
| Quality of onsite assessment | 4.4 |
| Format of assessment information | 4.2 |
| Clarity of assessment information | 4.0 |

*Source: Guidehouse analysis*

Participants were also asked to indicate the three most valuable parts of the assessment report. The largest proportion of participants found the project cost estimate to be most valuable (60%). Others identified the electric utilization assessment (40%), siting information (40%), and preliminary project design information (20%). One participant indicated the assessment helped them in various ways including overcoming the hurdle of getting the information they needed when they were not sure where else to look. Another said that the assessment helped them validate that the path they were on was good, and a third participant indicated the assessment helped them open discussions with vendors.

When asked if they are planning to implement the project, 60% indicated it was very likely while 40% indicated they were definitely planning to implement.

When asked about challenges moving forward, participants were concerned with:

- Picking the right charging units
- Funding for the project, figuring out which charging franchise to use, who exactly owns the equipment, how to charge users for the service, and the ability to add chargers as EVs become more numerous
- Coordinating with the City of Portland and working through the approval process
- Finding vendors willing or able to provide a quote for the chargers and installation

#### *3.4.2.2 End-of-Project Survey Results*

Twenty-two organizations participated in the end-of-project survey. Among those who took the survey, half indicated that the installation of chargers had not been started yet, three had decided against installation, and three had put installation on hold. Installation had been completed or was underway for three of the respondents while two were unsure about the current status.

Participants who indicated that installation had not started yet provided a range of reasons, as Table 3-3 shows. Reasons for delaying installation and deciding against installation are shown in Table 3-4 and Table 3-5, respectively.

**Table 3-3. Reasons Installation Has Not Been Started**

| Reason | Number Reporting |
|---|---|
| Applying for grant | 3 |
| COVID-19 pandemic | 3 |
| No funding yet | 1 |
| Not enough information | 1 |
| Other | 3 |

*Source: Guidehouse analysis*

**Table 3-4. Reasons for Delay in Installation**

| Reason for Delay | Number Reporting |
|---|---|
| Inability to secure funding | 1 |
| COVID-19 pandemic | 1 |
| Available power is insufficient | 1 |
| Will try again in 2021 | 1 |
| Expense and indecisiveness | 1 |
| Other | 1 |

*Source: Guidehouse analysis*

**Table 3-5. Reasons for Deciding Against Installation**

| Reason for Decision Against | Number Reporting |
|---|---|
| Cost vs. use | 1 |
| Space requirements | 1 |
| Primary benefit for tourism vs. local residents | 1 |

*Source: Guidehouse analysis*

When asked directly about the impact of the COVID-19 pandemic on their decision to complete the installation of the charging station, 45% of participants indicated the pandemic did not impact their decision, 32% indicated it delayed the installation, 14% said it caused them to decide against installation for the foreseeable future, and 9% indicated that it influenced them in some other way.

Approximately half of respondents indicated that changes were made to the original project design or implementation plan after the assessment, while half indicated that no changes were made. Changes included following recommendations to upgrade service, changing the

configuration of different charger types, changing the planned location of chargers, and changes in the timing of the work.

Of respondents, 41% indicated the technical assistance they received improved the design of the charging station, 27% said the design was not improved, and 32% were uncertain. Twenty-seven percent of respondents said the technical assistance improved the cost-effectiveness of the charging station, 32% indicated that cost-effectiveness was not improved, and 41% were uncertain.

Toward the end of the project, overall satisfaction with the technical assistance program averaged 7.9 on a 10-point scale; scores ranged from 4 to 10, and 69% of participants provided a score of 8 or above. Table 3-6 shows participant satisfaction with various pilot elements.

**Table 3-6. End-of-Project Satisfaction Scores**

| Satisfaction Topic | Average Satisfaction Score |
|---|---|
| Ease of application process | 8.8 |
| Ease of installation | 9.3 |
| Value of information and services | 8.4 |
| Clarity and comprehensibility of technical assistance | 8.3 |
| Time commitment required | 8.2 |
| Ease of assessment process | 8.2 |
| Transparency of the assistance process | 8.4 |
| Timeliness of technical assistance feedback | 8.1 |
| Level of effort required | 8.0 |
| Responsiveness of technical assistance program staff | 8.4 |

*Source: Guidehouse analysis*

Customer satisfaction was also measured by asking respondents how likely they would be to recommend the program to others using a 0-10 scale, where 0 is not at all likely and 10 is very likely. As Table 3-7 shows, most respondents (73%) provided a score of 8 or above, with an average likelihood score of 8.5.

**Table 3-7. Likelihood to Recommend the Technical Assistance Program**

| Likelihood Score | Number | Percent |
|---|---|---|
| 0 | 0 | 0% |
| 1 | 0 | 0% |
| 2 | 0 | 0% |
| 3 | 0 | 0% |
| 4 | 1 | 5% |
| 5 | 3 | 14% |
| 6 | 0 | 0% |
| 7 | 2 | 9% |
| 8 | 2 | 9% |
| 9 | 1 | 5% |
| 10 | 13 | 59% |
| **Total** | **22** | **100%** |

*Source: Guidehouse analysis*

Finally, respondents were asked what changes they would recommend to the technical assistance program. Forty-one percent of respondents indicated they would not recommend any changes. The remaining participants made the following recommendations:

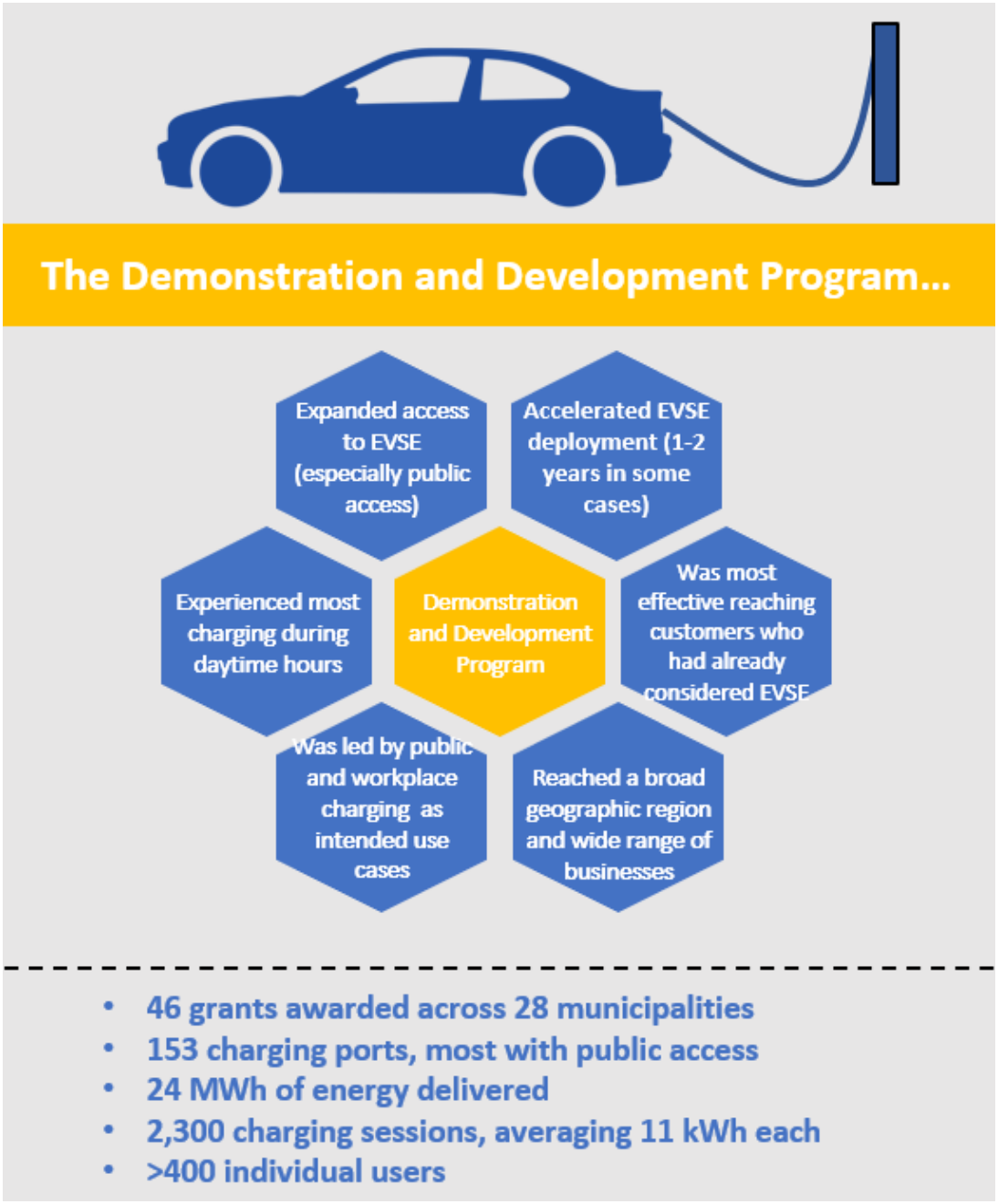
- Vet some of the hardware manufacturer salespeople to provide technical assistance
- Make it Pacific Power's responsibility and expense to analyze project power need in the area, perform power analysis, and design a stable power and interactive grid
- Provide a list of installers, types of EV stations, types of operation (such as buy, lease, on network, off network)
- Advertise more to make it more widely known
- Present results more clearly and conduct more proactive follow-up to make sure the information is understood
- Allow for direct communication with Pacific Power team members once the project is given a grant
- Do not require a commercial account for all business applicants
- Expand funding

# 4. Demonstration and Development Pilot Program

## 4.1 Key Findings – Demonstration and Development Program

The Demonstration and Development program achieved key goals of expanding access to EVSE and enabling customers to deploy EVSE sooner or when they otherwise would not have. Figure 48 outlines the key evaluation findings.

**Figure 48. Demonstration and Development Findings**




*Source: Guidehouse*

The Demonstration and Development program expanded access to EVSE in Pacific Power's service territory, and **appears to have enabled more or earlier deployment of EVSE than would have otherwise occurred in the absence of the program**. The grant-funded project sites are distributed across a wide geographic area in Oregon. The overwhelming majority of project sites did not have EVSE prior to participating in the program, and about three-quarters of the grant-funded EVSE will be accessible by the public for charging. Program funding reached a wide range of business types, and workplace charging was also a leading use case after public charging.

**The program appears to be most effective at reaching customers who had already considered installing EVSE at their businesses, although many were in the early stages of planning.** About one-quarter of grant recipients had not considered installing EV charging infrastructure before participating in the program.

Even though many customers had already considered installing EVSE, only a small portion would have installed the same equipment at the same time without the program. Participant feedback suggests the **program accelerated the timing of EVSE deployment by 1-2 years, even for those who may have installed EVSE without the program**. Findings indicate that program experience may stimulate the market by influencing some participants to install additional EVSE beyond that funded by the program.

More than 24 MWh of energy was dispersed from the program EVSE during about 2,300 charging sessions over the evaluation period. **Most charging occurred during daytime hours, following a similar profile as Pacific Power's public pods**, which were discussed in Section 2. Although more than 400 individual users charged their EVs, **a considerable portion of charging sessions were completed by a relatively small number of individual users**. This suggests that the program EVSE is experiencing repeated use by a limited number of employees, guests, or patrons that frequent the grant recipient locations.

## 4.2 Demonstration and Development Program Summary

The Demonstration and Development pilot program provides customers with grant funding to offset the costs of installing EVSE at nonresidential sites. The grants are awarded through a competitive application process with the goal of identifying projects that will address key market barriers and reach areas that are underserved by the existing market. Customers can receive funding that covers up to 100% of the total eligible costs of their projects. The funding was enabled by the Oregon Clean Fuels Program.

Pacific Power administered quarterly grant awarding cycles beginning in Q4 2018 and ending in Q3 2020. A third-party grant manager applied certain predetermined evaluation criteria to score each project for the award process. These criteria were summarized in Pacific Power's program overview[12] and included:

- Project feasibility
- Use of funds

[12] Pacific Power, "Oregon Electric Mobility Grant Application," https://www.pacificpower.net/content/dam/pcorp/documents/en/pacificpower/savings-energy-choices/electric-vehicles/Oregon_Electric_Mobility_Grant_Overview.pdf

- Innovation and analysis
- Equity
- Educational, environmental, and community benefits

According to the data provided to Guidehouse, Pacific Power selected 49 projects for grant award funding. The total funding amounted to just over $1.6 million, which covered about 56% of the total reported project costs. At the time of this evaluation report, Pacific Power notified Guidehouse that at least three of the projects would not be proceeding to completion for various reasons, meaning that the anticipated funding dispersal was closer to $1.4 million for 46 projects.

## 4.3 Demonstration and Development Evaluation Objectives and Activities

### 4.3.1 Objectives

Pacific Power wanted to understand how three specific market barriers were affected by utility-sponsored grant funding to supplement the cost of private EVSE deployment at nonresidential customer sites:

- **High upfront cost to invest in electric transportation technology:** Explored the effect of grant funding to enable EVSE projects to occur at greater scale or earlier timing than would have otherwise occurred in absence of the program.
- **Lack of accessible EVSE:** Explored how the grant funding enabled EVSE development in challenged market segments or underserved geographic locations.
- **Lack of awareness of electric transportation options and benefits:** Explored how the awareness or educational activities undertaken by grant recipients may have promoted broader awareness of EV charging technologies and how grant funding may have supported more advanced or innovative EVSE configuration than would otherwise have occurred.

### 4.3.2 Activities

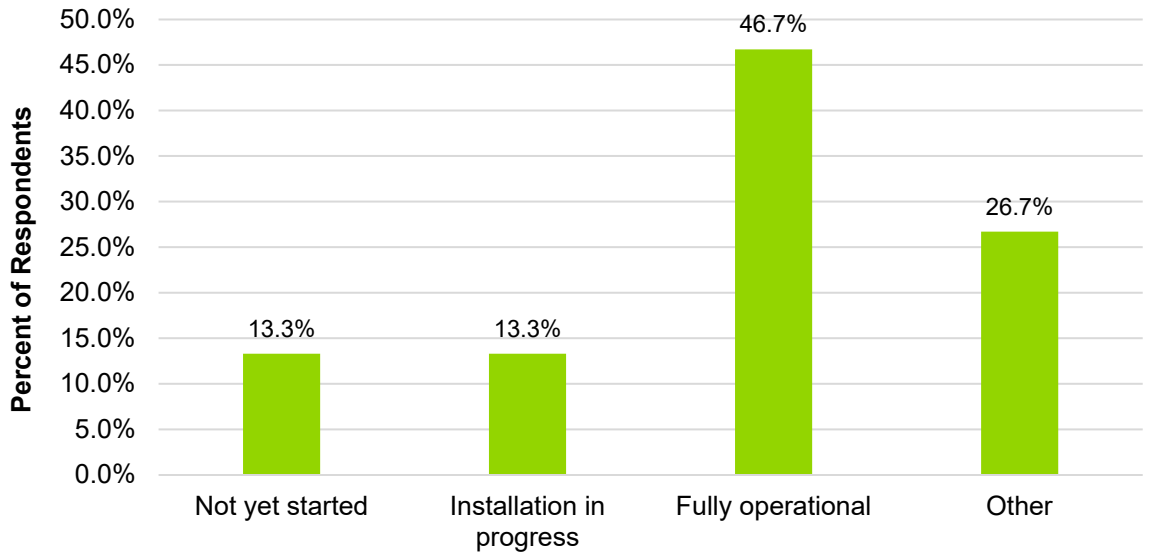
Guidehouse performed the following activities to address the evaluation objectives:

- **Assess grant project characteristics:** Guidehouse reviewed information from grant project application files to summarize qualitative and quantitative characteristics of the project sites. Pacific Power provided Guidehouse with periodic data about the project sites selected for grant awards, along with the grant application file from each site. The evaluation team used this information to develop a summary of the project characteristics to understand the technology trends and site features being represented by the program.
- **Survey grant recipients:** Guidehouse administered electronic and phone surveys with customers who received grant awards to assess their experience with the program. The surveys also evaluated the impacts that grant funding had on the equipment selection, project scope, and timing relative to what may have happened in the counterfactual scenario where customers did not receive grants. The initial survey outreach was intended for early 2020 but was delayed until May 2020 due to the coronavirus outbreak.

Guidehouse performed a second wave of survey outreach in July 2020 to increase the response rate.

Guidehouse received completed responses from 15 grant recipients, which represents about one-third of all participants. As Figure 49 shows, the survey responses are representative of participants at various stages project completion, ranging from those who have not yet started the development process to those with fully operational EVSE. Of the respondents who selected the Other option, three were in the design and contracting phase and one was operational but experiencing difficulties with cellular connectivity at the time of the survey.

**Figure 49. Status of EVSE Project (n=15)**




Question: "How would you describe the current status of your EV charging infrastructure project?"
*Source: Guidehouse analysis*

- **EVSE utilization analysis:** Guidehouse analyzed all available data from the grant project EVSE to develop a set of metrics that characterize how the chargers are being used and are affecting the grid. The available data included session-level information unique to each charging event and hourly and 15-minute interval data for energy (kWh) and demand (kW) impacts. Data was only available from the projects that had completed construction and were connected to the ChargePoint platform (11 projects).

## 4.4 Demonstration and Development Results and Findings

The evaluation findings are presented to illustrate how the program addressed the key market barriers Pacific Power identified.

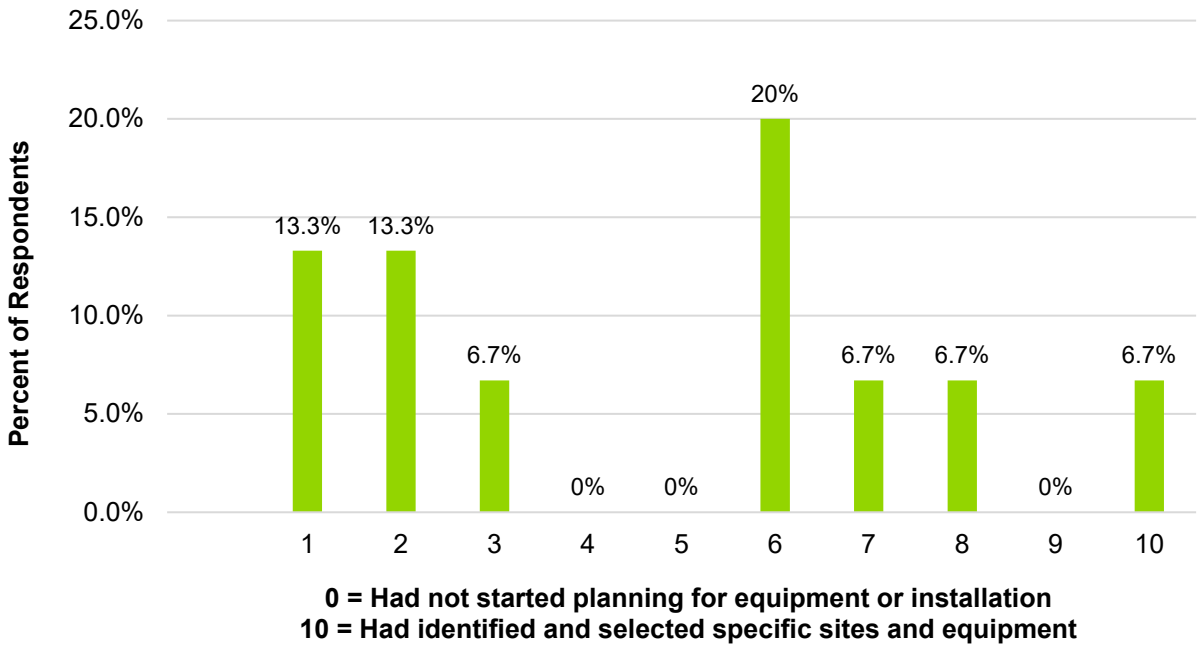
### 4.4.1 How the Program Addressed the High Upfront Cost of EVSE for Nonresidential Customers

Guidehouse used the participant surveys to evaluate the program impact on this barrier. The surveys included a series of questions exploring the impact of grant funding on the ultimate

project outcome. These questions assessed whether the grant recipient had any prior existing plans to develop EVSE, whether the funding enabled greater scope or scale of the EVSE project, whether the EVSE was installed sooner than otherwise would have occurred, and whether the project resulted in extended benefits to the participants.

Nearly three-quarters (73.3%) of survey respondents reported they considered installing EV charging infrastructure at their facilities prior to participating in Pacific Power's program. Those who had considered installing were then asked to rate, prior to participating in the program, how much planning they had done for equipment selection or installation. As Figure 50 shows, about 45% of respondents indicated minimal planning, about 45% indicated some level of planning, and 9% indicated that they had already identified equipment and specific sites. This finding suggests the program was effective in reaching customers in the early stages of considering EV charging infrastructure and a notable portion (>25%) of respondents who had not considered EV charging infrastructure at all.

**Figure 50. Prior Planning for EVSE at Customer Sites (n=11)**



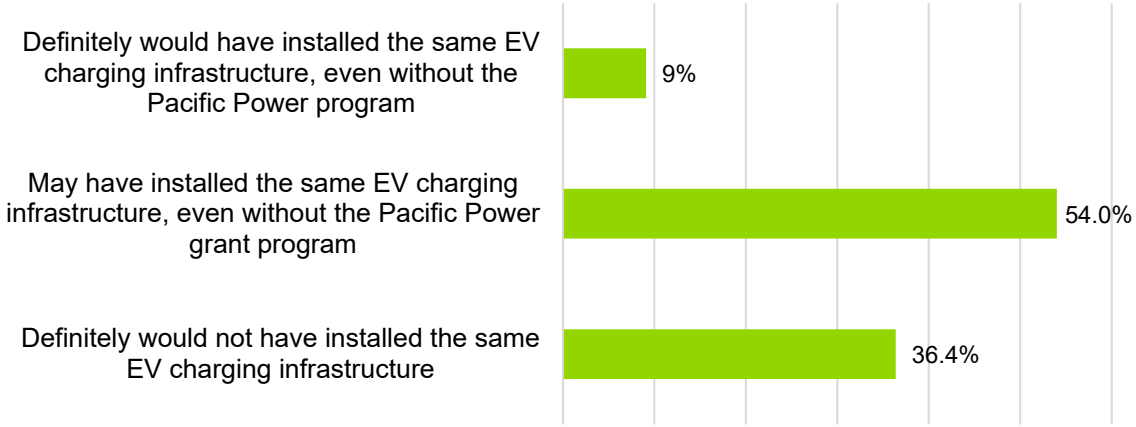

Question: "Please identify how far along you were in your plans to install charging equipment before participating in the grant program."

*Source: Guidehouse analysis*

To explore the counterfactual scenario further, Guidehouse asked those that had previously considered installing charging infrastructure to indicate the likelihood they would have installed the same charging infrastructure in the absence of Pacific Power's program. Figure 51 shows that more than one-third (36.4%) of respondents definitely would not have installed the same EVSE in the absence of the program. More than half (54%) may have installed the EVSE, and 9% definitely would have installed the same EVSE without the program.[13]

[13] The respondent who indicated they would have definitely installed the same EVSE without the program (Figure 51) also selected "would have never installed without the program" to a follow-up question. Based on that respondent's

**Figure 51. Likelihood of Installing EVSE Without the Program (n=11)**

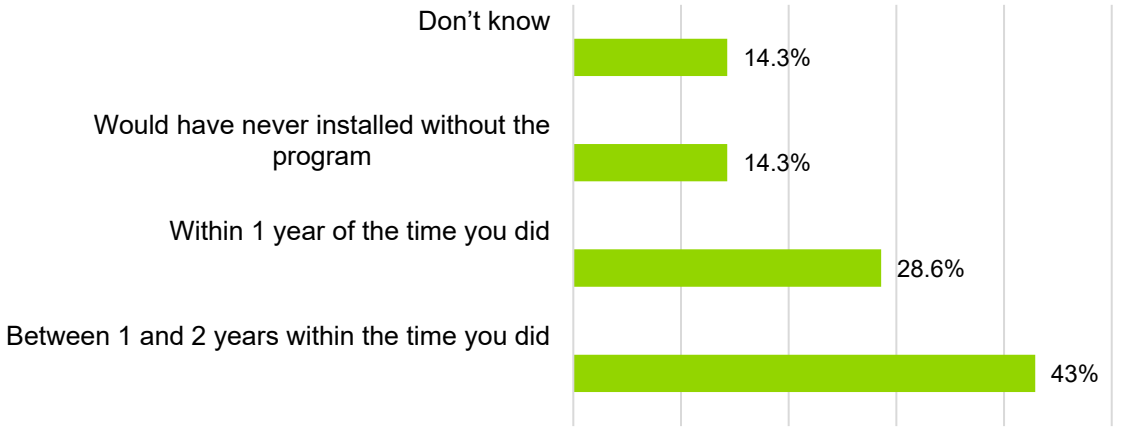



Question: "What is the likelihood that you would have installed the same EV charging infrastructure without the Pacific Power grant program?"

*Source: Guidehouse analysis*

Respondents who indicated they may have or definitely would have installed EVSE in the absence of the program were then asked to estimate the timing of when that installation would have occurred in the absence of the program. Figure 52 shows that the majority of respondents who may have installed EVSE without the program would have waited at least 1 year before doing so. This result suggests that the program accelerated the timing of EVSE deployment at grant recipient sites, even for those respondents who may have installed EVSE without the program.

**Figure 52. Timing of EVSE Installation Without the Program (n=7)**




Question: "Without the grant program, about when would you have installed the EV charging infrastructure?"

*Source: Guidehouse analysis*

selections for other questions, Guidehouse believes the response shown in Figure 51 was likely selected inadvertently by that respondent.

To understand how the program may have affected the equipment and site selection, Guidehouse asked respondents to comment about how the program changed their existing plans for EVSE installation in terms of site location, number of chargers, level of charging (i.e., L1, L2, DCFC), and equipment choice. The survey only asked these questions to respondents who indicated they had considered installing EVSE prior to participating in the program. Some findings are listed below.

- **Site location:**
  - One respondent indicated they specifically chose locations within Pacific Power's service territory.
  - One respondent indicated that an easily accessible public location was selected because the grant program enabled DCFC rather than L2 charging.
- **Number of chargers:**
  - One respondent indicated the program enabled a doubling of chargers at the site.
  - Three respondents indicated no change in the number of chargers.
- **Level of charging:**
  - One respondent indicated the program enabled them to consider DCFC.
  - Most respondents indicated no change in the level of charging they had considered.

Although these are a limited number of discrete reponses, they do suggest that the program eanbled customers to install additional ports (even if they were already planning some) and to consider fast charging when they may have previously considered L2.

### 4.4.2 How the Program Addressed the Lack of Accessible EVSE in Pacific Power's Service Territory

Guidehouse developed a summary profile of the grant recipient sites to understand key geographic, customer, technology, and user characteristics.

#### *4.4.2.1 Geographic Characteristics*

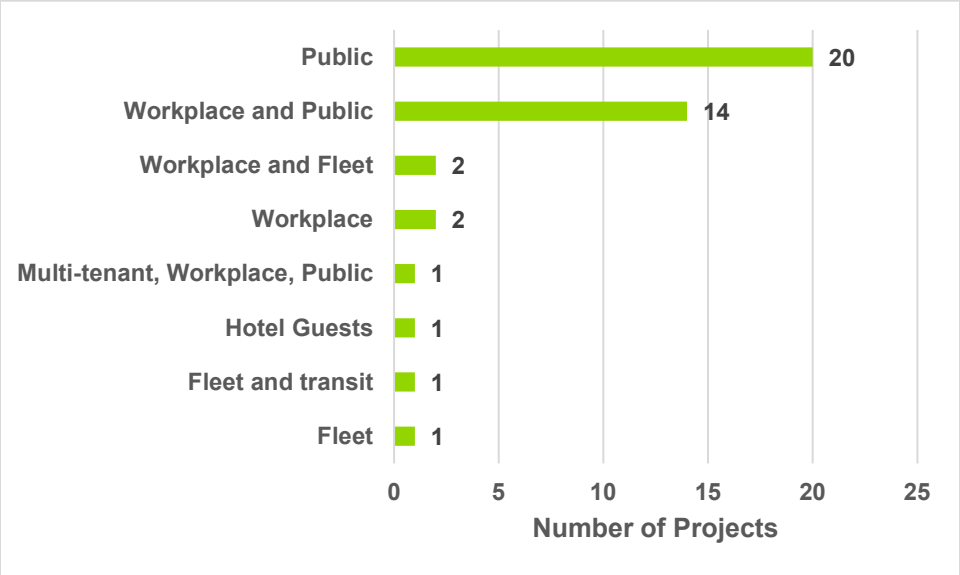
Pacific Power awarded grant funding for 46 projects at 45 different locations. One customer received grant funding for two separate projects. The projects included 153 EV charging ports. Some geographic characteristics of the project sites include the following:

- The project sites were distributed among 28 different municipalities across Pacific Power's service territory.
- Five project sites were located in Portland, with 13 charging ports. This represents about 8% of the charging ports.
- More grants were awarded to customers in Bend than any other municipality. Seven projects were awarded to customers in Bend for 27 charging ports. As presented in Section 2, the Bend location received the most use of Pacific Power's public charging pods.

#### *4.4.2.2 Customer Characteristics*

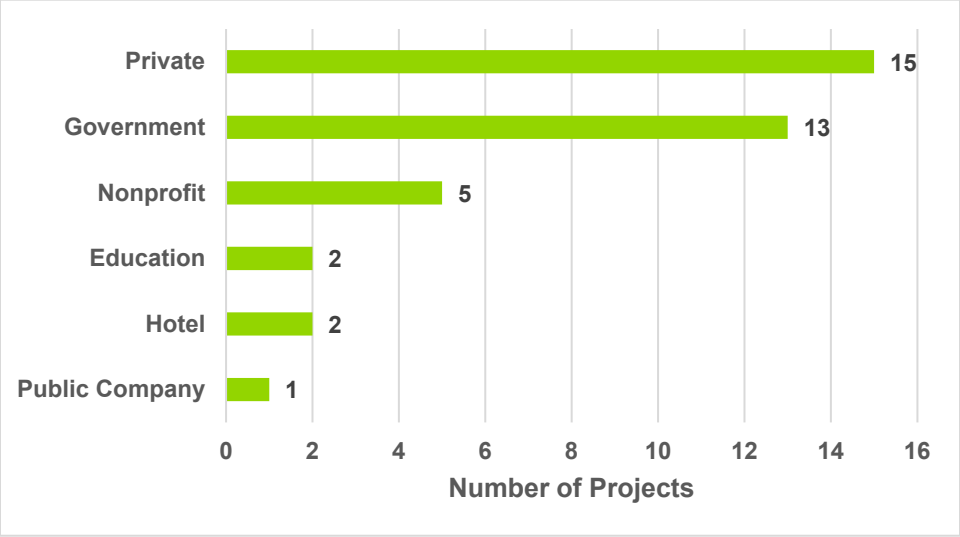
During the application process, grant recipients provide information about which market segments will be served by their EVSE, as well as information about their organization. Figure 53 shows that most charging projects will be accessible for public use, and that workplace charging is also a leading use case. Figure 54 shows that private and government facilities were the two leading organization types to receive grant awards. Some grant application files were missing this information.

**Figure 53. Grant Project Use Cases (n=42)**




*Source: Guidehouse analysis*

**Figure 54. Grant Project Organization Type (n=38)**



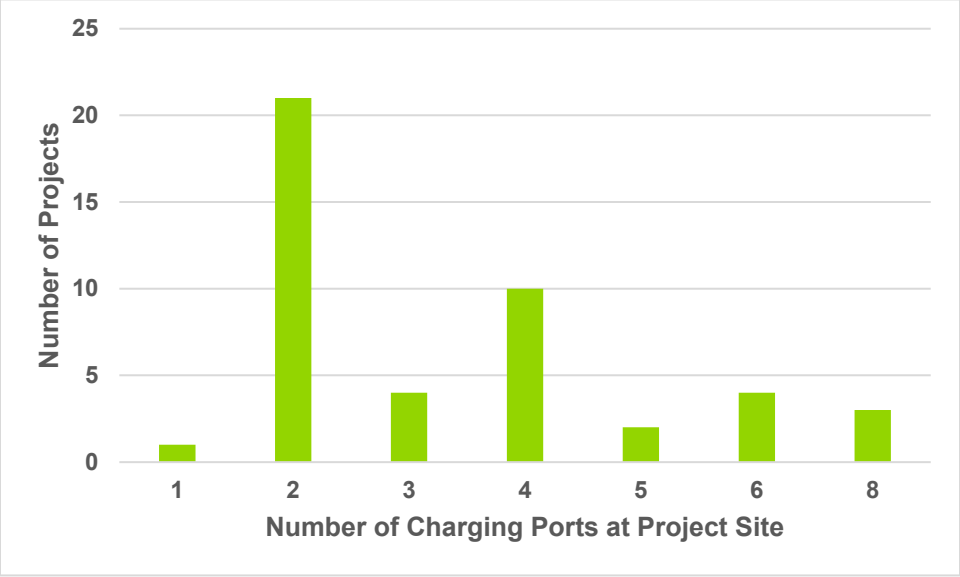

*Source: Guidehouse analysis*

More than half of the grant recipients indicated their facilities had dedicated parking spaces for EVs, and only three recipients indicated their facility already had some EV chargers prior to the grant project.

#### *4.4.2.3 Technology Characteristics*

Grant recipients selected EVSE equipment from nine different technology vendors, although a single vendor accounted for about half of all projects. The majority of grant projects will include L2 charging, with the most common reported charging capacity being 7.2 kW. In total, seven of the 46 projects will include fast charging EVSE. On average, each project includes 3.4 charging ports. The most common number of ports per project was two, as shown in Figure 55.

**Figure 55. Distribution of Charging Ports per Project (n=45)**



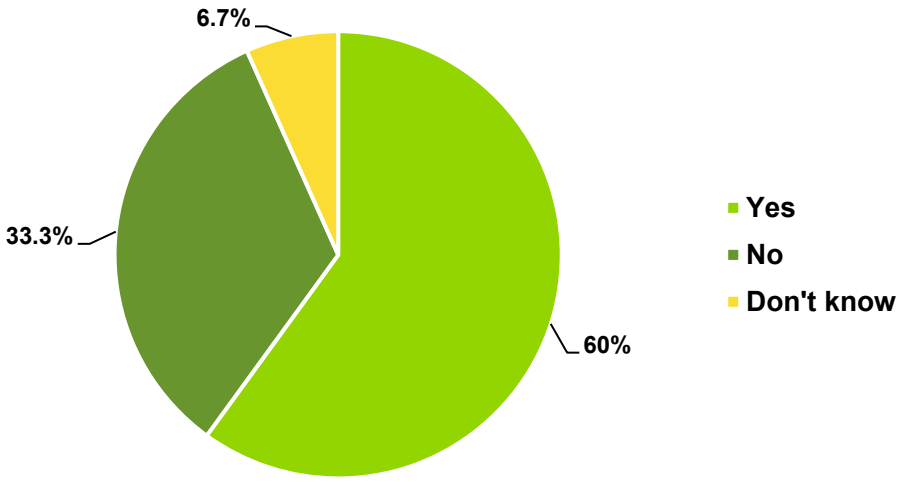

*Source: Guidehouse analysis*

### 4.4.3 How the Program Addressed the Lack of Awareness of Electric Transportation Options and Benefits

Guidehouse used the participant surveys and grant application files to collect information about how grant participants used their projects to spread awareness of electric transportation options. Figure 56 shows that 60% of survey respondents indicated they performed educational activities related to their EVSE grant projects. One-third of respondents had not conducted awareness activities as of the time of the survey, and the remainder were not sure.[14]

[14] Of the seven respondents whose EVSE projects were fully operational at the time of the survey, five reported they had conducted educational activities, one had not, and one didn't know.

**Figure 56. Grant Recipients Who Conducted Awareness Activities (n=15)**




Question: "As a result of participating in this grant program, has your business conducted any education activities related to EVs or EV charging?"

*Source: Guidehouse analysis*

Of respondents whose EVSE was either fully operational or undergoing installation, about half reported they placed signs at the charging stations to educate users and passersby and provided information about the charging stations to employees or customers at their facilities. Respondents also cited the following as activities they conducted to promote awareness of EVs or EV charging:

- "Blog posts, promotions to customers, local newspaper article"
- "Presentations at Earth Day and the local community college"
- "Reached out to local EV club to alert them of our installation"
- "A groundbreaking ceremony that featured many types of EVs for the public to learn about"
- "We have a digital educational kiosk about energy: solar, wind, EV, etc."
- "We continue to reach out to interested consumers both in and out of this service territory to provide information on EV adoption and EV charging. Each site we install helps us to provide infrastructure available to consumers, and we have an incentive to educate the public so they might use the chargers as well."
- Placing local signage to help drivers locate the charging station

These findings indicate that the majority of grant recipients make an effort to promote awareness about EVs or EV charging among patrons of their businesses, their employees, or through broader outreach in their communities. Although it is difficult to quantify the impacts that these educational efforts may have had on overall consumer awareness of electric transportation, Guidehouse did ask respondents who performed educational activities whether they had observed any change in the utilization of their EVSE. Of the nine respondents who received this question:

- Three indicated their charging stations are being used more frequently as a result of the educational activities.
- Three indicated that employees or customers have purchased EVs as a result of the charging stations.
- One reported no noticeable change in the charging station use.
- Two provided unspecified answers.

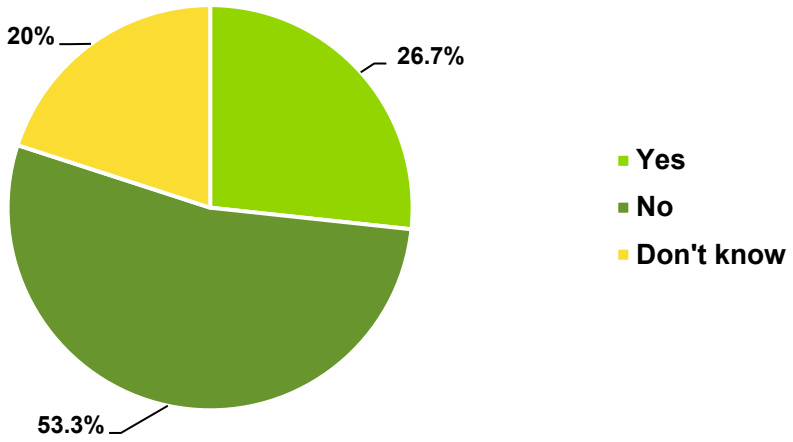
### 4.4.4 Additional Benefits Associated with Program Participation

Guidehouse asked survey respondents to identify additional benefits that their business may have experienced as a result of participating in the program and to identify whether participation in the program influenced them to deploy additional EV charging infrastructure beyond their grant project.

#### *4.4.4.1 Additional EVSE Beyond That Funded by the Program*

Figure 57 shows that about one-quarter of survey respondents indicated that their experience with the program influenced them to install additional EVSE beyond that funded by the grant award.

**Figure 57. Grant Recipients Who Considered Installing Additional EVSE (n=15)**




Question: "Did your experience with the grant program in any way influence you to incorporate additional EV charging infrastructure beyond the amount you installed using the grant funding?"

*Source: Guidehouse analysis*

Three of the respondents who reported the program influenced them to install additional EVSE provided further detail:

- One respondent indicated the program grant funding allowed their business to justify additional EV charging stations within their existing EV infrastructure budget. This respondent indicated that their business was in the process of identifying potential EVSE locations, but that they would likely be in Washington state "in Pacific Power's territory or elsewhere."

- One respondent indicated their business would plan to install an additional EV charger once they were able to justify the purchase based on utilization.
- One respondent indicated their business was able to install two additional Tesla chargers.

When asked to rate on a scale of 0-10 how important the program participation was in the respondent's decision to install the additional EVSE, all four respondents indicated 7 or higher, meaning the program was important or extremely important in their decision to pursue additional EVSE. These findings suggest the program may contribute to the deployment of additional EV chargers beyond those incentivized by the grant funding. The responses shown above indicate that at least two grant recipients leveraged their existing EVSE budgets to purchase additional EV chargers rather than reallocating those funds to another cause.

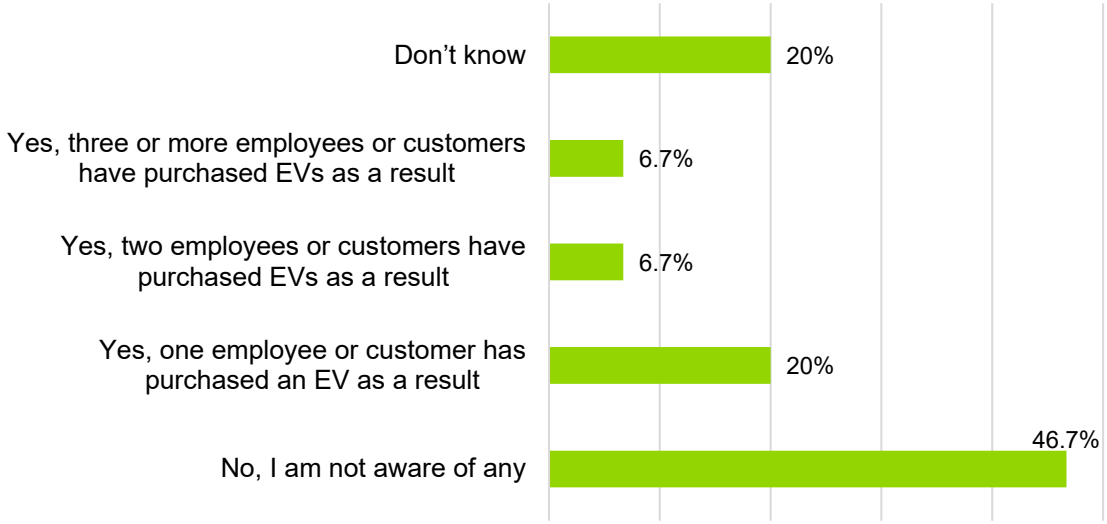
#### *4.4.4.2 Other Impacts, Benefits, and Information Reported by Program Participants*

The survey asked grant recipients if the addition of EV charging infrastructure had any notable impact on their business. Nearly three-quarters of respondents reported they didn't know of any impacts, and one respondent (~7%) indicated there was no impact. Three survey respondents (20%) indicated the EV charging infrastructure did have an impact, and the responses can be summarized as:

- The EVSE project "moved us forward in our environmental efforts which pleases our community, guests, and helps the bottom line."
- "People really appreciate [the EV charging stations], and many appreciate learning about EVs too. I think it helps our non-EV guests to see that EVs are not as complicated or intimidating as they had originally thought."
- "Owning EV charging infrastructure allows us real-world experience to offer to our customers."

The survey also asked respondents to indicate whether they were aware of any employees or customers who had purchased an EV as a results of the charging infrastructure at the respondent facilities. As Figure 58 shows, two-thirds of respondents were not aware of any EV purchases as a result of the charging infrastructure. However, three respondents (20%) reported they were aware of one person who purchased an EV, one respondent (6.7%) was aware of two people who had purchased an EV, and one respondent (6.7%) was aware of three or more people who had purchased an EV. Without collecting more information directly from those individuals, Guidehouse does not recommend converting this result into an attribution estimate for EV adoption. The responses do indicate the program-funded charging infrastructure may have contributed to the decision-making process of some individuals who purchased EVs.

**Figure 58. Reported Awareness of New EV Purchases (n=15)**




Question: "Are you aware of any employees or customers who have purchased an EV as a result of the charging infrastructure at your facility?"

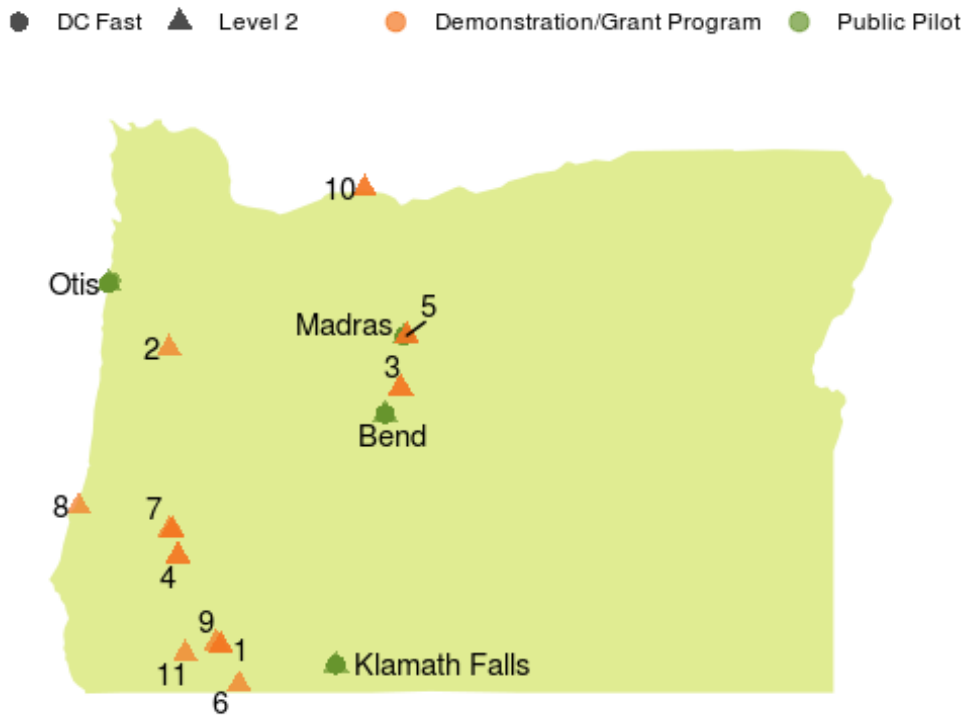
*Source: Guidehouse analysis*

### 4.4.5 EVSE Utilization Analysis

Guidehouse analyzed EVSE interval and session data from grant projects that had operational EVSE and were connected to the ChargePoint platform. Several additional grant projects were completed at the time of this report, but data was not available from the other EVSE hardware vendors. Figure 59 shows the location of the 11 grant projects included in this analysis, along with the locations of Pacific Power's public charging pods (discussed in Section 2).[15] This figure demonstrates a wide geographic distribution of the grant project EVSE sites throughout Oregon. All of these projects include L2 chargers, and there are 34 charging ports at the 11 project locations. For this report, Guidehouse presented the EVSE analysis on a per-project basis to align with how Pacific Power awarded the grant funding. A small number of projects include charging stations deployed at multiple locations, typically in close proximity. Therefore, the results for a given project site are an aggregate of all chargers and ports associated with that grant project.

[15] Since the timing of final data collection, additional grant projects have become operational.

**Figure 59. Location of Grant Project Sites Relative to Pacific Power Public Sites**




*Source: Guidehouse analysis*

### *4.4.5.1 Charging Session Activity*

Nearly 2,300 charging sessions occurred across the program EVSE during the time of this evaluation. Table 4-1 summarizes charging activity at each project site and the date that each project became operational. The first project became operational in June 2019, and the most recent project in April 2020. Most charging stations are used a few times each week, whereas the Grant Project 7 and Grant Project 10 sites experienced about three charging sessions per day, on average.[16]

[16] Grant Project 7 includes three charging stations located in on municipality: one at a public park, one at a library, and one in a parking garage.

**Table 4-1. Summary of Charging Activity by Project**

| Grant Project | Day of First Event | Ending Date | Number of Days in Operation | Number of Sessions | Average Sessions per Day | Average Sessions per Week | Average Sessions per Month |
|---|---|---|---|---|---|---|---|
| Grant Project 1 | 2019-06-10 | 2020-10-01 | 479 | 231 | 0.48 | 3.40 | 15 |
| Grant Project 2 | 2019-09-24 | 2020-10-01 | 373 | 138 | 0.37 | 2.60 | 11 |
| Grant Project 3 | 2019-09-26 | 2020-10-01 | 371 | 196 | 0.53 | 3.70 | 16 |
| Grant Project 4 | 2019-10-04 | 2020-10-01 | 363 | 69 | 0.19 | 1.30 | 6 |
| Grant Project 5 | 2019-10-11 | 2020-10-01 | 356 | 60 | 0.17 | 1.20 | 5 |
| Grant Project 6 | 2019-10-24 | 2020-10-01 | 343 | 70 | 0.20 | 1.40 | 6 |
| Grant Project 7 | 2019-11-08 | 2020-10-01 | 328 | 938 | 2.86 | 20.00 | 87 |
| Grant Project 8 | 2019-12-19 | 2020-10-01 | 287 | 38 | 0.13 | 0.90 | 4 |
| Grant Project 9 | 2020-02-18 | 2020-10-01 | 226 | 70 | 0.31 | 2.20 | 9 |
| Grant Project 10 | 2020-04-13 | 2020-10-01 | 171 | 449 | 2.63 | 18.40 | 80 |
| Grant Project 11 | 2020-05-13 | 2020-10-01 | 141 | 33 | 0.23 | 1.60 | 7 |

*Source: Guidehouse analysis*

On average, about 11 kWh was dispersed during a typical charging session, as shown in Table 4-2. This is very consistent with the amount of energy delivered from a typical L2 session at Pacific Power's public pods, which were discussed in Section 2. A total of 420 distinct users charged their EVs at the grant project sites.[17] On average, EVs were plugged into the station for 3.17 hours per charging session, although the EV was only charging for about 2.23 hours, on average. Figure 60 shows the distribution of charging session durations across all program EVSE locations.

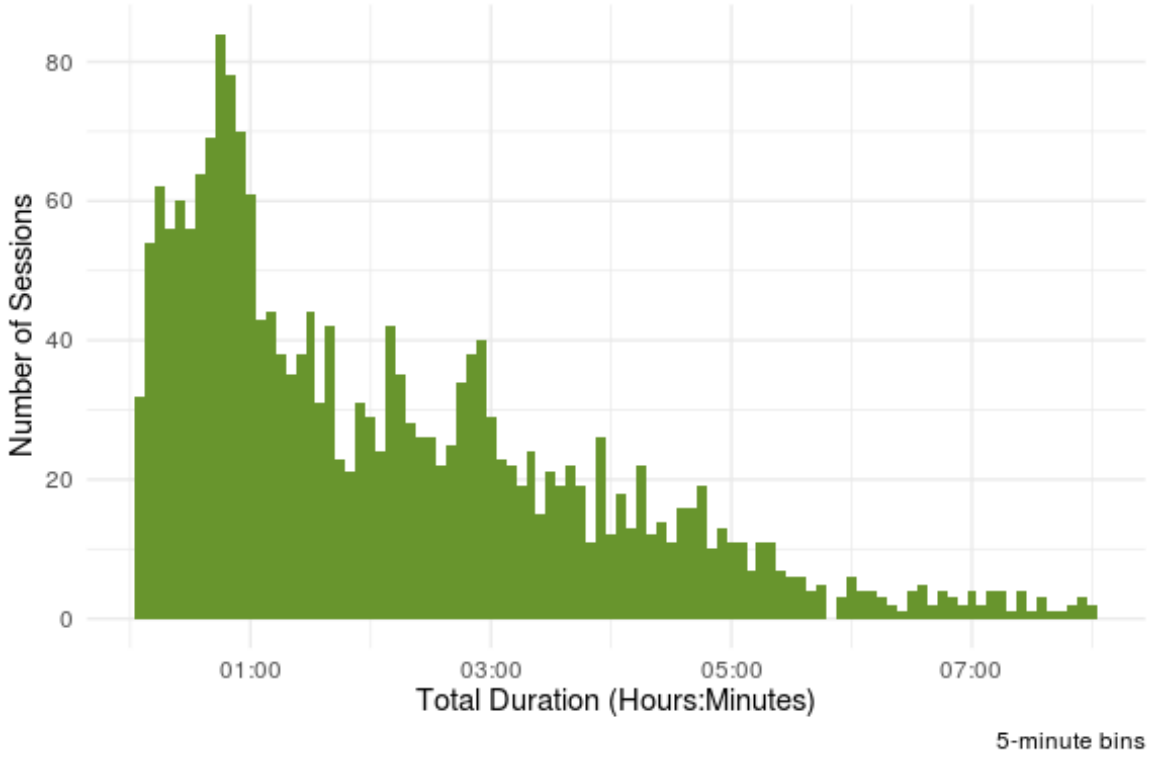
**Table 4-2. Session Characteristics**

| Station | Number of Sessions | Average Time EV Plugged in per Session (H) | Average EV Charging Time per Session (H) | Average Energy per Session (kWh) | Number of Distinct Users |
|---|---|---|---|---|---|
| All Stations | 2,292 | 3.17 | 2.23 | 10.59 | 420 |

*Source: Guidehouse analysis*

[17] A distinct user is defined by a unique account ID in the charging session data. Guidehouse did not have the information to determine if a single person could have multiple account IDs, or if multiple people could share a single account ID.

**Figure 60. Distribution of Grant Project EVSE Charging Session Duration (n~2,300)**

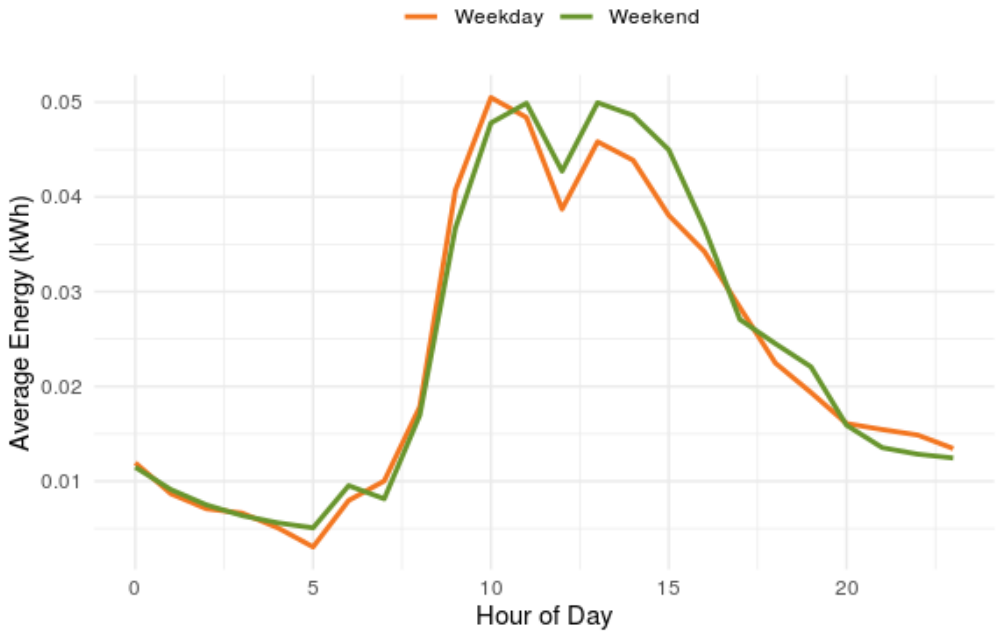



*Source: Guidehouse analysis*

### *4.4.5.2 Energy and Power Impacts*

Figure 61 shows the aggregate charging load profiles for weekdays and weekends across all grant project EVSE. Most charging occurred during the daytime hours, with similar profiles occurring on weekdays and weekends. These profiles are relatively similar to the profiles for Pacific Power's public charging pods, suggesting a customer preference for daytime public charging at both utility-owned and privately-owned EVSE.

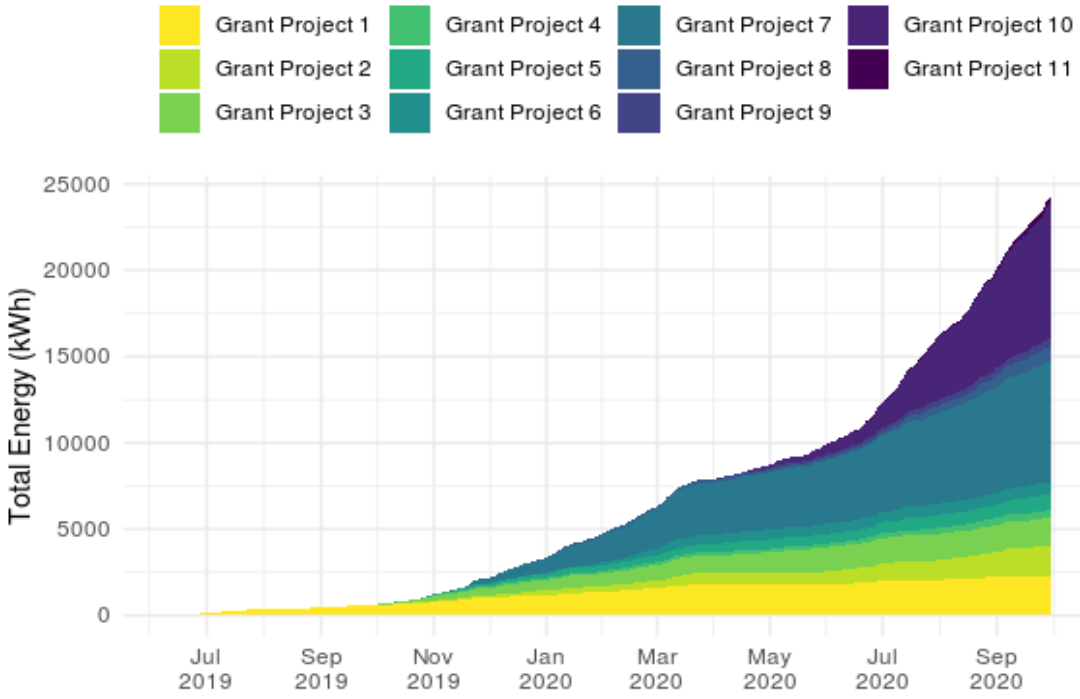
**Figure 61. Charging Load Profiles by Day Type**




*Source: Guidehouse analysis*

Figure 62 shows the cumulative energy consumption for the grant project EVSE. About 24.2 MWh of energy had been dispersed by the grant project EVSE as of this evaluation.

**Figure 62. Cumulative Energy Consumption for Grant Projects**




*Source: Guidehouse analysis*

Table 4-3 summarizes charging station use and the energy and demand impacts. The percentage of time that any given charging port was in use ranged from about a 0.5% to over 9%.

**Table 4-3. Grant Project EVSE Usage and Impacts**

| Site | Number of Days in Operation | Number of Hours | Energy (kWh) | Max Hourly Power (kW) | Rated Capacity (kW) |
|---|---|---|---|---|---|
| Grant Project 1 | 479 | 11,484 | 2,283.9 | 7.38 | 28.80 |
| Grant Project 2 | 373 | 8,936 | 1,779.2 | 12.81 | 14.40 |
| Grant Project 3 | 371 | 8,895 | 1,613.3 | 12.24 | 28.80 |
| Grant Project 4 | 363 | 8,697 | 416.5 | 11.19 | 14.40 |
| Grant Project 5 | 356 | 8,535 | 917.3 | 12.48 | 28.80 |
| Grant Project 6 | 343 | 8,224 | 704.4 | 12.04 | 14.40 |
| Grant Project 7 | 328 | 7,861 | 7,019.9 | 25.93 | 43.20 |
| Grant Project 8 | 287 | 6,875 | 819.0 | 6.19 | 14.40 |
| Grant Project 9 | 226 | 5,410 | 473.8 | 6.40 | 14.40 |
| Grant Project 10 | 171 | 4,091 | 7,869.9 | 25.76 | 28.80 |
| Grant Project 11 | 141 | 3,377 | 349.0 | 6.23 | 14.40 |

*Source: Guidehouse analysis*

#### *4.4.5.3 EVSE User Characteristics*

In total, 420 individual users charged at the program EVSE. Table 4-4 shows additional charging session details by grant project. By comparing the number of distinct users at each site with the total number of sessions, Guidehouse found that certain EV drivers charged multiple times at the same location. This is particularly evident at Grant Project 1 where 7 distinct users completed 231 charging sessions. The grant application form for Grant Project 1 indicated that workplace charging was the primary use case, which explains these results.

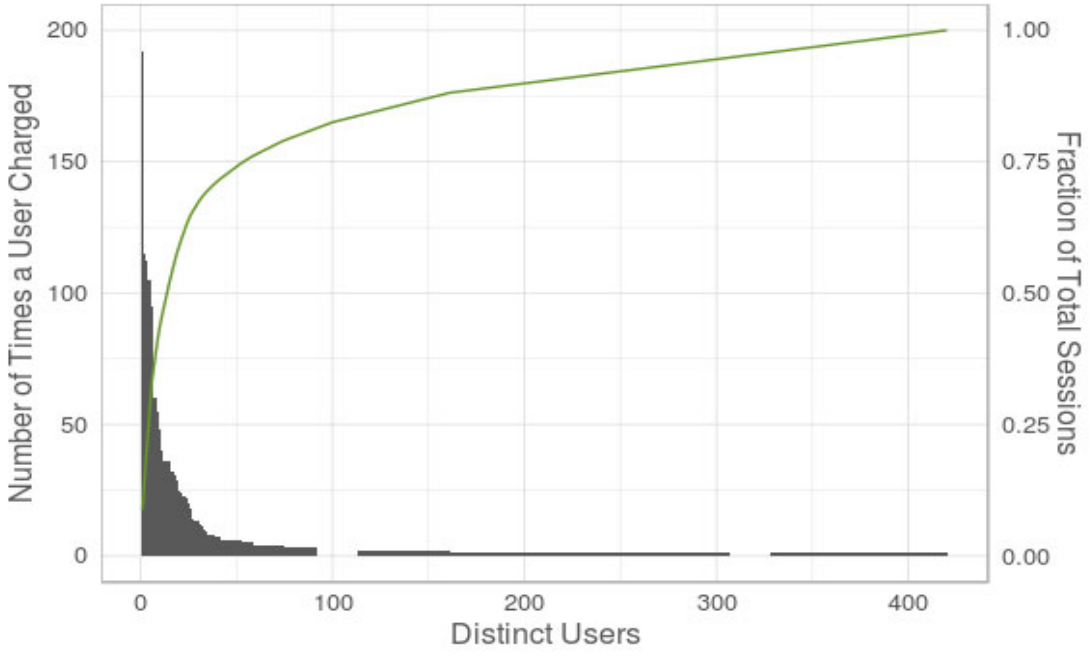
**Table 4-4. Charging Session Details by Grant Project Location**

| Site | Number of Sessions | Average Total Time per Session (Hours) | Average Charging Time per Session (Hours) | Average Energy per Charge per Session (kWh) | Number of Distinct Users |
|---|---|---|---|---|---|
| Grant Project 1 | 231 | 3.75 | 3.05 | 9.90 | 7 |
| Grant Project 2 | 138 | 2.62 | 2.43 | 12.89 | 46 |
| Grant Project 3 | 196 | 2.29 | 1.82 | 8.25 | 51 |
| Grant Project 4 | 69 | 1.35 | 1.27 | 6.05 | 29 |
| Grant Project 5 | 60 | 3.17 | 2.67 | 15.29 | 15 |
| Grant Project 6 | 70 | 2.34 | 2.07 | 10.09 | 33 |
| Grant Project 7 | 938 | 1.79 | 1.48 | 7.49 | 131 |
| Grant Project 8 | 38 | 6.15 | 4.42 | 21.55 | 3 |
| Grant Project 9 | 70 | 2.54 | 2.32 | 6.80 | 9 |
| Grant Project 10 | 449 | 6.56 | 3.38 | 17.53 | 96 |
| Grant Project 11 | 33 | 3.49 | 2.24 | 10.58 | 17 |

*Source: Guidehouse analysis*

Figure 63 shows the distribution or charging sessions by each individual user, demonstrating that a relatively small number of individuals are using the chargers frequently.

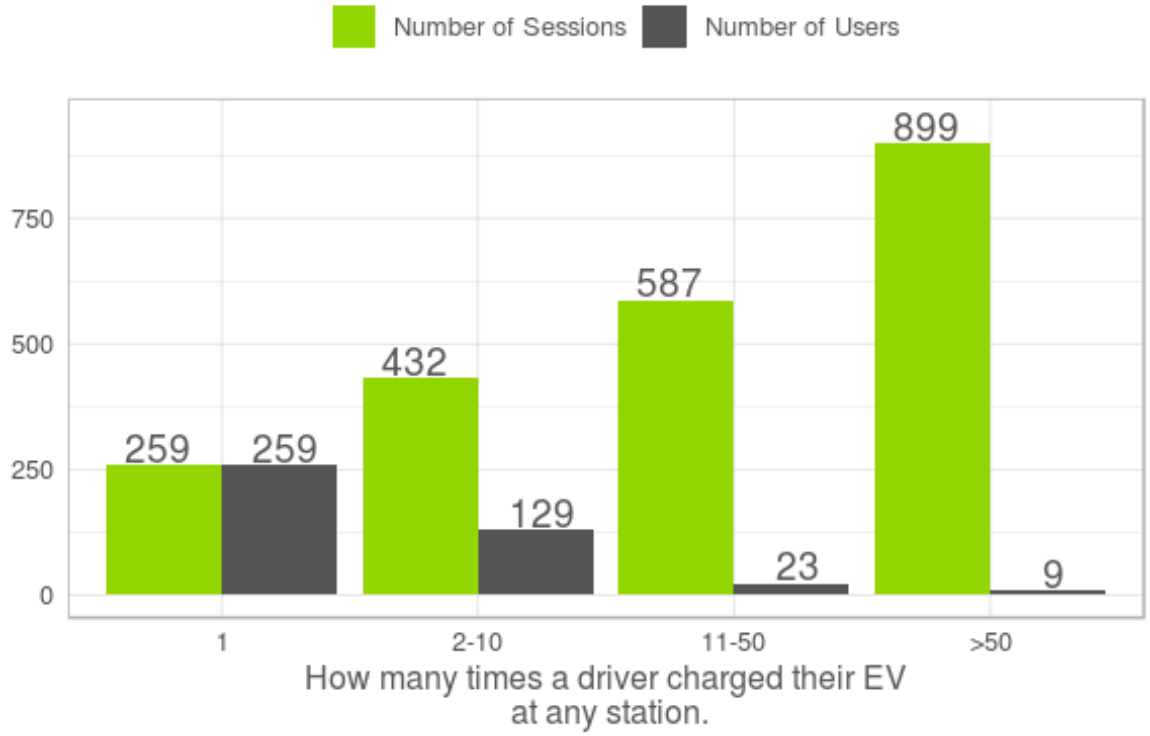
**Figure 63. Histogram Showing Number of Charging Sessions by User**




*Source: Guidehouse analysis*

Figure 64 presents user frequencies in a different format. On the far left, the figure shows that 259 individual users completed one charging session each. On the far right, the figure shows that nine individual users each completed more than 50 charging sessions, for a total of 899 charging sessions.

**Figure 64. Distribution of Users Completing Increments of Charging Sessions**



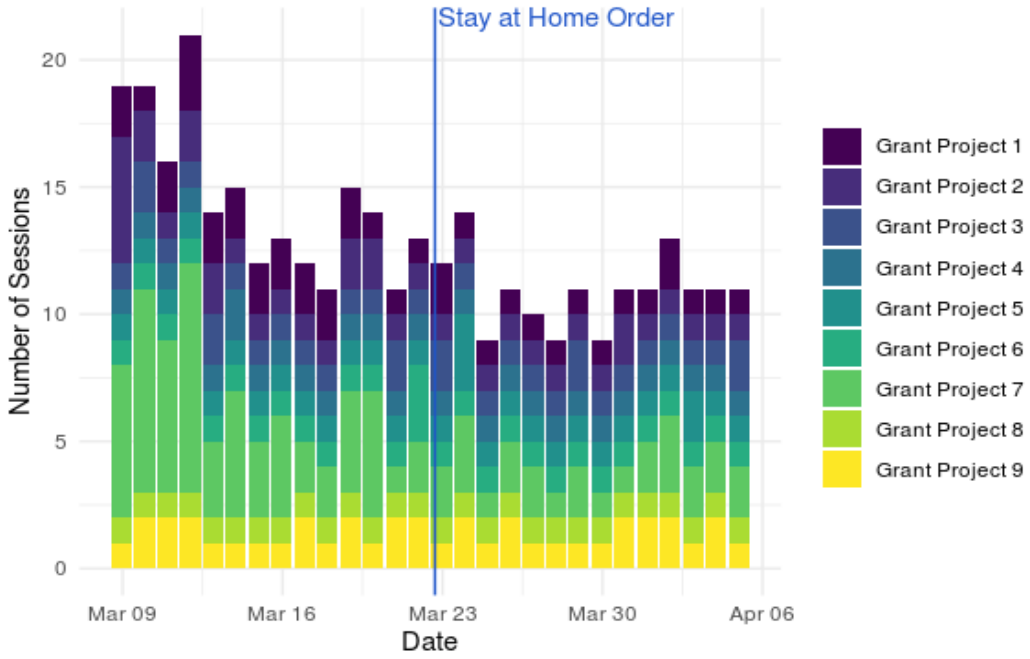

*Source: Guidehouse analysis*

### *4.4.5.4 Effects of COVID-19 Pandemic on Grant Project EVSE Usage*

Given the limited amount of time that most grant project EVSE had been in operation, it was difficult to quantify the impacts that the COVID-19 pandemic may have had on EVSE utilization. Pacific Power indicated that some program participants experienced challenges with permitting, staff turnover, and supply chain disruption as a result of the pandemic. These factors likely contributed to delays in project commissioning and ultimately, EVSE usage. Guidehouse created visual displays to show how EVSE utilization changed right around the time of Oregon's stay-at-home order and phase 1 reopening.

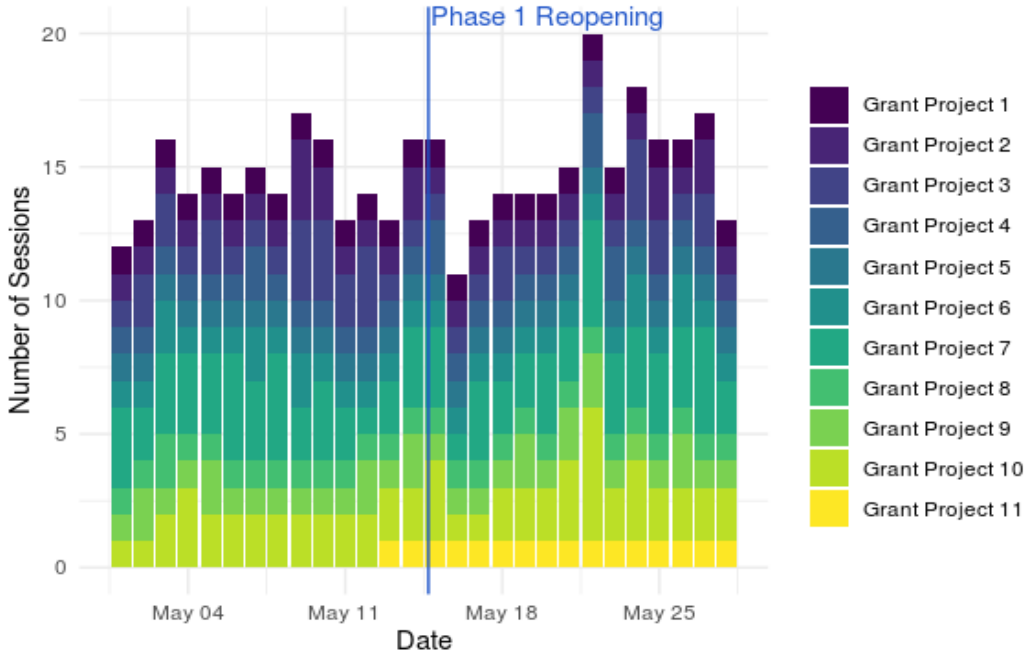
Figure 65 shows an apparent decline in EVSE utilization from the 2 weeks before and after the March 2020 stay-at-home order. Figure 66 shows the analogous information for the 2 weeks before and after the May 2020 phase 1 reopening; there does not appear to be a clear trend of increased charging usage in that period.

**Figure 65. Grant Project EVSE Usage Before and After Stay-at-Home Order**




*Source: Guidehouse analysis*

**Figure 66. Grant Project EVSE Usage Before and After Phase 1 Reopening**




*Source: Guidehouse analysis*

# 5. Pilot Program Cost-Effectiveness

## 5.1 Cost-Effectiveness Background

Pacific Power directed Guidehouse to evaluate the cost-effectiveness of the pilot programs by using the framework developed by a group of utilities and stakeholders in Oregon. Pacific Power coordinated with Portland General Electric (PGE) and participated in stakeholder meetings that included regulatory staff. The outcome of this process was a cost-effectiveness framework that would apply to transportation electrification programs.

In early 2019, Pacific Power provided Guidehouse with a copy of PGE's filing that included PGE's Application for the Deferral of Costs and Revenues Associated with the Electric Vehicle Charging Pilots. This document contained an appendix that summarized the development process and final methodology of the cost-effectiveness framework. The framework is known as the Transportation Electrification Assessment Methodology, or TEAM, and is essentially a modified version of the ratepayer impact measure (RIM) test, which has long been used to evaluate cost-effectiveness of utility programs.

Pacific Power asked Guidehouse to review the cost-effectiveness appendix from PGE's filing and to provide feedback on how the approach would apply to Pacific Power's pilot programs. Guidehouse provided this feedback in 2019 and this report contains only the results of the TEAM analysis.

Evaluating the cost-effectiveness of transportation electrification programs is not straightforward. Traditional cost-effectiveness tests were designed to assess energy conservation measures that tend to be stationary and are meant to either replace existing (less-efficient) measures or to substitute for a less-efficient counterfactual scenario. Transportation programs add load to the grid, and the topic of attribution complicates matters further. The PGE appendix defines attribution as "the degree of influence that utility programs have on customer actions" and also states that "attribution will not be applied in cost effectiveness calculations."

## 5.2 Guidehouse's Cost-Effectiveness Approach

Guidehouse used the TEAM approach to assess cost-effectiveness for the pilot programs. Pacific Power provided Guidehouse with the necessary data to quantify the benefit and cost streams as outlined in the TEAM approach. Table 5-1 shows the value streams used for the TEAM analysis, and a definition of each term is included below the table.

**Table 5-1. TEAM Approach Value Streams**

| Value Stream | Public Charging | Outreach & Education: Residential | Outreach & Education w/ TA | Demonstration & Development |
|---|---|---|---|---|
| **EV-specific Value Streams** | | | | |
| **Additional Generation Capacity (EV Load)** | N/A | Cost | Cost | Cost |
| **Incremental Vehicle Cost** | N/A | N/A | N/A | N/A |
| **Additional Energy Supply** | Cost | Cost | Cost | Cost |
| **Electricity Sales Revenue** | Benefit | Benefit | Benefit | Benefit |
| **Avoided GHG Emissions** | N/A | N/A | N/A | N/A |
| **Avoided NOx Emissions** | N/A | N/A | N/A | N/A |
| **Program-specific Value Streams** | | | | |
| **Equipment & Construction** | Cost | N/A | N/A | N/A |
| **Incentives/ Grants** | N/A | N/A | N/A | Cost |
| **Additional Generation Capacity (Charger)** | Cost | N/A | N/A | N/A |
| **Annual Program Admin** | Cost | Cost | Cost | Cost |
| **Annual Equipment O&M** | Cost | N/A | N/A | N/A |

*Source: Guidehouse analysis*

*Additional Generation Capacity (EV Load)* – the cost for additional generation capacity needed to accommodate added EV load, where the EVSE is assumed to be L2 or less.

*Incremental Vehicle Cost* – the incremental cost of EVs over a conventional combustion vehicle.

*Additional Energy Supply* – the additional cost of energy supply required by Pacific Power to accommodate added EV load.

*Electricity Sales Revenue* – the revenue accrued by Pacific Power as result of electricity sales for EV charging. For this analysis, Guidehouse assumed 90% of the charging occurs in Pacific Power's service territory.

*Avoided GHG Emissions* – the avoided greenhouse gas emissions as result of EVs added to the grid.

*Avoided NOx Emissions* - the avoided nitrogen oxide emissions as result of EVs added to the grid.

*Equipment and Construction* – the capital cost incurred by Pacific Power for infrastructure development (e.g. charging stations, trenching, etc.).

*Incentives/Grants* – the program incentive or grant payments disbursed by Pacific Power to program participants.

*Additional Generation Capacity (Charger)* – the cost for additional generation capacity needed to support EVSE deployment where DCFC stations are installed.

*Annual Program Admin* – program costs related to administration, operations, and evaluation.

*Annual Equipment O&M* – ongoing operations and maintenance costs incurred by Pacific Power to maintain program equipment.

To quantify the lifetime costs and benefits of Pacific Power's investments, Guidehouse assumed the following measure lives for each program:

- Public Charging – 20 year measure life, consistent with industry assumptions for the lifespan of DCFC infrastructure.
- Outreach and Education – 2 year measure life, to align with the pilot program duration.
- Demonstration and Development – 10 year measure life, consistent with industry assumptions for the lifespan of L2 infrastructure.

## 5.3 Cost-Effectiveness Results

Guidehouse's analysis includes the effects of EV lift, which the evaluation team defines as the incremental number of EVs added to the grid. Because the TEAM approach does not include the effect of attribution, Guidehouse presents the cost-effectiveness results in a format that shows what the EV lift must be to achieve a cost-benefit ratio of 1.0. In other words, using the TEAM approach, Guidehouse has estimated the minimum number of additional EVs that must be added to the grid in Pacific Power's service territory, as a result of each pilot program, for the program to be cost-effective. The benefits of the programs are all normalized on a per-EV basis while the costs are at the program level. As such, Guidehouse was able to quantify the number of EVs needed for the total net benefits to offset the total program costs.

Table 5-2 shows the summary of cost-effectiveness results using the TEAM approach. The total program costs represent the lifetime total of all cost streams specified in Table 5-1, for each program. Table 5-2 also shows the number of EVs that must be added to Pacific Power's service territory over the life of each program, to achieve a benefit to cost ratio of 1.0. Note that the results for each program are presented using a relevant unit basis. For example, the results for the Public Charging program are presented on a "per charging pod" basis, meaning that 159 EVs must be added for each charging pod to make the program cost-effective.

**Table 5-2. Summary of Cost-Effectiveness Results**

| Summary | Public Charging | Outreach & Education: Residential | Outreach & Education w/ TA | Demonstration & Development |
|---|---|---|---|---|
| | Per Charging Pod | Overall Program | Per Site | Per Site |
| Program Lifetime (yrs.) | 20 | 2 | 2 | 10 |
| Total Program Cost (NPV) | $686,508 | $449,704 | $193,416 | $86,126 |
| Total EVs Req. for 1 B/C | 159 | 172 | 74 | 19 |
| Avg. EVs/Yr. Req. for 1 B/C | 8 | 86 | 37 | 2 |

*Source: Guidehouse analysis*

Although the inputs to this analysis were reviewed by Pacific Power, there is uncertainty around the anticipated EV loads and charging patterns that can influence the per-EV benefits.

# 6. Recommendations

Pacific Power can use key findings from this evaluation to inform decisions about expanding the existing pilot programs or developing new offerings and services. Guidehouse developed a set of recommendations for Pacific Power to consider.

1. **Public Charging Pod Configuration** - For future Pacific Power public charging stations, consider the costs and benefits of installing fewer charging ports at more locations, rather than consolidating to larger pods. Guidehouse understands that there are significant infrastructure costs associated with each location, as well as siting and permitting challenges. However, Pacific Power could design charging locations such that additional charging ports could be added in the future as EV penetration increases. This may save on short-term capital costs and allow for increased utilization of charging ports.
2. **Creating Pre-Qualified Equipment List** – Pacific Power should consider establishing a pre-qualified list of eligible equipment and vendors for the Demonstration and Development program, or future incentive programs. This can ensure that Pacific Power has more reliable access to charging data, and can also allow Pacific Power to select equipment that meets certain standards such as having capabilities to enable future managed charging programs. A predetermined list of options may be well-received by participants since it provides utility-vetted guidance on product selection.
3. **Make-Ready Solutions** – Pacific Power should consider whether a make-ready program model would be viable as an alternative to the Demonstration and Development grant funding program model. Make-ready programs typically involve utility funding for the infrastructure needed to connect EV chargers to the grid (e.g. conduit, grid connection), but require the end customer to purchase the actual charging station hardware. This program model would still offset some costs for participants, while potentially allowing program funding to reach more customers.
4. **Maximizing Accessibility to Customer-Owned Charging** – Pacific Power should consider establishing program requirements for the Demonstration and Development program that ensure EVSE are available for use by more drivers. Although most projects were available for public access, a considerable portion of charging sessions were completed by a small number of drivers; a trend that was most prominent for workplace charging projects. Some utilities offer dedicated programs for workplace charging, and Pacific Power should consider whether this is an attractive option for future programs.
5. **Targeted Outreach Activities** – Guidehouse recommends that Pacific Power continue to sponsor EV-related outreach and education initiatives. The evaluation found that customer newsletters and information on bill envelopes reached the most customers. However, customer interest and intent to purchase EVs appears correlated to customer experience riding in or driving an EV. Pacific Power should consider how to allocate outreach funding to target markets in order to maximize the effect.

# Appendix A. Outreach and Education General Population Survey Findings

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## Pacific Power EV Pilot Program Evaluation

Presentation of Select Results from General Population Surveys (2019 and 2020)

October 2020

## Evaluation Objectives

Guidehouse administered two rounds of a General Population ("Gen Pop") survey as part of evaluation efforts for Pacific Power's electric vehicle (EV) Outreach and Education pilot program. The purpose of the survey was to assess customer willingness to purchase an EV, determine customers' understanding of the pricing model, and investigate the exposure to and effectiveness of Pacific Power's outreach and communications campaigns

More specifically, evaluation activities were used to measure and evaluate changes in:

- Customer understanding of the technology, features, and its readiness
- Customer understanding of the economics of ownership
- Customer concern about charging logistics, including access to electric vehicle supply equipment (EVSE)
- Customer awareness of environmental and community/social benefits
- Market drivers, consumer interests, and barriers to adoption.

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# Survey Methods

## Online Panel Survey

**Survey Respondents**

- Panel design, all survey responses in 2020 are from customers who previously completed 2019 survey.
- 2020 respondents were asked to indicate whether they had moved and if the were still serviced by Pacific Power.

| | 2019 Respondents | 2020 Respondents |
|---|---|---|
| Response GOAL | 500 | 300 |
| Actual Respondents | 1,482 | 631 |
| Response Rate | 14.8%* | 42.6%** |

*A total of 10,000 customers were invited to take the survey

**Only respondents from 2019 were invited to participate

**Survey Timelines**

- Baseline general population EV survey—June 2019
- Impact general population EV survey— June 2020

**Survey Analysis**

- All analysis in this presentation is based on 2020 results, unless otherwise noted.
- Thorough survey results and analysis from 2019 were presented in a separate slide deck.





# Key Independent Variables

1. Exposure to outreach and education
2. Experience with electric vehicles
3. Demographics and COVID
4. Barriers to adoption

# Key Mediating and Dependent Variables (perceptions, knowledge, concerns, interests)

1. Customer understanding of the technology
2. Customer understanding of the economics of ownership
3. Customer concerns about charging
4. Customer awareness of environmental and social benefits
5. Customer impressions, interest, consideration and intention

# Influence of Education, Outreach and Experience on Dependent Variables

# Summary of Findings

### Plug-in Electric Vehicle (PEV) Perceptions and Plans to Purchase

**Impressions.** Overall impressions of plug-in hybrid electric vehicles (PHEVs) are more favorable than battery electric vehicles (BEVs), however BEV impressions appear to be improving. Between 2019 and 2020, impressions of BEVs ***increased*** slightly while impressions of PHEVs ***declined*** slightly.

**Interest.** Respondents expressed interest in a PHEV or a BEV by ranking these vehicle types as either their first or second vehicle type choice. Interest in PHEVs was higher with 38% of respondents indicating an interest in a PHEV and 23% in a BEV. The level of interest for both remained steady between 2019 and 2020.

**Considerations.** When asked if they are considering a PHEV or BEV for their next vehicle purchase, 41% of respondents said they were considering a PHEV and 29% a BEV. The proportion of respondents considering purchase remained steady between 2019 and 2020.

**Intentions.** When asked to rate their likelihood of purchase (on a 10-point scale), average intention scores for both PHEVs and BEVs were relatively low (4.1 and 3.7, respectively). Between 2019 and 2020, intentions to purchase a PHEV ***declined*** by 4.7% and remained steady for BEVs.

| | 2020 Level | | Change (2019-2020) | | | |
|---|---|---|---|---|---|---|
| | PHEV | BEV | PHEV | | BEV | |
| Impressions (Avg. on 7 pt. scale) | 5.2 | 4.9 | -1.4% | ** | 1.3% | ** |
| Interest (Ranking of 1 or 2) | 38% | 23% | 2.0% | NS | 3.0% | NS |
| Consideration (y/n) | 41% | 29% | 1.0% | NS | 3.0% | NS |
| Intention (Avg. on 10 pt. scale) | 4.1 | 3.7 | -4.7% | * | -2.6% | NS |

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# Summary of Findings

**Outreach and Education** reached about 30% of respondents however exposure was fairly shallow. (Only 13% of respondents were exposed to more than one O&E activity).

**Motivators.** The top three PEV features of most interest to (> 70%) respondents are: eco-friendliness, emissions reductions, and convenience (ability to charge from home).

**Knowledge.** There was little change in most measures of knowledge. There were small increases in understanding of lower maintenance costs (4%) and environmental benefits (5%).

**Awareness of Public Charging Locations** increased by 4.5%

**Vehicle Experience.** Ownership remained steady while the percent of respondents who had driven a BEV nearly doubled from 6.4% to 12.1%.

**Barriers to Adoptions.** 74.5% of respondents are NOT planning to purchase a new vehicle in next 2 years.

One-third of respondents are NOT willing to pay more. Of those who are, 1/3 are willing to pay up to $2k more, 1/3 are willing to pay up to $5k more, and 1/3 are willing to pay a premium greater than $5k.

One-third does not have a dedicated parking spot with an outlet.

**COVID** has had a small dampening effect on plans to purchase a vehicle in the next 3 years.

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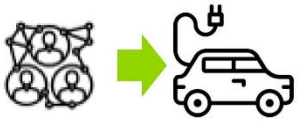
# Summary of Findings

**Influence of Outreach and Education on Perceptions and Plans to Purchase***

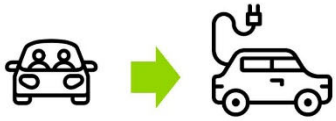


Exposure to outreach and education appears to be associated with…

- ***better impressions*** of BEVs (but not PHEVs) and ***greater intentions*** to purchase both types of vehicles
- Increased interest in BEVs when O&E is moderate (but no significant change in interest in PHEVs)
- No significant change in consideration of either a PHEV or a BEV.
- ***A significant influence on the likelihood (intention) to purchase a BEV*** among those who were NOT already considering a purchase.

O&E make the biggest difference in the likelihood of purchasing a BEV among those people who were not already interested and considering BEVs

**Influence of In-Car Experience on Perceptions and Plans to Purchase***



For BEVs – Higher levels of interest, consideration and intentions are associated with both types of in-car experiences. Impressions seem to exist independently of in-car experiences.

For PHEVs – Higher levels of interest and consideration of PHEVs are associated with having ridden in a PEV. Respondents' intention to purchase a PHEV is positively associated with both riding and driving experience.

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*The influence of outreach and education and experience is assessed using bivariate analysis only.



# Exposure to Outreach and Education

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# Outreach and Education Measures

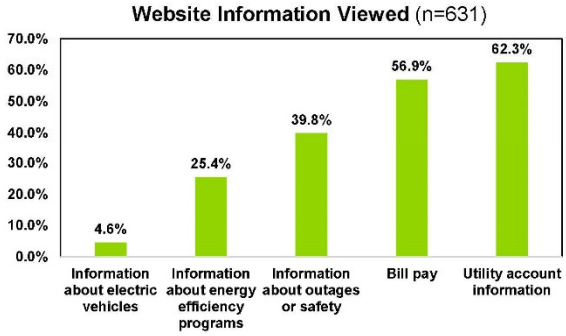
1. Types of information viewed on the Pacific Power website
2. Exposure to EV information in newsletter or bill envelope
3. Attendance at a Pacific Power community event
4. Awareness of ride and drive events sponsored by Pacific Power
5. Awareness of Pacific Power ads in various media
6. Composite exposure score to Outreach and Education



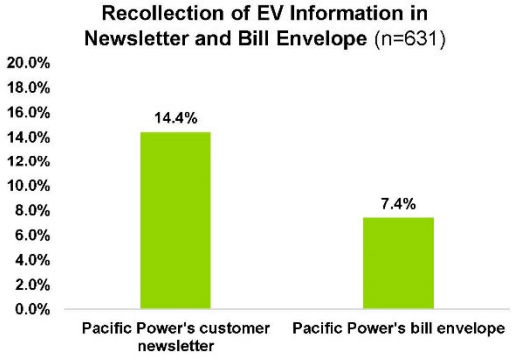


# Website Use, Newsletter and Bill Envelope

Nearly 5% of respondents viewed information about EVs on Pacific Power's website while 14.4% saw information in the newsletter and 7.4% on the bill envelope




*Which of the following types of information do you recall looking at when visiting the Pacific Power website during the past year?*

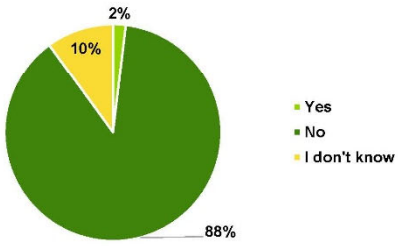



*Do you recall seeing any information about electric vehicles in the following resources?*

# Attendance at Community Events with Pacific Power

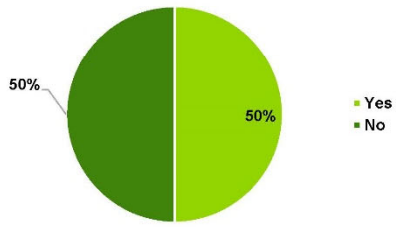
2% of respondents attended an event where Pacific Power provided information about EVs, but only 6 respondents spoke with Pacific Power staff at the event.

**Event Attendance** (n=622)




*Did you attend any community events where Pacific Power staff were present to provide information about EVs?*

**Spoke with Pacific Power Staff at Event** (n=12)




*Did you talk to Pacific Power staff about electric vehicles at a community event?*

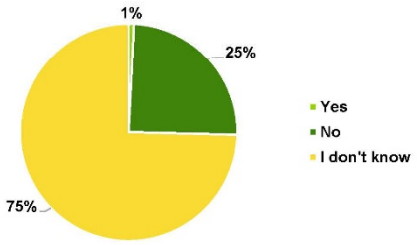




# Awareness of Ride/Drive Events and Exposure to EV Ads

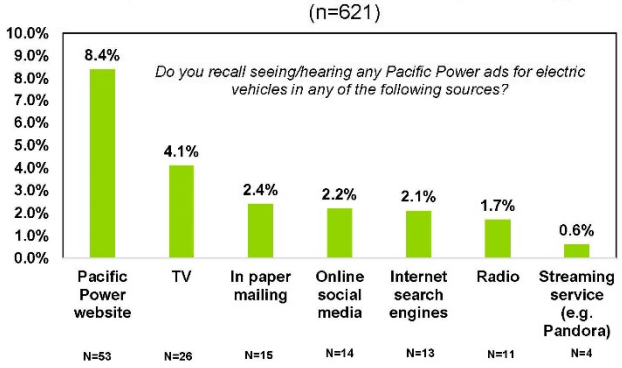
1% of respondents reported awareness of a ride and drive event sponsored by Pacific Power in the past year. Over 8% recalled seeing an EV ad on the Pacific Power website.

**Awareness of Ride and Drive Events** (n=621)




*Were you aware of any ride and drive events sponsored by Pacific Power in the past year?*

**Exposure to Pacific Power EV Ads by Media Type** (n=621)



## Outreach and Education Composite Score

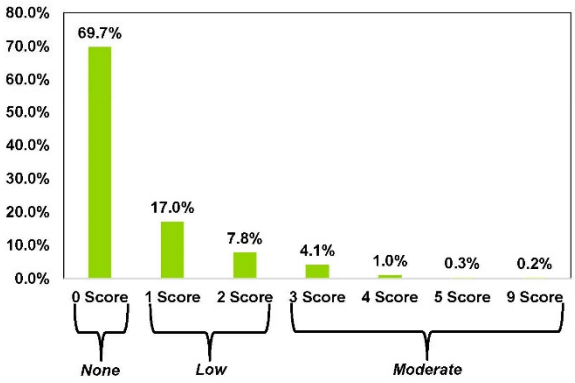
Most respondents reported no exposure to Pacific Power's EV outreach. Of those who were exposed, the level of exposure was low.

Guidehouse developed a composite score to measure customers' overall exposure to Pacific Power's EV outreach and education activities. The score reflects exposure to the following:

- EV info viewed on Pacific Power website (1 point)
- EV Information in Pacific Power customer newsletter (1 point)
- EV information in Pacific Power bill envelope (1 point)
- Pacific Power ride & drive event attendance (1 point)
- Pacific Power staff present at ride & drive event (1 point)
- Talked to Pacific Power staff at ride & drive event (1 point)
- Pacific Power EV Ads (7 points)

Points were assigned based on whether the respondent had been exposed to or were aware of each of the Pacific Power EV activities.

**Pacific Power Outreach and Education Composite Score** (n=631)

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# EV Experience

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# Electric Vehicle Experience

1. Electric vehicle ownership
2. Riding and driving experience
3. Know someone with a PEV

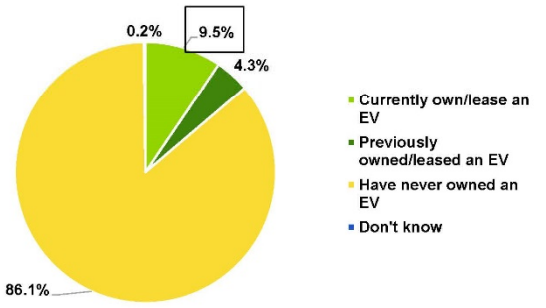




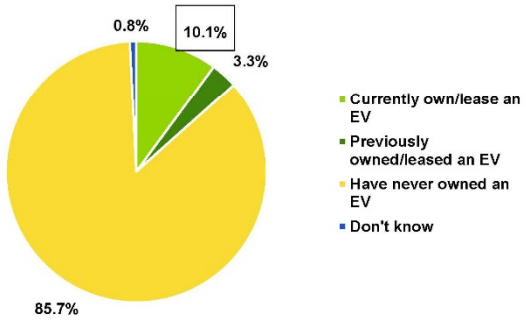
# Electric Vehicle Ownership

10% of respondents currently own or lease an electric vehicle (including HEVs), which is a 0.6% increase from 2019 (~4 respondents).

**2019 EV Ownership*** (n=631)




**2020 EV Ownership*** (n=631)




**EV ownership, in this case, includes BEVs, PHEVs, and HEVs.*



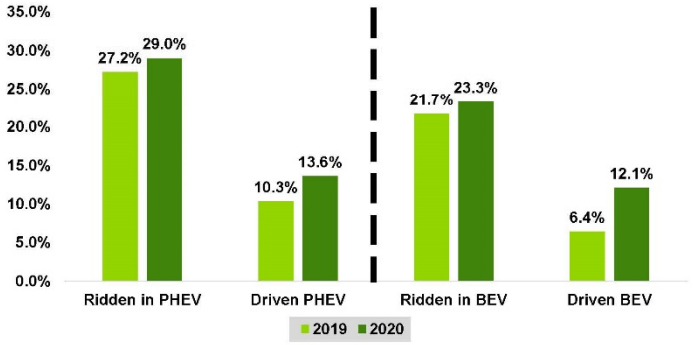


*Note: Statistical significance of the difference between years was not tested.*

# Experience: Ridden In or Driven PEVs

- Respondent experience with PEVs (riding in and driving) increased from 2019 to 2020.
- The largest change in experience is those who had driven a BEV, which increased 5.7%.

**Experience with PEVs: Ridden In or Driven*** (n=631)




*Which of the following vehicle types have you ridden in or driven?*

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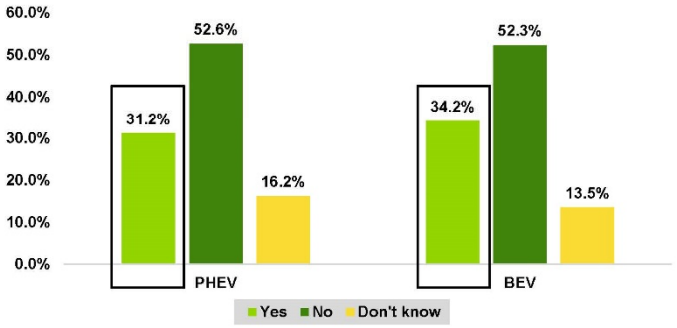
*Note: Statistical significance of the difference between years was not tested.*

# Know Someone with a PEV

31% of respondents know someone outside of their household who drives a PHEV.
34% know someone who drives a BEV.

**Know Someone with a PEV** (n=631)




*Do you know anyone outside of your household who currently drives a PHEV or BEV?*

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*Note: Statistical significance of the difference between years was not tested.*

# Demographics and Housing

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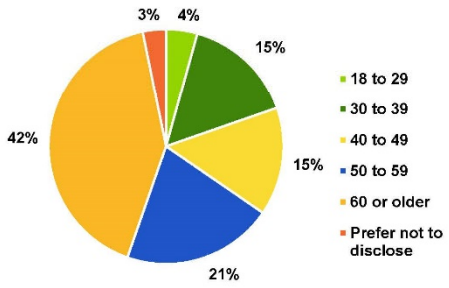
## Demographics and Housing

1. Age and education
2. Housing type and ownership

# Age & Education

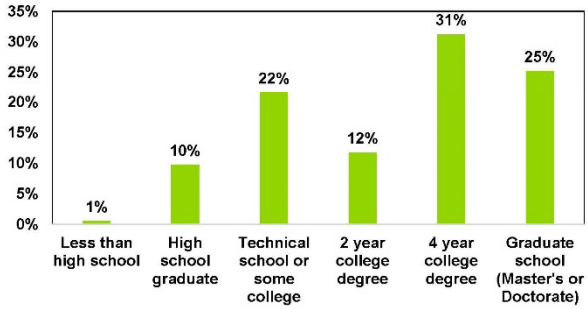
Most respondents (63%) were 50 years or older and 56% of respondents had a 4-year college degree or more

**Age*** (n=631)




*In 2019, 50 and over = 44%

**Education Level** (n=631)



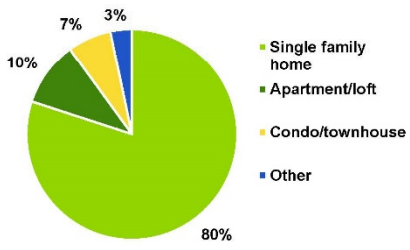




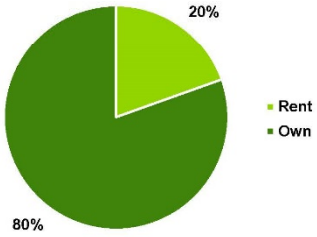

# Housing Type and Ownership

Most respondents (80%) reside in a single-family home, while 80% own their home

**Current Housing Type**
(n=631)




**Rent or Own House**
(n=631)



# Barriers and Motivators

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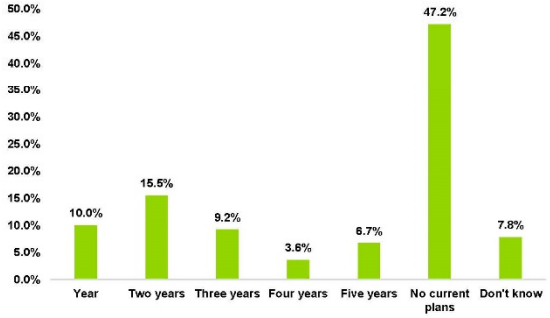
## Barriers and Motivators

1. Purchase timeline
2. Willingness to pay
3. Home parking and outlet availability
4. Workplace location and workplace charging
5. COVID Impacts
6. Motivators and Early Adopters

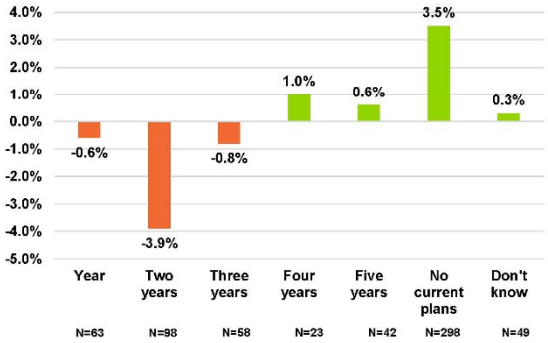
# Vehicle Purchase Timeline

- Between 2019 and 2020, there was a downward shift in the proportion of respondents planning to purchase a vehicle in the next 3 years to approximately 30%.

**2019 Vehicle Purchase Timeline** (n=631)




**Change in Vehicle Purchase Timeline**

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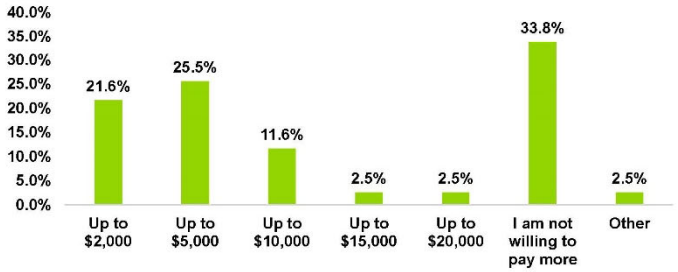
# Willingness to Pay

- Approximately one-third of respondents indicated they are not willing to pay more to purchase a PEV, while two-thirds are willing.
- Of those willing to pay more, approximately one-third indicated they would pay up to $2,000 more while one-third indicated they would pay up to $5,000 more and the final third would pay more than an additional $5,000.

**Willingness to Pay More for a PEV** (n=631)




*How much more would you be willing to pay for a new BEV or PHEV in comparison to a conventional gasoline/diesel powered vehicle?*

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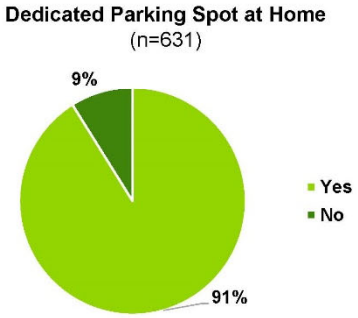
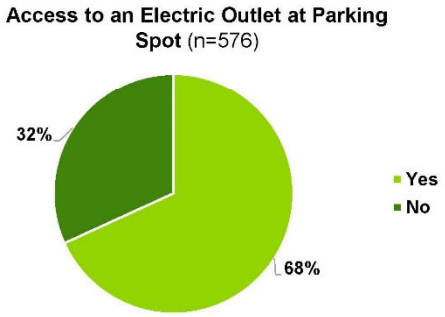
## Availability of Dedicated Parking and Outlet

- 91% of respondents had dedicated parking at home.
- 62% of all respondents had access to an electrical outlet within 9 feet of their parking spot

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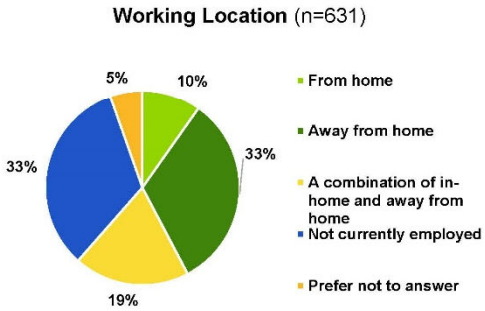
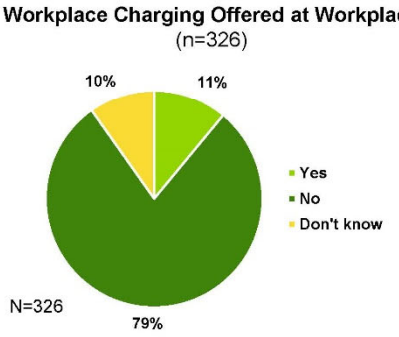
## Workplace Location and Workplace Charging

- 33% of respondents worked away from home, 33% were currently not employed, and 10% worked from home
- Of those respondents who worked away from home, 79% did not have EV charging at their workplace

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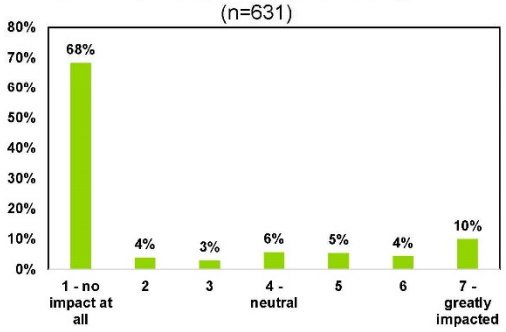
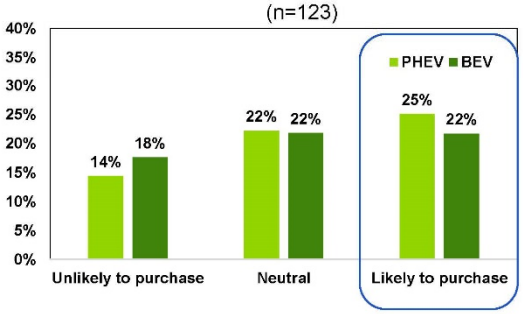
# COVID Impacts

19% of respondents reported an impact of COVID on purchasing plans. Customers who reported a COVID impact are less likely to purchase a PHEV or BEV compared to respondents as a whole.

**COVID Impact on Vehicle Purchasing Plans**
(n=631)




**Likelihood of Purchasing a PEV among Customers who Reported an Impact of COVID on Purchasing Plans***
(n=123)




*Likelihood for all respondents was 33% and 29% respectively

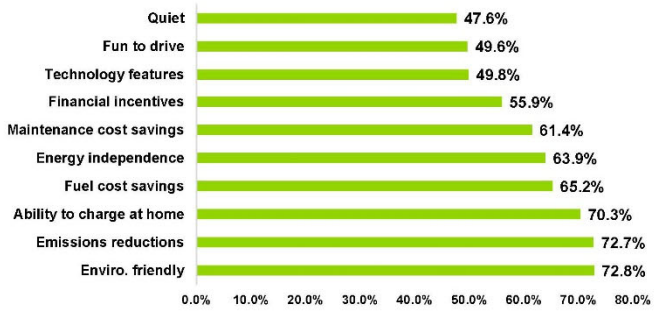




# Motivating Factors and Early Adopters

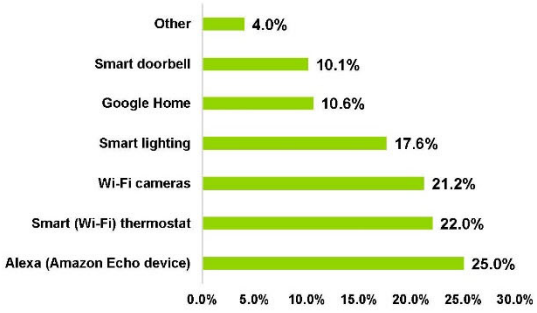
- Being environmentally friendly and reducing emissions were rated the most important motivating factors for purchasing a PEV.
- 25% of respondents had purchases an Alexa and 22% a smart thermostat.

**PEV Purchase Motivations** (n=631)




*Please indicate the importance of the following factors in determining your interest in purchasing or leasing a PHEV/BEV.*

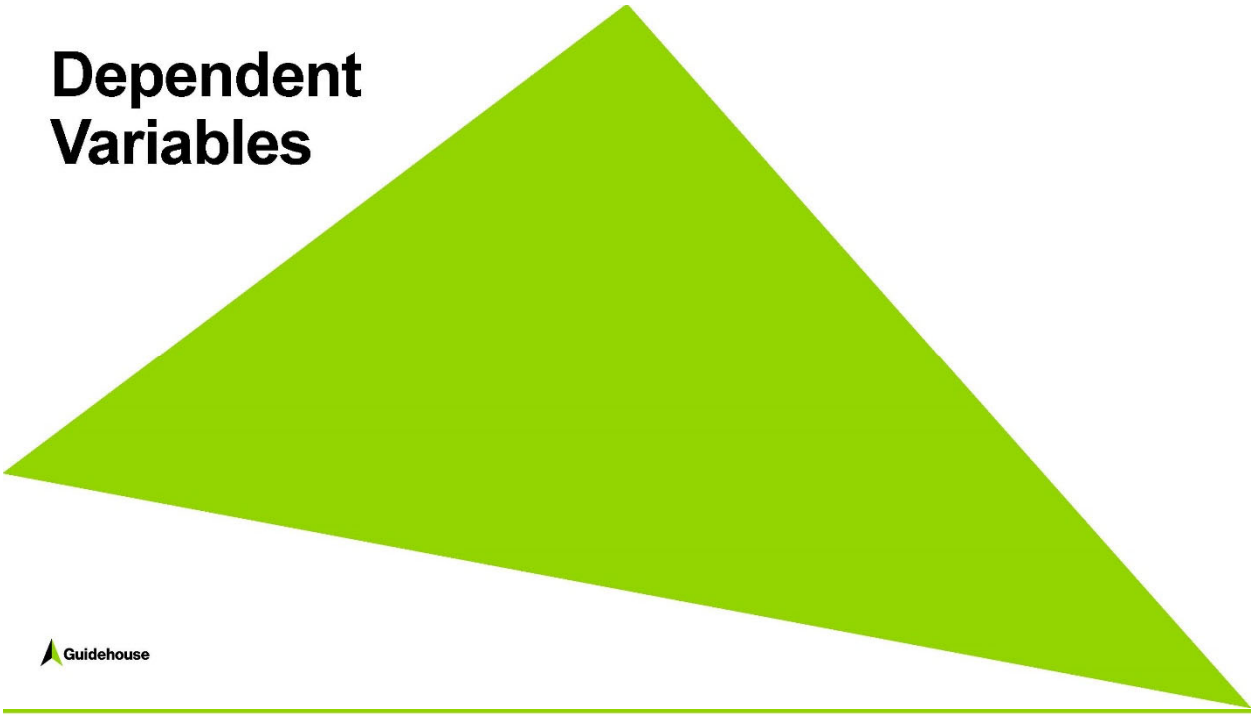
**Early Adopter Technologies*** (n=631)




*Which of the following technologies have you ever purchase?*

*A 15% adoption rate is generally an indication of early adopter status

# Dependent Variables



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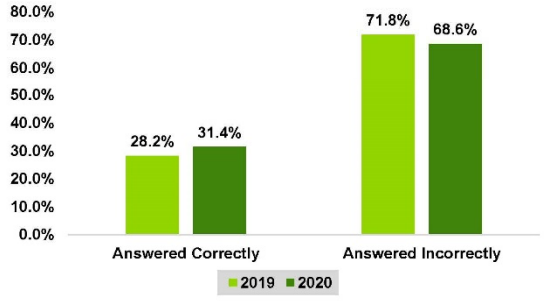
## Knowledge, Concerns, Perceptions, and Intentions

1. Customer understanding of the technology
2. Customer understanding of the economics of ownership
3. Customer concerns about charging logistics including EVSE
4. Customer awareness of environmental and social benefits
5. Customer impressions, interest, consideration and intention

# Customer Understanding of the Technology

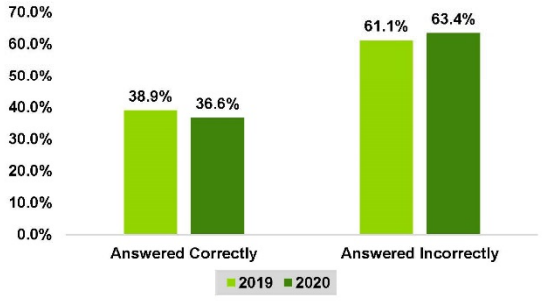
- Knowledge of direct current fast charging (DCFC) station charge time increased slightly between 2019 and 2020
- Knowledge of standard PEV ranges decreased slightly between 2019 and 2020

**Knowledge of DCFC Charge Time** (n=631)




*How long would it typically take to fully charge a BEV using a high-powered charging station that you might find at a location such as a library, grocery store, or curbside?*

**Knowledge of Drivable Range** (n=631)




*What is the drivable distance per change for a typical sedan-style BEV?*

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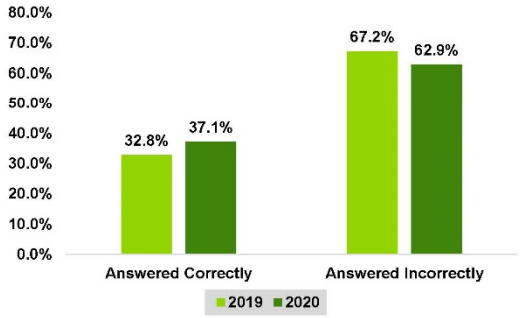
*Note: Statistical significance of the difference between years was not tested.*

# Customer Understanding of the Economics of Ownership

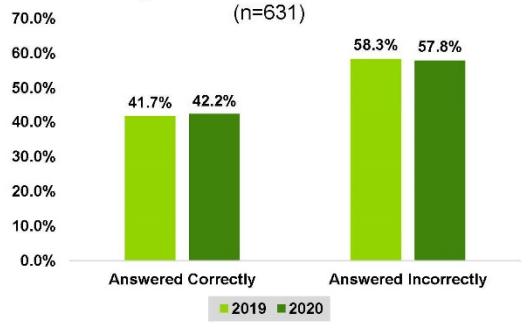
- Knowledge of PEV maintenance cost savings increased slightly from 2019 to 2020
- Knowledge of standard BEV purchase price largely remained the same from 2019 to 2020

**Knowledge of Maintenance Costs** (n=631)




*When compared to a traditional gas or diesel-powered vehicle, are the maintenance of a BEV typically…*

**Knowledge of Standard BEV Purchase Price** (n=631)




*How much would you expect to pay for a standard BEV, such as a Chevrolet Bolt or Nissan Leaf?*

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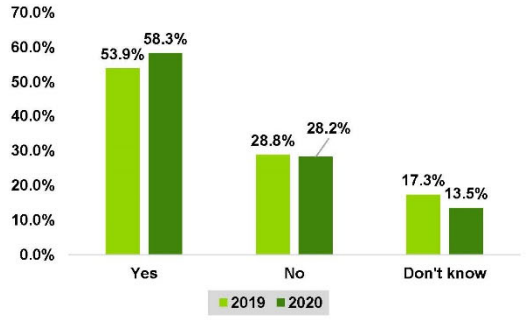
*Note: Statistical significance of the difference between years was not tested.*

# Customer Awareness of Charging

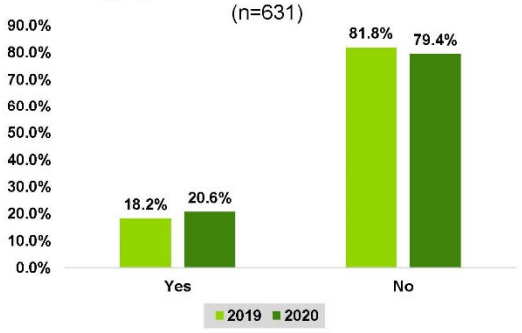
- Awareness of nearby public charging stations increased slightly from 2019 to 2020
- Awareness of charging location information increased slightly from 2019 to 2020

**Public Charging Awareness** (n=631)




*Are you aware of any public EV charging locations within 25 miles of your home?*

**Charging Location Information Awareness** (n=631)




*Are you aware of any sources of free information to help you locate the nearest publicly available EV charging stations?*

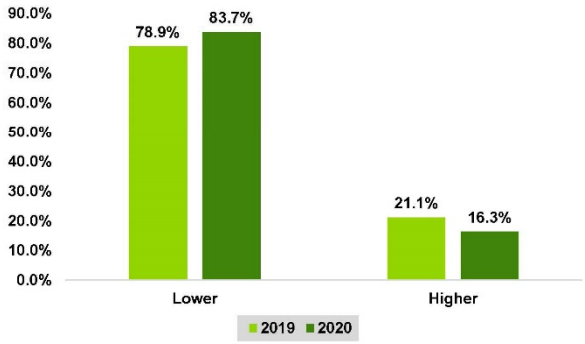



*Note: Statistical significance of the difference between years was not tested.*

# Customer Knowledge of Social and Environmental Benefits

Knowledge of the emissions benefits of driving a BEV increased slightly between 2019 and 2020

**GHG Emissions from BEVs Awareness** (n=631)




*When compared to a gasoline or diesel fuel, are the greenhouse gas emissions associated with the electricity used to fuel a BEV typically…*

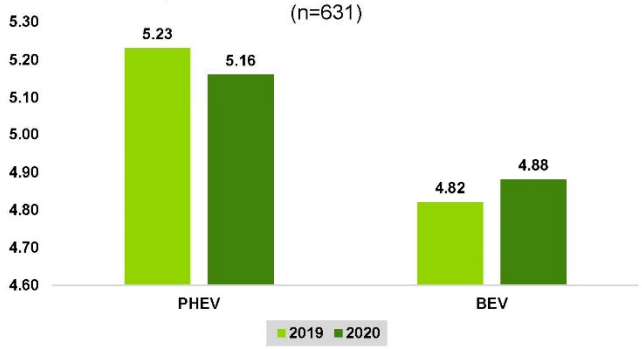



*Note: Statistical significance of the difference between years was not tested.*

# General Impressions of PEVs

- Respondents reported more favorable impressions of PHEVs than BEVs
- Average impressions of PHEVs declined slightly between 2019 to 2020, while impressions of BEVs increased slightly[1]

**General Impressions of PHEVs and BEVs—Mean Score**
(n=631)




| | Change Score | Significance Score |
|---|---|---|
| PHEV | -0.07 | 0.013 |
| BEV | +0.06 | 0.001 |

*Significance based on two-tailed paired t-test*

*What is your general impression of these vehicle types?*



[1]Most respondents had favorable impressions of PEVs. 64% of respondents had favorable impressions of PHEVs and 56% of respondents had favorable impressions of BEVs.

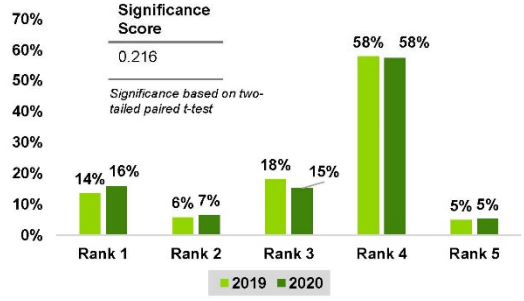


# Interest in PEVs

- Respondents ranked their interest in PHEVs higher than BEVs for their next vehicle purchase[1]
- There was no significant change in the level of interest between 2019 and 2020.

**Ranked Powertrain Preferences—PHEVs**
(n=631)


**Ranked Powertrain Preferences—BEVs**
(n=631)




*Please rank your preferences for each of the following fuel types, using #1 to indicate the fuel type of most interest.*



[1]71.2% of respondents ranked ICEV as their first or second ranking in 2019 and 69.9% in 2020.

# Percent of Respondents Considering a PEV Purchase

There was no significant change in the proportion of respondents considering either a PHEV or BEV for purchase between 2019 and 2020.[1]

**Respondents Considering PEV for Purchase** (n=631)


*Which of the following vehicle types would you consider for purchase/lease?*

| | Change Score (%) | Significance Score |
|---|---|---|
| PHEV | +1.3% | 0.571 |
| BEV | +3.2% | 0.651 |

*Significance based on two-tailed paired t-test*

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[1]71% of respondents were considering an ICEV for purchase in 2019 and 72.4% in 2020.

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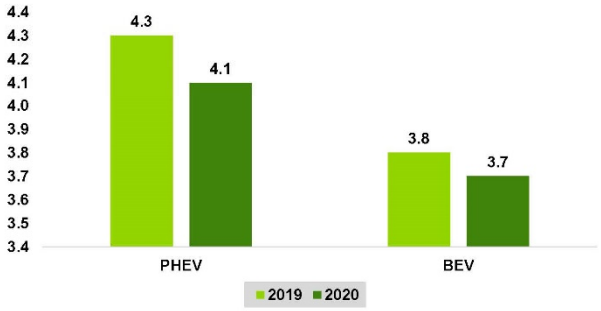
# Intention to Purchase

Likelihood of purchasing[1] a PHEV decreased slightly from 2019 to 2020.
Likelihood of purchasing a BEV remained steady during the same period.

**Likelihood of Purchase by Powertrain—Mean Score**
(n=631)




*On a scale of 0 to 10, Indicate how likely or unlikely you are to select a PHEV or BEV as your next vehicle.*

| | Change Score | Significance Score |
|---|---|---|
| PHEV | -0.2 | 0.076 |
| BEV | -0.1 | 0.117 |

*Significance based on paired-sample t-test*

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[1]19% of respondents indicated a high likelihood of purchasing a PHEV in 2020 while 18% of respondents indicated a high likelihood of purchasing a BEV.

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# Bivariate Analysis

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## Influence of Outreach and Experience on Impressions, Interest, Consideration and Intention

1. Influence of Pacific Power's outreach and education (O&E) activities
2. Influence of PEV experience

SUMMARY of FINDINGS

**Exposure to outreach and education activities** is positively associated with:

- More favorable impressions of BEVs
- Interest in purchasing a BEV when exposure to O&E was moderate
- Reported consideration of purchasing a BEV
- Intentions to purchase a BEV among those who were not considering

**Having *ridden* in a PEV** is associated with better impressions, greater consideration and a higher likelihood to purchase both PHEVs and BEVs.

**Having *driven* a PEV** is associated with greater interest, greater consideration and a higher likelihood of purchasing a BEV.

For PHEVs, driving experience is only associated with a higher likelihood of purchasing.

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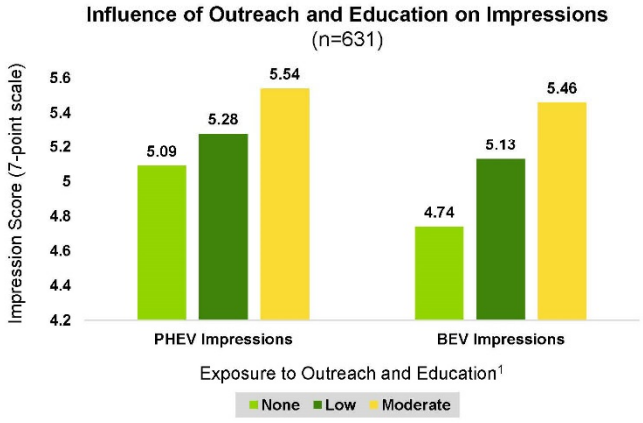
# Influence of O&E on Impressions of PEVs

Impressions of BEVs are significantly more favorable among respondents with greater exposure to outreach and education messages. Results for PHEVs are not significant.




| | Sig. Score (None & Low) | Sig. Score (None & Mod.) |
|---|---|---|
| PHEV | 0.214 | 0.119 |
| BEV | 0.024 | 0.028 |

*Significance based on independent samples t-test*

*[1]Exposure to outreach and education is shown here using the composite score described on slide 12. None = no exposure. Low = exposure to 1 or 2 instances of outreach and education. Moderate = exposure to 3 or more instances of outreach and education.*

*Note: Conclusions on this slide are based on bivariate analysis only. Conclusions show the relationship between exposure to outreach and education and PEV impressions in 2020.*

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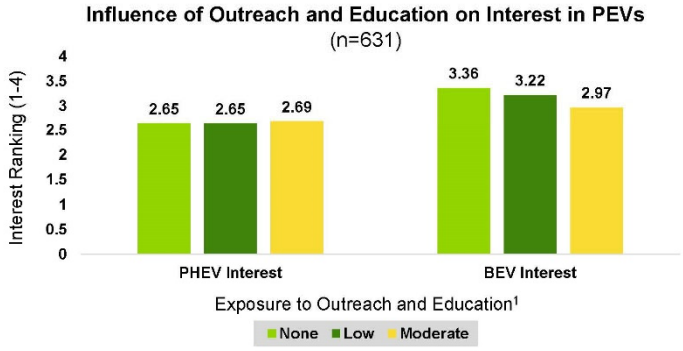
# Influence of O&E on Interest Ranking for PEVs

Exposure to moderate levels of Pacific Power O&E activities is associated with respondent interest in purchasing a BEV, however low levels of O&E were not. O&E exposure did not appear to influence interest in PHEVs.




***Rank 1 = Most Interest—Lower means indicates more favorable ranking***

| | Sig. Score (None & Low) | Sig. Score (None & Mod.) |
|---|---|---|
| PHEV | 0.927 | 0.839 |
| BEV | 0.204 | 0.062 |

*Significance based on independent samples t-test*

*[1]Exposure to outreach and education is shown here using the composite score described on slide 12. None = no exposure. Low = exposure to 1 or 2 instances of outreach and education. Moderate = exposure to 3 or more instances of outreach and education.*

*Note: Conclusions on this slide are based on bivariate analysis only.*

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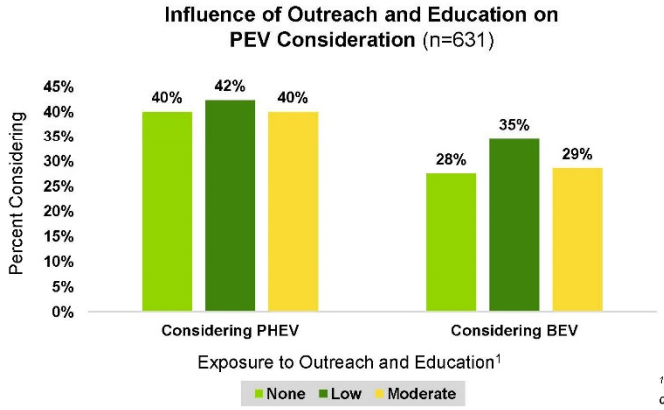
# Influence of O&E on PEV Consideration

There is no significant relationship between exposure to Pacific Power O&E activities and respondent considerations for purchasing a PEV




| | Sig. Score (None & Low) | Sig. Score (None & Mod.) |
|---|---|---|
| PHEV | 0.615 | 1.00 |
| BEV | 0.105 | 0.892 |

*Significance based on independent samples t-test*

[1]*Exposure to outreach and education is shown here using the composite score described on slide 12. None = no exposure. Low = exposure to 1 or 2 instances of outreach and education. Moderate = exposure to 3 or more instances of outreach and education.*

*Note: Conclusions on this slide are based on bivariate analysis only.*

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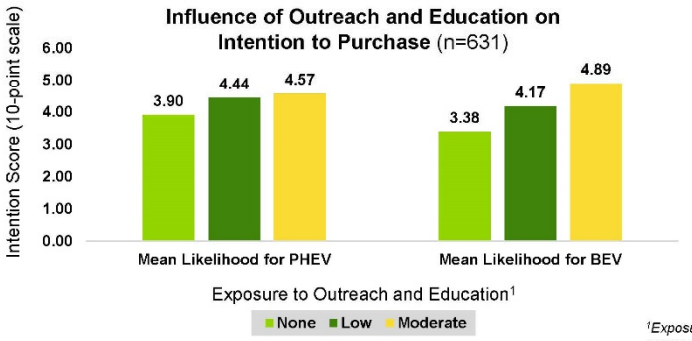
# Influence of O&E on Intention to Purchase

- Low and moderate levels of exposure to O&E are associated with a higher likelihood of purchasing a BEV.
- Low levels of exposure to O&E are associated with a higher likelihood of purchasing a PHEV, however moderate levels of exposure are not.




| | Sig. Score (None & Low) | Sig. Score (None & Mod.) |
|---|---|---|
| PHEV | 0.069 | 0.149 |
| BEV | 0.011 | 0.008 |

*Significance based on independent samples t-test*

[1]*Exposure to outreach and education is shown here using the composite score described on slide 12. None = no exposure. Low = exposure to 1 or 2 instances of outreach and education. Moderate = exposure to 3 or more instances of outreach and education.*

*Note: Conclusions on this slide are based on bivariate analysis only.*

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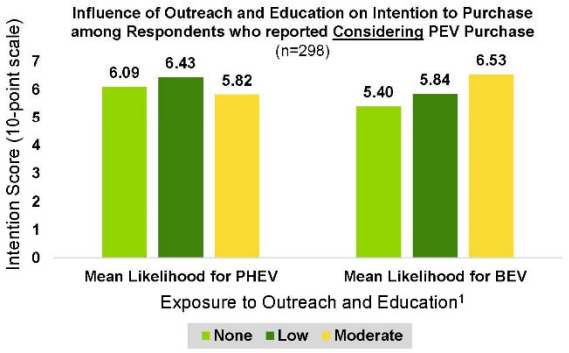
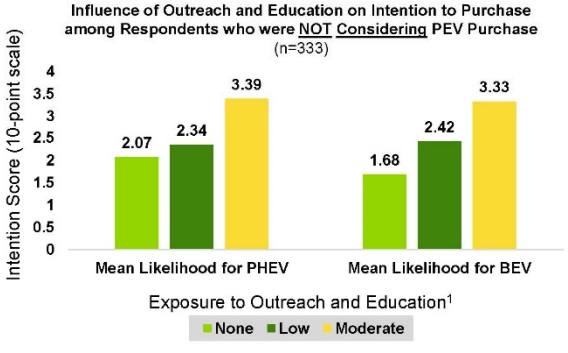
## Influence of Outreach and Education on Intention to Purchase when Controlling for Consideration

The influence of O&E on the likelihood of purchasing a BEV is significant among those respondents who had NOT been considering a PEV purchase but not among those who had been considering a purchase. The Impact on PHEV intentions is largely not significant.




| | Sig. Score (None & Low) | Sig. Score (None & Mod.) |
|---|---|---|
| PHEV | 0.329 | 0.684 |
| BEV | 0.295 | 0.147 |

*Significance based on independent samples t-test*

| | Sig. Score (None & Low) | Sig. Score (None & Mod.) |
|---|---|---|
| PHEV | 0.345 | 0.013 |
| BEV | 0.035 | 0.003 |

*Note: Conclusions on this slide are based on bivariate analysis only.*

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## Summary: Influence of Outreach and Education

Exposure to outreach and education is associated with…

- ***better impressions*** of BEVs (but not PHEVs) and ***greater intentions*** to purchase both types of vehicles
- increased interest in BEVs when O&E exposure is moderate
- no significant change in interest in PHEVs or consideration of either a PHEV or a BEV
- ***A significant influence on a respondent's intention to purchase a BEV*** among those who were NOT already considering a purchase.

  – O&E might make the biggest difference for those people who are already interested and considering and may play the important role of helping people feel more assured in making the decision to purchase.

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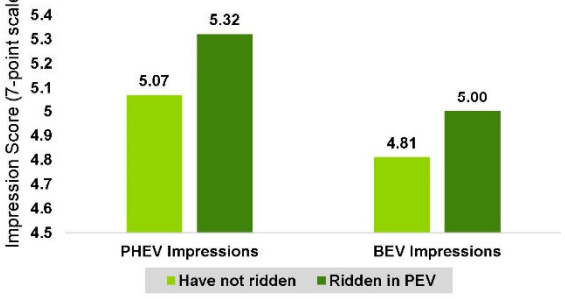
# Influence of PEV Experience on Impressions

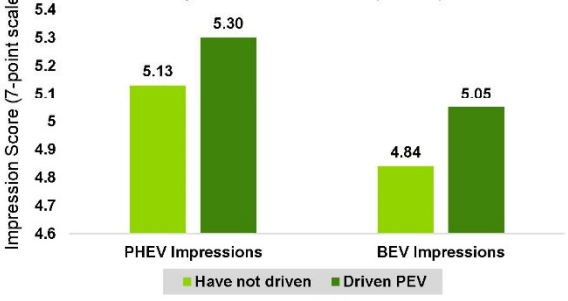
Respondents who have ridden in a PHEV have slightly more favorable impressions of PEVs. Impressions are not significantly associated with driving experience.

**Influence of Riding in PEVs on Respondent Impressions of PEVs** (n=631)




| | Significance Score |
|---|---|
| PHEV | 0.065 |
| BEV | 0.218 |

**Influence of Driving a PEVs on Respondent Impressions of PEVs** (n=631)




| | Significance Score |
|---|---|
| PHEV | 0.315 |
| BEV | 0.268 |

*Significance based on independent samples t-test*

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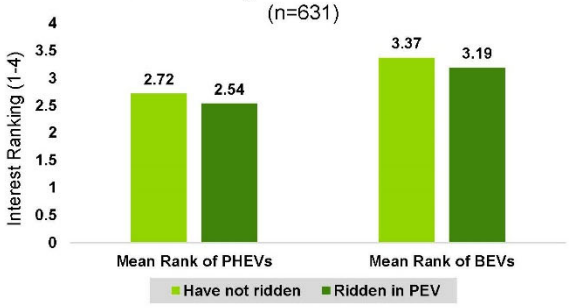
*Note: Conclusions on this slide are based on bivariate analysis only.*

# Influence of PEV Experience on Interest in PEVs

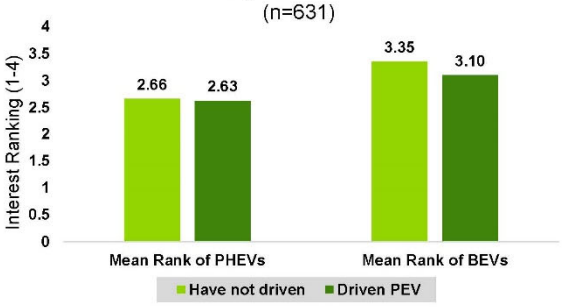
Respondents who have ridden in either a PHEV or BEV ranked their interest more favorably than those without in-car experiences. Driving experience was associated with more favorable rankings for BEVs only.

**Influence of Riding in PEVs on Interest in PEVs** (n=631)




| | Significance Score |
|---|---|
| PHEV | 0.013 |
| BEV | 0.082 |

**Influence of Driving in PEVs on Interest in PEVs** (n=631)




| | Significance Score |
|---|---|
| PHEV | 0.723 |
| BEV | 0.063 |

*Significance based on independent samples t-test*

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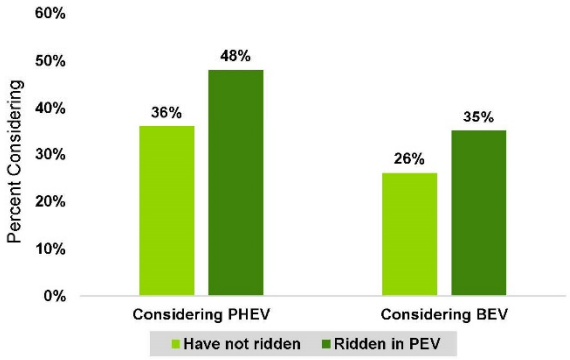
*Note: Conclusions on this slide are based on bivariate analysis only.*

# Influence of PEV Experience on Consideration to Purchase

- Respondents who have ridden in a PEV are more likely to consider a PHEV or BEV for purchase.
- Respondents who have driven a PEV are more likely to consider a BEV for purchase.

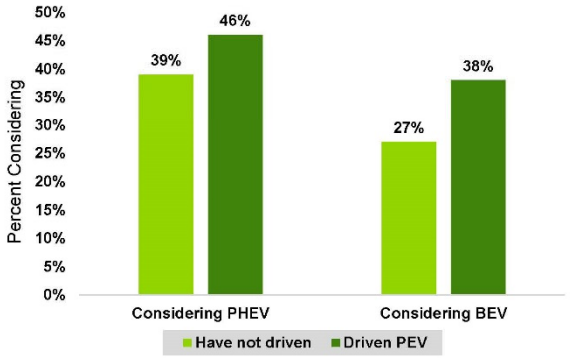
**Influence of Riding in PEVs on Consideration to Purchase** (n=631)




| | Significance Score |
|---|---|
| PHEV | 0.003 |
| BEV | 0.018 |

*Significance based on independent samples t-test*

**Influence of Driving in PEVs on Consideration to Purchase** (n=631)




| | Significance Score |
|---|---|
| PHEV | 0.215 |
| BEV | 0.034 |

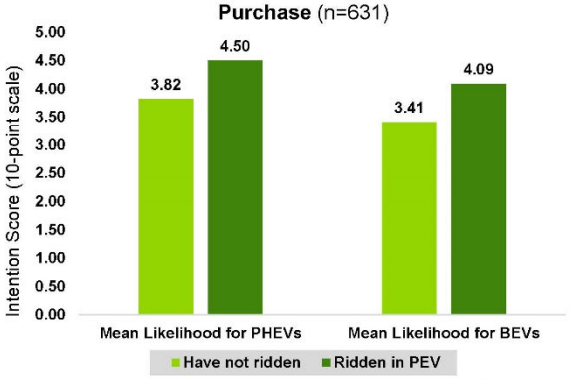
*Note: Conclusions on this slide are based on bivariate analysis only.*




# Influence of Experience on Intention to Purchase

- Respondents who have ridden in or driven a PEV report a higher likelihood of purchasing either type of PEV
- Respondents who have driven a PEV report a higher likelihood of purchasing either type of PEV than those who had ridden in a PEV

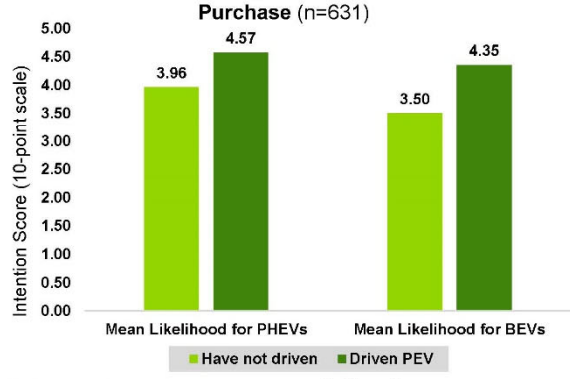
**Influence of Riding in PEVs on Intention to Purchase** (n=631)




| | Significance Score |
|---|---|
| PHEV | 0.007 |
| BEV | 0.013 |

*Significance based on independent samples t-test*

**Influence of Driving in PEVs on Intention to Purchase** (n=631)




| | Significance Score |
|---|---|
| PHEV | 0.057 |
| BEV | 0.013 |

*Note: Conclusions on this slide are based on bivariate analysis only.*

# Summary: Influence of In-Car Experience

In-car Experience is associated with…

| | Ridden In | Driven |
|---|---|---|
| Impression | ***Better impressions of PHEVs*** (but not BEVs) | No change in impressions for either BEVs or PHEVs |
| Interest | ***Higher levels of interest*** for both PHEVs and BEVs | ***Increased interest in BEVs*** (but not PHEVs) |
| Consideration | ***Increased consideration of both PHEVs and BEVs*** | ***Increased consideration of BEVs*** *(but not PHEVs)* |
| Intention to Purchase | ***Increased intention to purchase both PHEVs and BEVs*** | ***Increased intention to purchase both PHEVs and BEVs*** |

**BEVs –** Respondents interest, consideration and intentions are positively associated with both types of in-car experiences. Impressions seem to exist independently of in-car experiences.

**PHEVs** – Respondents interest and consideration of PHEVs are positively associated with having ridden in a PEV. Respondents' intention to purchase a PHEV is positively associated with both riding and driving experience.

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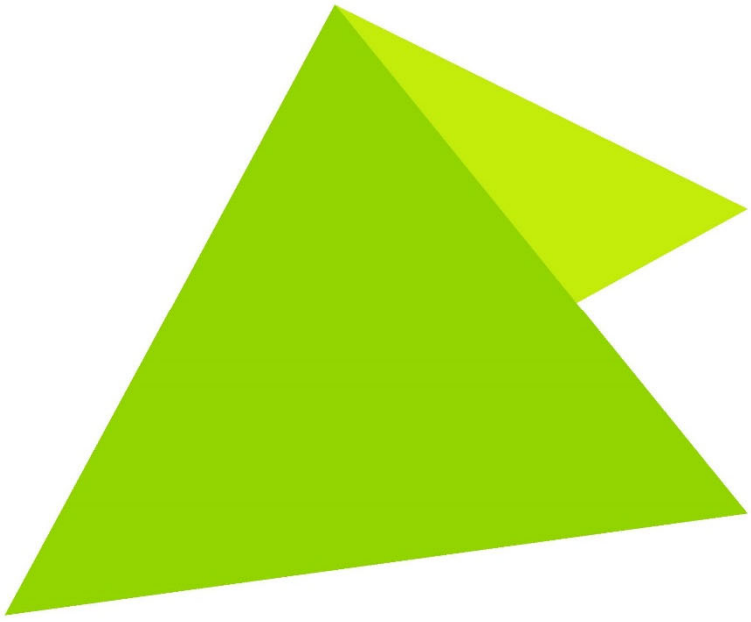

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# Appendix

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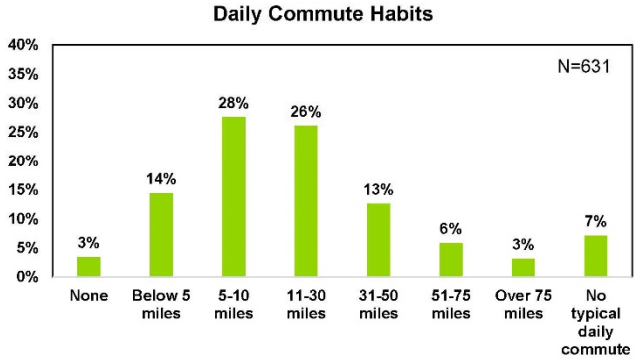
## Daily Commute Habits

- Nearly half (45%) of respondents commute 10 miles or less



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