



**Portland General Electric Company**  
121 SW Salmon Street • 1WTC0306 • Portland, OR 97204  
portlandgeneral.com

July 21, 2021

***Via Electronic Filing***

Public Utility Commission of Oregon  
Attention: Filing Center  
P.O. Box 1088  
Salem, OR 97308-1088

Re: UM 1938 PGE Deferred Accounting for Costs/Transportation Electrification Plan

Dear Filing Center,

In accordance with Portland General Electric Company's (PGE's) Transportation Electrification (TE) Plan approved by Commission Order No. 18-054 in Docket No. UM 1811 and the TE Pilots Deferral in Docket No. UM 1938, enclosed is the 2020 evaluation of PGE's TE pilots: Electric Mass Transit (TriMet), Electric Avenue (EA), and Outreach & Education. This evaluation addresses the required learnings agreed to by parties in Docket UM 1811 and approved in Order 18-124 as well as the reporting requirements stated in OAR 860-087-0040. The UM 1938 Pilot Deferral also includes cost detail regarding the evaluation.

The Evaluation

PGE contracted with a third-party evaluator, Opinion Dynamics or ODC, to track progress towards pilot goals; document implementation successes, challenges, and key learnings; and offer recommendations for continuing implementation. ODC's 2020 evaluation report is enclosed.

This is the second of multiple evaluation reports that will be produced, and the report appendix lists evaluation activities planned in 2021 through 2023 (some 2021 activities may be revised in response to the COVID-19 pandemic). In addition, this report includes the first analyses of TriMet and EA charger utilization and load impacts. These analyses were not conducted in 2019 to allow for completion of all six EAs and stabilization of TriMet electric bus service.

Some of the key findings from ODC's 2020 evaluation include:

**Outreach & Education:**

- Nonresidential customers gave positive feedback about the technical assistance consultations they received, which has been effective and influential, resulting in 53% of surveyed customers installing chargers and 41% electrifying some portion of their fleets.

- Findings from an online focus group with Transportation Network Company (TNC)<sup>1</sup> drivers show that drivers are financially and environmentally motivated to buy an Electric Vehicle (EV) but may face difficulty qualifying for financing. Additionally, TNC drivers are encouraged to see expanded charging availability, but still expressed range anxiety and desire for more fast chargers along highways outside of Portland.
- An analysis of customer survey data revealed that while low-income customers and seniors are less familiar with EVs, they rate similarly to other customer groups when asked about their intention to consider or purchase an EV.

### **Electric Avenue:**

- PGE was able to apply learnings from the first three EA sites, resulting in a smoother process for constructing and commissioning the remaining EA sites.
- The EA network continued to see frequent hardware and software issues in 2020. While technical issues decreased in frequency, the lengthy commissioning process for the additional EA sites in 2020 caused issues with charger availability. Around the same time as the commissioning of the remaining EA sites, measures aimed to curb the spread of COVID-19 were put into place, which decreased EA utilization significantly.
- The EA network does not significantly contribute to PGE's system peak and the EA pricing structure has been effective at influencing charging behavior. The peak pricing component from 3:00 p.m. to 8:00 p.m. has shown to be highly effective in shifting charging away from system peak load periods.
- There is a clear customer preference for Direct Current Fast Chargers (DCFCs), which serve 96% of energy delivered by EA chargers and have a utilization rate nearly twice that of Level 2 (L2) chargers. In addition, TNC EA subscribers consume the most energy on a per-customer basis and also exhibit the greatest shift in load to off-peak hours.

### **Electric Mass Transit:**

- Over the course of the pilot, TriMet and PGE have worked together, with bus and charger vendors, to ensure smoother deployment of electric buses. However, the buses have been grounded several times due to technical issues with communication between the buses and chargers, as well as service reductions related to COVID-19.
- Despite these challenges, TriMet remains committed to fleet electrification and plans to expand its electric bus fleet, integrating learnings from this pilot along the way.
- Analysis of charging data suggests that bus charging load does not currently contribute significantly to PGE's system peak or distribution system, suggesting there is no current need to change bus charging behavior.

Following are ODC's recommendations to PGE, and PGE's planned response:

---

<sup>1</sup> TNCs are companies that use a digital network to connect riders to drivers who provide prearranged rides (e.g. Lyft or Uber).

<b>Pilot Area</b>	<b>ODC Recommendation</b>	<b>Actions</b>
Outreach & Education	Increase data collection efforts during the technical assistance consultation process beyond current metrics. Improved data tracking from these consultations will allow for PGE to do robust customer segmentation supporting a more targeted go-to-market, focusing efforts on organizations who are most interested or in need of charger installation or fleet electrification.	PGE has created an application process for fleet customers that includes gathering data on customer segment, existing EVs, and existing chargers. PGE plans to implement a similar approach for non-fleet business customers later this year.
	Continue to evolve marketing and engagement activities, including sponsoring or having a presence at larger events in the future and expand dealer engagement through additional educational kiosks and dealer education.	PGE intends to sponsor National Drive Electric Week in partnership with the Oregon Electric Vehicle Association (OEVA). PGE has partner relationships with six local auto dealerships and is expanding to include four more by year end 2021. Each dealer receives training on EV sales, a Chargeway Beacon, and is incentivized to provide referrals for customers that express interest in PGE's Residential Smart Charging Pilot offering.
	Continue to work with the TNC company to offer EA subscriptions and consider broadening collaboration with on-demand delivery service providers, as many TNC drivers have transitioned to these companies.	PGE is working with the EA team to explore options related to EA subscriptions as part of an EV bundle targeting underserved/multifamily customers. PGE is evaluating cost effectiveness and impacts, with the intention to deploy such a package by the end of 2021.
	Consider providing financial assistance to TNC drivers to reduce the barriers to purchasing an EV. This may include vehicle incentives, rental subsidies, or partnerships with financial institutions to provide low-interest loans to TNC drivers.	PGE is partnering with Forth Mobility, a local non-profit, on bundling a vehicle financing offer with the Residential Smart Charging Pilot to support TNC drivers in switching to electric fuel.
	Continue to provide messaging to low-income customers focused on the low cost of fuel through PGE (both at home and at public EA stations), lower maintenance costs associated	PGE plans to launch marketing to underserved communities by Q4 of 2021. The marketing messages include the cost savings associated with EVs, and links to the programs PGE offers to

	with EVs, and the availability of charging in its service territory.	support customers switching to electric fuel.
Electric Avenue	Apply best practices (i.e., project delivery approach, coordination with municipal governments, and coordination with vendors) to future charger installations beyond the EA sites, including heavy- and medium-duty charging applications.	PGE documented lessons learned during the EA deployment phase and integrated these lessons into its design of the Fleet Partner Build pilot (Schedule 56).
	Continue to monitor utilization to better understand how the measures to curb COVID-19 impact charger usage across subscribers, non-subscribers, TNC drivers, and new users such as on-demand delivery services.	PGE will track utilization of EA sites over the next couple of years with focus on better understanding the impacts of COVID-19.
	Continue to implement the peak pricing component and monitor utilization as usage of the EA sites increases to determine system impacts.	PGE will continue to gain learnings from the EA pricing plan, including the peak pricing component, and will share these learnings with non-residential customers who are deploying public EV charging.
	Conduct additional customer research to determine the potential size of user groups, particularly non-subscribers, and gain a better understanding of charging behaviors for these groups through surveys.	As additional PGE-owned public charging sites (approved outside of UM 1811) are brought under the Schedule 50 pricing and subscription plan that is offered at EAs, PGE will market EA subscriptions and the EA network more widely.
TriMet	Establish a more responsive issue resolution process that can be codified in existing or new service level agreements with participating vendors. Apply similar processes, as relevant, to future medium- and heavy-duty vehicle charging applications.	PGE plans to meet with TriMet and the third-party service provider to review and update roles, responsibilities, and issue resolution process. PGE will continue to document lessons learned and share them internally and with customers who are adopting electric fleets.
	Continue to monitor usage to confirm that there is not a negative peak impact once all buses are in operation. Conduct additional research to understand if there is flexibility to leverage rates to influence charging behavior with the adoption of longer range buses that are less reliant on en-route charging.	PGE intends to monitor en-route and depot charging energy use patterns and use the findings to inform future rate design.

Public Utility Commission of Oregon  
Page 5  
July 21, 2021

If you have any questions or require further information, please contact Alina Nestjorkina at (503) 464-2144. Please direct all formal correspondence and requests to the following e-mail address [pge.opuc.filings@pgn.com](mailto:pge.opuc.filings@pgn.com).

Sincerely,

*/s/ Jaki Ferchland*

Jaki Ferchland  
Manager, Revenue Requirement

*Enclosure*

cc: Eric Shierman, OPUC Staff



Opinion **Dynamics**

Portland

503 287 9136 tel  
503-281-7375 fax

3934 NE MLK Jr. Blvd.  
Suite 300  
Portland, OR 97212



# Evaluation of Portland General Electric's Transportation Electrification Pilot Programs 2020 Annual Report

July 16, 2021



# Table of Contents

1. Executive Summary .....	1
1.1 Pilot Summary and Evaluation Activities.....	1
1.2 Key Findings and Recommendations.....	2
2. Introduction .....	5
2.1 Transportation Electrification Pilot Background .....	5
2.2 Evaluation Objectives and Activities.....	5
3. OPUC Learnings .....	9
3.1 Outreach, Education, and Technical Assistance Pilot.....	9
3.2 EA Pilot .....	10
3.3 Electric Mass Transit 2.0 (TriMet) Pilot .....	12
4. Outreach, Education, and Technical Assistance Pilot .....	15
4.1 Staff and Partner Feedback.....	15
4.2 Business Technical Assistance and Training Recipient Feedback.....	17
4.3 TNC Driver Focus Group.....	22
4.4 Impact Analysis.....	25
5. Electric Avenue Pilot .....	33
5.1 Staff and Partner Feedback.....	33
5.2 Impact Analysis.....	38
6. Electric Mass Transit 2.0 (TriMet) Pilot.....	51
6.1 Staff and Partner Feedback.....	51
6.2 Impact Analysis.....	56
Appendix A. Future Evaluation Activities.....	63
Appendix B. Business Technical Assistance and Training Survey Detailed Findings.....	64
Business Technical Assistance and Classes.....	64
Awareness of PGE EV Pilot Efforts.....	65
Workplace Charger Installations.....	66
Fleet Electrification.....	68
Appendix C. TNC Driver Focus Group Memo.....	70
Introduction and Key Findings .....	70
Methods .....	71
Electric Vehicles.....	72

Vehicle Charging .....	73
Informational Resources .....	76
Partner TNC EV Offerings .....	76
Appendix D. Additional EA Impact Analyses .....	78
EA Charging Load Shapes .....	78
COVID-19 Impact .....	80
Appendix E. Wave 2 Business Technical Assistance and Training Survey Instrument.....	83
Instrument Information .....	83
Instrument.....	84
PGE EV Consultations.....	87
Appendix F. Wave 1 and 2 Technical Assistance and Training Follow-up Survey Instrument.....	104
Instrument Information .....	104
Instrument.....	105
Appendix G. TNC Focus Group Instrument.....	117
Instrument Information .....	117
Focus Group Guide .....	117



# 1. Executive Summary

## 1.1 Pilot Summary and Evaluation Activities

Portland General Electric (PGE) launched a coordinated set of three pilot programs in late 2018 that encourages greater electrification of the transportation sector. While each pilot program has its specific activities and immediate targets, they work together to bring about several overlapping near-term outcomes including increasing customer awareness and use of electric vehicles (EVs), buses, and charging stations to lower barriers to the adoption of EVs. The following summarizes each pilot’s objectives and related evaluation activities conducted by Opinion Dynamics (“the team”) in 2020.

### Outreach, Education, and Technical Assistance Pilot (OE&TA) Pilot



- **Residential customers:** In 2020, PGE’s OE&TA activities targeting residential customers were limited due to the COVID-19 pandemic. Prior to the pandemic, PGE provided outreach to potential EV purchasers and lessees by sponsoring ride-and-drive events, working with a transportation network company (TNC) to increase adoption of EVs among TNC drivers, and attending the Portland International Auto Show. Additional residential OE&TA activities included sponsoring interactive educational kiosks at auto dealerships and providing dealer training, as well as partnering with original equipment manufacturers (OEMs) to offer vehicle rebates to PGE customers.

- Evaluation approach: Interviews with pilot staff and partners, online focus group with transportation network company (TNC) drivers, and documentation of pilot performance metrics, including looking at how the pilot addresses equity issues.



- **Nonresidential customers:** PGE provided technical assistance and education to customers interested in fleet electrification or workplace charging and providing fleet electrification assessments.

- Evaluation approach: Interviews with pilot staff and partners, surveys with recipients of technical assistance consultations and PGE-sponsored education, and documentation of pilot performance metrics, including effectiveness of technical assistance consultations in helping organizations install chargers and electrify fleets.

### Electric Avenue (EA) Pilot



- PGE installed six EA charging stations consisting of 12 Level 2 (L2) and 22 Direct Current Fast Charging (DCFC) chargers geographically dispersed throughout its service territory.

- Evaluation approach: Interviews with pilot staff and partners and an impact analysis documenting charging patterns, distribution system impacts, and charging behaviors by user groups.

### Electric Mass Transit 2.0 (TriMet) Pilot



- PGE installed, owns and operates two bus depot charging stations and one en-route charging station, while TriMet procured five electric buses with 200 kWh batteries.

- Evaluation approach: Interviews with pilot staff and partners and an impact analysis documenting charging profiles, distribution system impacts, and bus performance.

## 1.2 Key Findings and Recommendations

The following section provides key evaluation findings and recommendations, by pilot. **Evaluation activities will continue through 2023 which will allow the team to monitor and expand on these findings (See Appendix A for a summary of future evaluation activities).**

### 1.2.1 Outreach, Education, and Technical Assistance (OE&TA) Pilot

- **Technical assistance and education:** Nonresidential customers gave positive feedback about the technical assistance consultations they received, which has been effective and influential, resulting in 53% of surveyed customers installing charging and 41% electrifying some portion of their fleets. The COVID-19 pandemic has decreased customer interest in consultations for charger installations, potentially because of the increased number of employees working from home, but consultations for fleet electrification have continued to be sought out by customers.
  - **Recommendation:** Increase data collection efforts during the consultation process beyond current metrics (subject, topics discussed, and contact info). Recommend adding the following metrics for workplaces: business sector, number of employees, number of employees with EVs, number of existing chargers, and number of planned chargers. Also recommend adding the following metrics for fleets: business sector, number and type of existing vehicles in fleet, number and type of planned EVs, number of existing chargers, and number of planned chargers. Improved data tracking from these consultations will allow for PGE to do robust customer segmentation supporting a more targeted go-to-market, focusing efforts on organizations who are most interested or in need of charger installation or fleet electrification.
- **Marketing and engagement:** PGE is in the process of adjusting its EV messaging to customers to improve customer engagement. Changes include updating EV content on the PGE website and reevaluating engagement activities such as ride-and-drive events, as they have proven to not be cost effective. PGE has continued to engage with dealers and data indicate that educational kiosks at dealerships are increasing consumer and sales staff knowledge of EVs.
  - **Recommendation:** Continue to evolve marketing and engagement activities, including sponsoring or having a presence at larger events in the future and expand dealer engagement through additional educational kiosks and dealer education.
- **TNC collaborations:** The collaboration with a TNC company has continued to be effective in encouraging use of EA sites by TNC drivers. Findings from an online focus group with TNC drivers show that drivers are financially and environmentally motivated to buy an EV but may face difficulty qualifying for financing. Additionally, TNC drivers are encouraged to see expanded charging availability, but still expressed range anxiety and desire for more fast chargers along highways outside of Portland. While unlimited EA charging subscriptions and tax incentives for EVs are appealing to TNC drivers, uptake of the TNC-subsidized EA subscription offer has declined since 2019, perhaps due to the COVID-19 pandemic.
  - **Recommendation 1:** Continue to work with the TNC company to offer EA subscriptions and consider broadening collaboration with on-demand delivery service providers, as many TNC drivers have transitioned to these companies.
  - **Recommendation 2:** Consider providing financial assistance to TNC drivers to reduce the barriers to purchasing an EV. This may include vehicle incentives, rental subsidies, or partnerships with financial institutions to provide low-interest loans to TNC drivers.

- **Equity:** An analysis of customer survey data uncovered trends among low-income customers, renters, and persons of color in their perceptions of EVs and barriers to adoption. While low-income customers and seniors are less familiar with EVs, the share of respondents that intend to purchase an EV or are considering purchasing an EV is similar to other customer types. Customers that identified as low-income, person of color, and renters were more likely to categorize certain characteristics of EVs (price of the vehicle, vehicle reliability, and ability to charge at work) as “major concerns,” indicating that these groups face some unique barriers to adoption, especially when it comes to access to charging.
- **Recommendation:** These results suggest that customers who are renters, low-income, or persons of color have some misconceptions of owning an EV and could benefit from targeted marketing and additional support connecting to sources of financing and funding for EVs. PGE should continue to provide messaging focused on the low cost of fuel through PGE (both at home and at public EA stations), lower maintenance costs associated with EVs, and the availability of charging in its service territory. Customers within these communities would also likely benefit from continued access to programs that allow them to share in the benefits of transportation electrification without investing in a vehicle, including ride sharing and public transportation. PGE is currently partnering with community-based organizations (CBOs) and non-profits that support these communities through the Drive Change Fund. As such, PGE could consider leveraging and expanding these partnerships to support targeted education campaigns focused on the features of EVs that are part of a typical car-buying decision and help ease concerns about the technology.

## 1.2.2 Electric Avenue (EA) Pilot

- **Opening the remaining EA sites:** PGE was able to apply learnings from the first three EA sites resulting in a smoother process for constructing and commissioning the remaining EA sites. The design-build project delivery approach for constructing the EAs has been an improvement and PGE has achieved cost savings as a result. The remaining EA sites encountered some minor challenges during the construction process, which PGE was able to overcome through coordination with site hosts and local jurisdictions.
- **Recommendation:** Apply best practices learned through the Pilot (i.e., the project delivery approach, coordination with municipal governments, and coordination with vendors) to future charger installations beyond the EA sites, including heavy- and medium-duty charging applications.
- **Charger up-time and utilization** The EA network continued to see frequent hardware and software issues in 2020. While technical issues decreased in frequency in 2019, the lengthy commissioning process for the additional EA sites in 2020 caused issues with charger availability. Around the same time as the commissioning of the remaining EA sites, measures aimed to curb the spread of COVID-19 were put into place which decreased utilization significantly.
- **Recommendation:** Continue to monitor utilization to better understand how the measures to curb COVID-19 impact charger usage across subscribers, non-subscribers, TNC drivers, and new users such as on-demand delivery services.
- **Pricing structure and system peak impact:** The EA network does not significantly contribute to PGE’s system peak and the EA pricing structure has been effective at influencing charging behavior. EA Charging load is not observed to be highly coincident with PGE’s system peak. Further, EV drivers continue to be receptive to the EA pricing structure. The peak pricing component from 3:00 p.m. to 8:00 p.m. has shown to be highly effective in shifting charging away from system peak load periods.
- **Recommendation:** Continue to implement the peak pricing component and monitor utilization as usage of the EA sites increases to determine system impacts.

- **EA user group differences:** Charging profiles and utilization differ between EA user groups. TNC EA subscribers consume the most energy on a per customer basis and exhibit the greatest shift in load to off peak hours compared to other users. Non-subscribers do about 21% of their charging during the peak pricing period while subscribers do 10%–13% of their charging during the peak pricing period. The impact of the peak period surcharge can be observed in the charging profiles from TNC subscribers and EA monthly subscribers while the peak pricing impact is not observed in the charging profile of non-subscribers. The charging load of subscribers drops off at 3:00 p.m. when peak period pricing begins and then sharply increases at 8:00 p.m. at the end of the peak period.
  - Recommendation: Conduct additional customer research to determine the potential size of user groups, particularly non-subscribers, and gain a better understanding of charging behaviors for these groups through surveys.
- **Utilization of DCFCs versus L2 chargers:** There is a clear customer preference for DCFCs and the daily usage patterns of L2 and DCFC chargers exhibit significant differences. DCFCs served 96% of energy delivered by EA chargers and have a utilization rate nearly twice that of L2 chargers. Further, DCFC usage exhibits a dual peak that corresponds with the peak pricing period whereas use of L2 chargers does not seem to be as impacted by peak pricing. Differences in charger usage could be related to the pricing structure, limited understanding of the pricing structure and charger types, or DCFC availability.
  - Recommendation: Conduct additional customer research to better understand EV owner knowledge, preference, and charging behavior across DCFCs and L2 chargers through surveys.

### 1.2.3 Electric Mass Transit 2.0 (TriMet) Pilot

- **Technical issues with buses and chargers:** The buses running on Line 62 were grounded at several points during the last year due to issues with communication between the buses and the chargers, as well as service reductions related to COVID-19. Coordination between the bus and charger vendors to resolve these issues has been slow and inadequate, resulting in long periods when the buses were pulled from service over the pilot. Further, PGE Operations and Maintenance staff who monitor the dashboard provided by the charging vendor reported communication challenges when contacting the vendor for more information, encountering response times of up to five weeks.
  - Recommendation: Establish a more responsive issue resolution process that can be codified in existing or new service level agreements (SLA) with participating vendors. An enhanced, detailed SLA can be designed to improve collaboration between the vendors to resolve technical issues more quickly and efficiently. We also recommend applying similar processes, as relevant, to future medium- and heavy-duty vehicle charging applications.
- **System peak impact:** Bus charging load does not currently contribute significantly to PGE's system peak or distribution system, suggesting there is not currently a need to change bus charging behavior. Neither the Sunset Transit Center nor the Merlo Garage feeders are at risk of overloading despite the use of high-powered chargers. Further, TriMet and PGE staff report there are limited opportunities to use rates to influence bus charging behavior and the flexibility to shift bus charging is limited due to the limited capacity of the buses' batteries and the route configuration.
  - Recommendation: Continue to monitor usage to confirm that there is not a negative peak impact once all buses on Line 62 have been in operation over a longer period of time and additional bus lines are electrified. Conduct additional research to understand if there is flexibility to leverage rates to influence charging behavior with the adoption of longer range buses that are less reliant on en-route charging. This information can be used to inform future expansion of electric buses in TriMet as well as future investment in medium- and heavy-duty EVs and associated infrastructure.

## 2. Introduction

### 2.1 Transportation Electrification Pilot Background

PGE launched a coordinated set of pilot programs in late 2018 that encourages greater electrification of the transportation sector. While each pilot program has specific activities and immediate targets (Table 1), they work together to bring about overlapping near-term outcomes: (1) PGE customers will see and use EVs, buses, and charging stations, helping to lower barriers to the adoption of EVs; (2) Multifamily and low-income customers will have better access to EV transportation; and (3) Businesses, municipalities, and governmental agencies will receive technical assistance and education that will improve their ability to support an EV-ready infrastructure and encourage adoption of EV fleets.

Table 1. Description of PGE’s Pilot Activities and Outcomes

Outreach, Education, and Technical Assistance Pilot (OE&TA)
<p>This pilot relies on the following strategies to increase the adoption of EVs in PGE’s territory:</p> <ul style="list-style-type: none"> <li>▪ EV technical assistance to commercial and industrial customers, municipalities, governmental agencies, non-profits, transit agencies and providers, low-income service providers, and community-based organizations (CBOs) that are considering fleet electrification, workplace charging, or procurement of EVs.</li> <li>▪ EV ride-and-drive events (currently paused due to COVID-19).</li> <li>▪ Educational kiosks and education of auto dealer staff on a proprietary EV charger labeling system and mobile application for EV drivers who reside in PGE territory.</li> <li>▪ Partnerships with OEMs (BMW, Chevrolet, and Nissan) to offer combined PGE and OEM incentives for an EV to PGE customers (referred to as “bulk purchase partnerships”).</li> <li>▪ Partnerships with TNCs to educate drivers about the benefits of driving EVs and increase EV utilization through discounted charging initiatives.</li> </ul>
Electric Avenue Pilot
<p>PGE installed six EA charging sites geographically dispersed throughout its service territory. The pilot will test pricing signals to encourage off-peak charging and charging when excess renewable energy is available. The pilot will also examine the impact of community charging on increasing adoption of EVs by PGE customers (including multifamily residents) and TNC drivers.</p>
Electric Mass Transit 2.0 (“TriMet”) Pilot
<p>PGE owns two bus depot charging stations (150 kW each) and one en-route charging station (450 kW), while TriMet procured five electric buses with 200 kWh batteries. The pilot will gather bus charging data from the stations to assess the energy and cost impacts of electrifying an entire bus route over time as well as operations impacts to TriMet.</p>

### 2.2 Evaluation Objectives and Activities

This report is the second annual report as part of a five-year evaluation and covers pilot activities that began in late 2019 and continued through December 2020. There are three primary objectives for the 5-year evaluation:

- Understand how PGE can improve its program implementation during and after the pilots;
- Quantify the impacts of the pilots on EV awareness, sales, use, and barriers; and
- Determine the load impacts of public and electric bus chargers.

This report primarily addresses the first and third objectives covering the first and second years of pilot activities. The team conducted four research activities in 2020, beginning in January 2020 and ending in December 2020. Appendix A provides a summary of planned evaluation activities through 2023.

### 2.2.1 PGE TE Pilot Staff and Pilot Partner Interviews

The team conducted the second of two rounds of PGE program staff and pilot partner in-depth interviews in July and August 2020. The purpose of the interviews was to document successes and challenges associated with the three pilots after the second year of program activities. During the second round of interviews, the team interviewed 11 program staff and nine pilot partners (Table 2).

Table 2. Count of 2020 Pilot Staff and Pilot Partner Interviews Conducted

Pilot	Pilot Staff	Pilot Partners	Total
OE&TA	3	2	5
EA	4	5	9
TriMet	4	2	6
<b>Total</b>	<b>11</b>	<b>9</b>	<b>20</b>

### 2.2.2 Business Technical Assistance Survey

The team completed two rounds of surveys with businesses who received technical assistance or attended a PGE-sponsored session on workplace charging or fleet electrification. In 2019 and 2020, we conducted an initial survey with 37 organizations between five and twelve months (typically six months) following receipt of the technical assistance or after attending the PGE-sponsored event (Table 3). The survey explored several key research questions, including:

- Experience and satisfaction with the technical assistance received or education
- How understanding of charger siting, maintenance, and costs changed because of the technical assistance or education
- The influence the technical assistance or education had on installations, purchases, charger installations or EV fleet purchases.

In 2020, the team completed 19 follow-up surveys with organizations who had received technical assistance consultations and completed the initial survey. We fielded this survey between seven and eight months after the initial survey to learn how the organizations were progressing toward electrification. We report the combined results from the initial surveys conducted in 2019 and 2020 and the follow-up surveys conducted in 2020.

Table 3. Business Technical Assistance Survey Dispositions

Interaction Type	Number of Attendees Invited	Number of Initial Surveys Completed	Number of Follow-Up Surveys Completed
Business Technical Assistance Consultations (2019/2020)	118	31	19
The Fleet of the Future event (2019)	17	4	0
Electrifying School Transportation Conference Session (2019)	2	1	0

Workplace Charging Webinar (2019)	2	1	0
<b>Total</b>	<b>139</b>	<b>37</b>	<b>19</b>

Respondents represent a variety of organizations, including cities, hospitals, universities, research centers, a port district that oversees aviation and marine activity, non-profits, apartments, a school district, a park, a zoo, a water district, transit operators, and businesses including a real estate firm, car manufacturer, car dealer, auto repair shop, air filtration business, construction companies, designing and architectural business, and trucking companies.

### 2.2.3 TNC Driver Focus Group

The team hosted the first of two focus groups with Transportation Network Company (TNC) drivers who were PGE customers that either recently drove or currently drive for a TNC company and who were considering purchasing or leasing an EV or PHEV for their next vehicle. The online focus group was held July 2020, and the discussion explored participants' experiences as a TNC driver, and their thoughts about using EVs and EV charging for rideshare driving. The team will host a second focus group in 2022 with TNC drivers who own or lease an EV to get their thoughts about charging and using their EV for ridesharing driving.

The team recruited from a list of 199 TNC drivers who signed up for a rideshare community event and information session in Downtown Portland sponsored by PGE's ride-and-drive implementer and a TNC in November 2019. Among the 199 TNC drivers, 19 responded to a ride-and-drive screening survey conducted by the team and expressed interest in participating in a focus group. The survey confirmed respondents were currently or recently a TNC driver, did not work for an industry that would pose a conflict of interest, were PGE customers, did not currently own an EV, and were considering an EV for their next vehicle.

After TNC drivers responded to the screening survey, the research team prioritized respondents who were current TNC drivers and previous drivers who indicated they were likely to drive for the TNC company again in the future. The team recruited 10 participants and seven attended the online focus group. The focus group was recorded with participants' permission. Note that one participant joined the focus group late, and for that reason, some findings are reported out of six participants instead of seven.

### 2.2.4 Impact Analyses

#### OE&TA Pilot

The OE&TA impact analysis consisted of documenting key Pilot performance metrics, including the number of Ride-and-Drive events, rebates distributed through bulk purchase partnerships, social media activity, the number of businesses receiving technical assistance or training from PGE, and whether such businesses pursued investing in charging infrastructure or fleet electrification. Additionally, the evaluation team used interviews with PGE staff and Pilot stakeholders and conducted analyses of residential customer survey data to investigate the performance of key metrics across demographic sub-groups. The team aggregated the results from the 2018 Baseline and a 2019 post-pilot launch (Wave 1) surveys to allow for more statistically rigorous comparisons between sub-groups.<sup>1</sup> Survey questions addressed pilot awareness, purchase considerations, intentions to purchase or lease an EV, as well as questions specific to the pilot activities.

<sup>1</sup> In 2018, PGE conducted a baseline survey with the general population of residential customers who indicated they were considering purchasing a vehicle in the next five years to assess EV awareness and perceptions in the PGE territory. The team adapted the 2018 Baseline survey to create a post-pilot launch (Wave 1) survey in 2019. For the Baseline and Wave 1 surveys, a random sample of PGE residential customers with email addresses was invited to take the web-based survey via email invitation.

## EA Pilot

The EA impact analysis focuses on how the charging load at each EA site impacts PGE’s bulk and distribution systems. In addition to evaluating the system impact, the evaluation team investigated the average charging shapes and utilization at each site to draw high-level insights on users’ charging preference and site utilization. The evaluation team also looked at the charging behavior differences across varying charger types and payment plans and the impact of COVID-19 on EA use. The analysis was conducted based on the charging data measured at the chargers at each EA site from March 2019 to October 2020.

## Electric Mass Transit 2.0 (TriMet) Pilot

The TriMet impact analysis presents the characteristics of the buses’ charging load and discusses its impact on PGE’s system. The analysis also summarizes the energy consumption and charging session duration at Merlo Garage and the Sunset Transit Center, quantifies the charging load factors and impact on PGE’s system peak, and investigates how electricity consumption of the buses changes by season.

The evaluation team primarily conducted these analyses using TriMet charging data measured at the meters from March 2019 to November 2020 (the “study period”). Some analyses use session data measured at the charger where appropriate. Within the study period, there were intervals when buses were not in service due to technical issues (i.e., December 2019 and the period after May 2020).<sup>2</sup> As a result, some analysis excludes those periods to focus on charging behaviors during normal bus operation periods.

---

<sup>2</sup> At the time of this report the buses were still not in service due to technical issues.



### 3. OPUC Learnings

PGE provides the Oregon Public Utilities Commission (OPUC) with learnings associated with each pilot as part of the effort to monitor the progress of the pilots.<sup>3</sup> Table 4 through Table 6 provide findings associated with the OPUC learnings by pilot. Note that the key findings are derived from both 2019 and 2020 evaluation activities and details for some findings are presented in the 2019 evaluation report. Also note that data collection activities related to some OPUC learnings are in progress or have not yet been initiated, as noted in the tables.

#### 3.1 Outreach, Education, and Technical Assistance Pilot

Table 4. Outreach, Education, and Technical Assistance Pilot OPUC Learnings Key Findings

OPUC Learning	Key Findings
1.The impact of outreach efforts (e.g., ride-and-drive events, education) and marketing (e.g., ads), if available, on:	<ul style="list-style-type: none"> <li>▪ Ride-and-drive events at dealerships have been of mixed success and could be improved with additional support from PGE.</li> <li>▪ Partnerships with dealerships may lead to future ride-and-drive events, although the partnerships' effectiveness at promoting ride-and-drive events has been mixed.</li> <li>▪ The partnership between the ride-and-drive implementer and PGE can be leveraged further to increase attendance at ride-and-drive events in the future.</li> <li>▪ The Portland International Auto Show is an effective venue in educating people who are interested in EVs, and more cost-effective than ride-and-drives.</li> </ul>
1a. PGE customer awareness of EVs in the service area as measured through PGE customer surveys, focus groups, one-on-one interviews, program data, etc.;	<ul style="list-style-type: none"> <li>▪ About three-quarters of customers report being familiar with EVs (73%) or PHEVs (78%).</li> </ul>
1b. The consideration of an EV for new car shoppers; and	<ul style="list-style-type: none"> <li>▪ Dealers say that EV educational kiosks help to explain EVs to new-car shoppers and alleviate their concerns regarding range and where and how to charge.</li> <li>▪ Kiosks are being used by consumers and dealership sales staff, but use has declined due to the COVID-19 pandemic.</li> <li>▪ Among likely vehicle purchasers, about half report they are either considering (25%) or intending (24%) to purchase an EV or PHEV in the next five years.</li> </ul>
1c. Overall sales and leases of EVs in the service area as measured through the evaluation of recent EV purchasers/lessees.	Results pending 2 <sup>nd</sup> impact analysis in 2023.
2. The impact of technical assistance programs and marketing on the installation of workplace EV chargers.	First and second wave survey results suggest technical assistance from PGE was influential in the decision to install workplace charging (60% of respondents indicated PGE's technical assistance was highly influential).
2a. Number of recipients of technical assistance that result in charger installations.	About half of technical assistance survey respondents (53%) who provide on-site parking have installed chargers or outlets for charging since receiving assistance.

<sup>3</sup> Report on Finalized Learnings for PGE's Transportation Electrification Programs (2018): <https://apps.puc.state.or.us/orders/2018ords/18-124.pdf>

3. The change to participation rates in TOU rate schedules by EV owners.	Results pending 2 <sup>nd</sup> impact analysis in 2023.
4. The change in EV charging load characteristics, influenced by education efforts.	Results pending 2 <sup>nd</sup> impact analysis in 2023.
5. The major challenges business customers face when planning for and siting EV charging infrastructure.	Business customers noted a variety of challenges including the installation taking more time to complete than expected, permitting taking longer than expected, and stations not working as intended.
5a. Evaluate the efficacy of outreach effort including challenges; and	Anecdotally, customers have positive feedback about their consultations. PGE could improve their ability to evaluate the efficacy of their outreach, however, by systematically tracking data on the customers' experience, including whether they have purchased EVs or installed charging equipment as a result of the consultation.
5b. Adjustments to outreach efforts to increase effectiveness and response to barriers.	Currently, most customers reach out to PGE about their consultation needs. A PGE contact indicated that outreach efforts could be improved by tracking data about customers' needs and knowledge of EVs to improve future outreach efforts.
6. Gather data on customer awareness of EVs and their exposure to PGE's EV marketing campaigns.	<ul style="list-style-type: none"> <li>▪ The Portland International Auto Show, which has been well-attended, has engaged customers and is likely more effective in educating people who are interested in EVs compared to ride-and-drives.</li> <li>▪ One-fifth (20%) of likely vehicle purchasers indicated seeing at least one PGE EV resource, campaign, or discount.</li> </ul>
7. Develop and implement a plan to gather sample information from a variety of populations in PGE's service territory, including those listed below:	Evaluation meets this requirement
7a. General sample of PGE customers;	Evaluation meets this requirement
7b. Recent EV purchasers;	Evaluation meets this requirement
7c. Recent technical assistance customers;	Evaluation meets this requirement
7d. Recent non-EV purchasers;	Evaluation meets this requirement
7e. Trade allies (e.g., dealers, manufacturers); and	Evaluation meets this requirement
7f. Key stakeholders (e.g., ride-and-drive implementer, transportation authorities, program staff).	Evaluation meets this requirement

### 3.2 EA Pilot

Table 5. EA Pilot OPUC Learnings Key Findings

OPUC Learning	Key Findings
1. Effect of EV charging on PGE's system to determine how EVs can be used to create a system benefit	Results pending 2 <sup>nd</sup> impact analysis in 2023.
2. The impact of the presence of visible, reliable, and accessible charging infrastructure on:	Results pending EV Owner and EA intercept surveys in 2021.

2a. Customers' willingness to purchase an EV; and	Results pending EV Owner and EA intercept surveys in 2021.
2b. Customers' willingness to take longer trips in an EV.	Results pending EV Owner and EA intercept surveys in 2021.
3. The extent possible, learning who the predominant users of the charging infrastructure are:	Results pending EV Owner and EA intercept surveys in 2021.
3a. Whether there are distinct use cases with predictable load profiles;	<ul style="list-style-type: none"> <li>▪ TNC and EA Monthly Subscribers show similar charging profiles with highest peak occurring at 8 PM and the secondary peak in the early afternoon.</li> <li>▪ TNC EA Subscribers have the greatest shift in load to off peak hours, with a sharp increase at 8 PM.</li> <li>▪ The impact of the peak period surcharge is observed in the charging profiles from TNC subscribers and EA monthly subscribers while the peak pricing impact is not observed in the charging profile of non-subscribers. In addition, TNC EA subscribers consume the most energy on a per customer basis.</li> </ul>
3b. Whether the chargers are regularly utilized by non-PGE customers; and	Customer response TBD via intercept surveys in 2021.
3c. If possible, use by and effects of TNCs.	<ul style="list-style-type: none"> <li>▪ One TNC company offers its drivers a discounted subscription pricing plan for EA charging. In 2020, PGE reports that the Downtown Portland and East Portland EA sites are popular with TNC drivers, suggesting that drivers are utilizing the pricing plan and the EA network. EA impact analysis confirmed East Portland was most popular with TNC drivers, however, user group data was unavailable for the Downtown Portland EA. These sites are likely popular due to their central location and relative proximity to the airport.</li> <li>▪ TNC drivers aggregately consumed 1,879 kWh per month on average, which was approximately 19% of total EA charging between March 2019 and October 2020.</li> </ul>
4. Utilization and/or demand for quick chargers versus L2 chargers, including the time of day and pricing information.	<ul style="list-style-type: none"> <li>▪ Partner interview data revealed that customer demand for L2 chargers still exists among EA users though charging and utilization data suggests that customers prefer DCFC chargers. DCFCs served 96% of energy delivered by EA chargers. In addition, The DCFC utilization rate was 6.5%, nearly twice that of L2 chargers.</li> <li>▪ The daily usage patterns of L2 and DCFC chargers exhibit differences: the daily average DCFC load profile exhibits two peaks with a dip between 3:00 p.m. and 8:00 p.m., during peak pricing, while the L2 average charging profile only peaks once around noon. The impact of peak pricing is not observable in the L2 average charging profile.</li> </ul>
5. To the extent possible, learning who is not using the charging infrastructure and why?	Results pending EV Owner and EA intercept surveys in 2021.

<p>6. Network load profiles and the impacts on PGE's distribution system, including coincident and noncoincident peak loads of DC fast chargers and power quality in the vicinity of the chargers.</p>	<ul style="list-style-type: none"> <li>▪ Charging load at six EA sites has minimal impact on PGE's distribution system.<sup>a</sup> None of the feeders at the EA sites are at risk of overloading even when all chargers are used at the same time.</li> <li>▪ EA Charging load is not observed to be highly coincident with PGE's system peak. For all EA sites combined, the non-coincident Peak (NCP) ranged from 153-239 kW month by month after all charging stations were online, which is about 13-20% of the total charging capability. As for the coincident peak, on average, 48 kW of charging happens during the top 3% of PGE load hours, which is approximately 4% of the total charging capability.</li> </ul>
<p>6a. Gathering of information to assist with analysis of impacts to PGE's system, including how many users are charging off-peak and how that affects the system.</p>	<p>52% of charging occurred during off-peak period, 31% occurred during mid-peak period, and 17% occurred during peak periods.<sup>b</sup></p>
<p>7. A comparison of customer use of charging infrastructure under time-variant rates versus free charging.</p>	<p>The \$0.19/kWh peak charge from 3:00 p.m. to 8:00 p.m. on weekdays has an observable impact on the charging load shape and has helped shift the charging away from the system peak period. An estimated 14.2 MWh of peak period charging for the Beaverton, East Portland, Hillsboro, Milwaukie, Salem, and Wilsonville EAs was shifted to off-peak hours during the study period or approximately 39.1 kWh/day.</p>
<p>7a. Gathering of information to assist with analysis of whether price signals change charging behavior and why or why not.</p>	<p>Both PGE and the evaluation team have observed on-peak and off-peak charging patterns among customers at a couple of EA sites. This preliminarily demonstrates that the price signals have been successful at changing charging behavior at some sites. COVID-19 also had an impact on daily charging patterns among customers and utilization rates, post COVID-19 may be different.</p>
<p>8. Impact of, and customer interest in, unlimited monthly charging versus other pricing options (e.g., single use, who uses, behavior),</p>	<ul style="list-style-type: none"> <li>▪ Although still minor in scope, the unlimited monthly charging pricing may have an adverse effect on popular EA sites, where congestion occurs because drivers have no incentive to unplug and move on once charging is complete. If the problem persists, an alternative pricing structure may be warranted.</li> <li>▪ EA monthly subscribers and TNC subscribers show observable responses to peak pricing while the peak pricing impact is not observed in the charging profile of non-subscribers.</li> <li>▪ PGE reportedly wants to gauge customer awareness of and interest in different pricing options (such as charging per minute or per kWh) as a future research effort.</li> </ul>
<p>9. The additional PGE infrastructure, if any, needed to support and ensure highly reliable public charging infrastructure (and applicable costs).</p>	<p>EA charger downtime was an issue throughout 2020. PGE is assessing how to ensure highly reliable public charging infrastructure, including considering a new charging equipment vendor.</p>

<sup>a</sup> Six EA sites include Beaverton, East Portland, Hillsboro, Milwaukie, Salem, and Wilsonville EAs.

<sup>b</sup> Off-peak, mid-peak, and on-peak periods are defined based on PGE's residential TOU tariffs: <https://portlandgeneral.com/energy-choices/energy-choices-home/time-of-use-pricing-home>.

### 3.3 Electric Mass Transit 2.0 (TriMet) Pilot

Table 6. Electric Mass Transit 2.0 (TriMet) Pilot OPUC Learnings Key Findings

OPUC Learning	Key Findings
---------------	--------------

<p>1. Pilot design elements, including an exploration of:</p>	
<p>1a. Program Implementation (Pricing and Suppliers)</p>	<ul style="list-style-type: none"> <li>▪ An electric bus manufacturer supplied five buses to TriMet for \$930,000 each (including warranties and upfitting).</li> <li>▪ A transit charging vendor supplied the charging systems for a total cost of \$789,000 for equipment.</li> <li>▪ TriMet estimated the total make-ready cost (installation, engineering, design, and permits) for both charging systems was \$787,670.</li> </ul>
<p>1b. PGE physical infrastructure and cost (line extension, line drop, and distribution equipment requirements)</p>	<ul style="list-style-type: none"> <li>▪ At Merlo Garage, transformer pads and primary power connections were designed to ensure larger transformers and additional secondary runs could be accommodated in the future.</li> <li>▪ The Sunset Transit Center has capacity for a second 450 kW charger.</li> </ul>
<p>1c. Customer service and technical assistance needs</p>	<ul style="list-style-type: none"> <li>▪ TriMet trained its drivers on bus operation and charging and trained its dispatchers so their advice to operators matched their bus.</li> <li>▪ PGE and TriMet determined the scope of O&amp;M to include routine maintenance, emergency repair, having spare parts on site, and monitoring services.</li> <li>▪ PGE monitors charger operation and informs TriMet and, if needed, the charging vendor of any problems.</li> <li>▪ PGE is advising TriMet on the build-out of its Powell Garage.</li> <li>▪ PGE reports it needs greater communication and more timely response when contacting the charging vendor with questions related to the dashboard.</li> </ul>
<p>2. Actual impacts of bus charging load on system infrastructure:</p>	<p>No feeder or substation upgrades were required for the Merlo Garage/Sunset Transit Center chargers.</p>
<p>2a. Additional infrastructure and cost, if any, needed to support and ensure reliable bus charging infrastructure.</p>	
<p>3. Actual impacts of bus charging load on the distribution system loading:</p>	<ul style="list-style-type: none"> <li>▪ Neither the Sunset Transit Center nor the Merlo Garage feeders are at risk of overloading despite the use of high-powered chargers.</li> <li>▪ The current loading in the summer on the feeders serving Merlo Garage and Sunset Transit Center is 58% and 41% of its rating, respectively, below the threshold that would trigger a capacity study by PGE.</li> </ul>
<p>3a. Total load and non-coincident peak load compared to feeder loading.</p>	<ul style="list-style-type: none"> <li>▪ The non-coincident peak load at the Sunset Transit Center ranged from 300 to 425 kW. The non-coincident peak load at Merlo Garage was typically around 150 kW.</li> <li>▪ The charging capacity (450 kW) of the Sunset Transit Center represents about 2.5% of the feeder's capacity, and the charging capacity (300 kW) at Merlo Garage represents about 1.7% of the feeder's capacity, showing that bus charging contributes very little to feeder loading.</li> </ul>
<p>3b. Coincident peak demand, summer and winter of combined depot chargers.</p>	<ul style="list-style-type: none"> <li>▪ The total bulk system coincident peak demand at the Sunset Transit Center and Merlo Garage ranged between 14 and 161 kW during summer. The coincident peak demands are 107 kW and 77 kW during winter morning and evening peak periods, respectively.</li> <li>▪ Coincident peak load on the distribution system is generally low. The Merlo Garage charging load averaged less than 3 kW, or 1% of the chargers' capacity, in the top 3% of feeder load hours in the summer 2019, winter 2019-2020, and summer 2020 seasons. Sunset</li> </ul>

	<p>Transit Center’s average load during summer 2019 peak hours was 44 kW, or 10% of the en-route charger’s capacity. During other seasons, the average load during peak hours was significantly lower on Sunset Transit Center’s feeder as 28 and 6 kW during winter 2019-2020 and summer 2020, respectively.</p>
<p>4. Actual impacts to the bus fleet and fleet facility, of which TriMet will provide some information.</p>	<ul style="list-style-type: none"> <li>▪ In 2019 all buses had mechanical and electronic-related performance issues affecting reliability and availability.</li> <li>▪ Some bus components wore down quicker than expected, such as the bus suspension system and tires, due to the extra weight of the batteries and charging system components.</li> <li>▪ Between December 2019 and July 2020, the buses were occasionally grounded due to issues connecting to the en-route charger: rainwater intruded into the high voltage area of the en-route charger, preventing it from activating and a mechanical component broke on the en-route charger, preventing it from connecting with the bus. At Merlo Garage, software interoperability issues caused the buses to not charge overnight.</li> </ul>
<p>4a. How does the integration of chargers impact the internal logistics of route planning? (Benefits and costs to operations).</p>	<p>For TriMet’s next round of electric buses, they plan to purchase long-range buses that will use only depot charging because en-route charging had reliability issues.</p>
<p>4b. How does their optimal schedule for charging align with system load?</p>	<p>The charging load did not contribute significantly to PGE’s system peak during the study period; however, the team observed high variation of average peak demand during the system peak hours due to the variation of buses arrival time at Sunset Transit Center. Given that, high-power charging at the Sunset Transit Center could occur by chance during PGE’s peak hours in the future.</p>
<p>4c. How flexible is their charging need such that it could better align with system loading?</p>	<p>First-year and second year findings indicate charging flexibility for the transit sector is based on bus type and route length. There is little flexibility to shift buses charging to off-peak times given the short-range buses and route configuration.</p>
<p>4d. TriMet staff feedback on operations and charging compared to existing fleet resources.</p>	<p>Operators enjoyed the buses because of their performance and quietness.</p>
<p>4e. Total combined costs from PGE and TriMet, including charging infrastructure installation, operation, and maintenance costs.</p>	<p>See 1a above for charging and infrastructure costs.</p>
<p>5. PGE’s initial deployment with TriMet will include TOU rates with demand charges (through Schedule 85-P). PGE intends to study the system impacts on peak days, evaluate the bus charging use case, and assess the customer’s needs.</p>	<p>Results pending 2<sup>nd</sup> impact analysis in 2023.</p>

## 4. Outreach, Education, and Technical Assistance Pilot

### 4.1 Staff and Partner Feedback

The section below presents key findings from in-depth interviews conducted with OE&TA Pilot staff (n=4) and Pilot partners (n=2) throughout 2020. The section describes four of the OE&TA Pilot's main strategies for increasing EV adoption: technical assistance, marketing, EV educational kiosks at dealerships, and TNC collaborations.

#### 4.1.1 Technical Assistance

**Customers have positive feedback about the technical assistance consultations they receive, but PGE can be more targeted in their go-to-market approach.** One PGE contact noted, and technical assistance survey responses indicated, that customers have positive feedback about the consultations. One PGE contact further suggested that when PGE interacts with customers for EV charging or fleet electrification consultations, PGE could track the data about the customers' needs and knowledge of EVs and use this information to segment future customers. This approach would help PGE to identify fleet customers that need support planning and allow PGE to reach out to those customers rather than having the customers contact PGE.

**The COVID-19 pandemic decreased customer interest in consultations for charger installations, but consultations for fleet electrification have continued to be sought out by customers.** Prior to the COVID-19 pandemic, a PGE contact explained that the number of business customers interested in consultations in general was increasing as interest in EVs and EV charging increased. Since the pandemic, consultations for workplace charging have declined while demand for fleet electrification consultations has remained steady. The contact suggested that this is because adding an EV to one's fleet is overall a less costly investment than charger installations and because more companies are establishing sustainability goals, causing fleet managers to evaluate their fleets.

**The COVID-19 pandemic has changed *how* the consultations are provided.** A PGE contact who conducts the consultations explained that their work is now completed over the phone, by email, or through video, and that despite the change in format, the consultations are just as effective and easy to conduct as when they were conducted in-person prior to COVID-19. They noted however, that they may transition back to in-person and onsite assessments in the future with social distancing measures in place.

#### 4.1.2 Marketing

**PGE staff are unsure of the impact of ride-and-drive events given the costs associated with sponsoring them and suggest that other pursuits may be a more effective use of resources.** While the partnership with the ride-and-drive implementer continues, PGE staff noted that the ride-and-drives may not be cost effective, (i.e., the cost of ride-and-drives per participant is not having a meaningful impact on EV sales). The contact went on to say that ride-and-drive attendees have likely made up their mind about purchasing prior to the event. Other outreach and educational endeavors, however, such as sponsoring the Portland International Auto Show, have yielded more participation and may be more effective uses of funding. A PGE representative noted that the 2020 Portland International Auto Show is lower cost per impression, a more engaging environment, and likely more effective in terms of educating people who are interested in EVs. Aside from the ride-and-drive events, the ride-and-drive implementer is partnering with PGE on promoting the Oregon Clean Vehicles Rebate and other education and awareness activities PGE has planned.

**PGE is changing its EV messaging to customers to improve their customer engagement.** PGE contacts and a partner noted that PGE's marketing is changing to focus on its critical role as a fuel provider rather than on marketing EVs themselves. As one PGE contact noted, it is not PGE's role, nor is it intuitive to customers, to turn to PGE for information about EVs, but that messaging should focus on its role as the fuel provider to support customers. To that end, PGE will not promote specific brands or models but will still play a role in educating customers on the benefits of EVs where applicable.

**PGE is updating EV content on its website as part of its marketing plan.** The updated EV website will include five sections based on what staff referred to as "key pillars" of EVs: that they are cleaner, powerful, charge at home, are inexpensive to charge, and they are everywhere. Each section will provide customers with useful information on EVs. On the page discussing how EVs are inexpensive to charge, for example, the webpage will provide information on PGE incentives. Additionally, PGE is also working with a partner to include a cost calculator on the website for users to determine the total cost of ownership. According to a PGE contact, the website update, which is critical to their education and awareness plan, will help ensure consistency in PGE's messaging to dealerships.

### 4.1.3 Dealership Engagement

**PGE and its partners both view dealer engagement as effective and data indicate that educational kiosks at dealerships are increasing consumer and sales staff knowledge, which may lead to increased EV sales.** Educational kiosk usage is tracked by the dealer engagement implementer and data have indicated that they are being used at participating dealerships. These kiosks include three main elements: the charging station finder tool, the charging timer tool, and the road trip planner. The kiosks also track whether the user accesses information about financial incentives that are available to the buyer. According to the implementer, the data show that activations occur two times a day, on average, at each of the three kiosk locations, and that the three main elements of the kiosk are utilized equally (around 33% for each). Qualitatively, a partner noted that they are doing follow-ups and secret shopping at the dealership locations and speaking with sales representatives. The dealers have made it clear that the dealer engagement implementer and the educational kiosks have helped customers who need more information about cost of ownership and charging availability.

The dealer engagement implementer is making additional improvements to the kiosks to provide more information to consumers. These improvements include additions to the trip planner, such as the ability to add a midpoint destination and to include the outside temperature and the speed consumers plan to drive in, which improves the accuracy of the fuel usage estimation.

The dealer engagement implementer provides sales staff training on the kiosks, which includes role-playing, a discussion of frequently asked questions, and then a question-and-answer session at the end. A partner who has conducted training explained that most dealerships typically have one or two sales representatives considered to be EV experts. Based on the implementer's secret shopping, they found sales representatives at participating dealerships, regardless of whether they are an EV expert, can answer questions about EV charging.

The dealer engagement implementer collects data from dealerships with kiosks in PGE territory and is tracking sales monthly. One PGE contact noted that the kiosks appear to be helping EV sales. They explained that at the end of 2019, a dealership in the Portland metro area with a kiosk was able to sell about two to four times as many plug-in EVs compared to the three other dealerships for the same manufacturer that did not have a kiosk.

**The COVID-19 pandemic has affected kiosk and app utilization and EV sales.** The dealer engagement implementer observed a sharp decline in kiosk activations as stay-at-home orders began in the spring of 2020.



A decline in vehicle use has also decreased use of the app. EV sales and kiosk utilization also decreased due to the pandemic. The implementer, however, has observed that use of the app started to increase again toward the summer of 2020 and at the time of the interview in June 2020, kiosk utilization was increasing as well.

#### 4.1.4 TNC Programs

**Rideshare driver uptake of the subsidized charging subscription offer declined since 2019.** A TNC company provides a subsidized monthly charging subscription to drivers with EVs to use at EA chargers. The TNC company pays PGE for the monthly subscriptions for all eligible EV drivers on the platform to get charging at one of those stations. All drivers who drive an EV for the TNC company are eligible for the offer. The monthly subscription cost, paid by the TNC company, varies from \$20 to \$25 depending on current subscription volumes. While the offer has not changed, the TNC company explained that subscription uptake among drivers has declined. Given the low uptake, the TNC company rolled users over for the second quarter of 2020 to the third quarter.

**The TNC company is committed to having an all-EVs fleet by 2030 but will need to address some barriers to achieve this, with the help of PGE.** A PGE contact reported that they are working with the TNC company to determine what they can do to assist them with their programs and how they may achieve their goal. Currently, the most predominant barrier to greater EV adoption is that the Oregon Clean Vehicles Rebate is not available to fleet vehicles. Both parties are looking into whether PGE can help to lobby the state to increase the number of rebates an organization can use.

## 4.2 Business Technical Assistance and Training Recipient Feedback

The following section provides key findings from the Business Technical Assistance and Training Survey and follow-up survey. Respondents include both business and governmental organizations who received technical assistance from PGE staff (n=31), and businesses and organizations who attended PGE-sponsored trainings on fleet electrification (n=5), or a webinar on workplace charging where a PGE representative presented (n=1). Responses from the follow-up survey are also included in each section. See Appendix B for detailed findings.

### 4.2.1 Reasons for Business Technical Assistance and Class Attendance, and Recipient Feedback

**Respondents indicated they sought technical assistance for charging, fleet electrifications, or both.** About half of surveyed technical assistance recipients (16 of 31) reported receiving technical assistance for charging infrastructure only, three reported receiving technical assistance for fleet electrification only, and 12 reported receiving assistance for both.

**Most respondents indicated they were in the middle stages of deciding about EV options or charging investments when they had their consultation and wanted to learn about how PGE could help (Table 7).** Among respondents who received technical assistance, most indicated that they were either considering or planning their investment (14 of 31).

**At follow-up, respondents appear to be further along in the process of deciding about fleet electrification or investments in charging (Table 7).** Among follow-up respondents who received technical assistance, most indicated they were in the design or purchase/installation process (6 of 19). One respondent also indicated they were awaiting PGE Drive Change Fund award announcements (one additional mention) and another respondent (one additional mention) indicated that their plans were cut from the budget.

Table 7. Decision Stage for Respondents at Time of Initial Survey and Follow-up Survey (Multiple responses allowed)

Decision Stage	Initial Survey Count (n=31)	Follow-up Survey Count (n=19)
Project on hold due to budget or uncertainty	0	2
Still seeking out information	4	1
Considering or planning investment	14	5
Actively evaluating plan	13	0
In design or purchase/installation process	9	6
Already designed or purchased equipment	5	3
Something else	0	2

The key reasons for receiving the technical assistance were to either learn about EV incentives available (23 of 31) and/or to understand costs associated with chargers (20 of 31) (Table 8).

Table 8. Reported Reasons for Receiving Technical Assistance (multiple responses allowed; n=31)

Reason for Receiving Technical Assistance	Count
Learn about EV incentives available	23
To understand costs associated with chargers	20
Learn about potential PGE distribution system upgrades needed	18
Learn about technical expertise and resources available	17
To understand best location to place chargers	13
Get help selecting chargers	12
Learn the benefits of EVs for business or organization	5

At follow-up, three respondents (of 19) indicated still needing additional information to help them with their decisions including, help comparing charger brands (one mention), having concerns about reliability and durability of the chargers (one mention), and charger siting recommendations (one mention).

#### 4.2.2 Influence of PGE on Workplace Charger Installations

Most respondents (30 of 37) indicated that their organizations provide parking to their employees or customers. Of those, about half (16 of 30; 53%) have installed chargers after working or interacting with PGE (Table 9). Of those who have installed chargers, one respondent indicated that their chargers are open to the public and one indicated they are open to employees and guests.

Of the 14 respondents that have not installed chargers but have parking for their employees or customers, almost three-quarters (10 of 14) indicated that they are still considering installing charging in the future. The remaining respondents either indicated that they are not considering installing charging or do not know.

Table 9. Number of Respondents Who Have Installed Chargers or Are Considering Future Charger Installation (n=30)

Installation Status	Count
Installed chargers	16
Have not installed chargers but are considering	10
Have not installed chargers and are not considering	4

The most prevalent concerns among respondents who have not yet installed chargers were the chargers being cost-prohibitive, capital budget uncertainty, and lack of staff resources to devote to the project.

At follow-up, three respondents indicated that they installed additional workplace chargers in addition to those that they had reported installing during the initial survey.

Of the 16 respondents who installed workplace chargers, L2 chargers were the most-frequently installed (Table 10).

Table 10. Workplace Charger Installations, by Type (n=16)

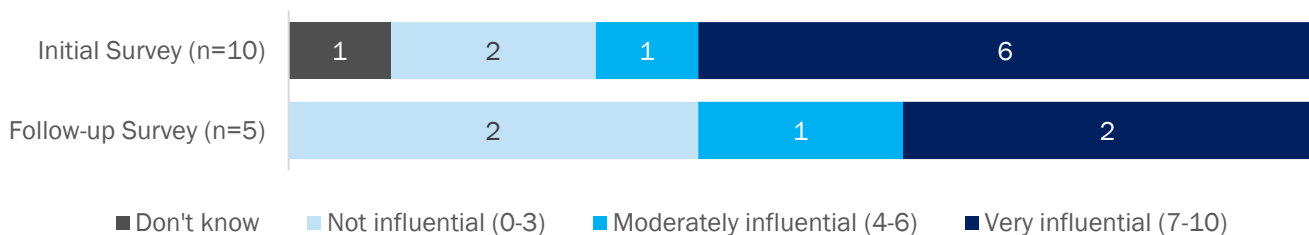
	DCFC	L2 (240 V)	Standard Outlets (120 V)
Five or less	1	6	0
More than five	2	6	4

Note: Counts include initial survey and follow-up surveys. Four respondents could not provide any information about the types of and number of chargers installed.

**Surveyed technical assistance recipients indicated that the consultations they received were very influential in their decision to install chargers and without it, they would have scaled back their projects.** About two-thirds of respondents who reported installing chargers following their consultation (6 of 10) rated the consultation they received as very influential in their decision to install their charger(s) (Figure 1). Further, when asked what they would have done if they had not had the PGE consultation, four (of 10) said that they would have scaled their project down. The remaining respondents indicated they would have done the exact same installations (two mentions), postponed installing the charging equipment for two to three years (one mention), done something else (one mention), or did not know what they would have done (two mentions). The respondent who indicated they would have done something else said that they would have “over-installed” charging if it had not been for PGE’s consultation.

Similarly, at follow-up (Figure 1), two respondents who indicated they installed additional chargers (of five) reported that the initial consultations they received were very influential. Four respondents (of five) indicated that without receiving the technical assistance from PGE, they would have either done the exact same installation of their additional chargers (two mentions), postponed installing their additional charging equipment for 2–3 years (one mention), or installed additional chargers but scaled the project down (one mention). One additional respondent indicated that they did not know what they would have done.

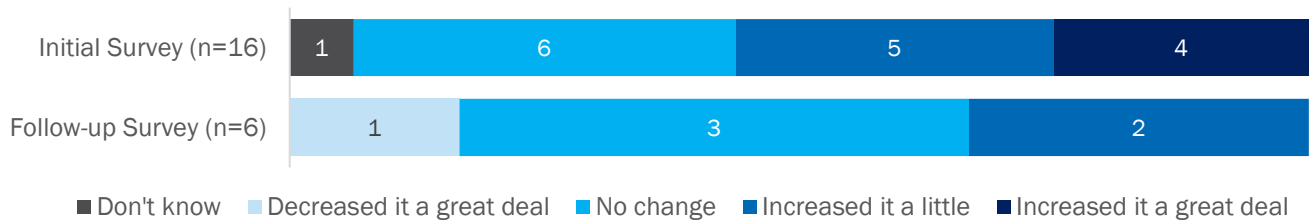
Figure 1. Influence of PGE Consultation on Respondents’ Decision to Install Chargers



**Technical assistance recipients were varied in terms of the consultation’s impact on their likelihood to install charging in the next three years.** Four respondents (of 16) indicated that the consultation increased their likelihood of installing charging within the next three years “a great deal” and five indicated the consultation increased their likelihood “a little.” Most respondents (six) indicated that the consultation did not change their likelihood (Figure 2). At follow-up, two respondents indicated the consultation increased their likelihood “a

little,” three indicated it did not change their likelihood, and one indicated that the consultation decreased their likelihood a great deal.

Figure 2. Consultation Impact on Likelihood of Installing Charging within Three Years



Of the two additional respondents who attended the Fleet of the Future event or webinar on workplace charging, one indicated that the event decreased their likelihood of installing charging “a little” and one indicated that it did not change their likelihood.

### 4.2.3 Influence of PGE on Fleet Electrification

Approximately a year after receiving their consultation with PGE, about 40% of respondents whose organizations own fleet vehicles indicated that their organization purchased EVs (Table 11). EVs purchased include forklifts/trucks, passenger cars, school buses, and public transit buses.

Table 11. EVs Purchased After Working or Interacting with PGE (n=13)

EV Type	Number Purchased
Forklifts/Lift Trucks (n=1)	3
Passenger cars (n=11)	Between 1 and 10
School buses (n=1)	5
Public transit buses (n=1)	2

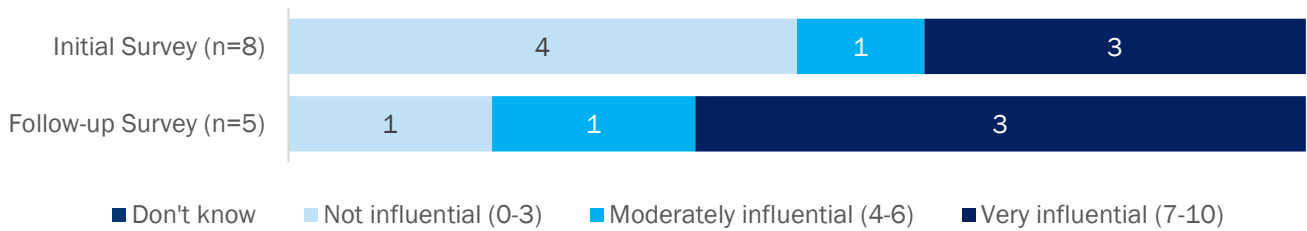
Note: Counts include initial survey and follow-up surveys. At follow-up, one respondent indicated purchasing additional EVs on top of those that they reported purchasing during the initial survey.

The most prominent barriers for respondents who had not purchased EVs for their fleet include the cost being too high compared to gasoline or diesel models, concerns about vehicle range, and concerns about where to charge.

**Technical assistance influenced some respondents’ decisions to purchase EVs.** Less than a half of respondents who received a consultation (3 of 8) indicated that their consultation was “very influential” in their decision to purchase EVs for their fleet (Figure 3). An additional respondent indicated that it was moderately influential. Four respondents indicated the consultation was not influential in their decision to purchase EVs.

**At follow-up, respondents were somewhat more likely to indicate the consultation was influential.** Three respondents indicated the consultation was very influential and additional respondent indicated it was moderately influential. One respondent indicated that the consultation was not influential in their decision.

Figure 3. Influence of PGE Consultation on Respondents' Decision to Purchase EVs

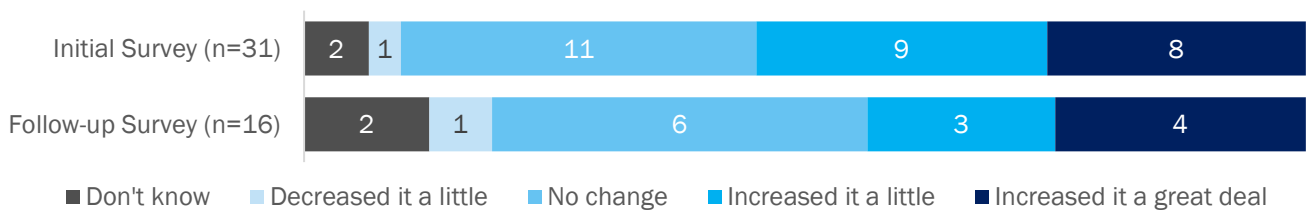


One respondent who attended a Fleet of the Future event, indicated that the event was extremely influential in their decision to purchase EVs for their fleet.

**Technical assistance and education have increased some respondents' likelihood of purchasing or leasing an EV within the next three years, but not all.** Less than a third of respondents (8 of 31) who received a consultation indicated that their consultation increased their likelihood of purchasing or leasing an EV within the next three years “a great deal” (Figure 4). About another third (9 of 31) of respondents who received a consultation said that it “increased [their likelihood] a little.” Eleven respondents indicated it did not change their likelihood, one indicated it decreased it a little, and two indicated that they did not know how the consultation influenced their likelihood to purchase or lease an EV.

**At follow-up, respondents varied in terms of the extent to which their initial consultation impacted their likelihood of purchasing or leasing EVs in the next three years.** About a quarter of respondents (4 of 16) indicated that their consultation increased their likelihood of purchasing or leasing EVs in the next three years “a great deal” and three (of 16) indicated it increased a little (Figure 4). Over a third of respondents (6 of 16) indicated that their consultation did not change their likelihood to purchase or lease EVs in the next three years.

Figure 4. Consultation Impact on Likelihood of Purchasing or Leasing an EV within Three Years

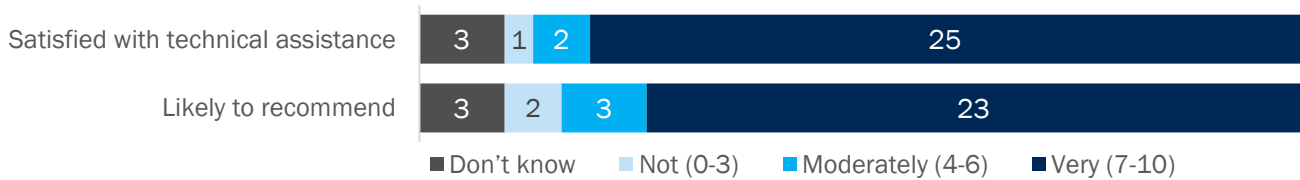


Among those who attended a PGE-sponsored event or webinar, two indicated the education increased their likelihood a great deal, one indicated it increased it a little, two indicated it did not change their likelihood, and one indicated they did not know how the consultation influenced their likelihood to purchase an EV within the next three years.

#### 4.2.4 Satisfaction with PGE's Technical Assistance

Most respondents indicated being very satisfied with the technical assistance they received (25 of 31) and would be very likely to recommend the technical assistance they received from PGE to a colleague or other industry professional (23 of 31) (Figure 5).

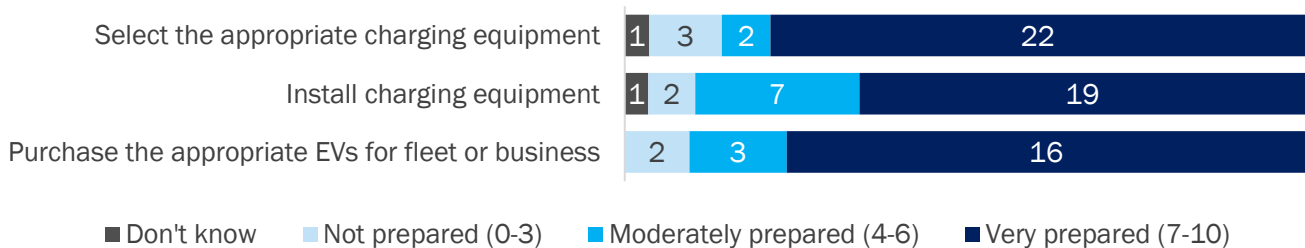
Figure 5. Respondents' Satisfaction with the Technical Assistance they Received from PGE and Likelihood to Recommend the Technical Assistance Received from PGE (n=31)



While respondents generally indicated high levels of satisfaction with the technical assistance they received, five indicated that they would have liked additional information during their consultations. Respondents most often indicated they would have liked assistance from PGE on financial plans to fund charging installations and more information about financial assistance.

**The technical assistance provided by PGE staff is effective in preparing businesses and organizations to electrify their fleets and install workplace charging.** Respondents mostly indicated that after receiving a consultation from PGE staff, they were very prepared to select the appropriate charging equipment, install charging equipment, and purchase the appropriate EVs for their fleet or business (Figure 6).

Figure 6. Respondents' Preparedness after Receiving a Consultation from PGE (n=31)



Note: Analysis excludes respondents who provided "not applicable" responses.

### 4.3 TNC Driver Focus Group

This section presents key findings from the first of two focus groups with TNC drivers who were PGE customers that either recently drove or currently drive for a TNC company and who were considering purchasing or leasing an EV or PHEV for their next vehicle. The online synchronous focus group was held July 2020, and the discussion explored participants' experiences as a TNC driver, and their thoughts about using EVs and EV charging for rideshare driving. The team recruited 10 participants, of which seven attended the online focus group. Detailed findings from the focus group can be found in Appendix C.

The team will host a second focus group in 2022 with TNC drivers who own or lease an EV to get their thoughts about charging and using their EV for ridesharing driving.

#### 4.3.1 Test Driving EVs

**TNC drivers had experience with EVs from either test driving a friend's EV or attending an EV ride-and-drive event.** About half the focus group participants first test drove a friend's EV, which demonstrates social diffusion whereby current EV drivers encourage others to explore EVs. Three others reported test driving an EV at a ride-and-drive event and two visited a car dealership to look for and test drive EVs.

**Participants were highly satisfied with the performance of the EVs they test drove, including the regenerative braking after getting used to it.** Participants liked that EVs “take off” from a stop faster than hybrids, which for one, was important when you need to get through an intersection. Another found the EV easy to maneuver and control and was “very quiet and very smooth to drive.” Two mentioned that they liked the regenerative braking on the EVs and how that would result in fewer brake pad replacements. They noted the braking style was different from an internal combustion engine car and took a little getting used to. As one driver said,

*“I got the hang of the balance of lifting up your foot to slow down the vehicle. It's a funny thing for your brain to adjust to. But once I did adjust to it, I really liked it, and just the ease of being able to control those in one fluid motion was very nice.”*

### 4.3.2 Purchasing and Leasing EVs

**Participants were primarily interested in an EV to reduce their fuel and maintenance costs and help the environment.** Two participants mentioned wanting an EV because it would have a much better fuel economy than their current vehicles. Others wanted to reduce the amount they spent on fuel and move away from fossil fuels. Participants also expected lower vehicle maintenance costs. Participants estimated they could save between \$400 and \$625 in monthly maintenance and fuel costs by switching to an EV. One driver estimated their monthly fuel and maintenance costs would reduce from \$750 to \$125 with an EV and the \$25 unlimited charging subscription. A few participants indicated they fill up their gas tank every day or every other day, and two participants mentioned needing to get oil changes about once a month. One said avoiding the \$70 oil changes would result in “significant savings”. Another was looking forward to not having to replace brake pads due to the regenerative braking in EVs. One participant elaborated and said, “Over time, electric vehicles way more than pay for themselves because you're paying \$25 a month [for charging] versus \$700 a month in gas. That's two car payments right there.”

**First cost and qualifying for financing are likely barriers to purchasing an EV for TNC drivers.** One participant voluntarily mentioned the difficulty rideshare drivers encounter qualifying for a loan for vehicles. Lenders reportedly do not consider TNC driving wages as income until they have been driving at least two years, and after that, it may not be considered “steady” income. When asked of the group, all other participants agreed that qualifying for financing to purchase the EV was a concern for them.

### 4.3.3 EV Charging and Familiarity with EAs

**Participants expected to charge their vehicle at home or at the grocery store and were interested in installing L2 charging at their home.** Slightly over half of participants thought that charging at the end of the day at home made the most sense (4 of 7). Others said they have found free chargers at the grocery store and might charge there (3 of 7). No participants voluntarily mentioned they would use an EA location for charging. All participants were interested in installing a L2 charger at their home. One participant who lived in a condominium said while it is possible to get a L2 charger installed there, the homeowner association (HOA) requirements would be a barrier to installation.

**Participants indicated they drive by the Downtown Portland and Beaverton EA sites most often, typically driving by those locations at least once per week for ridesharing.** About half of participants reported driving by the East Portland, Hillsboro, and Milwaukie locations at least once per week, while no participants reported driving by the Salem location with that frequency. Before informing the participants about the EA locations, only one reported having seen an EA site on their own. Another participant reported they drive by the Beaverton location regularly but had never noticed the EA.

**Participants favored EA locations that were easily accessible, near a highway, or near frequent rides.** Locations near a highway would allow drivers to charge easily and then get onto a main thoroughfare. Participants were interested in having additional EA locations in Portland, including Northeast Portland (near the Portland International Airport, Hollywood District, and Lloyd Center), Inner Southeast Portland, and Southwest Portland near Oregon Health Sciences University.<sup>4</sup>

### 4.3.4 EA Pricing

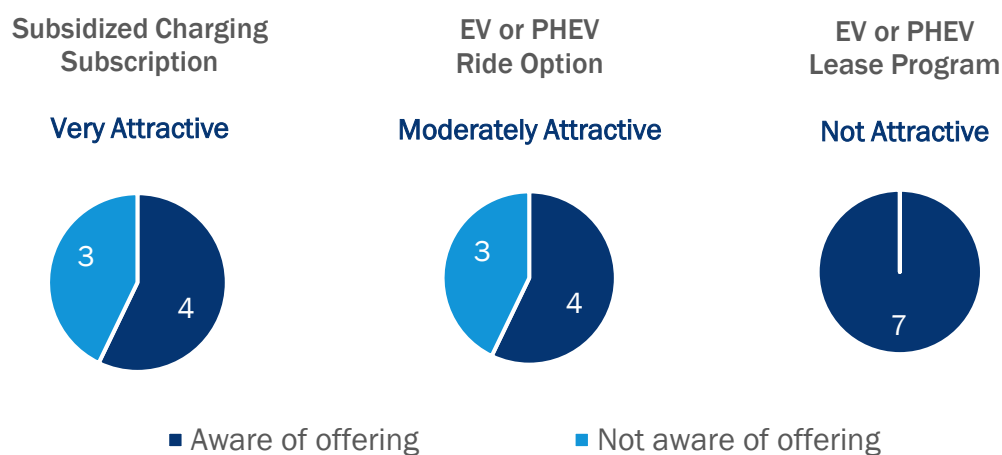
**All participants preferred the \$25 unlimited monthly EA charging subscription over the hourly pricing.** Participants agreed the hourly charging rates were not practical for the amount of charging they would need and that the \$25 unlimited charge was “reasonable” and “the way to go” for a rideshare driver. One participant noted that they could spend \$25 on gas per day, so \$25 for a month was attractive.

One participant noted that the unlimited charging subscription is so attractive that they heard some EV drivers complete the minimum number of rides with the TNC company so they may qualify for the \$25 unlimited charging offer and do no additional rideshare drives beyond that minimum. In other words, it would seem their motivation for rideshare driving is to qualify for the discounted charging and not to generate income. Another participant relayed a story they heard from a friend who drives for the TNC and uses this \$25 unlimited charging subscription and was satisfied with that being their main source of charging.

### 4.3.5 TNC EV Offerings

**Participants expressed varying levels of awareness and attraction to the TNC EV offerings but were very attracted to the subsidized charging offer (Figure 7).** All participants were familiar with the TNC’s offering that allows drivers to lease an EV or PHEV for rideshare driving. Fewer (4 of 7) were familiar with the option in the TNC app that allows riders to request a driver with an EV or PHEV or the subscription plan that allows qualified rideshare drivers to charge for free at EAs. After learning about the TNC subsidized EA charging, all but one participant said the offering increased their interest in purchasing an EV. One participant added that if there were greater availability of EA locations, the offer would be even more attractive.

Figure 7. Awareness and Attractiveness of TNC EV Offerings (n=7)



<sup>4</sup> The Northeast Portland locations reported to be lacking charging infrastructure are in Pacific Power service territory.



## 4.4 Impact Analysis

### 4.4.1 Pilot Performance Metrics

Since the beginning of the OE&TA Pilot in late 2018, PGE has conducted several outreach and education activities:

- **Installing EV educational kiosks:** Chevrolet dealership (December 2018), a pre-owned EV dealership (June 2019), and a BMW dealership (July 2019). Additional educational kiosks will be placed at three other dealerships in late 2020 or early 2021.
- **Partnering to offer financial incentives for EVs and chargers to PGE customers:** A \$3,500 rebate on the Nissan Leaf (87 rebates issued in 2019<sup>5</sup>), a \$500 rebate on the Chevrolet Bolt or a free L2 home charger at a Chevrolet dealership (12 Chevrolet Bolt rebates issued in 2019), and \$5,000 in a raffle towards an EV for 2019 National Drive Electric Week.
- **Sponsoring Ride-and-Drive events:** Portland International Auto Show (January 2019), at a Chevrolet dealership (February 2019), EA grand openings (April, May, and October 2019), The Electric Car Guest Drive (June 2019), National Drive Electric Week (September 2019), and for drivers of a TNC (November 2019). Note that no PGE-sponsored Ride-and-Drive events occurred in 2020 due to COVID-19.
- **EA exhibit at 2020 International Auto Show:** PGE along with other stakeholders sponsored an EA exhibit at the 2020 International Auto Show in February 2020. The exhibit included three 2020 EVs, a vehicle display wall showcasing readily available EVs and PHEVs in Oregon, an information booth with staff available to answer questions from attendees, two EV educational kiosks similar to the ones placed in participating dealerships, and two charging stations. The exhibit generated approximately 230,000 impressions over the course of four days.
- **Business technical assistance:** PGE staff provided workplace charging and fleet electrification technical assistance to commercial, industrial, non-profit organizations as well as local governments and transit authorities. In total, 148 individuals consulted with PGE staff since September 2018 (34 in 2018, 89 in 2019, and 25 in 2020), representing 78 local organizations (18 in 2018, 42 in 2019, and 18 in 2020).
- **Comprehensive fleet electrification assessments:** In addition to the business technical assistance consultations, PGE and a fleet electrification solution provider produced five comprehensive fleet electrification assessments in 2020. The five assessments found that 4,597 light-duty fleet vehicles could be economically converted to EVs, resulting in a reduction of 17,642 metric tons of CO<sub>2</sub> annually, lifetime fuel savings of \$49 million, and lifetime maintenance savings of \$25 million.
- **Educational events webinars, classes, and conference sessions:** Two educational events co-sponsored by a builder training implementor for those interested in building EV-ready homes, two workplace charging webinars, two fleet electrification classes, an electrifying school transportation session at the 2018 Oregon Pupil Transportation Conference, and a workplace charging session at the 2019 Northwest Facilities Expo. In total, 92 individuals attended an educational events, webinar, or class since May 2018.
- **Social media activity:** A total of 330 posts on Twitter, Facebook, and Instagram since 2018 (97 in 2018 and 233 in 2019) resulting in 3,435 engagements (830 “likes,” comments, and shares in 2018 and

---

<sup>5</sup> Due to changes to the dealership database, the team was unable to determine the number of Nissan Leaf rebates issued in 2020.

2,605 in 2019) and a reach of 2.2 million (394,000 in 2018 and 1.8 million in 2019). Note that due to COVID-19, PGE did not engage in any social media activity related to the OE&TA Pilot in 2020.

#### 4.4.2 Cross-cutting Equity Impact

A key cross-cutting objective of the TE pilots is to increase access to electrified transportation for environmental justice communities, including those with disproportionately lower-incomes, persons of color, seniors, renters, and low concentrations of charging infrastructure, herein referred to as “environmental justice communities.” PGE also intends to support physically disabled and elderly customers and rideshare drivers through the pilots. PGE is working to address the unique barriers that these communities face to sharing in the benefits of TE through the following channels:

- **EA siting:** PGE considered equity criteria including proximity to multifamily housing and low-income census blocks and local municipality preferences in the EA siting decision-making process.
- **Technical assistance for non-profits:** PGE staff focus their workplace charging and fleet electrification technical assistance efforts on non-profits, smaller municipalities, and other entities that would not otherwise have the means to pursue these activities.
- **Promoting awareness of EVs engagement opportunities beyond car ownership:** PGE recognizes that new car ownership and EV ownership in particular is not financially realistic for everyone, particularly customers from environmental justice communities. To address this limitation, PGE is working with Tri-Met to support the procurement of electric buses and the installation of electric bus charging stations. PGE is also using OETA efforts such as EA grand opening events to highlight opportunities to engage with other forms of electric transportation including electric transit buses, electric scooters, and electric rideshare options.
- **TNC collaborations:** Rideshare drivers are a target of the TE Pilots, as they are more likely to have lower incomes and be members of the environmental justice communities. PGE is educating drivers about the benefits of driving EVs and working with a TNC who provides its drivers with subsidized EA subscriptions.

The evaluation team analyzed the responses to two web surveys fielded in 2019 and 2020 with samples of PGE residential customers to establish a baseline on key pilot performance metrics. PGE can use this baseline to identify opportunities to better serve environmental justice communities. The findings compare four demographic sub-groups: low-income with non-low-income, seniors with non-seniors, White with People of Color (POC), and renters with owners (Table 12).

Table 12. Definitions of Key Customer Sub-Groups

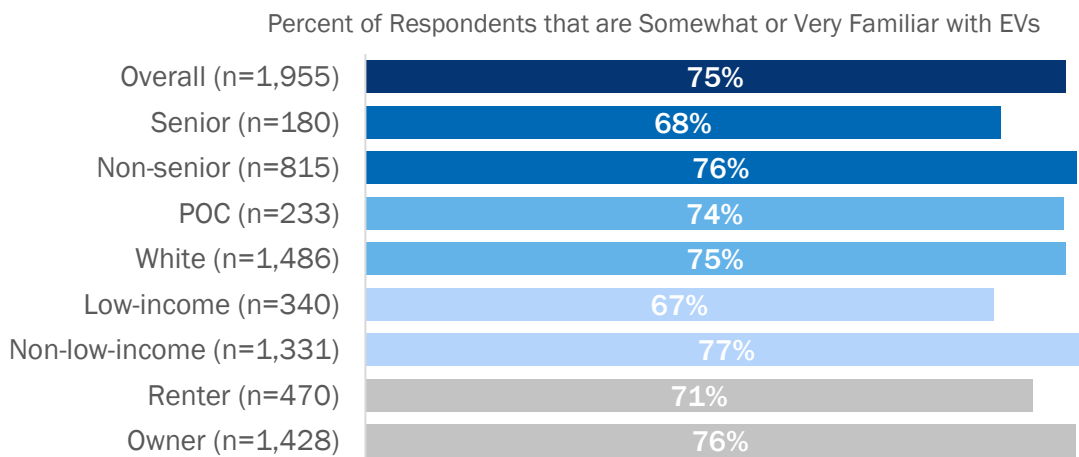
Segment	Definition	Count	Percent of Total Respondents
Low-income	Respondents who meet the Oregon Housing and Urban Development (HUD) low-income guidelines for the state of Oregon (80% percent of the area median household income level)	340	20%
Seniors	Respondents aged 65 or older	180	22%
POC	Respondent who indicated they were Hispanic/Latino (42% of POC group), Black or African American (9%), Asian (Japanese, Korean, Pacific Islander, etc.) (40%), or American Indian/Native American (8%)	233	14%
Renters	Respondents who rent their home	470	25%

Note: Respondents’ age was not asked on the baseline survey.

## Key Findings

**Low-income respondents and seniors are less familiar with EVs.** Over one-third (67%) of low-income respondents were very or somewhat familiar with EVs compared to 77% of non-low-income respondents (Figure 8). Additionally, 68% of seniors were very or somewhat familiar compared to 76% of non-seniors. Low-income respondents also had lower awareness of other more common types of vehicles. For example, 90% of low-income respondents were very or somewhat familiar with Internal Combustion Engine (ICE) vehicles vs. 97% of non-low-income respondents. In addition, 75% of low-income respondents were familiar with hybrid (non-plug-in) vehicle compared to 83% of non-low-income respondents. Low-income communities tend to have lower rates of car ownership compared to the general population, which may explain why these respondents consider themselves to be less familiar with all vehicle types, including EVs.

Figure 8. Familiarity with EVs by Demographic Sub-group

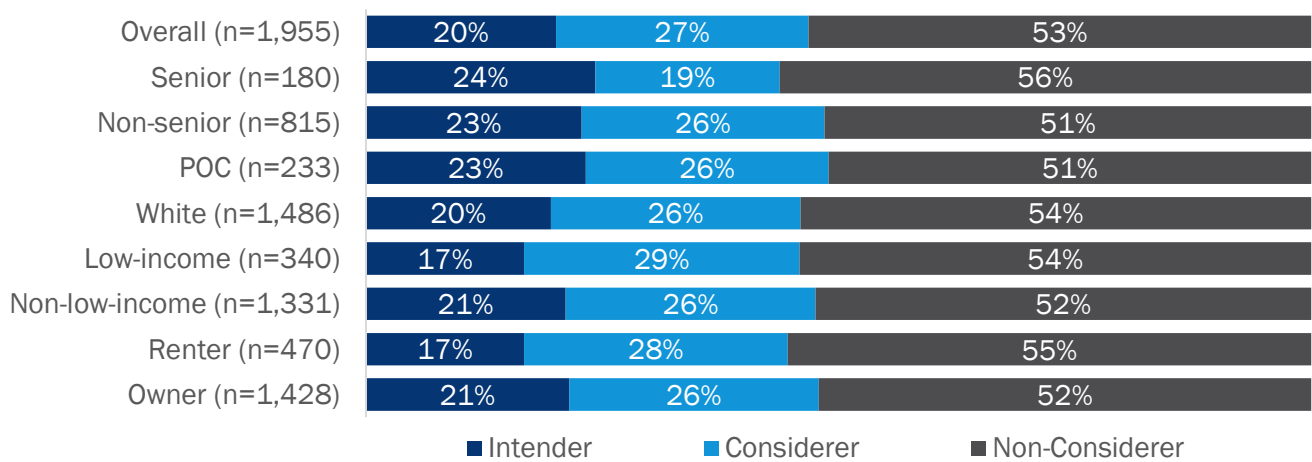


Q1. In addition to vehicles using traditional gasoline internal combustion engines, some automobile manufacturers offer vehicles with powertrains that use other fuel types including diesel, biodiesel, natural gas and electricity. Please indicate how familiar you are with EVs.

**The share of respondents who intend to purchase an EV or are considering purchasing an EV is similar across demographic sub-groups.** The team assessed intentions to purchase an EV by breaking down results into three key customer segments: EV/PHEV Non-Considerers, EV/PHEV Considerers, and EV/PHEV Intenders.<sup>6</sup> Although renters, low-income respondents, white respondents, and seniors have higher proportions of non-considerers, the breakdown of these segments is similar across demographic sub-groups (Figure 9).

<sup>6</sup> EV/PHEV non-considerers are likely vehicle purchasers who indicated they are not planning to consider an EV or PHEV for their next vehicle purchase. EV/PHEV considerers are likely vehicle purchasers who indicated they will consider an EV or PHEV for their next vehicle but selected another type of vehicle when asked which one type they are most likely to acquire the next time they purchase or lease a vehicle. EV/PHEV intenders are respondents who selected EV or PHEV when asked, “Considering everything you currently know, which one type of vehicle listed below are you most likely to acquire the next time your household purchases or leases a vehicle?”

Figure 9. EV Purchase Segments by Demographic Sub-group



**EV intenders and considerers who identify as POC and low-income more frequently categorized factors associated with EVs as major reasons to purchase or consider an EV (Table 13).** Low-income respondents were more likely to identify protecting the environment, vehicle safety, reduced vehicle maintenance, vehicle performance and handling, and the convenience of charging at work as major reasons to consider an EV in comparison to non-low-income respondents. Respondents that identify as POC were more likely to consider all benefits associated with EVs as major reasons to purchase an EV.

Table 13. Differences in How Demographic Sub-groups Identify EV Benefits vs. Their Counterparts <sup>a,b</sup>

Reason for Purchasing or Leasing an EV/PHEV (% Reporting a Major Reason)	Overall (n=935)	Senior (n=79)	POC (n=116)	Low-income (n=157)	Renter (n=216)
Protecting the environment	80%	81% (-1)	88% (+10)	87% (+9)	82% (+2)
Lower fuel cost	76%	56% (-19)	83% (+7)	80% (+4)	78% (+3)
Vehicle safety	66%	56% (-10)	78% (+14)	72% (+9)	62% (-5)
Less vehicle maintenance required	60%	58% (+0)	78% (+21)	71% (+14)	61% (+1)
The convenience of charging vehicle at home	58%	64% (+20)	70% (+14)	58% (-2)	49% (-12)
Vehicle's performance and handling	58%	51% (-5)	74% (+19)	63% (+6)	57% (-1)
Availability of public charging stations in the Portland/Salem metro areas	43%	33% (+3)	52% (+12)	46% (+3)	38% (-7)
Availability of public charging stations outside the Portland/Salem metro areas	42%	31% (+2)	51% (+12)	39% (-4)	33% (-11)
Tax incentives and rebates	36%	28% (-6)	52% (+18)	39% (+3)	31% (-7)
The convenience of charging vehicle at work	21%	9% (-11)	37% (+19)	27% (+6)	26% (+7)
Priority parking at some locations	10%	6% (-4)	19% (+11)	13% (+4)	11% (+2)
How I look driving and owning this vehicle	5%	6% (+0)	8% (+4)	4% (-1)	8% (+4)

Greater than 6% more likely to consider benefit than non-target group	3% to 6% less likely to consider benefit than non-target group
3% to 6% more likely to consider benefit than non-target group	Greater than 6% less likely to consider benefit than non-target group

Q17. For each of the factors below, please indicate whether that factor is a major reason, a minor reason, or not a reason you are considering an all-EV/PHEV for your next purchase/lease.

Note: Differentials in percentages between each demographic sub-group (low-income and non-low income respondents, renters and owners, etc.) are shown in parentheses.

<sup>a</sup> This question was only asked of respondents in the EV/PHEV Considerer and Intender segments.

<sup>b</sup> Numbers in parentheses indicate percentage differences seniors compared to non-seniors, POC compared to white respondents, Low-income compared to non-low-income respondents, and renters vs. owners.

**EV intenders and considerers who identified as low-income, POC, and renters were more likely to categorize certain characteristics of EVs as “major concerns,” indicating that these groups face some unique barriers to adoption (Table 14).** EV intenders and considerers who identified as low-income, POC, and renters were more likely to indicate the purchase price of the vehicle, vehicle reliability, and ability to charge at work as major concerns when thinking about whether to purchase or lease an EV. POC and low-income respondents also showed greater levels of concern about the cost of charging EVs and vehicle maintenance costs. Additionally, respondents who identified as POC showed higher levels of concern about several aspects of EV technology

include the vehicle's performance and handling, appearance, safety, the amount of time required to charge battery, availability of body types and sizes, and appearance. These results suggest that customers who are renters, low-income, or POC know less about the advantages of owning an EV and would benefit from additional support connecting to sources of financing and funding for EVs. Customers from these communities would also likely benefit from continued access to programs that allow them to share in the benefits of transportation electrification without investing in a vehicle. PGE is currently partnering with CBOs and non-profits that support these communities through the Drive Change Fund. As such, PGE could consider leveraging and expanding these partnerships to support targeted education campaigns focused on the features of EVs that are part of a typical car-buying decision and help to ease concerns about the technology.

PGE may want to move beyond focusing on the environmental benefits of EVs when designing OETA efforts targeted towards reaching environmental justice communities. Survey results show that most respondents from environmental justice customer groups have high levels of awareness about the environmental benefits of EVs and environmentally motivated customers that have the means to purchase an EV would likely have already done so. Instead, environmental justice customer groups and communities of color would likely benefit from increased educational support focused on the features of EVs that are part of a typical car-buying decision to ease concerns about the technology.

**Table 14. Differences in EV Purchase Barriers by Experienced Demographic Sub-Groups<sup>ab</sup>**

Barriers to Purchasing or Leasing an EV/PHEV (% Reporting a Major Concern)	Overall (n=935)	Senior (n=79)	POC (n=116)	Low-income (n=157)	Renter (n=216)
Purchase price of vehicle	85%	83% (-6)	89% (+4)	91% (+7)	90% (+6)
Number of miles vehicle will go on a single charge	82%	68% (-10)	80% (-2)	79% (-5)	78% (-6)
Vehicle safety	70%	73% (+1)	80% (+12)	75% (+6)	69% (-2)
Ability to charge at home	65%	70% (+8)	70% (+6)	65% (-1)	65% (+0)
Vehicle's performance and handling	61%	54% (-8)	76% (+19)	63% (+2)	60% (-2)
Maintenance costs	60%	57% (-1)	73% (+15)	69% (+11)	58% (-2)
Amount of time required to charge battery	58%	59% (+6)	69% (+12)	55% (-5)	55% (-5)
Availability of public charging stations outside the Portland/Salem metro areas	54%	57% (+14)	51% (-2)	54% (+0)	51% (-4)
Availability of public charging stations in the Portland/Salem metro areas	49%	48% (+6)	55% (+8)	53% (+4)	49% (-1)
Cost of charging vehicles	46%	32% (-14)	60% (+17)	57% (+14)	45% (+0)
Vehicle reliability <sup>c</sup>	41%	75% (-6)	55% (+16)	47% (+13)	45% (+5)
Electric vehicle body types and sizes available	40%	37% (-1)	48% (+9)	37% (-5)	30% (-14)
Ability to charge at work	23%	11% (-12)	40% (+20)	35% (+15)	29% (+8)
Availability of body type and sizes <sup>d</sup>	20%	39% (+1)	33% (+15)	21% (+5)	21% (+1)
Electric vehicle appearance	19%	19% (-4)	24% (+7)	18% (+0)	19% (+0)
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p><span style="color: #0070C0;">■</span> Greater than 6% more likely to consider barrier than non-target group</p> <p><span style="color: #4F81BD;">■</span> 3% to 6% more likely to consider barrier than non-target group</p> </div> <div style="width: 45%;"> <p><span style="color: #A6A6A6;">■</span> 3% to 6% less likely to consider barrier than non-target group</p> <p><span style="color: #4F4F4F;">■</span> Greater than 6% less likely to consider barrier than non-target group</p> </div> </div>					

Q19. For each item, please indicate whether the issue described is a major concern, a minor concern, or not a concern to you at all when considering whether or not to purchase or lease an EV.

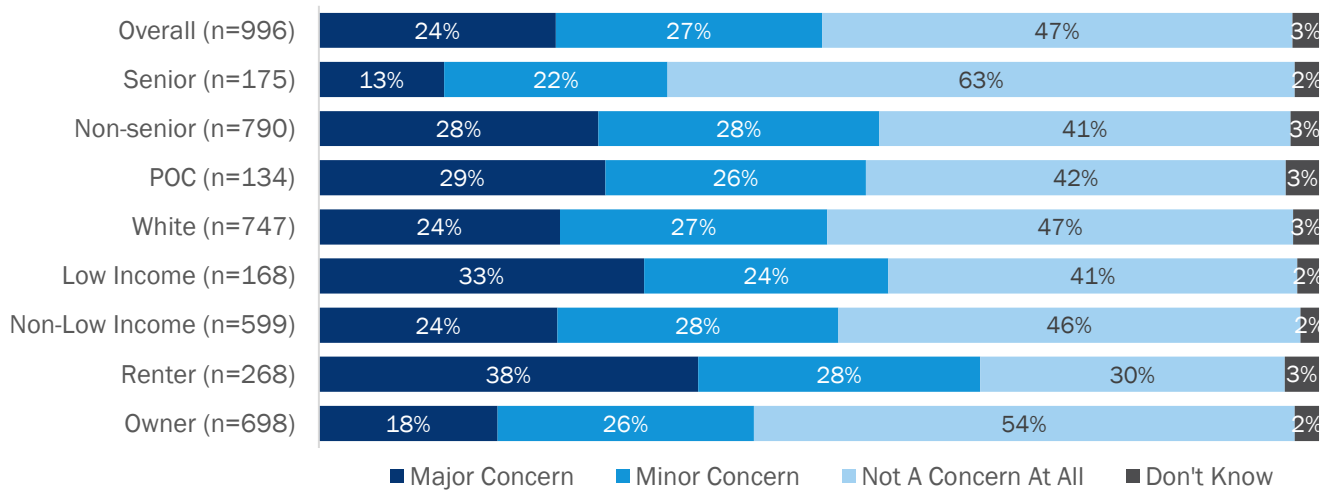
<sup>a</sup> Numbers in parentheses indicate percentage differences seniors compared to non-seniors, POC compared to white respondents, low-income compared to non-low-income respondents, and renters vs. owners.

<sup>b</sup> Results in this table only include the EV intender and considerer customer segment.

<sup>c, d</sup>These two items were not asked in Baseline survey.

**Respondents who identified as low-income, POC, and renters are more likely to face barriers related to access to charging (Figure 10).** Renters, POC, and low-income respondents were all more likely to say that their current parking situation is a major concern for their decision on whether to purchase an electric or plug-in hybrid vehicle in the future. One possible explanation for the differential in levels of concern among these communities is that renters, low-income respondents, and POC were all less likely to say they have an electric service outlet available where they park their car at work and at home. There were no substantial differences in awareness of public EV charging stations in public areas and parking lots around Oregon between demographic sub-groups.

Figure 10. Level of Concern about Current Parking Situation on EV Purchase Decision



Q25. How much of a concern is your current parking situation in your decision on whether to purchase an electric or plug-in hybrid vehicle in the future?



## 5. Electric Avenue Pilot

As described in the 2019 annual report, PGE developed the EA Pilot Program under its initial Transportation Electrification Plan to help increase the growth of EV adoption and support the growing network of EV charging infrastructure. PGE’s first EA site in Downtown Portland was opened to the public in 2015. EA Pilot activities in 2019 and 2020 included expanding the EA network to include six additional sites throughout PGE’s service territory (Table 15). Users can charge their vehicles at EA sites for \$3 per two-hour session using a L2 charger, \$5 per two-hour session using a DCFC, or an unlimited charging plan for \$25 per month.<sup>7</sup> To take peak time into account and shape demand, PGE charges an additional 19 cents per kWh when customers charge their EVs at the EA sites between 3:00 p.m. and 8:00 p.m.

Table 15. EA Network Site Information

Location	Site Description	Opening Date	# L2 Chargers	# DCFCs
Downtown Portland <sup>a</sup>	Street parking in front of World Trade Center in Downtown Portland	2015	2	4
Milwaukie	Parking lot in Downtown Milwaukie	4/6/2019	2	4
Hillsboro	Shopping plaza	5/18/2019	2	4
East Portland	Shopping plaza	10/26/2019	2	4
Salem	Street parking in front of Oregon State Capital building	1/16/2020	2	2
Beaverton	Public parking lot across from shopping plaza	2/3/2020	2	4
Wilsonville	Library and shopping plaza	4/6/2020	2	4

<sup>a</sup> Also known as the World Trade Center EA. Note that the Downtown Portland EA was the first EA site PGE opened and is not included in the EA pilot evaluation.

### 5.1 Staff and Partner Feedback

The section below presents key findings from in-depth interviews conducted with EA Pilot staff (n=4) and Pilot partners (n=5) throughout 2020. This section also summarizes PGE staff and partner feedback on the process of designing, building, and opening the EAs, utilization of the EA sites, ongoing charger downtime and maintenance issues, lessons learned, and challenges encountered throughout the process. In 2019, the team evaluated two of the six EA sites that were in operation: Milwaukie and Hillsboro. The team described PGE’s site selection and development processes in depth, in addition to key findings around the operations and maintenance of the sites, issues with and resolution for charger downtime, and challenges encountered throughout the Pilot. In 2020, the team evaluated the remaining four EA sites: East Portland Plaza, which opened to the public in October 2019, and Wilsonville, Salem, and Beaverton, all of which opened in 2020.

#### 5.1.1 Building & Opening the Remaining EAs

##### Siting

The remaining EA sites were selected using the same siting criteria used for the initial two sites: highly accessible locations, equity, local EV ownership levels, and cost-effectiveness were all important factors that were taken into consideration. PGE worked with site hosts collaboratively to weigh the different attributes and

<sup>7</sup> The two-hour charging time limit is dictated by the parking signage installed at the EA sites and not the tariff.

criteria of potential sites. The remaining EA sites are in visible, centrally located areas adjacent to amenities, housing developments, or major thoroughfares. Additionally, equity was a prominent attribute in the siting process; PGE contacts reported that the siting team assessed the median household income of nearby neighborhoods to the EA sites and prioritized proximity to low-income communities and multifamily housing developments. PGE's Diversity, Equity, and Inclusion staff, which has partnerships with local CBOs in PGE's territory, was consulted during the site selection process.

Site hosts of the remaining EA sites were motivated to host an EA for a variety of reasons. Two of the cities pride themselves on having an innovative spirit and position themselves as municipalities that prioritize leading-edge technologies and innovation. These hosts also perceive their municipalities as energy-conscious and sustainable, where both use planning documents and Climate Action Plans to guide their policies and measures around transportation electrification. Another site host was motivated to host the EA because it was a zero-cost option and would provide a good service to local shoppers. Furthermore, another entity had existing charging infrastructure at the designated EA location and was looking to upgrade the old charging equipment.

## Design

**PGE understands that the siting and design of each EA site is unique and has its own set of challenges; this requires an iterative and collaborative design process.** PGE staff and site hosts of the remaining EA sites did encounter challenges during the design process that were resolved through negotiations. Site hosts initially had concerns about the aesthetics and impacts on the infrastructure on their property but were appeased through iterative mock-ups, redesigns, and discussions. For example, one EA site pivoted from its original design due to an existing construction project adjacent to the site that would have affected or harmed the charging infrastructure once installed. Another site host was concerned about the aesthetics of the proposed EA. Two site hosts were initially concerned about the loss of existing parking spots for employees and patrons due to the installation of the charging equipment. All of these concerns were alleviated through coordination and collaborative negotiation; sites hosts were ultimately satisfied with the end designs.

**PGE has learned to integrate ADA access in the absence of federal and state guidelines for ADA accessibility at EV charging sites.** There are currently no federal guidelines or standards around ADA compliance for charging stations. One site host felt that one of the charging stations should have a handicap accessible parking spot. This city's legal team worked with PGE's legal team to come up with a solution for ADA compliance. A sidewalk ramp and handicap signage were introduced into the design and then subsequently incorporated into the design of another EA site, which allowed for one handicap accessible L2 charging port at both EA sites.

## Construction and Permitting

**The design-build approach for constructing the EAs has been an improvement and PGE has achieved cost savings as a result.** PGE switched its contracting structure to a design-build approach for the four remaining EA sites to help reduce project costs and shorten design and construction timelines. PGE previously used a design-bid-build structure for the first EA sites, but quickly reevaluated their approach after experiencing inefficient design and construction timelines.

The Wilsonville and Beaverton EA sites used a similar design as the Hillsboro EA site, where the charging stations require cars to be parked head-on; East Portland and Salem are similar, but the parking spots are angled parking. The Salem EA has four parking spots, rather than six like the other EA sites, due to existing site conditions. Salem was also different in that the chargers installed, although the same manufacturer, were different models than the chargers at other EA sites—they are larger and self-contained. As described in the

2019 Annual Report, PGE designed the EA sites with flexibility and upgradeability in mind, where new equipment can be installed easily to replace existing, faulty equipment or as new technology comes to market.

**All remaining EA sites encountered some challenges during the construction process.** One municipality expressed dissatisfaction with the primary contractor involved in constructing the site, noting that the contractor did not provide an acceptable traffic control plan and was not receptive to their requests. PGE staff also reported several issues with this same site, where the chargers were not properly wired, and the ADA ramp needed to be redone. Further, one site experienced an issue with conduit being installed improperly and another site experienced construction delays due to COVID-19.

**The EA permitting process continues to be straightforward and seamless due to the collaboration between PGE's Property Services Team and municipal planning departments.** Site host representatives reported they had little involvement in the permitting processes themselves but did not hear of any major issues. According to PGE, two EA sites experienced some delay in permitting due to COVID-19.

## Site Openings

**The opening and marketing activities for the 2020 EA sites were affected by COVID-19.** PGE decided to cancel all remaining EA grand openings in the spring of 2020 due to COVID-19. Some outreach and marketing for these sites had occurred prior, such as notices in the municipalities' newsletters, but all ribbon-cutting ceremonies were cancelled. None of the site hosts were able to confirm future marketing activities for their EA sites.

One EA site opened in 2019 (and was not part of the 2019 evaluation) and thus was not impacted by COVID-19. This site host described the grand opening event as very successful and collaborative. Further, they reported it was easy to work with PGE's marketing team throughout the planning process for this event due to proactive communication and coordination.

## 5.1.2 Charger Utilization

### Utilization

**COVID-19 negatively impacted the utilization of the EA sites in the Spring of 2020.** According to staff, in 2019, the EA network saw a gradual increase in charger utilization, where the Downtown Portland EA received the highest usage. According to data provided by the EV charging software provider (EVSP), utilization varied in 2020: COVID-19 caused a steep decline in usage in March and April across the network, but then a gradual increase has occurred since then, with the exception of the Hillsboro site. The usage of the Hillsboro EA has been mostly stagnant since COVID-19, possibly due to less activity near the location. In 2020, the Downtown EA continues to see the highest usage with East Portland coming in second. Milwaukie, Hillsboro, and Beaverton EAs experience similar utilization, while Wilsonville and Salem have seen the lowest use. Although COVID-19 negatively affected the utilization of the EA chargers in the short-term, PGE staff do expect the charging load of the network to increase over time.

Two site hosts report they have not heard any feedback from community members or peers about the opening of the new EA sites, while two other hosts had received feedback. One site host had received positive feedback from local shoppers about the addition of the EA, where it is described as a great amenity. The Downtown and East Portland EA sites have seen high usage, particular by TNC drivers, due to their relative proximity to the Portland International Airport. Another site host had received some negative feedback from users about the EA not having enough L2 chargers due to the addition of the handicapped stall (as there is only one non-handicap accessible L2 charging port available).

## Users

Although COVID-19 has prevented many of the site hosts from directly observing the utilization of their EA sites, they did describe their expectations for anticipated users of EA sites. The site hosts believe their EA sites are visible and discoverable by EV drivers. Expected users include customers of adjacent businesses, such as restaurants and grocery stores, commuters on a nearby highway, employees of a large school close by, residents from surrounding neighborhoods and mixed-use developments, and patrons of public facilities.

**PGE staff report that the EA network has been successful in providing low or no-cost access to public charging infrastructure to a likely group of low-to-moderate income customers: TNC drivers.** TNC drivers are provided a monthly EA subscription plan subsidized by a TNC company. PGE reports that they can see which EA users are TNC drivers through the usage data, as it shows their subscription plan. TNC drivers can be considered a low-to-moderate income population and charging their EVs at a very low cost could help improve their economic livelihood, demonstrating that the EA Pilot has been equitably serving this group.

## Pricing

**As noted in the 2019 annual report, EV drivers continue to be responsive to the EA pricing structure and uptake of the unlimited charging plan has been positive so far.** Now that some EA sites have been operating for more than a year, PGE has been able to observe some charging patterns in relation to their pricing structure. For example, PGE staff heard from vocal TNC drivers that some users stay plugged in at some EA sites even after their charging is complete, as there is no financial incentive for them to unplug and move on. This causes congestion and users have to wait to charge. Another pattern that PGE staff have observed related to pricing is the effectiveness of the on-peak pricing. From 3:00 p.m. to 8:00 p.m., PGE charges users an additional \$0.19/kWh fee to charge, on top of the two-hour flat fee or the monthly subscription cost. PGE staff noted a reduction in charger use during the peak pricing period, which the team confirmed through charger utilization analysis discussed in Section 5.2.3.

Currently, PGE and their EVSP do not plan to make any changes to the pricing plans. Pricing plan adjustments may need to occur in 2021, however, if the pricing structure continues to cause congestion at the EA sites and it escalates into a larger problem. PGE staff also noted wanting to explore how familiar and receptive customers would be to other pricing structures, such as cost per kWh or per minute.

### 5.1.3 Charger Maintenance and Availability Issues

#### Charger Downtime

**The EA network continued to see frequent hardware and software issues in 2020.** While such issues decreased in frequency in 2019, the commissioning and opening of additional EA sites in 2020 has caused issues with charger availability. PGE reports that charger downtime continues to be an ongoing problem. Staff reported experiencing one issue per day, on average, across the network. The chargers at the Salem EA site are particularly problematic and are often offline. Since the Salem EA opened, the charging equipment vendor has had to frequently visit the site to troubleshoot and resolve hardware issues. As a result, the charging equipment at the Salem EA will be replaced with more proven technology manufactured by a different vendor. On average, charger downtime is two weeks across the network when a major problem occurs.

Chargers are frequently down due to hardware and software issues. One prominent hardware issue is related to the charger modem and can cause a charger to be down for a significant amount of time. Other ongoing charger issues include malfunctioning credit card readers and frequent vandalism at the Downtown and East Portland EAs.

One reason charger downtime has increased is that the previous method for resetting and restarting a charger—via a power cycle—is no longer recommended by the EV charging equipment vendor. This is because the power cycle erases the data on the charger and prevents the vendor from being able to troubleshoot and identify the issue. The power cycle allows PGE staff to quickly bring the charger back online, but it does not truly diagnose the root of the issue.

PGE staff and the charging vendors report that there has been some issue resolution. PGE staff note that they now can predict when a charger may go offline because they track and understand the equipment's error codes and history of issues. Furthermore, site hosts have been satisfied with the operations and maintenance of the sites and have mostly been unaware of the equipment technical issues.

### Relationship with Hardware and Software Vendors

The partnerships between PGE and its EA hardware and software vendors continued to evolve in 2020. In 2019, the evaluation team found that coordination and communication between PGE and their vendors had improved significantly since the initial deployment of the first two EA sites. This is because both entities had increased their customer service efforts, thereby improving the customer experience at the EA sites. In 2020, PGE described multiple inefficiencies with their vendor partnerships and maintenance processes. These issues included:

- **Vendor communication and responsiveness.** While the hardware and software vendors have been making strides to improve communication with PGE, the hardware vendor continues to provide delayed responses. Furthermore, PGE has encountered some resistance and disagreement from this vendor about charger issues and resolutions. PGE staff would like the hardware vendor to take on more accountability for the hardware issues of the chargers.
- **Process of dispatching technicians.** PGE staff reported there is a new process in place for dispatching equipment vendor technicians to sites: PGE staff must first submit a ticket through the vendor's maintenance system. Previously, they were able to communicate directly via text or phone call with the field technicians and have them visit a site quickly. Staff note that the new protocol slows down the issue resolution process.
- **Vendor staffing.** PGE staff report that their main point of contact changes frequently, requiring staff to work with new hires to get them up-to-speed. This turnover prevents operational issues being addressed efficiently: PGE experiences longer wait times than they would prefer to get technicians out to an EA site.

### 5.1.4 Challenges and Lessons Learned

**COVID-19 presented challenges for the development and utilization of the EA network in 2020 and will require PGE to adjust for and evaluate its impacts.** Site hosts and PGE staff noted that COVID-19 impacted the construction, permitting, marketing, opening, and monitoring of the 2020 EA sites. Notably, EA utilization rates dropped steeply in March and April once COVID-19 hit. Despite these negative impacts, PGE and EVSP contacts reported that there has been a steady increase in EA utilization since April. PGE understands that COVID-19 impacts on the EA Pilot could be profound and that ongoing evaluation will help to comprehend the short-term and long-term effects. PGE plans to evaluate and subsequently adjust EA utilization and revenue goals, future EA site upgrades and plans, and planned pricing modifications in response to the COVID-19 pandemic.

**Issues with the EV charging equipment vendor persist and may warrant a new charger vendor if communication and performance do not improve.** In 2019, the research team reported that coordination with the software and hardware vendors had improved over time and issue resolution was more efficient. In 2020,

as more sites have come online, coordination with the hardware vendor has worsened and concerns about the product's functionality have surfaced. PGE staff reported concerns with the vendor's lack of responsiveness, number of equipment issues, compliance with their requests, and sense of urgency to resolve issues. The frequency of hardware issues is higher than what PGE expected. PGE contacts reported they may consider alternative charging equipment vendors in the near future.

## 5.2 Impact Analysis

The following sections provide results from the evaluation team's analysis of EA charger utilization data. The analysis was conducted based on charging data measured at the chargers at each EA site from March 2019 to October 2020.

### 5.2.1 Change to Consumption and Charging Patterns

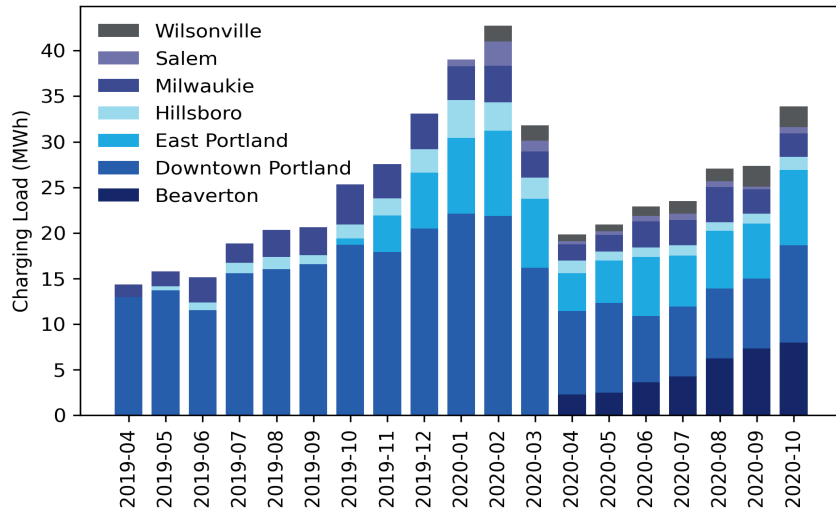
**Aggregated monthly energy consumption increased from March 2019 through February 2020, reaching 43 MWh per month, as the number of charging stations increased with the opening of the Hillsboro, East Portland, Salem, and Wilsonville sites (Figure 11).** After all sites were operational, the monthly charging load ranged from 20–34 MWh and the load factor ranged from 10% to 18%. The monthly charging load varied significantly between sites. In most months, the Downtown Portland EA had the highest usage and the greatest monthly energy consumption at 13.9 MWh on average.<sup>8</sup> This site's location near many amenities and businesses could explain the high charging load relative to other sites. The East Portland site has the second highest usage at 6 MWh on average. This might be explained by East Portland's high population density and its proximity to the airport. Conversely, relatively little charging occurred at Salem, likely due to frequent issues with the charging equipment that PGE is in the process of replacing and because the site is located at the Oregon State Capital building, which is primarily used when the state legislature is in session.

A significant decline in charging occurred following February 2020 due to the impact of COVID-19. The charging load has since increased, in part due to the opening of the Beaverton EA in April and the slight recovery from COVID-19 in some sites beginning in June. Additional analysis on the impacts of COVID-19 on EA site usage can be found in Appendix D.

---

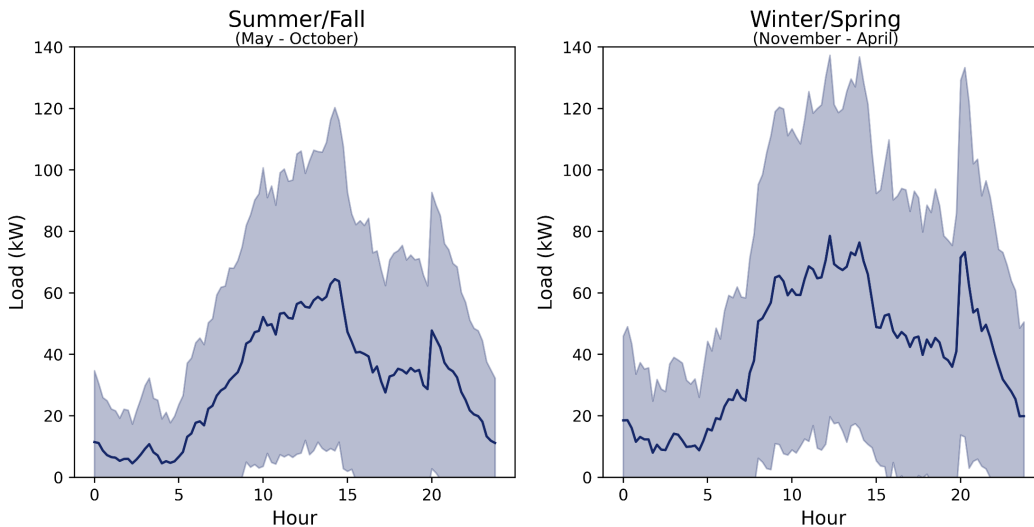
<sup>8</sup> Note that the Downtown Portland EA is not part of the EA Pilot. Downtown Portland EA results are included in order to provide a comparison for other EA sites. Some of the analyses do not include the Downtown Portland EA, and those results are noted separately in the chapter.

Figure 11. Monthly Charging Load at EA Sites



The average charging load for all EA sites combined is plotted in Figure 12 with 1 standard deviation from the average shaded. The average load profile starts to ramp up around 7:00 a.m. and peaks in the afternoon. The peak is around noon in the winter/spring and around 2:00 p.m. in the summer/fall.<sup>9</sup> Charging load decreases after 3:00 p.m. due to the implemented peak pricing (weekdays, 3:00 p.m. to 8:00 p.m.). A secondary peak happens around 8:00 p.m. in both winter and summer and it can likely be attributed to the end of the peak pricing hours at EA sites. Significant seasonal differences in charging behavior were not observed.

Figure 12. Average and Standard Deviation (shaded) Seasonal Load Profile for all EA Charging Load



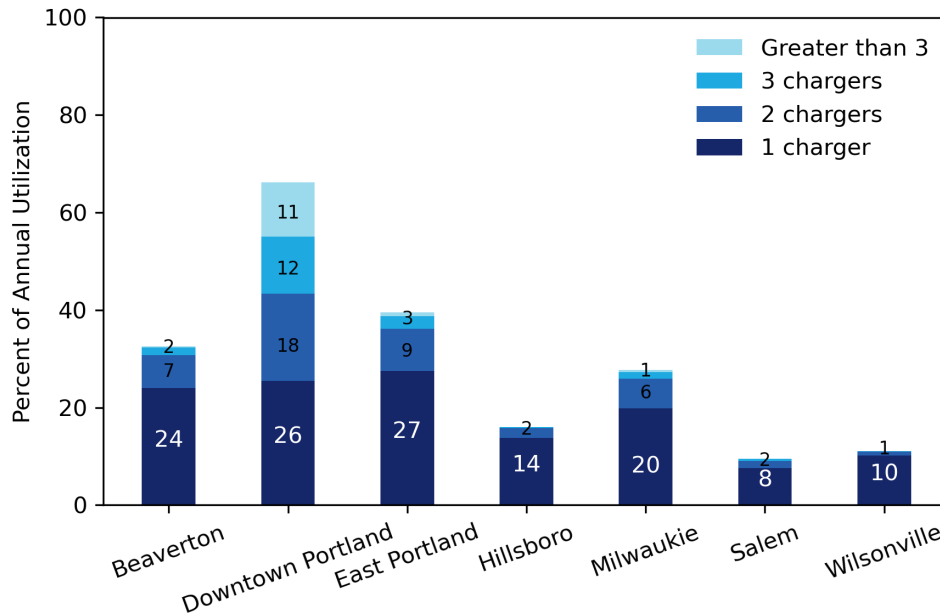
**Peak pricing surcharges appear to be influencing charger usage.** Analysis shows that charging load patterns varied slightly between EA sites. On weekdays at Beaverton, Downtown Portland, East Portland, Hillsboro, and Milwaukie, lower load is observed from 3:00 p.m. to 8:00 p.m. followed by a load spike at the end of this

<sup>9</sup> Summer/fall is defined as May through October, and winter/spring is November through April.

period. This pattern is most noticeable at the East Portland and Downtown Portland EAs. Depressed load from 3:00 p.m. to 8:00 p.m. is not observed at any site on the weekends, suggesting that peak pricing surcharges are influencing charging patterns. Downtown Portland and Salem are the only two sites that exhibit a weekday morning peak. As the Salem EA is located next to the Oregon State Capitol, this morning peak could be due to lobbyists or other early-morning visitors and state employees using the station when they arrive to work, but given limited data for this site due to technical issues, it is difficult to conclude that drivers are using Salem differently than other sites. All sites generally experience lower loads from midnight to 5:00 a.m. Average weekend load is not significantly lower than weekday load at any site. (See Figure 39 in Appendix D for average charging load shapes by weekday and weekend for each EA site.)

The EA site with the highest utilization rate was Downtown Portland followed by East Portland, Milwaukie, and Beaverton (Figure 13).<sup>10</sup> At least one charger was in use between 8% to 27% of the time at all sites. Salem had the lowest utilization rate due to frequent outages during the study period. More than two chargers were in simultaneous use at a site less than 3% of the time at all sites except Downtown Portland, suggesting that customers usually do not need to wait for charging when they visit EA sites.

Figure 13. Annual Charger Utilization at EA Sites

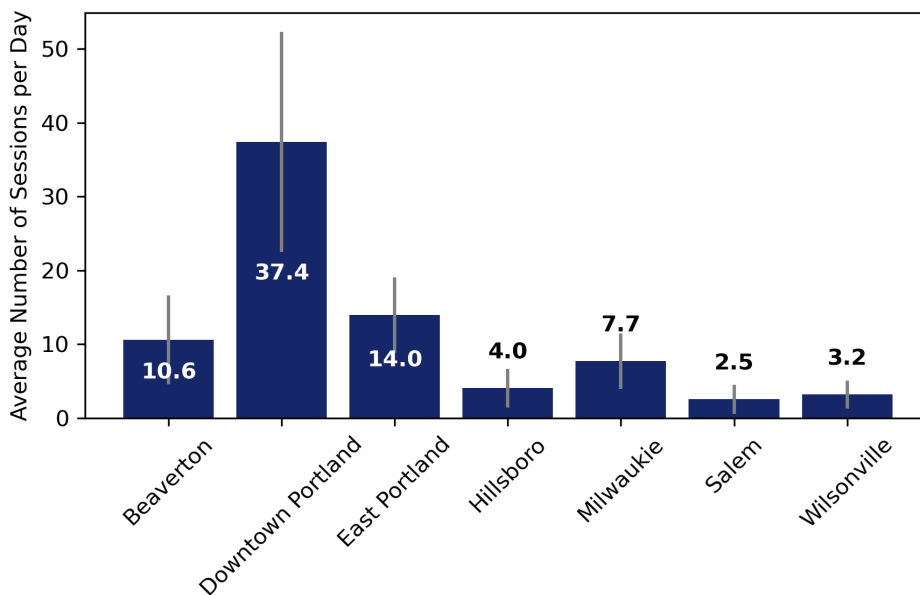


The average number of EA charging sessions ranges between 2.5 to 37.4 per day (Figure 14). Downtown Portland has the highest average number of sessions per day (37.4) and Salem has the lowest average number of sessions per day (2.5).

<sup>10</sup> The site utilization rate was calculated for each EA site as the percentage of time a given number of chargers were in simultaneous use since the site became operational. Note that the site utilization measures whether any of the chargers are in use while the other commonly reported metric, charger utilization, measures whether a particular charger is in use.



Figure 14. Average Number of Charging Sessions per Day at EA Sites



Note: The average number of charging sessions in the blue bars along with the standard deviation of the number of charging sessions in the gray lines.

### 5.2.2 Peak Impact

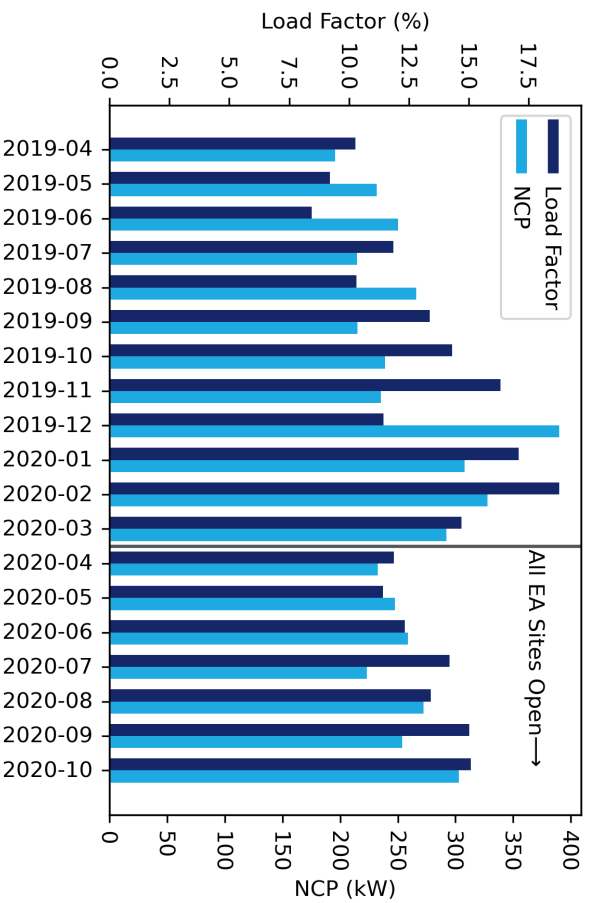
Throughout the study period, the non-coincident peak (NCP) load and the load factor of all EA charging generally increased (Figure 15). The increase in load factor can be attributed to the growing energy consumption during the study period, and the increase in NCP load is due to more chargers coming online as additional EA sites opened.<sup>11</sup> After all charging stations were online, the NCP ranged from 223–302 kW.

PGE’s EAs are seeing utilization that is in line with other utility territories with average load factors of approximately 13%. Previous studies have found that load factors at “highly utilized” DCFC charging stations in California are around 15% to 20%.<sup>12</sup> Note that many areas of California have a greater penetration of EVs than PGE’s service territory currently has. In addition, the monthly load factors and NCP decreased during the pandemic and might increase further after the recovery.

<sup>11</sup> The load factor is defined as the ratio of average charging load and the maximum charging load over a given period of time. Here the load factor is calculated as the average charging load of all EA stations divided by the non-coincident peak load for each month of the study period.

<sup>12</sup> Source: <https://www.nrel.gov/docs/fy19osti/73303.pdf>

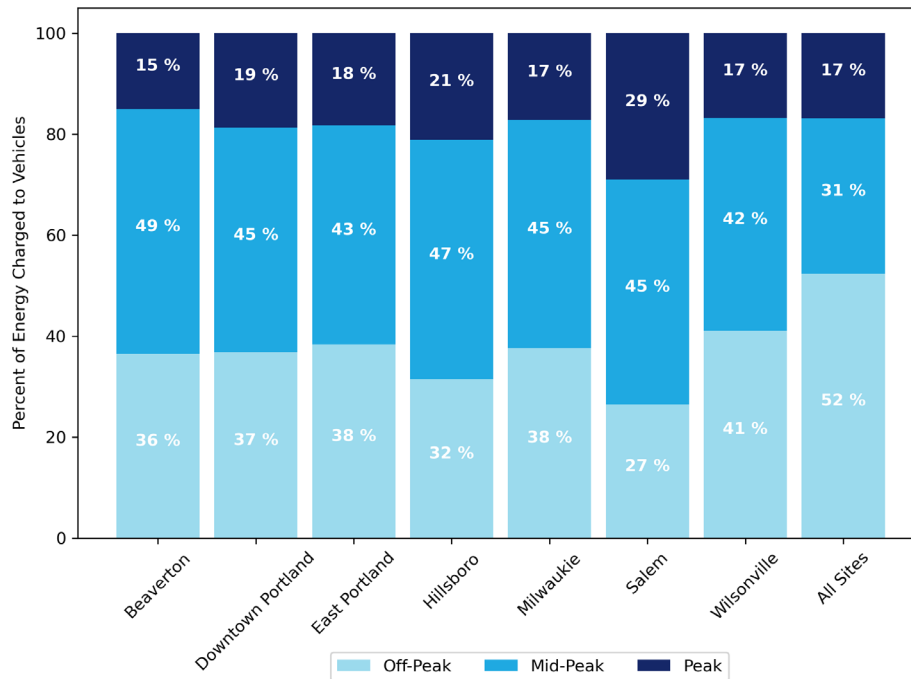
Figure 15. Monthly Non-Coincident Peak Load and Load Factors of all EA Charging



The percentage of total energy consumption that occurred during the peak time periods (weekdays between 3:00 p.m. and 8:00 p.m.) ranges between 15% to 29% at EA sites, and the total on-peak TOU period energy consumption for all sites combined is 17% (Figure 16).<sup>13</sup> The peak energy consumption was highest at the Salem EA and lowest at the Beaverton EA. The high peak period energy consumption at Salem EA might be explained by the government employees' morning charging need, but given limited data for this site, it is difficult to conclude whether Salem's charging pattern will persist when the site is fully operational and employees return to work following the pandemic.

<sup>13</sup> The TOU period is defined based on PGE's residential TOU tariffs. The evaluation team chose to use this tariff because the residential TOU period is potentially more in line with PGE's system load and provides a good proxy for estimating peak impact. <https://portlandgeneral.com/energy-choices/energy-choices-home/time-of-use-pricing-home>

Figure 16. Percentage of Energy Consumption According to Time-of-Use Period at EA Sites



### Bulk System Peak Impact

In addition to non-coincident peak, the evaluation team also investigated the system coincident peak, which represents the charging load peak contribution during PGE’s system peak hours. Charging load at most EA sites is more coincident with system load in the winter/spring than in the summer/fall.<sup>14</sup> The modal hour in the top 3% of load hours in summer 2019 and 2020 is 6:00 p.m. while the modal hour in the winter evening peak is 7:00 p.m. and the modal hour is 8:00 a.m. in the winter morning peak. The later system peak hour in winter leads to more coincidence with the rebound in charging that occurs around 8:00 p.m. About 12% of peak system hours in summer occurred at 8:00 p.m. while 18% of winter system peak hours occurred at 8:00 p.m. The Downtown Portland EA has the highest charging during peak hours among all EA sites, likely due to its higher overall utilization. Table 16 below summarizes the total charging load contribution as a percentage of site capacity during the top 3% of PGE’s system peak hours, which indicate that EV charging peak load is not frequently coincident with PGE system peak load.

<sup>14</sup> Summer/fall is defined as May through October, and winter/spring is November through April.

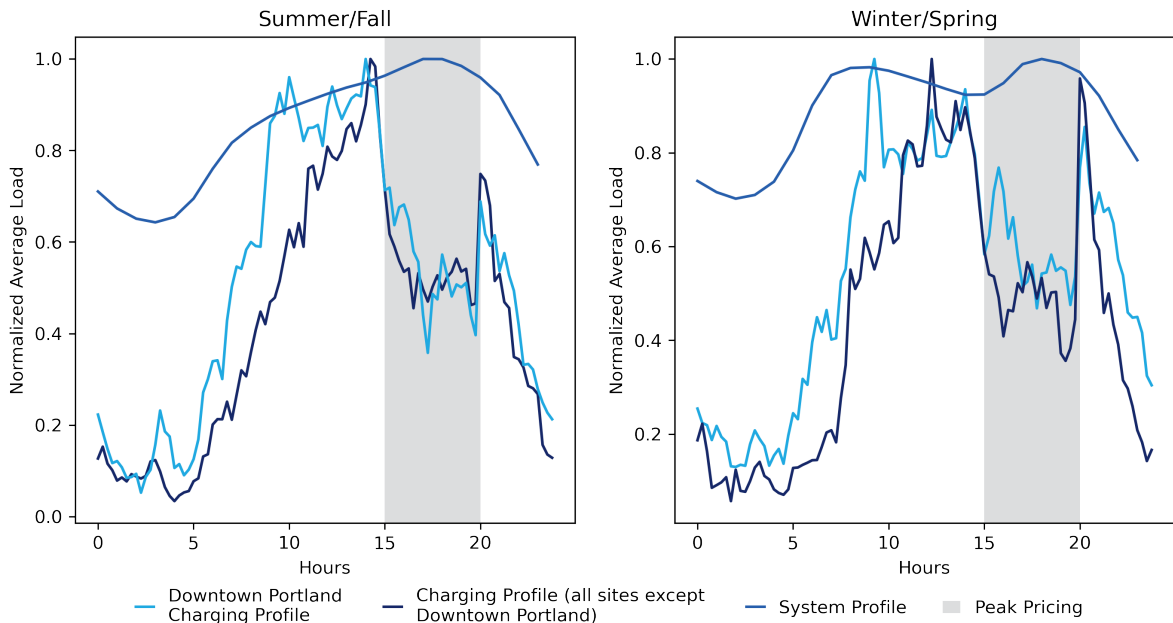
Table 16. Charging Load During Top 3% Peak Hours as a Percentage of Site Capacity

EA Site	Charging Load During Top 3% Peak Hour as a Percentage of Site Capacity			
	Summer/Fall 2019 (n=131)	Winter/Spring 2019-2020		Summer/Fall 2020 (n=110)
		Morning (n=66)	Evening (n=66)	
Beaverton	N/A	N/A	N/A	11.0%
Downtown Portland	22.9%	41.6%	28.3%	13.6%
East Portland	N/A	17.5%	12.8%	12.7%
Hillsboro	2.8%	8.0%	10.7%	1.6%
Milwaukie	4.9%	10.8%	8.4%	6.9%
Salem	N/A	10.9%	0.9%	2.9%
Wilsonville	N/A	1.4%	0.1%	3.6%

Note: Summer/fall is defined as May through October, and winter/spring is November through April. N/A means that the site was not in operation at during this period.

The peak pricing program appears to be highly effective in shifting charging away from system peak load periods. The normalized average system load in the summer peaks around 6:00 p.m.–7:00 p.m. when EV charging load is lowest during the peak pricing window (Figure 17). In the winter, neither the morning nor evening system peak occurs when charging load is peaking. There is a greater coincidence of Downtown Portland EA charging load with the system peak load in the winter where the normalized charging profile for all other sites is lower in both the morning and evening peak than the Downtown Portland profile. This suggests that charging at the Downtown Portland EA ramped up faster in the morning compared to the other sites and stayed at a higher charging level even during the peak pricing hours (3:00 p.m.–8:00 p.m.).

Figure 17. Normalized System Load Shape versus the Normalized Charging Profile



### Distribution System Peak Impact

The evaluation team investigated the EA sites’ potential impact on the distribution system based on the feeder loads and ratings provided by PGE. To estimate the impact on the potential feeder upgrades, we calculated the feeder loading with the added historical EA charging load. In addition, we estimated the contribution to feeder loading of EA stations in a worst-case scenario, when all chargers are used at the same time.

**The team found that none of the feeders at the EA sites are at risk of overloading.** When a feeder’s loading is above the 67% threshold, it triggers a capacity study by PGE. The maximum total load on feeders serving EA sites has been below 56% of rated capacity, indicating that they are not at risk of needing an upgrade (Table 17). The potential feeder loading increase ranges from 0.8 - 2.1%, if all chargers are in simultaneous use, indicating that even if this were to occur, there would be minimal impact on the distribution system.

Table 17. Loading on Feeders Serving EA Sites

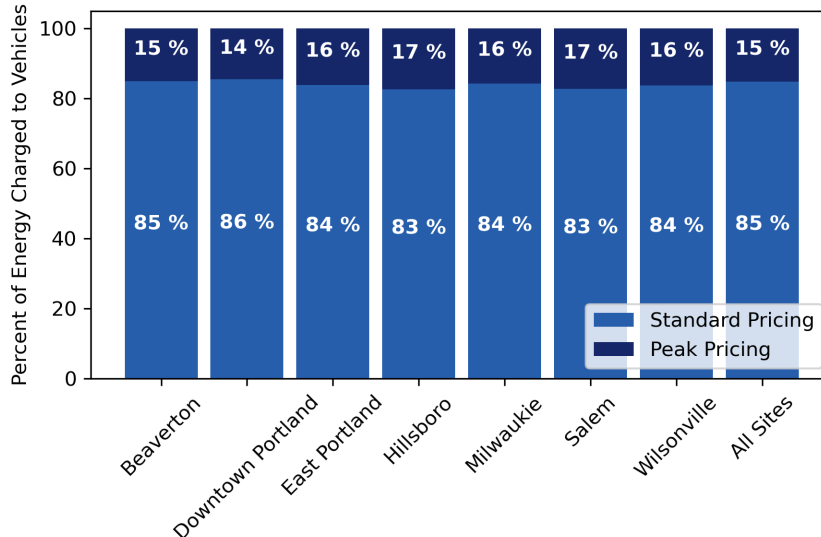
EA Site	Feeder % loading with historical EA charging load		Feeder loading % increase if all chargers are in use	
	Winter	Summer	Winter	Summer
Milwaukie	31%	48%	1.4%	2.1%
East Portland	36%	55%	1.4%	2.1%
Wilsonville	54%	56%	1.1%	1.2%
Beaverton	32%	40%	1.1%	1.2%
Salem	29%	39%	0.8%	0.9%

Note: Downtown Portland EA is not included in the distribution system peak impact analysis because the evaluation team did not receive feeder data for the site. Hillsboro was not included in the analysis because data for this feeder was not available. Potential feeder loading % increase is calculated as maximum EA charging capacity (MW) / feeder seasonal rating provided by PGE.

### 5.2.3 Peak Pricing Impact

During weekdays, EA users incur a \$0.19/kWh peak charge between 3:00 p.m. and 8:00 p.m., which has helped shift charging away from the system peak period. Less than 18% of energy consumed at each site occurs when EA sites have peak pricing in effect (Figure 18).

Figure 18. Peak Pricing Period Energy Consumption at EA Sites



To estimate the kWh impact of this peak pricing mechanism on PGE’s system, the evaluation team used data PGE previously observed at the Downtown Portland EA site.<sup>15</sup> PGE has seen the energy used during the peak pricing period decrease by approximately 50% after instituting peak pricing surcharges.<sup>16</sup> Assuming that the peak pricing at the other EA sites successfully shifted load away from system peak hours to a similar extent as was observed at the Downtown Portland EA, an estimated 14.2 MWh of peak period charging for the Beaverton, East Portland, Hillsboro, Milwaukie, Salem, and Wilsonville was shifted to off-peak hours during the study period or approximately 39.1 kWh/day (Table 18).

Table 18. Shifted Charging due to the Implemented Peak Pricing

EA Site	Shifted Peak Period Charging (kWh/day)
Beaverton	10.1
East Portland	13.8
Hillsboro	3.8
Milwaukie	6.15
Salem	2.0
Wilsonville	3.3
<b>Total</b>	<b>39.1</b>

### 5.2.4 Fast Charger vs L2 Charger

EA sites offer both DCFC and the L2 charging options. In the following section, we provide a summary of how charging behavior and utilization differs between the two types of chargers.

The vast majority (94% or 450 MWh) of energy delivered by EA chargers was served by DCFCs. Given the higher capacity of DCFCs, greater energy delivery from DCFCs is expected; however, this finding might also suggest a customer preference for fast charging.

**This preference for fast charging is also observable in relative utilization rates (the percentage of time the charger is in use) of DCFCs and L2 chargers.** The DCFC utilization rate was 10.7% for all EA sites, nearly twice that of L2 chargers, despite L2 charging sessions requiring more time to deliver the same amount of energy (Table 19). This utilization rate is similar to the 4%–15% utilization rates observed at DCFC charging locations in California.<sup>17</sup>

Table 19. L2 and DCFC Energy Charged and Utilization

Charger Type	Utilization (%)		Energy Consumed (MWh)	
	All EA Sites	All EA Sites Except Downtown Portland	All EA Sites	All EA Sites Except Downtown Portland
L2	6.3%	2.7%	30	9.5
DCFC	10.7%	6.5%	450	207

**The daily usage patterns of L2 and DCFC chargers exhibit significant differences (Figure 19).** The daily average total DCFC load profile exhibits two peaks. The first occurs around 2:00 p.m. to 3:00 p.m. and the later peak

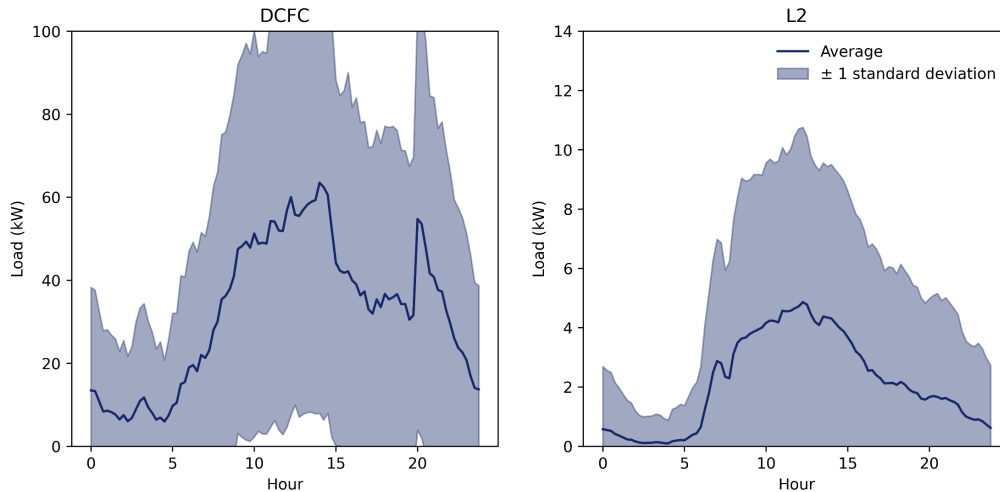
<sup>15</sup> Formerly called the World Trade Center EA site.

<sup>16</sup> PGE Transportation Electrification Plan 2019

<sup>17</sup> Fitzgerald and Nelder, 2017, “EVgo Fleet and Tariff Analysis: Phase 1: California,” Rocky Mountain Institute, [https://rmi.org/wp-content/uploads/2017/04/eLab\\_EVgo\\_Fleet\\_and\\_Tariff\\_Analysis\\_2017.pdf](https://rmi.org/wp-content/uploads/2017/04/eLab_EVgo_Fleet_and_Tariff_Analysis_2017.pdf)

occurs around 8:00 p.m., at the end of the peak pricing period. The average daily L2 charging pattern does not exhibit a dual peak. Instead, the daily average profile peaks around noon. Almost no L2 charging occurs between midnight and 6:00 a.m. The average charging session duration on L2 chargers is 2.2 hours with a standard deviation of 2.6 hours while the average charging session duration on DCFC chargers was shorter at 0.9 hours with a standard deviation of 2.21 hours. The usage variation between L2 and DCFCs may be due to the cost differential between the chargers (L2 chargers are \$3 for 2-hours and DCFCs are \$5 for 2 hours), limited understanding of charger types, or limited DCFC availability.

Figure 19. Average Daily Load Profiles for DCFC and L2 Charging



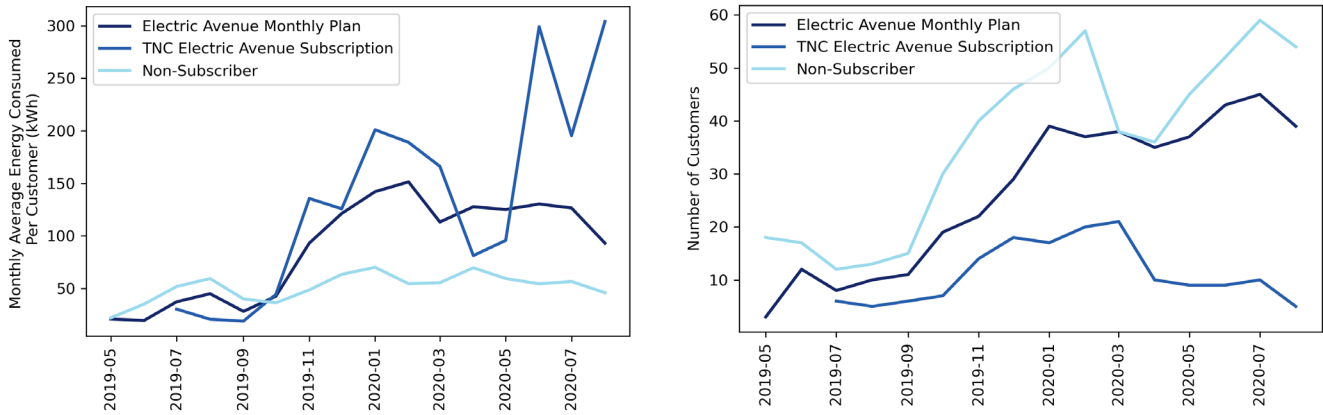
### 5.2.5 Charging Behavior by User Groups

The evaluation team categorized EA users into three groups, TNC EA Subscribers, EA Monthly Plan Subscribers, and other non-subscriber users, and investigated the usage pattern differences between these groups.<sup>18</sup>

**Of the three EA user groups, TNC Subscribers consume the most energy on a per customer basis.** While TNC Subscribers make up the smallest share of users, they have the highest per customer energy consumption in most months. This is expected as rideshare vehicles travel more miles than personal vehicles. The largest share of users in each month are the non-subscriber users, but they consume very little energy per customer compared to the subscriber groups (Figure 20). This finding is consistent with the idea that customers who consume more energy per month have greater motivation to enroll in a subscription program or that customers with a monthly subscription plan are more likely to go to the same charging network to fully utilize the subscription. During the initial period of the COVID-19 pandemic (March to May 2020), TNC Subscribers experienced the greatest decrease in energy consumption and non-subscriber users experienced the most significant drop in the number of users.

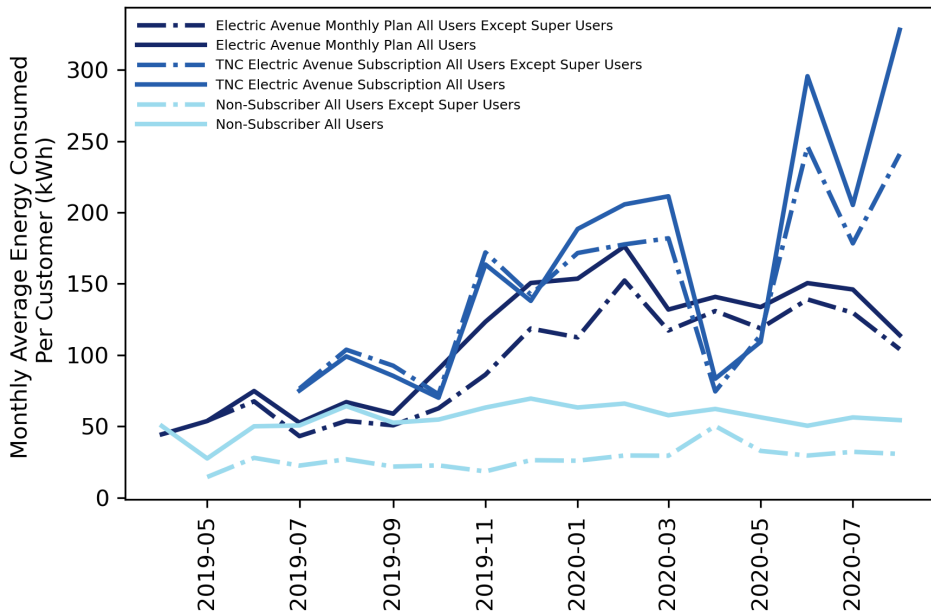
<sup>18</sup> The data used in the user group analysis is only a subset of the charging data because the dataset used in previous analyses did not contain user subscription information. The data used for this analysis is from May 2019 to August 2020 and does not include the Downtown Portland site.

Figure 20. Average Per Customer Monthly Energy Consumption (left) and Number of Customers Per Users Group (right) by User Group



To investigate the impact of “super users” on impact findings, the evaluation team identified super users in each user group and analyzed their impact on average monthly charging consumption for each group by comparing the monthly average energy consumption per customer with and without the super users in the population. The team defined customers that consume more energy than three standard deviations above the average energy consumption for the user group as super users. The team identified three Monthly Plan Subscriber super users and one TNC and non-subscriber group super user each. While these users consumed significantly more energy than the average user in their group (Figure 21), the team found their impact on the average consumption per user and on the conclusions was minimal.

Figure 21. All Users Except Super User Monthly Average Energy Consumption

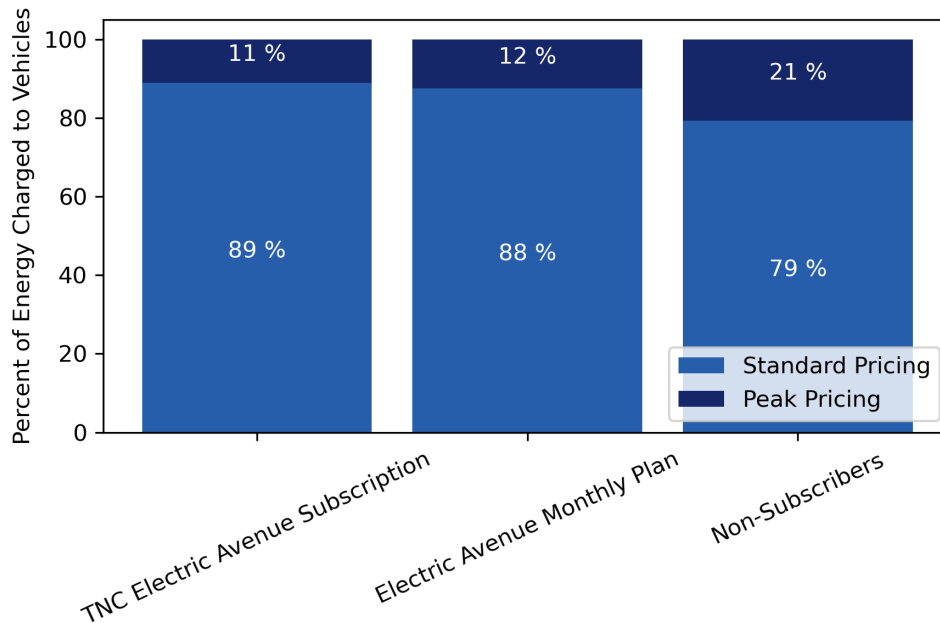


Charging behavior of users on subscription plans is different from non-subscription users (Figure 22). Non-subscriber users conduct about 21% of their charging during the peak pricing period while subscribers conduct



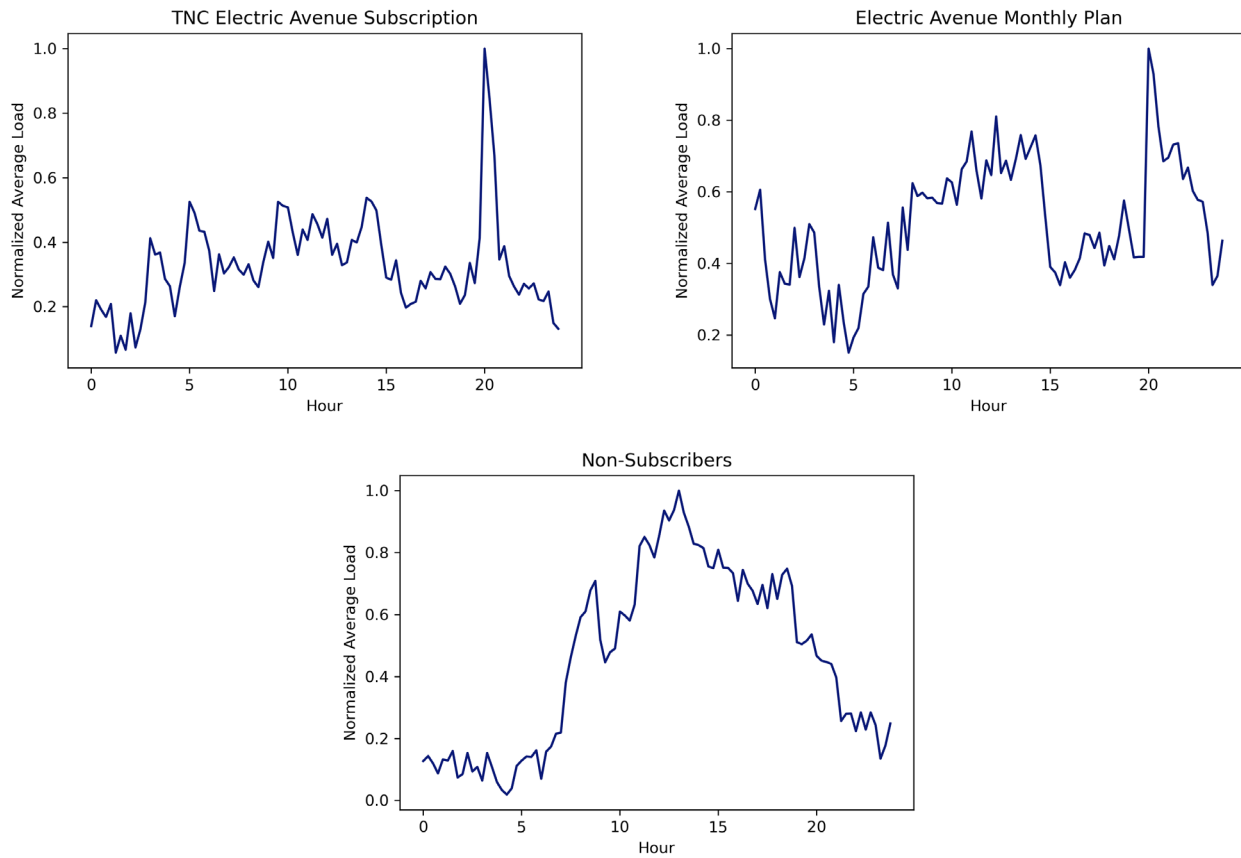
10%–13% of their charging during the peak pricing period. The greater share of on peak charging among non-subscriber users as compared to subscription drivers indicates that the peak period surcharge might be most effective in changing charging behavior if the driver is already on a subscription plan.

Figure 22. Peak Pricing Energy Consumption by User Group



TNC and EA Monthly Subscribers show similar charging profiles with highest peak occurring at 8:00 p.m. and the second peak in the early afternoon (Figure 23). The TNC Subscribers have the greatest shift in load to off peak hours, with a sharp increase at 8:00 p.m. which may be a response to the pricing structure. The impact of the peak period surcharge can be observed based on the charging profiles from TNC Subscribers and EA Monthly Subscribers as seen in the drop in load from 3:00 p.m. to 8:00 p.m. The peak pricing impact is not observed in the charging profile of non-subscribers, whose charging load peaks at around noon.

Figure 23. Normalized Average Daily Load Profile for Each User Group



TNC Subscribers and EA Monthly Subscribers receive less than 3% of their energy from L2 chargers, compared to almost 10% for non-subscribers (Table 20). All three user groups obtain more than 90% of their energy at DCFC chargers. Since an individual session at a DCFC charger costs more than an L2 session (on a \$/minute basis), non-subscribers are more likely to choose the L2 charger if it can satisfy their charging needs than the DCFC charger. Subscribers do not pay more for using a DCFC charger and are more likely to choose DCFC chargers because of the shorter charging time.

Table 20. Percentage of Energy Charged at L2 and DCFC Chargers by User Group

User Group	% of Energy Charged at L2	% of Energy Charged at DCFC
TNC Subscriber	2.5%	97.5%
EA Monthly Plan Subscriber	2.1%	97.9%
Non-Subscribers	9.6%	90.4%

## 6. Electric Mass Transit 2.0 (TriMet) Pilot

TriMet and PGE completed the installation and commissioning of two 150 kW Merlo Garage chargers and one 450 kW overhead fast charger at Sunset Transit center in early 2019. An electric bus manufacturer delivered the first of five electric buses in April 2019. By October 2019, all five buses on Line 62 had been delivered by the bus manufacturer and were in service. As of December 2020, all buses on Line 62 were not in service due to equipment and software issues. TriMet anticipated having all five buses back in service in 2021.

### 6.1 Staff and Partner Feedback

The section below presents key findings from in-depth interviews conducted with TriMet Pilot staff (n=4) and Pilot partners (n=2) throughout 2020. The section below summarizes stakeholder roles and documents the ongoing issues with operating the buses and chargers, charging practices, and future electrification plans.

#### 6.1.1 Stakeholder Roles and the Service Level Agreement

The TriMet Pilot stakeholders include PGE, TriMet, the electric bus manufacturer, and the charging vendor. TriMet operates and maintains five electric buses.<sup>19</sup> At the time of purchase, the bus manufacturer selected the charging vendor to provide chargers compatible with the buses. PGE owns and maintains the chargers with technical support from the charging vendor. As part of the purchase, the stakeholders signed a Service Level Agreement (SLA), which specifies that PGE can bill TriMet for the costs it incurs maintaining the chargers. The SLA also specified that the charging vendor or their subcontractors would respond in a timely manner if PGE could not resolve any issues themselves.

The 2019 annual report describes PGE and TriMet's dissatisfaction with the technical assistance and troubleshooting provided by the charging vendor and its subcontractors in 2019. In 2020, PGE explored other providers for technical assistance, but reportedly did not find any cost-effective options. As a result, PGE renewed their SLA with the charging vendor, but downgraded it to the minimum level of service that the charging vendor offers. The SLA in 2020 stipulated that the charging vendor provides connectivity to the chargers, has support staff available by phone, and provides PGE access to the charging vendor's website portal to view the charger status.

#### 6.1.2 Electric Buses

**The buses running on Line 62 were grounded at several points in the last year.** The buses were not running in December 2019 when water intruded into the high voltage area of the en-route charger. In April and May 2020, there was an interoperability issue connecting the buses to the chargers. And in July 2020, a mechanical component of the en-route charger arm broke, which grounded the buses through mid-August. Please see Section 6.1.3 for details regarding charging infrastructure issues.

**Transit ridership was down an estimated 70% in the Spring of 2020 and has been lower than normal because many people sheltered in place during the COVID-19 pandemic.** As such, TriMet could handle demand on Line 62 by running only three buses instead of the typical five. During this time, TriMet diverted two of the electric buses to other routes so that they were still able to use the buses, get more miles on them, and get more public exposure to the buses. One route was a 15-mile round trip route that connected the Beaverton Transit Center to a neighborhood circulator. Since this route was short, it did not need a mid-point re-charge and

---

<sup>19</sup> The evaluation team conducted in-depth interviews with PGE staff involved in the TriMet pilot and all Pilot partners except for the bus manufacturer who was declined to participate an interview.

TriMet called this a “rather successful demonstration.” The other bus was used for one-way service from Oregon Health and Science University to the Beaverton Transit Center.

**The less TriMet uses the buses, the more it costs them on a kWh basis.** The more the buses are running, and the more miles driven, the lower the kWh cost per mile. In June 2020, for example, when a few buses were going through the lVP6 testing, they had an average kWh of 3.12 per mile which was worse than in the winter when buses can average 2.2 kWh per mile including heater use and, in the summer, when buses average 1.5 to 1.8 kWh per mile.

TriMet reported a variety of mechanical issues with the five electric buses:

- Numerous occasions where the air conditioning did not work
- Instances where the bus breaks “locked up” and caused it to not move
- The bushings on the front suspension wore out and needed to be replaced sooner than expected
- Tires wore out sooner than expected

One TriMet interviewee had the opinion that it is not fair to compare the electric bus’s durability to a diesel engine bus because the diesel buses have been around for 100 years and the industry has had time to improve and reinforce their components. This interviewee said they “haven’t seen too many differences in the wear items” of the electric buses compared to diesel buses. However, the other TriMet interviewee reported that the unreliability of the buses has meant they have not realized any cost savings.

### 6.1.3 Charging Infrastructure

#### Charger Issues

**PGE and TriMet expected some setbacks with equipment because this is a Pilot and the industry is nascent, but the problems have been severe enough to ground the fleet and some problems were not resolved in a timely manner.** The issues that have occurred with the chargers and the amount of attention and service needed to resolve them has been “above and beyond what TriMet signed up for” according to one interviewee. The charger issues have been numerous, and only some relate to interoperability issues with the buses.

- **A mechanical component broke on the en-route charger due to wear and tear.** A mechanical part broke on the overhead bar that lowers to connect the charger with the bus. TriMet grounded the buses and PGE had the charging vendor come out to the site and replace the part, which PGE later found out was under recall. PGE reported that scheduling the work with the manufacturer was a challenge because they did not have a contract with the manufacturer. Once the manufacturer replaced the part, the charger did not work due to incompatibility issues between the new part and the existing gears, which further delayed redeployment of the buses.
- **Rainwater leaking into the en-route charger high voltage area prevented operation.** Water leaked into the high voltage area of the charger, preventing the charger from activating and causing a potentially hazardous situation. PGE and TriMet staff expressed dissatisfaction that more testing had not been done to ensure that the charger’s high voltage area is protected from rainwater intrusion before selling it to customers.
- **The charging vendor updated the en-route charger’s Internet Protocol version (IPv) causing compatibility issues. IPv6 is the new standard for all Wi-Fi communications and the update occurred during one of the planned bi-yearly maintenance visits.** The software update caused an interoperability

issue with the buses' communication system, which was still using IPv4. This issue grounded the fleet for at least 60 days, according to one interviewee. The Pilot stakeholders went through "a number of iterations and fixes," and had the IPv6 on four of the five buses at the time of the interviews in August 2020.

- **Software interoperability issues caused the buses to not connect correctly to the Merlo Garage chargers.** The buses reportedly kept disconnecting from the chargers, so they were unable to charge at night. Stakeholders said this was due to software issues between the bus and charger that prevented it from reliably connecting to the chargers.

The stakeholders want this Pilot to be successful as it is important to the future of the industry and to the reputation of the bus manufacturer and charging vendor. Toward this end, representatives from the bus manufacturer, PGE, TriMet, and the charging vendor recently began conducting weekly meetings over the phone to discuss issues and future plans. The goal of these meetings is to be transparent, ensure everyone is on the same page, and resolve issues as they arise.

### 6.1.4 Charger Maintenance

**Heavy duty vehicle charging is a new industry, and this Pilot is helping inform what needs to be included in a preventative maintenance schedule.** Stakeholders acknowledged that a couple years ago, no one understood what preventative maintenance activities needed to occur and on what schedule. There had been no history of lifetime charger performance and breakdowns to inform such a schedule. Due to the unknowns, PGE opted for the minimum level of service the charging equipment vendor offers. The charging vendor recognizes that the need for preventative maintenance grows with frequency of use and expects to work together with TriMet to update the maintenance schedule as their fleet grows. Currently, the charging vendor conducts a planned maintenance visit at the Merlo Garage chargers once a year and at the Sunset Transit center twice a year. PGE desired a higher level of communication around these visits to know exactly what the charging vendor is testing and working on and for how long.

### 6.1.5 Charger Monitoring and Troubleshooting

**PGE O&M staff who monitor the vendor-provided charging dashboard reported communication challenges when seeking more information.** PGE staff report having to go through multiple people to find the right person to answer their questions and have had questions go unanswered by the charging vendor for up to five weeks. In other cases, the PGE staff person noticed an issue and contacted the charging vendor, but the charging vendor told them that there were no issues. Additionally, the charging vendor upgraded their online dashboard, but did not notify the other Pilot stakeholders. They found out after noticing a note on the website. It reportedly took up to five weeks for all key PGE staff to be invited to access the new portal. In response, the charging vendor reported that the stakeholder team is "getting better at making sure we know who to call first and who to engage when" and that "PGE has been really good and patient" about this process.

**PGE and TriMet staff expressed concern that service calls were not well-documented, and they were unable to verify that a service job has been completed.** PGE staff reported submitting troubleshooting tickets through the charging vendor's online system, which sometimes would be marked as resolved without any follow-up or notification of what servicing was performed. PGE staff were unable to see if a change had been made using the dashboard, which requires contacting the charging vendor to find out if the chargers were operational. The charging vendor reported that more than 65% of issues are handled remotely and they usually do not inform PGE that a service call has been completed because they expect the online system to show they are working again.

**TriMet and PGE reported that the charging vendor has not resolved charger issues in a timely manner, though the vendor said unfortunate timing and a lack of staff caused the delays.** The charging vendor reports that when an issue occurs with the chargers that is not related to bus interoperability, the chargers are down an average of two to three days. However, they noted that three of the four issues that required site visits in the past year happened around 2:00 a.m. on a Saturday morning. By the time they were able to figure out what parts they needed and get the right people there, it was Monday of the following week. A TriMet representative stated that “Everyone is learning and growing, but some of the most important aspects, which is aftercare and our ability to get prompt response and resolution on these issues from the charging vendor has been a weakness.” The charging vendor said these events caused them to train additional subcontractors so they have enough resources to provide the level of service stipulated in the SLA and noted that as the industry grows, having chargers down for three days and using diesel backup buses will be “unacceptable.”

**As the charging vendor gains more experience with customers, they are looking to ensure their service aligns with their client’s expectations.** The charging vendor reported that the amount of service their clients expect is varied. Some customers want the charging vendor to handle all issues, including preventative maintenance and management of spare parts, while others prefer to take on more responsibility. The charging vendor reports that PGE has been communicative and helped the vendor learn that different clients have different needs. The vendor is looking to put things in place so that as their client base grows, they will provide the appropriate level of service to ensure the chargers keep operating.

### 6.1.6 Bus Charging Practices

**The Sunset Transit Center charger is the buses’ main charging source, and the charging schedule has not changed since 2019.** All buses stop at the Sunset en-route charger once during every round trip and charge the battery back up to a full charge. Drivers can take a 10- to 25-minute break while the bus charges, depending upon the time of day. The bus battery does not get fully depleted. At the end of the day, the bus returns to the Merlo Garage and slowly charges to get the battery back up to full charge.

**This charging schedule does not change during the year, but the energy-intensity of the route varies seasonally.** What does change on a seasonal basis is the amount of recharge the buses need, with cold winter days making the biggest impact on energy consumption. TriMet staff reported the bus heater can use up to 35% of the stored energy depending upon how cold it is. However, the air conditioning on the bus makes a negligible impact on energy consumption, even on the hottest days of the year.

### 6.1.7 PGE Rates and Grid Impacts

**There are limited opportunities to use rates to influence bus charging behavior, but PGE will consider that in the future when it has more data upon which to base such a decision.** The Merlo Garage chargers do not affect system peaks because TriMet uses them at night, and they stay below the 200 kW threshold. For the Sunset Transit Center, these short-range buses must charge when they stop by the Transit Center during their route. Therefore, the charging routine is constrained and cannot change based on pricing signals.

**PGE staff were not aware of any new rate schedules in the near future but may consider incorporating demand charges into new rates to make the electric buses cost competitive with diesel.** They want to wait until they have more data on bus performance and grid impacts before having those deliberations. A PGE staff person noted that TriMet’s consideration of their rates and peak demand has influenced the design of their future facilities. A couple interviewees mentioned how grid strain or grid outages may affect TriMet. If PGE needs to call a demand response event, they will need to be careful because they want to ensure TriMet will have enough service to charge the buses and keep them running. TriMet is reportedly discussing resiliency issues and how a grid outage could impact their ability to keep their buses running.

## 6.1.8 Future Plans

**TriMet will expand its electric bus fleet by adding extended-range buses that depend on depot chargers and not require en-route charging.** TriMet staff learned from this Pilot and from their peers in Europe that en-route charging is complicated and has not been fully vetted. Given that reliable charging is paramount to an operational bus fleet, TriMet staff reported “There needs to be more refinement and robustness [in mid route-charging] before TriMet will feel comfortable with a short-range bus platform.” TriMet also plans to do more testing and vetting themselves on the buses before putting them into revenue service.

TriMet is pursuing grants from the Federal Transportation Administration to fund the purchase of the long-range buses.<sup>20</sup> They anticipate acquiring nine long-range buses between by the first quarter of 2021. Initially, they will return to the Merlo Garage to charge at night but will go to the Powell Garage when it becomes ready in September 2021. PGE is acting as a technical consultant on the Powell Garage and will help TriMet select the chargers for it. They are exploring options but could have up to 12 chargers there.

TriMet will train drivers on the extended-range buses and deploy them on an 18-mile line from Beaverton to Gresham. This route is well utilized with frequent stops and has 25 buses or more on a given weekday. TriMet plans to have a mix of electric and diesel buses on this route so they can do a robust comparison between the two. TriMet reported this will be a difficult route to electrify, but that is by design. If the extended-range electric bus can perform successfully on the most difficult routes that are long with many frequent stops, then TriMet will feel comfortable putting them on any route.

**All interviewed stakeholders were disappointed the electric bus fleet had been grounded as much as it had and wanted to learn from the issues so they may be avoided in the future.** The stakeholders expressed the need for a more explicit SLA that clearly spells out the warranty terms, expected response times, and relative roles and responsibilities. The charging vendor also recommend that the industry create a standardized schedule of upgrades for the buses and charging equipment so they can be aligned to avoid glitches when software upgrades are not applied consistently to all related equipment. TriMet and PGE, however, would have liked the bus manufacturer and the charging vendor to have worked more closely in vetting and testing the equipment prior to selling it.

**PGE staff reported this Pilot has been a valuable learning experience.** They have learned the pros and cons of the different charging infrastructure from the grid perspective as well as from a customer perspective. From the lessons learned in this Pilot, PGE will be better positioned to talk to customers in a meaningful way about the type of infrastructure that might best suit their needs and help them plan for long-term needs. A PGE interviewee said, “Every customer is different, but if we can try to generalize what we’re seeing with TriMet and understand the challenges that they are facing, I think it will help us be better in the long-run.” PGE expects to continue to fulfill an O&M role for the charging infrastructure as long as there are no other market entities providing such a service.

---

<sup>20</sup> Note that the current effective range of a long-range transit bus is approximately 150-250 miles, depending on manufacturer and bus configuration (i.e., length, battery size, capacity, etc.).

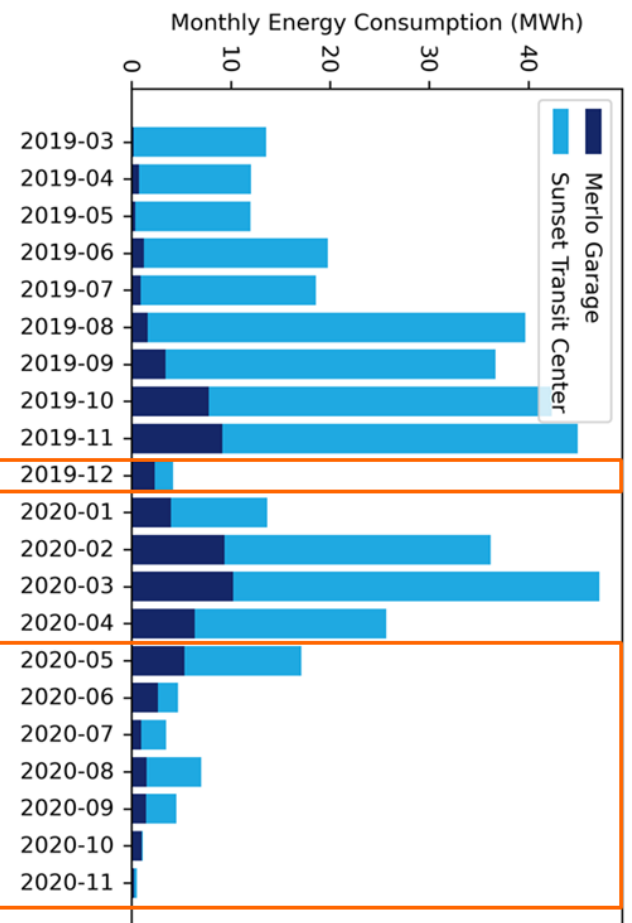
## 6.2 Impact Analysis

### 6.2.1 Overview

According to TriMet, during normal operation, buses charge every time they stop at Sunset Transit Center using a 450 kW over-head charger. Each bus has a 200 kWh battery, which can support one or two roundtrips. At night, buses return to the Merlo Garage where they charge overnight using two 150 kW bus depot charging stations. More than 80% of charging occurred during daytime at the Sunset Transit Center (Figure 24). This is because the buses have limited battery capacity and need to be charged during daytime to support bus operations.

During the study period, charging load varied significantly between months, reflecting periods of time when the buses were not in-service (Figure 24). Starting from March 2020, TriMet reduced the bus frequency and lowered the number of buses in service due to COVID-19. As discussed in Section 6.1, the buses also started experiencing technical issues related to software updates in April 2020 and have remained grounded at the time of this impact analysis (December 2020). The COVID-19 impact combined with the buses' technical issues contributed to the significant decline in charging load starting in April 2020.

Figure 24. Monthly Energy Consumption for TriMet Electric Buses

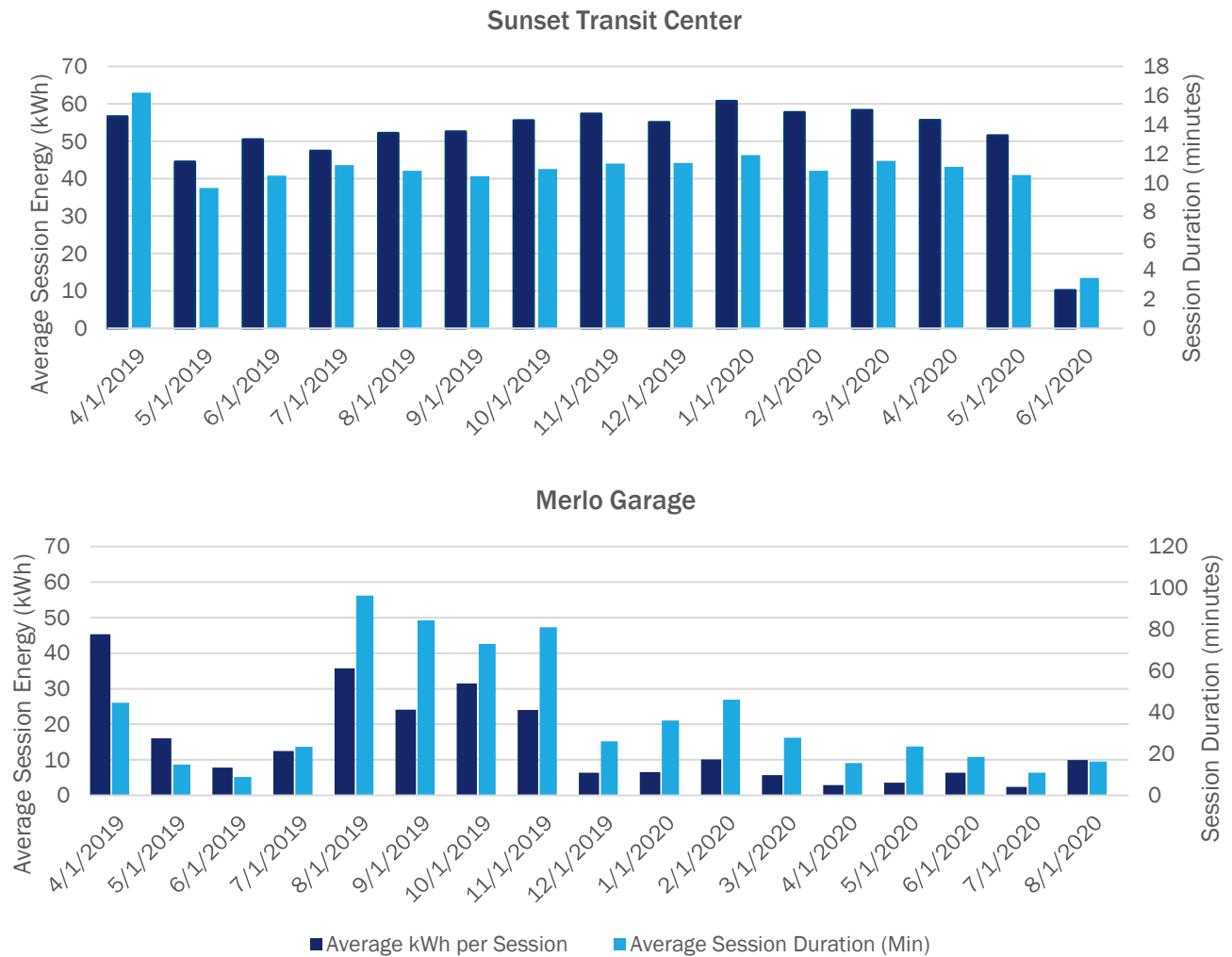


Note: Time periods included in orange boxes are periods that buses were not in service due to technical issues. Energy consumption displayed during periods when the buses were out of service is due to testing.

Average charging session energy consumption and duration are generally consistent at the Sunset Transit Center during the study period, with the average energy consumed at 54.3 kWh/session and charging duration at 11 minutes (Figure 25). In contrast, the charging duration at Merlo Garage changed significantly over time ranging from 10 to 90 minutes. The variance in charging session duration and energy consumption still exists after removing the outliers, suggesting that there might be a substantial amount of testing happening in Merlo Garage during the study period.



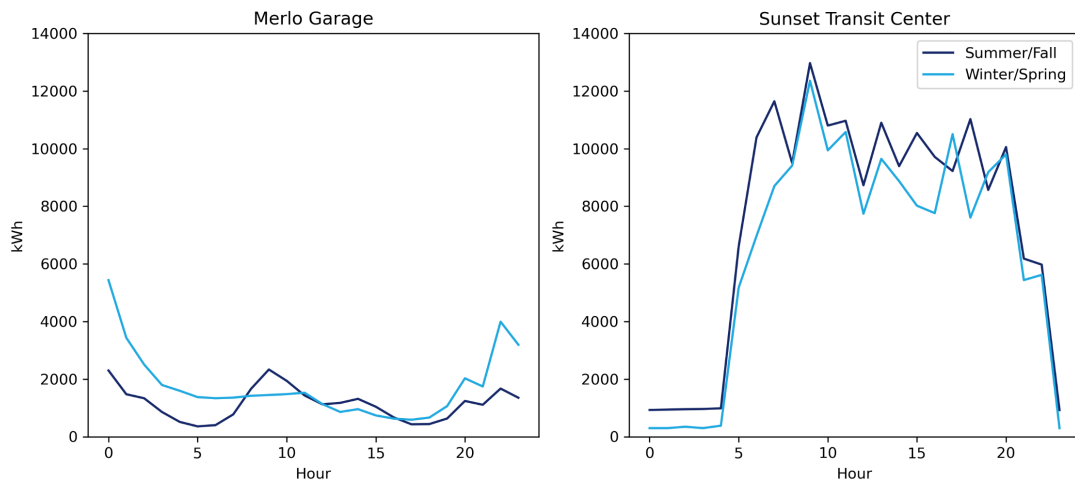
Figure 25. Average kWh Charged per Session and Average Session Duration



### 6.2.2 Charging Profile and Load Factors

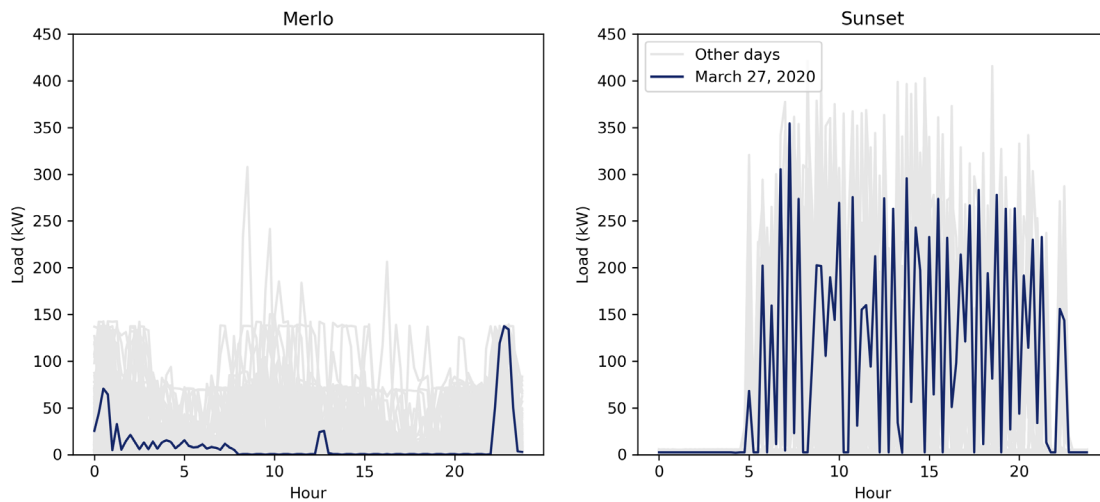
Since the buses typically charge at night, Merlo Garage generally has lower energy consumption during the day than at night. Daytime charging at Merlo Garage is attributed to testing during the study period. Sunset Transit Center has no energy consumption at night as the buses are not in operation during that time. Total hourly energy consumption varies significantly at Sunset Transit Center due to the variation in buses' actual arrival time. Charging occurred slightly more in the morning compared to the afternoon due to a slightly busier bus schedule. Differences in seasonal charging patterns were not observed for either charging location (Figure 26).

Figure 26. Total Hourly Energy Consumption at Merlo Garage and Sunset Transit Center by Season



Daily charging load patterns at Sunset Transit Center are highly variable (Figure 27). Given that high-powered chargers are used and buses charge for only short periods when en-route, the load profiles exhibit many spikes of short duration. The en-route charger can adjust the charging power given the state of the buses' batteries, which is why the charging power is not always at the maximum. Charging at Merlo Garage usually happens during the night and only involves one charger at a time due to the use of sequential charging. As discussed, daytime charging at Merlo Garage is attributed to testing.

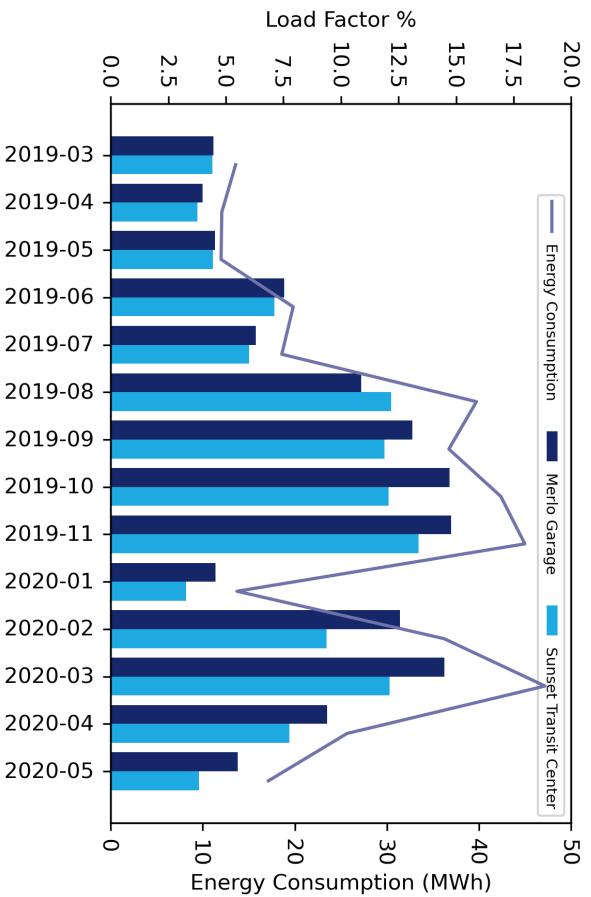
Figure 27. Example Day Load Profiles



Daily charging profiles for one example day are shown in dark blue with the daily charging profiles for each day in the dataset plotted in gray in the background. The example day, March 27, 2020, was chosen randomly within bus normal operation periods.

The load factors at both charging locations are generally low and don't exceed 15% (Figure 28). Months in which more energy is consumed have higher load factors. Merlo Garage load factors are higher than those at Sunset Transit Center due to the lower power charger, but the load factors are still lower than expected suggesting that the duration of charging sessions at Merlo Garage is short.

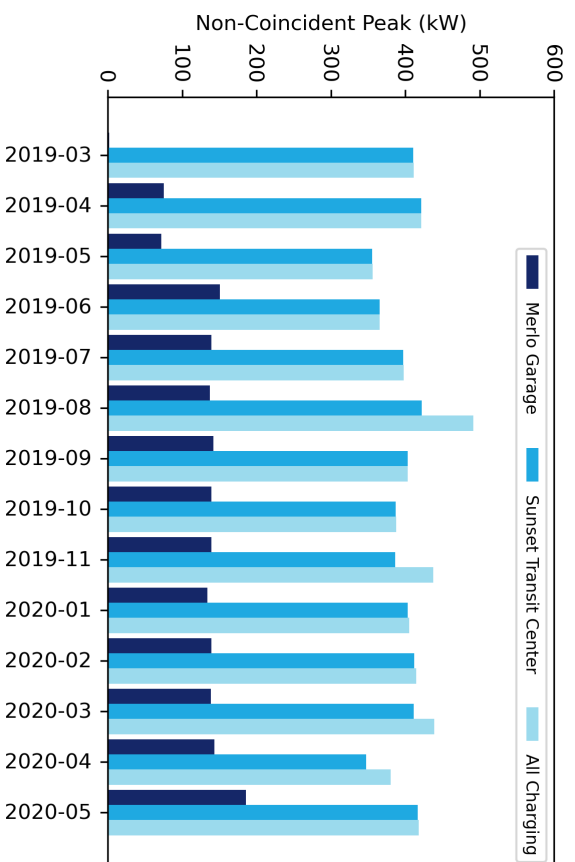
Figure 28. Monthly Load Factors and Energy Consumption at Merlo Garage and Sunset Transit Center



### 6.2.3 Peak Impact

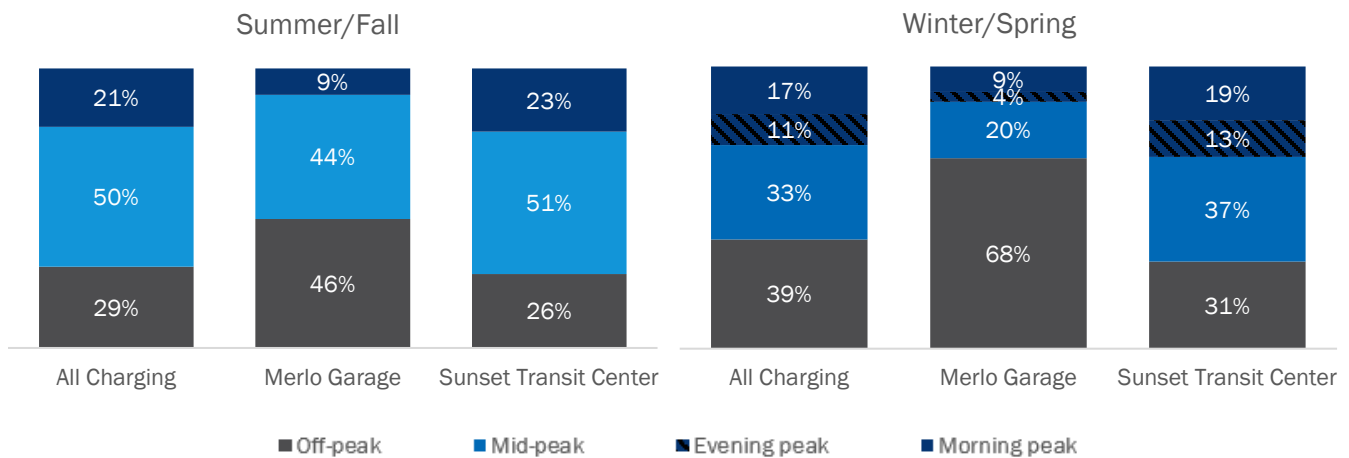
The Sunset Transit Center had consistently higher charging load due to the higher-power charger and primarily drove the combined non-coincident peak (NCP) (Figure 29). The NCP load at the Sunset Transit Center was between 300-425 kW. The NCP at Merlo Garage was typically around 150 kW, indicating that usually only one charger was in use at a time throughout the study period.

Figure 29. Non-Coincident Peak Load at Merlo Garage, Sunset Transit Center, and Both Locations



**Merlo Garage has lower on-peak energy consumption than Sunset Transit Center (Figure 30).**<sup>21</sup> In the summer/fall, 9% of charging at Merlo Garage occurs on-peak, and 23% of Sunset Transit Center charging occurs on-peak.<sup>22</sup> In the winter/spring, there is more charging load during the peak period as the charging load overlaps more with the morning peak. Among all on-peak charging, 60% occurs during the morning peak period.

Figure 30. Percentage of Tri-Met Energy Consumption by Time-of-Use Period



### Bulk System Impact

**Bus charging load did not contribute significantly to PGE’s system peak during the study period (Table 21).** The evaluation team investigated the charging load that occurred during PGE system peak hours or coincident peak. The average demand during system peak hours varied but was small compared to the capacity of the bus chargers (450 kW + 150 kW × 2).

More charging occurred during system peak hours in summer 2019 than summer 2020 because the buses were not in operation due to technical issues. In winter 2019–2020 peak hours, more charging occurred during the top 3% (66 hours) of morning peak hours than the top 3% of evening peak hours. The average demand in the morning and evening peak hours in the winter was also low compared to the capacity of the chargers.

Table 21. Pilot’s Average Peak Demand during System Peak Hours

Season		Total Energy Consumed (kWh)	Average Peak demand (kW)
Summer 2019		8,601	161
Winter 2019-2020	Morning	2,989	107
	Evening	1,999	77
Summer 2020		519	14

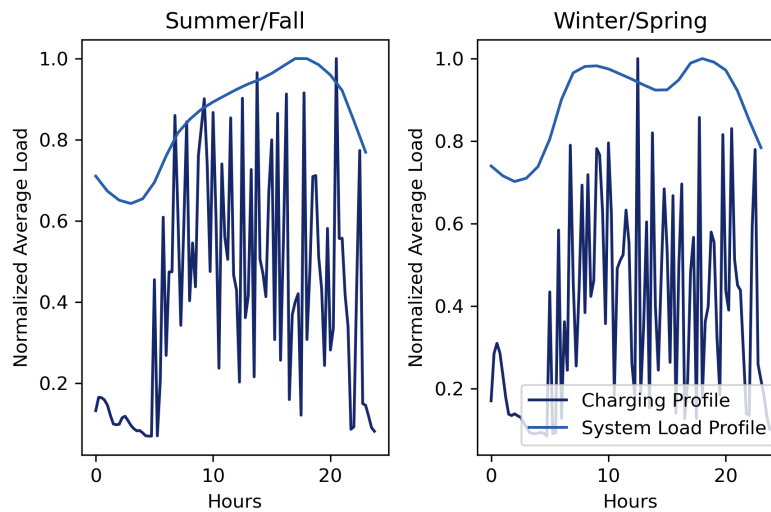
**The variation of average peak demand during the system peak hours is likely due the highly variable nature of transit bus charging during daytime hours.** To compare the charging load profile with the PGE system load profile, the team normalized the two shapes by their peaks and plotted them. The average daily charging load

<sup>21</sup> The TOU period is defined based on PGE’s residential TOU tariffs: <https://portlandgeneral.com/energy-choices/energy-choices-home/time-of-use-pricing-home>

<sup>22</sup> Summer/fall is defined as May through October, and winter/spring is November through April.

is highly variable during system peak hours and is lower during those hours in both summer and winter than in other hours of the day (Figure 31). However, given that the charging timing during the day is almost entirely determined by the timing of buses arrival, there is a chance that high-power charging at the Sunset Transit Center could occur during PGE’s peak hours.<sup>23</sup> If the peak period is relatively short, TriMet might be able to skip a charging session to help mitigate the system peak.

Figure 31. Normalized Average Daily Charging Load vs PGE System Load



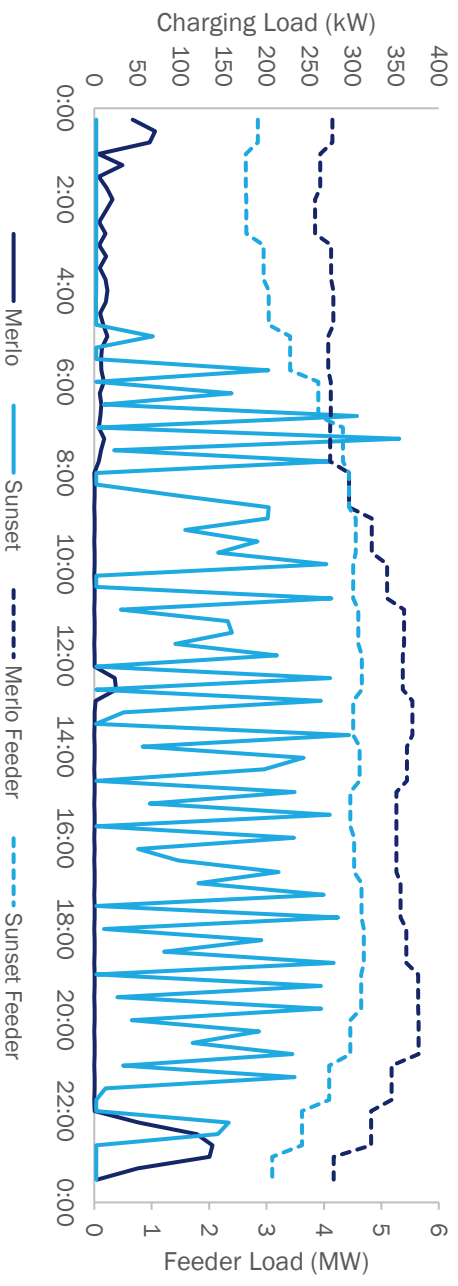
### PGE Distribution System Impact

**Neither the Sunset Transit Center nor the Merlo Garage feeders are at risk of overloading despite the use of high-powered chargers.** The current loading in the summer on the feeders serving Merlo Garage and Sunset Transit Center is 58% and 41% of its rating, respectively, below the threshold that would trigger a capacity study by PGE. The charging capacity of the Sunset Transit Center represents about 2.5% of the feeder’s capacity, and the charging capacity at Merlo Garage represents about 1.7% of the feeder’s capacity, showing that bus charging contributes very little to feeder loading. An example day (March 27, 2020) in which all TriMet buses were in operation was analyzed for coincidence with feeder load (Figure 32). Charging load at Merlo Garage is low during the day when the load on the feeder is higher. Charging load at the Sunset Transit Center is highest between 6:00 a.m. to 8:00 a.m. in the example day, right before the load on the feeder that serves it begins to plateau for the day.

TriMet charging data was also analyzed for coincidence with the top 3% of load hours on the feeders serving Merlo Garage and Sunset Transit Center in summer/fall 2019, winter/spring 2019–2020, and summer/fall 2020. In all seasons analyzed, the average load at Merlo Garage during the peak hours was less than 3 kW, or 1% of the charging capacity, indicating that depot charging had little impact on peak distribution system load. At Sunset Transit Center, the average load during the peak hours of summer/fall 2019 was 44 kW, approximately 10% of the en-route charger’s capacity. In winter/spring 2019–2020 and summer/fall 2020, the average charging load at Sunset Transit Center during peak hours was lower at 28 kW and 6 kW, respectively. This indicates that the high powered en-route charging contributed very little to distribution system peak loads.

<sup>23</sup> This issue might be mitigated by a communication of peak hours between PGE and TriMet through utility programs like Demand Response (DR) or managed charging.

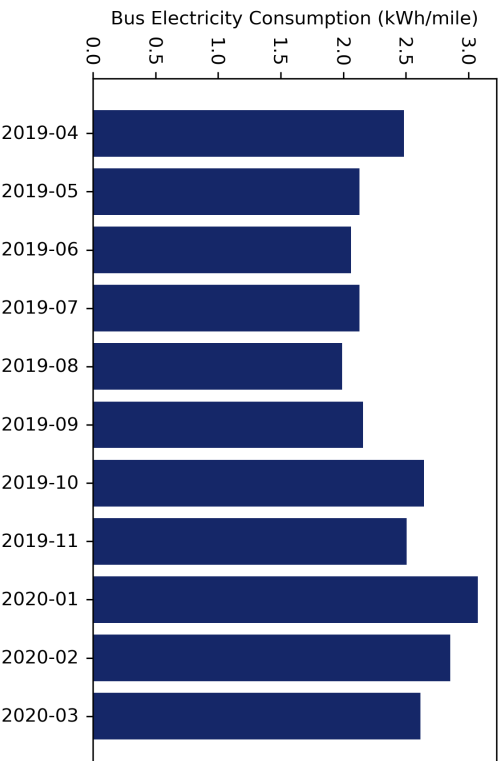
Figure 32. TriMet Charging Load and Feeder Load on March 27, 2020



### 6.2.4 Bus Electricity Consumption

The evaluation team calculated the bus electricity consumption per mile during the study period to investigate the seasonal impact on bus efficiency using charging session data. The average bus electricity consumption during the summer is 1.87 kWh/mile, and it increases to 2.73 kWh/mile during winter due to increased heating needs (Figure 33). The average electricity consumption is calculated after excluding the months when the buses were not in operation. Given the bus efficiency observed, a bus with 200 kWh battery can supply 73 to 107 miles of range, which would be able to support 2.8–4.1 roundtrips on Route 62 (assuming 13 miles one-way).

Figure 33. Bus Electricity Consumption During the Study Period



## Appendix A. Future Evaluation Activities

The evaluation of the pilots will continue through 2023. The following is a summary of planned evaluation activities by year. Note that some scheduled 2021 evaluation activities may be moved to 2022 or canceled due to restrictions associated with the COVID-19 pandemic and related changes in pilot activities.

- **Planned 2021 Evaluation Activities:**
  - Wave 2 of the general population survey
  - Wave 1 of the EV owner/lessee survey
  - Round 3 of ride-and-drive intercept surveys
  - Wave 3 of the initial technical assistance and follow-up technical assistance surveys
  - Round 1, 2, and 3 of the Electric Avenue intercept surveys
  - Multifamily building owner and manager in-depth interviews
- **Planned 2022 Evaluation Activities**
  - Wave 3 of the general population survey
  - Round 2 of focus groups with TNC drivers
- **Planned 2023 Evaluation Activities**
  - Wave 2 of the EV owner/lessee survey
  - Second pilot impact analysis, including analysis of equity impacts

## Appendix B. Business Technical Assistance and Training Survey Detailed Findings

The following section provides detailed findings from the Business Technical Assistance and Builder Education Survey. Findings are presented separately for businesses and governmental organizations who received technical assistance from PGE staff (n=31) and those who attended a workplace charging or fleet electrification event (n=6).

### Business Technical Assistance and Classes

#### Source of Awareness and Topics Discussed

About two-thirds of surveyed technical assistance recipients (19 of 31) indicated learning about PGE’s consultation services through someone from the PGE Key Customer Manager Team (KCMs; eight mentions) or someone else at PGE (15 mentions; multiple responses allowed). Other sources of awareness included colleagues (11 mentions), PGE’s ride-and-drive implementer (seven mentions), PGE’s website (three mentions), emails from PGE (three mentions), a class or webinar where a PGE speaker presented (two mentions), a letter or postcard from PGE (one mention), PGE’s dealer engagement implementer (one mention), Oregon Applied Research (one mention), and ongoing business with Puget Sound Energy (PSE; one mention, multiple mentions allowed).

During their consultations, respondents discussed a range of topics with PGE staff, most of which covered costs associated with charging infrastructure and financial and technical resources available for charging infrastructure (Table 22).

Table 22. Topics Discussed During Consultations (Multiple Responses Allowed; n=31)

Topics Discussed	Count
<b>Charging Infrastructure (27 total respondents)</b>	
Associated costs	23
Financial resources available	20
Technical resources available	18
PGE distribution systems upgrades required	14
Benefits to your business or organization	11
<b>Fleet Electrification (15 total respondents)</b>	
Associated costs	13
Financial resources available	12
Benefits to your business or organization	11
Technical resources available	10

Five respondents indicated that they would have liked additional information during their consultations. One respondent wanted to know about opportunities to share information they were compiling such as power metering of high-power chargers for trucks. Another reported wanting to see more active involvement from PGE in planning EV charging locations and help in developing long-term business models for charging infrastructure, and a financial plan to fund charging installations and to maintain charging installations in the long term. Three other respondents indicated wanting more information from PGE including information about



design services they can provide (one mention) and information about financial assistance (including funding for installing employee charging stations) and timelines for when they may be available (two mentions).

## Event Attendee Feedback on Fleet Electrification and Workplace Charging Information

Of the six respondents who received information about fleet electrification and workplace charging from the Electrifying School Transportation conference session, the Fleet of the Future event, and the Making the Business Case for Workplace Charging Webinar, three learned about the event from a PGE email, one learned from the ride-and-drive implementer, one learned about it from a colleague, one learned from a conference where PGE presented, and another learned from the Public Fleet Managers Association. In terms of their reasons for attending, four reported attending to learn about fleet electrification and two to learn about installing workplace charging.

All respondents provided high satisfaction ratings with the events and indicated they would be very likely to recommend the events to others. The conference session attendee suggested that having a demonstration bus would have improved the event.

The conference session attendees indicated that they were moderately prepared to purchase the appropriate EVs for their fleet after attending the event. Both respondents indicated that they were either very or moderately prepared to select the appropriate charging equipment, and both indicated they were moderately prepared to install or find someone to install charging equipment. All four the Fleet of the Future attendees indicated that they were extremely or very well prepared to purchase the appropriate EVs for their fleet and to select the appropriate charging equipment after attending the event. Finally, four respondents (two who attended the conference session and webinar and two who attended the Fleet of the Future event) indicated that they were in the initial, information-gathering stage of their respective projects. One respondent was considering or planning their investment, and one had already designed or purchased but was looking for additional advice.

## Awareness of PGE EV Pilot Efforts

Nearly all (31 of 37) respondents reported having seen or being aware of at least one of PGE’s EV resources, campaigns, or discounts (Table 23).

Table 23. PGE EV Resources, Campaigns, or Discounts Respondents Have Seen or Heard Of (Multiple Responses Allowed)

PGE EV Resources, Campaigns, or Discounts	Technical Assistance (n=37)
PGE’s Electric Avenues	22
PGE’s Electric Avenues in Downtown Portland	20
PGE’s Electric Avenues in Milwaukee	16
PGE’s Electric Avenues in Hillsboro	15
PGE’s Electric Avenue in Salem	5
PGE’s Electric Avenue in Portland, Eastport Plaza	3
PGE’s Electric Avenue in Wilsonville	3
PGE’s Electric Avenue in Beaverton	3
PGE’s website	22
PGE’s Drive Change Fund	20

PGE EV Resources, Campaigns, or Discounts	Technical Assistance (n=37)
PGE's Workplace Charging Program	15
Emails on EV services or classes	14
PGE's and Nissan's \$3,500 Nissan Leaf discount	11
EV educational kiosks at dealerships	11
National Drive Electric Week advertising	10
Social media information on EVs	7
Nothing	6

Note: Column counts include results from the six respondents who attended trainings on fleet electrification, a conference session, and webinar.

## Workplace Charger Installations

### Financial Assistance

About a third of respondents (5 of 14) who reported installing charging indicated they received financial assistance to procure or install charging equipment, including grants (three mentions), rebates (two mentions), a tax credit (one mention), and a discount from a manufacturer or vendor (one mention). All but one respondent who received financial assistance indicated that the assistance they received came from a source other than PGE. The three grant recipients indicated the grants were “extremely important” in influencing their organization to install the chargers. Among the two rebate recipients (one of whom also received a grant), one rated the rebate as “extremely important” and one rated it as “not at all important” in their decision to installing charging. The respondent who indicated receiving a tax incentive reported being unsure of its importance and the respondent who indicated receiving a discount from a manufacturer or vendor rated the discount as “extremely important” in their decision to install charging.

At follow-up, one respondent indicated that they received a discount from a vendor or manufacturer for their charger installation and that this assistance was from a source other than PGE. The respondent indicated that the discount was not influential in their decision to install the chargers. Five respondents (of five) indicated that the technical assistance they received from PGE was the most influential factor in their decision to install the chargers.

None of the follow-up survey respondents indicated that their chargers are open to the public. Three respondents indicated that they promote workplace charging to their employees. One respondent indicated they promote workplace charging to their employees by having 25 free 120V chargers and eight 240V chargers their employees pay to use. Another respondent indicated they have over 20 workplace chargers at their offices.

### Challenges and Barriers

Six of the fourteen respondents who installed workplace charging indicated encountering challenges with purchasing, installing, or permitting their charger(s). Challenges included it taking more time to complete the installation than expected (four mentions), stations not working as intended (three mentions), the project going over budget (two mentions), permitting taking longer than expected (two mentions), and that the stations still do not function properly (one mention, multiple mentions allowed). Three respondents indicated the installation was on budget and three indicated the stations worked well from the beginning (multiple mentions allowed).

At follow-up, one respondent who installed workplace charging indicated encountering challenges with purchasing, installing, or permitting their chargers. Challenges included the contractor taking more time than expected to complete the installation, permitting taking extra time, and the stations not working as intended from the beginning. Two other respondents indicated their stations worked well from the beginning.

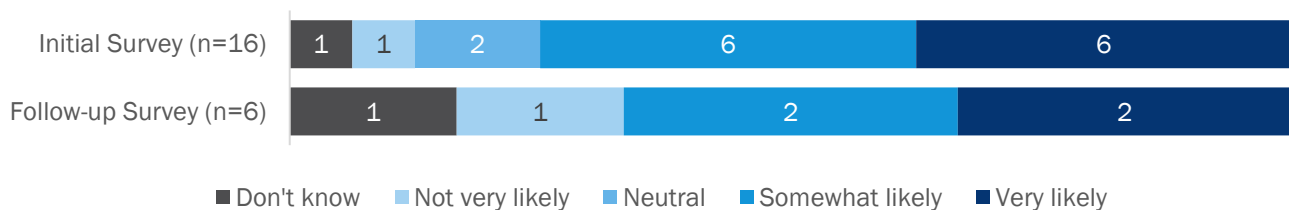
Eleven respondents (of 17 who did not install workplace charging) noted several factors preventing them from installing chargers. Challenges included chargers being cost-prohibitive (11 mentions), capital budget uncertainty (eight mentions), concerns about maintenance (four mentions), lack of staff resources to devote to the project (four mentions), staff and customers sharing access over the course of the day (three mentions), concerns with reliability (two mentions), the benefits of adding charging not being clear (two mentions), insufficient space for the chargers, uncertainty regarding future operations, staffing, or customer traffic, and being unsure of how to find a contractor (one mention each; multiple mentions allowed). Respondents were evenly split about their concern with the cost of the chargers or the cost of the onsite upgrades to install the chargers. Four (of nine) indicated they were most concerned with the cost of the chargers and four (of nine) indicated they were most concerned with the cost of the onsite upgrades. One additional respondent noted they were most concerned with both equally.

Six respondents in the follow-up survey, who reported providing off-street parking for their employees and who did not install workplace charging, noted the following factors preventing them from installing chargers: capital budget uncertainty (six mentions), chargers being cost-prohibitive (five mentions), lack of staff resources to devote to the project (two mentions), uncertainty regarding future operations, staffing, or customer traffic (two mentions), concerns with maintenance, concerns about reliability, concerns about staff and customers sharing access over the course of the day, and being unsure of how to find a contractor (two mention each; multiple mentions allowed). Of the five respondents who indicated chargers were cost prohibitive, three indicated they were mostly concerned about the cost of the onsite upgrades, and one indicated they were most concerned with the cost of the chargers. One additional respondent indicated they were most concerned about the total project cost.

### Likelihood of Future Charging Installation

Of the sixteen respondents who reported providing off-street parking for their employees and who received a consultation, six indicated they are very likely to install charging within the next three years and an additional six indicated that they are somewhat likely (Figure 34). At follow-up, two respondents indicated they are very likely to install charging infrastructure within the next three years. An additional two respondents indicated that they are somewhat likely.

Figure 34. Likelihood of Installing Charging within the Next Three Years by Survey



Of the two respondents who attended the Fleet of the Future event and one who attended a webinar, one indicated that they are not at all likely to install charging within the next three years and one indicated that they are not very likely.

## Fleet Electrification

### Financial Assistance

Surveyed technical assistance recipients indicated that the financial assistance they received was somewhat influential in their organizations' decision to purchase an EV for their fleet. Financial assistance included grants (three mentions), rebates (four mentions; one rebate from PGE); tax credit(s) (three mentions), a manufacturer/dealer discount (one mention); one other respondent indicated they are currently seeking assistance from Drive Change Fund, nine said they did not receive assistance. Three respondents (of eight) indicated that rebates were extremely influential in their organizations' decision to purchase an EV for their fleet, three (of eight) indicated that tax credits were extremely influential, two respondents (of eight) rated grants as very or extremely influential, and one (of eight) indicated their manufacturer or dealer discount was extremely influential. Despite reporting that financial and technical assistance were influential, respondents indicated that if their organization had not received financial assistance, their organization would have bought the exact same number of vehicles (six mentions), postponed buying EVs for two to three years (six mentions) or would have purchased fewer EVs (one mention). Among those whose organizations received financial assistance to purchase an EV for their fleet, PGE's technical assistance was the most important influence in their decision process. PGE's technical assistance was ranked as having the greatest influence on the decision to buy an EV by three respondents. Information from PGE's class, webinar, or presentation, grants, tax credit(s), and rebates were ranked as most influential by one other respondent each.

At follow-up, three respondents (of eight) indicated that they received financial assistance including grants (three mentions), a tax credit (one mention), a rebate (one mention), and a manufacturer discount (one mention). One respondent reported receiving a grant from PGE. Among those who received financial assistance, two respondents rated the grants, tax credit, rebate, and manufacturer discount as extremely influential in their decision to purchase any of their EVs. Three respondents ranked their grant as the most influential in their decision. Two respondents (of seven) indicated that the consultation was extremely influential in their decision to buy their EVs. Respondents (six total) indicated that if they had not received the technical assistance from PGE, they would have postponed buying EVs for two to three years (one mention), would have purchased the EVs, but not as many (one mention), and would have not purchased EVs at all (one mention). Three additional respondents indicated they did not know what they would have done.

### Challenges and Barriers

Nearly all (27 of 31) respondents whose organizations purchased electric fleet vehicles indicated several factors that keep their organizations from purchasing additional EVs for their fleet. Barriers included concerns about where to charge (13 mentions), vehicle range (13 mentions), the cost being too high compared to the gasoline or diesel model(s) (13 mentions), not being aware that there is an electric version for certain fleets (nine mentions), longevity of the battery (eight mentions), being unable to install chargers on their own property (two mentions), and chargers owned by others (one mention; multiple mentions allowed). Despite several barriers, respondents indicated they are likely to purchase or lease an EV for commercial or business use within the next three years.

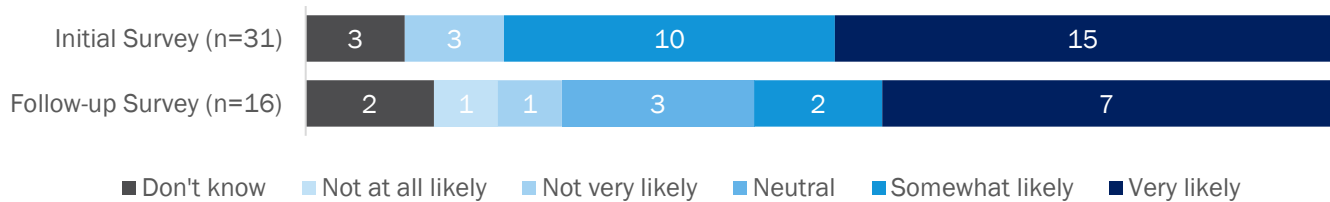
At follow-up, eleven respondents indicated several factors that keep their organizations from purchasing electric or additional EVs for their fleet. Barriers include the cost being too high compared to gasoline or diesel models (seven mentions), concerns about vehicle range (five mentions), concerns about where to charge (four mentions), not being aware that there is an electric version for certain fleets (two mentions), concerns about longevity of the battery (two mentions). Respondents also mentioned barriers including it being cost prohibitive

(two mentions) and waiting for vehicle manufacturers to produce trucks and vehicles comparable to their gasoline and diesel vehicles (one mention).

### Likelihood of Future Fleet Electrification

Almost half (15 of 31) of surveyed technical assistance recipients indicated that they are very likely to purchase or lease an EV in the next three years and an additional ten indicated they are somewhat likely (Figure 35). At follow-up, seven (of 16) respondents indicated they are very likely to purchase or lease an EV in the next three years and an additional two indicated they are somewhat likely.

Figure 35. Likelihood of Purchasing or Leasing an EV within the Next Three Years by Survey



The six respondents who attended a conference session, webinar, and Fleet of the Future event were evenly distributed in terms of their likelihood to purchase or lease an EV in the next three years. One indicated they are very likely, one indicated they are somewhat likely, one indicated a “neutral” response, one indicated they are not very likely, and one indicated they are not at all likely. An additional respondent indicated that they did not know how likely they are to purchase or lease an EV.

## Appendix C. TNC Driver Focus Group Memo

### Introduction and Key Findings

This memo summarizes the results of an online focus group discussion Opinion Dynamics hosted with seven Portland General Electric (PGE) customers who either recently drove or currently drive for a partner Transportation Network Company (TNC) and are considering purchasing or leasing an electric vehicle (EV) or plug-in hybrid electric vehicle (PHEV) for their next vehicle. The focus group was held on July 7, 2020, and the discussion explored participants' experiences as a TNC driver, and their thoughts about using EVs and EV charging for rideshare driving. Opinion Dynamics will host a second focus group in 2022 with TNC drivers who own or lease an EV to get their thoughts about charging and using their EV for ridesharing driving.

Key findings from the focus group discussion include:

- **TNC drivers either test drove a friend's EV or an EV at a ride-and-drive event.** About half the focus group participants (n=3) first test drove a friend's EV, which demonstrates social diffusion whereby current EV drivers encourage others to explore EVs. Three others reported test driving an EV at a ride-and-drive event and two visited a car dealership to look for and test drive EVs. Participants who test drove an EV indicated being highly satisfied with the vehicle's performance, control, quietness, and the regenerative braking after they became accustomed to it.
- **TNC drivers are financially and environmentally motivated to buy an EV but may face difficulty qualifying for financing.** Participants expected being able to reduce their fuel and vehicle maintenance costs by switching to an EV. Participants also indicated that the environmental benefits associated with EVs were appealing. At the same time, all participant drivers expressed concern with qualifying for financing to purchase the EV. Given the higher upfront cost for EVs compared to conventional vehicles and because lenders may not consider rideshare income steady or reliable, TNC drivers may have difficulty qualifying larger loan amounts necessary for a new EV. After they purchase an EV, most participants expected to use it as both their rideshare and personal vehicle.
- **Unlimited EA charging subscriptions and tax incentives for EVs are appealing to TNC drivers.** Participants found PGE's \$25 unlimited EA charging subscription and the availability of subsidized charging subscriptions provided by the TNC to be attractive offers. Participants, however, found the TNC's EV lease program not to be sufficiently attractive. Participants were generally aware of incentives for EVs and chargers through manufacturers and PGE, as well as state and federal tax rebates, and they were keen to take advantage of them.
- **TNC drivers are interested in charging both at home and outside the home.** All participants were very interested in installing a L2 charger at their homes, but one condominium resident faced installation barriers. Participants indicated that if they were to charge in public, they would most likely use chargers at grocery stores or at PGE's EA locations. They preferred EA locations that were easily accessible, near highways, or at locations where ridesharing is likely to occur (e.g., areas with bars and restaurants or near the Portland International Airport). Participants indicated driving by the Downtown Portland and Beaverton EA most often.
- **TNC drivers are encouraged to see expanded charging availability, but still expressed range anxiety and desire for more fast chargers along highways outside of Portland.** Participants desired vehicles that offered a driving range of about 180 miles. Participants want to see more EAs, particularly by the Portland International Airport and in inner Northeast Portland near Interstate 84. Participants were also eager to see or learn about plans for more fast chargers along highways outside of Portland.

Given these findings, the research team recommends PGE consider the following:

- Highlight in marketing materials how using an EV for ridesharing results in substantial savings from reduced fuel and maintenance costs, which can largely offset a monthly lease payment.
- Expand promotions of the \$25 unlimited charging subscription with the TNC to increase the appeal of purchasing an EV.
- Partner with food delivery companies. The ongoing COVID-19 pandemic has many people staying home and some TNC drivers have responded by driving for food delivery companies. These drivers may want to take advantage of offers similar to those available through the partner TNC.

## Methods

### Recruitment

Opinion Dynamics recruited from a list of 199 TNC drivers. We received a list of TNC drivers who signed up for a rideshare community event and information session in Downtown Portland sponsored by PGE's ride-and-drive implementer and a TNC in November 2019. Among the 199 TNC drivers, 19 responded to a ride-and-drive survey conducted by the research team and expressed interest in participating in a focus group. We sent an email to all 199 TNC drivers and asked them to fill out a short screening survey. The survey confirmed they were currently or recently a TNC driver, they did not work for an industry that would pose a conflict of interest, they were PGE customers, they did not currently own an EV, and they were considering an EV for their next vehicle.

After TNC drivers responded to the screening survey, the research team prioritized respondents who were current TNC drivers and previous drivers who indicated they were likely drive for the partner TNC again in the future. The team recruited 10 participants, of which seven attended the online focus group. At the outset of the focus group, the moderator explained to the participants that they were free to agree and disagree with one another and encouraged participants to share their true thoughts and opinions. The focus group was recorded with participants' permission. Note that one participant joined the focus group late, and for that reason, sometimes the findings below are reported out of six participants instead of seven. After completing the focus group, participants were provided a \$100 Visa gift card.

### Focus Group Participants

In the pre-screen survey, participants reported driving between 100 and 1,000 miles per week as a TNC driver. All but two of the participants were currently driving for the partner TNC at the time of the focus group. For most, participants indicated their TNC driving decreased as a result of the COVID-19 pandemic. Two were currently driving for delivery service companies (one in addition to rideshare driving), because, as one reported, they did not feel as comfortable having people in their vehicle during the pandemic and were able to keep busy with delivery services.

All but one of the drivers used their personal vehicle for rideshare driving. The one who did not, indicated they had leased an EV through the partner TNC's leasing program. Participants had been driving for the partner TNC for an average of three years (answers ranged from two to four years). The age of their vehicles ranged from one year old for the TNC-leased vehicle to six years old.<sup>24</sup>

---

<sup>24</sup> The age of the six participants' vehicles included a one-, a two-, a three-, a four-, a five- and a six-year old vehicle (one mention each).

## Electric Vehicles

### Test Driving

None of the participants owned an EV or PHEV, though two had leased a Hyundai Ioniq™ through the Partner TNC's leasing program.

**Nearly all participants had test drove an electric vehicle.** Half test drove a friend's EV while the other half test drove an EV at the 2019 rideshare community event. One participant who attended the event attempted to test drive a Chevy Bolt™, but was unable to adjust the vehicle mirrors to provide proper visibility. They did not feel safe enough to take the car on the road. The participant also tried the Nissan Leaf™, which felt better. Another participant test drove their friend's Tesla™ and another their friend's BMW EV. One participant went to one of PGE's partner dealerships to look for vehicles other than an EV but reported not noticing the EV educational kiosk.

Two participants shared their expectations for EVs prior to test driving them. One participant who drove large trucks and a motorcycle previously, expected EVs not to have much acceleration or power. The other, "decently tall" participant has been driving sport-utility vehicles (SUVs) and said they were concerned the interior of EVs would be too small. Both reported that their concerns were alleviated after test driving the vehicle.

**Participants were highly satisfied with the performance of the EVs they test drove, including the regenerative braking after getting used to it.** Participants liked that EVs "take off" from a stop faster than hybrids, which for one, was important when you need to get through an intersection. Another found the EV easy to maneuver and control and was "very quiet and very smooth to drive." Two mentioned that they liked the regenerative braking on the EVs and how that would result in fewer brake pad replacements. They noted the braking style was different from an internal combustion engine car and took a little getting used to. As one driver said,

*"I got the hang of the balance of lifting up your foot to slow down the vehicle. It's a funny thing for your brain to adjust to. But once I did adjust to it, I really liked it, and just the ease of being able to control those in one fluid motion was very nice."*

**Other participants seemed to agree with the characterization presented.**

### Purchasing and Leasing

**Participants had been thinking about purchasing or leasing an EV for at least a year.** A few participants mentioned they had been considering purchasing or leasing an EV for "a long time" and others mentioned getting more serious about it in the last year or six months in particular. Most participants (5 of 7) were planning to purchase or lease their next vehicle within the next year. One who planned to purchase a vehicle within the next one to two years wanted to see if EV battery range will increase in that time. The last was unsure when they might purchase or lease a vehicle and said they would more seriously consider after COVID-19 impacts have subsided.

Participants were familiar with EV and PHEV models, and some knew when new models were coming to the US market. Three were considering the Nissan Leaf™ and two were considering the Kia Soul™ (Table 24). One participant who was considering the Nissan Leaf™ said that the TNC company did not allow the model they were considering due to its classification as a sub-compact.



Table 24. EVs Considered by Participants (n=7; Multiple Responses Allowed)

Car Make and Model	Number of Participants
Nissan Leaf™	3
Kia Soul™	2
Hyundai Ioniq™	1
Subaru Evoltis™	1
Toyota Prius Prime™	1
No specific model	1

**Participants were primarily interested in an EV to reduce their fuel and maintenance costs and help the environment.** Two participants mentioned wanting an EV because it would have a much better fuel economy than their current vehicles (a Jeep™ and Subaru™). Others wanted to reduce the amount they spent on fuel and move away from fossil fuels. Participants also expected lower vehicle maintenance costs. Participants estimated they could save between \$400 and \$625 in monthly maintenance and fuel costs by switching to an EV. One driver estimated their monthly fuel and maintenance costs to reduce from \$750 to \$125 with an EV. A few participants indicated they fill up their gas tank every day or every other day, and two participants mentioned needing to get oil changes about once a month. One said avoiding the \$70 oil changes would result in “significant savings” by switching to the EV. Another was looking forward to not having to replace brake pads due to the regenerative braking in EVs. One participant elaborated and said, “Over time, electric vehicles way more than pay for themselves because you're paying \$25 a month [for charging] versus \$700 a month in gas. That's two car payments right there.”

**Participants were looking to purchase an EV rather than lease and most would use the vehicle as both a rideshare and personal vehicle.** All focus group participants said they would purchase an EV rather than lease. One participant elaborated, saying that rideshare drivers put too many miles on vehicles for leasing to make sense.<sup>25</sup> All but one participant expected to use their future EV for both rideshare and personal driving.

**Financial support and incentives influence participant decision-making.** There was moderately high awareness of financial incentives for EVs and PHEVs, including the PGE Nissan Leaf™ rebate and state and federal tax incentives. One participant suggested that the partner TNC website present all the tax incentives and financial support available to drivers for EVs in one place.

**First cost and qualifying for financing are likely barriers to purchasing an EV for TNC drivers.** One participant voluntarily mentioned the difficulty rideshare drivers encounter qualifying for a loan for vehicles. Lenders reportedly do not consider TNC driving wages income until they have been driving at least two years, and after that, it may not be considered “steady” income. When asked of the group, all other participants agreed that qualifying for financing to purchase the EV was a concern for them.

## Vehicle Charging

**Participants were happy to see increased availability of EV charging infrastructure in recent years, but still expressed range anxiety.** Most participants indicated they were not familiar with PGE’s EAs, though two reported seeing the Downtown Portland EA, while none reported having used one. Participants knew about

<sup>25</sup> Drivers with a vehicle lease often have mileage limitations as part of the contract and if they exceed the mileage, they can be financially penalized.

other charger availability from driving by and seeing them. The one participant whose friend had a Tesla™ reported using a phone app to locate Tesla™ chargers.

**Participants agreed that a vehicle range of 180 to 200 miles would allow them to only charge at night and not need to stop at a charger during the day.** Participants reported that the minimum vehicle range that would be feasible was 120 miles, but that made a few in the group feel uneasy. The unpredictability of the customer’s ride destination can also cause some anxieties among participants, as they do not want to run out of fuel with a customer in the vehicle.

## Charging Locations

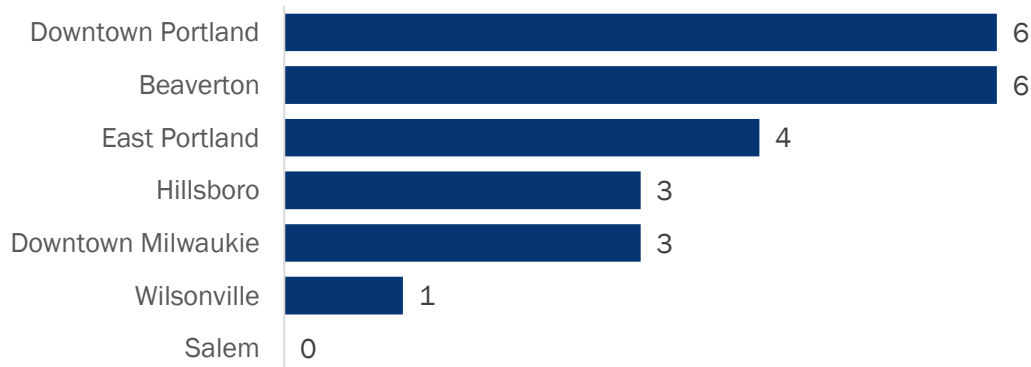
**Most participants were unaware that PGE sponsored the EA charging stations they had seen.** One attributed their lack of awareness to a “lack of advertising” on PGE’s part. Another who was aware said that the PGE website has the charging stations locations and information on financial incentives for a home charger or for an EV.

**Participants expected to charge their vehicle at home or at the grocery store.** Slightly over half of participants thought that charging at the end of the day at home made the most sense (4 of 7). One participant had solar panels at his home, which made him want to take advantage of the "free" electricity. Others said they have found free chargers at the grocery store and might charge there (3 of 7). No participants voluntarily mentioned they would use an EA location for charging. All but one participant, however, reported being interested in using an EA location if they were to purchase an EV after learning more about the unlimited charging subscription.<sup>26</sup>

**All participants were interested in installing a L2 charger at their home.** One participant who lived in a condominium said while it is possible to get a L2 charger installed there, the homeowner association (HOA) requirements would be a barrier to installation. Some participants were aware of PGE incentives for L2 chargers and knew it needed a 240-volt outlet. No participants expressed parking limitations at home.

**Participants indicated they drive by the Downtown Portland and Beaverton EA sites most often, typically driving by those locations at least once per week for ridesharing.** Figure 36 shows that about half of participants reported driving by the East Portland, Hillsboro, and Milwaukie locations at least once per week, while no participants reported driving by the Salem location with that frequency.

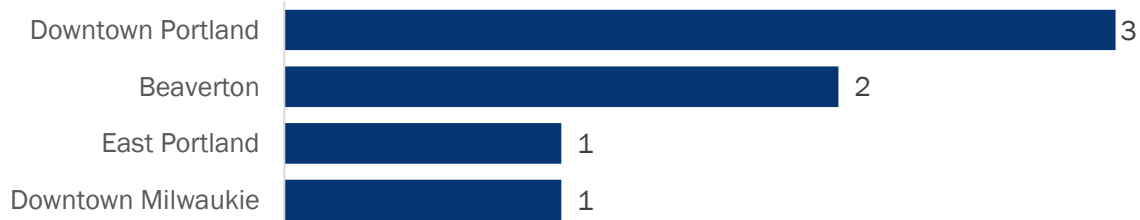
Figure 36. Participants Who Drive by EAs at Least Once per Week (n=7; Multiple Responses Allowed)\*



<sup>26</sup> The one participant who was not particularly interested in using an EA for their future EV reported having solar PV at home.

Participants mostly stayed in the Portland metro area, with the Downtown Portland and Beaverton EA locations being driven by the most-often (Figure 37). One participant drove by the East Portland EA most often, and another drove by the Milwaukie location most often.

Figure 37. EA Locations Driven by Most Often in a Typical Week (n=7)



Participants favored EA locations that were easily accessible, near a highway, or near frequent rides. Locations near a highway would allow drivers to charge easily and then get onto a main thoroughfare. Participants expressed interest in having an EA location in the following areas:

- **Northeast Portland, near the Portland International Airport (n=3).** Two drivers agreed that if they go by the airport, they can spend a lot of time working in that area. One of the two drivers mentioned that airport rides are frequent on evenings and weekends and they can spend a whole evening taking airport rides. A third participant mentioned having a lot of airport rides in the morning.
- **Northeast Portland, near the Hollywood district (n=2).** It is centrally located and near an onramp to Interstate 84.
- **Northeast Portland, near the Lloyd Center (n=2).** By a highway exit, and easily accessible *going into and coming out of Portland as well as being near downtown Portland.*
- **Southeast Portland, near SE Belmont St. (n=1).** There are many restaurants and bars in this area with patrons who use ridesharing.
- **Southwest Portland, near Oregon Health Sciences University (n=1).** One participant mentioned frequent weekday rideshares to the area.

Participants were curious to know about PGE’s plans to expand the EA charging network. Participants were wondering about plans to add more charging stations for expanded accessibility, particularly along highways. One participant who mentioned they were looking to buy an EV two years ago, said the lack of charging availability on highways made road trips “not feasible” at the time. Another driver in the group wondered what data PGE uses to determine the number of chargers at a given EA and if the TNC’s subscriptions and usage data factor into which locations they might expand.

## EA Pricing

All participants preferred the \$25 unlimited monthly EA charging subscription over the hourly pricing. Participants agreed the hourly charging rates were not practical for the amount of charging they would need and that the \$25 unlimited charge was “reasonable” and “the way to go” for a rideshare driver. One participant noted that they could spend \$25 on gas per day, so \$25 for a month was attractive.

One participant noted that the unlimited charging subscription is so attractive that they heard some EV drivers complete the minimum number of rides with the partner TNC so they may qualify for the \$25 unlimited charging offer and do no additional rideshare drives beyond that minimum. In other words, it would seem their

motivation for rideshare driving is to qualify for the discounted charging and not to generate income. Another participant relayed a story they heard from a friend who drives for the TNC and uses this \$25 unlimited charging subscription and was satisfied with that being their main source of charging.

One participant questioned whether it was possible for PGE to offer a similar flat-rate charging subscription for charging at home (rather than paying per kWh).

## Informational Resources

**Participants would use online resources and consumer reviews to learn more about EV models.** Three participants indicated they would visit manufacturer websites or a dealership to learn more about EVs, while another mentioned relying on “a lot of information” from regular emails from PGE’s ride-and-drive implementer. Three participants asserted that if they were to seek information, it would be for something specific and they would select their sources based on the specific topic they were looking for. Participants did not consider PGE as a source of information for vehicle range or for comparing EV models.

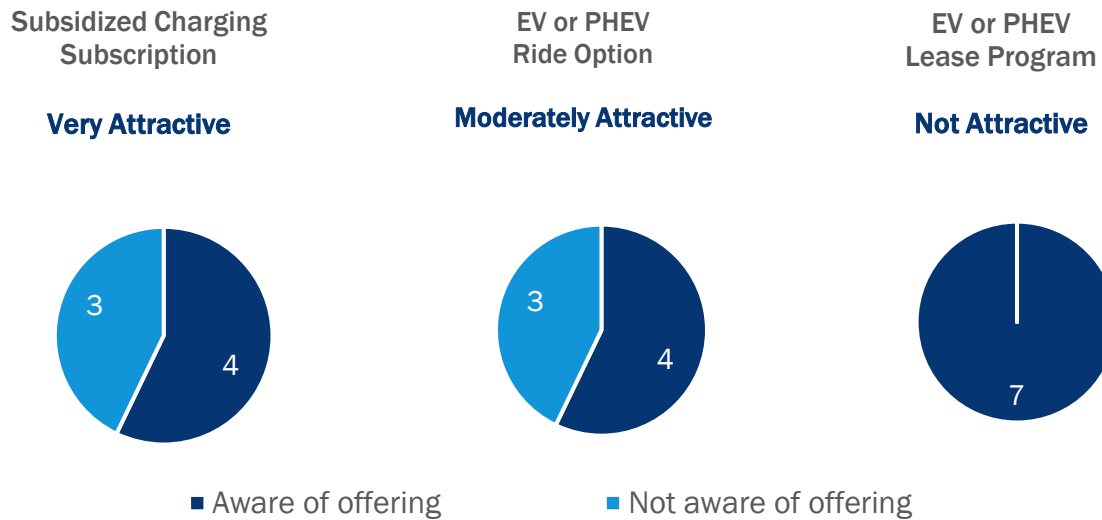
**About half of the participants were aware of PGE’s EV-related offerings (n=3).** Though some did not know of any PGE offerings, two reported knowing about dealership incentives co-promoted by PGE to offset the upfront cost of an EV and two knew about the partnership with the TNC that offered subsidized charging subscriptions for EA. One respondent mentioned they heard PGE offered a rebate for L2 chargers at home.

## Partner TNC EV Offerings

All participants were familiar with the TNC’s offering that allows drivers to lease an EV or PHEV for rideshare driving (Figure 38). Fewer (4 of 7) were familiar with the option in the TNC’s app that allows riders to request a driver with an EV or PHEV or the partnership with PGE that allows qualified rideshare drivers to charge for free at EA.

**Participants expressed varying levels of attraction to the TNC EV offerings, but were very attracted to the subsidized charging offer (Figure 38).** After learning about the TNC subsidized EA charging, all but one participant said the offering increased their interest in purchasing an EV. One participant added that if there were greater availability of EA locations, the offer would be even more attractive.

Figure 38. Awareness and Attractiveness of TNC EV Offerings (n=7)



**Participants had mixed feelings about the TNC’s EV or PHEV ride option.** Three participants reported that the EV or PHEV ride option increased the appeal of purchasing an EV, however, two participants expressed negative opinions of it. One participant felt it was discriminatory and not fair for non-EV drivers. The other reported that not enough customers would choose the option to make it worthwhile for a driver to purchase an EV. This participant was of the opinion that customers prefer the quickest and cheapest ride they can get and will not prioritize EVs. Another participant disagreed with this assertion, saying:

*“I’d choose to wait the extra minutes if there was an EV that was closer. I think especially in Portland, I think that’s important to a lot of people. And I’ve heard people voice that they’re kind of frustrated that they don’t have the option to choose, or you’d have to sift through a whole bunch of cars and see what kind of car it is. [...] And I know some people who don’t have vehicles. They just have bicycles. I know they’d be more likely to use rideshare apps like [the TNC] if they have the option of keeping low carbon footprints by choosing EVs [through the app].”*

**Participants agreed that the EV or PHEV lease program was not attractive in its current form.** Two participants reported using the program when it first started and had a lower minimum-drive requirement and higher incentives (lease payment discount per number of rides). However, the program now has a long waitlist, higher minimum-drive requirements, and lower financial incentives that do not cover as much of the cost of renting the car. One participant stated:

*“The incentives were reduced by the number of rides. It went from almost paying for the entire thing to maybe half, if that. I think you even make a little bit less doing it. Yes, it was a good option at the time, but it’s not as appealing now.”*

The findings indicate drivers are interested in programs such as these but are sensitive to the incentive levels.

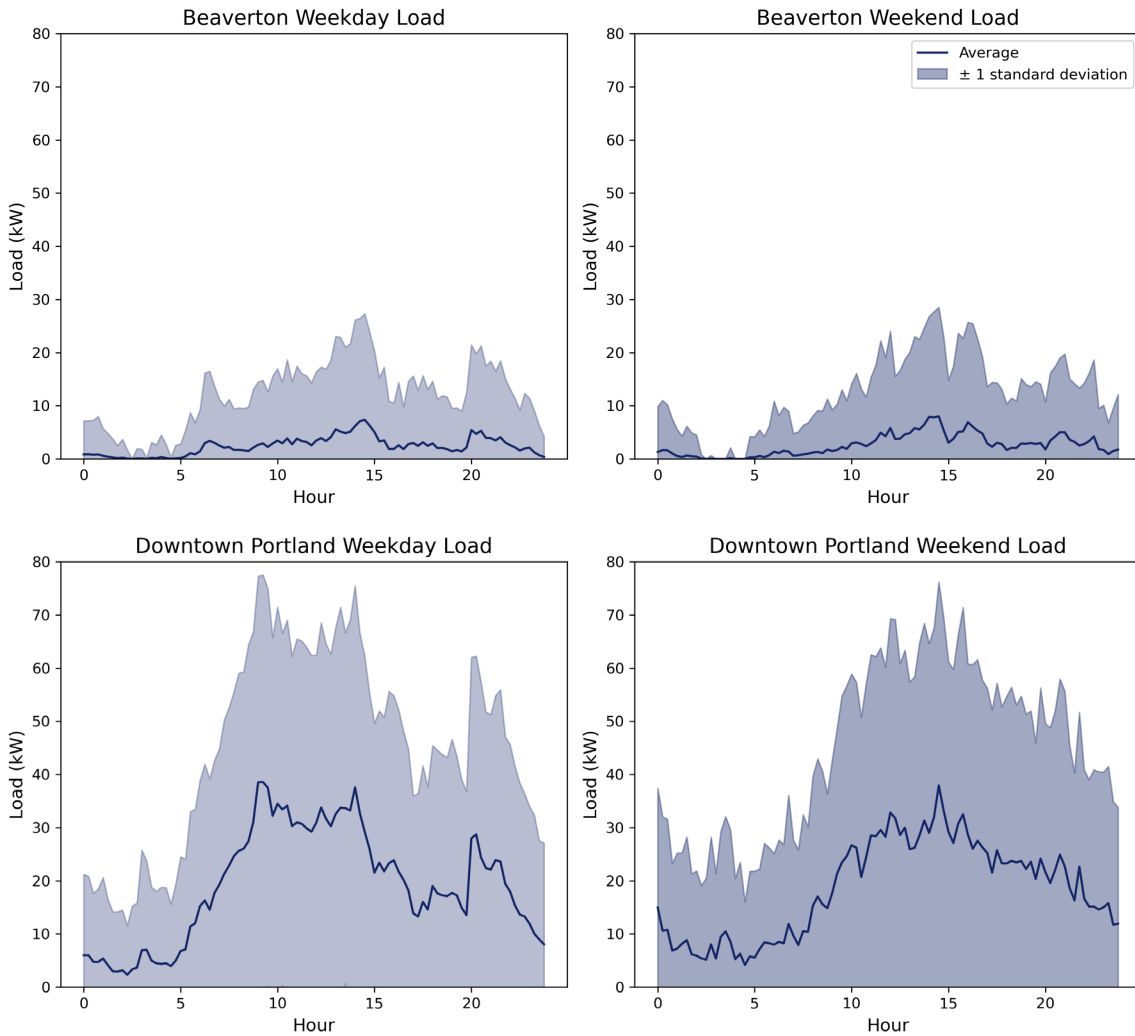
\*All product or company names that may be mentioned in this publication are tradenames, trademarks or registered trademarks of their respective owners.

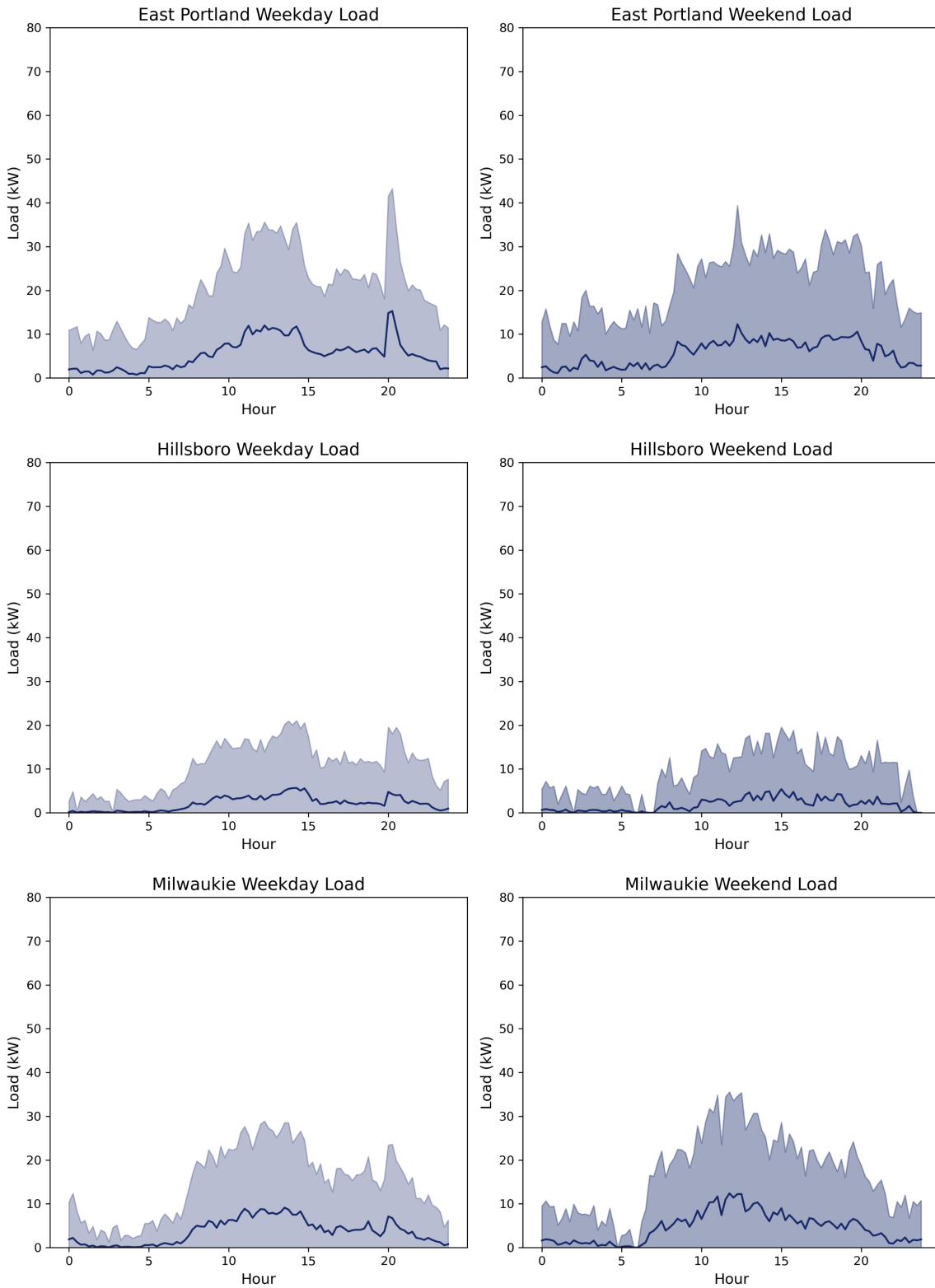
## Appendix D. Additional EA Impact Analyses

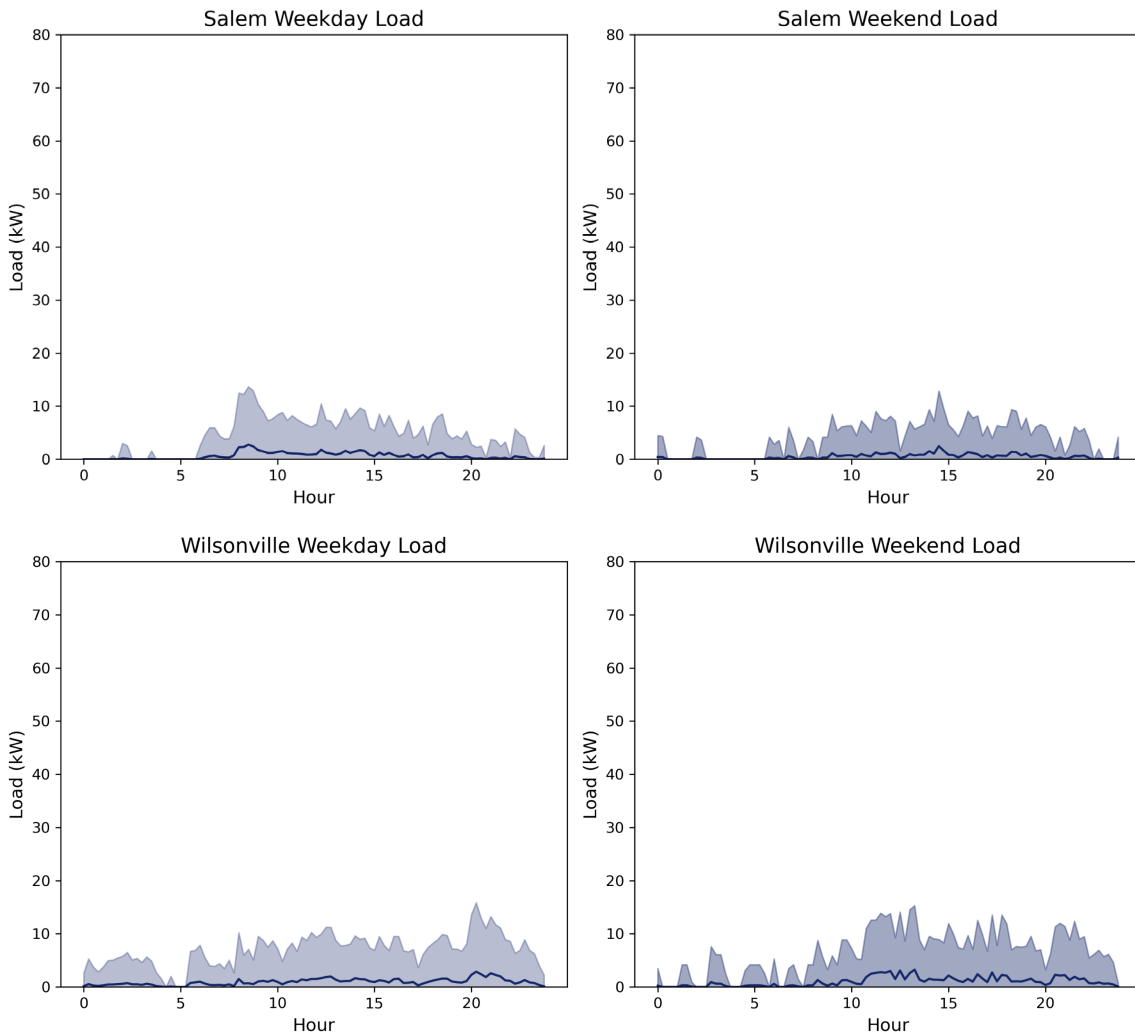
### EA Charging Load Shapes

Figure 39 shows the average charging load shape by weekday and weekend along with a shaded area showing how load level ranges with plus and minus one standard deviation.

Figure 39. Average and Standard Deviation (shaded) Weekday and Weekend Load at EA Sites







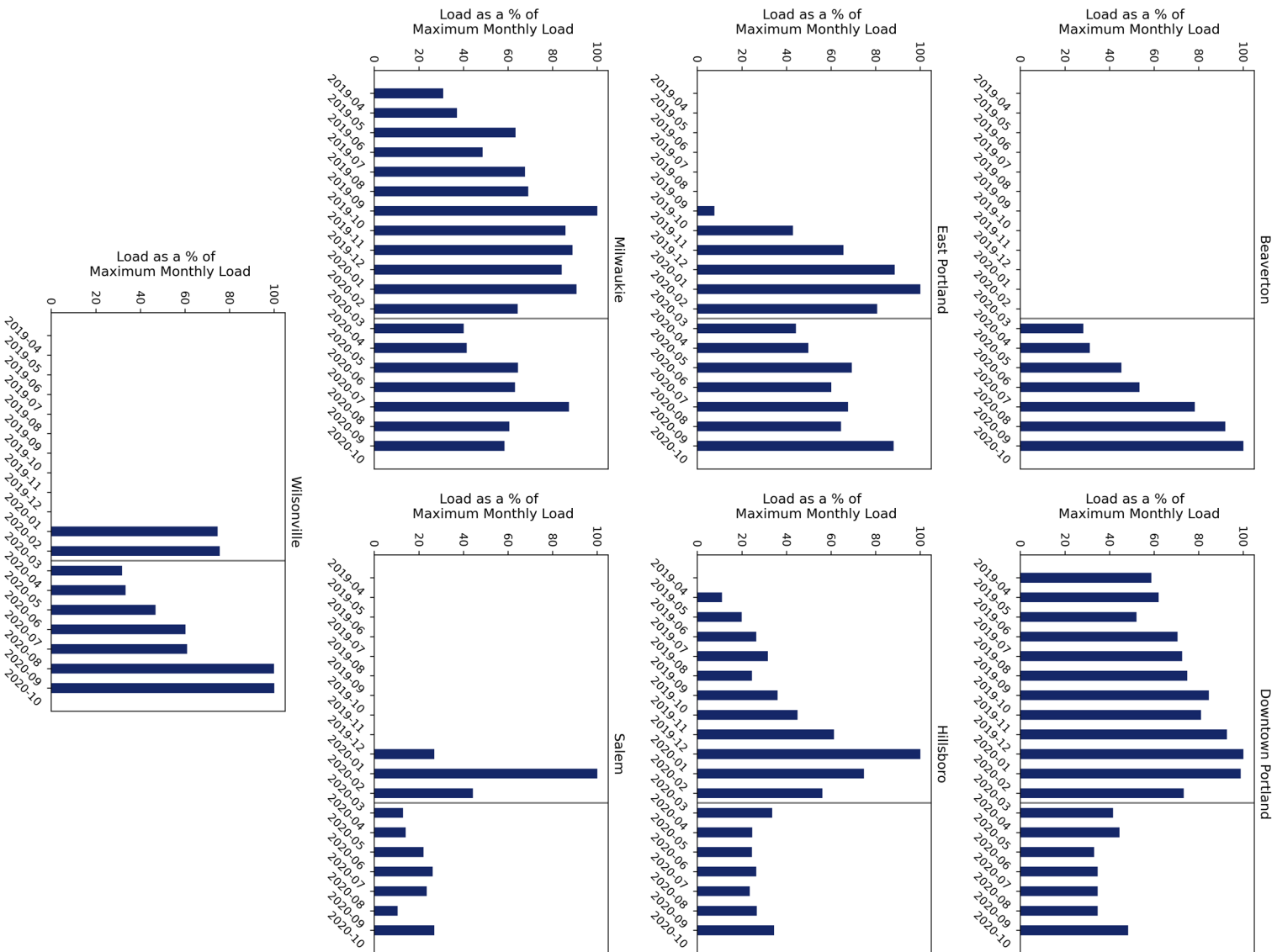
## COVID-19 Impact

As discussed in Section 5.2.1, a large decrease in monthly energy consumption occurred at the beginning of the COVID-19 pandemic. Total monthly energy consumption during the study period was greatest in February 2020 at 43 MWh, just prior to the issuance of a stay-at-home order in Oregon in late-March 2020. Monthly energy consumption dropped to 32 MWh in March and to 20 MWh in April. Energy consumption rebounded through the summer of 2020, in part buoyed by the opening of the Beaverton EA site.

The Salem, Downtown Portland, and Wilsonville EAs experienced the sharpest drop in load between February and March 2020 (Figure 40). Load rebounded in May and June at most sites, but monthly load at Downtown Portland, Hillsboro, and Salem remained low. This might be due to that business activity around the Downtown Portland EA remaining low and the commuters in the Hillsboro area working from home.



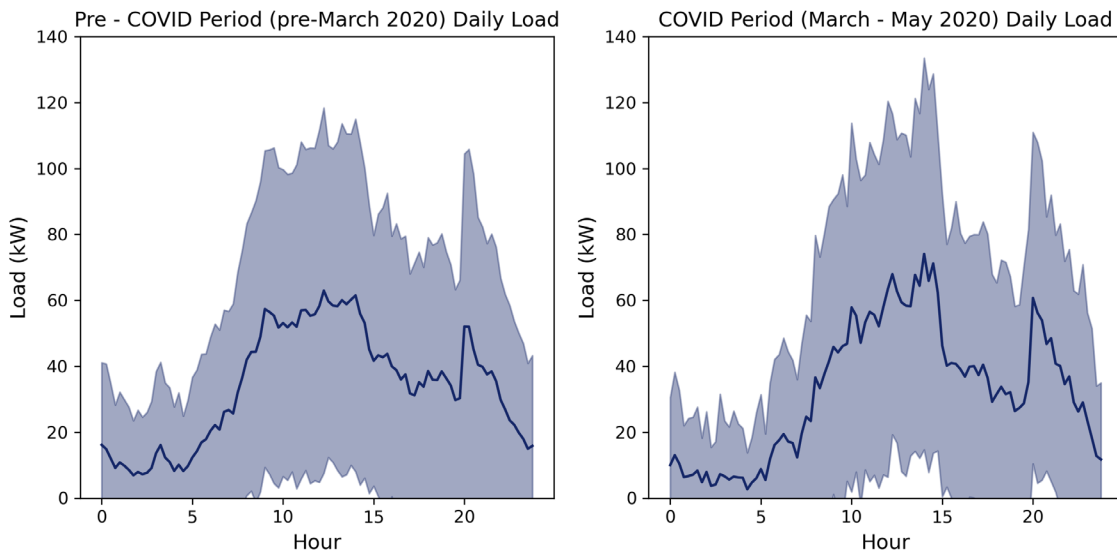
Figure 40. Normalized Monthly Charging Load by EA Site



The user group that experienced the greatest drop in charging during the early period of the pandemic was TNC Subscription users. The average monthly energy consumption of TNC Subscription users dropped from 206 kWh/user to 83 kWh/user, an 59% decrease, between February and April 2020 (Figure 41). TNC Subscribers went from having the greatest per user energy consumption to the second lowest behind Monthly Plan Subscribers. Monthly Plan Subscribers experienced a 20% decrease in per customer monthly energy consumption, while non-subscribing users experienced only a slight decrease.

The average daily energy profile during the pandemic period did not exhibit a significantly different pattern than it did prior to the pandemic. A decrease in load between 3:00 p.m. and 8:00 p.m. is still visible as well as a secondary peak after the high-priced period (Figure 41.).

Figure 41. Average Pre-COVID-19 and COVID-19 Daily Load Shape



## Appendix E. Wave 2 Business Technical Assistance and Training Survey Instrument

### Instrument Information

Table 25. Overview of Data Collection Activity

Descriptor	This Instrument
Instrument Type	Web survey
Estimated Time to Complete	10-15 minutes
Population Description	(1) Businesses who attended PGE workplace charging, or fleet electrification webinars or industry sessions; and (2) Businesses (including transit companies) who received technical assistance
Population Size	43 consultation recipients who received a consultation between June and December 2019; 61 consultation recipients who received a consultation between September 2018 and June 2019, and who did not respond to the Wave 1 survey; 17 Fleet of The Future Class Attendees
Completion Goal(s)	Online survey: ~60 completes (~20 per wave; 3 waves) Note: Completion goals exclude the Earth Advantage builder training participants, which were only include in the Wave 1 survey.
Contact List Source and Date	PGE (as of 1/3/2020)
Type of Sampling	Census, but per PGE request, ODC removed contacts that PGE recently contacted for feedback
Contact Sought	Specific persons who received technical assistance and/or attended classes, webinars, or industry sessions on electrification sponsored by PGE
Fielding Firm	Opinion Dynamics

Table 26. Research Objectives and Associated Questions

Research Objective	Associated Questions
Assess satisfaction with technical assistance (consultations) and/or webinars/industry sessions	Q3, Q4, Q5, Q6, Q7, Q15, Q16, Q17
Assess how knowledge changed as result of receiving technical assistance or training	Q8, Q9, Q14, Q18
Determine if any in the sample who received consultations or attended webinar/industry session(s) installed charging infrastructure or bought EVs	Q21, Q21A_NEW, Q21B_NEW, Q22, Q22A_NEW, Q22B_NEW, Q23, Q24, Q25, Q26, Q39, Q40, Q41
Ask those in the sample who are builders or in construction industry if they are considering including a 240V plug in new construction or offering an EV-plug or charger option when bidding on electrical or remodeling jobs  <i>Note: Questions related to this objective are no longer used as Earth Advantage builder training is no longer being offered.</i>	Q56-Q65

Research Objective	Associated Questions
Assess influence of consultations or webinar/industry session(s) on decisions to install chargers or electrify fleet(s)/buy EVs	Q2, Q10, Q12 Q13, Q27, Q28, Q29, Q30, Q31, Q32, Q38, Q43, Q44, Q45, Q46, Q47, Q49, Q50, Q57, Q58, Q60, Q61
Document reasons for not installing charging infrastructure	Q35, Q36, 0, Q37,
Assess whether consultations and/or training sessions encouraged businesses who installed charging to promote their chargers to employees or the public, and if so, how	Q33, Q33A_NEW, Q34, Q34A_NEW, Q34B_NEW
Assess exposure to other PGE outreach or marketing campaigns	Q1, Q11, Q19
Document major challenges faced when planning for and siting EV charging infrastructure	Q35, Q36, Q37, Q48, Q49
Firmographics	Q39, Q20, Q51, Q62

NOTE: Green highlighted questions and options are specific to those who attended the Earth Advantage builder training in 2019. Since the training is no longer being offered, these questions will not be displayed to any Wave 2 respondents.  
 NOTE: Questions related to the Earth Advantage training will not be displayed in the survey as no contacts in the Wave 2 sample will have attended an Earth Advantage training event. Questions about home charging and smart home technologies are no longer asked in this survey.  
 NOTE: Some questions are not displayed to all respondents. In that case, survey display logic is noted in all caps and in brackets.

## Instrument

### Screening

[PIPE IN THOSE WHO RECEIVED A CONSULTATION FROM PGE]

S1. Has anyone in your organization consulted with PGE about electric vehicles and/or charging in 2018, 2019, or 2020?

[SINGLE RESPONSE]

1. Yes – I have spoken with PGE staff about electric vehicles and/or charging in 2018, 2019, or 2020
2. Yes – someone else in my organization spoke with PGE staff about electric vehicles and/or charging in 2018, 2019, or 2020
3. No – my organization did not receive a consultation from PGE about electric vehicles and/or charging

[IF S1=2, ASK S2]

S2. Please provide us with the name and email address of the person at your organization who spoke with PGE staff about charging, electric vehicles, or fleet electrification.

Name: [OPEN-ENDED RESPONSE]

Email: [OPEN-ENDED RESPONSE]

[TERMINATE THOSE WHO SAID THEY DID NOT RECEIVE CONSULTATION FROM PGE UNLESS THEY ATTENDED PGE-FUNDED EV CLASS, WEBINAR, OR INDUSTRY EVENT. IF ATTENDED PGE-FUNDED EV CLASS, WEBINAR, OR INDUSTRY EVENT, PROCEED TO S3]

[PIPE IN THOSE WHO ATTENDED THE PGE-FUNDED EV CLASS, WEBINAR, OR INDUSTRY EVENT]

S3. Did you attend the following PGE-funded EV webinar, class, or an industry presentation event(s)?

[EVENT\_1]

[EVENT\_2]

1. Yes
2. No

[TERMINATE IF THEY SAY THEY DID NOT ATTEND PGE-FUNDED EV CLASS, WEBINAR, OR INDUSTRY EVENT]

## EV Education: Classes, Webinars, and Industry Events

[ASK THOSE WHO ATTENDED PGE EV CLASS, WEBINAR, OR INDUSTRY PRESENTATION EVENT]

Q1. How did you hear about the following PGE event(s)?

[INPUT CLASS, WEBINAR, OR INDUSTRY PRESENTATION EVENT THEY ATTENDED]

Select all that apply.

[MULTIPLE RESPONSE- RANDOMIZE OPTIONS]

1. PGE emailed me
2. A colleague or someone in my industry told me
3. From PGE's website
4. [Ride-and-Drive Implementer]
5. [SHOW IF ATTENDED PGE'S PRESENTATION AT A CONFERENCE] At a conference PGE speaker presented at
6. [SHOW IF ATTENDED PGE/EARTH ADVANTAGE EVENT] From Earth Advantage
96. Another source, please specify: [OPEN-ENDED RESPONSE]
98. Don't know

[ASK THOSE WHO ATTENDED PGE EV CLASS, WEBINAR, OR INDUSTRY PRESENTATION EVENT]

Q2. Why did you attend PGE's class or presentation on charging or fleet electrification? Select all that apply.

[MULTIPLE RESPONSE- RANDOMIZE OPTIONS]

1. [SHOW IF ATTENDED PGE/EARTH ADVANTAGE EVENT] To learn about smart home technologies
2. To learn about electric vehicles (EVs)
3. To learn about installing EV chargers on your premises
4. [SHOW IF ATTENDED PGE/EARTH ADVANTAGE EVENT] To learn about making new homes EV ready
96. Another reason, please specify: [OPEN-ENDED RESPONSE]
98. Don't know

[ASK THOSE WHO ATTENDED PGE EV CLASS, WEBINAR, OR INDUSTRY PRESENTATION EVENT]

Q3. Thinking about how PGE staff or PGE-sponsored speakers explained the EV or charging concepts, would you say that the explanation was:

[SINGLE RESPONSE]

1. Far too advanced
2. Somewhat too advanced
3. About right
4. Somewhat too basic

- 5. Far too basic
- 96. Other, please specify: [OPEN-ENDED RESPONSE]
- 98. Don't know

[ASK IF Q3 = 1 OR 2]

Q4. What about the explanation was too advanced?

- 1. [OPEN-ENDED RESPONSE]

[ASK THOSE WHO ATTENDED PGE EV CLASS, WEBINAR, OR INDUSTRY PRESENTATION EVENT]

Q5. What concepts were not covered that *should have been covered*? *If no additional concepts should have been covered, please select "none"*.

- 1. [OPEN-ENDED RESPONSE]
- 2. 97. None

[ASK THOSE WHO ATTENDED PGE EV CLASS, WEBINAR, OR INDUSTRY PRESENTATION EVENT]

Q6. How likely are you to recommend PGE's [INPUT CLASS, WEBINAR, OR INDUSTRY PRESENTATION EVENT THEY ATTENDED] to a colleague or other industry professional?

[SINGLE RESPONSE]

- 1. 0 - Not at all likely
- 2. 1
- 3. 2
- 4. 3
- 5. 4
- 6. 5
- 7. 6
- 8. 7
- 9. 8
- 10. 9
- 11. 10 - Extremely likely
- 98. Don't Know

[ASK THOSE WHO ATTENDED PGE EV CLASS, WEBINAR, OR INDUSTRY PRESENTATION EVENT]

Q7. Please rate your overall satisfaction with PGE's [INPUT CLASS, WEBINAR, OR INDUSTRY PRESENTATION EVENT THEY ATTENDED] on the following scale.

[SINGLE RESPONSE; INSERT 0-10 SCALE WHERE 0=Not at all satisfied AND 10=Completely satisfied WITH DON'T KNOW OPTION; LABEL ONLY THE END POINTS]

[ASK THOSE WHO ATTENDED PGE EV CLASS, WEBINAR, OR INDUSTRY PRESENTATION EVENT EXCEPT FOR THOSE WHO ATTENDED EARTH ADVANTAGE EVENTS]

Q8. After attending PGE's [INPUT CLASS, WEBINAR, OR INDUSTRY PRESENTATION EVENT THEY ATTENDED], how well were you prepared to:

- a. Purchase the appropriate EVs for your fleet or business if you chose to do it
- b. Select the appropriate charging equipment if you chose to do it
- c. Install or find someone to install charging equipment if you chose to do it

[FOR EACH ITEM ABOVE, INSERT 0-10 SCALE WHERE 0=Not at all prepared AND 10=Extremely well prepared WITH DON'T KNOW OPTION; LABEL ONLY THE END POINTS)

**[ASK THOSE WHO ATTENDED PGE PRESENTATION AT EARTH ADVANTAGE EVENTS]**

**Q9. After attending PGE's and Earth Advantage presentation on EV-ready homes in [INSERT DATE], how well are you prepared to make a new home "EV-ready"?**

[INSERT 0-10 SCALE WHERE 0=Not at all prepared AND 10=Extremely well prepared WITH DON'T KNOW OPTION; LABEL ONLY THE END POINTS)

[ASK THOSE WHO ATTENDED PGE EV CLASS, WEBINAR, OR INDUSTRY PRESENTATION EVENT]

Q10. At the time you attended PGE's [INPUT CLASS, WEBINAR, OR INDUSTRY PRESENTATION EVENT THEY ATTENDED], where were you in your process of deciding about electric vehicle options or investment(s) in charging?

[MULTIPLE RESPONSE]

1. Seeking initial information
2. Considering or planning an investment
3. Actively evaluating your plan
4. In the design or purchase process
5. Had already designed or purchased but looking for additional advice
96. Other, please specify: [OPEN-ENDED RESPONSE]
97. Not applicable – please explain: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

## PGE EV Consultations

[ASK THOSE WHO RECEIVED A CONSULT]

Q11. How did you hear about PGE's business electric vehicle consultation services? *Select all that apply.*

[MULTIPLE RESPONSE- RANDOMIZE OPTIONS]

1. PGE emailed me
2. PGE sent a letter or postcard about it
3. A colleague or someone in my industry told me
4. From PGE's website
5. At a conference a PGE speaker presented at
6. A class or webinar a PGE speaker presented at
7. Someone from the PGE Key Customer Manager team
8. Someone else at PGE
9. [SHOW IF ATTENDED PGE/EARTH ADVANTAGE EVENT] From Earth Advantage
10. From [Ride-and-Drive Implementer]
96. Another source, please specify: [OPEN-ENDED RESPONSE]
98. Don't know

[ASK THOSE WHO RECEIVED A CONSULT]

Q12. Where were you in your process of deciding about electric vehicle options or investment in charging? Were you...

[MULTIPLE RESPONSE]

1. Seeking initial information
2. Considering or planning investment
3. Actively evaluating your plan
4. In the design or purchase process
5. Had already designed or purchased but looking for additional advice
96. Other, please specify: [OPEN-ENDED RESPONSE]
97. Not applicable
98. Don't know
99. Refused

[ASK THOSE WHO RECEIVED A CONSULT]

Q13. Why did you decide to have a consultation from PGE? *Select all that apply.*

[MULTIPLE RESPONSE- RANDOMIZE OPTIONS]

1. Wanted to know the benefits of electric vehicles for my business or organization
2. Wanted to understand the costs associated with chargers
3. Wanted to understand where the best location to place chargers
4. Wanted to learn about required or potential PGE distribution system upgrades
5. Needed help selecting the right chargers for my business or organization
6. Learn about technical expertise and resources available
7. Learn about electric vehicle incentives available
96. Another reason, please specify: [OPEN-ENDED RESPONSE]
98. Don't know

[ASK THOSE WHO RECEIVED A CONSULT]

Q14. What topics were covered during your consultation(s)?

[MULTIPLE RESPONSE]

1. Fleet electrification – associated costs
2. Fleet electrification – benefits to your business or organization
3. Fleet electrification – technical resources available
4. Fleet electrification – financial resources available
5. Charging infrastructure – associated costs
6. Charging infrastructure – benefits to your business or organization
7. Charging infrastructure – technical resources available
8. Charging infrastructure – financial resources available
9. Charging infrastructure – PGE distribution systems upgrades required
96. Something else, please specify: [OPEN-ENDED RESPONSE]
98. Don't know

[ASK THOSE WHO RECEIVED A CONSULT]

Q15. What, if any, additional information would you have liked from the consultation you received?

1. [OPEN-ENDED RESPONSE]
97. No additional information
98. Don't know

[ASK THOSE WHO RECEIVED A CONSULT]

Q16. How likely are you to recommend the PGE's consultation you received to a colleague or other industry professional?



[SINGLE RESPONSE]

1. 0 - Not at all likely
2. 1
3. 2
4. 3
5. 4
6. 5
7. 6
8. 7
9. 8
10. 9
11. 10 – Extremely likely
98. Don't Know

[ASK THOSE WHO RECEIVED A CONSULT]

Q17. Please rate your overall satisfaction with the consultation you received using a scale from 0 to 10, with 0 meaning “not at all satisfied” and 10 meaning “completely satisfied”.

[SINGLE RESPONSE; INSERT 0-10 SCALE WHERE 0=Not at all satisfied AND 10=Completely satisfied WITH DON'T KNOW OPTION; LABEL ONLY THE END POINTS]

[ASK THOSE WHO THOSE WHO RECEIVED A CONSULT]

Q18. After receiving a consultation from PGE, how well prepared were you to:

- a. Purchase the appropriate EVs for your fleet or business if you chose to do it
- b. Select the appropriate charging equipment if you chose to do it
- c. Install or find someone to install charging equipment if you chose to do it

[FOR EACH ITEM ABOVE, INSERT 0-10 SCALE WHERE 0=Not at all prepared AND 10=Extremely well prepared WITH DON'T KNOW OPTION; LABEL ONLY THE END POINTS]

## Awareness of Other PGE EV Pilot Efforts

[ASK ALL]

Q19. Which of these PGE electric vehicle resources, campaigns, or discounts have you seen or heard of?  
*Select all that apply.*

[MULTIPLE RESPONSE – RANDOMIZE OPTIONS]

1. Social media information from PGE on electric vehicles
2. Emails from PGE on electric vehicle services or classes
3. PGE website information on electric vehicles
4. PGE's and Nissan's combined \$3,500 discount for the Nissan Leaf
6. Interactive displays at dealerships with vehicle charging information (PGE sponsors those)
7. National Drive Electric Week advertising (in 2018 or 2019)
8. PGE's Electric Avenue in downtown Portland
9. PGE's Electric Avenue in Milwaukee
10. PGE's Electric Avenue in Hillsboro
11. PGE's Drive Change Fund
12. Workplace charging program

13. PGE's Electric Avenue in East Portland (Eastport Plaza)
14. PGE's Electric Avenue in Beaverton
15. PGE's Electric Avenue in Wilsonville
16. PGE's Electric Avenue in Salem
97. DID NOT SEE ANY OF THESE
98. Don't know

## Charging Installations, Fleet Purchases

### Charging Installations

[ASK ALL]

Q20. Does your organization provide a parking garage or lot for your employees or customers? *This does not include on-street parking.*

[SINGLE RESPONSE]

1. Yes
2. No
98. Don't know

[ASK IF Q20= 1 (YES)]

Q21. Has your organization installed any electric vehicle charging equipment in your parking garage or lot?

[SINGLE RESPONSE]

1. Yes
2. No
98. Don't know

[ASK IF Q21 = 2 or 98 (NO or don't know)]

Q21a\_NEW. Are you considering installing any electric vehicle charging equipment in your parking garage or lot in the future?

[SINGLE RESPONSE]

1. Yes
2. No
98. Don't know

[ASK IF Q21a\_NEW= 1 (YES)]

Q21B\_NEW. How many chargers and ports (i.e., the number of vehicles that can charge at the same time) are you considering adding to your parking garage or lot?

[MULTIPLE RESPONSE]

1. Number of DC fast chargers: [OPEN-ENDED RESPONSE]
2. Number of DC fast charging ports: [OPEN-ENDED RESPONSE]
3. Number of Level 2 chargers: [OPEN-ENDED RESPONSE]
4. Number of Level 2 charging ports: [OPEN-ENDED RESPONSE]
96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know

[ASK IF Q21 = 1 (YES)]

Q22. How many chargers did you install? *Select appropriate quantity for each type. If zero, select “none”.*

DC FAST CHARGERS	LEVEL 2 (240 V)	STANDARD OUTLETS (120 V)
None	None	None
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
More than 5	More than 5	More than 5
98. Don't Know	98. Don't Know	98. Don't Know

[IF Q22 DC FAST CHARGERS > 0]

Q22A\_NEW. How many ports (i.e., the number of vehicles that can charge at the same time) do **each of your DC fast chargers** have?

- 1. [OPEN-ENDED NUMERIC RESPONSE] \_\_\_\_\_ ports per DC fast charger
- 98. Don't know

[IF Q22 LEVEL 2 (240 V) > 0]

Q22B\_NEW. How many ports (i.e., the number of vehicles that can charge at the same time) do **each of your level 2 chargers** have?

- 1. [OPEN-ENDED NUMERIC RESPONSE] \_\_\_\_\_ ports per level 2 charger
- 98. Don't know

[ASK IF Q21= 1 (YES) AND (Q22\_DC FAST CHARGERS >0 OR DON'T KNOW)]

Q23. When were the DC Fast charger(s) installed? *If at multiple dates, please select all dates that apply.*

Year 2018 [MULTIPLE RESPONSE]	Year 2019 [MULTIPLE RESPONSE]	Year 2020 [MULTIPLE RESPONSE]
<input type="checkbox"/> Before May 2018	<input type="checkbox"/> January 2019	<input type="checkbox"/> January 2020
<input type="checkbox"/> May 2018	<input type="checkbox"/> February 2019	<input type="checkbox"/> February 2020
<input type="checkbox"/> June 2018	<input type="checkbox"/> March 2019	<input type="checkbox"/> March 2020
<input type="checkbox"/> July 2018	<input type="checkbox"/> April 2019	<input type="checkbox"/> April 2020
<input type="checkbox"/> August 2018	<input type="checkbox"/> May 2019	
<input type="checkbox"/> September 2018	<input type="checkbox"/> June 2019	
<input type="checkbox"/> October 2018	<input type="checkbox"/> July 2019	
<input type="checkbox"/> November 2018	<input type="checkbox"/> August 2019	
<input type="checkbox"/> December 2018	<input type="checkbox"/> September 2019	
	<input type="checkbox"/> October 2019	
	<input type="checkbox"/> November 2019	

Year 2018 [MULTIPLE RESPONSE]	Year 2019 [MULTIPLE RESPONSE]	Year 2020 [MULTIPLE RESPONSE]
	<input type="checkbox"/> December 2019	
<input type="checkbox"/> Don't know		

[ASK IF Q21= 1 (YES) AND (Q22\_LEVEL 2 >0 OR DON'T KNOW)]

Q24. When were the Level 2 charger(s) installed? *If at multiple dates, please select all dates that apply.*

Year 2018 [MULTIPLE RESPONSE]	Year 2019 [MULTIPLE RESPONSE]	Year 2020 [MULTIPLE RESPONSE]
<input type="checkbox"/> Before May 2018	<input type="checkbox"/> January 2019	<input type="checkbox"/> January 2020
<input type="checkbox"/> May 2018	<input type="checkbox"/> February 2019	<input type="checkbox"/> February 2020
<input type="checkbox"/> June 2018	<input type="checkbox"/> March 2019	<input type="checkbox"/> March 2020
<input type="checkbox"/> July 2018	<input type="checkbox"/> April 2019	<input type="checkbox"/> April 2020
<input type="checkbox"/> August 2018	<input type="checkbox"/> May 2019	
<input type="checkbox"/> September 2018	<input type="checkbox"/> June 2019	
<input type="checkbox"/> October 2018	<input type="checkbox"/> July 2019	
<input type="checkbox"/> November 2018	<input type="checkbox"/> August 2019	
<input type="checkbox"/> December 2018	<input type="checkbox"/> September 2019	
	<input type="checkbox"/> October 2019	
	<input type="checkbox"/> November 2019	
	<input type="checkbox"/> December 2019	
<input type="checkbox"/> Don't know		

[ASK IF Q21= 1 (YES) AND (Q22\_STANDARD >0 OR DON'T KNOW)]

Q25. When were the standard outlets for charging installed? *If at multiple dates, please select all dates that apply.*

Year 2018 [MULTIPLE RESPONSE]	Year 2019 [MULTIPLE RESPONSE]	Year 2020 [MULTIPLE RESPONSE]
<input type="checkbox"/> Before May 2018	<input type="checkbox"/> January 2019	<input type="checkbox"/> January 2020
<input type="checkbox"/> May 2018	<input type="checkbox"/> February 2019	<input type="checkbox"/> February 2020
<input type="checkbox"/> June 2018	<input type="checkbox"/> March 2019	<input type="checkbox"/> March 2020
<input type="checkbox"/> July 2018	<input type="checkbox"/> April 2019	<input type="checkbox"/> April 2020
<input type="checkbox"/> August 2018	<input type="checkbox"/> May 2019	
<input type="checkbox"/> September 2018	<input type="checkbox"/> June 2019	
<input type="checkbox"/> October 2018	<input type="checkbox"/> July 2019	
<input type="checkbox"/> November 2018	<input type="checkbox"/> August 2019	
<input type="checkbox"/> December 2018	<input type="checkbox"/> September 2019	
	<input type="checkbox"/> October 2019	
	<input type="checkbox"/> November 2019	
	<input type="checkbox"/> December 2019	
<input type="checkbox"/> Don't know		

[ASK IF Q22 <> 0 (NONE) OR 98 (DON'T KNOW) ELSE SKIP TO Q36]

Q26. Did you receive financial assistance for any of your installed chargers? *Please select all that apply.*  
[MULTIPLE RESPONSE]

- 1. Grant(s)
- 2. Loan(s)
- 3. Tax Credit
- 4. Rebate(s)
- 5. Discount(s) from manufacturer(s) or vendor(s)
- 96. Other, please specify: [OPEN-ENDED RESPONSE]
- 97. No – I did not receive any financial assistance
- 98. Don't know

[ASK IF Q26 = 1 – 96]

Q26a. Did you receive this financial assistance from PGE or other sources?

	PGE	Non-PGE
[IF Q26 = 1] Grant(s)	<input type="checkbox"/>	<input type="checkbox"/>
[IF Q26 = 2] Loan(s)	<input type="checkbox"/>	<input type="checkbox"/>
[IF Q26 = 3] Tax Credit	<input type="checkbox"/>	<input type="checkbox"/>
[IF Q26 = 4] Rebate(s)	<input type="checkbox"/>	<input type="checkbox"/>
[IF Q26 = 5] Discount(s) from manufacturer(s) or vendor(s)	<input type="checkbox"/>	<input type="checkbox"/>
[IF Q26 = 96] [pipe in response from Q26_other] [OPEN-ENDED RESPONSE]	<input type="checkbox"/>	<input type="checkbox"/>

[ASK IF Q21= 1(YES) AND THEY RECEIVED A CONSULT]

Q27. Please indicate how influential the consultation from PGE was in the decision to install any of your charger(s).

[INSERT 0-10 SCALE FOR EACH ITEM WHERE 0=Not at all influential AND 10=Extremely influential WITH DON'T KNOW OPTION; LABEL ONLY THE END POINTS]

[ASK IF Q21= 1(YES) AND THEY ATTENDED A PGE-FUNDED CLASS, WEBINAR, OR INDUSTRY EVENT]

Q28. Please indicate how influential the information you received when you attended PGE class, webinar, or presentation was in the decision to install any of your charger(s).

[INSERT 0-10 SCALE FOR EACH ITEM WHERE 0=Not at all influential AND 10=Extremely influential WITH DON'T KNOW OPTION; LABEL ONLY THE END POINTS]

[ASK IF Q21= 1(YES) AND Q26 (AT LEAST ONE ITEM SELECTED)]

Q29. The following is a list of additional items that could have influenced your organization to install the charger(s). For each one, please indicate how important the item was in the decision to install the charger(s).

[INSERT 0-10 SCALE FOR EACH ITEM WHERE 0=Not at all important AND 10=Extremely important WITH DON'T KNOW OPTION; LABEL ONLY THE END POINTS]

[DISPLAY ONLY OPTIONS THAT THEY SELECTED IN Q26]

- 1. Grant(s) you said you received
- 2. Loan(s) you said you received
- 3. Tax credit you said you received
- 4. Rebate(s) you said you received

- 5. Manufacturer/vendor discount(s) you said you received
- 6. Anything else – if so, please specify: [OPEN-ENDED RESPONSE]

[ASK IF Q21= 1(YES) AND ANY ITEM IN Q27 TO Q29 WAS RATED 1 AND ABOVE]

Q30. Please use #1, #2, and so forth to rank which factors had the greatest influence (#1), next-greatest influence (#2), and so forth on the decision to install charger(s)

*If there is only one item on the list below, please enter "1" and click on the arrow button to proceed.*

Display Only Those Items They Rated In Q27 To Q29 As 1 Or Above and Randomize Options	Rank
1. PGE’s technical assistance/ consultation you received	
2. Information from PGE’s class, webinar or presentation	
3. Grant(s) you said you received	
4. Loan(s) you said you received	
5. Tax credit you said you received	
6. Rebate(s) you said you received	
7. Manufacturer/vendor discount(s) you said you received	
8. Other factor(s) you mentioned	

[ASK IF Q21= 1]

Q31. If your organization had not received [INPUT “a consultation from PGE” if they received a consultation or INPUT “information from PGE” if they attended PGE-funded class, webinar, or industry event], which of the following is most likely: Your organization would have...

[SINGLE RESPONSE]

- 1. ...postponed installing charging equipment for 2-3 years
- 2. ...done the installation, but would have scaled the project down
- 3. ...done the exact same installation(s)
- 4. ...done something else. If so, what: [OPEN-ENDED RESPONSE]
- 98. Don't Know

[ASK IF Q31= 2]

Q32. You said your organization would have scaled the project down. How would the scope have changed?

- 1. [OPEN-ENDED RESPONSE]
- 98. Don't know

[ASK IF Q21= 1 (YES)]

Q33. Is/are your charging station(s) open to the public?

[SINGLE RESPONSE]

- 1. No – it is intended for private-use, company electric vehicles only

2. Yes, but only employees, customers, or guests who drive an EV can use it/them
3. Yes, anyone with an EV can use it/them
4. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know

[ASK IF Q33=2 OR 3 (YES)]

Q33A\_NEW. What do you charge for parking in EV spaces?

[SINGLE RESPONSE]

1. Users pay a charging fee
2. Users pay a parking fee
3. No parking or charging fee at all for charger users
96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know

[ASK IF Q21= 1 (YES) AND Q33=2, 3, OR 4]

Q34. On the following scale, did these interactions with PGE influence you to open your charging station(s) to others outside of your organization?

[INSERT 0-10 SCALE FOR EACH ITEM WHERE 0=No at all influential AND 10=Extremely influential WITH DK; LABEL ONLY THE END POINTS]

[DISPLAY ONLY OPTIONS THAT APPLY TO EACH RESPONDENT]

1. PGE's technical assistance/ consultation you received
2. Information from PGE's class, webinar, or presentation(s)

Q34A\_NEW. DO YOU PROMOTE WORKPLACE CHARGING TO YOUR EMPLOYEES?

1. Yes
2. No
98. Don't know

[ASK IF Q34A\_NEW = 1 (YES)]

Q34B\_NEW. HOW DO YOU PROMOTE WORKPLACE CHARGING TO YOUR EMPLOYEES?

1. [OPEN-ENDED RESPONSE]
98. Don't know

[ASK IF Q21= 1 (YES)]

Q35. What experiences, including challenges and benefits did you have with purchasing, installing, or permitting your charging station(s)?

[MULTIPLE RESPONSE; RANDOMIZE OPTIONS]

1. Contractor took more time than expected to complete the installation
2. The installation went over budget
3. Permitting took extra time
4. Stations did not work as intended initially
5. Stations still do not function properly
6. Installation was on budget
7. Stations worked well from the beginning
8. Other, please specify: [OPEN-ENDED RESPONSE]

- 9. None of the above
- 98. Don't know

[ASK IF Q21 = 2 OR 98]

Q36. What is stopping you from installing charging infrastructure in your parking area(s)?

[MULTIPLE RESPONSE – RANDOMIZE OPTIONS]

- 1. Too expensive (high up-front cost even after the incentives)
- 2. Concerns with maintenance
- 3. Concerns about reliability or uptime
- 4. Concerns about staff and customers sharing access over the course of the day
- 5. Not sure how to find a vendor that does these installations
- 6. Not sure how to start the process
- 7. Benefits of adding charging not clear to me
- 8. Lack of staff resources to devote to the project
- 9. Insufficient space for chargers
- 10. Capital budget uncertainty
- 11. Uncertainty regarding future operations/staffing/customer traffic
- 12. Other, please describe: [OPEN-ENDED RESPONSE]
- 98. Don't know

[IF Q36 = 1]

Q36A\_NEW. Are you most concerned with the cost of the chargers or the on-site upgrades required to install the chargers (i.e., new electrical lines, transformers, services panels, etc.)?

[SINGLE RESPONSE]

- 1. The cost of the chargers is our main concern
- 2. The cost of the on-site upgrades is our main concern
- 96. Other, please specify: [OPEN-ENDED RESPONSE]
- 98. Don't know

[ASK IF Q21 = 2 OR 98]

Q37. What is your likelihood of installing charging infrastructure in your parking area(s) within the next three years?

[SINGLE RESPONSE]

- 1. Not at all likely
- 2. Not very likely
- 3. Neutral
- 4. Somewhat likely
- 5. Very likely
- 98. Don't know

[ASK IF Q21 = 2 OR 98]

Q38. What effect did [INPUT “a consultation from PGE” if they received a consultation or INPUT “information from PGE” if they attended PGE-funded class, webinar, or industry event] have on your likelihood of installing a charging infrastructure in your parking area(s) within the next three years?

[SINGLE RESPONSE]



1. Decreased our likelihood a great deal
2. Decreased our likelihood a little
3. No change
4. Increased our likelihood a little
5. Increased our likelihood a great deal
98. Don't know

### EV Purchases

[ASK ALL]

Q39. What types of commercial fleets, if any, does your organization own?

[MULTIPLE RESPONSE]

1. Forklifts/Lift Trucks
2. Passenger cars
3. Vans
4. School buses
5. Public transit buses
6. Tour buses
7. Delivery refrigeration trucks
8. Other, please specify: [OPEN-ENDED RESPONSE]
9. None
98. Don't know

[ASK IF ANY OF THE 1-8 OPTIONS ARE SELECTED IN Q39]

Q40. Please indicate the number of electric vehicles in your fleet today, by type.

[DISPLAY ONLY OPTIONS THEY SELECTED IN Q39]

1. Forklifts/Lift Trucks: [OPEN-ENDED RESPONSE]
2. Passenger cars: [OPEN-ENDED RESPONSE]
3. Vans: [OPEN-ENDED RESPONSE]
4. Buses: [OPEN-ENDED RESPONSE]
5. Delivery refrigeration trucks: [OPEN-ENDED RESPONSE]
6. Other [PIPE IN FROM Q39\_OTHER]: [OPEN-ENDED RESPONSE]

[ASK IF ANY EVS IN Q40]

Q41. And please indicate the number of electric vehicles in your fleet that you purchased **after working or interacting with PGE**.

[DISPLAY ONLY OPTIONS THEY SELECTED IN Q40]

1. Forklifts/Lift Trucks: [OPEN-ENDED RESPONSE]
2. Passenger cars: [OPEN-ENDED RESPONSE]
3. Vans: [OPEN-ENDED RESPONSE]
4. Buses: [OPEN-ENDED RESPONSE]
5. Delivery refrigeration trucks: [OPEN-ENDED RESPONSE]
6. Other [PIPE IN FROM Q39\_OTHER]: [OPEN-ENDED RESPONSE]

[ASK IF ANY 1-6 OPTIONS IN Q40 > 0]

Q42. Did you receive any financial assistance when you bought your electric vehicle(s)? *Please select all that apply.* [MULTIPLE RESPONSE]

1. Grant(s)
2. Loan(s)
3. Tax Credit
4. Rebate(s)
5. Discount(s) from manufacturer(s) or vendor(s)
96. Other, please specify: [OPEN-ENDED RESPONSE]
97. No – I did not receive any financial assistance
98. Don't know

[ASK IF Q42 = 1 – 96]

Q42a. Did you receive this financial assistance from PGE or other sources?

	PGE	Non-PGE
[IF Q42 = 1] Grant(s)	<input type="checkbox"/>	<input type="checkbox"/>
[IF Q42 = 2] Loan(s)	<input type="checkbox"/>	<input type="checkbox"/>
[IF Q42 = 3] Tax Credit	<input type="checkbox"/>	<input type="checkbox"/>
[IF Q42 = 4] Rebate(s)	<input type="checkbox"/>	<input type="checkbox"/>
[IF Q42 = 5] Discount(s) from manufacturer(s) or vendor(s)	<input type="checkbox"/>	<input type="checkbox"/>
[IF Q42 = 96] [pipe in response from Q42_other] [OPEN-ENDED RESPONSE]	<input type="checkbox"/>	<input type="checkbox"/>

[ASK IF ANY 1-6 OPTIONS IN Q41 > 0 AND THEY RECEIVED A CONSULT]

Q43. Please indicate how influential the consultation from PGE was in the decision to buy any of your electric vehicles.

[INSERT 0-10 SCALE FOR EACH ITEM WHERE 0=No at all influential AND 10=Extremely influential WITH DON'T KNOW OPTION; LABEL ONLY THE END POINTS]

[ASK IF ANY 1-6 OPTIONS IN Q41 > 0 AND THEY ATTENDED A PGE-FUNDED CLASS, WEBINAR, OR INDUSTRY EVENT]

Q44. Please indicate how influential the information you received when you attended PGE class, webinar, or presentation was in the decision to buy any of your electric vehicles.

[INSERT 0-10 SCALE FOR EACH ITEM WHERE 0=Not at all influential AND 10=Extremely influential WITH DON'T KNOW OPTION; LABEL ONLY THE END POINTS]

[ASK IF ANY 1-6 OPTIONS IN Q41 > 0]

Q45. The following is a list of additional items that could have influenced your organization to buy an electric vehicle(s). For each one, please indicate how influential it was the decision to purchase an electric vehicle(s) for your fleet(s).

[INSERT 0-10 SCALE FOR EACH ITEM WHERE 0=Not at all influential AND 10=Extremely influential WITH DK; LABEL ONLY THE END POINTS] [DISPLAY ONLY OPTIONS THAT APPLY TO EACH RESPONDENT]

1. Grant(s) you said you received
2. Loan(s) you said you received
3. Tax credit you said you received
4. Rebate(s) you said you received

- 5. Manufacturer or dealer discount(s) you said you received
- 6. [INPUT RESPONSE FROM Q42 OTHER]

[ASK IF ANY 1-6 OPTIONS IN Q41 > 0 AND ANY ITEM IN Q43 – Q45 WAS RATED 1 AND ABOVE]

Q46. PLEASE USE #1, #2, AND SO FORTH TO RANK WHICH FACTORS HAD THE GREATEST INFLUENCE (#1), NEXT-GREATEST INFLUENCE (#2), AND SO FORTH ON THE DECISION TO BUY AN ELECTRIC VEHICLE(S)  
 IF THERE IS ONLY ONE ITEM ON THE LIST BELOW, PLEASE ENTER "1" AND CLICK ON THE ARROW BUTTON TO PROCEED.

Display Only Those Items They Rated In Q43 – Q45 As 1 Or Above	Rank
1. PGE's technical assistance/ consultation you received	
2. Information from PGE's class, webinar or presentation	
3. Grant(s) you said you received	
4. Loan(s) you said you received	
5. Tax credit you said you received	
6. Rebate(s) you said you received	
7. Manufacturer/dealer discount(s) you said you received	
8. Other factor(s) you mentioned	

[ASK IF ANY 1-6 OPTIONS IN Q40 > 0]

Q47. If your organization had not received [INPUT "a consultation from PGE" if they received a consultation or INPUT "information from PGE" if they attended PGE-funded class, webinar, or industry event], which of the following is most likely: Your organization would have...

[SINGLE RESPONSE]

- 1. ...postponed buying electric vehicles for 2-3 years
- 2. ...bought the electric vehicles, but not as many
- 3. ...bought the exact same and number of vehicles
- 4. ...done something else. If so, what: [OPEN-ENDED RESPONSE]
- 98. Don't Know

[ASK IF ANY OF THE 1-8 OPTIONS ARE SELECTED IN Q39]

Q48. What keeps your organization from purchasing an electric or additional electric vehicle(s) for your fleet]?

[MULTIPLE RESPONSE]

- 1. Not aware that there is an electric version for certain fleets
- 2. Concerns about vehicle range
- 3. Concerns about where to charge (chargers owned by others)
- 4. Unable to install chargers on my property
- 5. Cost is too high compared to the gasoline or diesel model(s)

6. Concerns about longevity of the battery
7. My entire fleet is now electrified
8. Other, please describe: [OPEN-ENDED RESPONSE]
98. Don't know

[ASK ALL]

Q49. What is your likelihood of purchasing or leasing a plug-in vehicle(s) (100% electric or plug-in hybrid) for commercial or business use within the next three years?

[SINGLE RESPONSE]

1. Not at all likely
2. Not very likely
3. Neutral
4. Somewhat likely
5. Very likely
98. Don't know

[ASK ALL]

Q50. What effect did [INPUT "a consultation from PGE" if they received a consultation or INPUT "information from PGE" if they attended PGE-funded class, webinar, or industry event] have on your likelihood of purchasing or leasing a plug-in vehicle(s) (100% electric or plug-in hybrid) within the next three years?

[SINGLE RESPONSE]

1. Decreased it a great deal
2. Decreased it a little
3. No change
4. Increased it a little
5. Increased it a great deal
98. Don't know

[ASK ALL]

Q51. What is your organization's primary business or activity?

[SINGLE RESPONSE]

1. Local government
2. Architecture or design
3. Property development or property management
4. Building or construction
5. Electrical subcontractor
6. Other, please describe: [OPEN-ENDED RESPONSE]
98. Don't know

### EV-ready Homes

[ASK IF Q51=2,3,4,5 (BUILDING TRADE) AND ATTENDED EARTH ADVANTAGE TRAINING]

Q52. In how many new construction homes or buildings has your organization included a 240V electric vehicle charging plug(s)?

[SINGLE RESPONSE]

1. None

- 2. 1
- 3. 2
- 4. 3
- 5. 4
- 6. 5
- 7. 6
- 8. 7
- 9. 8
- 10. 9
- 11. 10
- 12. More than 10 – please specify: [OPEN-ENDED RESPONSE]
- 97. Not Applicable – not involved in new construction
- 98. Don't know

[ASK IF Q52=2 THROUGH 12 (INDICATED THEY INCLUDED A 240V PLUG)]

Q53. When did you decide to include a 240V electric vehicle option in new construction?

- 1. Please provide an approximate date – month and year: [OPEN-ENDED RESPONSE]
- 98. Don't know

[ASK IF Q51=2,3,4,5 (BUILDING TRADE)]

Q54. Do you sell, recommend or include EV-plug or charging options when bidding on electrical or remodeling jobs in existing homes or buildings?

[SINGLE RESPONSE]

- 1. Yes
- 2. No
- 99. Not Applicable – not involved in remodeling existing homes or buildings
- 98. Don't know

[ASK IF Q54=1 (YES)]

Q55. When did you decide to include EV-plug or charging options when bidding on electrical or remodeling jobs in existing homes or buildings?

- 1. Please provide an approximate date – month and year: [OPEN-ENDED RESPONSE]
- 98. Don't know

[ASK IF Q54=1 (YES)]

Q56. In how many existing homes or buildings have you installed an EV-plug or charging option?

- 1. None
- 2. 1
- 3. 2
- 4. 3
- 5. 4
- 6. 5
- 7. 6
- 8. 7
- 9. 8
- 10. 9

- 11. 10
- 12. More than 10 – please specify: [OPEN-ENDED RESPONSE]
- 98. Don't know

[ASK IF Q52=2-12 (YES) OR Q54=1 (YES) AND EARTH\_ADVANTAGE = 1]

Q57. If you had not received information from PGE when you attended their presentation at Earth Advantage event on [INSERT DATE], which of the following is most likely: Your organization...

[SINGLE RESPONSE]

- 1. ... would have not considered offering EV-ready home options
- 2. ... would have considered offering EV-ready home options
- 3. ...done something else. If so, what: [OPEN-ENDED RESPONSE]
- 98. Don't Know

[ASK IF Q52=2-12 OR Q54=1 (YES) AND EARTH\_ADVANTAGE = 1]

Q58. Please indicate how influential the information you received when you attended PGE presentation at Earth Advantage event was in the decision to offer EV-ready home options.

[INSERT 0-10 SCALE FOR EACH ITEM WHERE 0=Not at all influential AND 10=Extremely influential WITH DON'T KNOW OPTION; LABEL ONLY THE END POINTS]

[ASK IF Q52=1 (NONE) OR Q54=2 (NO)]

Q59. What keeps your organization from selling EV-ready homes or charging plug option(s)?

[MULTIPLE RESPONSE]

- 1. Added cost
- 2. Clients are not asking for it
- 3. Not sure what an EV-ready home is
- 4. Other, please describe: [OPEN-ENDED RESPONSE]
- 98. Don't know

[ASK IF Q52=1 (NONE) OR Q54=2 (NO)]

Q60. In the next three years, how likely is it that you will always offer a 240V electric vehicle charging plug when bidding on a project or building/designing a home?

[SINGLE RESPONSE]

- 1. Not at all likely
- 2. Not very likely
- 3. Neutral
- 4. Somewhat likely
- 5. Very likely
- 98. Don't know

[ASK IF Q52=1 (NONE) OR Q54=2 (NO)]

Q61. What effect did information from PGE have on your likelihood to offer a 240V electric vehicle plug when bidding on a project or building/designing a home?

[SINGLE RESPONSE]

- 1. Decreased it a great deal

2. Decreased it a little
3. No change
4. Increased it a little
5. Increased it a great deal
98. Don't know

## Firmographics

[ASK ALL]

Q62. How many employees work for you organization in Oregon?

[SINGLE RESPONSE]

1. Less than 10
2. 11-50
3. 51-100
4. 101-500
5. 501-1,000
6. Over 1,000
98. Don't know

**Thank you for your time and feedback. We may follow up with you in six months to see how your electric vehicle efforts are progressing.**

Please enter your preferred email address below and a \$20 gift card will arrive in your inbox today.

1. Email address: [OPEN END]
2. Please do not send me a gift card

## Termination Script:

[IF RESPONDENTS DO NOT PASS SCREENING QUESTIONS AT THE BEGINNING OF THE SURVEY]

Thank you for being willing to take our survey. We are looking for those who received a consultation from PGE or attended a PGE-funded class, webinar, or presentation at an industry event.

We don't have any additional questions for you now but we may reach out in the future.

## Appendix F. Wave 1 and 2 Technical Assistance and Training Follow-up Survey Instrument

### Instrument Information

Table 27. Overview of Data Collection Activity

Descriptor	This Instrument
Instrument Type	Web survey
Estimated Time to Complete	10 minutes
Population Description	Businesses (including transit companies) who received technical assistance and completed the first wave of the survey in September/October 2019
Population Size	Wave 1 - 13; Wave 2 - TBD; Wave 3 - TBD
Completion Goal(s)	Online survey: ~30 (or ~10 per wave)
Contact List Source and Date	Respondents of Wave 1-3 Technical Assistance surveys
Type of Sampling	Census
Contact Sought	Specific persons who received technical assistance from PGE staff
Fielding Firm	Opinion Dynamics

Table 28. Research Objectives and Associated Questions

Research Objective	Associated Questions
Determine if any in the sample who received consultations installed charging infrastructure or bought EVs	Q21, Q5, Q6, Q22, Q8, Q9, Q23, Q24, Q25, Q26, Q9a, Q39, Q40, Q29, Q29, Q24a
Assess influence of consultations on decisions to install chargers or electrify fleet(s)/buy EVs	Q1, Q2, Q27, Q29, Q30, Q31, Q32, Q37, Q38, Q43, Q45, Q46, Q47, Q49, Q50
Document reasons for not installing charging infrastructure	Q2, Q35, Q36, Q37
Assess whether consultations encouraged businesses who installed charging to promote their chargers to employees or the public, and if so, how	Q33, Q19a, Q34, Q20a, Q20b
Assess exposure to other PGE outreach or marketing campaigns	Q3
Document major challenges faced when planning for and siting EV charging infrastructure	Q35, Q36, Q48

Programming note style conventions in this document:

[PROGRAMMING] Programming instructions are in bracketed CAPS.

[Piped value] Database inputs are in **bold**.



## Instrument

### Screening

S4. Thank you for providing feedback to PGE in 2019 about your experience with the consultation you received. Would you still be the best person to answer questions about your organization's current efforts to [S1\_Pipe-in]?

[SINGLE RESPONSE]

7. Yes, I am the best person
8. No, someone else at my organization

[IF S1=No, ASK]

S5. Please let us know who the best person at your organization would be to talk to.

Name: [OPEN-ENDED RESPONSE]

Email: [OPEN-ENDED RESPONSE]

[TERMINATE THOSE WHO SAID THEY DID NOT RECEIVE CONSULTATION FROM PGE]

### PGE EV Consultations

Q1. When you provided feedback last [LASTSURVEY], you mentioned you were [Q1\_RESPONSE]. Where are you *today* in your process of deciding about electric vehicle options or investment in charging? Are you...

[MULTIPLE RESPONSE]

1. Still seeking initial information
2. In the planning process to [purchase some EVs/in the process to install charging]
3. In the purchase and installation process
4. Have completed purchase and installation
96. Other, please specify: [OPEN-ENDED RESPONSE]
97. No change in process
98. Don't know

[ASK ALL]

Q2. What, if any, additional information do you need at this time to help you with your decisions?

1. [OPEN-ENDED RESPONSE]
2. No additional information
98. Don't know

### Awareness of Other PGE EV Pilot Efforts

Q3. Which of these PGE electric vehicle resources, campaigns, or discounts have you seen or heard of?  
*Select all that apply.*

[MULTIPLE RESPONSE – RANDOMIZE OPTIONS]

1. Workplace charging program

2. Social media information from PGE on electric vehicles
3. Emails from PGE on electric vehicle services or classes
4. PGE website information on electric vehicles
5. PGE's and Nissan's combined \$3,500 discount for the Nissan Leaf
6. Interactive displays at dealerships with vehicle charging information (PGE sponsors those)
7. National Drive Electric Week advertising (in 2018 or 2019)
8. PGE's Electric Avenue in downtown Portland
9. PGE's Electric Avenue in Milwaukee
10. PGE's Electric Avenue in Hillsboro
11. PGE's Electric Avenue in East Portland (Eastport Plaza)
12. PGE's Electric Avenue in Wilsonville
13. PGE's Electric Avenue in Beaverton
14. PGE's Electric Avenue in Salem
15. PGE's Drive Change Fund
97. DID NOT SEE ANY OF THESE
98. Don't know

## Charging Installations, Fleet Purchases, or Building EV Ready Homes

### Charging Installations

[ASK IF PARKING = 1, ELSE SKIP TO EV PURCHASES SECTION (Q26)]

Q4. [IF INSTALLED\_CHARGERS = 1] Since last **[LASTSURVEY]**, has your organization installed any **additional** electric vehicle charging equipment in your parking garage or lot?

[IF INSTALLED\_CHARGERS = 0] Has your organization installed any electric vehicle charging equipment in your parking garage or lot?

*Please indicate below:*

[SINGLE RESPONSE]

1. Yes
2. No
98. Don't know

[ASK IF Q4 = 2 OR 98 (NO OR DON'T KNOW)]

Q5. [IF INSTALLED\_CHARGERS = 1] Are you considering installing any **additional** electric vehicle charging equipment in your parking garage or lot in the future?

[IF INSTALLED\_CHARGERS = 0] Are you considering installing any electric vehicle charging equipment in your parking garage or lot in the future?

*Please indicate below:*

[SINGLE RESPONSE]

1. Yes
2. No
98. Don't know

[ASK IF Q5 = 1 (YES)]

Q6. How many chargers and ports (i.e., the number of vehicles that can charge at the same time) are you considering adding to your parking garage or lot?

[MULTIPLE RESPONSE]

- 1. Number of DC fast **chargers**: [OPEN-ENDED RESPONSE]
- 2. Number of DC fast charging **ports**: [OPEN-ENDED RESPONSE]
- 3. Number of Level 2 **chargers**: [OPEN-ENDED RESPONSE]
- 4. Number of Level 2 charging **ports**: [OPEN-ENDED RESPONSE]
- 96. Other, please specify: [OPEN-ENDED RESPONSE]
- 98. Don't know

[ASK IF Q21= 1 (YES)]

Q7. [IF INSTALLED\_CHARGERS = 1] Thinking about the **additional** chargers you installed since last [LASTSURVEY]...

How many chargers did you install? *Select appropriate quantity for each type. If zero, select "none".*

DC Fast Chargers	Level 2 (240 V)	Standard Outlets (120 V)
None	None	None
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
More than 5	More than 5	More than 5
98. Don't Know	98. Don't Know	98. Don't Know

[IF Q7 DC FAST CHARGERS > 0]

Q8. How many charging ports (i.e., the number of vehicles that can charge at the same time) do **each of your DC fast chargers** have?

- 1. [OPEN-ENDED NUMERIC RESPONSE] \_\_\_\_\_ports per DC fast charger
- 98. Don't know

[IF Q7 LEVEL 2 (240 V) > 0]

Q9. How many ports (i.e., the number of vehicles that can charge at the same time) do **each of your level 2 chargers** have?

- 1. [OPEN-ENDED NUMERIC RESPONSE] \_\_\_\_\_ ports per level 2 charger
- 98. Don't know

[ASK IF Q21= 1 (YES) AND (Q22\_DC FAST CHARGERS >0 OR DON'T KNOW)]

Q10. [IF INSTALLED\_CHARGERS = 1] Thinking about the **additional** chargers you installed since last [LASTSURVEY]...

When were the DC Fast charger(s) installed? *If at multiple dates, please select all dates that apply.*

Year 2019 [MULTIPLE RESPONSE]	Year 2020 [MULTIPLE RESPONSE]
[DISPLAY IF LASTSURVEY = SEPTEMBER] ( ) September 2019	( ) January 2020
( ) October 2019	( ) February 2020
( ) November 2019	( ) March 2020
( ) December 2019	( ) April 2020
( ) Don't know	

[ASK IF Q21= 1 (YES) AND (Q22\_LEVEL 2 >0 OR DON'T KNOW)]

Q11. [IF INSTALLED\_CHARGERS = 1] Thinking about the **additional** chargers you installed since last [LASTSURVEY]...

When were the Level 2 charger(s) installed? *If at multiple dates, please select all dates that apply.*

Year 2019 [MULTIPLE RESPONSE]	Year 2020 [MULTIPLE RESPONSE]
[DISPLAY IF LASTSURVEY = SEPTEMBER] ( ) September 2019	( ) January 2020
( ) October 2019	( ) February 2020
( ) November 2019	( ) March 2020
( ) December 2019	( ) April 2020
( ) Don't know	

[ASK IF Q21= 1 (YES) AND (Q22\_STANDARD >0 OR DON'T KNOW)]

Q12. [IF INSTALLED\_CHARGERS = 1] Thinking about the **additional** chargers you installed since last [LASTSURVEY]...

When were the standard outlets for charging installed? *If at multiple dates, please select all dates that apply.*

Year 2019 [MULTIPLE RESPONSE]	Year 2020 [MULTIPLE RESPONSE]
[DISPLAY IF LASTSURVEY = SEPTEMBER] ( ) September 2019	( ) January 2020
( ) October 2019	( ) February 2020
( ) November 2019	( ) March 2020
( ) December 2019	( ) April 2020
( ) Don't know	

[ASK IF Q22 <> 0 (NONE) OR 98 (DON'T KNOW) ELSE SKIP TO Q36]

Q13. [IF INSTALLED\_CHARGERS = 1] Thinking about the **additional** chargers you installed since last [LASTSURVEY]...

Did you receive financial assistance for any of your installed chargers? *Please select all that apply.*  
[MULTIPLE RESPONSE]

1. Grant(s)
2. Loan(s)
3. Tax Credit
4. Rebate(s)
5. Discount(s) from manufacturer(s) or vendor(s)
96. Other, please specify: [OPEN-ENDED RESPONSE]
97. No – I did not receive any financial assistance
98. Don't know

[ASK IF Q13 = 1 – 96]

Q13a. [IF INSTALLED\_CHARGERS = 1] Thinking about the **additional** chargers you installed since last [LASTSURVEY]...

Did you receive this financial assistance from PGE or other sources?

	PGE	Non-PGE
[IF Q13 = 1] Grant(s)	<input type="checkbox"/>	<input type="checkbox"/>
[IF Q13 = 2] Loan(s)	<input type="checkbox"/>	<input type="checkbox"/>
[IF Q13 = 3] Tax Credit	<input type="checkbox"/>	<input type="checkbox"/>
[IF Q13 = 4] Rebate(s)	<input type="checkbox"/>	<input type="checkbox"/>
[IF Q13 = 5] Discount(s) from manufacturer(s) or vendor(s)	<input type="checkbox"/>	<input type="checkbox"/>
[IF Q13 = 96] <b>[pipe in response from Q13_other]</b>	<input type="checkbox"/>	<input type="checkbox"/>

[ASK IF Q21= 1(YES)]

Q14. [IF INSTALLED\_CHARGERS = 1] Thinking about the **additional** chargers you installed since last [LASTSURVEY]...

Please indicate how influential the consultation(s) from PGE was in the decision to install your charger(s).

[INSERT 0-10 SCALE FOR EACH ITEM WHERE 0=Not at all influential AND 10=Extremely influential WITH DON'T KNOW OPTION; LABEL ONLY THE END POINTS]

[ASK IF Q21= 1(YES) AND Q26 (AT LEAST ONE ITEM SELECTED)]

Q15. [IF INSTALLED\_CHARGERS = 1] Thinking about the **additional** chargers you installed since last [LASTSURVEY]...

The following is a list of additional items that could have influenced your organization to install the charger(s). For each one, please indicate how important the item was in the decision to install the charger(s).

[INSERT 0-10 SCALE FOR EACH ITEM WHERE 0=Not at all important AND 10=Extremely important WITH DON'T KNOW OPTION; LABEL ONLY THE END POINTS]

[DISPLAY ONLY OPTIONS THAT THEY SELECTED IN Q26]

1. Grant(s) you said you received
2. Loan(s) you said you received
3. Tax credit you said you received
4. Rebate(s) you said you received
5. Manufacturer/vendor discount(s) you said you received
96. Anything else – if so, please specify: [OPEN-ENDED RESPONSE]

[ASK IF Q21= 1(YES) AND ANY ITEM IN Q27 TO Q29 WAS RATED 1 AND ABOVE]

Q16. [IF INSTALLED\_CHARGERS = 1] Thinking about the **additional** chargers you installed since last [LASTSURVEY]...

Please use #1, #2, and so forth to rank which factors had the greatest influence (#1), next-greatest influence (#2), and so forth on the decision to install the charger(s).

*If there is only one item on the list below, please enter "1" and click on the arrow button to proceed.*

Display Only Those Items They Rated In Q27 To Q29 As 1 Or Above and Randomize Options	Rank
1. PGE's technical assistance/ consultation you received	
2. Information from PGE's class, webinar or presentation	
3. Grant(s) you said you received	
4. Loan(s) you said you received	
5. Tax credit you said you received	
6. Rebate(s) you said you received	
7. Manufacturer/vendor discount(s) you said you received	
8. Other factor(s) you mentioned	

[ASK IF Q21 = 1]

Q17. [IF INSTALLED\_CHARGERS = 1] Thinking about the **additional** chargers you installed since last [LASTSURVEY]...

If your organization had not received a consultation from PGE, which of the following is most likely: Your organization would have...

[SINGLE RESPONSE]

1. ...postponed installing charging equipment for 2-3 years
2. ...done the installation, but would have scaled the project down
3. ...done the exact same installation(s)
4. ...done something else. If so, what: [OPEN-ENDED RESPONSE]
98. Don't Know

[ASK IF Q31= 2]

Q18. You said your organization would have scaled the project down. How would the scope have changed?

1. [OPEN-ENDED RESPONSE]
98. Don't know

[ASK IF Q21= 1 (YES)]

Q19. Is/are your charging station(s) open to the public?

[SINGLE RESPONSE]

1. No – it is intended for private-use, company electric vehicles only
2. Yes, but only employees, customers, or guests who drive an EV can use it/them

- 3. Yes, anyone with an EV can use it/them
- 96. Other, please specify: [OPEN-ENDED RESPONSE]
- 98. Don't know

[ASK IF Q33=2 OR 3]

Q19a. What do you charge for parking in EV spaces?

[SINGLE RESPONSE]

- 1. Users pay a charging fee
- 2. Users pay a parking fee
- 3. No parking or charging fee at all for charger users
- 96. Other, please specify: [OPEN-ENDED RESPONSE]
- 98. Don't know

[ASK IF Q21= 1 (YES) AND Q33=2, 3, OR 96]

Q20. [IF INSTALLED\_CHARGERS = 1] Thinking about the **additional** chargers you installed since last [LASTSURVEY]...

How influential was the consultation you received from PGE on your decision to open your charging station(s) to others outside of your organization?

[INSERT 0-10 SCALE FOR EACH ITEM WHERE 0=No at all influential AND 10=Extremely influential WITH DK; LABEL ONLY THE END POINTS]

[ASK IF Q21= 1 (YES)]

Q20A. DO YOU PROMOTE WORKPLACE CHARGING TO YOUR EMPLOYEES?

- 1. Yes
- 2. No
- 98. Don't know

[ASK IF Q20A (PROMOTE WORKPLACE CHARGING TO EMPLOYEES) = 1 (YES)]

Q20B. HOW DO YOU PROMOTE WORKPLACE CHARGING TO YOUR EMPLOYEES?

- 3. [OPEN-ENDED RESPONSE]
- 98. Don't know

[ASK IF Q21= 1 (YES)]

Q21. [IF INSTALLED\_CHARGERS = 1] Thinking about the **additional** chargers you installed since last [LASTSURVEY]...

What experiences, including challenges and benefits, did you have with purchasing, installing, or permitting your charging station(s)?

[MULTIPLE RESPONSE; RANDOMIZE OPTIONS]

- 1. Contractor took more time than expected to complete the installation
- 2. The installation went over budget
- 3. Permitting took extra time
- 4. Stations did not work as intended initially
- 5. Stations still do not function properly
- 6. Installation was on budget

- 7. Stations worked well from the beginning
- 96. Other, please specify: [OPEN-ENDED RESPONSE]
- 97. NO CHALLENGES
- 98. Don't know

[ASK IF Q21 = 2 OR 98 AND INSTALLED\_CHARGERS = 0]

Q22. What is stopping you from installing charging infrastructure in your parking area(s)?

[MULTIPLE RESPONSE – RANDOMIZE OPTIONS]

- 1. Too expensive (high up-front cost even after the incentives)
- 2. Concerns with maintenance
- 3. Concerns about reliability or uptime
- 4. Concerns about staff and customers sharing access over the course of the day
- 5. Not sure how to find a vendor that does these installations
- 6. Not sure how to start the process
- 7. Benefits of adding charging not clear to me
- 8. Lack of staff resources to devote to the project
- 9. Insufficient space for chargers
- 10. Capital budget uncertainty
- 11. Uncertainty regarding future operations/staffing/customer traffic
- 96. Other, please describe: [OPEN-ENDED RESPONSE]
- 97. 98. Don't know

[IF Q22 = 1]

Q23. Are you most concerned with the cost of the chargers or the on-site upgrades required to install the chargers (i.e., new electrical lines, transformers, services panels, etc.)?

[SINGLE RESPONSE]

- 1. The cost of the chargers is our main concern
- 2. The cost of the on-site upgrades is our main concern
- 96. Other, please specify: [OPEN-ENDED RESPONSE]
- 98. Don't know

[ASK IF Q21 = 2 OR 98 AND INSTALLED\_CHARGERS = 0]

Q24. What is your likelihood of installing charging infrastructure in your parking area(s) within the next three years?

[SINGLE RESPONSE]

- 1. Not at all likely
- 2. Not very likely
- 3. Neutral
- 4. Somewhat likely
- 5. Very likely
- 98. Don't know

[ASK IF Q21 = 2 OR 98 AND INSTALLED\_CHARGERS = 0]

Q25. What effect did the consultation from PGE have on your likelihood of installing a charging infrastructure in your parking area(s) within the next three years?

[SINGLE RESPONSE]



1. Decreased our likelihood a great deal
2. Decreased our likelihood a little
3. No change
4. Increased our likelihood a little
5. Increased our likelihood a great deal
98. Don't know

## EV Purchases

[ASK ALL]

Q26. What types of commercial fleet vehicles, if any, does your organization own?

[MULTIPLE RESPONSE]

1. Forklifts/Lift Trucks
2. Passenger cars
3. Vans
4. School buses
5. Public transit buses
6. Tour buses
7. Delivery refrigeration trucks
96. Other, please specify: [OPEN-ENDED RESPONSE]
97. None
98. Don't know

[ASK IF ANY OF THE 1-96 OPTIONS ARE SELECTED IN Q39]

Q27. Please indicate the number of electric vehicles in your fleet today, by type.

[DISPLAY ONLY OPTIONS THEY SELECTED IN Q39]

1. Forklifts/Lift Trucks: [OPEN-ENDED RESPONSE]
2. Passenger cars: [OPEN-ENDED RESPONSE]
3. Vans: [OPEN-ENDED RESPONSE]
4. Buses: [OPEN-ENDED RESPONSE]
5. Delivery refrigeration trucks: [OPEN-ENDED RESPONSE]
96. [PIPE IN FROM Q39\_OTHER]: [OPEN-ENDED RESPONSE]

[ASK IF ANY EVS IN Q40]

Q28. [IF PURCHASED\_EVS = 1] Please indicate the number of **additional** electric vehicles in your fleet that you have purchased since last [LASTSURVEY].

[IF PURCHASED\_EVS = 0] Please indicate the number of electric vehicles in your fleet that you purchased since **after working or interacting with PGE**.

*Please enter the number in the box(es) below:*

[DISPLAY ONLY OPTIONS THEY SELECTED IN Q40]

1. Forklifts/Lift Trucks: [OPEN-ENDED RESPONSE]
2. Passenger cars: [OPEN-ENDED RESPONSE]
3. Vans: [OPEN-ENDED RESPONSE]
4. Buses: [OPEN-ENDED RESPONSE]
5. Delivery refrigeration trucks: [OPEN-ENDED RESPONSE]
96. Other [PIPE IN FROM Q39\_OTHER]: [OPEN-ENDED RESPONSE]

[ASK IF ANY 1 - 96 OPTIONS IN Q40 > 0]

Q29. [IF PURCHASED\_EVS = 1] Thinking about the **additional** electric vehicles in your fleet that you have purchased since [LASTSURVEY]...

Did you receive any financial assistance when you bought your electric vehicle(s)? *Please select all that apply.* [MULTIPLE RESPONSE]

1. Grant(s)
2. Loan(s)
3. Tax Credit
4. Rebate(s)
5. Discount(s) from manufacturer(s) or vendor(s)
96. Other, please specify: [OPEN-ENDED RESPONSE]
97. No – I did not receive any financial assistance
98. Don't know

[ASK IF Q29 = 1 - 96]

Q29a. Did you receive this financial assistance from PGE or other sources?

	PGE	Non-PGE
[IF Q29 = 1] Grant(s)	<input type="checkbox"/>	<input type="checkbox"/>
[IF Q29 = 2] Loan(s)	<input type="checkbox"/>	<input type="checkbox"/>
[IF Q29 = 3] Tax Credit	<input type="checkbox"/>	<input type="checkbox"/>
[IF Q29 = 4] Rebate(s)	<input type="checkbox"/>	<input type="checkbox"/>
[IF Q29 = 5] Discount(s) from manufacturer(s) or vendor(s)	<input type="checkbox"/>	<input type="checkbox"/>
[IF Q29 = 96] <b>[pipe in response from Q29_other]</b>	<input type="checkbox"/>	<input type="checkbox"/>

[ASK IF ANY 1 - 96 OPTIONS IN Q28 > 0]

Q30. [IF PURCHASED\_EVS = 1] Thinking about the **additional** electric vehicles in your fleet that you have purchased since [LASTSURVEY]...

Please indicate how influential the consultation from PGE was in the decision to buy any of your electric vehicle(s).

[INSERT 0-10 SCALE FOR EACH ITEM WHERE 0=No at all influential AND 10=Extremely influential WITH DON'T KNOW OPTION; LABEL ONLY THE END POINTS]

[ASK IF ANY 1 - 96 OPTIONS IN Q28 > 0]

Q31. [IF PURCHASED\_EVS = 1] Thinking about the **additional** electric vehicles in your fleet that you have purchased since [LASTSURVEY]...

The following is a list of additional items that could have influenced your organization to buy an electric vehicle(s). For each one, please indicate how influential it was the decision to purchase an electric vehicle(s) for your fleet(s).

[INSERT 0-10 SCALE FOR EACH ITEM WHERE 0=Not at all influential AND 10=Extremely influential WITH DK; LABEL ONLY THE END POINTS] [DISPLAY ONLY OPTIONS THAT APPLY TO EACH RESPONDENT]

1. Grant(s) you said you received
2. Loan(s) you said you received
3. Tax credit you said you received

4. Rebate(s) you said you received
5. Manufacturer or dealer discount(s) you said you received
6. Anything else – if so please, specify: [OPEN-ENDED RESPONSE]

[ASK IF ANY 1 - 96 OPTIONS IN Q40 > 0 AND ANY ITEM IN Q43 – Q45 WAS RATED 1 AND ABOVE]

Q32. [IF PURCHASED\_EVS = 1] Thinking about the **additional** electric vehicles in your fleet that you have purchased since [LASTSURVEY]...

PLEASE USE #1, #2, AND SO FORTH TO RANK WHICH FACTORS HAD THE GREATEST INFLUENCE (#1), NEXT-GREATEST INFLUENCE (#2), AND SO FORTH ON THE DECISION TO BUY AN ELECTRIC VEHICLE(S)

IF THERE IS ONLY ONE ITEM ON THE LIST BELOW, PLEASE ENTER "1" AND CLICK ON THE ARROW BUTTON TO PROCEED.

Display Only Those Items They Rated In Q43 – Q45 As 1 Or Above	Rank
1. PGE's technical assistance/ consultation you received	
2. Information from PGE's class, webinar or presentation	
3. Grant(s) you said you received	
4. Loan(s) you said you received	
5. Tax credit you said you received	
6. Rebate(s) you said you received	
7. Manufacturer/dealer discount(s) you said you received	
8. Other factor(s) you mentioned	

[ASK IF ANY 1 - 96 OPTIONS IN Q40 > 0]

Q33. [IF PURCHASED\_EVS = 1] Thinking about the **additional** electric vehicles in your fleet that you have purchased since [LASTSURVEY]...

If your organization had not received a consultation from PGE, which of the following is most likely: Your organization would have...

[SINGLE RESPONSE]

1. ...postponed buying electric vehicles for 2-3 years
2. ...bought the electric vehicles, but not as many
3. ...bought the exact same and number of vehicles
96. ...done something else. If so, what: [OPEN-ENDED RESPONSE]
98. Don't Know

[ASK IF ANY OF THE 1-8 OPTIONS ARE SELECTED IN Q39]

Q34. What keeps your organization from purchasing an electric or additional electric vehicle(s) for your fleet]?

[MULTIPLE RESPONSE]

1. Not aware that there is an electric version for certain fleets
2. Concerns about vehicle range

3. Concerns about where to charge (chargers owned by others)
4. Unable to install chargers on my property
5. Cost is too high compared to the gasoline or diesel model(s)
6. Concerns about longevity of the battery
7. My entire fleet is now electrified
  
96. Other, please describe: [OPEN-ENDED RESPONSE]
98. Don't know

[ASK ALL]

Q35. What is your likelihood of purchasing or leasing a plug-in vehicle(s) (100% electric or plug-in hybrid) for commercial or business use within the next three years?

[SINGLE RESPONSE]

1. Not at all likely
2. Not very likely
3. Neutral
4. Somewhat likely
5. Very likely
98. Don't know

[ASK ALL]

Q36. What effect did the consultation from PGE have on your likelihood of purchasing or leasing a plug-in vehicle(s) (100% electric or plug-in hybrid) within the next three years?

[SINGLE RESPONSE]

1. Decreased it a great deal
2. Decreased it a little
3. No change
4. Increased it a little
5. Increased it a great deal
98. Don't know

Thank you for your time and feedback. Please enter your preferred email address below and a \$20 gift card will arrive in your inbox today.

1. Email address: [OPEN END]
2. Please do not send me a gift card

### Termination Script:

[IF RESPONDENTS DO NOT PASS SCREENING QUESTIONS AT THE BEGINNING OF THE SURVEY]

Thank you for being willing to take our survey. We are looking for those who received a consultation from PGE.

We don't have any additional questions for you now but we may reach out in the future.

## Appendix G. TNC Focus Group Instrument

### Instrument Information

Table 29. Overview of Data Collection Activity

Descriptor	This Instrument
Instrument Type	Focus Group
Estimated Time to Complete	1.5 hours
Incentive Amount	\$100
Population Description	Rideshare partner company drivers
Contact List Size	199 (180 who signed up for the November 2019 TNC Ride-and-Drive event; 19 who completed the 2019 TNC Ride-and-Drive survey and expressed interest in participating in the focus group)
Contact List Source and Date	Ride-and-Drive implementer/PGE TNC Ride-and-Drive event signup list
Contact Sought	Current rideshare drivers who are PGE customers with moderate to high levels of interest in purchasing or leasing an EV or PHEV in the next five years. Contacts will be identified using a screening survey distributed via email (see supplemental screening document).
Fielding Firm	Opinion Dynamics

Table 30. Research Objectives and Associated Questions

Research Topics	Associated Questions
Customer exposure to PGE outreach campaigns.	Q40, Q42, Q45
How has the pilot impacted TNC and usage of EVs?	Q55, Q55, Q56, Q57
The impact of visible, reliable, and accessible charging infrastructure on customers' willingness to purchase an EV.	Q49, Q53, Q54
Electric Avenue use by and effect on TNC drivers.	Q47, Q48, Q49
To the extent possible, learning who is not using the charging infrastructure and why?	Q37, Q46, Q47, Q48, Q49
Impacts of monthly subscription options on multi-family and TNC customers.	Q52, Q55
Additional PGE infrastructure, if any, necessary to support and ensure highly reliable public charging infrastructure.	Q44, Q53, Q54
Customers' willingness to purchase an EV.	Q38, Q40, Q43, Q55
Equity issues related to charger siting and usage impacts on: urban/suburban/rural residents, multi-family housing residents, residents with no at-home charging, low-income populations and TNC drivers, who may view EVs as an opportunity to reduce their operations costs to earn more income.	Q37, Q43, Q44, Q46, Q55, Q57

### Focus Group Guide

#### Welcome (5 minutes)

## Introduction of the Moderator

Good afternoon. My name is \_\_\_\_\_, I am with Opinion Dynamics. First, I'd like to thank everyone for attending the focus group today. We are conducting this focus group for Portland General Electric (PGE). Today we are going to talk about your experiences as a rideshare driver and about your thoughts about electric vehicles and electric vehicle charging for rideshare driving.

### What is a moderator?

Before we start the focus group, I want to go over three things.

First - I am the moderator and my job as the moderator is to:

- Help guide the flow of conversation
- Make sure everyone's comments are heard
- Ensure that the questions PGE is interested in are covered

Since we have a lot to cover, I may have to break off the conversation at times to move on to another topic area.

### Informed Consent

*[Support Staff: Designated staff will send out and collect the consent form, as well as ask that all participants review, sign, and return the form prior to the start of the focus group.]*

Second - Earlier you were asked to review and sign an informed consent form. I just want to remind you about some key points on the form so you are comfortable participating.

- We are recording our discussion today as well as streaming it live to PGE staff.
- Your full names will never be made known to PGE or in any research reports.
- For this reason, please refer to each other by first name only.
- The video will be available to PGE staff, but as I said, your full names will not be used.

## Ground Rules

Finally - I'd like to review some ground rules for today's discussion.

- Because we are recording the discussion, I ask that you speak loudly and clearly and one at a time. If I think you are speaking too softly to be heard, I will ask you to speak up.
- Sometimes I'll go around and ask several of you for your input. At other times, I will just throw a topic open for general discussion. We want everyone to participate, but you don't have to answer every question.
- There are no right and wrong answers. Please feel free to disagree or question each other. We expect differences in how people see things. We want to know about these differences. It's important to tell us **YOUR** thoughts, not what you think others think or want to hear.
- As I noted before, observers are listening in since we are streaming this focus group live. They want to hear what you have to say about the topics we'll discuss, but we don't want you to feel constrained by their presence.
- If you have a cell phone, please turn it off or set to vibrate.
- The session will last until 5pm. I will do my best to end on time.
- After the session has been completed, we will email you an electronic gift card as a thank you for participating.

Does anyone have any questions?

## Introduction (10 minutes)

Q37. Let's start with introductions. You'll see a PowerPoint slide on your screen with questions. If you can please briefly introduce yourself with your first name and answer the questions. I'll go in alphabetical order.

- How long you have been a rideshare driver,
- What companies you drive for,
- Approximately how many miles per week you drive (your best guess is fine),
- Whether you own or lease vehicles (how many),
- If you use your personal vehicle for rideshare,
- The age of your rideshare vehicle(s), and
- Whether you have been working more, less or about the same in the past two months compared to before the COVID lockdown?

## Learning About Electric Vehicles (10 minutes)

Q38. Great. Let's move on to talk about electric vehicles or EVs. But first, a quick poll question. It should pop up on your screen. Please tell us if you've driven an electric vehicle.

Q39. Those who have, tell me about your first experience with an EV – was it at a ride and drive event, a dealership or with a friend or family member?

Q40. Has anyone else test driven an EV?

- For those who test drove at a dealer did anyone visit [partner dealership] in Beaverton or [partner dealership] in Wilsonville?

**[If partner dealership, ask:]** Did you see or use an interactive kiosk that provided information about EV charging, EV types, and financial incentives while at the dealership?

**[If used the kiosk:]** What was your experience like using the kiosk? Did you find the information available on the kiosk valuable?

- I know three of you attended the Ride and Drive event in November. Did anyone else and if so, which one? where you can compare EV models, go for a test drive, and get answers to your EV questions from experts and EV drivers - when and where did you do this?

Q41. For all of you who have driven an EV: What was your expectation for EVs before driving them?

- What do you think about EVs now?
- What are your thoughts about charging EVs?

Q42. What organizations would you contact to get information about EVs (such as about charging, batteries, driving range, vehicles)? For example, automobile dealers, utilities, [Ride-and-Drive implementer], others? (Who do you trust when it comes to EV information and relative importance of utility)

**[If PGE not mentioned:]** What about PGE? Do you consider PGE as a resource for information on electric vehicles? Why or why not?

**[PGE STAFF SENT US A FEW QUESTIONS TO ASK. READ QUESTIONS.]**

## Ownership and Driving EVs (15 minutes)

Q43. All of you told us in the screener that you were considering purchasing or leasing an EV or plug-in hybrid EV for your next vehicle.

- What is it that led to you consider an EV or plug-in hybrid EV for your next vehicle?
- When (how soon) would you likely purchase an EV or plug-in hybrid EV?
- What makes and models are you considering?
- For how long have you been considering purchasing one?
- Would you use this vehicle for rideshare only, or for personal use as well?
- Would you most likely purchase/lease an EV or a plug-in hybrid EV? Why?

Q44. What concerns do you have, with purchasing or leasing an EV or plug-in hybrid EV?

- What would need to change to alleviate the concerns you have?
- Is parking or charging availability at home a concern for anyone?
- How, if at all, has COVID-19 changed your consideration of purchasing or leasing an EV or plug-in hybrid EV?

**[PGE STAFF SENT US A FEW QUESTIONS TO ASK. READ QUESTIONS.]**



## Awareness of and Exposure to PGE EV Resources, Campaigns, or Discounts (10 minutes)

- Q45. What, if any, EV-related resources, campaigns, or discounts from PGE are you familiar with?
- Other than PGE, what sources, if any, have you accessed, read, or considered to get more information about electric vehicles?
  - Once you've done your research, how would you start shopping? [Would you look around online, or go to a dealership?]
- Q46. If you had an EV or plug-in hybrid, where do you think you would primarily charge your EV?  
**[If charging at home:]** Would those of you who charge at home be able and interested in installing a Level 2 charger, that is a charger that would be purchased separately from the vehicle and require an outlet similar to what you would use for a clothes dryer?
- Q47. **[if Electric Avenues not mentioned:]** Who has seen or heard about a PGE Electric Avenue EV charging location?
- Which Electric Avenue locations have you seen or heard about?
  - How did you learn about PGE's Electric Avenues?
- Q48. Has anyone had experience using the Electric Avenue?
- Tell me about that experience?

**[PGE STAFF SENT US A FEW QUESTIONS TO ASK. READ QUESTIONS.]**

## \*Interest in Electric Avenues, Electric Avenue Pricing Plans, and Influence on Electric Avenues in EV Purchase (15 minutes)

Let's talk a bit more about PGE's Electric Avenues. PGE has seven Electric Avenue locations in operation. We want to know how often you're driving by them. You'll see another poll question on your screen. I'll show each Electric Avenue location and please indicate whether you'd be driving near there daily, a weekly basis, or less frequently than that. So, at least once a day, at least once a week, or not even that much.

- 1) Downtown Portland (SW Salmon between SW 1st and 2nd Ave.) (Daily? Weekly?)
- 2) Downtown Milwaukie (Intersection of SE McLoughlin Blvd. & SE Jackson St.) (Daily? Weekly?)
- 3) Hillsboro (Sunset Esplanade Shopping Center - 2105-2643 SE Tualatin Valley Hwy.) (Daily? Weekly?)
- 4) East Portland (Eastport Plaza Shopping Center - 4000 SE 82nd Ave.) (Daily? Weekly?)
- 5) Wilsonville (SW Wilsonville Road and Memorial Dr.) (Daily? Weekly?)
- 6) Beaverton (SW Canyon Road and SW Broadway St.) (Daily? Weekly?)
- 7) Salem (Near State Capital - 900 Court St. NE.) (Daily? Weekly?)

**(Recap counts for each location)**

- Q49. Based on the poll, it looks like \_\_\_\_\_ Electric Avenue locations would be used most.

Why that location? (close to your home? Centralized for rideshare rides? Some other reason?)

- Q50. Based on the poll, it looks like \_\_\_\_\_ Electric Avenue location would be used the least? What might prevent you from using that PGE Electric Avenue location?
- Q51. If you needed to charge your rideshare vehicle, is there a location that you would like to have an Electric Avenue?
- Q52. [STIMULUS] At Electric Avenue locations, drivers can pay \$3 for two-hours of Level 2 charging (providing up to 21 miles of range in 60 minutes), \$5 for two-hours of DC Fast charging (providing up to 75 miles of range in 30 minutes), or \$25 for an unlimited monthly membership to use Level 2 or DC Fast charging.
- What are your thoughts on these rates?
- Q53. If you had an EV, what, if anything, would prevent you from using an Electric Avenue location?
- Q54. Is there anything that you would like to know about Electric Avenues?

[\[PGE STAFF SENT US A FEW QUESTIONS TO ASK. READ QUESTIONS.\]](#)

### Rideshare Company Offerings (15 minutes)

- Q55. In partnership with PGE, [a rideshare company] is offering its drivers who have EVs free charging at Electric Avenue locations. Are you familiar with this offer? [POLL]
- Does this offer increase the appeal of purchasing or leasing an EV or plug-in hybrid EV? Would the offer be critical in your decision to purchase or lease or just nice to have?
  - What questions, if any, do you have about this offer?
- Q56. [A rideshare company] offers customers in certain cities, including Portland, an option which only displays available drivers with EVs or hybrids to customers. Are you familiar with this offering? [POLL]
- How, if at all, does this influence the appeal of purchasing or leasing an EV or plug-in hybrid EV?
  - What questions, if any, do you have about this option?
- Q57. [A rideshare company] has a program available to its drivers, which allows drivers to rent an EV or plug-in hybrid through [a rideshare company] for ridesharing. You'll see a poll question pop up, please answer yes or no as to whether you're familiar with this program. [POLL]
- [If familiar with program:]** What cities is this program offered in, that you know of?
- Would you be interested in participating in the program? Why or why not?
- Q58. Why do you think [a rideshare company] is promoting EVs to its drivers?

[\[PGE STAFF SENT US A FEW QUESTIONS TO ASK. READ QUESTIONS.\]](#)

### Wrap-Up (10 minutes)

- Q59. So, let's review some of the key things we have talked about today.

(Summarize)

**For more information, please contact:**

**Zac Hathaway**  
**Managing Consultant**

503-943-2371 tel  
zhathaway@opiniondynamics.com

3934 NE Martin Luther King Jr. Blvd., Suite 300  
Portland, OR 97212



**Opinion Dynamics**

**Boston | Headquarters**

617 492 1400 tel  
617 492 7944 fax  
800 966 1254 toll free

1000 Winter Street  
Waltham, MA 02451

**San Francisco Bay**

510 444 5050 tel  
510 444 5222 fax

1 Kaiser Plaza  
Suite 445  
Oakland, CA 94612

**San Diego**

858 270 5010 tel  
858 270 5211 fax

7590 Fay Avenue  
Suite 406  
La Jolla, CA 92037

**Portland**

503 287 9136 tel  
503-281-7375 fax

3934 NE MLK Jr. Blvd.  
Suite 300  
Portland, OR 97212