PACIFIC POWER
A DIVISION OF PACIFICORP

825 NE Multnomah, Suite 2000
Portland, Oregon 97232

February 3, 2020

VIA ELECTRONIC FILING
AND OVERNIGHT DELIVERY

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

Attn: Filing Center

Re: UM ____—PacifiCorp's Oregon Transportation Electrification Plan

Pursuant to OAR 860-087-0020, PacifiCorp d/b/a Pacific Power (PacifiCorp) submits the enclosed Transportation Electrification Plan for acceptance by the Public Utility Commission of Oregon (Commission).

PacifiCorp's Transportation Electrification (TE) Plan highlights the company's commitment to accelerating the adoption of electric transportation options, reiterates the company's support for statewide transportation policy, reaffirms its commitment to removing barriers that may inhibit the adoption of electricity as a transportation fuel, and illustrates how the company is reducing the emission of greenhouse gas from Oregon's transportation sector. PacifiCorp respectfully requests that the Commission issue an order finding that the company's TE Plan meets the requirements of OAR 860-087-0020.

Additionally, PacifiCorp requests that all formal information requests regarding this matter be addressed to:

By email (preferred): datarequest@pacificorp.com

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

Informal inquiries may be directed to Cathie Allen, Regulatory Affairs Manager, at (503) 813-5934.

Sincerely,

Etta Lockey
Vice President, Regulation

Enclosure

PACIFIC POWER
OREGON TRANSPORTATION ELECTRIFICATION PLAN

FEBRUARY 3, 2020

Executive Summary

PacifiCorp dba Pacific Power is proud to submit this transportation electrification (TE) plan (the Plan) for acceptance by the Public Utility Commission of Oregon (the Commission). This plan highlights Pacific Power's (or the Company's) commitment to accelerating the adoption of electric transportation options, reiterates the Company's support for statewide transportation policy, reaffirms Pacific Power's commitment to removing barriers that may inhibit the adoption of electricity as a transportation fuel, and illustrates how the Company is reducing the emission of greenhouse gas (GHG) from Oregon's transportation sector.

In 2019, 40 percent of the state of Oregon's GHG emissions were from the transportation sector.[1] The State has set the ambitious goal to have 250,000 electric vehicles (EVs) registered by 2025,[2] and Senate Bill 1547[3] instructs Oregon's electric utilities to assume a leadership role in reducing GHG emissions from transportation fuels.

This Plan is filed in compliance with Order No. 19-134 and Oregon Administrative Rule (OAR) 360-087-0020. The Plan is designed to provide an assessment of the current and projected state of the EV market in Oregon, to review Pacific Power's activities to accelerate the adoption of electricity as a transportation fuel, and reiterates Pacific Power's intent to further the adoption of EVs.

The State of the EV Market

Although Oregon's EV market is nascent, it has shown rapid growth over the past decade, with EV registrations rising from fewer than 1,000 to close to 30,000.[4] Despite this growth, current EV adoption numbers illustrate the opportunity for both the State and Pacific Power to assist in transforming the EV market. In Pacific Power' service area, there were an estimated 5,600 vehicles at the end of 2019 (**Table 1**).[5]

National forecasts consistently project accelerated growth in light-duty vehicle adoption as many of the current market barriers are anticipated to decline. On a forward-looking basis, Pacific Power is preparing for how a continued increase in EVs may impact the system, and how this flexible load can be integrated in a way that benefits all customers.

[1] Oregon Global Warming Commission, 2018 Biennial Report To The Legislator Report (2018), *available at* https://static1.squarespace.com/static/59c554e0f09ca40655ea6eb0/t/5c2e415d0ebbe8aa6284fdef/1546535266189/2018-OGWC-Biennial-Report.pdf.

[2] S.B. 1044, 80th Leg. Assemb., Reg. Sess. (Or. 2019).

[3] S.B. 1547, 78th Leg. Assemb., Reg. Sess. (Or. 2016).

[4] State of Oregon Department of Environmental Quality, *Data for the Clean Fuels Program, Electric Vehicles in Oregon:* https://www.oregon.gov/deq/aq/programs/Pages/Clean-Fuels-Data.aspx (Last visited on January 31, 2020).

[5] State of Oregon Department of Transportation, *DMV Facts & Statistics*, *DMV Key Facts* https://www.oregon.gov/ODOT/DMV/Pages/News/factsstats.aspx (Last visited on January 31, 2020).

Table 1. Pacific Power Oregon Average Light-Duty Forecast Through 2025

Light-Duty Vehicles Average Forecast Through 2025							
	2019	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Cumulative EVs	5,558	7,729	10,385	13,427	16,771	21,342	26,630

As described in this document, TE currently faces multiple barriers such as:

- Awareness barriers – including a lack of knowledge of the capabilities or costs of EV technology, the available incentives for and operational savings of EVs, or their environmental and other benefits;
- Decision-making barriers - such as a lack of confidence in the technology's range or availability of charging stations;
- Economic barriers – referring to the perception of high upfront costs for EV technologies and insufficient operational cost savings;
- Policy and regulatory barriers – including a potential absence or limitation of targets, or consistent codes and standards;
- Technical barriers – such as range limitations, lack of available electric models for some vehicle classes, loss of range in cold weather due to heating loads, and the challenges of providing charging infrastructure for drivers without a garage or dedicated parking;
- Supply chain barriers – including a perceived lack of available EV models at dealerships or a lack of trained technicians for vehicle maintenance, Electric Vehicle Supply Equipment (EVSE) maintenance, and EVSE installation.

Informed by state policies and Pacific Power's commitment to be responsive to customer needs for sustainable, reliable, and affordable provision of essential energy services, Pacific Power's role in TE transformation is guided by three objectives:

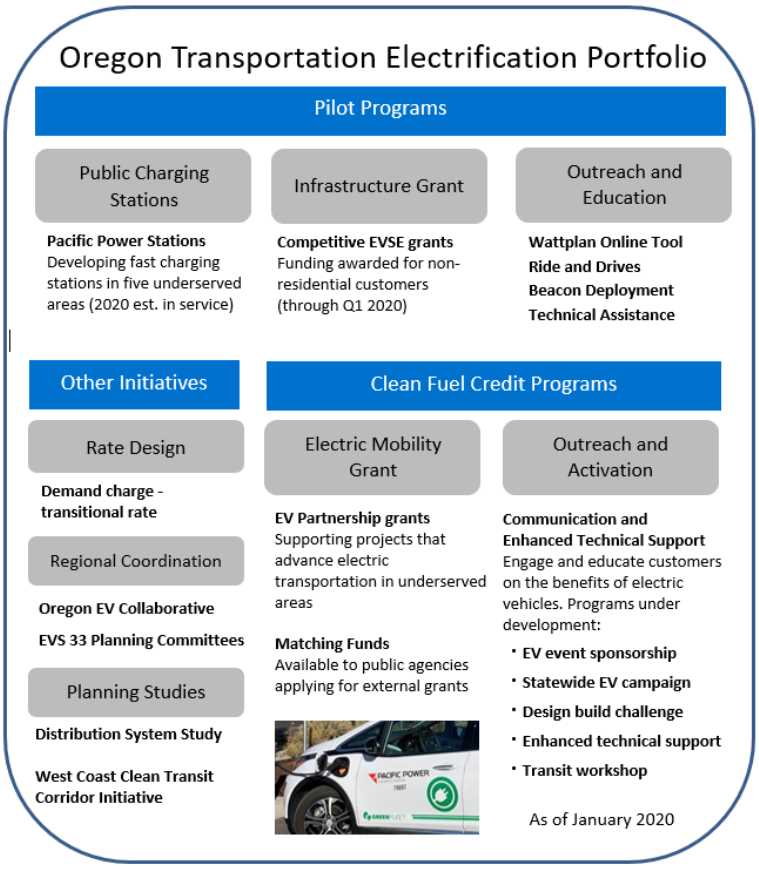
1) Accelerate consumer adoption of TE by increasing customer awareness and understanding of TE alternatives, and supporting equitable access to charging infrastructure;
2) Efficiently, prudently, and safely integrate and manage new loads from TE on the Pacific Power system to the benefit of all customers; and
3) Integrate renewables on the system to reduce carbon intensity and lower the cost to serve new loads from TE.

Pacific Power Investments, Programs, and Actions

Pacific Power is meeting these objectives through close collaboration with the communities served by Pacific Power to identify interventions and investments that have the greatest impact. This includes (as illustrated in **Figure 1**):

- Implementation of Pacific Power's TE programs approved by the Commission in docket UM 1810.
- The 2020 launch of the Electric Mobility Grant Program and the Outreach and Education Program in collaboration with Oregon's Clean Fuels Program (CFP); and
- Active participation in regional efforts such as the West Coast Clean Transit Corridor Initiative, the West Coast Collaborative Alternative Fuel Infrastructure Corridor Coalition, and the West Coast Electric Highway.

Figure 1. Pacific Power Existing Transportation Electrification Portfolio



Opportunities for Future Actions

In this plan, Pacific Power identifies future possible interventions that are shown to have the greatest impact on the market *and* that are able to be successfully deployed. The short term actions build on existing plans to 1) help guide customers through Awareness, Education and Decision Making barriers, 2) offer incentives and programs to address first and ongoing costs of adoption, and 3) signal Pacific Power's long-term commitment to transforming the market with infrastructure planning and regional actions.

Identified opportunities for future intervention are included in **Table 2** below.

Table 2. Potential Future Intervention Strategies

Category	Potential Intervention Strategies	Timing
Reducing Costs of EV Ownership	Efficient rate structures and pricing programs	Short/Medium-term
Sending Long-term Signal to Market	Develop EV Market Potential & Planning Studies	Short-term
	Broaden EV Adoption Target for Pacific Power's Own Fleet	Medium-term
Improving Access and Economic Viability of Charging	Updated Non Residential Line Extension Allowance	Short-term
	Develop a Residential EVSE Infrastructure Incentive Program	Short-term
	Expand the Grant Program for Non-profits and Public Entities (expansion of existing programs)	Short-term
	Develop a Commercial EVSE Infrastructure Incentive Program (includes Multifamily)	Short-term
	Assess public charging station program	Medium-term
	Develop a Fleet EVSE Make-Ready Incentive Program	Medium-term
Increasing Awareness and Education	Expand Technical Assistance	Short-term
	Provide Customers with High Quality EV Experiences (expansion of existing programs)	Short-term
	Develop and grow EV adoption strategies through broad stakeholder engagement (expansion of existing initiatives)	Short-term
	Provide Shared Use and/or Pooled EV Opportunities	Medium-term
	Support Workforce Training	Medium-term
Improving EV and EVSE Planning	Assess Transit Fleet Potential	Short-term
	Encourage EV-Ready New Construction for Residential Buildings	Short-term

Note: *This plan does not seek Commission approval of Pacific Power's current or future programs, investments, or initiatives nor is this list inclusive of all concepts that may be considered before the next plan is due. Pacific Power plans to continue to engage Commission Staff and external stakeholders as part of determining priorities for future program efforts and initiatives.*

Pacific Power looked to stakeholders and partners to help develop this plan through two workshops in December of 2019 and January of 2020. The Company will use these potential intervention strategies as guiding strategies to developing future programs.

Pacific Power is privileged to serve customers across the state of Oregon. From Enterprise, Portland and Cannon Beach, to Grants Pass, Klamath Falls, Bend and Hood River, and all of the communities served across the west – the Company is working to reduce TE barriers. Pacific Power takes its leadership role in this transition seriously. As Oregon's largest rural electric provider – serving 27 counties throughout the state –

we are proud to be powering Oregon's transportation options with electricity, and to have the opportunity to reduce barriers to driving electric through education, outreach, technical advice, grant funding, innovative pricing, and charging options.

Pacific Power's compliance with OAR 860-087-0020[6] is outlined in this plan as follows in **Table 3**:

Table 3. Crosswalk Between OAR 860-087-0020 and Pacific Power Transportation Electrification Plan

OAR 360-087-0020 Section	Transportation Electrification Plan Section
(3)(a)(A) Existing state policies and programs	Section 1.3
(3)(a)(B) Market barriers that the electric company can address and other barriers that are beyond the electric company's control, including any identified emerging challenges to transportation electrification	Section 3, Table 11, Table 12
(3)(a)(C) Existing data on the availability and usage patterns of charging stations	Section 2.3, Appendix B
(3)(a)(D) Number of electric vehicles of various sizes in the utility service territory and projected number of vehicles in the next five years	Section 2.1.1, Section 2.1.2, Section 2.1.3
(3)(a)(E) Other transportation electrification infrastructure, if applicable	Section 4.1.4
(3)(a)(F) Charging and vehicle technology updates	Section 2.2.2, Section 2.1.3.4.1
(3)(a)(G) Distribution system impacts and opportunities for efficient grid management	Section 2.4, Section 2.4.1, Section 5: *Grid Integration*
(3)(b) A summary of the electric company's transportation electrification program(s) and future transportation electrification concepts and actions in its Oregon service territory. The TE Plan must incorporate project learnings and any other relevant information gathered from other transportation electrification infrastructure investments, programs, and actions to ensure that lessons learned are carried forward	Section 4, Section 5, Section 5.1, Table 15, Appendix D
(3)(c) A discussion of how the electric company's investments, programs, and actions are expected to accelerate transportation electrification, address barriers to adoption, and extend access to traditionally underserved communities	Section 3.1, Section 5, Section 5.1,Table 12 Table 15
(3)(d) Supporting data and analysis used to develop the TE Plan, which may be derived from elements such as review of costs and benefits; rate design, energy use and consumption, overlap with other electric company programs, and customer and electric vehicle user engagement	Section 2.4.1.3, Section 4.1.3, Appendix B

[6] *See* OAR 860-087-0020 (which includes guidance on how electric companies are to file their Transportation Electrification Plans and prescribes the required elements of those plans).

OAR 360-087-0020 Section	Transportation Electrification Plan Section
(3)(e) A discussion of the electric company's potential impact on the competitive electric vehicle supply equipment market, including consideration of alternative infrastructure ownership and business models, and identification of a sustainable role for the electric company in the transportation electrification market	Section 2.2.1, Section 2.4.1, Section 3.1, Section 5.1, Table 15
(3)(f) A discussion of current and anticipated electric company system impacts resulting from increased transportation electrification and the electric company's portfolio of actions, how transportation electrification can support the efficient integration of renewable energy, and how the TE Plan is designed to address these system impacts	Section 2.4.1, Section 4, Section 5, Section 5: *Transportation Diversity, Equity, and Inclusion*, Appendix D
(3)(g) A discussion of how programs and concepts in the TE Plan relate to carbon reduction goals, requirements and other state programs, including expected greenhouse gas emission reductions based on publicly available metrics	Section 4.1.3, Appendix C

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1 Introduction

In 2019, 40 percent of Oregon's GHG were emitted from the transportation sector.[7] Widespread adoption of electric transportation presents an opportunity to reduce GHG emissions and generate additional benefits, including reduced energy costs and usage, improved air quality and public health benefits, and increased grid flexibility and efficiency. As discussed in **Section 1.1**, **1.2** and **Appendix A. State Programs and Policies**, through executive order, legislative mandate, statewide market creation, and inter-agency processes, the State of Oregon has made clear that it is imperative to scale up TE markets. Within these multiple legislative and regulatory proceedings, the role of Oregon's electric utilities as essential contributors to transforming the transportation market has emerged—specifically to help accelerate the adoption of EVs in Oregon and integrate and manage new electric load cleanly and efficiently.

1.1 Pacific Power's Ability to Reach All of Oregon

Pacific Power has provided safe, reliable, and affordable energy to customers in Oregon, Washington, and California for over 100 years. Pacific Power's 3,000 distribution line miles and 33,000 utility poles serve over 600,000 customers throughout the state, providing vital touchpoints in the 27 Oregon communities the Company serves (**Figure 2**).

Figure 2. Pacific Power Service Territory

Pacific Power's service area is unique and diverse: while the Company serves a portion of the Portland metropolitan area, the majority of customers live in smaller communities and more rural areas, making Pacific Power the largest rural electricity provider in Oregon. Multnomah County has a population density of 1,700 residents per square mile while the average population density of other Oregon counties served by Pacific Power is only 43.[8] The nature of this service area means that the Company plays an important role in the electrification of Oregon's highways and communities. By serving a large part of the I-5 corridor and key surrounding communities along I-85 and Highway 97, Pacific Power can serve as the backbone to electrifying transportation throughout Oregon.

Pacific Power's support for transportation transformation and increased EV adoption are further advanced by partnerships with state and local, community, and regulatory entities across all six states PacifiCorp serves. The combined PacifiCorp efforts have resulted in ongoing investments of more than $20 million to support fast charging along key corridors, the development of robust workplace charging programs, and the

[7] Oregon Global Warming Commission, 2018 Biennial Report to the Legislator Report (2018).
[8] U.S. Census Bureau, *QuickFacts: Oregon*, https://www.census.gov/quickfacts/table/PST045216/41 (last visited Feb. 27, 2017).

implementation of smart mobility programs. In addition, in Oregon, Pacific Power has actively participated in the low-carbon fuels standard market since 2017, capturing the benefits of emissions reductions on behalf of customers and reducing the cost of future programs.

Pacific Power is privileged to serve customers across the state of Oregon. From Enterprise, Portland and Cannon Beach, to Grants Pass, Klamath Falls, Bend and Hood River, and all of the communities served across the west – the Company is working to reduce TE barriers.

1.2 Regulatory Background

On September 17, 2018, the Commission established a rulemaking regarding electric utilities' long-term TE plans.[9] On April 16, 2019, the Commission adopted regulations which require an electric company to file TE Plans, identifies the required elements of an electric company's TE Plan, and defines the objectives of the TE Plan.[10] These objectives are to:

> *(a) Integrate all of the electric company's transportation electrification actions into one document. This includes, but is not limited to, analyzing the electric company's portfolio of near-term and long-term transportation electrification actions, including approved program(s), future transportation electrification actions, and other transportation electrification actions such as Clean Fuels programs.*
>
> *(b) Identify a portfolio of actions, which may include investments and infrastructure for electric vehicles of various sizes, rate design, programs, and services, reasonably expected to achieve the objectives of ORS 757.357. The TE Plan should seek to address areas most affected by market barriers in the electric company's service territory and to provide benefits for traditionally underserved communities. [11]*

As part of Pacific Power's development of its TE plan, Pacific Power utilized comments and feedback from stakeholders received through workshops on December 16, 2019 and January 16, 2020. Pacific Power will continue to engage stakeholders as part of the regulatory process which is outlined below.

- Pacific Power will present its TE Plan to the Commission at a public meeting before the deadline for written public comment.
- Commission staff will present its recommendation on the TE Plan at a public meeting.
- The Commission will consider comments and recommendations before issuing an order of acceptance that Pacific Power has met the requirements of the rules.
- The Commission may provide direction regarding any additional analyses or actions that should be considered in its next TE Plan.

[9] *See In the Matter of Rulemaking Regarding Transportation Electrification Plans*, Docket No. AR 609, Order No. 18-351 (Sep. 26, 2018).
[10] *See* OAR 860-087-0020 (which includes guidance on how electric companies are to file their Transportation Electrification Plans and prescribes the required elements of those plans).
[11] OAR 860-087-0020 (a)-(b).

It is important to note, that this plan does not seek Commission approval of Pacific Power's current or future programs, investments, or initiatives. Pacific Power plans to engage Commission Staff and external stakeholders as part of future programs' efforts and initiatives.

1.3 *Existing State Policies and Programs*

The state of Oregon has a long history of legislative mandates and executive orders related to reduction of GHG emissions in support of environmental protection and public health. The overarching directive of these multiple policies have been designed in support of GHG emissions goals, which are set forth in Oregon Revised Statutes (ORS) 469A.205. This ORS set GHG emissions goals that aim to reduce emissions to 10 percent below 1990 levels by 2020 and at least 75 percent below 1990 levels by 2050.

Because the transportation sector is a major GHG contributor in the state, several polices have specifically targeted this sector. The Zero Emission Vehicle (ZEV) Mandate of 2005,[12] directed towards vehicle manufacturers, adopted California's requirement that a certain percentage of vehicle sales be low-emissions. This was followed by the Low Carbon Fuel Standard (LCFS) of 2009[13] which authorized the Oregon Environmental Quality Commission to adopt rules to reduce the average carbon intensity of the state's transportation fuels by 10 percent over a 10-year period. Today this program is known as the Oregon Clean Fuels Program (CFP).

The role Oregon's electric utilities can play in transforming the transportation market and reducing emissions from that sector was first recognized with the passage of Senate Bill 324, which allowed the Oregon Department of Environmental Quality to fully implement the CFP in 2016.[14] Within the CFP rules, electric utilities are allowed to register as aggregators of clean fuels credits when electricity is used as a transportation fuel. As described in later sections of this Plan, the ability to aggregate and monetize CFP credits according to the principles approved by the Commission is one source of funding for current Pacific Power programs.

The role of electric utilities in decarbonizing the transportation sector expanded further with the adoption of Senate Bill 1547.[15] In addition to ensuring that electric utilities continue to invest in renewables, utilities were encouraged to accelerate TE by proposing prudent investments through programs. The law mandated that the Commission direct Oregon investor-owned utilities to file proposals for TE programs by December 31, 2016, and that the Commission also "direct the form and manner" of those applications. Pacific Power is currently implementing the three programs which were proposed in 2016 and approved in 2018.

As an additional showing of strong support for TE acceleration, through Executive Order 17-21, Oregon's Governor Kate Brown set the ambitious – but achievable – target of registering 50,000 EVs in the state by the

[12] ZEV Task Force, Multi-state ZEV Action Plan, Accelerating the Adoption of Zero Emission Vehicles (2018), *available at* https://www.oregon.gov/deq/FilterDocs/MultiStateZEVActionPlan.pdf.
[13] Oregon Department of Environmental of Quality, Oregon Low Carbon Fuel Standards, Advisory Committee Process and Program Design (2011), *available at* https://www.oregon.gov/deq/FilterDocs/LCFSreportFinal.pdf.
[14] *See* S.B. 324, 78th Leg. Assemb., Reg. Sess. (Or. 2015).
[15] *See* S.B. 1547, 78th Leg. Assemb., Reg. Sess. (Or 2016).

end of 2020.[16] This goal was furthered in Oregon Senate Bill 1044, under which the Oregon State Department of Energy will report on whether:

- By 2020, 50,000 registered motor vehicles will be zero-emission vehicles;
- By 2025, at least 250,000 registered motor vehicles will be zero-emission vehicles;
- By 2030, at least 25 percent of registered motor vehicles, and at least 50 percent of new motor vehicles sold annually, will be zero-emission vehicles; and
- By 2035, at least 90 percent of new motor vehicles sold annually will be zero-emission vehicles.[17]

Since these policies have been adopted over the past decade, the number of registered zero-emissions vehicles in Oregon has increased from less than 1,000 to close to 30,000.[18]

Existing state policies and programs are illustrated in the **Figure 3** below. A detailed summary of existing state policies and programs is provided in **Appendix A. State Programs and Policies**. Additional information on Oregon policies and incentives can be found at the U.S. Department of Energy's Alternative Fuels Data Center website.[19]

Figure 3. Timeline of Recent State Policies and Programs

1.4 Development of the Plan

The intent of this Plan is to integrate all of the Pacific Power's Oregon TE actions into one document, including current customer and CFP programs and future initiatives and efforts. Although required through OAR 860-087-0020, the development of this Plan was a necessary and valuable process for the Company as it spurred new opportunities for more internal and external coordination, awareness and connections around TE impacts to the system and customers. As new TE plans are filed every two years, they will build upon the

[16] Or. Exec. Order No. 17-21 (2017), *available at* https://www.oregon.gov/gov/Documents/executive_orders/eo_17-21.pdf.
[17] S.B. 1044 80th Leg. Assemb., Reg. Sess. (Or. 2019).
[18] State of Oregon Department of Environmental Quality, *Data for the Clean Fuels Program, Electric Vehicles in Oregon:* https://www.oregon.gov/deq/aq/programs/Pages/Clean-Fuels-Data.aspx (Last visited on January 31, 2020).
[19] U.S. Department of Energy, Alternative Fuels Data Center, *Oregon Laws and Incentives*, https://afdc.energy.gov/laws/state_summary?state=OR.

connections and understanding included here. The approach to creating this plan to address the requirements set forth in rules is summarized by the following steps below.

1.4.1 Defining the Utility Role

Pacific Power supports the State of Oregon in its efforts to reduce GHG emissions and to increase TE. In supporting state efforts, the Company is also committed to continuing to be responsive to customers' desires for a more sustainable, reliable and affordable energy future. With the transformation of the transportation sector to electric alternatives, utilities' role will necessarily expand to one of a transportation fuel provider, a new area of essential service needs for customers.

Pacific Power's role in TE transformation is guided by three objectives:

1) Accelerate consumer adoption of TE by increasing customer awareness and understanding of TE alternatives, and supporting equitable access to charging infrastructure;
2) Efficiently, prudently, and safely integrate and manage new loads from TE on the Pacific Power system to the benefit of all customers; and
3) Integrate renewables on the system to reduce carbon intensity and lower the cost to serve new loads from TE.

These objectives set the framework for what the Company plans to achieve going forward and complement the previously identified Guiding Principles from the 2017 Transportation Electrification application that defined how Pacific Power implemented current programs.

1.4.2 Knowing Customers and Understanding the TE Market

Pacific Power's Oregon service territory is composed of predominantly rural counties with an overall average median household income that is 20 percent lower than Multnomah County.[20] In seeking to build a TE plan that meets customer needs, the Company took into account these characteristics across its Oregon service territory to identify barriers and opportunities for customers. Current levels of EV adoption in the service territory vary greatly, with significant areas far below other parts of the state, signifying that more work needs to be done to ensure customers in these areas are not disadvantaged in the adoption of EVs and associated local benefits.

1.4.3 Understanding System Impacts and Needs

Pacific Power estimates that TE charging load in its Oregon service territory will be just over 2 average megawatt (aMW) in 2020. Although this amount is a small percentage of total load, as with the addition of any new load, local impacts to the distribution system could lead to necessary upgrades in some locations. The company is actively working to find ways to limit this potential impact.

Given the Company's understanding of the TE market, policies, barriers to adoption and system impacts, Pacific Power is well positioned to inform future actions, initiatives and strategies that meet three key objectives. The plan focuses on addressing barriers the Company can impact and preparing the system for future TE growth.

[20] U.S. Census Bureau, *QuickFacts: Oregon*, https://www.census.gov/quickfacts/table/PST045216/41 (last visited Feb. 27, 2017).

2 Current & Projected Conditions of the Transportation Electrification Market

2.1 EV Adoption

The global auto market is changing rapidly. As of March 2019, annual US EV sales reached over 1.18 million, with EV sales increasing 81 percent from 2017 to 2018.[21] According to Reuters, global automakers are planning an unprecedented level of spending, at least $300 billion, to develop and procure batteries and EVs over the next five to 10 years.[22] Automakers' plans are driven largely by environmental concerns and government policy, and supported by rapid technological advances that have improved battery cost, range and charging time. These investments indicate the industry is anticipating widespread adoption of EVs.

In November 2018, the Edison Electric Institute (EEI) and the Institute for Electric Innovation (IEI) published a consensus forecast of light-duty EV sales projections in the U.S. from 2018 to 2030 based on five independent forecasts (**Figure 4**):

- Bloomberg New Energy Finance (BNEF) – Electric Vehicle Outlook 2018 (May 2018)[23]
- Boston Consulting Group (BCG) – The Electric Car Tipping Point (November 2017)[24]
- Energy Innovation (BAU) – Energy Policy Simulator 1.4.1 (accessed July 2018)[25]
- U.S. Energy Information Administration (EIA) – Annual Energy Outlook 2018 Reference Case (February 2018)[26]
- Wood Mackenzie – The Electric Vehicle Outlook Data (August 2018)[27]

The EEI/IEI forecast projects that by 2030, annual light-duty EV sales will exceed 3.5 million vehicles, or over 20 percent of annual light-duty vehicle sales in that year. This would equate to 18.7 million vehicles on the road, or seven percent of all vehicles nationally in 2030. This projected increase in EV adoption is driven by two primary factors: 1) lower vehicle prices from reductions in battery costs, and 2) state and national regulatory policies requiring or incentivizing EVs.

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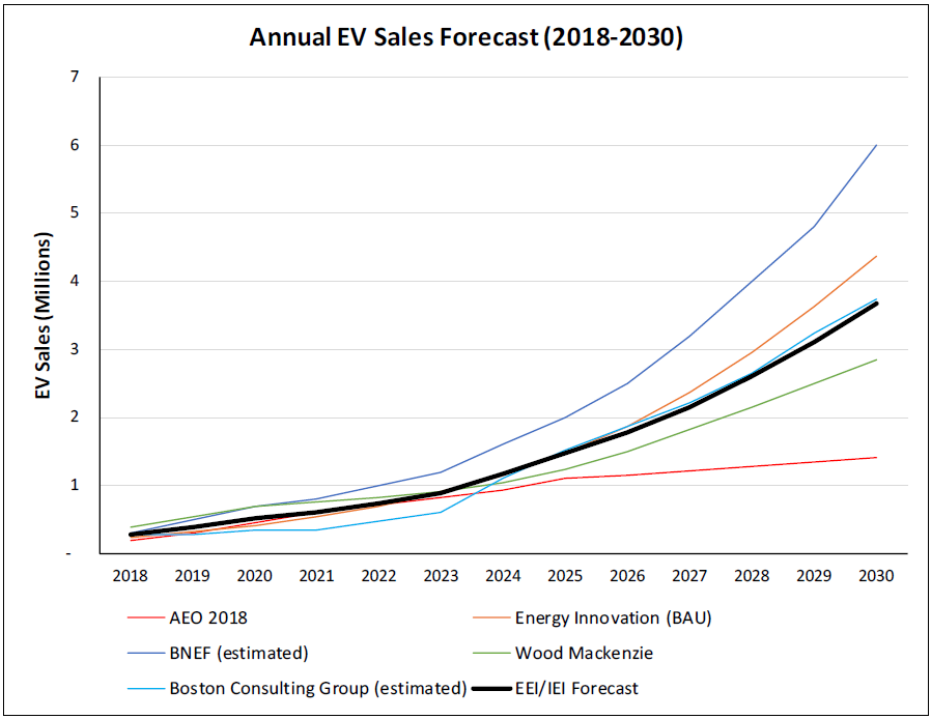
[21] Edison Electric Institute, April 2019 EV sales Update (2019), *available at* https://www.eei.org/issuesandpolicy/electrictransportation/Documents/FINAL_EV_Sales_Update_April2019.pdf.
[22] *Exclusive: VW, China Spearhead $300 Billion Global Drive to Electrify Cars,* Reuters, *(*January *2019)*, https://www.reuters.com/article/us-autoshow-detroit-electric-exclusive/exclusive-vw-china-spearhead-300-billion-global-drive-to-electrify-cars-idUSKCN1P40G6.
[23] *BP Invests in Tech to Charge Cars as Quickly as Filling Gas Tank*, Bloomberg News (May 22, 2018), https://www.bloomberg.com/news/articles/2018-05-22/bp-invests-in-tech-to-charge-cars-as-quickly-as-filling-gas-tank; Bloomberg New Energy Finance, Electric Vehicle Outlook 2019, *available at* https://about.bnef.com/electric-vehicle-outlook/#toc-download.
[24] The Electric Car Tipping Point, Boston Consulting Group (2017), *available at* https://www.slideshare.net/TheBostonConsultingGroup/the-electric-car-tipping-point-81666290; https://www.bcg.com/en-us/publications/2018/electric-car-tipping-point.aspx.
[25] Energy Policy Simulator, Energy Innovation, July 2018 https://us.energypolicy.solutions/scenarios/home.
[26] U.S. Energy Information Administration, Annual Energy Outlook 2018 (Feb. 2018) https://www.eia.gov/outlooks/aeo/.
[27] Electric Vehicle Outlook Data, Wood Mackenzie (Aug. 2018).

Figure 4. EEI/IEI US Electric Vehicle Sales Projections (2018-2030)



When using national data it is important to understand local market conditions when projecting state-specific or jurisdiction EV adoption. For example, through June 2019, of the 1.2 million light-duty EVs sold in the U.S., 48 percent of them (581,674) were sold in California.[28]

Table 4 and **Table 5** shows the relative market share and "sales" of light-duty EVs (including both plug-in hybrid and pure electric) in each of the states served by Pacific Power.[29] However, state-level data does not necessarily capture the specific markets Pacific Power serves, which tend to be more rural and dispersed. Additional state-specific considerations in forecasting TE are discussed later in this section.

Table 4. Light-Duty Electric Vehicle Electric Sales in Pacific Power States

State	Total Light Duty Electric Sales (Jan 2011 – Jun 2019)[30]	National Rank[31]
California	581,674	1
Washington	47,786	4
Oregon	25,035	13

[28] Auto Alliance, Advanced Technology Sales Dashboard, https://autoalliance.org/energy-environment/advanced-technology-vehicle-sales-dashboard/ (last visited Jan. 29, 2019).
[29] *Id.*
[30] *Id.*
[31] EVAdoption, *Percent Share of US EC Sales by State*, https://evadoption.com/ev-market-share/percent-share-of-us-ev-sales-by-state/ (last visited Dec. 18, 2019).

Table 5. EV Market Share by State

Rank	State	% of 2018 US EV Sales
1	California	46.80%
2	New York	4.80%
3	Florida	4.20%
4	Washington	3.90%
5	Texas	3.60%
6	New Jersey	2.80%
7	Massachusetts	2.70%
8/9	Illinois	2.20%
8/9	Arizona	2.20%
10	Colorado	2.10%
11/12	Maryland	1.90%
11/12	Virginia	1.90%
13	**Oregon**	**1.80%**

2.1.1 Number of EVs in Oregon

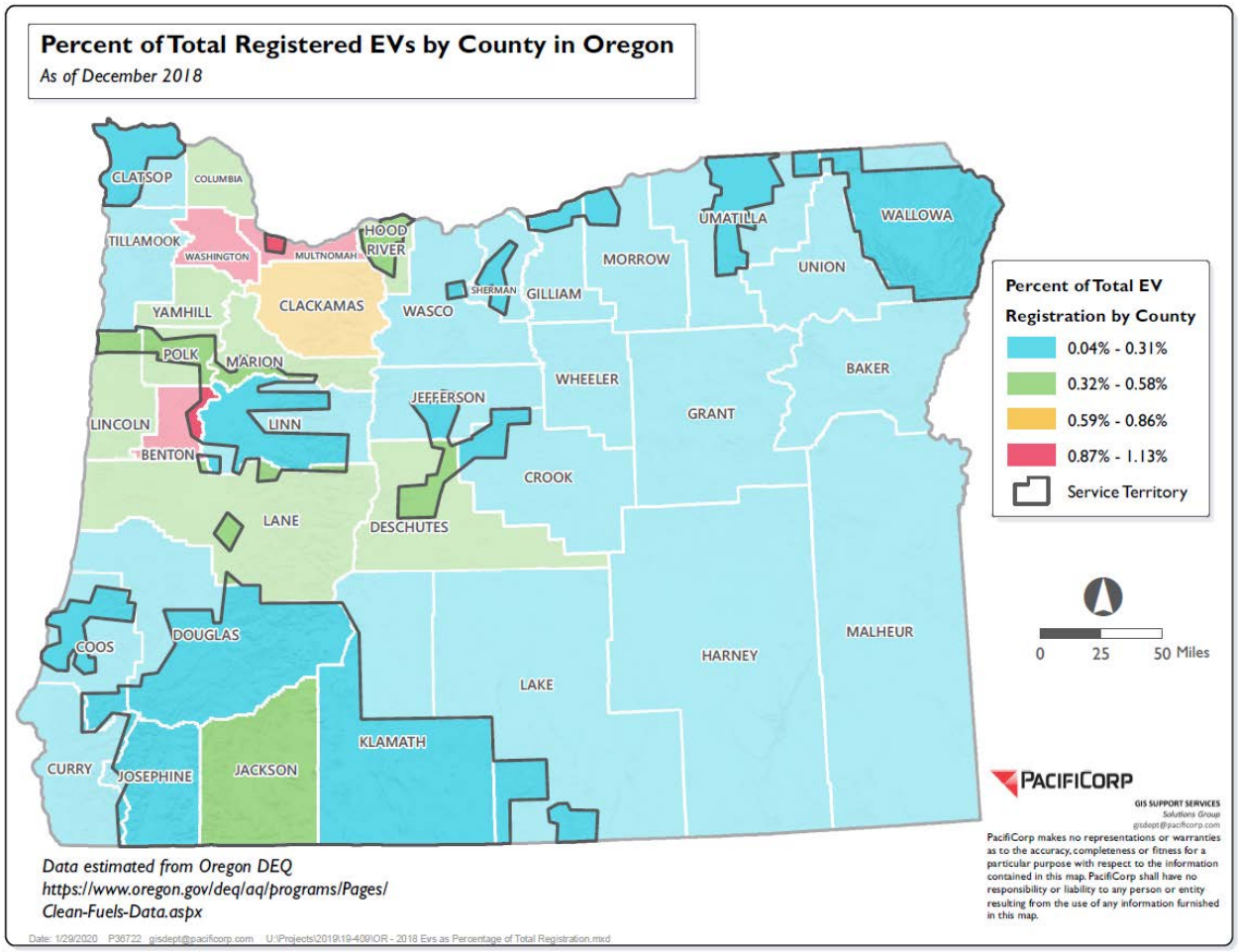
As of September 2019, there were approximately 27,796 EVs registered in Oregon, which represents less than one percent of the 4.1 million registered vehicles in the state.[32]

The majority of registered EVs are located within Clackamas, Multnomah, and Washington Counties (66 percent of all registered EVs in Oregon). [33] Pacific Power's Oregon service area is diverse and ranges from areas with low population densities to portions of the city of Portland.

Figure 5 illustrates the current distribution of registered EVs as a percent of registered vehicles in the county. This view highlights the low but growing adoption rates in a relatively immature market. The distribution of EV adoption and infrastructure is not uniform across the state, and Pacific Power is focused, in part, to increasing efforts in areas where adoption rates are falling behind.

[32] Oregon Department of Transportation, *DMV Facts & Statistics*, *DMV Key Facts.* https://www.oregon.gov/ODOT/DMV/Pages/News/factsstats.aspx (last visited on January 31, 2020).
[33] *Id.*

Figure 5. Percent of Registered EVs by County in Oregon as of December 2018



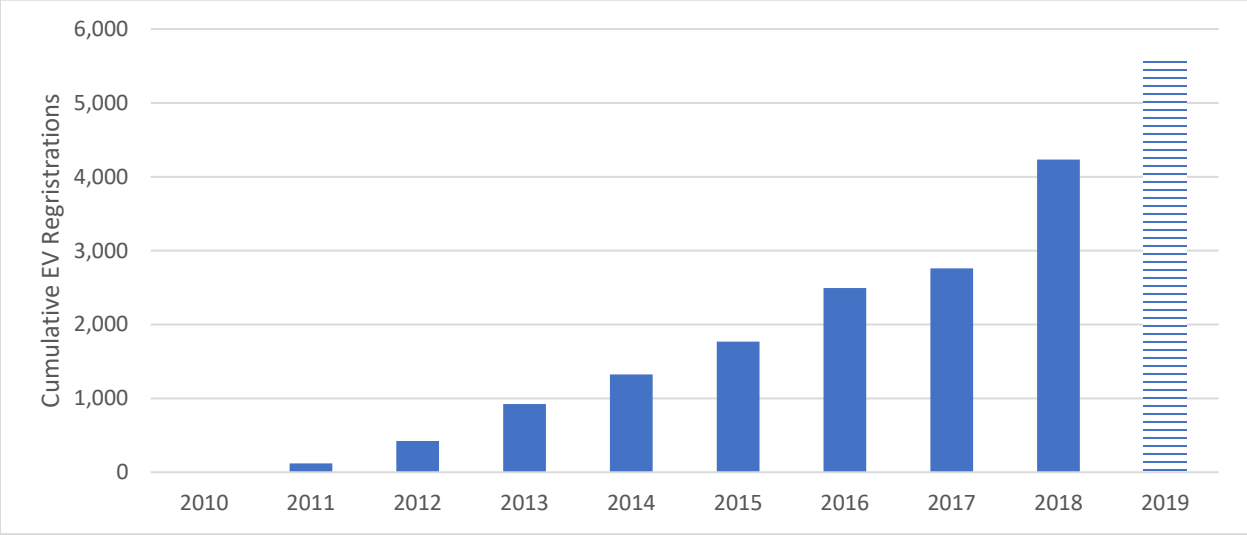
2.1.2 Number of EVs in Pacific Power's Service Territory

The EV market can generally be divided into three classes of vehicle type: light-, medium-, and heavy-duty. As of September 30, 2019, there were an estimated 5,018 registered light-duty EVs in Pacific Power's service territory, which represents 18.1 percent of the total registered EVs in Oregon.

To determine the estimated number of registered EVs in Pacific Power's service territory through the end of 2019, the Company used the estimated registered EV growth rate from June 2019 to September 2019 from the Oregon DEQ. This growth rate was applied as the "growth trend" for fourth quarter 2019 EV sales. [34] **Figure 6** and **Table 6** show the trend in registered EVs in Pacific Power's Oregon service territory since 2010.

[34] Oregon Department of Environmental Quality, *Clean Fuels Data*, https://www.oregon.gov/deq/aq/programs/Pages/Clean-Fuels-Data.aspx (last visited January 31, 2020).

Figure 6. Cumulative Light-Duty EV Registrations – Pacific Power Oregon Service Territory



Note: The 2019 value is an estimate using a three month forecast applied to September 2019 actuals.

Table 6. Cumulative Light-Duty EV Registrations – Pacific Power Oregon Service Territory

	Actuals									Estimated
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
BEVs								*1,544*	*2,410*	*3,128*
PHEVs								*1,217*	*1,823*	*2,430*
Total EVs	**2**	**121**	**423**	**923**	**1,324**	**1,769**	**2,494**	**2,761**	**4,233**	**5,558**

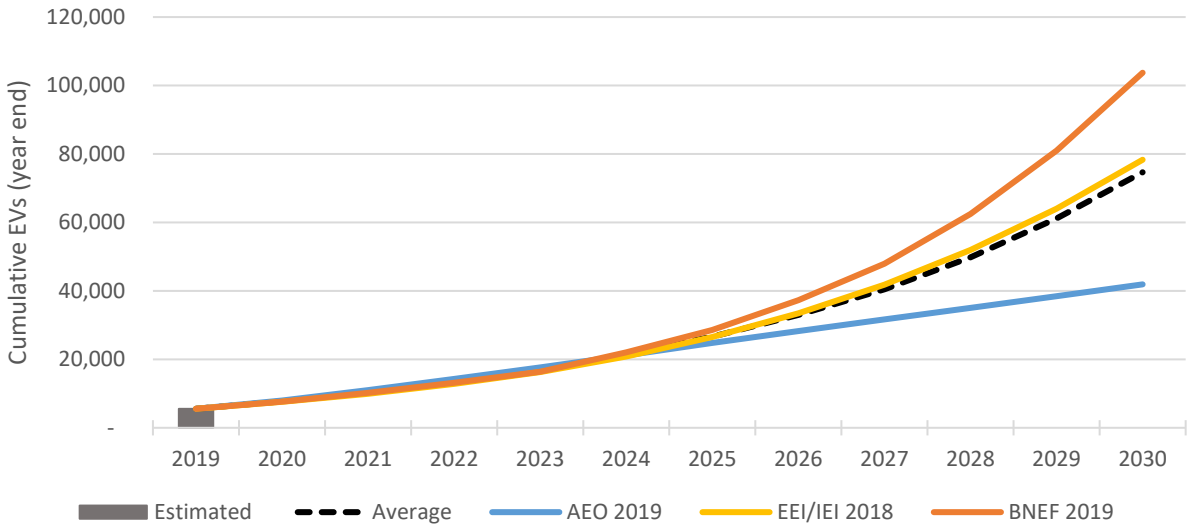
2.1.3 Projected Number of EVs in Pacific Power's Territory Through 2025

2.1.3.1 Projected Number of Light-Duty EVs

Pacific Power engaged a third party consultant, AEG, to create three possible future scenarios of adoption by starting with national EV futures, and then tailoring them to the Company's Oregon service territory. AEG conducted analysis on national forecasts of EV adoption from three industry sources: 1) US EIA Annual Energy Outlook (AEO) 2019; 2) EEI/IEI 2018 Forecast and 3) Bloomberg New Energy Finance Electric Vehicle Outlook 2019. National EV market growth rates from each source for 2020 to 2030 were applied to estimated 2019 year-end light-duty EV registrations in Pacific Power's Oregon service territory to create the three potential forecasts of future EV adoption.

The resulting forecasts of cumulative light-duty EV adoption in Pacific Power's Oregon service territory under the three scenarios are presented in **Figure 7** and **Table 7** below. As shown, all three scenarios build off the same estimate for year-end 2019 EV registrations, applying source-specific growth rates beginning in 2020. The three sources produce extremely similar results through 2024.

Figure 7. Pacific Power Oregon Potential Future Scenarios



Pacific Power estimated potential system impacts by averaging the three potential future scenarios. These average vehicle counts, and the associated estimated impact per vehicle, were used to estimate load and carbon impacts. Pacific Power used the CFP's average daily residential charging rate of 8.5 kilowatts per hour (kWh)[35] per EV times 365 days to develop a per vehicle annual load (3,103 kWh).

Table 7. Pacific Power Oregon Average Light-Duty Forecast Through 2025

Light-Duty Vehicles Average Forecast Through 2025								
	2019	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**Total**
Cumulative EVs	5,558	7,729	10,385	13,427	16,771	21,342	26,630	
Incremental EV Impacts								
Vehicles		*2,171*	*2,656*	*3,043*	*3,344*	*4,571*	*5,288*	**21,072**
MWh	*3,177*	*6,734*	*8,240*	*9,440*	*10,375*	*14,181*	*16,405*	**65,376**
average MW	*0.36*	*0.77*	*0.94*	*1.08*	*1.18*	*1.62*	*1.87*	**7**

Of the three sources, the EIA's 2019 Annual Energy Outlook is the only source that provided separate adoption forecasts for battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs). This source was used to forecast adoption separately for PHEV and BEV vehicle types. The AEO scenario forecast by vehicle type suggests the share of BEV will outpace PHEV moving forward.

2.1.3.2 Projected Number of Medium- and Heavy-Duty Electric Vehicles

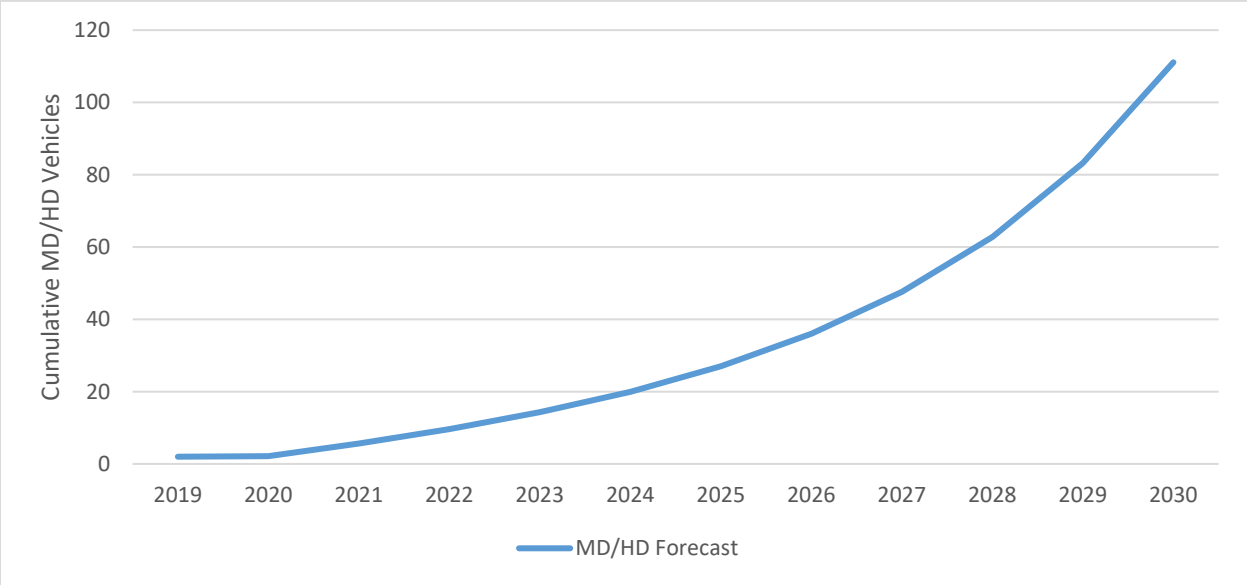
While the light-duty EV market continues to expand, currently medium- and heavy-duty electric bus and truck options are limited in the US. However, all of the major truck manufacturers have announced plans to develop medium- and heavy-duty electric trucks. Nationally, 50 percent of all commercial trucking occurs

[35] Oregon Department of Environmental Quality, *Oregon Clean Fuels Program, Calculating Residential EV Credits* (2018), *available at* https://www.oregon.gov/deq/FilterDocs/cfp-resevcredits.pdf.

within a radius of 100 miles; however, adoption of EV vehicles is expected to be slow for this demographic. A study by McKinsey on EV adoption in the trucking industry projects that commercial trucks should begin achieving price parity, based on total cost of ownership, with diesel and natural gas for urban and regional haul operations (100 miles or less) in 2025.[36] Once price parity is achieved, adoption of electric trucks could occur rapidly, particularly in urban areas. Additionally, more stringent emission standards for medium- and heavy-duty trucks are expected to take effect in 2025, increasing the incentive to switch to EVs.

To develop its forecast for medium- and heavy-duty trucks in **Figure 8** and **Table 8**, Pacific Power utilized the transportation sector energy use by fuel type within a mode dataset from the U.S. EIA's AEO's 2019 study.[37] This data was used to determine the percentage of total EV energy consumption that is likely to be attributed to this market. This forecast suggests adoption of medium- and heavy-duty EVs will be minimal through 2025. The timing of anticipated increased adoption is in line with the forecast for light-duty EV sales growth inflection.

Figure 8. Pacific Power Oregon Medium- and Heavy-Duty Estimated Growth Forecast



[36] Electric Vehicle Outlook Data, Wood Mackenzie (Aug. 2018).
[37] U.S. Energy Information Administration, Annual Energy Outlook 2018 (Feb. 2018) https://www.eia.gov/outlooks/aeo/.

Table 8. Pacific Power Oregon Estimated Cumulative Medium- and Heavy-Duty Forecast

Medium- and Heavy-Duty Vehicle Forecast Through 2025							
	2019	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
MD/HD Cumulative Total	2	2	6	10	14	20	27

Note: This forecast is based on national medium and heavy-duty growth estimates for transit buses and delivery trucks and is not reflective of the unique nature of this evolving market. As transit authorities, school districts, and fleet managers begin converting vehicles, the results may not reflect a slow and smooth ramp up.

2.1.3.3 Working Vehicles and Other Transport Modes

Though Pacific Power did not quantify the impact of off-road TE, there could be additional opportunities for TE beyond the light-, medium- and heavy-duty vehicle markets including:

- Forklifts
- Agricultural vehicles (e.g. tractors)
- Construction vehicles
- Truck Refrigeration Units (TRU)
- Airport applications

Avoided emissions from use of propane and diesel to fuel these vehicles could have economic as well as local air quality benefits. Further exploration of the potential for electrification of this category is needed as alternate technologies become more accessible in the market.

2.1.3.4 Factors Affecting the Forecast

2.1.3.4.1 Vehicle Technology Updates

Currently, the light-duty EV market has over a dozen fully battery-electric models available. Well-known brands like Tesla, BMW, Audi, Jaguar, Chevrolet, Honda, Hyundai, Kia, and Nissan all have sedan or SUV electric models that range from the more affordable Nissan Leaf ($30,000) to the luxury Porsche Taycan ($150,000). The all-electric range of EVs on the market is continually increasing, with multiple models available that exceed 200 miles (Tesla, Chevrolet, Hyundai Kia, Jaguar, Audi, and Porsche).

Fully-EV options are becoming cost-competitive in some market segments with their internal combustion engine (ICE) counterparts. Depending on utility rate structures, fuel costs for EVs can be lower than for ICE vehicles; likewise EVs typically experience lower maintenance costs than their ICE counterparts. Especially for vehicles with high annual mileage, savings on fuel and maintenance over a vehicle's lifetime can translate to a lower total cost of ownership, making EVs a cost-effective investment. Increasingly, vehicles are coming online that can compete head-to-head on purchase price with their conventional counterparts, such as the Nissan Leaf and Chevrolet Bolt. It is still generally the case that in terms of retail prices, EVs will be more costly up-front than comparable ICE vehicles.

The next big market for electric light-duty vehicles is fully battery-electric light pickup trucks. Six companies have announced the arrival of electric pickup truck models in the coming years. Ford is working on an electric version of their F-150, expected to go on sale by 2021. GM announced the revival of their Hummer brand to support the launch of their electric truck models (coming in 2022). Tesla is also preparing their Cybertruck

model to compete in this space by 2022. Other startups have also announced electric truck models, including Rivian's R1T (2021), Lordstown's Endurance (2021), and Bollinger's B2 (2020).

Similarly, the next innovation on the horizon for medium- and heavy-duty vehicles is electric long-haul trucking. Companies like Daimler, Nikola Motors, Tesla, BYD and Volvo have all announced their intent to develop fully electric semi-trucks with commercial sales beginning in 2020. Delivery vans are another market where electric technologies are likely to be competitive with ICE vehicles in the near future, with Chanje, BYD, Rivian, and Workhorse developing fully electric and commercially-viable models. The medium- and heavy-duty market for EVs is currently comprised of refuse trucks, school buses, shuttle buses, vans, tractors, and transit buses. Purchase prices for medium- and heavy-duty models are typically higher than their conventional alternatives, but fully-electric options are becoming more cost-competitive. Similar to light-duty vehicles, the fuel and maintenance costs of electric medium- and heavy-duty vehicles are low enough to make some of these alternatives cost-effective over the lifespan of the vehicles. High mileage vehicles, like transit buses, stand to benefit the most because of savings on fuel costs; fleets will also benefit from the higher predictability of electricity prices compared to the price volatility of conventional fuels.

2.1.3.4.2 EV Adoption Factors

On a national scale, EV adoption may be influenced by many factors, including vehicle availability, cost, tax credits, range, customer awareness, and technology familiarity. When considering a specific geographical area, additional factors affecting EV adoption may include fuel costs, population density, income, local tax credits and rebates, programs and educational campaigns, and charging station availability and visibility. EV battery pack prices in 2010 were roughly $1,000/kWh. Fast forward to the end of 2018 and average prices hit a low of $176/kWh, an 85 percent decrease in eight years. As prices decrease, the mileage range of new EVs is increasing; improving at around 5 to 7 percent per year.

State and federal regulations will also have an impact on EV adoption. In 2012, the Federal administration established new vehicle emission standards that required automakers to nearly double the fuel economy of passenger vehicles to an average of about 54 miles per gallon by 2025. Further, California has unique authority under Section 209 of the Clean Air Act to maintain motor vehicle emission standards that are stricter than the federal standards and other states, including Oregon and Washington, have adopted these standards. These new rules were set to be a driver of vehicle electrification nationally, until August 2018 when the Federal administration proposed amending the rule. The outcome of this process is unknown at this time.

2.2 EVSE

EVSE is typically characterized as one of three types based on how quickly it can provide charge: Level 1, Level 2, and DC Fast Charger (DCFC). Level 1 chargers can be used with a standard 120 V AC plug and deliver 2 to 5 miles of range per hour of charging. Level 1 is most commonly used in residential applications and occasionally in workplace applications. Level 2 chargers typically require electrical infrastructure upgrades as they charge through a 240 V AC plug (for residential) or 208 V AC plug (for commercial). These chargers can provide 10 to 20 miles of range per hour of charging. Level 2 chargers are the most common and are found across residential, public, and workplace sites. DCFCs require specialized, high-powered equipment because

they provide charge through a 480 V AC outlet. DCFC are found most often at public charging stations and along heavy traffic corridors because they can deliver 60 to 80 miles of range in 20 minutes of charging.[38] Not all vehicles can accept charge from a DCFC.

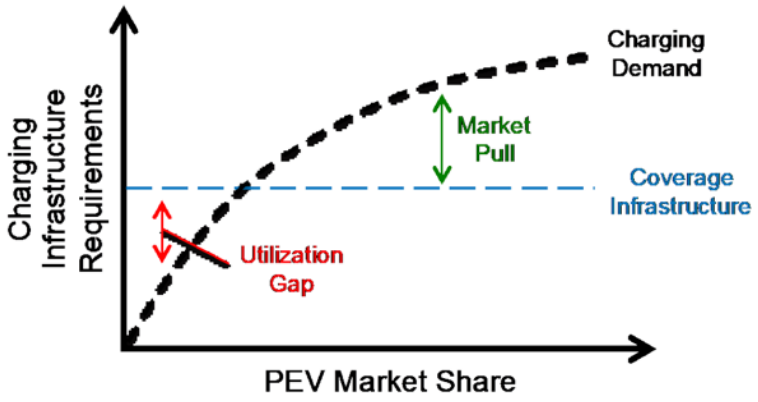
According to the International Council of Clean Transportation's (ICCT) report on quantifying the EV charging infrastructure gap across U.S. markets, most EV drivers prefer to charge at home.[39] ICCT also notes that early adopters of EVs were primarily commuters with access to a garage and home charging. As the profile of customers buying EVs is changing, more public charging is becoming available to support them. Workplace charging has the potential for high utilization because workplaces are typically the second-most frequented parking locations (after homes). Most public and workplace chargers are Level 2 chargers where people can expect to charge for a few hours. Along travel corridors, where people are driving longer distances, DCFC are most common since drivers often do not want to wait to refuel for long periods of time.

2.2.1 Potential Impact on Competitive EVSE Market

Pacific Power's engagement in the EVSE market is centered on customer needs, which the company understands to be tied to the development of a robust, competitive EVSE market throughout its service territory. The EVSE industry is still in its infancy in Pacific Power's service territory, as discussed throughout **Section 2**. In early stages of market development, EV adoption and EVSE installations are mutually constrained—potential EV drivers desire charging infrastructure that provides broad coverage in their region, while private EVSE developers cannot justify developing a broad EVSE network when utilization of stations is expected to be low.[40] This conundrum is behind the "utilization gap" depicted in **Figure 9**, where the level of coverage of charging infrastructure *required* by EV drivers (indicated by the blue hashed line) is greater than the level of charging the market will provide given the low utilization of EVSE infrastructure when the EV market share is low.[41]

[38] U.S. Department of Energy, *Electric Vehicle Charging*, https://www.energy.gov/eere/electricvehicles/vehicle-charging (last visited January 31, 2020).
[39] ICCT, Quantifying the EV Charging Infrastructure Gap Across U.S. Markets (2019), https://theicct.org/sites/default/files/publications/US_charging_Gap_20190124.pdf.
[40] Shanjun Li et. al., *The Market for Electric Vehicles: Indirect Network Effects and Policy Design*, Journal of the Association of Environmental and Resource Economists (March 2017), *available at* https://www.journals.uchicago.edu/doi/pdfplus/10.1086/689702.
[41] National Renewable Energy Laboratory, New EVSE Analytical Tools/Models (2018) *available at* https://www.nrel.gov/docs/fy18osti/70831.pdf.

Figure 9. EVSE Utilization Gap When EV Market Share is Low



(Source: NREL 2018, https://www.nrel.gov/docs/fy18osti/70831.pdf)

This is the dynamic in rural areas of Pacific Power's service territory, which parallels the situation in other states with distinct urban and rural regions. Industry actors are beginning to recognize the need for particular focus on rural areas to ensure they are not excluded from the benefits of TE, noting that if driven by the private sector alone, charging stations will tend to be installed initially only in urban areas, major regional corridors, and places where EVs are already concentrated.[42, 43]

Pacific Power is engaged in the EVSE market for the purpose of supporting its maturation in currently underserved areas. To address the utilization gap, Pacific Power is introducing five DCFC stations that should help push the region towards higher EV market share. To this end, Pacific Power has also pursued several solutions designed to support the development of the private EVSE market, including:

- Setting fees for charging at its EVSE installations based on the average of rates offered by other private actors in the state. This ensures that Pacific Power will not unintentionally undercut the competitive market as it develops in the region.
- Designing a custom electricity rate for EVSE stations that shifts costs toward energy charges from demand charges to make the prospect of developing and operating EVSE more financially viable.[44]

Pacific Power is sensitive to concerns about the electric company's potential impact on the competitive EVSE market and is actively working with EVSE developers, stakeholders, and policymakers to ensure a thoughtful,

[42] Utility Dive, *Colorado Passes Bill to Avoid Urban Rural Divide on EV Chargers* (Apr. 12, 2019) https://www.utilitydive.com/news/colorado-passes-bill-to-avoid-urban-rural-divide-on-ev-chargers/552561/.
[43] CleanTechnica, *Urban & Rural People In The US Need A Grand Compromise On Cars & EV Infrastructure* (July 29, 2019) https://cleantechnica.com/2019/07/29/urban-rural-people-in-the-us-need-a-grand-compromise-on-cars-ev-infrastructure/.
[44] *See* Pacific Power Electric Service Schedule No. 45 *available at* https://www.pacificpower.net/content/dam/pcorp/documents/en/pacificpower/rates-regulation/oregon/tariffs/rates/045_Public_DC_Fast_Charger_Optional_Transitional_Rate_Delivery_Service.pdf.

strategic approach in the role it takes. Furthermore, Pacific Power understands that this is a dynamic market and continually reassesses how it can best serve its customers in this transitioning industry.

2.2.2 Charging Technology Updates

The charging infrastructure market for light-duty vehicles is more mature than it is for medium- and heavy-duty vehicles. Oregon has approximately 1,600 public charging outlets across the state at varying levels (Level 1, Level 2, and DCFC) that serve light-duty vehicles.[45] Currently, most EV owners charge at home with a Level 1 or Level 2 charger. Publicly available chargers are usually Level 2 or DC fast chargers. There are multiple charging station providers, the most prominent being ChargePoint, Tesla, Greenlots, Blink Network, SemaConnect, and EVgo. Charging technology is expected to continue moving towards publicly available higher-powered models that enable fast and convenient charging. There is still work to be done to further the standardization of light-duty charging; however, the segment is maturing and the light-duty charging industry is coalescing around a defined set of technology standards and operational protocols.

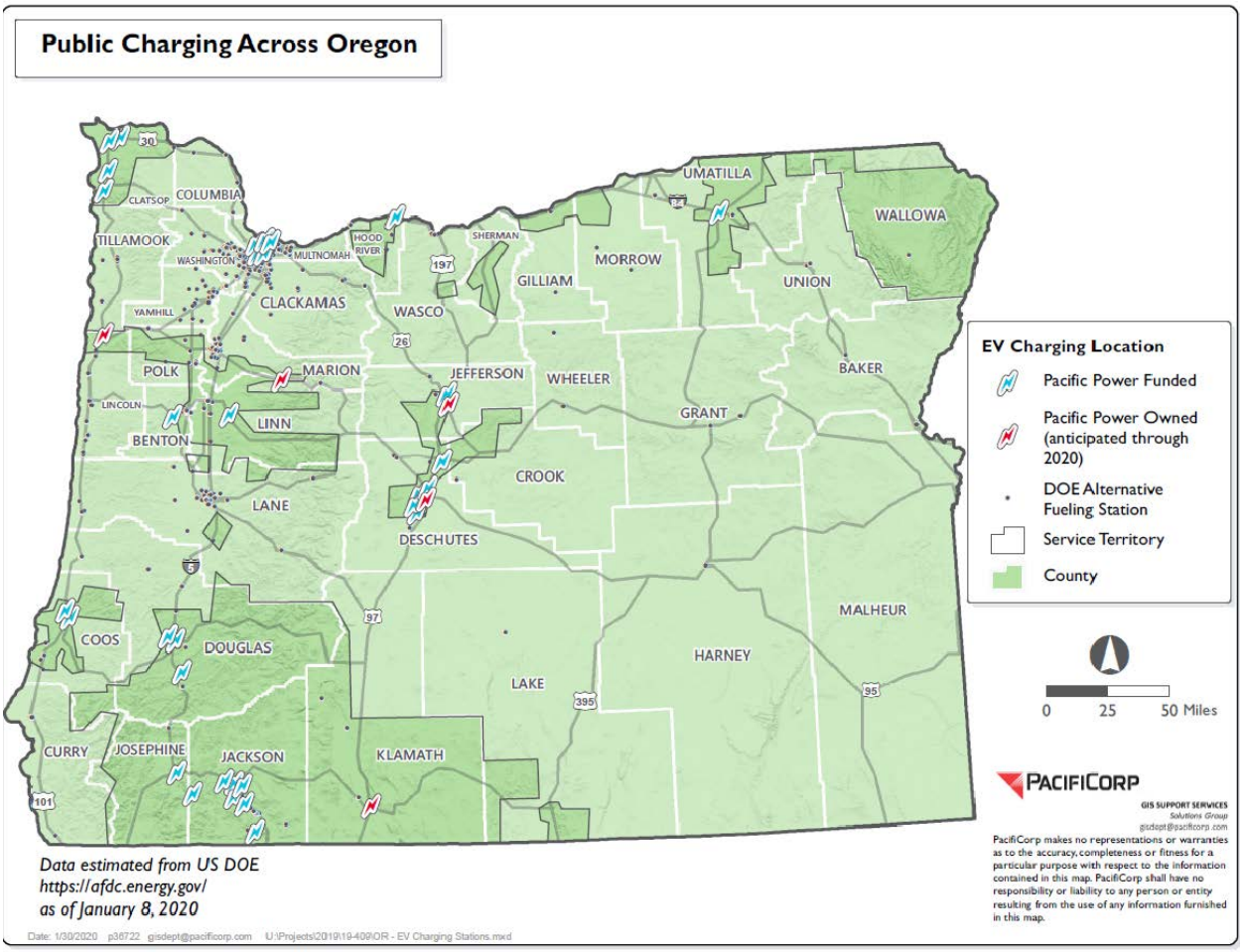
Most charging solutions sized to meet the needs of medium- and heavy-duty vehicles are custom installations designed specifically for a particular site and use-case. Because there is more variation in the electrical needs and operational schedules of medium- and heavy-duty EVs, they have more variety in the charging options available to them. Chargers can range in power rating from 50 kW to upwards of 500 kW. Charging methods are also varied, with some vehicles able to take advantage of depot-style charging and others using overhead on-route extreme fast charging. Developers such as ABB, BTC Power, ChargePoint, Proterra, Siemens, BYD, and others create these custom solutions. The market for medium- and heavy-duty vehicle charging is less mature and thus the industry has not coalesced around technology standards and operational protocols to the same degree that it has in the light-duty EV charging market.

2.3 Existing Data on the Availability of Charging Stations in Oregon

Pacific Power utilized alternative fueling station data from the US Department of Energy (US DOE) to map the number of existing Oregon public electric fueling stations (**Figure 10**).[46] Currently, there are over 600 publically available electric fueling stations (with approximately 1,600 "ports" or "outlets"), with 45 percent of these stations being located in Oregon's major metropolitan area. To date, Pacific Power has contributed funds to 46 total charging stations, 41 being customer owned charging stations, and an additional 5 stations to be owned and operated by Pacific Power. Of the 46 charging stations, 88 percent are located in non-metropolitan areas. These sites will assist Oregon in building out its EV infrastructure in rural and coastal communities across the state.

[45] Go Electric Oregon, *Charge on the Go* (January 2020) https://goelectric.oregon.gov/charge-your-ev.
[46] Alternative Fuels Data Center, *Electric Vehicle Charging Station Locations* (January 2020) https://afdc.energy.gov/fuels/electricity_locations.html#/find/nearest?fuel=ELEC.

Figure 10. Oregon EV Charging Stations



2.3.1 Preliminary Insights into Availability and Usage Patterns

Most EV charging occurs at home, but widespread EV adoption will require the development of a national network of charging stations within cities, long distance corridors, and rural communities. A 2017 NREL report conducted analysis on the US electric charging infrastructure and found that in order to ease range anxiety, 4,900 charging stations would need to be installed across the US to ensure urban city drivers are never more than three miles from a station.[47] The analysis also found that approximately 400 long distance travel corridors would require charging stations every 70 miles to provide convenient access to drivers across the U.S. Interstate System.

NREL's analysis of electric charging infrastructure data is one example of the power of data. Data and analytics will allow Pacific Power to continue to shape the way drivers travel and charge across Oregon. Pacific Power is dedicated to utilizing data to identify opportunities to influence charging at optimal times, thus creating a more efficient grid. At this time and due to the immaturity of EV charging in Pacific Power's service territory, current data on the availability and usage of charging stations can provide only limited

[47] U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, National Plug-In Electric Vehicle Infrastructure Analysis (2017) *available at* https://www.nrel.gov/docs/fy17osti/69031.pdf.

insights. For example, early utilization data is from stations that just recently came online, and thus should not be interpreted prematurely or generalized broadly as it may or may not be representative of the population of charging stations across Pacific Power's service territory. Pacific Power will continue to analyze and monitor data and will report back on further learnings in its next TE plan.

Thorough details on availability, usage, and relevant data are provided in **Appendix B. Charging Availability and Usage Patterns**.

2.4 *Current and Projected Electric Company System Impacts*

Pacific Power's traditional distribution and transmission planning study process is designed to predict overload conditions that require system changes to mitigate. This existing process will account for and prepare the system for the installation of residential EV charging and development of small public charging stations. For load additions that exceed 1000 kilowatts (kW), Pacific Power's existing large load interconnection process provides the mechanisms necessary to evaluate heavy duty charging stations through a system impact study process, ensuring impacts to the distribution and transmission system associated with these load addition are addressed and the reliability of the power system is maintained.

Pacific Power performed an independent study to determine the impact if the EV market share increased by current adoption trends. This was based on a state-level vehicle adoption forecast provided by the Oregon Department of Transportation, which anticipates the market share of new EVs growing to 10 percent by 2025. The study analyzed sensitivities of 20 percent and 40 percent higher than the state-level adoption forecast (i.e., 12 percent and 14 percent market share by 2025, respectively) with random and clustered EV adoption. Each scenario was also studied with an additional 30 percent penetration of private solar generation to understand potential interactions between high levels of EV and private generation adoption. It is also assumed that customers installing EVSE will contact Pacific Power regarding load additions. It should be noted that the market share values used in this study are specific to the areas and circuits analyzed. The forecast provided with the Oregon TE Plan is for all areas and circuits in Oregon in Pacific Power's territory.

The results of this study predict that in some locations, normal load growth will cause isolated system component overloading issues, which may be compounded by additional EV load. However, Pacific Power's traditional distribution planning study process is designed to predict overload conditions that require system changes to mitigate. Barring a large increase in the installation of EVSE in a short time period, this process will account for and prepare the system for the installation of residential EVSE.

Most overload conditions created by the installation of residential EV charging are capable of being mitigated by balancing the feeder load across all three phases. At some single phase locations, the solution to mitigate the overload condition will require the evaluation and modification of the feeder configuration and protection scheme. The addition of private solar generation equal to 30 percent of the existing load is not projected to significantly impact the conductor overload conditions present due to residential EV adoption.

Outside of Pacific Power's distribution planning study and system impact study process, the summer and winter peak load information for each circuit in Pacific Power's service territory is recorded and reviewed

annually. If there is a sudden or large increase in peak load, the timeline for planned projects is accelerated to accommodate the increase in load.

2.4.1 Opportunities for Efficient Grid Management and Renewables Integration

Pacific Power is identifying opportunities to integrate the consideration of renewables into all areas of the business. Planning for the growth of EV charging load on the electric system is unlike most other major end use load segments that have emerged over time in that there is a clear opportunity for Pacific Power to influence the shape of the load for efficient grid operations. In addition to encouraging accelerated TE adoption, Pacific Power can look for opportunities to steer that load into times when excess renewable generation is present during the day or shift that load away from critical peak times, which needs to be a part of any early market intervention strategy development. Efficient rate design, distribution system planning, integrated resource planning and direct load control are all tools that can guide efficient grid management and renewables integration.

2.4.1.1 Rate Design

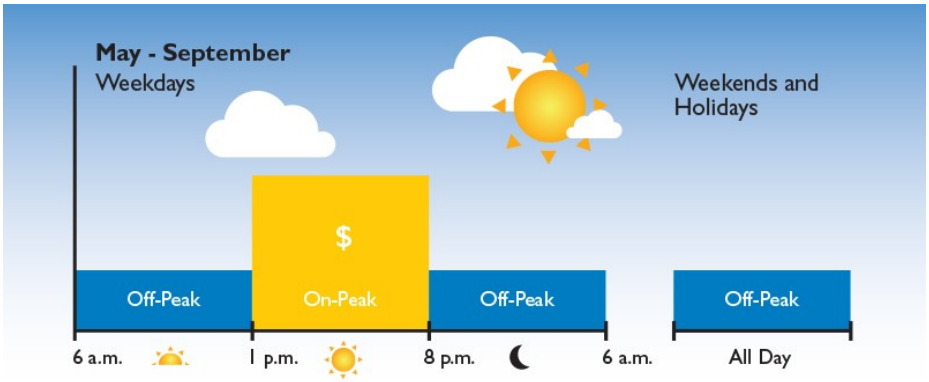
Efficient rate design that sends clear price signals to customers is a tool which will become a central component to the EV load growth plan. The general concept is to use rate design to minimize system costs from charging load and allocate costs fairly across customer segments. Time of Use (TOU) rates define distinct time periods over which rates vary. The difference between those rates directly signals to customers when is the most economical time period for them to use energy, thus helping to steer customers to use energy more efficiently. Pacific Power anticipates that it will introduce new time-varying rate options as well as propose ongoing refinement to existing rate structures within the context of ratemaking proceedings.

2.4.1.1.1 PacifiCorp's Utah Residential Time of Use (TOU) and Load Research Study

In Utah, PacifiCorp is currently piloting new residential TOU rates for electric car owners and the results of this work may be used to inform future rate design. [48] The voluntary Utah TOU program helps customers save money if they move a substantial portion of their electricity use to off-peak hours. The time periods for On-Peak and Off-Peak are below in **Figure 11**. In its next Oregon general rate case, Pacific Power plans to propose cost-based rates that promote TE. This will include time varying rate pilot(s) as well as addressing issues surrounding the affordability of incremental energy consumption.

[48] *See* Rocky Mountain Power Electric Service Schedule No. 2E *available at* https://www.rockymountainpower.net/content/dam/pcorp/documents/en/rockymountainpower/rates-regulation/utah/rates/002E_Residential_Service_Electric_Vehicle_Time_of_Use_Pilot_Option_Temporary.pdf.

Figure 11. PacifiCorp's Utah Residential TOU Program



2.4.1.1.2 Schedule 45: Fast Charging

In advance of filing TE program applications for Senate Bill 1547, the Company held a series of public stakeholder workshops, during which various parties indicated that, at current utilization levels, demand charges are a significant impediment to maintaining and expanding a network of public DC fast-charging stations. Pacific Power addressed these concerns in its initial filing in Advice 16-020, which proposed replacing demand charges with on-peak energy charges for separately-metered, publicly-available DC fast chargers. After discussions with Commission staff, the Company's Supplemental Filing included a proposal for both annual and triennial reporting on Schedule 45, a cap of 200 program participants, and an explicit glide-path for Schedule 45 customers back to Schedule 28 over a period of nine years.

Customers on Schedule 45 pay all applicable rates under Schedule 28, plus a 10.738 cents per kilowatt-hour on-peak energy adder that is designed to collect the same amount of revenue as the Schedule 28 demand charges. While the customer pays both the demand charges and the on-peak energy adder, the schedule includes complementary percentage discounts that prevent the customer from ever paying the full amount of either charge. These percentage discounts are scheduled to change each May 15th in a way that increases the demand charges and decreases the on-peak energy adder by 10 percent. Continuing this glide-path, rates will return to standard Schedule 28 rates after nine years. From the annual report filed in October 2019, participation is still well below the 200 participant cap with 18 customers enrolled.[49] Since July 2017, the average monthly customer bill savings for participants is 50 percent.

2.4.1.2 Direct Load Control (DLC)

Capability to directly control the timing of TE charging is another opportunity for future incorporation in tools to manage TE load. Keeping this potential future role in mind, creative program design today will lead to minimization of lost opportunity when building out TE infrastructure. For example, as Level 2 chargers are installed, defining what functionality is necessary for those specific chargers to participate in a DLC program in the future may help avoid encouraging investment of equipment that is incompatible with control needs.

[49] *PacifiCorp's Annual Report in compliance with Order No. 17-172, Schedule 45, Public DC Fast Charger Optional Transitional Rate Delivery Service. Customer participation in DC Fast Charger*, Docket No. RE 180 (Oct. 9, 2019).

An “in between” opportunity that automates alignment of charging load to the customer TOU rate schedule is currently emerging with smartphone apps.

2.4.1.3 Distribution System Planning Tools

As described earlier in this section, near-term distribution system impacts are manageable within the feeder scenarios tested and large charging loads will be studied independently similar to interconnection requests. In addition, as described in Pacific Power’s Smart Grid Report[50] and in reply comments to UM 2005,[51] the distribution system planning investigation docket, Pacific Power deployed a distributed energy resource (DER) screening tool for transmission and distribution planners to utilize to compare alternative DER solutions to traditional solutions.

On an annual basis, the Company conducts a 10-year capital planning process in which the Company identifies distribution feeders, distribution substations and local transmission lines with anticipated thermal or voltage constraints driven by load growth and recent load additions. For each of these constrained transmission and distribution facilities, the costs and benefits of facility upgrades such as replacement of equipment or increasing wire size are evaluated within this tool against the costs and benefits of various non-wires solutions including demand-side management, energy storage and solar generation.

In 2017, based on the results of the DER screening tool, Pacific Power collaborated with Energy Trust of Oregon to implement a targeted load management pilot in the North Santiam Canyon, resulting in 174 efficiency projects and an estimated 3,554 annual megawatt-hour (MWh) saved. A second pilot is now in the implementation phase, which will test the flexibility of additional tactics to achieve demand reduction objectives including peak savings. As EV charging load is added to the system, use of this tool could identify alternate demand-side management options to integrate the new load with other DERs and renewables on the distribution system.

As current distribution planning efforts with regulators and stakeholders in Oregon develop, the Company will continue to discuss and consider planning opportunities.

3 Market Barriers

EV and EVSE market barriers may be broadly grouped across the following six categories: 1) awareness barriers, 2) decision-making barriers, 3) economic barriers, 4) policy and regulatory barriers, 5) technical barriers, and 6) supply chain barriers. Each of these barriers is detailed below and summarized below in **Table 9**.[52]

[50] *Pacific Power Annual Smart Grid Report*, Docket No. UM 1667.

[51] *In the Matter of the Public Utility Commission of Oregon, Investigation into Distribution System Planning*, Docket No. UM 2005, PacifiCorp Response to Oregon Public Utility Commission Staff’s Utility Survey (Section A through C) and Stakeholder Survey (Section D) (Aug. 30, 2019).

[52] See for example: (1) Blynn, K. et al. (2019). Pennsylvania Electric Vehicle Roadmap. Prepared for the Pennsylvania Department of Environmental Protection. Prepared by Meister Consultants Group, A Cadmus Company. Retrieved from http://files.dep.state.pa.us/Energy/OfficeofPollutionPrevention/StateEnergyProgram/PAEVRoadmap.pdf. (2)

- **Awareness barriers** include those that hinder the awareness of consumers, fleet owners, dealers, policymakers, and other key stakeholders regarding EVs. Examples include a lack of knowledge of the capabilities or costs of EV technology, the available incentives for and operational savings of EVs, or their environmental and other benefits. For example, a recent survey of 1,400 consumers in Pacific Power's territory reveals that well over half of respondents (64 percent) are not aware of any EV initiatives, 70 percent are unaware of the federal tax incentive for EVs, and 77 percent are unaware of the Oregon vehicle rebate.[53]
- **Decision-making barriers** are those that complicate or hinder the ability to choose to invest in EV or EVSE technology. Even if consumers or fleets are aware of EV technology, other barriers may affect their decision to invest in EVs, such as a lack of confidence in the technology's range or availability of charging stations, uncertainty about the consistent availability of incentives, or split incentives between landlords and tenants or fleet managers and owners. Notably, within rural areas (like Pacific Power's service territory), range anxiety is especially problematic, because rural residents on average travel longer distances than their urban counterparts.[54]
- **Economic barriers** refer primarily to the: 1) high upfront costs for EV technologies, and 2) insufficient operating cost savings. Together, these challenges negatively impact the cost-effectiveness of EVs for consumers and fleet owners. Examples impacting upfront costs include high EV and EVSE capital costs, inadequate or unavailable financial incentives to help with the upfront cost, and lack of affordability for low-income populations. Barriers impacting operating cost savings include, for example, a lack of favorable EV electricity rate options; increasing efficiency of gasoline vehicles and low gas prices, which diminish the cost advantage of EVs; and insufficient utilization (mileage) for fleet vehicles, which hinders return on investment.
- **Policy and regulatory barriers** can refer to the absence or limitations of overarching policies—like targets, standards, or incentive programs—that can drive investment in cleaner technologies. Examples include a lack of the overarching mechanisms that drive investment in EVs. These barriers can also take the form of regulations that complicate investment, installation, or other aspects of implementation. Examples of regulatory barriers include restrictions on public procurement methods that hinder fleet EV investment, or a lack of EV readiness codes for buildings and parking areas that increase the installation costs of EVSE.
- **Technical and infrastructure barriers** refer to EV technology or infrastructure limitations that decrease the likelihood that EVs can serve as a replacement for conventional technologies. Examples include range

National Research Council (2013a). Overcoming barriers to electric-vehicle deployment: Interim report. National Academies Press. Washington, DC. Retrieved from https://www.nap.edu/catalog/18320/overcoming-barriers-to-electric-vehicle-deployment-interim-report. (3) Baatar, B. et al. (2019). Preparing Rural America for the Electric Vehicle Revolution. A Report for the American Center for Progress. Washington DC. Retrieved from https://epm.ucdavis.edu/sites/g/files/dgvnsk296/files/inlinefiles/Preparing%20Rural%20America%20for%20the%20Electric%20Vehicle%20Revolution.pdf.

[53] See Attachment 1, Navigant Select Baseline Survey.

[54] Baatar, B. et al. (2019). Preparing Rural America for the Electric Vehicle Revolution. A Report for the American Center for Progress. Washington DC. Retrieved from https://epm.ucdavis.edu/sites/g/files/dgvnsk296/files/inline-files/Preparing%20Rural%20America%20for%20the%20Electric%20Vehicle%20Revolution.pdf

limitations, lack of available electric models for some vehicle classes, loss of range in cold weather due to heating loads, and the challenges of providing charging infrastructure for drivers without a garage or dedicated parking. In rural areas, low population density, remoteness of infrastructure, and low utilization rates all make it more difficult to find optimal areas for public charging infrastructure. Robust collaboration between utilities, government leaders, and other stakeholders (at the local, state, and regional level) will be necessary to address these challenges. Importantly, some of these barriers may diminish over time as EV technologies improve (e.g., as range increases, EVs become a viable option for an increasing share of drivers, especially in rural areas).

- **Supply chain barriers** refer to limitations in access to EV and infrastructure technologies for consumers and fleet owners. Examples include a lack of available EV models at dealerships or a lack of trained technicians for vehicle maintenance, EVSE maintenance, and EVSE installations. Some research has found EV model availability to be an important factor affecting EV adoption.[55] For example, pickup trucks, which are highly desirable among rural Americans, are in development but are not currently available as EVs.[56] In addition, while Oregon has a sales mandate, there is no policy requirement that those sales be spread evenly across all regions of the state, which means model availability could be limited in Pacific Power's (rural) service territory.

[55] Lutsey, N., Searle, S., Chambliss, S., Bandivadekar, A. (2015, July). *Assessment of leading electric vehicle promotion activities in United States cities.* Retrieved from www.theicct.org/sites/default/files/publications/ICCT_EV-promotion-US-cities_20150729.pdf.

[56] Ford has an all-electric F-150 on the way. General Motors estimates it will put an electric pickup on the market in 2021. And EV startup Rivian is scheduled to release its electric pickup in late 2020.

Table 9. General Summary of EV and EVSE market barriers

Barrier categories	Examples of specific barriers to EV deployment
Awareness barriers	▪ Lack of awareness of EV technology availability, performance, and costs ▪ Lack of awareness of co-benefits of EV technology ▪ Lack of awareness of EV incentives and other supportive policies
Decision-making barriers	▪ Lack of confidence in EV technology (e.g., range anxiety) ▪ Lack of confidence in EVSE coverage ▪ Lack of OEM and dealer EV market confidence ▪ Competing financial priorities and capital constraints ▪ Barriers and complications for installing EVSE on rented commercial or residential property or common-interest developments such as HOAs
Economic barriers	▪ High EV and EVSE upfront costs ▪ Low-cost effectiveness of public EVSE investments at low levels of EV adoption ▪ Lack of affordability for low-income populations ▪ Certain electricity rates can limit potential fuel savings ▪ Increasing fuel efficiency of gasoline vehicles and/or low gas prices can limit savings ▪ Low utilization hinders fuel savings and investment payback
Policy/ Regulatory barriers	▪ Permitting and approval process ▪ Limited policy incentives to invest in clean vehicles ▪ New to public procurement methods ▪ Nascent EV-friendly codes
Technical/ Infrastructure barriers	▪ Change in customer refueling experience ▪ Range limitations ▪ Lack of EVSE standardization ▪ Insufficient EVSE coverage to enable certain trips ▪ Insufficient electrical capacity for EVSE installation ▪ Providing EVSE for drivers without dedicated parking (e.g., multifamily)
Supply chain barriers	▪ Lack of available EV models and inventory ▪ Lack of trained EV/EVSE maintenance, EVSE installation technicians ▪ Inefficient supply chain compared to competitors

3.1 Pacific Power's Influence over EV Market Barriers

Pacific Power can influence EV market barriers to varying degrees. Of the six barrier categories in **Table 9**, greatest potential influence lies in four: awareness, decision making, economic, and technical barriers as seen in **Table 10**.

Table 10. Pacific Power's level of Influence on Barriers

Barrier categories	Pacific Power's Level of Influence	
	Less	More
Awareness barriers		***X***
Decision-making barriers		***X***
Economic barriers		***X***
Policy/ Regulatory barriers	***X***	
Technical/ Infrastructure barriers		***X***
Supply chain barriers	***X***	

As the electricity service provider for its customers, Pacific Power has ongoing contact and communications with customers and is uniquely positioned to address awareness barriers through outreach and engagement to educate customers on the availability, applications, costs and benefits of EV technologies and programs. Pacific Power is in the communities it serves every day and can be a trusted resource for technical considerations that the integration of EV will raise for customers. Many years of experience with energy efficiency program assistance, customer service and communications is highly translatable to being effective in increasing awareness.

Notably, a recent study notes that because rural communities tend to have minimal knowledge of EV availability and technologies, the permitting and approval process for EV infrastructure can be unusually lengthy and require extensive stakeholder engagement. In particular, because the majority of stakeholders are not EV drivers, robust stakeholder engagement is often needed to address residents' concerns about losing parking spaces to EV dedicated spaces, skepticism regarding whether the "new technology" will catch on, and education on the potential benefits (and costs) to the community.[57]

Similarly, Pacific Power is well positioned to support comprehensive planning and integration initiatives to enable the build-out of a charging network in the service territory. Through incentives and rate design programs, the Company can be influential in reducing the cost of EVSE capital and operating costs, thereby mitigating economic barriers to deployment.

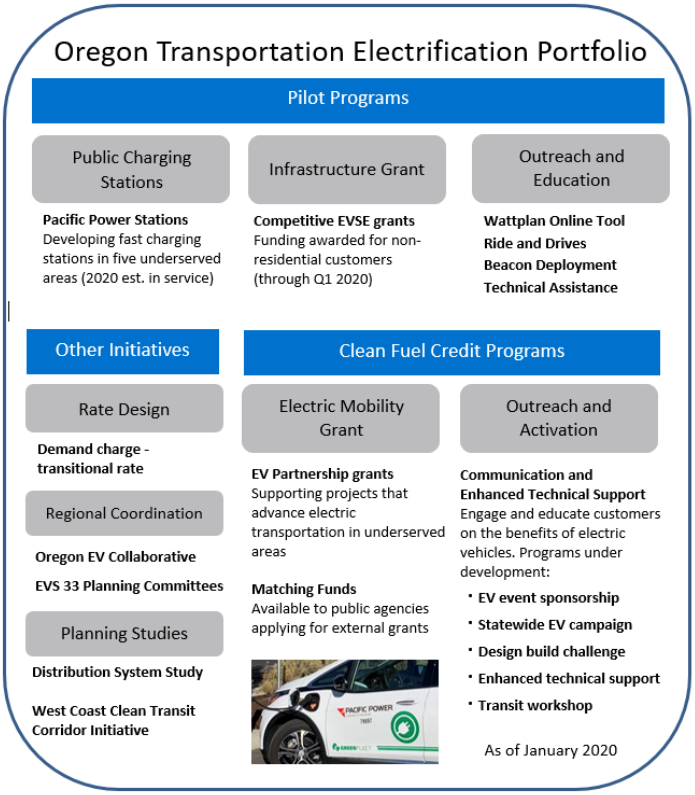
Pacific Power has less influence over vehicle availability or supply chain practices but can align efforts to be complementary to other larger market influences.

[57] (Baatar, B. et al., 2019).

4 Pacific Power Investments, Programs and Actions

The Company is currently engaged in a range of activities which address market barriers in support of TE transformation across three categories: 1) Implementation of customer pilot programs, 2) Aggregation, monetization and program design of CFP actions: 3) Coordination across efforts in other PacifiCorp states, and 4) Regional collaboration and research. A snapshot of the program an initiatives are provided in **Figure 12** below and greater detail on specific program is provided in **Appendix D. Pacific Power Current Programs**.

Figure 12. Pacific Power Existing Transportation Electrification Portfolio



In reviewing the broad range of current activities to help plan actions going forward, the need for a framework to organize and connect the pieces emerged, starting with objectives. Guided by state policies and a commitment to be responsive to customer needs for sustainable, reliable and affordable provision of essential energy services, Pacific Power's role in TE transformation is guided by three objectives:

1) Accelerate consumer adoption of TE by increasing customer awareness and understanding of TE alternatives, and supporting equitable access to charging infrastructure;

2) Efficiently, prudently, and safely integrate and manage new loads from TE on the Pacific Power system to the benefit of all customers; and

3) Integrate renewables on the system to reduce carbon intensity and lower the cost to serve new loads from TE.

For each category of activities below, **Appendix D. Pacific Power Current Programs** provides additional background for the initiation of the work and then details on the current state of work.

Overall, the Company's Oregon TE portfolio is growing and the elements bring together new initiatives and programs that cross a range of activities and two primary funding sources. At the same time, the EV market is also growing and changing fast. As implementation of the Company's programs and future efforts mature, the Company will continue to work to make the programs complementary across funding sources and increasingly consistent for customers.

4.1.1 Implementation of Customer Pilot Programs

Pacific Power designed its initial TE pilot programs to help reduce market barriers identified in its service area, while complementing and enhancing the efforts of other market actors working to accelerate TE in Oregon. The proposed pilot programs are designed to test different market intervention strategies, gather data, and develop experience that will be used for future system and program planning. The estimated investment of $4.6 million over three years by pilot program is listed in **Table 11**.

Table 11. Pacific Power Transportation Electrification Pilot Programs

Pacific Power Transportation Electrification Pilot Programs[58]
Public Charging Pilot Pacific Power will install, own and operate publicly accessible charging stations in its Oregon service area
Outreach and Education Pilot Tactics and messages that increase exposure and access to reliable information about electric transportation options and benefits
Demonstration and Development Pilot Grant funding to help non-residential Pacific Power customers develop creative, community-driven EVSE projects

A common theme of the regulatory process when seeking approval for these pilot programs was the impact of limited data and experience from which to frame costs and benefits.

Given the pilot nature of these programs and the uncertainty around program participation and utilization, two major drivers of program costs and benefits, prospective cost-effectiveness analysis was not performed for the proposed pilots. The Company provided program-specific budgets to capture estimated costs but did not attempt to quantify benefits.

Through Order 18-075 approving the Company application for the pilot programs, the Commission also directed Pacific Power to fund and develop an attribution model and a cost effectiveness framework for future evaluation and program development. Related to cost effectiveness, Pacific Power has since participated in Staff workshops and worked with PGE to develop a revised RIM test which narrows costs to the customer perspective and includes select environmental and societal costs which can be monetized.

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

One necessary input to any cost effectiveness test is a measurement of program impact or attribution. Quantifying attribution starts with creation of a counterfactual, a forecast of what adoption would have looked like without the program, which is then compared to actual adoption. Market transformation for energy efficiency programs, informed by market adoption data and similar past experiences, have used complex models for this purpose of attribution with success. However, for these pilot programs, parsing attribution with multiple other influences on customer behavior in the market, measuring influence may be challenging within the planned evaluations.

The Company will include an assessment of pilot costs and benefits as part of pilot evaluation efforts, and will use evaluation results to inform future program planning and TE strategy.
Program specific detail is provided in **Appendix D. Pacific Power Current Programs**.

4.1.2 Clean Fuels-Funded Programs

In July 2017, the Commission directed Pacific Power to register as a generator of residential clean fuels credit.[59] The Company developed its Oregon CFP in response to Commission Order No. 18- 376, which requested utilities file a proposal CFP after the first program year that utilizes Oregon Clean Fuels funds in accordance with Commission approved principles. Order No. 18-376 established a schedule for the CFP selection process and required utilities to file their final program(s) and expenditure plans in docket UM 1826 in November 2019. In compliance with Order No. 18-376 and the schedule established in docket 1826, the Company submitted a filing to provide an overview of Pacific Power's planned program design and expenditure for the CFP funds in 2020, which consists of the programs listed below in **Table 12**.

Table 12. Pacific Power Clean Fuels-Funded Programs

Pacific Power Clean Fuels-Funded Programs[60]
Electric Mobility Grant Program Funding for electric transportation projects that benefit residential customers and traditionally underserved communities.
Outreach and Education Electric transportation offers numerous benefits for both individual drivers and communities as a whole, yet most residential Pacific Power customers are unaware of these benefits. The Company's outreach and education programs use both broad and specific education and marketing tactics to increase electric transportation adoption in the state.

[59] The Company is separately generating non-residential credits from its public charging and demonstration and development pilots, which are used to offset the costs of those programs.
[60] *In the Matter of PacifiCorp d/b/a Pacific Power*, *Application for Transportation Electrification Program*, Docket No. UM 1810, PacifiCorp's Supplemental Application (April 12, 2017).

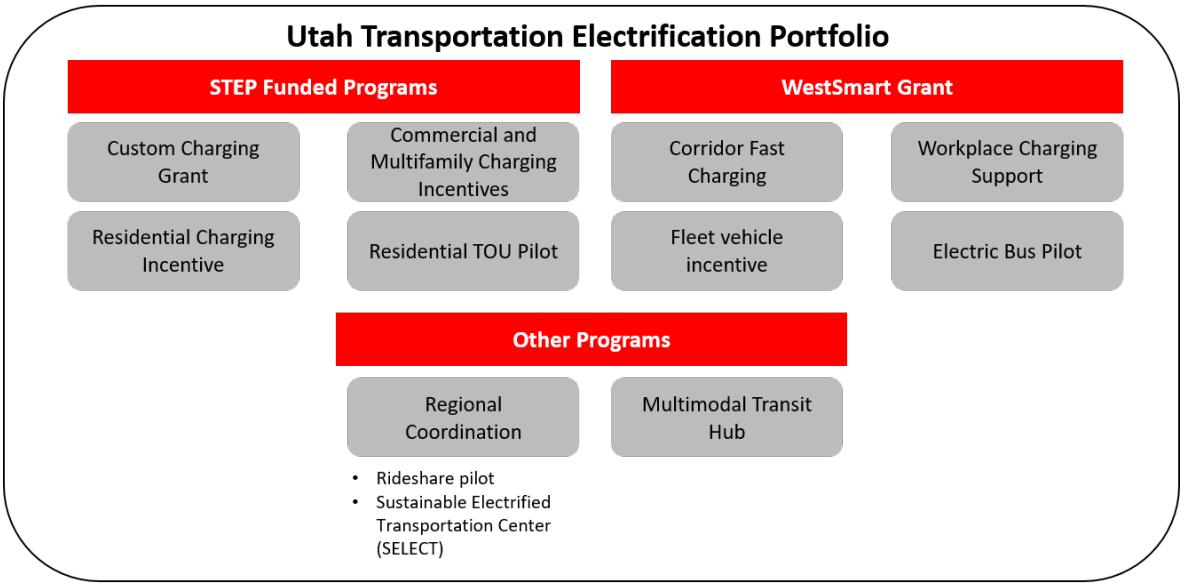
Additional information on these efforts, results and budgets can be found on the Oregon Public Utility Commission's website under Docket No. UM 1826.[61] Program specific detail are provided in **Appendix D. Pacific Power Current Program**

4.1.3 Coordination across PacifiCorp States

PacifiCorp is a six-state utility, which allows coordination across programs and states. PacifiCorp serves communities in Idaho, Utah and Wyoming as Rocky Mountain Power. PacifiCorp staff working on Electric Transportation across the Company are in close coordination and benefit from sharing program implementation lessons learned and emerging opportunities.

In Utah, the Company has engaged in electric transportation investments through the Utah Sustainable Transportation and Energy Plan (STEP) and a grant (WestSmart) from the US DOE. The STEP TE infrastructure incentive program provides funding through 2021. The WestSmart grant for $4 million was awarded in January 2017 and will continue through the late 2020. The figure below provides a snapshot the portfolio of PacifiCorp's Utah programs in **Figure 13**.

Figure 13. PacifiCorp Utah Transportation Electrification Portfolio



4.1.4 Regional Initiatives

In parallel with the customer pilot programs and programs funded by Clean Fuels funds, Pacific Power is closely monitoring relevant regional initiatives that complement and augment the company's work.

4.1.4.1 Stakeholder Engagement

During the development of this TE plan, Pacific Power engaged stakeholders on December 16, 2019, and January 16, 2020. These meetings were used to inform Pacific Power's knowledge of market barriers, forecast

[61] *In the Matter of Public Utility Commission of Oregon, Investigation into Utility Participation in Oregon Clean Fuels Programs*, Docket No. UM 1826, Staff Report (April 18, 2017).

development, and future intervention strategies. Pacific Power values the input it received through the stakeholder engagement process and would like to thank stakeholders for their thoughtful participation.

4.1.4.2 Leading by Example

PacifiCorp is transitioning the Company's fleet to EVs. The company currently has two BEVs and one plugin hybrid and is planning to purchase only BEV sedans. The vehicles are used as staff pool cars and often on display at community events where customers can ask questions and hear about the experience from staff. As soon as electric trucks and working vehicles are available the Company will phase in those technologies as older equipment is retired.

4.1.4.3 Community Action Plans

Many of Pacific Power's Oregon communities have adopted community action plans with voluntary actions and goals. These plans include electric transportation objectives and serve as a roadmap for communities to pave a path to a sustainable future as illustrated in **Figure 14** and **Figure 15**.

Figure 14. Example Community Action Plans for Corvallis and Hood River County

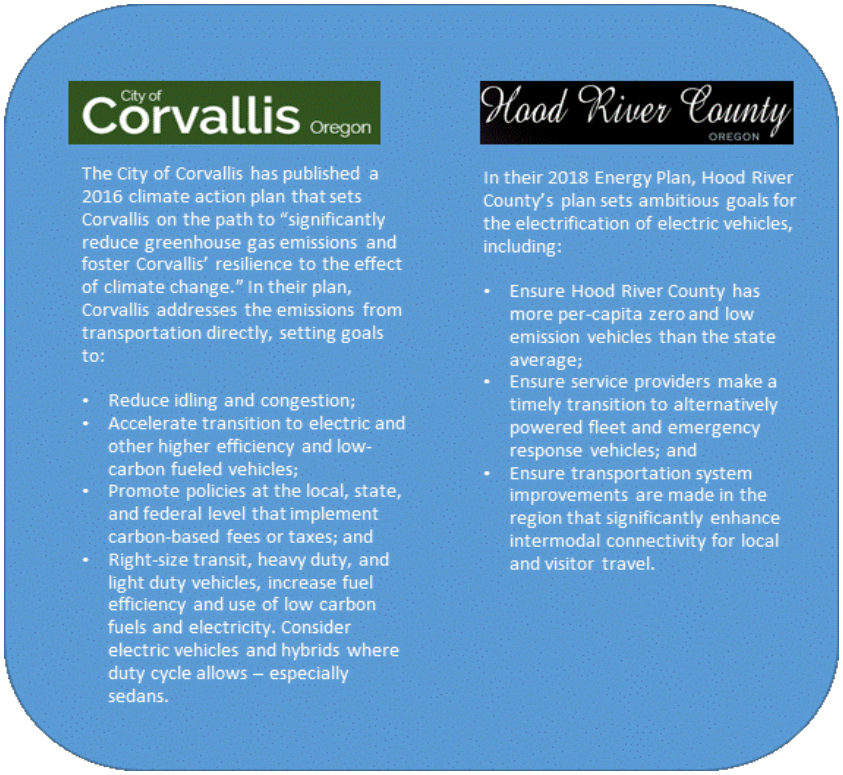
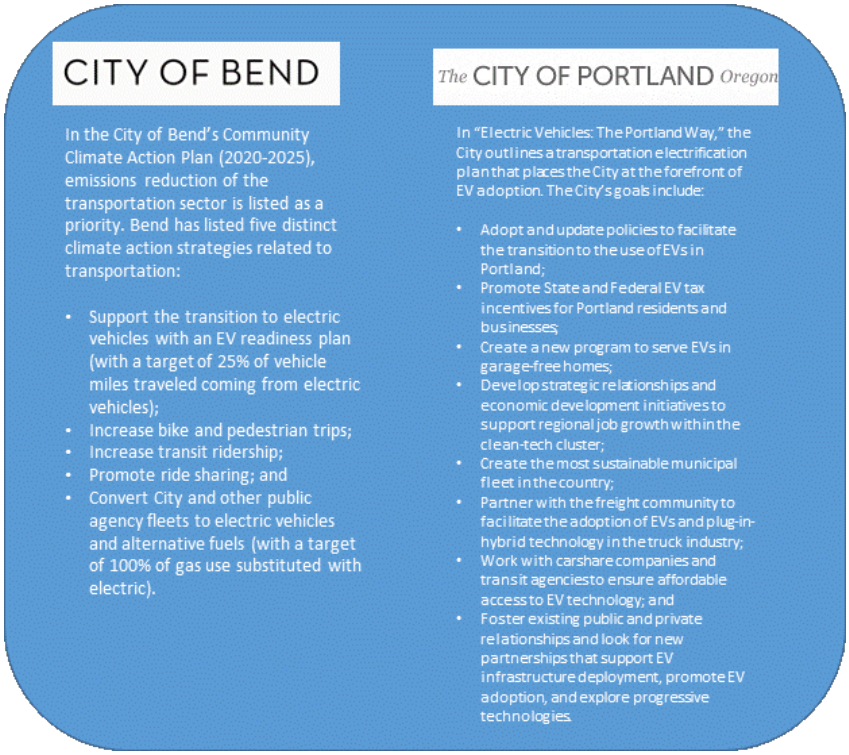


Figure 15. Example Community Action Plans for Portland and Bend



4.1.4.4 West Coast Clean Transit Corridor Initiative (WCCTCI)

Eleven utilities across the states of Washington, Oregon and California sponsored the WCCTCI which aims to determine how best to ensure that Interstate 5 from the Canadian to the Mexican border is equipped with sufficient charging to support electric medium- and heavy-duty vehicles.

4.1.4.5 West Coast Collaborative Alternative Fuel Infrastructure Corridor Coalition (WCC AFICC)

The WCC AFICC aims to accelerate the modernization of west coast transportation corridors by deploying alternative fuel infrastructure for medium and heavy-duty vehicles and equipment in synergy with other investments. This effort is a public-private collaboration to plan projects, leverage funding, and construct modernized corridors with alternative fuel infrastructure that will create jobs, increase domestic fuel supply diversity, reduce emissions, improve public health and support more robust medium and heavy-duty fleet operations.[62]

4.1.4.6 West Coast Electric Highway

The "West Coast Electric Highway" is an extensive network of EV DC fast charging stations located every 25 to 50 miles along Interstate 5, Highway 99, and other major roadways in British Columbia, Washington, Oregon, and California. The initiative is a collection of projects, funding sources, and partners with the same vision—

[62] https://westcoastcollaborative.org.

to provide a network of fast charging stations enabling EV drivers to make longer trips and travel between cities.[63]

4.1.4.7 Electrify America

Over a 10-year period ending in 2027, Electrify America will invest $2 billion in ZEV infrastructure, access, and education programs in the United States. Of this $2 billion, $800 million will be invested in California, one of the largest ZEV markets in the world. The remainder will be invested throughout the United States, providing support to current EV owners and those interested in learning more about the benefits of driving EVs.[64]

5 Future Intervention Strategies

Pacific Power has an important role to play in addressing barriers and accelerating development of the EV market in its service territory. As described in Section 4, Pacific Power has already piloted a range of initial market programs in response to specific Commission requests. The early programs have provided a foundation of knowledge and experience on which Pacific Power will build.

The following section describes Pacific Power's proposed strategic approach to accelerate EV market development in its service area and contribute to Oregon's broader goals of an EV market transformation. To the greatest extent possible, Pacific Power seeks to take an evidence-based approach to market development, deploying policies and programs that have been shown to be most effective. To this end, the Company draws on findings from the PEV Policy Evaluation Rubric, which was created by National Association of State Energy Officials (NASEO) and The Cadmus Group (Cadmus) in close coordination with Electrify America and an external advisory committee, to evaluate the impact of policies on PEV adoption across the U.S.[65]

Specifically, the Company categorizes market interventions across the following strategic framework. Within these categories, the Company seeks to apply interventions that are shown to have the greatest impact on the market *and* that are able to be successfully deployed. Categories of interventions are listed below in descending order of effectiveness in transforming the market.

- **Reducing Upfront and Operational Costs of EV Ownership**. The best available evidence suggests that programs like vehicle purchase grants, rebates, and other incentives that reduce the upfront cost of owning EVs and EV infrastructure are the most important market intervention that states, cities, and utilities can implement to drive deployment of EVs in emerging market areas. Similarly, financing programs can help end-users overcome the high upfront costs of EV ownership. While operational costs are part of the accepted costs of vehicle ownership, they tend to be less influential in vehicle purchase decisions than

[63] West Coast Green Highway, West Coast Electric Highway, http://www.westcoastgreenhighway.com/electrichighway.htm (last visited Jan. 31, 2020).
[64] Electrify America, *Our Plan*, https://www.electrifyamerica.com/our-plan (last visited Jan. 31, 2020).
[65] Morrison, G., Veilleux, N. & Powers, C., PEV Policy Evaluation Rubric: A Methodology for Evaluating the Impact of State and Local Policies on Plug-in Electric Vehicle Adoption, National Association of State Energy Officials (NASEO) and The Cadmus Group (2018) *available at* https://naseo.org/Data/Sites/1/pevpolicyrubricmethodology_naseo.pdf.

upfront costs. As it relates to Pacific Power's sphere of influence, this category primarily includes potential programs and policies that improve operational costs associated with vehicle operation or travel such as rate design that avoids creating a disincentives for EV charging.[66]

- **Sending Long-term Signal to Market**. There is widespread agreement that market interventions that send a long-term signal about the stability and certainty of market development—like binding EV deployment targets (*e.g*. the ZEV mandate)—are key drivers of EV adoption.
- **Improving Access and Economic Viability of Charging**. Policies that facilitate the adoption of EVSE, either through direct incentives for EVSE installation or by helping the business case of EVSE, can improve the economic viability of charging. Especially because of the rural nature of Pacific Power's territory—and the relatively high levels of range anxiety (compared to urban areas)—incentives and initiatives to improve the economic viability of charging or otherwise increase the availability of EVSE infrastructure will be important to support long-term market development.
- **Increasing Awareness and Education**. There is widespread agreement among experts that supporting marketing and communication initiatives, community support programs, and other outreach and education programs are important to stimulate local market development. When run by the utility, these programs can effectively build on existing customer relationships and insights.
- **Improving EV and EVSE Planning**. Planning activities at the municipal, utility, or community levels can influence development of the EV market. A number of sub-categories, including (1) EV and EVSE planning, (2) EV-Ready building codes and zoning ordinances, and (3) streamlined EVSE permitting, are not squarely within the purview of the utility and there is not significant empirical evidence quantifying the impact of such initiatives on EV deployment. Nevertheless, market experts and practitioners have highlighted the importance of things like technical assistance and partnerships on new construction as approaches to developing robust markets.[67]

As Pacific Power designs specific interventions, the Company will incorporate the following key design aspects:

Transportation Diversity, Equity, and Inclusion

Low-income communities and communities of color are disproportionately impacted by the lack of access to transportation options. Pacific Power recognizes that frontline communities in outlying urban and rural have been traditionally underserved by public transit, generally have less access to transportation options compared to the urban core and experience greater barriers to electrification. There are many barriers to TE that these communities face compared to their more affluent counterparts. In a 2018 Mobility Needs Assessment survey conducted by Verde, 55 percent of residents in the Cully neighborhood did not have a

[66] Please note, Pacific Power seeks to develop EV policies and programs that complement federal, state and city initiatives. For example, the Oregon DEQ Oregon Clean Vehicle and *Charge Ahead Rebate* programs offers Oregonians up to $5,000 on the purchase or lease of a qualifying EVs. Accordingly, because Oregon DEQ already offers incentives to reduce upfront costs, Pacific Power proposes to focus on programs that reduce operational costs of EVs for this category.

[67] Research on the impact of such initiatives often relates to the impact on EVSE availability and/or cost of installing EVSE rather than on the impact on EV purchases.

driver's licenses and solely relied on public and shared transportation.[68] Previous car share models like Car2go and ReachNow included EV models in their fleet but limited service in underserved areas. Both of these car services have since experienced business closures. Ensuring clean and equitable transportation for these communities is essential. A publication by The Greenlining Institute outlines four steps to addressing equity in mobility projects:[69]

1) Embed Equity in the Mission, Vision, & Values
2) Build in Equity in the Process
3) Implementation: Ensure Equity Outcomes
4) Measure & Analyze for Equity

Pacific Power intends to use this approach in program deign in partnership with community-based organizations. In the past, the Company has collaborated on pilot projects to address inequalities. One of these projects with Forth, the Hacienda CDC car share program, provided a total of 66 community rentals and 2,000 driving miles over the course of the project.[70] There are many key takeaways from this project; primarily, that barriers to infrastructure can be alleviated with creative public and private partnerships. It is the Company's intent to propel TE in these communities by imbedding equity and inclusion goals with future projects.

Coordination of Programs and Funding

Pacific Power will assist customers in leveraging a variety of available funds to achieve TE goals. The Company can serve as a central hub for information, can help potential customers navigate funding opportunities, and can ensure that funding is "stackable" (for combination) with other sources. This approach will help address economic and awareness barriers by increasing the pool of funds that can be drawn upon for TE and by expanding customers' knowledge of parallel TE programs.

Grid Integration

Likewise, Pacific Power seeks to design current programs to enable greater opportunities for managed charging, load shifting, and other dynamic approaches in order to integrate new TE load in the future. Planning for future advanced grid management opportunities will influence how Pacific Power prioritizes technologies, program designs, and market interventions in the near-term. By preparing today's programs and technologies for tomorrow's capabilities, Pacific Power aims to maximize value of customer and public investments in a rapidly changing and dynamic field.

5.1 Summary of Potential Intervention Strategies

Table 13 below describes specific initiatives that Pacific Power may consider in order to accelerate market development efforts in its territory. This is not a definite list, other interventions may be considered as

[68] VERDE, *Verde presents the Living Cully Community Mobility Needs Assessment* (October 26, 2018), http://www.verdenw.org/verde-news/clean-mobility-assessment
[69] Greenlining, *Mobility Equity Framework: How to Make Transportation Work for People* (March 21, 2018)
[70] Forth, *Electrifying Community Car Share* (June 28, 2018)

market conditions evolve. The table indicates potential timing of such initiatives, including: **(1) short-term interventions** that would be considered within one to two years and **(2) medium-term initiatives** that would be considered within two to five years.

Table 13. Summary of Potential Future Intervention Strategies

Category	Potential Intervention Strategies	Timing
Reducing Costs of EV Ownership	Efficient rate structures and pricing programs	Short/Medium-term
Sending Long-term Signal to Market	Develop EV Market Potential & Planning Studies	Short-term
	Broaden EV Adoption Target for Pacific Power's Own Fleet	Medium-term
Improving Access and Economic Viability of Charging	Updated Non Residential Line Extension Allowance	Short-term
	Develop a Residential EVSE Infrastructure Incentive Program	Short-term
	Expand the Grant Program for Non-profits and Public Entities (expansion of existing programs)	Short-term
	Develop a Commercial EVSE Infrastructure Incentive Program (includes Multifamily)	Short-term
	Assess public charging station program	Medium-term
	Develop a Fleet EVSE Make-Ready Incentive Program	Medium-term
Increasing Awareness and Education	Expand Technical Assistance	Short-term
	Provide Customers with High Quality EV Experiences (expansion of existing programs)	Short-term
	Develop and grow EV adoption strategies through broad stakeholder engagement (expansion of existing initiatives)	Short-term
	Provide Shared Use and/or Pooled EV Opportunities	Medium-term
	Support Workforce Training	Medium-term
Improving EV and EVSE Planning	Assess Transit Fleet Potential	Short-term
	Encourage EV-Ready New Construction for Residential Buildings	Short-term
Note: *This plan does not seek Commission approval of Pacific Power's current or future programs, investments, or initiatives nor is this list inclusive of all concepts that may be considered before the next plan is due. Pacific Power plans to continue to engage Commission Staff and external stakeholders as part of determining priorities for future program efforts and initiatives.*		

5.1.1 Reducing Upfront and Operational Costs of EV and EVSE Ownership.

Current and near term actions already underway: Pacific Power is actively involved in a number of initiatives today that play a part in reducing operational costs of EV ownership.

- In its next Oregon general rate case filing (anticipated in 2020), Pacific Power anticipates proposing cost-based rates that promote TE. This will include time-varying rate pilot(s) and will seek to address issues

surrounding the affordability of incremental energy consumption. TOU rates address economic barriers by offering options to manage the cost of EV operation.

- Schedule 45 is an innovative rate design favoring off-peak charging and transitions the balance of rates between demand and energy to encourage use.

Future actions for consideration:

- **Efficient Rates and Prices.** Electricity rates can be designed to promote TE along with increasing efficiency, affordability, and integration of renewables. In Utah, the Company is currently piloting new residential time-of-use rates for electric car owners. The results of this work may inform future rate design.

  Medium- and heavy-duty fleets. The aim of these rates would be to shift bills from demand charges to energy charges in order to decrease the significant financial barrier that demand chargers pose to high-powered charging and therefore increase the financial feasibility of fleet charging. Exploring financing structures may also provide an important benefit.

  Commercial light-duty fleets and multi-family residences. Concentrations of light-duty charging depots, whether for commercial purposes or at multi-family residential sites, can serve as assets to the grid if rates properly reflect the value of these resources to grid operations.

5.1.2 Sending Long-term Signals to the Market

Current and near term actions already underway: The Company is actively involved in a number of initiatives today that play a part in sending a long-term signal to the market.

- Most notably, the Company has installed its first fast charging station in Madras, Oregon with four additional locations in other parts of the state coming on line in 2020. This is notable as many part of the company's service area remain underserved with charging infrastructure.

- Pacific Power is in the initial stages of developing workshops to support transit agencies with the exploration of electric buses.

- Pacific Power is actively engaging in community stakeholder meetings, including with the City of Portland, to identify barriers and potential solutions to tenant EV charging.

- The Company is also currently collaborating with utilities across the west in the West Coast Clean Transit Corridor Initiative, the Oregon Electric Vehicle Collaborative, and the Electric Vehicle Symposium (EVS) 33 Planning Committee.

Future actions for consideration:

- **Develop EV Market Potential & Planning Studies.** The Company could perform a variety of market and infrastructure planning studies. These studies would inform Pacific Power's market development goals and send market signals about public and private sector investment opportunities. In doing so, Pacific Power would reduce uncertainty in the market and encourage further investment in EV infrastructure. The availability of clear information on development trends and market opportunity

will address decision-making barriers through increased market confidence of original equipment manufacturers (OEMs), dealerships, and potential EV drivers.

Market and infrastructure planning studies could provide quantitative and qualitative assessments of the propensity to adopt EVs in key market segments, including by customer type and customer activity. Customer types could include residential, commercial, industrial, agricultural, or municipal customers and target common or strategic vehicle types in the Company's service territory such as working vehicles. Customer activities studied could include average daily vehicle miles traveled, types of vehicles in use, and duty-cycles. To provide insights on these key market segments, the studies could include technical and economic potential assessments, customer adoption assessments, and grid infrastructure impact assessments, among other analyses.

- **Increase EV Adoption for Pacific Power's Own Fleet.** If properly branded, Pacific Power can increase public exposure to EVs when driving them on public roads during the daily operations of its business. Further, Pacific Power will gain valuable data on maintaining a fleet of EVs, including: total cost of ownership, infrastructure needs, and best practices for EV charging. Opportunities will increase as working trucks become available in the market.

5.1.3 Improving Access and the Economic Viability of Charging

Current and near term actions already underway: The Company is actively involved in a number of initiatives today that improve the economics of charging infrastructure for customers.

- The competitive EVSE grant program has reduced the cost of installations for 32 non-residential grant projects to date.
- In addition, the Electric Mobility Grant funded through Clean Fuel Program Credits is designed to target funds towards nonprofit and public entities for projects which benefit residential customers in underserved communities. The Company anticipates $1.3 million of grant awards in 2020 under this program.

Future actions for consideration:

- **Updated Line Extension Allowance**. The Company is considering a more expansive line extension allowance for non-residential TE (e.g., DC fast charger, bus charging, and commercial fleet charging). An expanded line extension policy would help address interconnection and grid upgrade costs that can make developing charging infrastructure infeasible for customers while maintaining benefits for all ratepayers due to increased revenues. Therefore, this program would help address economic and policy barriers.
- **Residential EVSE Infrastructure Incentive Program.** The vast majority of charging takes place at home; this is even more pronounced in rural markets like some of Pacific Power's service territory, where private EVSE developers have not made significant inroads due to low EV market penetration. Level 2 charging can be especially important in rural communities where EV drivers regularly deplete significant charge in the course of routine trips due to the distance between destinations. This EVSE

incentive would reduce up-front costs of installing a charger, addressing economic barriers to EV adoption. The incentive would be for the purchase and installation of a Level 2 charger, including licensed electrician labor, materials, and permits. This program would be coupled with a TOU rate or future direct load control program to efficiently manage the charging load on the system.

- **Expand the Infrastructure Grant Program.** The existing grant program has seen significant customer interest and has stimulated the development of new EV charging infrastructure. Providing incentives for EVSE has decreased the cost for the site host and increased the economic viability of projects. The goals of the program are two-fold. First, to increase certainty of funding for customers who need time to scope projects and secure additional funding sources. Second, this expansion will seek to integrate technical assistance services to improve the quality of applications.

- **Develop a Commercial EVSE Infrastructure Incentive Program**. The Company will build upon experience with the existing EVSE grant program and the lessons learned specifically for commercial workplace customers. Decreased economic barriers lead more workplaces to install EVSE, providing a more robust charging network and therefore reducing range anxiety for drivers. Additionally, installing EVSE at workplaces can significantly increase public exposure to EVs.

  Moving beyond a customer grant approach, the Company is considering offering a streamlined prescriptive incentive approach for qualifying equipment, similar to the program currently offered by Rocky Mountain Power in Utah. The objectives of this program would be to:
  - Encourage the development of new EV charging stations at non-residential locations;
  - Address upfront cost barriers through financial incentives;
  - Potentially utilize charging equipment for demand response; and
  - Gather data.

- **Assess and Consider Expansion of Public Charging Station Program.** As a ***medium term*** concept, in addition to incentives for charging equipment, the Company will assess its existing public charging station program. That assessment will help provide direction on future steps

- **Develop a Fleet EVSE Make-Ready Incentive Program.** These programs can significantly reduce the cost of installing EVSE for site hosts, increasing the economic viability of installing EVSE. Fleets are good candidates for a make-ready program because the concentrated load at fleet sites can trigger significant and costly upgrades to local grid infrastructure. Additionally, the managed nature of many fleets provides opportunities to optimize load to align with the needs of the grid and maximize benefits across the system that will accrue to all customers. In the short term, the Company can work to assess potential for specific types of fleets, such as transit agency opportunities, to inform development of this program.

This program would ensure that all conduit and wire is pulled to the station location(s), all concrete work is completed properly so the stations can be mounted, and any cellular repeaters are installed if required. An EVSE make-ready program could be structured to provide rebates in stages based on the achievement of

various project development milestones as a way to mitigate the up-front costs that site hosts would incur as they develop fleet charging infrastructure.

5.1.4 Increasing Awareness and Education

Current and near term actions already underway: The Company is actively involved in a number of initiatives today that improve customer awareness and education, leading to informed decision making.

- The Outreach and Education Pilot has led to the implantation of Wattplan, an online decision support tool for customers, multiple "Ride and Drive" events throughout the state, technical assistance assessments for over 30 Oregon customers, and the deployment of three Chargeway Beacons.
- Outreach and Education actions from Clean Fuels Credit funds will be designed to educate residential customers in underserved communities on the benefits of EVs.
- Also noted under Sending a Long Term Signal to the Market, Pacific Power is collaborating with communities and cities that are actively looking for ways in which to accelerate their transition to TE for their communities.

Future actions for consideration:

- **Expand Technical Assistance.** The Company could expand technical assistance (TA) offerings to help customers identify opportunities for charging at their facilities. This strategy would help address both decision-making and technical barriers. It would expand EVSE coverage, inspiring greater confidence in EVSE availability and reducing range anxiety among new EV adopters. Expert TA could also maximize charging opportunities available at any one location.

  Currently EVSE TA is available from the Outreach and Education pilot through the C2 Group for commercial customers. A similar program could expand on these services to enhance uptake in residential Light-Duty vehicle markets or industrial medium- and heavy-duty vehicle markets. Expanded service could lead to engaging more customers across a broader spectrum.

- **Provide Customers with High Quality EV Experiences.** By providing high quality EV experiences for communities, the Company can address awareness barriers by informing customers about EV technology, performance, and costs. In addition, this will provide an opportunity for the Company to inform participants of the co-benefits of EV technology and the programs and policies available to them.

  "Ride & Drive" events can be developed a few different ways. For example, the Company could provide an EV for Driver's Education courses at high schools in its service territory. Another method would be to provide "Ride & Drive Responsibly" demonstrations at community events. The Company could also provide EV loans to community influencers who could in turn share their experience more broadly with the community. One other example would be to partner with car rental agencies for EV rental programs.

- **Develop and grow EV adoption strategies through broad stakeholder engagement.** Engaging existing EV working groups or convening new ones would help address awareness barriers as members can comment on existing programs and how effectively they address local market barriers. They could also inform and vet new program ideas for future exploration by Pacific Power.

  EV working groups can exist at the local or state level - from increasing awareness in a local, tough-to-break-into market, to informing state-wide policies and programs. Membership might include local market influencers such as political leaders, church leaders, auto dealerships or key community advocates. Regardless of whether Pacific Power is convening a new group, or engaging an existing one, the Company will endeavor to ensure that working groups are equitably representative of the communities they will influence.

- **Provide Shared Use and/or Pooled EV Opportunities.** As a ***medium term*** concept, the Company will explore options to provide grants to support innovative electric transportation programs like a sharing/rental program for electric working vehicles (fork lifts, tractors, etc.) or a Clean VanPool program. This program can address both awareness and economic barriers. By creating a shared program, Pacific Power can give customers the opportunity to experience medium-duty EVs without the upfront purchase cost. It also gives customers the opportunity to understand the technology, performance, and costs of EVs and experience the co-benefits. A Clean VanPool program can also increase the visibility of medium-duty EVs and reach traditionally underserved communities.

  Pacific Power's involvement could be in providing grants or developing a rebate program. These financial incentives could support the charging infrastructure or another component of the sharing program. The Company could assess locations that would benefit the most from these shared programs and determine what kind of financial incentive system would best support them.

- **Support Workforce Training.** In the ***medium term***, the Company could sponsor training courses or workforce development programs to enhance knowledge in the local market. This program would increase the amount of skilled labor in the region available to support a growing EV and EVSE market. By creating more professionals confident in their understanding of EV and EVSE technology, this program could address supply chain, economic, and awareness barriers. It would increase awareness of EV and EVSE technology, inspire confidence in expanding EVSE coverage, and grow the local skilled labor population who can service and install EVSE.

5.1.5 Improving EV and EVSE Planning

Current and near term actions already underway: The Company is currently involved in actions that support informed planning practices.

- Distribution Planning runs system impact studies for specific large charging infrastructure proposals as well as broader system impacts and will be engaged in UM 2005, Distribution System Planning.

- Also represented under Sending a Long-Term Signal to the Market, the Company is actively engaged with several communities, providing technical support for EVSE components of their sustainability plans and with transit agencies interested in planning an infrastructure transition to EV.
- The Company is also currently collaborating with utilities across the west in the West Coast Clean Transit Corridor Initiative

Future actions for consideration:

- **Assess Transit Fleet Potential.** There are multiple transit agency bus fleets within the Company's service territory, two of which have electric buses. Fleet sizes vary as do the service route terrains and utilization rates. In the short term the Company could assess the factors related to decision making for these transit agencies and as appropriate, could assist with education and technical support within planning processes. This action would inform future development of a Fleet EVSE Make-Ready Incentive Program, as described above.
- **Encourage EV-ready New Construction.** The Company could develop a program that encourages cities to require builders to wire new homes with service and outlets necessary for EVSE at the time of construction. As appropriate, the program may include TA offered to builders on EV-Ready requirements. Requiring new homes to be EV-ready significantly reduces the overall cost of installing an EV charger. By improving the economic viability of installing EVSE, EV-ready new construction programs can reduce economic barriers to EV adoption. Installing infrastructure that allows drivers to fully charge an EV overnight also helps address decision-making barriers related to range anxiety.

  The Company could partner with Energy Trust of Oregon, who currently implements a program for energy efficiency and solar-ready new construction. The Company could further work with state agencies to encourage adoption of the EV-ready building codes recently approved by the International Code Council (ICC) as part of the changes to its building standard.

As noted in the Introduction, this plan does not seek Commission approval of Pacific Power's current or future programs, investments, or initiatives. Pacific Power plans to engage Oregon Commission Staff and external stakeholders as part of any development of future programs and initiatives.

6 Conclusion

Pacific Power plays an important role in the transformation of the TE market in Oregon. The Company's objectives are to ease barriers to adoption for customers, ensure this new load is integrated most efficiently into the system, and continue to reduce the GHG intensity of the resource portfolio. To meet these objectives, Pacific Power plans to:

1) ***Continue existing programs and actions***, which are in early stages of implementation but show promising results, to inform future actions.
2) ***Consider expansion of awareness, education and decision making actions*** aimed to connect the dots for customers where the Company is best suited to assist.

3) ***Couple awareness and decision actions with programs to address first and ongoing costs of ownership*** which are designed to generate benefits for and be accessible to all of the Company's Oregon customers.
4) ***Signal a long term commitment to transforming the market*** through supporting infrastructure planning efforts and participating in regional planning work and studies.

The Company's established and ongoing role in these communities provides a unique position to implement these actions effectively. In the short term, the focus will be on ensuring no customers are left behind by improving access to charging infrastructure in public areas throughout our service territory.

Transforming the TE market will require coordinated work of many entities. Pacific Power looked to stakeholders and partners to help develop this plan through two workshops with stakeholders in December of 2019 and January of 2020. Pacific Power's plan aims to apply feedback from those meetings to future interventions and strategies which will have the greatest near-term impact on the market *and* that are within the Company's capacity and purview to successfully deploy. The Company will use these potential intervention strategies as guiding points to developing programs in the future. As **Table 13** illustrates, there are a large number of impactful actions worthy of further consideration. The sheer volume highlights the need for further prioritization. As this moves forward, important choices will need to be made to balance costs, risks and benefits of achieving key objectives. Pacific Power is committed to continuing to work with stakeholders to ensure that parties are working in partnership to tackle this challenging task of transforming the market.

Appendix A. State Programs and Policies

2020 Session Version of 2019 House Bill 2020: Statewide Greenhouse Gas Emissions Reductions

While cap and trade legislation did not pass in 2019, legislative leadership and the environmental community have expressed their determination to pass some form of carbon reduction legislation during the 2020 legislative session. PacifiCorp staff have been active and productive participants in relevant interim meetings.

Senate Bill 1044: Zero-emissions Vehicles

In 2019, Oregon Senate Bill 1044 created aggressive goals for vehicles owned in Oregon through 2035. It also established certain requirements for state agency fleet purchases and leases of zero-emission vehicles and requires that at least 25 percent of new light-duty vehicles owned or leased by the state be zero-emission vehicles by 2025. The bill also authorizes school districts to use public purpose charge moneys for school district fleet audits, for the purchase or lease of zero-emission vehicles and for the purchase or installation of EV charging stations.

Oregon Solutions Process: Accelerated Electric Transportation

In 2018, the Oregon Electric Vehicle Collaborative was created as a new project under the Oregon Solutions Process. Oregon Solutions began with the passage of the state of Oregon's Sustainability Act in 2001, and brings business, government, and nonprofits to the table to agree on what role each can play to address a community need. The group has played a vital role in almost 100 community-based projects, with over 60 projects receiving official Governor's designation. The Oregon Electric Vehicle Collaborative project will focus on convening stakeholders to work together to achieve the state goals of accelerating EV adoption. Pacific Power actively participates in this effort.

Executive Order 17-21: Statewide Electric Vehicle Goal

Governor Kate Brown's Executive Order (EO) 17-21 established a statewide goal of 50,000 EVs (EVs) on the road by 2020. The EO also directed state agencies to begin rulemaking for an EV rebate program, and to plan and budget for the installation of EV charging infrastructure. Oregon recently crossed the halfway point of meeting its EV goal with over 25,000 EVs currently on the road. On average, EV growth has increased by 38-percent per year in Oregon.[71]

House Bill 2017: Transportation Preservation and Modernization

In 2017, Oregon House Bill 2017 created a $5.3 billion transportation funding package designed to target congestion, public transportation, crumbling roads and decaying bridges. The bill created the guidelines and a program for zero-emission vehicle rebates as well as cost containment provisions for the Clean Fuels Program.

Senate Bill 1547: Clean Energy Bill

In 2016, Senate Bill 1547, passed requiring each electric company to file applications with the Public Utility Commission for programs to accelerate TE, and allows return of and return on investment made by the electric company.

[71] OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY, *Clean Fuels Data*, https://www.oregon.gov/deq/aq/programs/Pages/Clean-Fuels-Data.aspx (last visited Nov. 29, 2019).

Volkswagen Diesel Emissions Mitigation

Through a series of three partial settlements that took place from 2016 to 2017, the U.S. Environmental Protection Agency (EPA) resolved a civil enforcement case against Volkswagen (VW). These settlements resolve allegations that VW violated the Clean Air Act (CAA) by selling approximately 590,000 diesel motor vehicles equipped with "defeat devices" (model years 2009 to 2016).[72]

The State of Oregon is eligible to receive at least $72.9 million as a beneficiary of the VW partial consent decree to support eligible pollution mitigation projects. Through Oregon Revised Statue (ORS) 468A.801, The Oregon Legislature authorized Oregon Department of Environmental Quality (DEQ) to accept funds from the settlement into the Clean Diesel Engine Fund. Currently, DEQ is authorized to fund school bus projects that reduce harmful diesel emissions in the first phase of the ten-year period. The legislature will likely revisit the issue of authorizing additional allowable mitigation actions in future sessions.

Senate Bill 324: Clean Fuels Program

The 2015 Oregon Legislature passed Senate Bill 324 allowing DEQ to fully implement the Clean Fuels Program (also known as CFP or the LCFS) in 2016, and adopted into the Oregon Administrative Rules.[73] The rule allows electric utilities to register as a credit aggregator for electricity used as a transportation fuel.

In April 2017, the OPUC opened an investigation into the utilities' role regarding the LCFS.[74] The OPUC found that electric company participation in the CFP as a credit generator is in the public interest.[75] Further the OPUC adopted Credit Monetization Principles and Program Design Principles giving direction on how the program should be administered; however, because these programs are not funded by utility customers, programs will not be held to traditional cost effectiveness or prudence review processes.[76]

House Bill 2186: Low Carbon Fuels Standard

In 2009, Oregon House Bill 2186 authorized the Oregon Environmental Quality Commission to adopt rules to reduce the average carbon intensity of Oregon's transportation fuels by 10 percent over a 10-year period.[77]

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[72] U.S. ENVIRONMENTAL PROTECTION AGENCY, *Volkswagen Clean Air Act Civil Settlement*, https://www.epa.gov/enforcement/volkswagen-clean-air-act-civil-settlement (last visited January 30, 2020).
[73] *See* OAR 340-253-0000.
[74] *In the Matter of Public Utility Commission of Oregon, Investigation into Utility Participation in Oregon Clean Fuels Programs*, Docket No. UM 1826, Staff Report (April 18, 2017).
[75] *In the Matter of Public Utility Commission of Oregon, Investigation into Utility Participation in Oregon Clean Fuels Programs*, Docket No. UM 1826, Order No. 17-250 (July 12, 2017).
[76] *In the Matter of Public Utility Commission of Oregon, Investigation into Utility Participation in Oregon Clean Fuels Programs*, Docket No. UM 1826, Order No. 17-512 (Dec. 18, 2017); *In the Matter of Public Utility Commission of Oregon, Revised Principals and Process for Utility Use of Revenue from Clean Fuels Program*, Docket No. UM 1826, Order No. 18-376 (Oct. 11, 2018).
[77] *See* H.B. 2186 75th Leg. Assemb., Reg. Sess. (Or. 2009).

Federal Tax Credit: Plug-in EV Tax Credit, IRC Section 30D

Established by the Energy Improvement and Extension Act of 2008, this tax credit currently ranges between $2,500 and $7,500 per vehicle based upon battery capacity of the vehicle.[78] The credit begins to phase out once a manufacturer has sold 200,000 qualifying vehicles.[79]

Oregon Administrative Rule (OAR) 860-085-0050: Greenhouse Gas Emissions Targets

OAR 860-085-0050 govern the implementation of the state's GHG emissions standard for electric companies and electricity service suppliers, under ORS 757.522 through 757.538, and natural gas companies. GHG Emission Targets, found in ORS 468A.205 and are implemented through OAR 860-085-0050, and to achieve GHG levels that are 10 percent below 1990 levels by 2020 and at least 75 percent below 1990 levels by 2050.

Oregon Administrative Rule (OAR) 340-257-0040: Zero-emissions Vehicle Mandate

OAR 340-257-0040 adopted California's zero-emission vehicle mandate which required each vehicle manufacturer to achieve a certain percentage of vehicle sales each year from low-emission vehicles, hybrids, plug-in hybrids and modest numbers of battery-electric and fuel cell vehicles.

[78] I.R.C. §30D (b)(2)-(3).
[79] I.R.C. §30D (e)(2).

Appendix B. Charging Availability and Usage Patterns

Pacific Power is collecting data on charging availability and usage patterns from a number of different programs, including: Company workplace charging stations; Company-owned public charging station (as they begin to come on line) and through charging stations incentivized through Pacific Power grants. Current data from these programs is limited as the first of these stations are only a few months old. The Company will continue to collect and analyze this data to inform future activities, programs, and initiatives. In addition to the data from newly installed charges in the Pacific Power service area, the Company has access to data collected for the Utah TOU study and conducted other load research on charging patterns in Utah and Oregon, all summarized below.

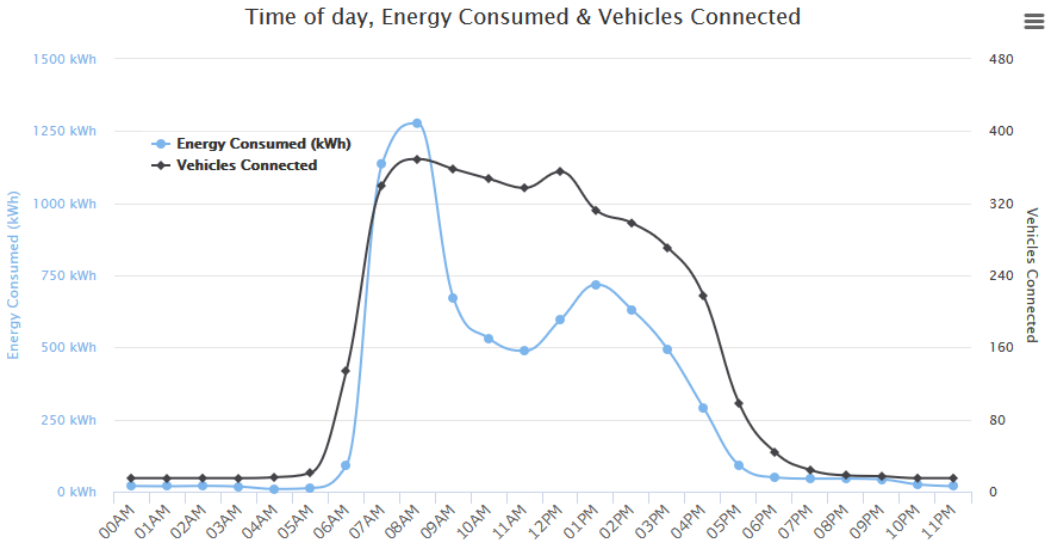
Pacific Power Workplace Charging

Because residential charging is convenient and inexpensive, most EV drivers do more than 80 percent of their charging at home.[80] As EVs increase, it may become increasingly valuable for drivers to have access to charge their vehicles at work during the non-peak times so this new demand does not create a negative impact to the grid. If charging occurs at off-peak times, the system can handle it with little impact, and new electricity sales could provide value to all customers.

Pacific Power has six onsite workplace chargers (installed in 2019) located at its Portland, Oregon headquarters that are available for employees to use. During fourth quarter of 2019, Pacific Power's workplace chargers had over 700 transactions within 92 days. Not surprisingly, as seen in **Figure 16**, vehicles tend to charge early in the morning and to a lesser extent in early afternoon with the energy consumed declining after each of those time periods.

[80] U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, *Charging at home*, https://www.energy.gov/eere/electricvehicles/charging-home (last visited January 28, 2020).

Figure 16. Pacific Power Workplace Charging

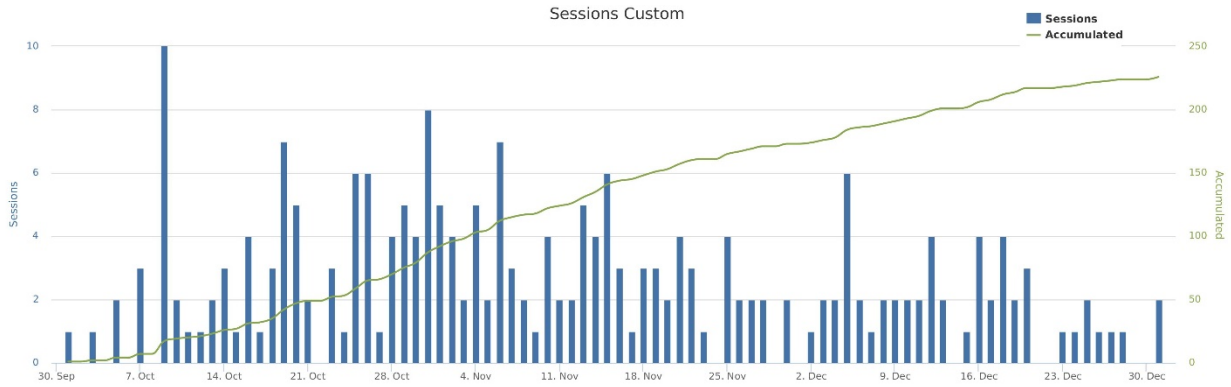


Pacific Power Incentivized, Customer Owned Charging

Pacific Power has grants available for charging infrastructure in California, Oregon, and Washington. As part of the grant, recipients must share available charging and usage data with the Company. As with much of the data in this section, while the grants have been awarded, many of the stations are just now coming on line. The following analysis is based on data from four customer owned charging locations within its Oregon service territory. The projects represent diverse types of organizations and charging use cases including city owned public charging, workplace charging, and mixed use charging. These stations are all newly installed in 2019 and provide data such as session length, station usage, unique drivers and real time power. Though the data received from every vehicle is unique based on the vehicle type and customer data sharing preferences, there is still a lot to learn from what the Company has received in these early stages of deployment. The data below is from fourth quarter of 2019 and it illustrates the type of data that's available in near-real time, including: session time of day and length, number of sessions, and data alarms.

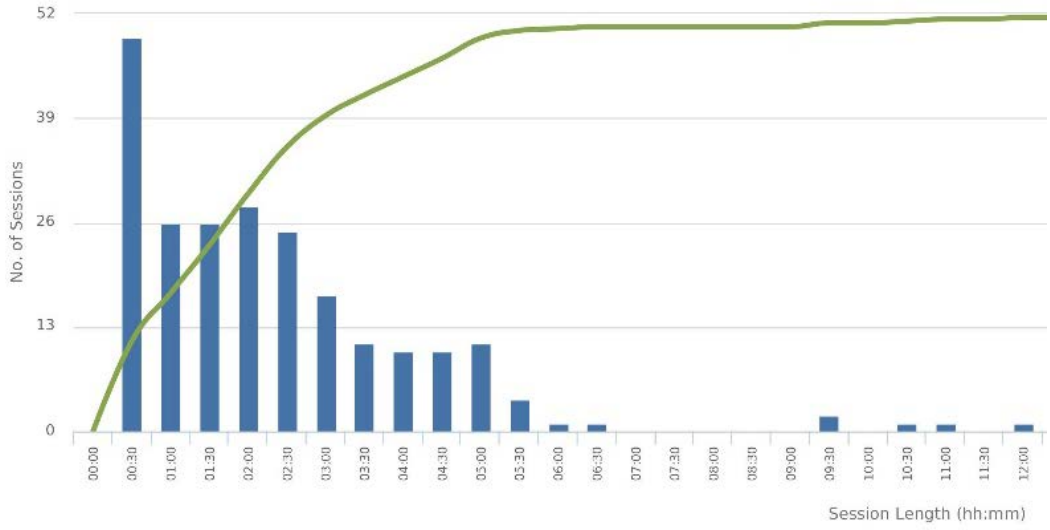
Figure 17 is a simple view of number of sessions by week. Interestingly, the customer owned chargers initially had approximately over 80 sessions per month. In the month of December, the number of sessions decreased by almost 40 percent.

Figure 17. Charging Sessions at Select Customer-Owned Level 2 Chargers



As seen in **Figure 18**, the majority of charging (over 50 percent) is occurring over charging sessions that are two hours or less, and additional view of the data suggest very initial utilization at ten percent or less.

Figure 18. Charging Session Length at Select Customer Owned Level 2 Chargers



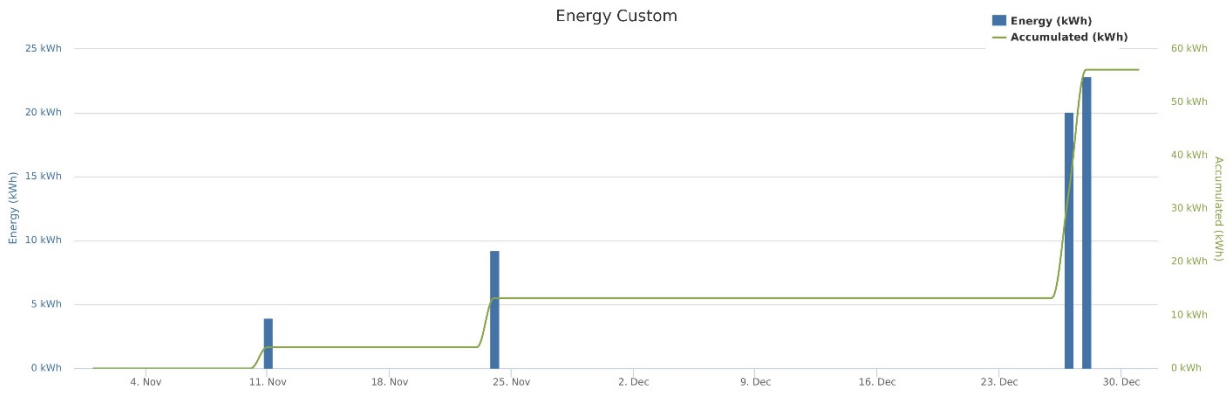
The Company can also track time of day usage and station alarms (related to boot up, tripping, powering off and firmware update fails). As the data sets mature, these will be critical points of interest.

An Early View into Destination Charging

Destination charging is when a customer charges for a few hours or overnight at locations such as hotels, resorts, recreation areas, and shopping areas. Pacific Power provided a grant to one destination charging station with two ports located at a ski resort in Southern Oregon, which was installed in November of 2019. Again, the data is just starting to develop. **Figure 19** illustrates the 2019 usage pattern of the station in the earliest days of its use. It appears charging occurred primarily during holidays. To date, data for the

destination station is limited with charging with an average utilization rate of 3 percent. Drivers at this location also tend to have a similar session length to those of workplace charging; however, they idled 33 minutes longer than workplace drivers.

Figure 19. Total Energy/Day At A New Destination Charger



Pacific Power Owned Fast-Charging

On December 6, 2019, Pacific Power opened its first EV charging station to the public. In the first few days that the station was open, it was used 10 times by eight unique drivers from five different areas in Oregon (two of the users did not share location data). Two of the drivers were local to the charging station in Madras, one was from Portland, one was from Albany, and one from Bend. **Figure 20** shows the distribution of charging sessions in the first 60 days of operation. Of these 53 charging sessions, 11 used the Level 2 charger and the remaining 42 sessions used the DC fast chargers.

Figure 20. First Ten Charging Sessions at Madras EV Station

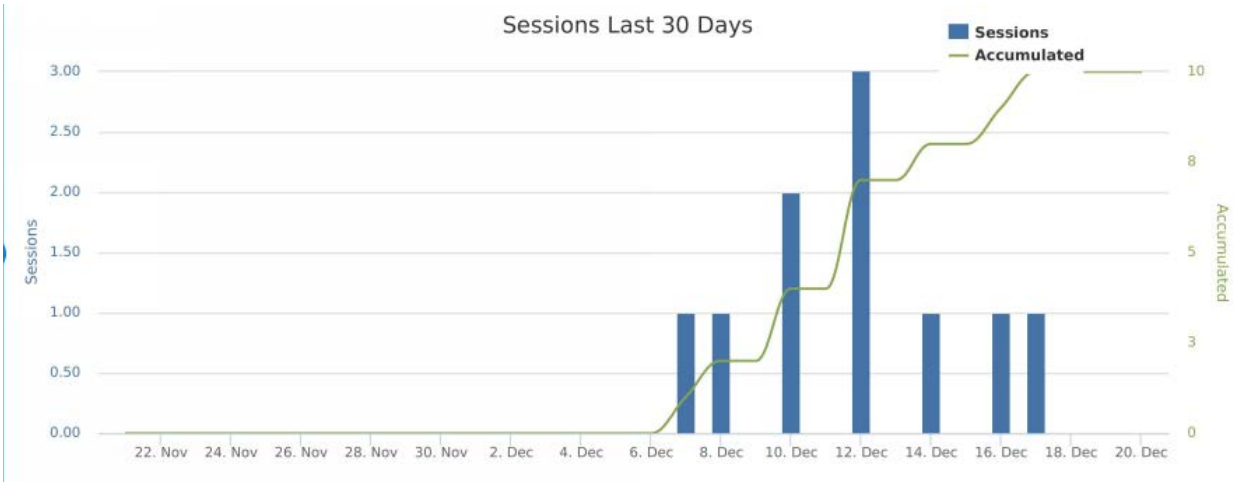


Figure 21 and **Figure 22** highlights some initial data from the EV charging station located in Madras, Oregon.

Figure 21. Charging Session Length in Time at Madras EV Station

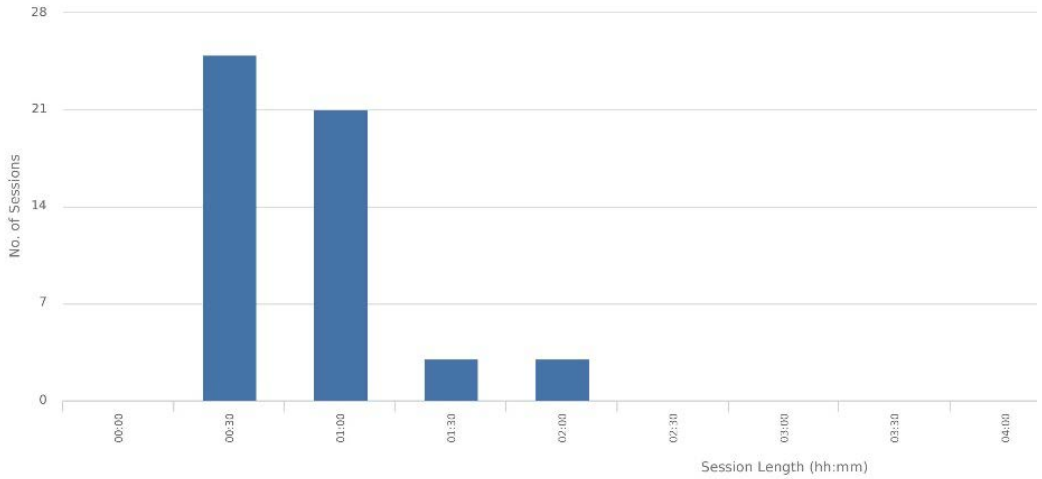
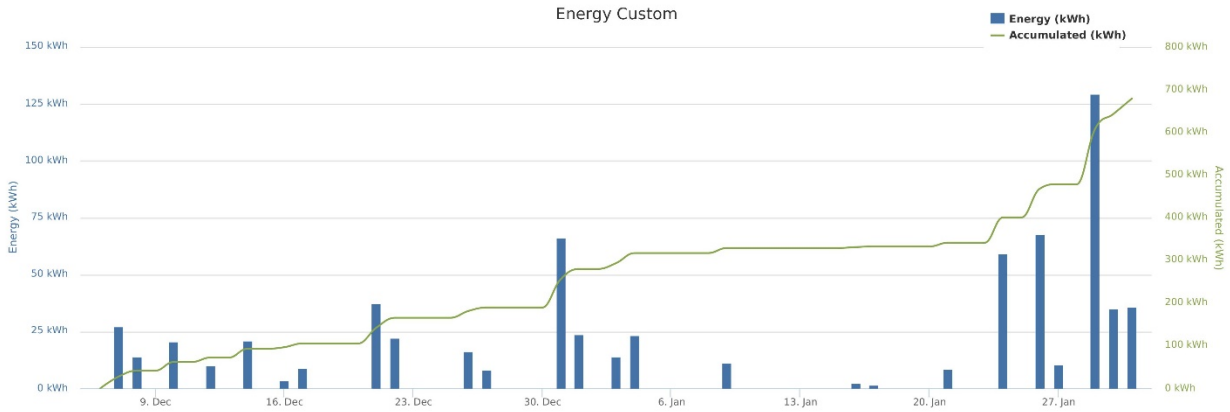


Figure 22. Station Power Dispersed per Charging Session - Madras EV Station



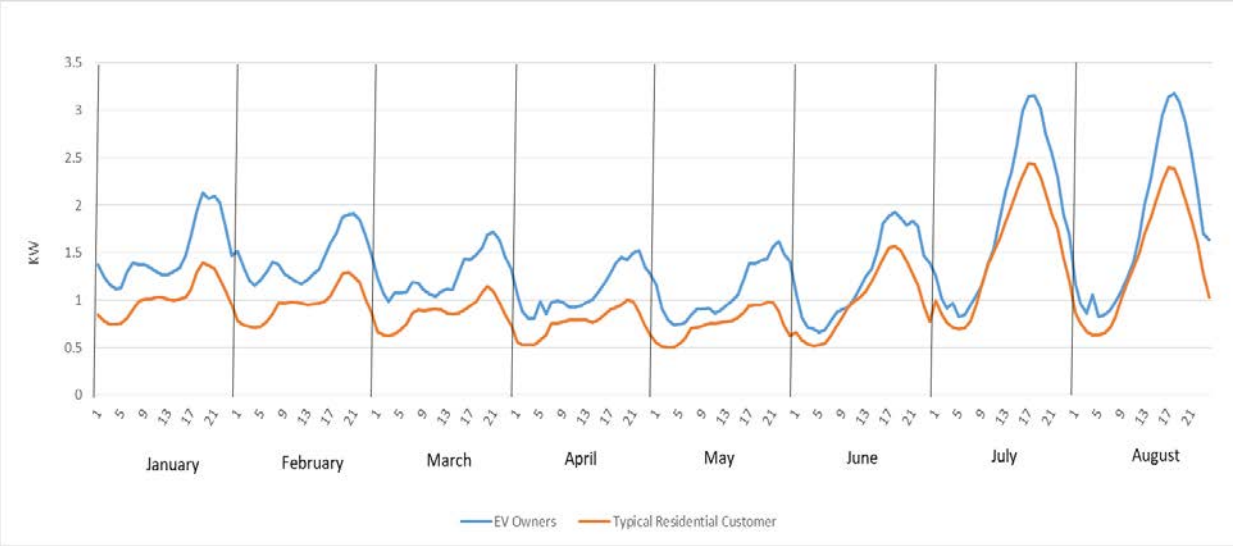
Residential Charging

Pacific Power does not currently have a specific residential charging program. However, insight can be provided by evaluating preliminary load research data from the Company's Utah EV TOU study. The EV TOU study was developed to understand how peak load for EV customers may shift under two TOU pricing regimes. This required an understanding of a typical EV owner's electric usage pattern compared to EV owners under a TOU program.

As provided in **Figure 23**, general observations of charging patterns and energy use can be made by evaluating the average profile for a residential (Schedule 1) customer and the average profile of an EV owner not enrolled in a TOU program. However, care should be taken when drawing conclusions from the differences between both profiles. Differences between the profiles are not completely attributable to EVs

charging alone. For example, EV owners tend to have higher than average incomes, which is affiliated with larger homes, which in turn tend to have higher than average energy usage. Households with EVs consume more electricity than a typical residential customer. The profiles tend to be more closely aligned in the morning. However around hour 17 and 18, there is a notable increase in energy usage for EV owners. This would indicate that many EV owners tend to charge their vehicles once arriving home from work.

Figure 23. Average Monthly Utah Electric Vehicle and Schedule 1 Profiles (2019)[81]



Load research results indicate that most EV owners begin charging their vehicles once they arrive home. This is supported by research conducted as part of the PacifiCorp 2017 Residential Survey, which solicited residential customers on the timing of when they charge their vehicle. In Utah, 53.9 percent of respondents begin charging once they arrive home from work, which is similar to Oregon respondents which indicate that 50.5 percent of EV owners begin charging once they arrive home (**Table 14**).

Table 14. Oregon and Utah Residential Electric Vehicle Charging Patterns

Timing	Utah	Oregon
Begin charging as soon as arrive home	53.9%	50.5%
Plug in vehicle in the evening	20.8%	23.1%
Program vehicle or charger to delay charging until a time when electric demand is lower	15.9%	13.6%
Other	9.4%	12.8%

The PacifiCorp 2017 Residential Survey also solicited locational charging pattern information from its Oregon customers. Specifically, Oregon customers were asked what percentage of their plug-in EV charging occurs at home, work, retail locations, fast charging stations, or other locations during a typical week. Oregon customers indicated that during a typical week, 88.6 percent of their charging occurs at home, while 4.7 percent of Oregon EV owner charging occurs at their place of employment. During a typical week, 6.7 percent of an Oregon EV owner charging occurs at retail locations, fast charging stations, and other locations (**Table 15**).

[81] Profiles are for the whole home and not end-use specific.

Table 15. Oregon Plug-in Electric Vehicle Owner Typical Weekly Charging by Location[82]

Location	Percent
At home	88.6%
At work	4.7%
At local retail locations (grocery stores, malls, etc.)	1.5%
At fast charging stations along highway corridors	2.3%
Other	2.9%

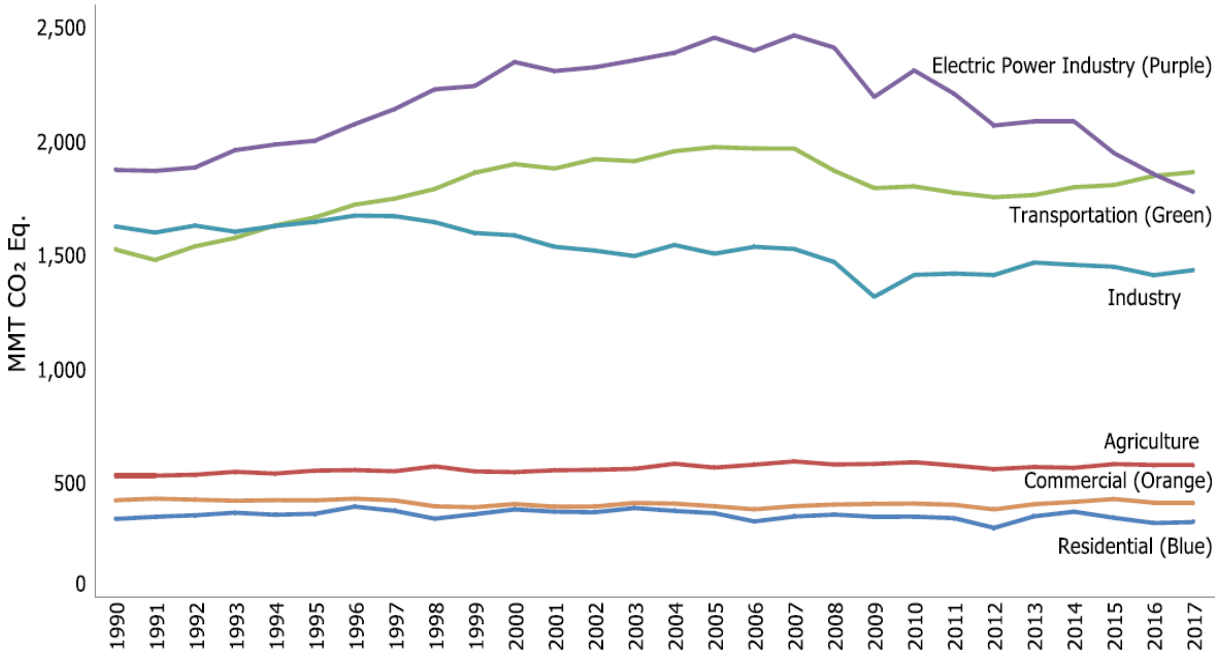
[82] PacifiCorp's 2017 Residential Survey.

Appendix C. Carbon Reduction Goals, Requirements and Other State Programs

Though the total GHG emissions decreased by 0.5 percent from 2016 to 2017, overall the total U.S. emissions have increased by 1.3 percent from 1990 to 2017. The decrease between 2016 and 2017 was driven in part by a reduction in CO_2 emissions from fossil fuel combustion, as a result of multiple factors, including a continued shift from coal to natural gas and increased use of renewable energy in the electric power sector, and milder weather that contributed to less overall electricity use.[83]

According to the U.S. Environmental Protection Agency (EPA), the transportation sector accounts for approximately 29 percent of greenhouse emissions in the U.S., resulting in 1,866.20 MMT.[84] In 2017, transportation activities accounted for the largest portion of total U.S. GHG emissions, while emissions from electric power accounted for the second largest portion (~28 percent), industry accounted for the third largest portion (~22 percent), and the remaining sectors accounted for the rest (~21 percent) of U.S. GHG emissions (**Figure 24**).

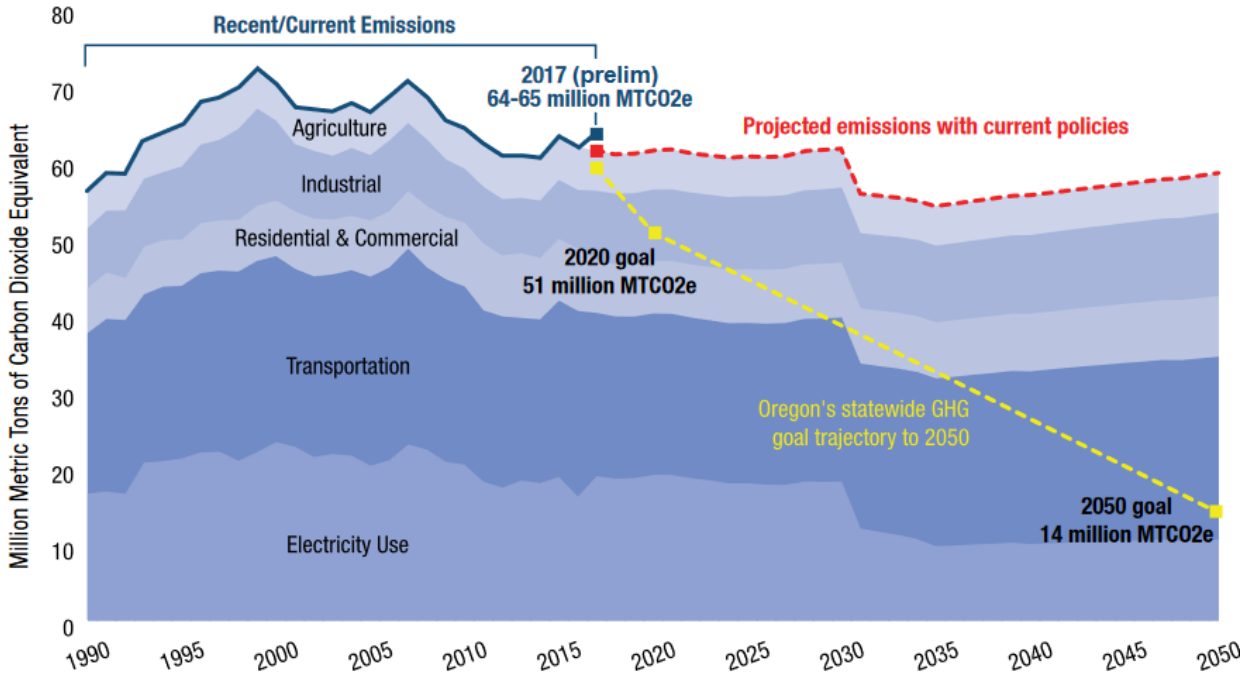
Figure 24. U.S. Greenhouse Gas Emissions Allocated to Economic Sectors (MMT CO_2 Eq.)[85]



[83] U.S. EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2017 (2019), *available at* https://www.epa.gov/sites/production/files/2019-04/documents/us-ghg-inventory-2019-main-text.pdf.
[84] *Id.*
[85] *Id.*

In Oregon, greenhouse emissions from the transportation sector are the largest contributor to emissions. Emissions from transportation have risen to approximately 40 percent since 2016. There has been a 14 percent increase, or more than 4.5 billion more vehicle miles traveled in Oregon (37.5 billion), in 2016 as compared to 2012.[86] As the total vehicle miles driven increases, Oregon will need to accelerate the rate of TE to meet its current policy goals (**Figure 25**).

Figure 25. Oregon Past and Projected Greenhouse Gas Emissions Compared to Policy Goals[87]



PacifiCorp has made significant progress over the past 13 years in growing its renewable portfolio, becoming the largest regulated utility owner of wind power in the West. Relative to a 2005 baseline (a ubiquitous baseline year in the industry), PacifiCorp's Oregon allocation of emissions are down 48 percent in 2025, and 84 percent by 2030.

Figure 26 below illustrates the forecast of Pacific Power's Oregon allocated emissions from generation, and **Figure 27** provides an estimate of annual tailpipe emission reductions from the EV forecast.

[86] Oregon Global Warming Commission, 2018 Biennial Report to the Legislator Report (2018), *available at* https://static1.squarespace.com/static/59c554e0f09ca40655ea6eb0/t/5c2e415d0ebbe8aa6284fdef/1546535266189/2018-OGWC-Biennial-Report.pdf.

[87] *Id.*

Figure 26. Pacific Power Oregon Allocated Emissions from Generations (MT CO_2)

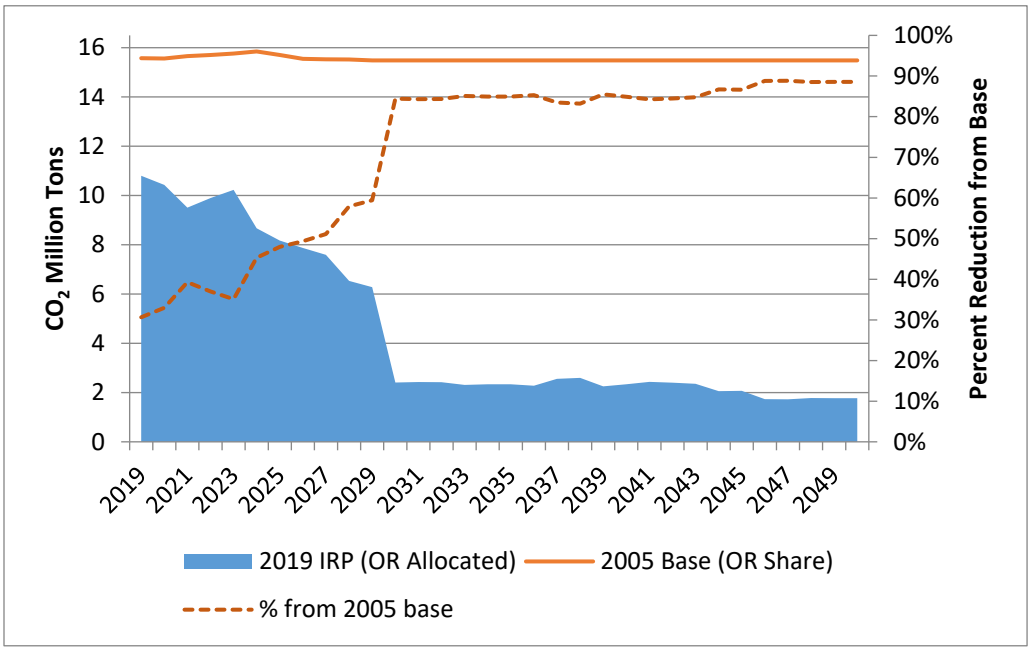
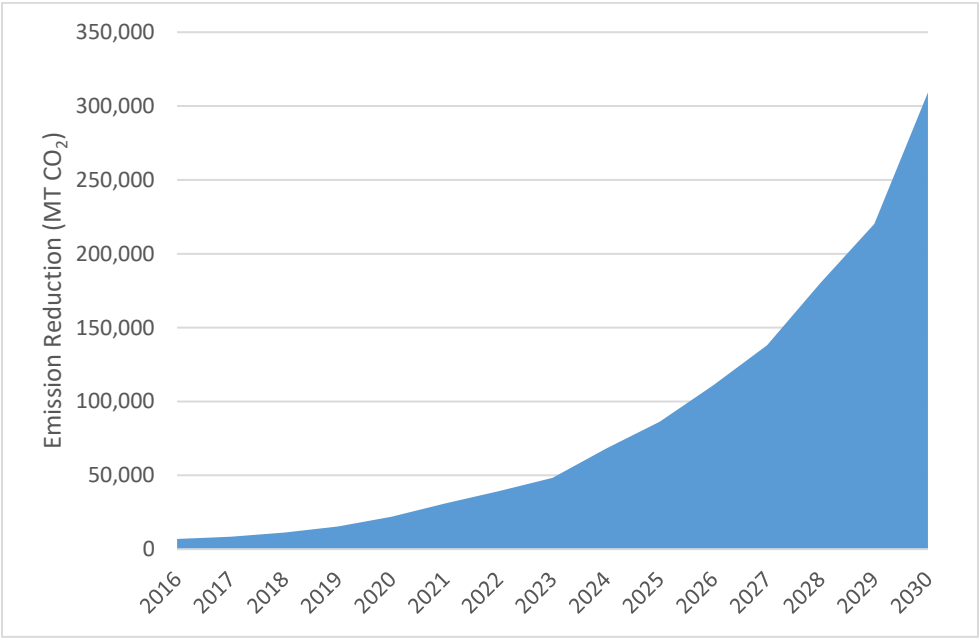


Figure 27 below shows the estimated tailpipe emission reductions from the average of the EV adoption forecast scenarios documented in this plan, with an estimated cumulative tailpipe emission reduction benefit of 1,296,420 MT CO_2.[88]

Figure 27. Annual Tailpipe Emission Reduction from EV Forecast in (MT CO_2)

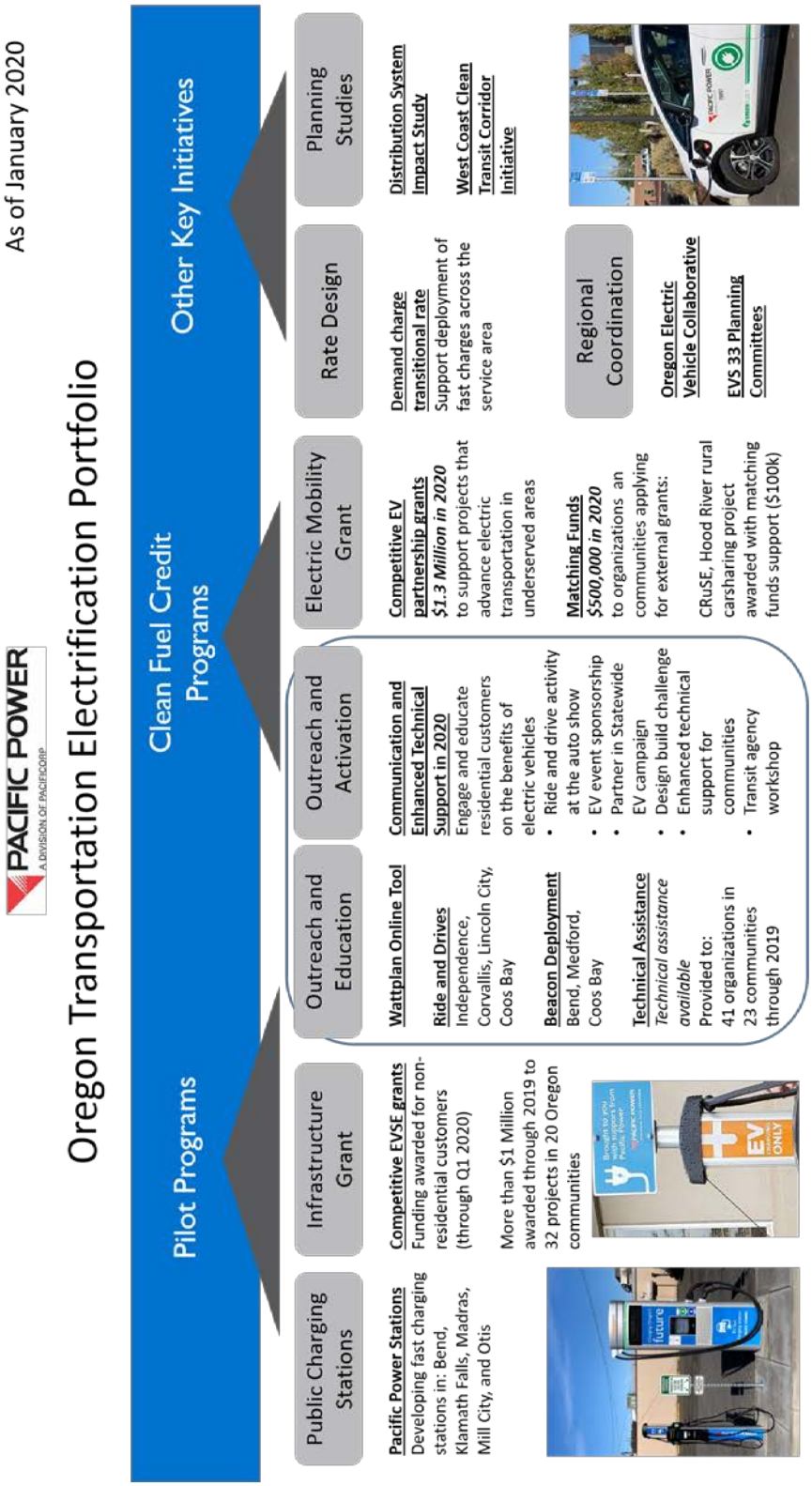


[88] Sum of annual emissions reduction in Figure 33 for the period of 2016 to 2030.

Emissions are calculated by determining tailpipe emissions avoided from electrification of light-duty, medium- and heavy-duty vehicles, and adjusting for emissions produced as a result of additional electric load from these vehicles charging on PacifiCorp's system. The results indicate a net emission reduction in the state of Oregon, with a large emission benefit in the transportation sector, and a relatively small emission increase for PacifiCorp. To develop the estimated emissions reduced through the transportation sector, the Company utilized the US EPA's GHG Emissions data from a "Typical Passenger Vehicle for Light-Duty Vehicles", and the UC Davis' Institute of Transportation Studies, "Fuel Economy Analysis of Medium/Heavy-duty Trucks: 2015-2050 study for medium- and heavy-duty vehicles. PacifiCorp's emission intensity is based on resources reflected in the Oregon retail rates paid by Oregon customers. The 2019-2030 forecast of Oregon allocated emissions is from the 2019 Integrated Resource Plan (2019 IRP) preferred portfolio.

Appendix D. Pacific Power Current Programs

Figure 28. Pacific Power Oregon Electrification Portfolio



The Company is currently engaged in a range of activities, as seen in **Figure 28**, which address market barriers in support of TE transformation across three categories: 1) Implementation of customer pilot programs, 2) Aggregation, monetization and program design of CFP actions, 3) Coordination across efforts in other PacifiCorp states, and 4) Regional collaboration and research. The information below provides additional information into current pilot programs and clean fuel credit programs.

Pilot Programs

Table 16 summarizes the program and estimated total budget for each of the three current pilots.

Table 16. Pacific Power Transportation Electrification Pilot Programs

Pacific Power Transportation Electrification Pilot Programs[89]	
Program	**Estimated Budget**
Public Charging Pilot Pacific Power will install, own and operate publicly accessible charging stations in its Oregon service area	$1.85 million
Outreach and Education Pilot Tactics and messages that increase exposure and access to reliable information about electric transportation options and benefits	$1.105 million
Demonstration and Development Pilot Grant funding to help non-residential Pacific Power customers develop creative, community-driven EVSE projects	$1.685 million
Total	**$4.64 million**

Public Charging Pilot

Through the Public Charging Pilot, Pacific Power is authorized to construct, own, and operate public EV charging stations at up to seven locations in its Oregon service territory (**Figure 29**). The Company began looking for potential locations in March of 2018, paying particular attention to areas currently underserved by existing charging infrastructure. An initial list of nine potential sites was shared in June of 2018 with Commission staff based on the criteria of convenience and anticipated use, visibility, availability of necessary electrical service, future-proofing, and permitting.

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

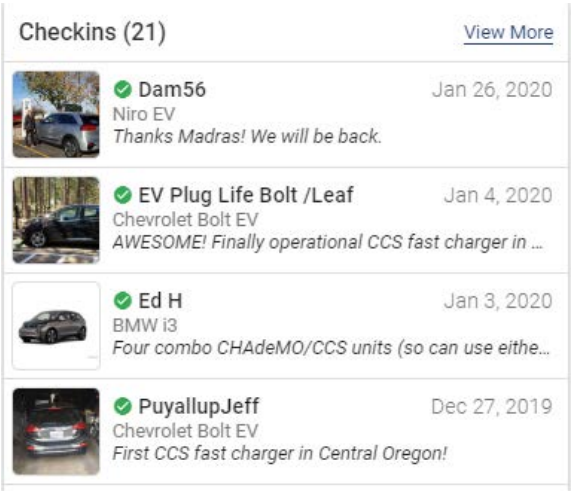
Figure 29. Pacific Power Public Charging Station (Courtesy of Madras Pioneer)

Communities were engaged through Pacific Power's Regional Business Managers to identify suitable locations to site charging stations. Potential sites were identified within seven communities. To ensure projects are completed without exceeding the approved budget, the number of locations was narrowed to five locations.

To date, Pacific Power has constructed and operates one utility-owned fast charging location in Madras, Oregon, with four DC Fast Chargers and one dual-port Level 2 Charger (**Figure 30** and **Figure 31**). An additional fast charging station is under construction in Bend with an anticipated opening in the first quarter of 2020. Additional stations are planned for Otis, Klamath Falls and Mill City, Oregon.

Figure 30. Social Media for Madras Charging Station Event

Figure 31. Sample EV Driver Checkins for the Madras Station on Plugshare.com



Outreach and Education Pilot

The Outreach and Education Pilot aims to educate both residential and commercial customers about EVs and their benefits within the parameter of the regulatory stipulation. The pilot primarily consists of four components: customer communications, self-service resources, community events and technical assistance. Progress updates on each component are provided below.

Customer Communications

As required in Docket UM1810, Pacific Power focused customer communications expenses, to the extent practical, on promoting and supporting the success of the Company's TE pilot programs that were approved by the Commission. [90] To date the majority of communications have focused on publicizing and soliciting applicants for the demonstration and development grants along with increasing awareness of technical assistance, encouraging customers to use self-service resources, and driving participation in customer events. **Figure 32, Figure 33 and Figure 34** are examples of a Pacific Power social media post and sample communications to customers.

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

Figure 32. Facebook ad for National Drive Electric Week 2019 Promoting Grants and Technical Assistance

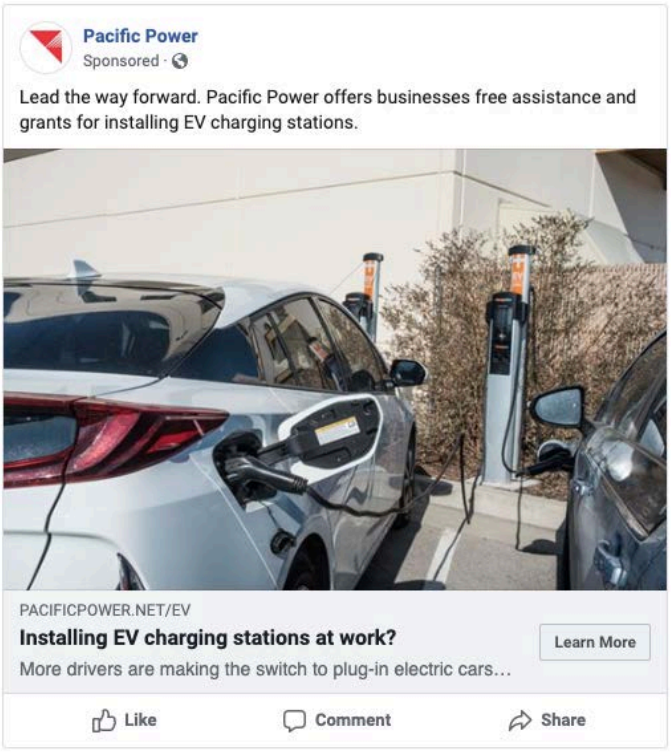


Figure 33. Sample Communication to Business Customers

Join Oregon businesses that are reimagining the way ahead. Pacific Power offers organizations free technical assistance and grants for installing electric vehicle charging stations.

Benefits:

- Contribute to a healthier environment.
- Build your reputation as a sustainability leader.
- Attract and retain employees.
- Add to Oregon's electric car charger network.

We can help you get started

Grants can pay for up to 100% of the costs to install your electric vehicle chargers. Applications for the next grant cycle are due November 15, 2019.

Not sure where to start? Our free on-site technical assessment can help you evaluate options and costs.

Learn more and apply at **pacificpower.net/ev**.

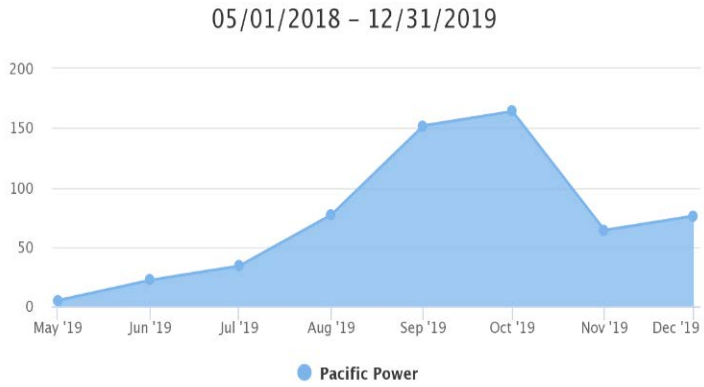
PACIFIC POWER
POWERING YOUR GREATNESS

Figure 34. Pacific Power Sample communication promoting a community event in Talent, Oregon

Self Service Resources

Through a competitive Request for Proposal process, the Company selected Clean Power Research's WattPlan tool to use on the company website. This assists customers interested in EVs to better understand total lifecycle costs through comprehensive vehicle options, utility bill impacts and incentive calculations. WattPlan went live on Pacific Power's website in May of 2019. To date, WattPlan has produced cost comparison estimates 614 times. It was marketed to residential customers through email and social media channels as part of the Company's website relaunch in August of 2019 and again as part of National Drive Electric Week during the month of September (**Figure 35**).

Figure 35. Monthly Usage of Wattplan through December 2019



The Company has also contracted with Chargeway to install another self-service tool, three Chargeway Beacons in dealerships within the Company's service area (**Figure 36**). While placed in car dealerships, the end users are Pacific Power residential customers at the dealerships.

Figure 36. TC Chevy Medford/Ashland Employees Training on Chargeway Beacons (Courtesy of Chargeway)

Chargeway is a system that uses colors to identify plug types and numbers for power levels. The higher the number the faster you can charge at that station. This label system on charging stations and in the Chageway app and Beacons makes it easier for customers to differentiate charging options for their needs. The Chargeway app is free to download for all Pacific Power customers and shows the simple color and number icons on the station finder map to identify all charging options available for every electric car a user adds to their account. The beacon is a 6 foot interactive touch screen that shows charging locations and aides salespeople in communicating about electric fuel.

These Beacons were installed in the fourth quarter of 2019 at TC Chevy in Medford/Ashland, Team Kia in Bend and Ware Chevy in North Bend/Coos Bay. Locations were chosen in coordination with the Oregon Dealers association using metrics of geographic location, participation in the state rebate program, EV inventory and dealer interest. Data on the number of EVs sold pre and post beacon installation will be gathered.

Community Events

Pacific Power coordinated five community events to date, which were primarily EV ride-and-drive events. Planning is underway for additional ride-and-drive events throughout Oregon through 2020 along with additional event participation. **Figure 37**, **Figure 38**, and **Figure 39** are examples of Pacific Power sponsored community events.

The Company has explored a diverse type of event participation and sponsorship alongside the Pacific Power's event manager, Forth. Some ride-and-drives have been organized as one part of a larger community event not specifically focused on EVs while others where stand-alone events with the sole focus on electric transportation. Most event participation included a ride-and-drive element with either Forth, local dealerships, or local owners associations supplying the vehicles for test drives. Some events did not have a ride-and-drive element but information about EVs and utility programs was available from Pacific Power or Forth staff. **Table 17** summarizes the Oregon events to date.

Table 17. Pacific Power Community Events

Event	Location	Date	Ride and/or Drives	Number of Customer Interactions
Touch-a-truck	Independence	5/11/2019	18	82
Da Vinci Days	Corvallis	7/20/2019	24	85
National Drive Electric Week- Lincoln City	Lincoln City	9/14/2019	53	106
National Drive Electric Week- Coos Bay/ North Bend	North Bend	9/21/2019	N/A	67
Talent EV Pop-up	Talent	01/18/2020	11	62
Total	**5**	**N/A**	**106**	**402**

Figure 37. Pacific Power EV Information Provided to Customers at Community Events – Example #1

Figure 38. Pacific Power EV Information Provided to Customers at Community Events – Example #2

Figure 39. Pacific Power EV Information Provided to Customers at Community Events – Example #3

Technical Assistance (TA)

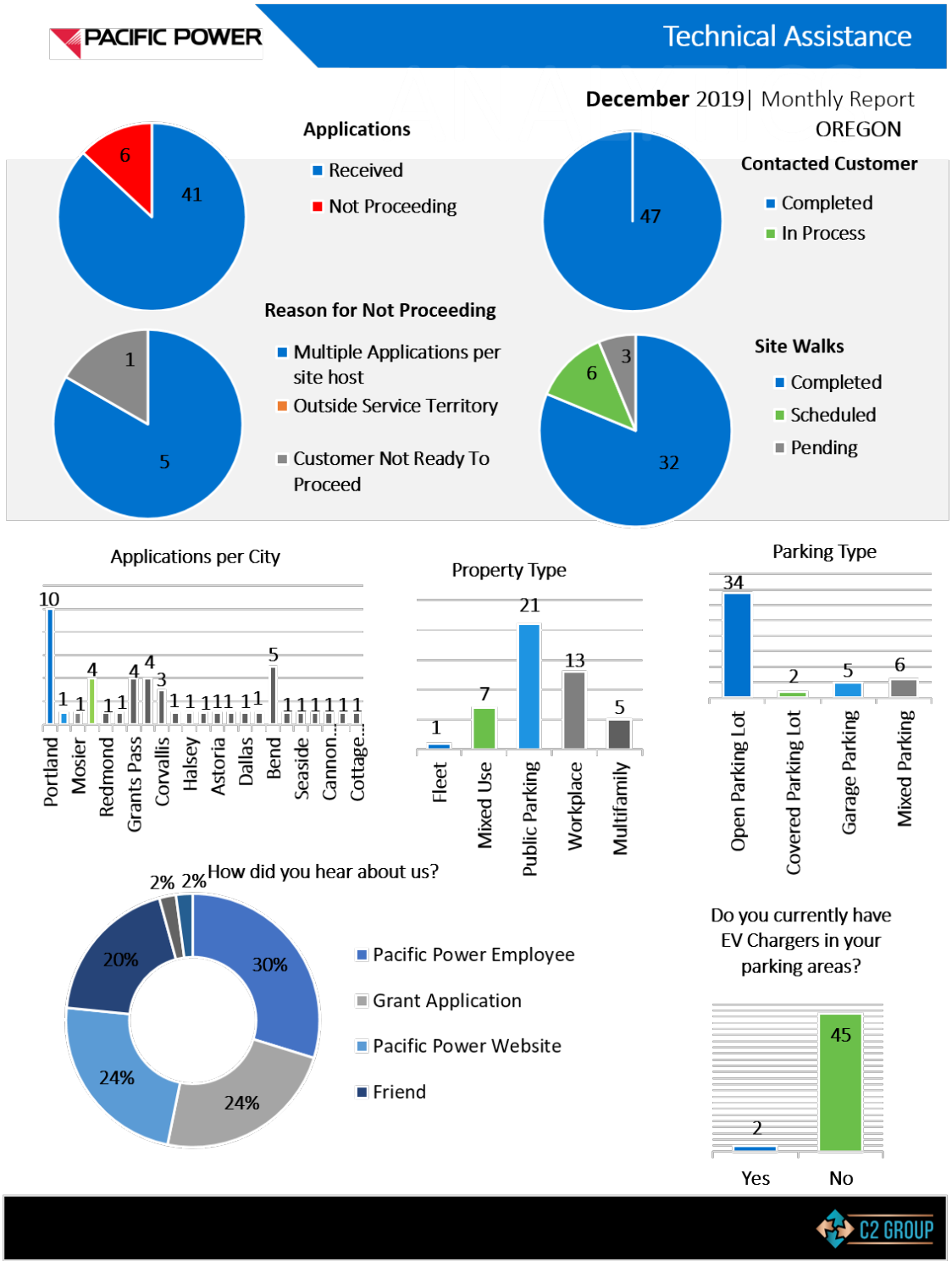
Pacific Power provides on-site TA to non-residential customers interested in installing charging infrastructure (**Figure 40**). This service is offered at no cost to customers.

Figure 40. A Technical Assistance Site Walk in Bend, Oregon

To date, the Company has conducted or received an application to conduct onsite technical assistance for 47 customers. Customers apply via an online application on the Company website. A desktop review and phone conversation follows to understand the customer's EVSE needs followed by an in-person site walk. A few weeks after the site walk, the customer receives their customized assessment and is given the option of a final 30 minute review session. Pacific Power receives a monthly report of TA details as seen in **Figure 41**.

TA has been well received by customers. Participants value both the site-specific information in the final reports that they receive, as well as the in-person support. The Company has seen a diverse type of non-residential customers participate in TA. Participating organizations have included local governments, nonprofits, multiunit family dwellings, medical centers, small and medium sized businesses, hotels, commercial centers and a transit provider. TA has been complementary to the grant program and vice versa. Announcements and communications about the grant encourage potential applicants to enroll in TA and customers are encouraged to apply for the grant throughout the TA process.

Figure 41. Technical Assistance December 2019 Monthly Report



Demonstration and Development Pilot- Grant Program

The Demonstration and Development Pilot provides grant funding to non-residential customers to help offset the upfront costs of installing EV charging infrastructure. Four full grant cycles have been completed with $1,024,400 awarded to 32 grant recipients. The first quarterly grant cycle opened to non-residential customers on October 15, 2018 with applications due November 15, 2018. As of the fourth quarter of 2019 the Company has received 72 applications.

Awardees are located across the state as seen in **Figure 42**, **Figure 43** and **Table 18**. Most grant recipients plan to install Level 2 charging stations representing an estimated total 115 charging ports, with three recipients planning to install DC Fast chargers. One recipient plans to charge transit vehicles with the fast chargers, although the project is contingent on outside funding for electric buses.

Figure 42. An Electric Vehicle Charges at a Level 2 Charging Station Funded Through the Grant in Philomath, Oregon

Figure 43. Roseburg Community Leaders and Pacific Power Staff Celebrate the Opening Of a Charging Station Partially Funded From the Grant Program

Table 18. Pacific Power Demonstration and Development Pilot Grant Recipients

Project Number	Project Location	Number of Charging Ports	Grant Award Amount
1.	Bend	6	**$93,088**
2.	Roseburg	8	**$25,000**
3.	Coos Bay	2	**$37,057**
4.	Coos Bay	2	**$56,804**
5.	Medford	4	**$33,123**
6.	Roseburg	6	**$17,475**
7.	Grants Pass	2	**$8,530**
8.	Portland	2	**$11,429**
9.	Tolovana Park	4	**$16,484**
10.	Portland	5	**$14,351**
11.	Portland	2	**$20,078**
12.	Redmond & Madras	8	**$58,664**
13.	Central Point	2	**$13,892**
14.	Portland	2	**$9,480**
15.	Seaside	4	**$26,120**
16.	Independence	4	**$15,655**
17.	Pendleton	3	**$68,995**
18.	Myrtle Creek	2	**$15,481**
19.	Philomath	2	**$25,786**
20.	Ashland/Medford	2	**$21,113**
21.	Astoria	2	**$29,021**
22.	Medford	8	**$62,420**
23.	Bend	2	**$9,565**
24.	Bend	6	**$14,724**
25.	Grants Pass	1	**$4,891**
26.	Portland	2	**$100,000**
27.	Talent	4	**$100,000**
28.	Hood River	4	**$37,127**
29.	Bend	4	**$7,645**
30.	Warrenton	6	**$35,717**
31.	Lebanon	2	**$20,000**
32.	Bend	2	**$14,988**
115 Charging Ports			**1,024,703**

The Company will file a yearly update on the UM 1810 pilot programs in March of 2020.

Clean Fuels Programs

Background on the Company's participation in Oregon's Clean Fuel Program (CFP) can be found in **Section 4.1.2.**

Electric Mobility Grant Program: A total of approximately $1.3 million of grants will be available in 2020 for electric transportation projects that benefit residential customers and traditionally underserved communities. An additional $500,000 will be available as matching funds for communities or transit agencies in need of matching funds to leverage external grant funds. **Table 19** summarizes the total budget for the program, including administration.

Table 19. Electric Mobility Grant 2020 Budget

Electric Mobility Grant Program Funding Source	Total Funding Available*
CFP 2019/20	$1,400,000
Matching funds	$500,000
Total funds	**$1,900,000**

**Total funding includes both program and administration costs*

In June 2019, Pacific Power provided a letter of support and Commitment of $100,000 to Forth in their application for the US DOE Advanced Vehicle Technologies Research Funding Opportunity Grant for the Clean Rural Shared Electric Mobility (CRuSE) Project. Forth is a Portland-based nonprofit dedicated to advancing electric, smart and shared transportation. In August 2019, the US DOE awarded the CRuSE Project $548,540, amplifying the impact of CFP revenue. CRuSE will provide electric car sharing in Hood River, Oregon. In addition to providing funding Pacific Power will be an active partner in this project and use lessons learned in future program design.

Outreach and Education: The Company's outreach and education programs use both broad and specific education and marketing tactics to support electric transportation adoption in the state. **Table 20** summarizes the total budget for the program, including administration.

Table 20. Electric Transportation Outreach and Education 2020 Budget

Outreach and Education Spending	Funding Available*
Public Outreach and Education CFP from 2019 funds	$250,000
Public Outreach and Education CFP 2020 funds	$227,000
Statewide Education Campaign	$125,000
Design Build Challenge	$25,000
EV Driver Customer Survey	$80,000
Total funds	**$707,000**

**Total funding Includes both program and estimated administration costs.*

Outreach and education funds are intended to educate residential customers about eclectic cars, electric fuel, and the benefits of vehicle electrification. Outreach and education activities may include ride and drive events, community event sponsorship, advertisements, development of educational and marketing materials and their translation, dealer engagement, educational workshops and other activities that align with CFP design principles.

Pacific Power plans to coordinate with Portland General Electric and other stakeholders on a statewide education campaign aimed at residential customers focused on driving EV adoption in support of the State's goal of 50,000 EVs on Oregon roads by the end of 2020. Additionally the two utilities have partnered on the Design Build Challenge, a statewide youth STEM competition that engages middle schoolers and their communities on electric transportation.

The Company will use CFP funding to identify and survey residential EV drivers to better understand driving and charging behaviors along with outstanding needs and concerns of EV drivers. The collected data and resulting analysis will inform future residential program design outlined in section five.

In addition to the above programs and activities above, Pacific Power has earmarked $300,000 to support public agencies like transit agencies and school districts throughout the lifecycle of an electrification project: from concept, project planning, securing funding, offering technical assistance, completing the project, and promotion (**Table 21**).

Table 21. Public Agency Electrification Support 2020 Budget

Additional Program Spending	Funding Available*
Electrification Lifecycle Support for Public Agencies	$300,000

Additional information on these efforts, results and budgets can be found on the Oregon Public Utility Commission's website under Docket No. UM 1826.[91]

[91] *In the Matter of Public Utility Commission of Oregon, Investigation into Utility Participation in Oregon Clean Fuels Programs*, Docket No. UM 1826, Staff Report (April 18, 2017).

ATTACHMENTS

1. Navigant Select Baseline Survey Responses, Pacific Power Gen Pop Survey as of July 26, 2019
2. Pacific Power Oregon EV Charging Grant Application
3. Technical Assistance Template, with example of customer-facing technical assistance study
4. AEG Oregon Light-Duty Electric Vehicle Forecast Scenarios Memo
5. Potential System Impact Study

Attachment 1

SELECT BASELINE SURVEY RESPONSES

PACIFIC POWER GEN POP SURVEY

JULY 26, 2019

NAVIGANT

SURVEY RESPONSES

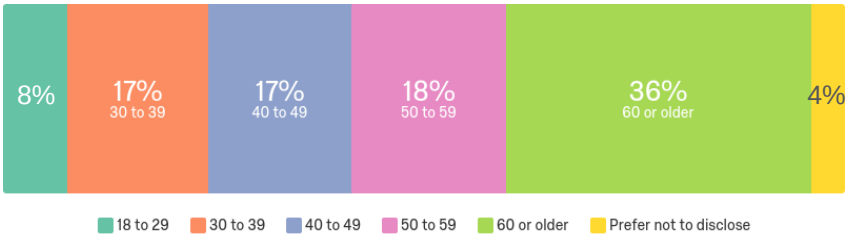
Number of Survey Responses*

Answer	%	Count	Response Rate
Completed Survey	97%	1482	14.8%
Screened Out	3%	47	
Total	100%	1529	15.3%

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

DEMOGRAPHICS: AGE

Take Away: More than 50% of respondents are over the age of 50



Survey Question: What is your age?

N=1422

NAVIGANT

CUSTOMER FEEDBACK FOR FIRST ROUND OF SURVEY

Several customers sent follow-up comments with feedback to Pacific Power using the email address provided in the survey invitation. Navigant identified a couple of themes from this customer feedback:

1. Three customers indicated they were not interested in electric vehicles and did not appreciate the survey on this topic
2. Three customers commented on the environmental impact or hazardous material concerns of EV batteries from manufacturing, end of vehicle life, and during crashes
3. Two customers commented that the survey should have included more questions about other forms of mobility options, including rideshare or car sharing
4. One customer commented that the survey did not explicitly point out the portion of Pacific Power's electricity generation that comes from fossil fuels, and how that impacts the cleanliness of EVs (the survey did ask a question about whether the GHG emissions from charging EVs is generally lower than the GHG emissions from conventional ICE vehicles)

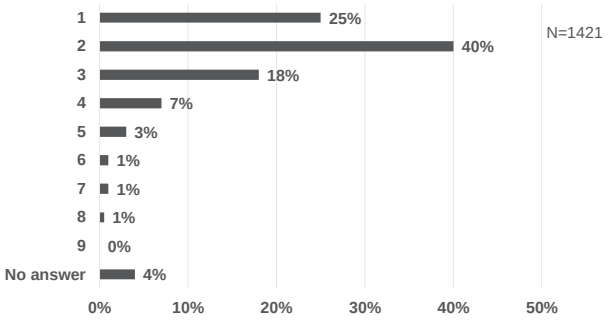
Navigant will consider this feedback when making any modifications to the survey instrument for the second-round panel survey in 2020

NAVIGANT

NUMBER OF HOUSEHOLD VEHICLES

Take Away:

- 25% of households have 1 vehicle
- 40% of households have 2 vehicles
- 31% of households have 3 or more vehicles



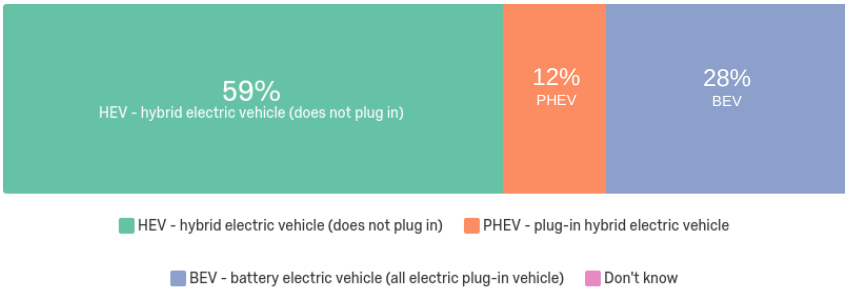
Survey Question: Approximately how many vehicles does your household currently own or lease?

NAVIGANT

CURRENT EV OWNERSHIP

Take Away:

- Nearly 8% (118) of *all* respondents own an electric vehicle
- *Of the 118 EV owners surveyed*, most (59%) have a hybrid-electric vehicle *without* a plug
- 47 respondents (40%) have an electric vehicle *with* a plug



Survey Question: Which type of electric vehicle do you currently own/lease?

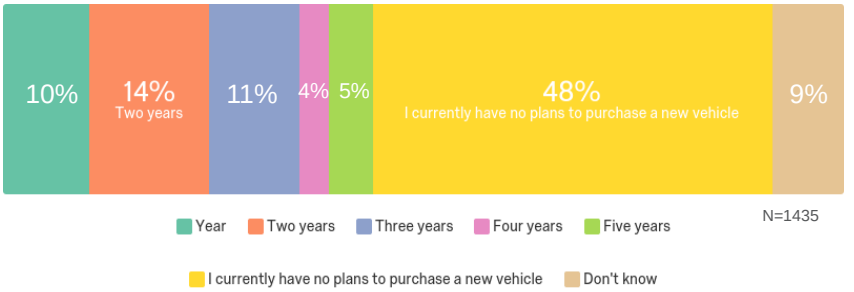
N=118

NAVIGANT

VEHICLE PURCHASE TIMEFRAME

Take Away:

- 35% of respondents plan to purchase/lease a new/used vehicle in the next 1-3 years
- Nearly half of respondents (48%) do not currently have plans to purchase/lease a new/used vehicle



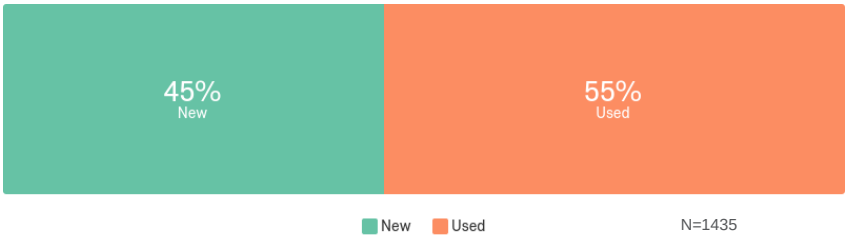
Survey Question: Please indicate whether you plan to purchase or lease a new or used vehicle in the next...

NAVIGANT

VEHICLE PURCHASE NEW/USED

Take Away:

- Respondents are more likely to be in the market for a used vehicle (55%) than a new vehicle (45%).



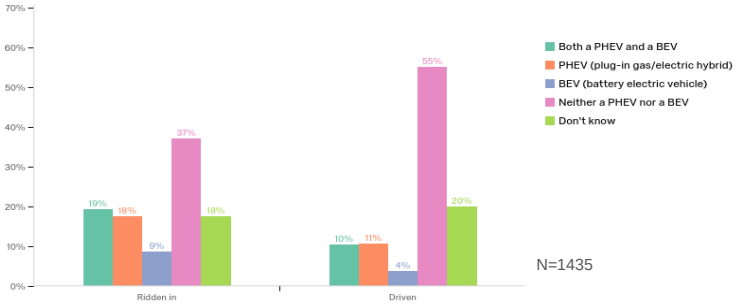
Survey Question: Are you more likely to be in the market for a new or used vehicle?

NAVIGANT

CUSTOMER EXPERIENCE: RIDDEN OR DRIVEN PEVS

Take Away:

- More people have ridden in a PHEV than a BEV (37% vs 28%)
- 25% of respondents have driven either a PHEV, BEV or both
- Roughly 20% of respondents aren't sure if they have ridden in or driven an electric vehicle.



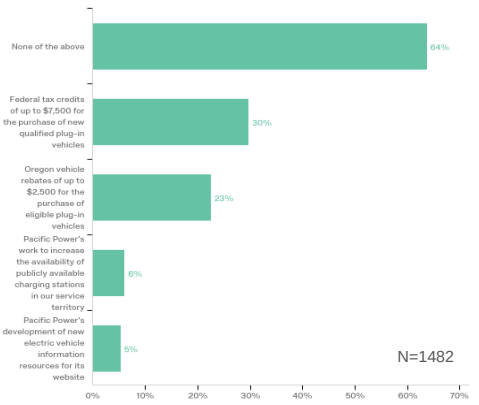
Survey Question: Which of the following vehicle types have you ridden in or driven? Select one response in each column.

NAVIGANT

AWARENESS OF EV INITIATIVES

Take Away:

- Well over half of respondents (64%) are not aware of any EV initiatives
- 30% are aware of the federal tax incentive for EVs
- 23% are aware of the Oregon vehicle rebate



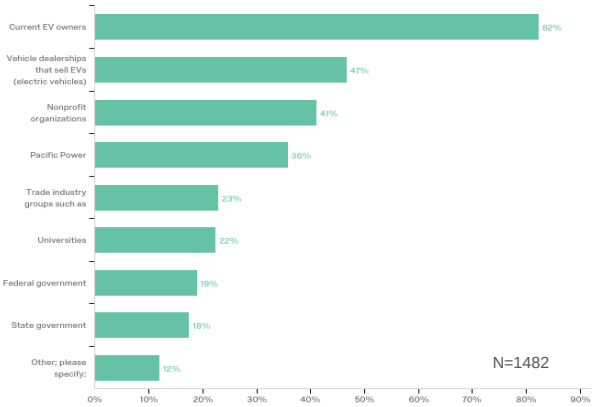
Survey Question: Which of the following electric vehicle initiatives were you aware of before taking this survey? Select all that apply.

NAVIGANT

TRUSTED INFORMATION SOURCES FOR ELECTRIC VEHICLES

Take Away:

- 82% of customers indicate current EV owners are the most trusted sources of EV information
- Dealerships, and non-profit organizations are also seen as trusted sources by many customers.
- Pacific Power is the 4th most trusted source of EV information

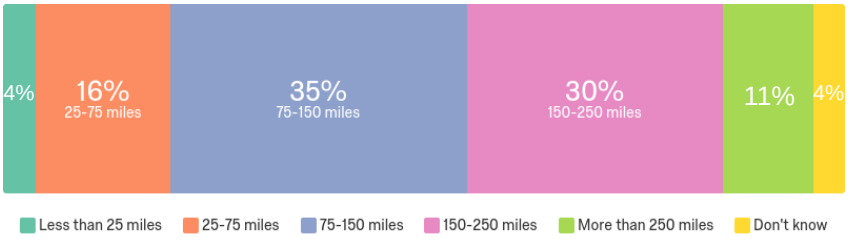


Survey Question: Which of the following do you consider to be the 3 most trusted sources of information about electric vehicles? Select three.

NAVIGANT

RANGE KNOWLEDGE (BEV)

Take Away: 30% of respondents correctly identify the typical range of a BEV, but more than half of respondents underestimate the drivable distance of a typical BEV.



Survey Question: Drawing on your current knowledge of BEVs (battery electric vehicles), what is the drivable distance per charge for a typical sedan-style BEV (battery electric vehicle)?

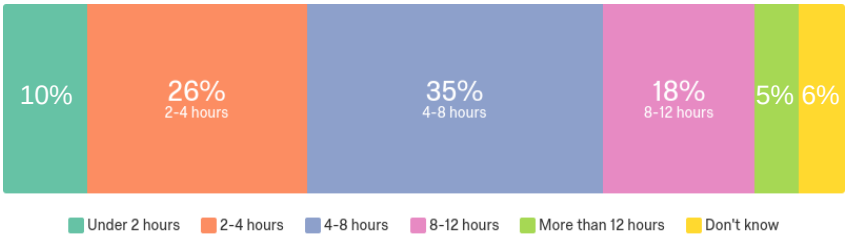
*Correct Answer: 150-250 miles

N=1379

NAVIGANT

CHARGING KNOWLEDGE-L2 (BEV)

Take Away: 35% of respondents correctly identify the charge time for a L2 charger, while 36% underestimate charge time, and 29% either overestimate or don't know.



Survey Question: How long would it typically take to fully charge a common BEV (battery electric vehicle) at your home using a 240-volt outlet similar to a clothes dryer outlet?

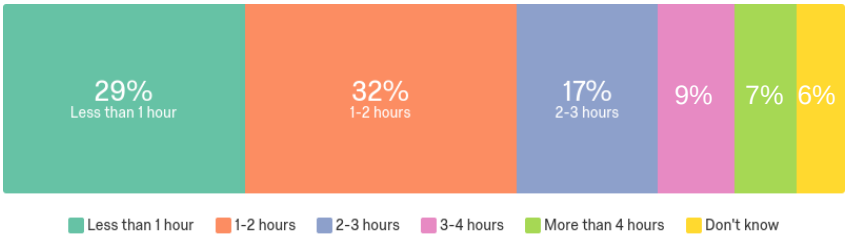
*Correct Answer: 4-8 hours

N=1353

NAVIGANT

CHARGING KNOWLEDGE-DCFC (BEV)

Take Away: 32% of respondents correctly identify the charge time for a DC fast charger, while nearly half (49%) of all respondents ***overestimate*** the charge time or don't know.



Survey Question: How long would it typically take to fully charge a BEV (battery electric vehicle) using a high-powered charging station that you might find at a location such as a library, grocery store, or curbside?

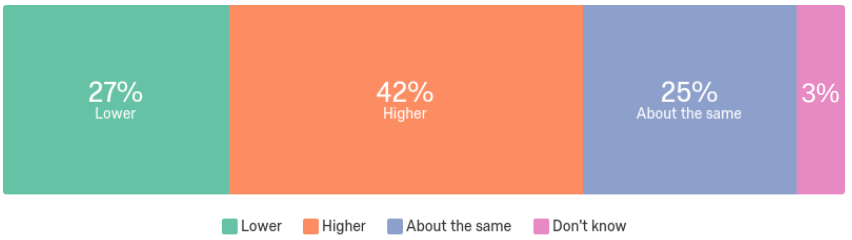
*Correct Answer: 1-2 hours

N=1350

NAVIGANT

MAINTENANCE COSTS KNOWLEDGE (BEV)

Take Away: Only 27% of respondents are aware that BEV maintenance costs are lower than those of an ICEV, while 42% believe BEV maintenance costs are higher.



Survey Question: When compared to a traditional gas or diesel-powered vehicle (of similar size and with similar features), are the maintenance costs of a BEV (battery electric vehicle) typically...

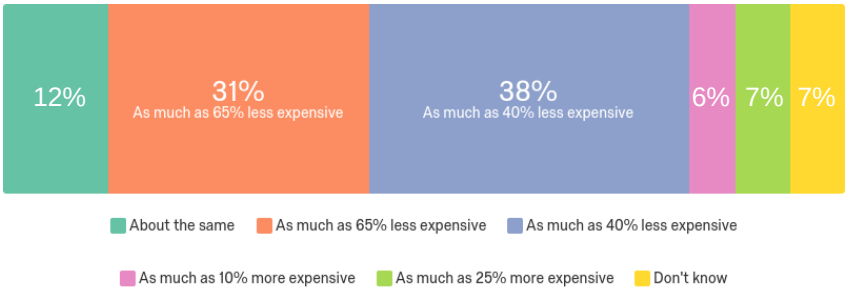
*Correct Answer: Lower

N=1349

NAVIGANT

FUEL COSTS KNOWLEDGE (BEV)

Take Away: Most respondents are aware that fuel prices for BEVs are less than ICEVs, although many respondents are not aware of the extent of the cost difference.



Survey Question: When compared to a traditional gas or diesel-power vehicle, are the fuel costs (i.e., charging costs) for a BEV (battery electric vehicle) typically...

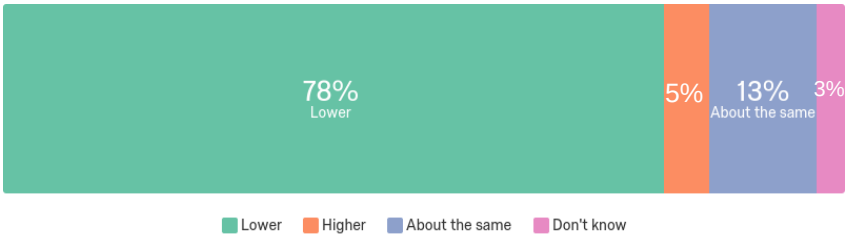
*Correct Answer: As much as 65% less expensive

N=1339

NAVIGANT

GREENHOUSE GAS EMISSION KNOWLEDGE (BEV)

Take Away: Nearly 80% of respondents are aware that BEVs emit fewer GHGs than ICEVs.



Survey Question: When compared to gasoline or diesel fuel, are the greenhouse gas emissions associated with the electricity used to fuel a BEV (battery electric vehicle) typically...

*Correct Answer: Lower

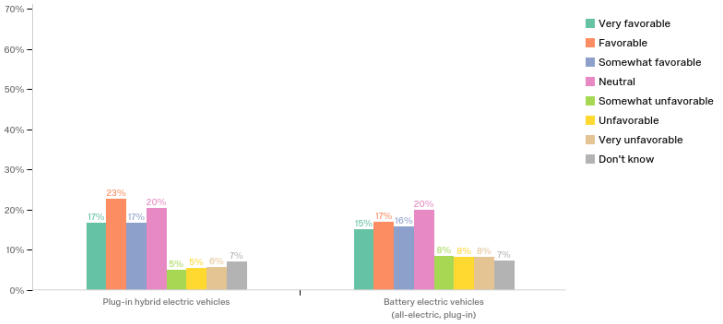
N=1386

NAVIGANT

GENERAL IMPRESSION OF PEVS

Take Away:

- 57% of respondents have favorable impressions of PHEVs
- 48% of respondents have favorable impressions of BEVs



Survey Question: What is your general impression of these vehicle types?

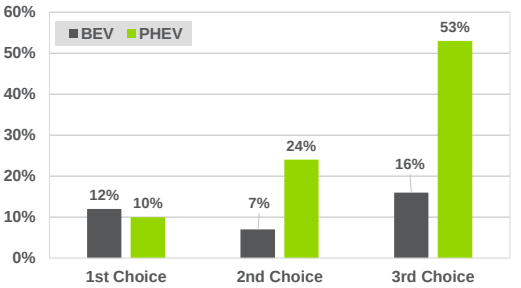
N=1435

NAVIGANT

FUEL TYPE PREFERENCES

Take Away:

- 34% of respondents indicate PHEVs are among their first or second vehicle choice by fuel type
- 19% of respondents indicate that BEVs are among their first or second vehicle choice by fuel type



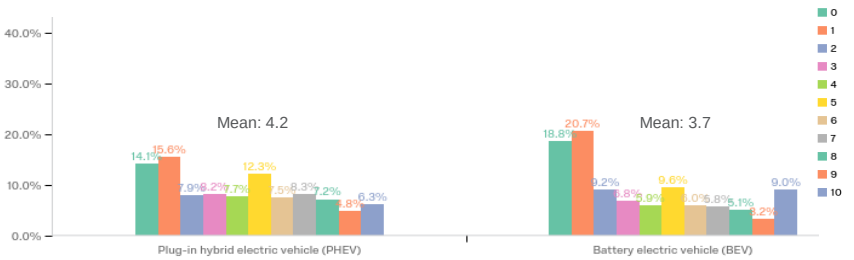
Survey Question: Please rank your preference for each of the following fuel types. N=1435

NAVIGANT

LIKELIHOOD OF PURCHASING A PHEV OR BEV

Take Away:

- 34% of respondents are more likely than not to select a PHEV for their next vehicle
- 29% of respondents are more likely than not to select a BEV



Survey Question: Please indicate how likely or unlikely you are to select each of the following vehicle types as your next vehicle (0=very unlikely, 10=very likely). N=1435

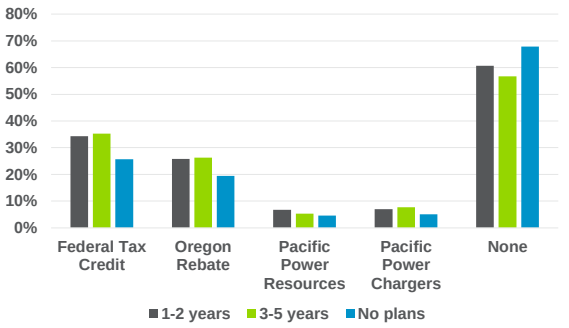
NAVIGANT

EV INITIATIVE AWARENESS BY VEHICLE PURCHASE TIMEFRAME

Take Away:

- Overall, respondents lack awareness of EV initiatives
- Respondents who are in the car market have slightly higher awareness of all initiatives than those who are not in the market.

**bar color indicates timeline for which respondent has plans to purchase next vehicle



Survey Question: Which of the following electric vehicle initiatives were you aware of before taking this survey? Select all that apply.

N=1435

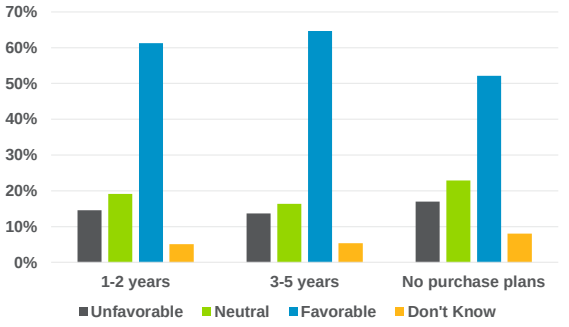
NAVIGANT

GENERAL IMPRESSIONS OF PHEVS BY VEHICLE PURCHASE TIMEFRAME

Take Away:

- Respondents views toward PHEVs are generally favorable.
- Respondents who are in the market for a new or used vehicle have more favorable impressions of PHEVs than those who are not in the market.

**Horizonal axis number range indicates timeline for which respondent has plans to purchase next vehicle



N=1435

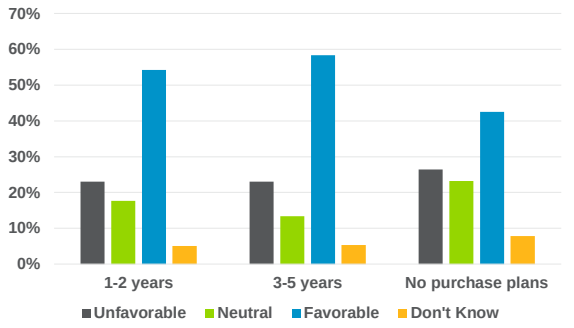
NAVIGANT

GENERAL IMPRESSIONS OF BEVS BY VEHICLE PURCHASE TIMEFRAME

Take Away:

- Respondents views toward BEVs are generally favorable
- Those who are in the market for a new/used vehicle have more favorable views of BEVs than those who are not in the market.

**Horizonal axis number range indicates timeline for which respondent has plans to purchase next vehicle



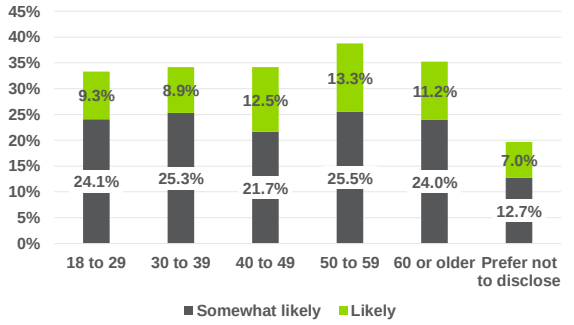
N=1435

NAVIGANT

LIKELIHOOD OF PURCHASING A PHEV BY AGE

Take Away:

- Roughly one-third of all customers indicate they are “somewhat likely” or “likely” to purchase a PHEV.
- Customers between the ages of 50 and 59 may be somewhat more likely to purchase a PHEV.



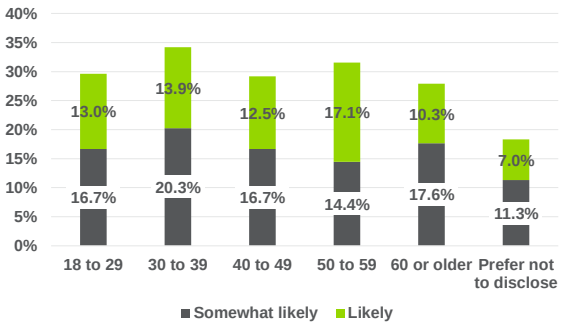
N=1435

NAVIGANT

LIKELIHOOD OF PURCHASING A BEV BY AGE

Take Away:

- Roughly one-third of all customers indicate they are “somewhat likely” or “likely” to purchase a BEV.
- Customers between the ages of 30 and 39 may be slightly more likely to purchase a BEV.



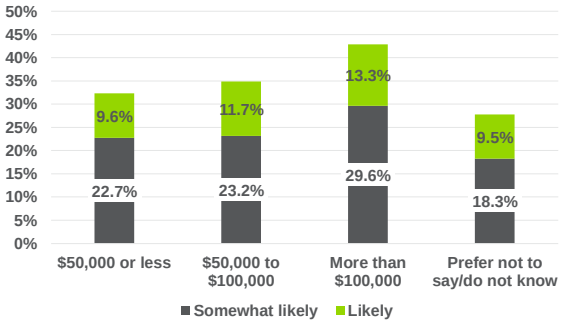
N=1435

NAVIGANT

LIKELIHOOD OF PURCHASING A PHEV BY INCOME

Take Away:

- Respondents from higher income brackets are slightly more likely to plan on purchasing a PHEV, although the differences between groups is subtle.



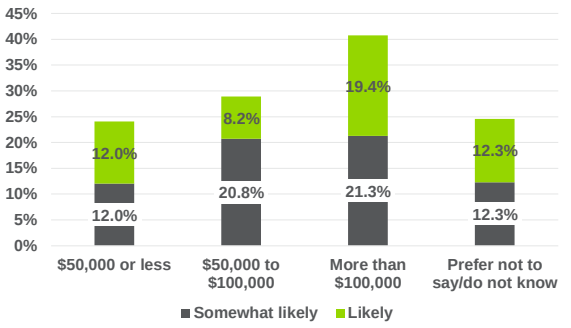
N=1435

NAVIGANT

LIKELIHOOD OF PURCHASING A BEV BY INCOME

Take Away:

- Respondents in higher income brackets are more likely to plan on purchasing a BEV than those in lower income brackets.



N=1435

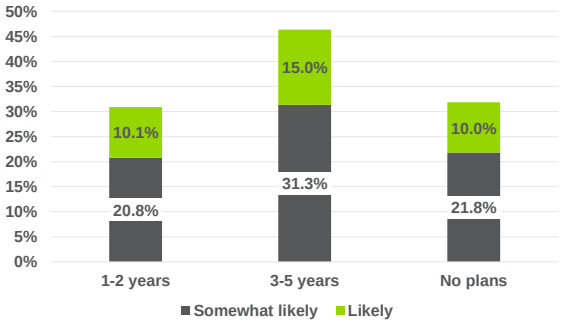
NAVIGANT

LIKELIHOOD OF PURCHASING A PHEV BY PURCHASE TIMEFRAME

Take Away:

- Respondents who plan to purchase a vehicle in 1-2 years are less likely to plan on purchasing a PHEV than customers who plan to purchase a vehicle in 3-5 years.

**Horizonal axis number range indicates timeline for which respondent has plans to purchase next vehicle



N=1435

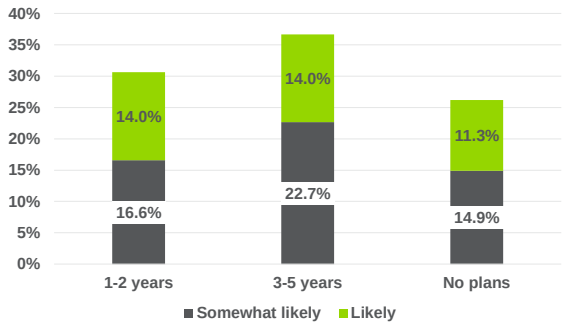
NAVIGANT

LIKELIHOOD OF PURCHASING A BEV BY PURCHASE TIMEFRAME

Take Away:

- Respondents who plan to purchase a vehicle in 1-2 years are less likely to plan on purchasing a BEV than those who plan to purchase a vehicle in 3-5 years.

**Horizonal axis number range indicates timeline for which respondent has plans to purchase next vehicle



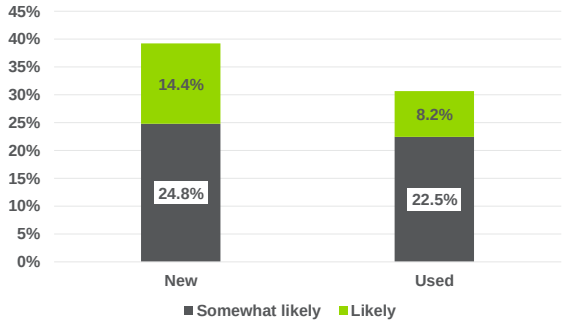
N=1435

NAVIGANT

LIKELIHOOD OF PURCHASING A PHEV BY INTENTION TO PURCHASE A NEW/USED VEHICLE

Take Away:

- Respondents who plan to purchase a ***new vehicle*** are more likely to plan on purchasing a PHEV than those in the used vehicle market.



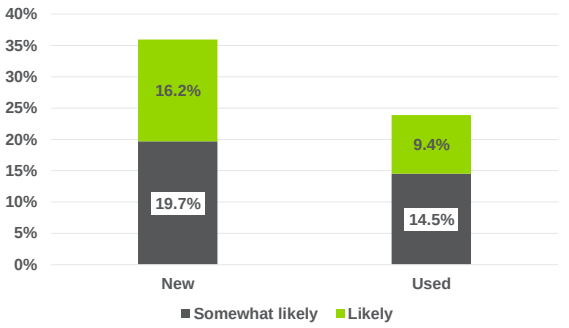
N=1435

NAVIGANT

LIKELIHOOD OF PURCHASING A BEV BY INTENTION TO PURCHASE A NEW/USED VEHICLE

Take Away:

- Respondents who plan to purchase a ***new vehicle*** are more likely to plan on purchasing a BEV than those in the used vehicle market



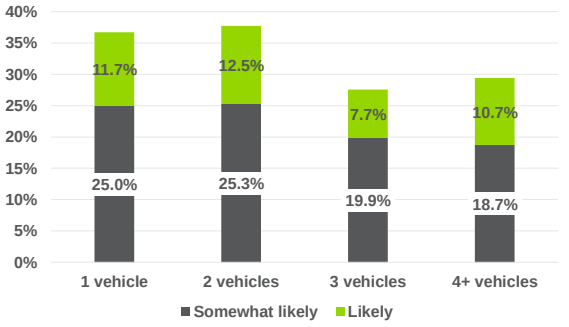
N=1435

NAVIGANT

LIKELIHOOD OF PURCHASING A PHEV BY NUMBER OF CURRENT HOUSEHOLD VEHICLES

Take Away:

- Respondents with a larger number of household vehicles are less likely to plan on purchasing a PHEV.



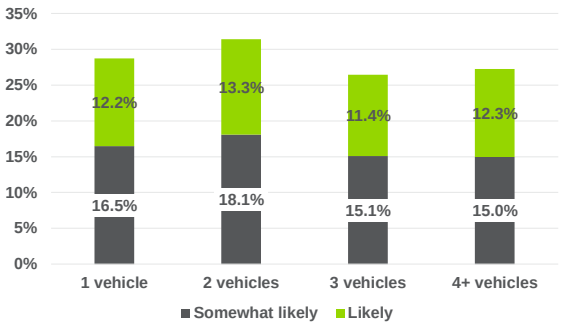
N=1421

NAVIGANT

LIKELIHOOD OF PURCHASING A BEV BY NUMBER OF CURRENT HOUSEHOLD VEHICLES

Take Away:

- Respondents with 2 household vehicles are slightly more likely to plan on purchasing a BEV than respondents with fewer or more vehicles.



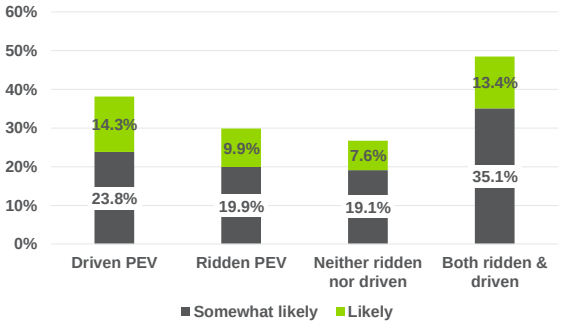
N=1421

NAVIGANT

LIKELIHOOD OF PURCHASING A PHEV BY PAST EXPERIENCE WITH PEVS

Take Away:

- Respondents who have both ridden in and driven a PEV are more likely to purchase a PHEV than those who have only ridden *or* driven.



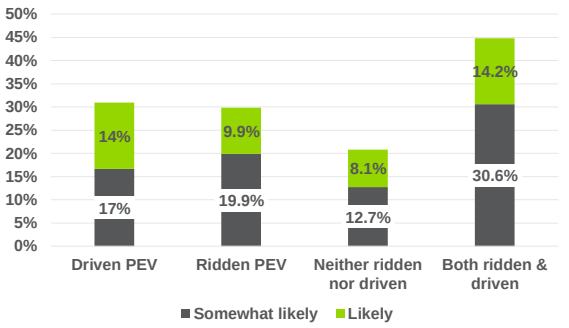
N=1435

NAVIGANT

LIKELIHOOD OF PURCHASING A BEV BY PAST EXPERIENCE WITH PEVS

Take Away:

- Respondents who have both ridden in and driven a PEV are more likely to purchase a BEV than those who have only ridden *or* driven.



N=1435

NAVIGANT

Attachment 2

Electric Vehicle Charging Grant Application

Application Checklist

1. Verify Eligibility
2. Collect bids and project information to support project scope
3. Complete Application and assemble Supplemental Documentation
4. Submit Application Package

Applications are due by **August 15, 2019 at 5pm PST**. Complete applications should be sent to plugin@pacificpower.net. Please submit the completed application and supplemental documentation as a single Microsoft Word document or PDF file. The signed certification page may be submitted as a separate PDF file or image file.

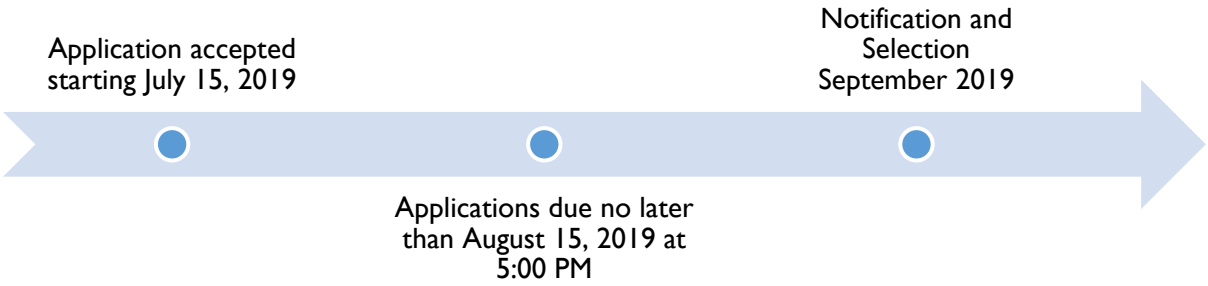
Electric Vehicle Charging Grant Information

Pacific Power is pleased to make electric vehicle (EV) charging grant funding available to non-residential customers in California, Oregon, and Washington. In total, $2.5 million in grant funding will be available to non-residential customers through the end of 2019 (CA & OR) and 2020 (WA), if funds remain available. For this grant cycle Pacific Power anticipates $300,000 in total funding will be available to applicants. Funding awards will cover up to 100 percent of eligible costs to purchase and install charging stations.

The grants are designed to offset the upfront cost of vehicle chargers and installation. Grant recipients will serve as project lead and be responsible for project design, project management, equipment purchase and installation, awareness building, data collection, and data transfer to Pacific Power, as well as the ongoing costs of operating and maintaining the charging equipment.

The timeline for the current funding cycle is provided in Table *1* below.

Table 1. Electric Vehicle Charging Grant Timeline



Grant recipients will have one calendar year to complete projects from the date of award. Projects will be reimbursed up to award amount for documented eligible expenses.

Requirements and Eligibility

Eligible Expenses include capital expenses directly associated with the installation of electric vehicle supply equipment (EVSE) or EV chargers, such as hardware and installation costs, make-ready costs, and upfront software license costs. Costs associated with outreach and education (e.g., signage, educational workshops) may be considered for funding.

Ineligible Expenses include previously incurred expenses, vehicle purchase or lease, extended warranty costs, project management costs, ongoing operations and maintenance costs, energy costs, ongoing network subscription or other software costs, and site and infrastructure improvements that would occur without the installation of EVSE (e.g., landscaping, information technology network enhancements).

Eligibility All Pacific Power customers on a non-residential electric service schedule are eligible to apply for program funds with preference given to community-focused organizations, such as 501(c)(3) and city, county, and regional governments with demonstrated need for funding. Eligible customers include commercial, industrial, and agricultural customers. Multi-unit dwellings on a non-residential electric schedule are considered commercial customers and are eligible to apply.

To be considered, applicants must:

- Submit a completed application along with supplementary documentation by the quarterly deadline.
- Agree to transfer any Oregon Clean Fuel Program Credits derived from grant funded EVSE to Pacific Power (Oregon Only).
- Provide interval charging data to Pacific Power on a monthly basis for the life of the project.
- Install permanent, Pacific Power approved signage to increase awareness and understanding of the benefits and opportunities for transportation electrification, the Electric Vehicle Charging Grant, and other available Pacific Power transportation electrification resources.
- Participate in program evaluation activities, such as surveys and questionnaires.

Application Evaluation

Pacific Power will use an independent, third-party grant manager to review and score projects based on established criteria outlined in Table 2 below

Table 2. Applicant Evaluation Criteria

Criteria	Measures
Project Feasibility/ Utilization	• Readiness of the project team and reasonableness of the project plan and timeline. • Feasibility study results, including compliance with national, state, and local safety and accessibility requirements. • Expectation that the EVSE will be sufficiently used, based on an assessment of applicant-provided utilization projections (e.g. community needs assessment data, electric vehicle ownership data, survey data). • Project life (as reported by the applicant) and robustness of the ongoing operations and maintenance plan. • Plan to address interoperability with driver technologies and Pacific Power's system (e.g. capabilities to interact with AMI when installed). • Expected driver payment pricing model, if applicable.
Use of Funds	• Customer and Company financial commitment and leveraging of funds from other sources.

	• Alignment of project costs with industry standards. • Reasonableness of the proposed budget (i.e., risk of exceeding budget). • How project is designed to avoid risk of stranded investments. • Applicant and project need for funding support.
Innovation	• Incorporation of emerging technologies, such as renewable generation, energy storage, or direct load control. • Creative project design, partnerships, and utilization of resources, particularly in serving underserved populations.
Data availability	• Type(s) of data available through the project (e.g., interval energy consumption, average session duration, station usage by time of day, number of unique drivers, etc.). • Plan to collect and analyze data. • Mechanism(s) to share data with Pacific Power. • Ability to incorporate potential future electric grid services (e.g., demand response, vehicle-to-grid integration).
Educational Benefits	• Physical and community visibility. • Education plan and awareness building opportunities. • Exposure in communities currently underserved by EVSE, such as multi-family, low-income and remote areas of the state.
Environmental benefits	• Proximity to areas with known air quality issues. • Alignment with the applicant's broader environmental mission or goals.
Community benefits	• Benefits provided to underserved populations. • Impact of the applicant on the community. • Use of local labor and/or materials. • Accessibility to the public.

California

In California twenty percent of grant funding is reserved for small business applicants.

Oregon

In Oregon seventy-five percent of funds in each cycle will be made available for projects evaluated based on the criteria in Table 2.

The remaining twenty-five percent of available funds in each grant cycle will be earmarked for projects focused on workplace charging and/or fleet vehicle electrification. The evaluation criteria for these projects will be the same as those presented in Table 2, with the following exceptions:

- Educational Benefits will not be considered in application evaluation
- Environmental Benefits will not be considered in application evaluation
- Community Benefits will not be considered in application evaluation

Washington

In Washington twenty-five percent of funds in each funding cycle are reserved for projects that directly benefit low-income customers.

Project Examples

In order to adapt to a rapidly evolving market, there is flexibility in the types of projects that may be considered for grant funding. Below is an example of a type of project the program is designed to support.

Hacienda CDC Low Income Car Sharing Pilot

In 2016, Pacific Power joined Hacienda Community Development Corporation (Hacienda CDC), the City of Portland, and Forth in a pilot project designed to test a model for low-income electric vehicle sharing. Through the pilot, low-income community members in an area underserved by existing public transit had access to three electric cars through a vehicle-sharing platform. Hacienda CDC hosted the vehicles at their North Portland headquarters. Two cars were available to Cully neighborhood residents at all times and one car was reserved for Hacienda CDC staff use. Pacific Power provided $10,000 toward the cost of procuring and installing Level 2 charging stations to serve the vehicles. Other community partners procured the vehicles and were responsible for implementing and managing the project.

The project at Hacienda CDC is a prime example of the type of project envisioned for grant funding, as it supports underserved communities, tests new and innovative solutions to addressing market barriers, leverages additional funding partnerships, and provides data and learnings that can be applied in Pacific Power's future planning efforts. Other representative potential project types are shown in Table 3. These project examples are illustrative and do not preclude alternative project proposals.

Table 3. Project Examples

Applicant	Project Description
Transit Agency	Transit agencies may apply for grants to fund infrastructure required to fuel electric buses in support of their electrification strategies.
Businesses (Small/ medium/ large)	Businesses of all sizes might use grant funding to install EVSE and provide charging as an amenity to customers, employees and the community. Applicants may investigate load management strategies to minimize distribution equipment upgrade and associated demand charges.
Non-profit	A non-profit organization might use grant funding to install EVSE for electric fleet vehicles and employee/client/community use.
Multiunit Family Housing Complex	A multi-unit property owner might use grant funding to install EVSE for tenant use, either in support of tenant-owned electric cars or in conjunction with offering electric cars for tenant use.
Fleet electrification	Organizations electrifying their fleet who might install EVSE to refuel their electric vehicles.
Community Car Share	Projects modeled after Hacienda CDC's community car sharing pilot that improve access to electric cars in underserved communities.

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Applicant Information

Applicant Information	
Host organization *Organization occupying the property where the Electric Vehicle Supply Equipment (EVSE) project will be installed.*	
Type of organization *Government, private, nonprofit, etc.*	
Pacific Power customer account number	
Organization website address	
Primary project contact information *Will be responsible for providing ongoing reporting for the project*	
Name	
Title	
Organization name	
Role in the project	
Phone number	
Email address	
Contractor/Installer/Engineer contact information:	
Name	
Title	
Phone number	
Email address	
Organization name	
Role in the project	
EVSE owner *Indicate if different from host organization. If more than one party, describe ownership structure.*	
Name of individual completing application *Include affiliation and contact information if different from primary contact or contractor/installer/engineer.*	
Please verify that the project satisfies the *Requirements & Eligibility* provided above *Also available at pacificpower.net/ev-grants*	☐ I certify that this project meets Pacific Power's Electric Vehicle Charging Grant funding award eligibility requirements

EVSE PROJECT INFORMATION	
Physical address where project will be installed *Include facility name, street address, city, state, zip code, and/or GPS coordinates where appropriate.*	
Number of chargers and make/model/type of each *DC Fast Charge, Level 2, dual pedestal, SAE J1772, etc.*	
Expected Percent Utilization by Category (*Workplace, public, fleet, transit*) *E.g. 40% Workplace charging, 60% public charging*	
Will the public be able to access the EVSE?	
Will the owner charge a fee for EVSE use?	
How many hours per week will the chargers be accessible?	
Estimated annual kWh usage	
Is there currently electric vehicle charging infrastructure at the site? If so, describe the current configuration and use.	
Location of installation on property *Where will the EVSE be located (Parking lot, roadway, parking garage, etc.)?*	
Number of dedicated EV parking spaces	
Anticipated commissioning/on-line date	
Applicant commitment to maintaining charging equipment (years)	
Has the project team been in contact with Pacific Power's estimators? *Call 1-800-625-6078or visit pacificpower.net/CU to schedule an estimator visit*	
Participation Information	
Has your organization applied for an Electric Vehicle Charging grant from Pacific Power in the past? *If yes, describe the project, whether an award was granted, and the application year. Also specify if the project proposed in your prior application is the same project proposed in this application.*	
How did you hear about Pacific Power's Electric Vehicle Charging Grant program?	

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PROJECT FEASIBILITY

Provide a brief description of the proposed EVSE project.
Include why the particular size, technology, and specific location were chosen.

Describe the overall structure of the project team and the primary roles of each team member.
List and describe each project team members' relevant experience and credentials demonstrating their ability to satisfy their role. If certain key contractors have not yet been selected, describe your contractor selection process.

Describe the current status of the project, planning, and design work that has been completed to date, and the plan for bringing the project to completion.
Identify potential challenges and risks to completing the project on time and your strategy for mitigating each of those risks.

Please identify the status of all necessary permits or other approvals required for the project:

Permit/Agreement Description	Not required	Required, application not yet submitted	Application submitted	Permit/ approval received	Unsure if required	**Cost**
Land use						
Electrical						
Structural						
Mechanical						
Zoning						
Environmental impact						
Cultural/historic impact						
City council/board approvals						
Other:						
					Total=	$

Please include an explanation of permitting status if necessary	

What operations and maintenance (O&M) activities are required over the project life? Describe the long-term O&M plan, including sources of funding to implement the plan.
List any warranties on equipment and labor, agreements with O&M service providers, and/or insurance that will be secured. Describe any data monitoring capabilities and who will be responsible for reviewing the data, responding to data anomalies and/or sharing the data with Pacific Power.

EVSE PROJECT COSTS AND FINANCING
Describe the financial structure of the EVSE project. *Include who will pay for and own the project, who will receive the financial benefits, and who will pay for maintenance and repairs.*
Describe efforts to ensure that the proposed budget represents the maximum value for the cost of the EVSE project. *Explain any significant price deviations from industry norms and whether you received multiple bids from competitive contractors.*
Identify potential challenges and risks to completing the EVSE project within budget and your strategy for mitigating each of those risks.
Describe efforts undertaken to explore alternate sources of funding. *Include whether the project owner and/or host is contributing funds.*
Explain why funds from the Electric Vehicle Charging Grant funding program are needed to make the project successful.
Describe the organization's current financial status. *Include the organization's plan to fund its portion of project costs (provide relevant evidence of creditworthiness, balance sheets, or other documentation as needed).*
Will the owner charge any fees for charger usage? *If yes, please include the organization's fee structure and plan to process fees (e.g. app, RFID card, credit card reader).*

Project Budget

Please provide an itemized budget for eligible costs including the categories listed below.

The following costs are <u>NOT</u> eligible for reimbursement:

- Previously incurred expenses
- Structural improvements or other site preparation that would be considered general facilities upgrades or maintenance (e.g. re-paving, upgrading an overloaded electrical panel, landscaping)
- Administrative or project management costs
- Construction bond costs or interest
- Ongoing system or facility maintenance or repair costs
- Donated, in-kind or volunteer labor or materials
- Equipment warranty costs
- Auxiliary equipment costs (e.g. solar systems, battery storage systems)
- Contingency

EVSE Project Component	***Cost***	***Line Item Description***
Costs already incurred (*ineligible for grant funding*)	*	
Total permitting fees, if applicable		
Engineering and design costs		
Charging equipment costs		
Upfront software costs		
Equipment warranty costs (*ineligible for grant funding*)	*	
Auxiliary equipment costs (*wiring, conduit, breakers, disconnects, etc.*)		
Construction costs (*trenching, paving, etc.)*		
Electrical installation costs		
General labor costs		
Other costs (*please itemize*)		
TOTAL PROJECT COSTS		
TOTAL ELIGIBLE PROJECT COSTS		Exclude costs marked with * and other ineligible costs
Optional: List the marketing and outreach costs associated with the project to be considered for additional funding on an individual basis. Marketing and outreach costs not included in the application budget will not be considered for reimbursement		
Amount of funding requested		
Funding request as % of Total Project Costs		

Sources of Funding					
List and describe all funding sources and income streams of the project, as well as the nature of the contribution – grant, donation, production or capital incentive, cash or in-kind. Please provide documentation confirming secured funding sources from external organizations.	Source and Type of Funding	Amount	% of Total Project Cost	Secured or Pending	Date secured or expected
	Requested Pacific Power Grant Funding (reimbursement)	$		Pending	March 2019
		$			
		$			
		$			
		$			
	Totals	$			
Briefly describe the process to secure any 'pending' funding sources					

INNOVATION
Describe the incorporation of emerging technologies, if applicable *Such as renewable generation, energy storage, or direct load control.*
Describe any creative project design, partnerships, and utilization of resources, particularly in serving underserved populations.

DATA
Describe the type(s) of data that will be available through the project. *e.g., interval energy consumption, average session duration, station usage by time of day, number of unique drivers.*
Describe the project's ability to incorporate potential future electric grid services. *e.g., demand response, vehicle-to-grid integration.*
Describe the plan to collect and analyze data and the mechanism(s) of how data will be shared with Pacific Power. *Grant funding recipients are required to provide interval charging data (and information on driver pricing structure, if applicable), to Pacific Power on a quarterly basis for the life of the project.*

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EDUCATION, ENVIRONMENT & COMMUNITY

Describe the host organization.
Including, but not limited to its mission, history, purpose, and who it serves.

What is the host organization's motivation for installing electric vehicle charging equipment?
Include the history, goals, and how transportation electrification aligns with the overall mission of your organization.

What are the economic, environmental, and social benefits of the proposed EVSE project?
Include how any cost savings will be used, how the project will help meet any environmental goals, and any additional benefits to the local community.

What educational benefits are associated with the proposed project?
Include whether the charging equipment will be visible to the public, how many people will see/learn/benefit from the project per year and at what level of engagement. Identify a point person who will take the lead on community education, the anticipated resources that this educational effort will require, and how you will ensure that educational benefits continue beyond the first year of project operation.

Please describe your plans to educate and engage the community about your EVSE project.
Check the box to the left for every item included in your education and recognition plan and use the boxes to the right to list and briefly describe each element. ***Note:*** *funding recipients are required, at minimum, to provide onsite recognition of Pacific Power's contribution. Funding may be available for education and recognition expenses, but only for expenses included in the application budget.*

Included in plan?		Community education	Pacific Power recognition
☐	Signage		
☐	Onsite monitoring display		
☐	Media and publications		
☐	Celebrations or events		
☐	Website information		
☐	Other		

Please share any additional information regarding this EVSE project relevant to your application.

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Supplemental Document Checklist

Applicants must include the following required application documents for their project to be considered for funding. Please submit the completed checklist along with your application. If any required documents are not included, please identify the reason why below.

Table 4 Required Documentation

Required	Included	Not included	**Required Documentation** Please clearly label each attachment included in your application with the labels in bold.
X	☐		**Completed Application.**
X	☐		**Signed Certification.**
X	☐	☐	**Letters of Support.** A support letter is required from the project owner, if different from the person compiling the application. Other support letters from key community members may also be provided.
X	☐	☐	**Customer Verification.** Please provide a copy of your most recent monthly electric bill.
X	☐	☐	**Contractor Bids with Itemized Labor and Equipment Costs.** Proposals, bids, and/or contracts to support the budget described in this application.
X	☐	☐	**Project Development Timeline.** Monthly or weekly installation timeline with key milestones (e.g., equipment procurement, equipment delivery on site, construction begins, construction ends, commissioning, go-live date, etc.).
X	☐	☐	**Credentials.** A list of project team members, roles, and qualifications. Include resume of the project manager and other key team members. Include list of any similar projects completed. Brief description of applicable experience with EV equipment (if any).
X	☐	☐	**Equipment Specifications.** Include performance and warranty information for all major components to be installed.
X	☐	☐	**Proof of Additional Secured Funding (if applicable).** Documentation (i.e. award letters, confirmation emails, and other communication) confirming secured or granted funding sources and amounts.
X	☐	☐	**Site Control Agreement.** Land ownership documentation or long-term lease agreement.
Explanation of Missing/Omitted Documentation			

Applicants are encouraged to include the following documents to strengthen their application.

Table 5 Recommended Documentation

Included	Not included	**Recommended Documentation** Please clearly label each attachment included in your application with the labels in bold.
☐	☐	**Site Evaluation(s)**. Include a technical assessment, any structural or installation feasibility assessments, electrical analysis and/or documentation of discussions with the Pacific Power estimator group.
☐	☐	**Design Drawings.** Electrical diagram and site plan showing the location of the project components on the property.
☐	☐	**Site Photos.** Photos of the proposed project site and/or building with captions.
Explanation of Missing/Omitted Documentation		

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Certification

I certify that in preparation for submitting this application I have reviewed the application as well as the award recipient requirements, understand that should this project be awarded funding, my organization will be able to meet the award recipient requirements as described above, and attest that the information provided in this application is both accurate and current. I also understand that submitting an application in no way obligates Pacific Power to provide funding and that funds are distributed at the sole discretion of Pacific Power.

Signature: _____ Date: _____

Printed name: _____

Title: _____

Company: _____

Contact number _____

If this request is being submitted by multiple parties or a party other than the host, please indicate below by providing the party's name, title and contact information. The project host/owner must approve the submittal on their behalf through signature demonstrating that the all parties linked to installation have reviewed the application and support the project, along with supporting documentation - please see above for a comprehensive list of required attachments.

Approving party (project host/owner) – if other than project applicant

Signature: _____ Date: _____

Printed name: _____

Title: _____

Company: _____

Contact number _____

Applications are due by **August15, 2019 at 5pm PST**. Complete applications should be sent to plugin@pacificpower.net. Please submit the completed application and supplemental documentation as a single Microsoft Word document or PDF file. The signed certification page may be submitted as a separate PDF file or image file.

Attachment 3

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Technical Assessment Report

Date

Project Number

Site/Company Name

Customer Contact Name

Executive Summary of Customers Desired EVSE Project

- Objectives of installing EVSE
- Short and long term utilization plan of a EVSE project
- Desired scope, including number of EVSE ports
- General site and building configuration

Electricity Utilization Assessment

- Current facility electricity usage (summer, winter, and daily peak)
- Current facility rate
- Expected EV load profile
- Load control options, and opportunities to minimize electricity costs
- Solar or battery storage considerations

Equipment Assessment

- EVSE equipment selection
  - Power level
  - Network services
  - Software data subscriptions
- Other equipment requirements or upgrades
  - Transformer
  - Meter panel
  - Breaker panel

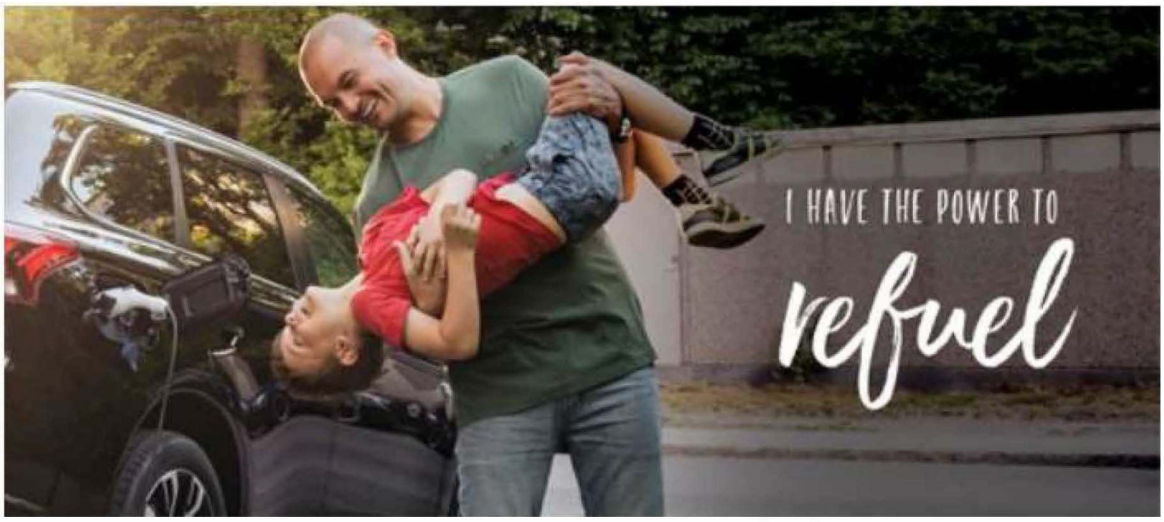
Site Design Assessment

- EV stall layout
- EVSE mounting
- ADA requirements
- Conduit and/or trenching route
- Conductor sizing

Attachments

1. Preliminary site layout plan
2. Project installation cost estimate (rough order of magnitude, ROM)

Initial Site Assessment: Preliminary Design



Application Number: **(job number)**
Property/Company Name: **(project name)**
Address: **(address)**

(date)

C2 GROUP

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ALTA VISTA SHOPPING 1234 ALTA VISTA RD 2

SITE ASSESSMENT

SCALE: 1" = 40'

PROJECT SUMMARY

THE PROJECT INCLUDES THE LOCATION OF ONE (1) EV STALL GROUPING AREA CONSISTING OF (5) STANDARD STALLS & (2) ADA STALLS. THE STALLS ARE LOCATED IN THE EAST SIDE OF THE PROJECT SITE. THE EV STALLS WILL BE SERVICED FROM THE EXISTING BUILDING METER PANEL AS DETAILED IN SITE LAYOUT HEREIN.

1. TOTAL PROPOSED EV STALLS = X
   A. STANDARD STALL = X
   B. STANDARD ADA STALL = X
   C. VAN ADA STALL = X
   D. AMBULATORY STALL = 0
   E. TOTAL EXISTING STALL REMOVED = X
2. TOTAL EV CHARGING STATIONS = X
   A. DUAL NOZZLE (PEDESTAL OR WALL MOUNT) = X
   B. SINGLE NOZZLE (PEDESTAL OR WALL MOUNT) = X
3. ELECTRICAL EQUIPMENT TO BE INSTALLED:
   A. INSTALL NEW METER
4. TOTAL LENGTH OF TRENCH / CONDUIT
   A. LENGTH OF ABOVE GROUND CONDUIT TO EV UNITS= XXX FT
   B. LENGTH OF TRENCHING TO EV UNITS= XXX FT
5. SITE WORK IMPACTS INCLUDE:
   A. REMOVAL & REPLACEMENT OF EXISTING CURB, PAVEMENT & LANDSCAPE.
   B. IMPACTS TO EXISTING UTILITIES TO BE VERIFIED DURING FINAL ENGINEERING.
   C. IMPACTS TO TREE ROOTS, TREE HEALTH AND POTENTIAL TREE IMPACTS TO BE VERIFIED.

LEGEND

- EV STANDARD PARKING STALL
- 2 EV ADA PARKING STALL
- SINGLE NOZZLE CHARGER
- DUAL NOZZLE CHARGER
- E NEW ELECTRICAL CONDUIT & TRENCH LINE
- EXISTING TRANSFORMER
- BUILDING METER PANEL

SITE CONSTRAINTS

SITE CONSTRAINTS DURING CONSTRUCTION INCLUDE:

1. VEHICLE TRAFFIC WILL BE INTERMITTENTLY CONSTRAINED TO ONE LANE DURING INSTALLATION OF CONDUIT.
2. ACCESS TO PARKING STALLS AND SIDEWALK ALONG CONDUIT LINE TO BE INTERMITTENTLY INACCESSIBLE DURING CONSTRUCTION.

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PRELIMINARY COST ESTIMATE TOOL

PROJECT MANAGEMENT PLAN

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A DIVISION OF PACIFICORP

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C2 GROUP

Preliminary Cost Estimate

Project Name:	Enter Project Name			Enter Information
Project Address	Enter Project Address			1. Address - Determines if site in DAC
	Enter Project City	Enter Zip Code		
	Project Summary			
No. of EVSE Ports				
No. of ADA Stalls				
Solar System Size (KW)				
Battery Storage (KW)				
	Preliminary Cost Summary			
Item No.	**Item Description**		**Total**	
EVSE Design and Permitting		0	$	-
EVSE Construction		0	$	-
EVSE Equipment		0	$	-
	EVSE Contingency		$	-
Solar Design and Permitting		0	$	-
Solar Construction		0	$	-
Solar Equipment		0	$	-
	Solar Contingency		$	-
	EVSE Subtotal		$	-
	Solar Subtotal		$	-
	Preliminary Cost Estimate Total		**$**	**-**
	EVSE Cost per Nozzle			#DIV/0!
	Solar Cost per kW			#DIV/0!

Attachment 4

MEMORANDUM

To: Angela Long, PacifiCorp

From: Eli Morris and Kurtis Kolnowski, Applied Energy Group (AEG)

Date: January 10, 2020

RE: PacifiCorp Oregon Light-Duty Electric Vehicle Forecast Scenarios

PacifiCorp engaged Applied Energy Group (AEG) to develop forecasts of potential light-duty electric vehicle (EV).[1] Adoption in its Oregon service territory.[2] To accomplish this and to provide a range of potential outcomes, AEG created three separate scenario forecasts based on industry sources of varying aggressiveness. The three scenarios produce extremely similar results through 2024, suggesting that there is general industry agreement around the rate of EV adoption over the next several years. In 2025, the three forecasts begin to diverge, highlighting the large uncertainty surrounding medium- and long-term EV adoption rates and the many factors that may affect uptake. The remainder of this memorandum summarizes the inputs, methodology, and results of AEG's analysis.

Historical EV Adoption in PacifiCorp's Oregon Service Territory

According to the Oregon Department of Environmental Quality (DEQ), 27,796 light-duty EVs were registered in Oregon as of September 30, 2019,[3] 5,018 of which were registered in PacifiCorp's service territory. Of the EVs registered in PacifiCorp's service territory at this time, 58% (2,897 vehicles) were battery electric vehicles (BEVs) and 42% (2,121 vehicles) were plug-in hybrid electric vehicles (PHEVs).

Figure 1 and Table 1 show the trend in light-duty EVs registered in PacifiCorp's Oregon service territory since mid-2017 based on current and previous DEQ reports.[4] Because actual year-end 2019 data were not available at the time of this analysis, AEG used the percentage growth rate from June through September to estimate the number of vehicles that would be registered by the end of 2019. Using this methodology, AEG estimates a total of 5,558 light-duty EVs registered in PacifiCorp's Oregon service territory by the end of 2019, composed of 3,128 BEVs and 2,430 PHEVs.

[1] This memo uses the term "electric vehicle" or "EV" to encompass both battery electric vehicles and plug-in hybrid electric vehicles.

[2] The discussion and results presented in this memo are specific to light-duty vehicles. Medium- and heavy-duty vehicles are outside the scope of this analysis.

[3] State of Oregon Department of Environmental Quality, *Electric Vehicles in Oregon – End of September 2019, Updated: December 31, 2019*. https://www.oregon.gov/deq/FilterDocs/CFP-electicvehicles.pdf (last visited Jan 7, 2020)

[4] DEQ began reporting EV registrations by utility service territory in mid-2017. Reports containing data before June 30, 2019 are no longer posted online, but were provided to AEG by DEQ.

Figure 1. Cumulative Light-Duty EV Registrations – PacifiCorp Oregon Service Territory (segmented line estimated)

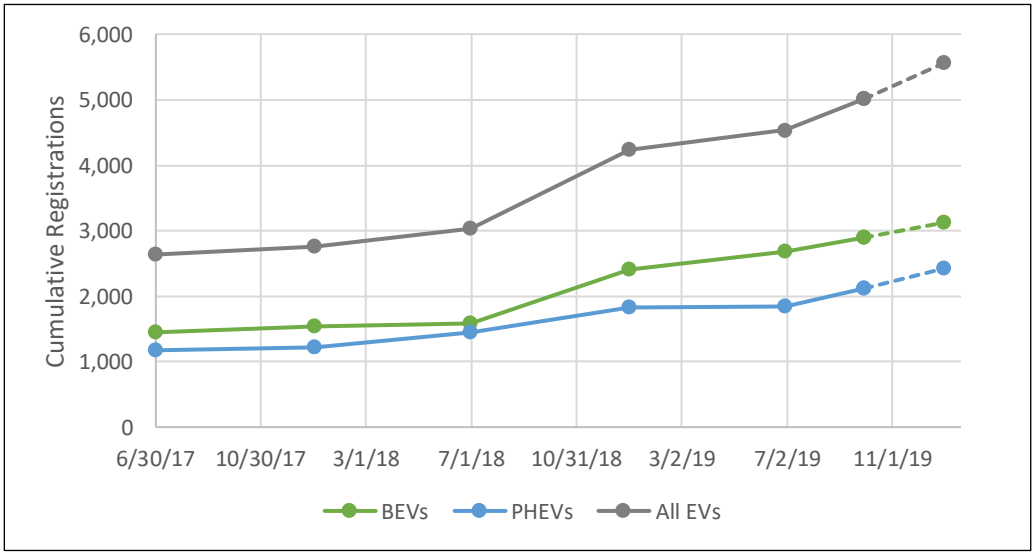


Table 1. Cumulative Light-Duty EV Registrations – PacifiCorp Oregon Service Territory

	Actual						Estimated
Vehicle Type	Jun 30, 2017	Dec 31, 2017	Jun 30, 2018	Dec 31, 2018	Jun 30, 2019	Sep 30, 2019	Dec 31, 2019
BEVs	1,455	1,544	1,587	2,410	2,683	2,897	*3,128*
PHEVs	1,182	1,217	1,450	1,823	1,851	2,121	*2,430*
All EVs	**2,637**	**2,761**	**3,037**	**4,233**	**4,534**	**5,018**	***5,558***

EV Adoption Forecast Scenario Sources

On a national scale, EV adoption may be influenced by many factors, including vehicle availability, cost, tax credits, range, customer awareness, and technology familiarity. When considering a specific geographical area, additional factors affecting EV adoption may include fuel costs, population density, income, local tax credits and rebates, programs and educational campaigns, and charging station availability and visibility. Because of the myriad factors that are likely to affect future EV adoption in PacifiCorp's Oregon service territory, AEG did not attempt to develop an independent forecast of how these factors may change over time and the affect this may have on the local EV market. Rather, AEG relied on national forecasts of EV adoption from the three industry sources described below. National EV market growth rates from each source for 2020-2030 were applied to estimated year-end 2019 light-duty EV registrations in PacifiCorp's Oregon service territory to create three potential forecasts of future EV adoption.

US Energy Information Administration Annual Energy Outlook 2019

Each year, the Energy Information Administration (EIA) publishes its Annual Energy Outlook (AEO), providing projections of domestic energy markets under a variety of scenarios.[5] To create a forecast of future EV adoption, AEG used the reference case forecasts of national EV stock growth from AEO 2019, the most recent AEO version available at the time of the analysis.[6] The EIA utilizes the Transportation Sector Demand Module of its National Energy Modeling System (NEMS) to project light-duty vehicle stock. This model is designed to "Endogenously incorporate the effects of technological innovation, macroeconomic feedback, infrastructure constraints, and vehicle choice in making the projections."[7]

[5] Current and previous versions of the AEO are available online at https://www.eia.gov/outlooks/aeo/.(last visited Jan 8, 2020)

[6] *Annual Energy Outlook 2019*, "Table 40. Light-Duty Vehicle Stock by Technology Type" and "Table 46. Transportation Fleet Car and Truck Stock by Type and Technology" https://www.eia.gov/outlooks/aeo/supplement/excel/suptab_40.xlsx (last visited Jan 8, 2020)

[7] *Transportation Sector Demand Module of the National Energy Modeling System: Model Documentation*, March 2019 at 3 (AEO 2018 Documentation) https://www.eia.gov/outlooks/aeo/nems/documentation/transportation/pdf/m070(2018).pdf (last visited Jan 8, 2020)

Of the sources discussed in this memo, AEO 2019 is the only one that presents forecasted adoption separately for BEVs and PHEVs rather than simply for EVs in total, allowing AEG to create separate forecasts of BEV and PHEV adoption. The mapping of AEO to DEQ EV categories is provided in Table 2.

Table 2. AEO and DEQ EV Type Mapping

DEQ EV Category	AEO EV Category
BEVs	100 Mile Electric Vehicle
	200 Mile Electric Vehicle
	300 Mile Electric Vehicle
PHEVs	Plug-in 10 Gasoline Hybrid
	Plug-in 40 Gasoline Hybrid

Edison Electric Institute/Institute for Electric Innovation 2018 Forecast

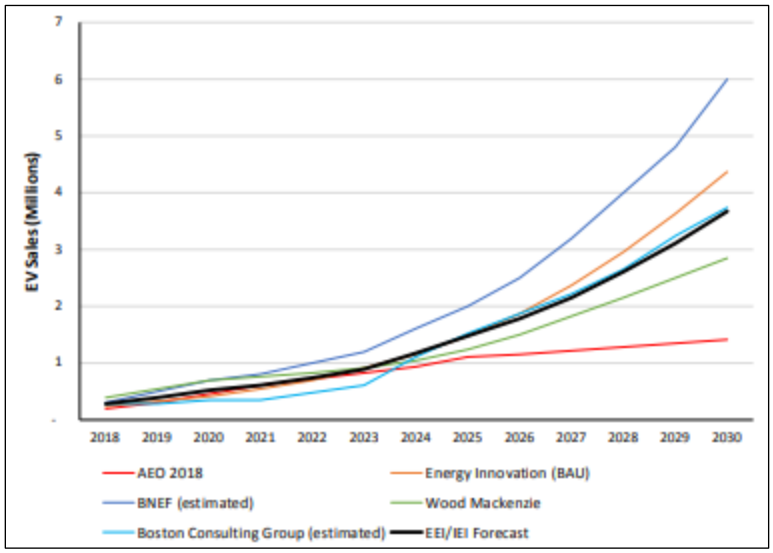
In November 2018, the Edison Electric Institute (EEI) and the Institute for Electric Innovation (IEI) jointly published a forecast of national electric vehicle adoption through 2030.[8] The EEI/IEI forecast was developed as a composite of five independent forecasts:

- Bloomberg New Energy Finance (BNEF) – Electric Vehicle Outlook 2018 (May 2018)
- Boston Consulting Group (BCG) – The Electric Car Tipping Point (November 2017)
- Energy Innovation – Energy Policy Simulator 1.4.1 (accessed July 2018)
- U.S. Energy Information Administration (EIA) – Annual Energy Outlook 2018 Reference Case (February 2018)
- Wood Mackenzie – The Electric Vehicle Outlook Data (August 2018)

These underlying forecasts and the EEI/IEI composite are provided in Figure 2. As shown, the underlying forecasts are very similar through the mid-2020s, then begin to diverge significantly. By averaging across these forecasts of varying aggressiveness, the EEI/IEI forecast represents a middle ground between the least aggressive (AEO) and most aggressive (BNEF) forecasts.

[8] A. Cooper and K. Schefter, *Electric Vehicle Sales Forecast and the Charging Infrastructure Required Through 2030*, Nov 2018. https://www.edisonfoundation.net/iei/publications/Documents/IEI_EEI%20EV%20Forecast%20Report_Nov2018.pdf (last visited Jan 8, 2020)

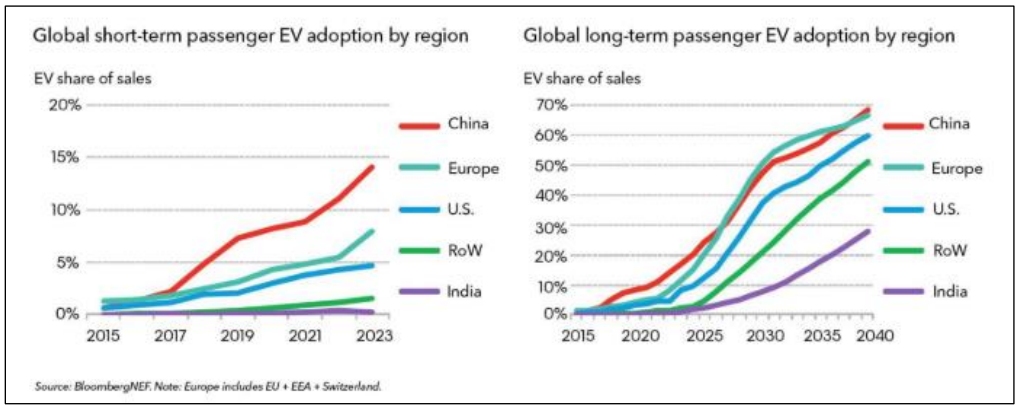
Figure 2. EEI/EIE Annual Sales Forecast Comparison [9]



Bloomberg New Energy Finance Electric Vehicle Outlook 2019

BNEF's annual Electric Vehicle Outlook provides long-term forecasts of electric vehicle adoption globally and for specific geographic markets, including the United States. BNEF's EV market share forecasts, by region, are provided in Figure 3. As shown, while the US EV market share forecasts are not as aggressive as China or Europe, they are expected to increase to over 40% of passenger vehicles by 2030 and 60% by 2040.

Figure 3. BNEF 2019 EV Market Share Forecasts [10]



As stated in the BNEF Electric Vehicle Outlook 2019, "Compared to other major organizations, BloombergNEF continues to hold the most aggressive view on EV adoption."[11] As such, by applying the US EV market shares from the figure above, AEG was able to create an aggressive forecast of EV adoption in PacifiCorp's Oregon service territory.

EV Adoption Forecast Scenario Results

The forecasts of cumulative light-duty EV adoption in PacifiCorp's service territory under the three scenarios are presented in Figure 4 and Table 3 below. As shown, all three scenarios build off the same estimate for year-end 2019 EV registrations, applying source-specific growth rates beginning in 2020. The three sources produce extremely similar results through 2024, with high and low estimates differing by only 6% in that year. The forecasts begin to diverge in

[9] *Id.* at 5

[10] BloombergNEF *Electric Vehicle Outlook 2019*, "Key Findings", p. 5. https://about.bnef.com/electric-vehicle-outlook/ (last visited Jan 8, 2020)

[11] *Id.* "Comparing EV Outlooks" at 1.

2025 and by 2030, there is a significant difference between forecasted EVs, particularly between BNEF (~104,000) and AEO (~42,000). The large difference in adoption between these two scenarios is likely driven by assumptions around price parity between EVs and gasoline vehicles, as the BNEF Electric Vehicle Outlook 2019 states that "…we expect price parity between EVs and internal combustion vehicles (ICE) by the mid-2020s."[12]

Figure 4. PacifiCorp Oregon Light-Duty EV Adoption Scenarios

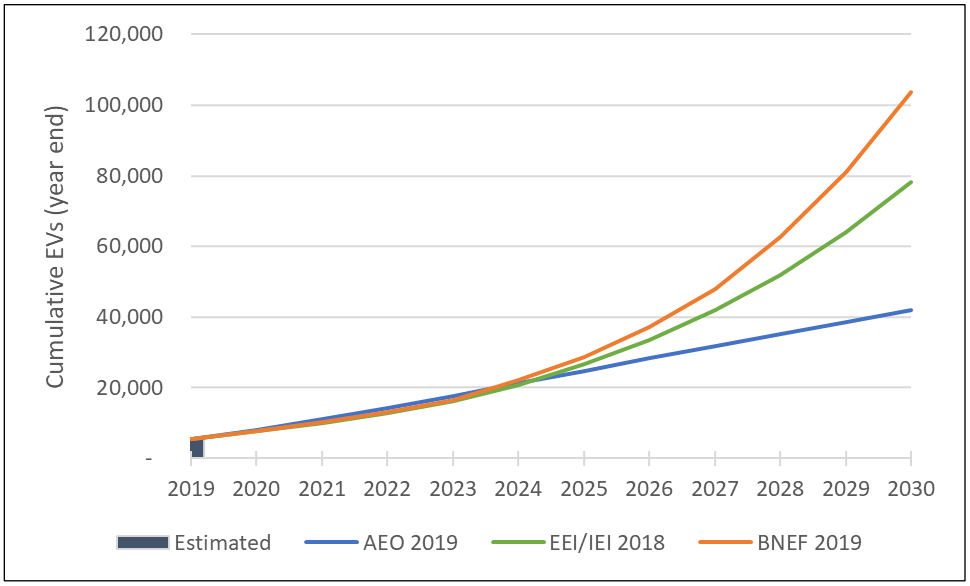


Table 3. PacifiCorp Oregon Light-Duty EV Adoption Scenarios

Scenario	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
AEO 2019	5,558	7,977	10,986	14,301	17,649	21,152	24,778	28,263	31,692	35,037	38,452	41,901
EEI/IEI 2018		7,582	9,940	12,822	16,279	20,819	26,516	33,432	41,828	51,957	64,012	78,311
BNEF 2019		7,627	10,228	13,158	16,386	22,057	28,596	37,260	47,918	62,492	80,995	103,734

As discussed above, AEO is the only source that provided separate adoption forecasts for BEVs and PHEVs, allowing AEG to forecast adoption separately for these two vehicle types. The AEO scenario forecast by vehicle type is provided in Figure 5 and Table 4. As shown, the AEO 2019 scenario projects that the share of EVs that are BEVs will grow from 56% in 2019 to 75% in 2030.

[12] *Id.* "Key Findings" at 1.

Figure 5. AEO Scenario Adoption Forecast by EV Type

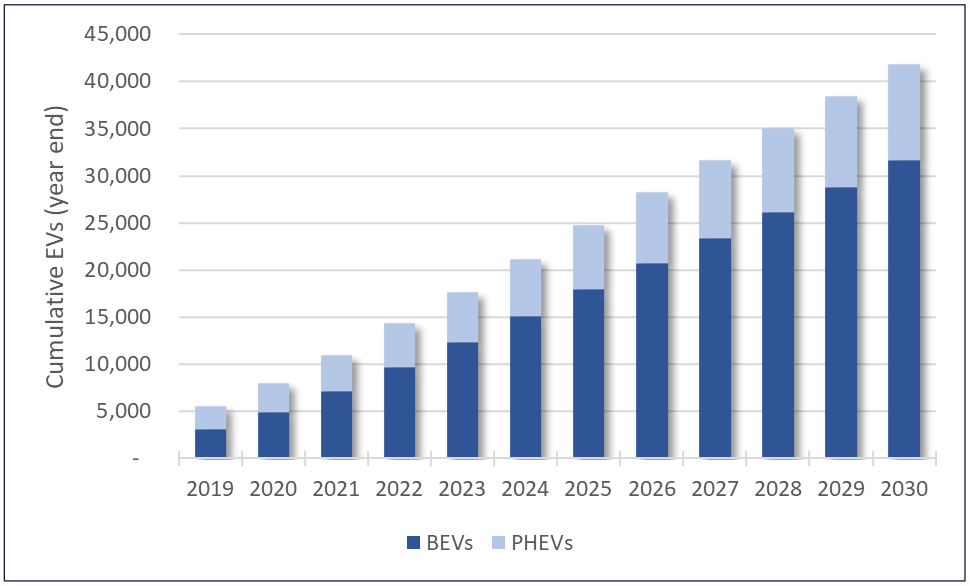


Table 4. AEO Scenario Adoption Forecast by EV Type

Scenario	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
BEVs	3,128	4,920	7,172	9,709	12,296	15,042	17,906	20,671	23,406	26,084	28,821	31,602
PHEVs	2,430	3,057	3,815	4,593	5,353	6,110	6,872	7,591	8,286	8,954	9,632	10,299
All EVs	**5,558**	**7,977**	**10,986**	**14,301**	**17,649**	**21,152**	**24,778**	**28,263**	**31,692**	**35,037**	**38,452**	**41,901**

Attachment 5

Potential System Impact Study

Executive Summary:

In Order 18-075, the Public Utility Commission of Oregon approved PacifiCorp's initial transportation electrification pilot programs, as modified by a stipulation supported by parties in Docket UM 1810. The stipulation includes the following provision:

> PacifiCorp will develop and conduct an initial pilot study of potential system impacts of residential electric vehicle adoption in a selected portion of the Company's Oregon service territory. Before beginning the study, PacifiCorp will share its proposed pilot study objectives, timeline and expected cost with the Stipulating Parties.[2]

In September 2018, the company shared its proposed pilot study objectives, timeline, and expected cost with UM 1810 parties and incorporated feedback received into the design of this study. Through this study, the company sought to understand the potential system impacts of residential electric vehicle adoption on the primary distribution system. The study accounts for variations in the company's Oregon service territory such as seasonality, geography, demographics, and electric vehicle adoption through 2025. The system impacts studied are equipment thermal loading, voltage range, and imbalance.

This study utilized a state-level vehicle adoption forecast provided by the Oregon Department of Transportation (ODOT), which considers the market share of new electric vehicles growing to 10% by 2025. The study analyzed sensitivities of 20% and 40% higher than the state- level adoption forecast (i.e., 12% and 14% market share by 2025, respectively) with random and clustered electric vehicle adoption. Each scenario was also studied with an additional 30% penetration of private solar generation to understand potential interactions between high levels of electric vehicle and private generation adoption. It is also assumed that customers installing electric vehicle charging will contact PacifiCorp regarding load additions.

The results of this study predict that in some locations, normal load growth will cause isolated system component overloading issues, which will be compounded by additional electric vehicle load. However, PacifiCorp's traditional distribution planning study process is designed to predict overload conditions that require system changes to mitigate. Barring a large increase in the installation of electric vehicle chargers in a short time period, this process will account for and prepare the system for the installation of residential electric vehicle charging.

Most overload conditions created by the installation of residential electric vehicle charging are capable of being mitigated by balancing the feeder load across all three phases. At some single-phase locations, the solution to mitigate the overload condition will require the evaluation and modification of the feeder configuration and protection scheme. The addition of private solar generation equal to 30% of the existing load is not projected to significantly impact the conductor overload conditions present due to residential electric vehicle adoption.

[2] Order 18-075 modified this requirement to include all parties, not only those that supported the stipulation.

Study Scope:

The study assessed three distribution substation transformers and their associated distribution circuits where the substation is categorized as primarily serving urban, suburban, or rural areas. The study starts with the expected loading in 2025 and then is adjusted with the additional increase from the electric vehicle loading sensitivities. The substation distribution transformers and associated distribution circuits are:

Portland (urban)
    Vernon substation, T3747
    5P394 (96% residential), 5P395 (97% residential)
Bend (suburban)
    Shevlin Park substation, T365701
    5D238 (91% residential), 5D241 (91% residential), 5D243 (79% residential)
Klamath Falls (rural)
    Texum substation, T338712
    5L112 (76% residential), 5L113 (12% residential), 5L116 (79% residential)

Methodology:

The study was performed using measured feeder loads and estimated load growth rates through 2025 as a baseline to evaluate the impacts of the ODOT projection of plausible electric vehicle increase to a 10% market share. To study potential impacts of higher levels of residential electric vehicle adoption, sensitivities representing electric vehicle market share of 12% and 14% by 2025 were analyzed. After adjusting the baseline to reflect the impacts of potential new electric vehicle adoption, power flow analysis was performed using time series analysis and peak feeder loading to evaluate the impacts of increased adoption on existing equipment, devices, and voltage delivery. The time series analysis included four one-week periods: the weeks of summer peak load, winter peak load, spring minimum daytime load, and fall minimum daytime load.

Electric vehicle penetration was studied using two different scenarios. The first scenario assumed that the electric vehicle distribution was evenly spread across the entire feeder. The second scenario assumed clusters of electric vehicles in specific areas of the feeders. The randomly spread scenario was modeled as a general load increase equal to the increase in load due to the assumed number of electric vehicle chargers. The clustered scenario was modeled as blocks of load added to feeder taps with a sufficient number of existing customers capable of sustaining the increase of electric vehicle charging. Each clustered scenario was also studied with the addition of private solar generation equal to 30% of the peak load on each feeder.

The study assumed that residents with plug-in hybrid electric vehicles (PHEVs) would use Level 1 chargers with an average peak demand of 3.5 kilowatts (kW) and that residents with battery electric vehicles (BEVs) would use Level 2 chargers with an assumed average peak demand of 8 kW.

The assumed registered electric vehicle penetration was based on statewide penetration of electric vehicles and adjusted by individual feeder population. The assumed registered electric vehicle penetration is shown below.

Substation	Feeder	12%		14%	
		BEV	PHEV	BEV	PHEV
Portland- Vernon- Urban	5P394	79	41	95	50
	5P395	53	28	64	34
Bend- Shevlin Park- Suburban	5D238	48	37	58	42
	5D241	52	40	63	45
	5D243	28	21	34	25
Klamath Falls- Texum- Rural	5L112	1	2	2	3
	5L113	0	0	0	0
	5L116	1	3	2	4

Results

Urban:
Summary: The urban Vernon feeders are projected to experience overloaded conductors in all scenarios during normal load growth, random electric vehicle adoption ramping up to 12% market share, clustered electric vehicle adoption at 12% market share, and clustered electric vehicle adoption at 14% market share by 2025.

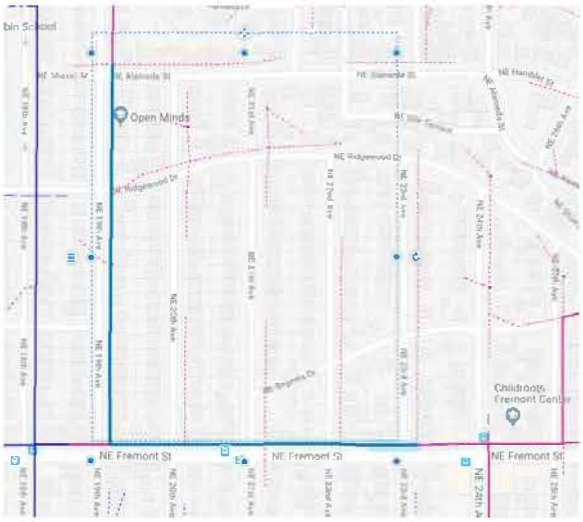
Normal Load Growth: The urban Vernon feeders are projected to experience normal load growth of up to 2.0% over the period ending in 2025. This normal growth rate is modeled to cause conductor overload of up to 118.5% on feeder 5P395 during summer loading conditions at multiple locations. There are no modeled overload conditions due to normal load growth during winter, spring, or fall loading conditions.

12% Electric Vehicle Market Share: The addition of electric vehicle charging to this feeder is modeled to increase this overload to 124.7% by 2025. Random electric vehicle adoption is modeled to overload one section of conductor on 5P395 to 100.5% during summer loading conditions. Clustered electric vehicle adoption in this scenario is modeled to overload one section of conductor on 5P395. All sections of overloaded conductor can be brought into tolerances with targeted phase balancing to move the load to under-loaded phases.

Random electric vehicle adoption in this scenario is modeled to overload the conductor between facility points 01101001.0236009 and 01101001.0236001 on feeder 5P395 to 100.5% during summer loading conditions.

Clustered electric vehicle adoption in this scenario is modeled to overload the section of #2/0 copper on feeder 5P395 beginning at facility point 01101001.0237203 and extending to facility point 01101001.0237003 to 111.3% during winter loading conditions. The addition of private solar generation is expected to decrease the overload to 109.1% in the case of 12% electric vehicle registration and 118.6% in the case of 14% electric vehicle registration. This section of conductor is shown in Figure 1.

Figure 1. Potentially Overloaded Conductor, FP 01101001.0237203 to 01101001.0237003



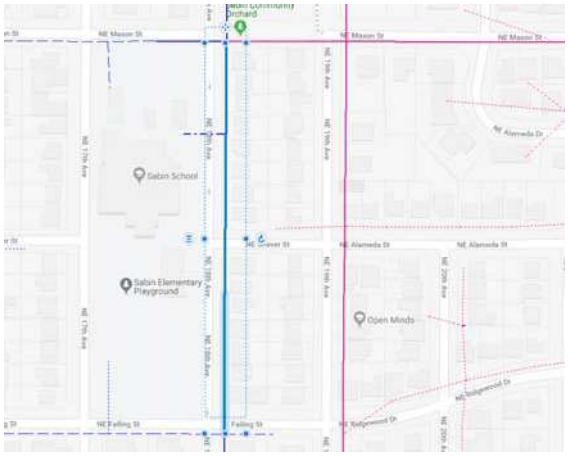
14% Electric Vehicle Market Share: Clustered electric vehicle adoption ramping up to 14% market share by 2025 is modeled to overload four additional sections of conductors on 5P394 and 5P395.

- The span of 336 ACSR conductor on feeder 5P395 beginning at 0101001.0236009 to 01101001.0236001 is modeled to be overloaded to 108.2% during winter loading conditions. The addition of private solar generation may reduce this overload to 106.4%. This span of conductor is shown in Figure 2.
- The section of 336 AAC conductor on feeder 5P395 beginning at facility point 01101001.0237305 to 01101001.0237202 is modeled to be overloaded to 107.1% during winter loading conditions. The addition of private solar generation may reduce this overload to 105.2%. This section of conductor is shown in Figure 3.
- The 5P394 feeder getaway of 1000 kcm aluminum is modeled to be overloaded to 102.6% during winter loading conditions. The addition of private solar generation may reduce this overload to 101%.
- The section of 4/0 copper conductor on feeder 5P394 beginning at 01101001.0236309 to 01101001.0236310 is modeled to be overloaded to 107.2% during winter loading conditions. The addition of private solar generation may reduce this overload to 105.4%. This section of conductor is shown in Figure 4.

Figure 2. Potentially Overloaded Conductor, FP 01101001.0236009 to 01101001.0236001

Figure 3. Potentially Overloaded Conductor, FP 01101001.0237305 to 01101001.023720

Figure 4. Potentially Overloaded Conductor, FP 01101001.0236309 to 01101001.0236310



Suburban:

Summary: The suburban Shevlin Park feeders are projected to experience overloaded fuse conditions during normal load growth, clustered electric vehicle adoption ramping up to 12% market share, random electric vehicle adoption ramping up to 14% market share, and clustered electric vehicle adoption at 14% market share. Overloaded elbow conditions are also projected on feeder 5D241 during clustered electric vehicle adoption of 14% market share.

Normal Load Growth: The suburban Shevlin Park substation is expected to experience normal load growth of up to 5.0% on feeder 5D243 while experiencing lower growth rates of 0.5% on feeders 5D238 and 5D241 over the period ending in 2025. The normal load growth on 5D243 is not expected to lead to overloading issues by 2025. This normal load growth is expected to lower the peak load voltage to 94.8%, which is outside of ANSI Range A. Normal load growth is modeled to cause overloading up to 128.7% at three fuse locations on 5D238 and 5D241 during summer and winter loading conditions.

12% Electric Vehicle Market Share: The random and clustered electric vehicle charging scenarios were shown to cause single-phase overloading at various additional fuse and elbow locations on feeders on 5D238 and 5D241. Extreme clustered electric vehicle charging on feeder 5D238 was shown to increase load up to 150% of the rated capacity of some devices during winter loading conditions. 5D243 was not shown to have any overload issues that are the result of electric vehicle charging.

When random electric vehicle is modeled, it is shown to cause the single-phase overload of the 200A elbows to 100.3% at facility point 01418012.0063782 during summer loading conditions. This is modeled to increase to 102.1% with the random electric vehicle adoption of 14% of registered vehicles. This location is shown in Fig 5.

Clustered electric vehicle adoption in this scenario is modeled to cause the single-phase overload at three fuse locations.

- The 100T fuse at 01417011.0252800 on feeder 5D238 is expected to be overloaded to 118% during winter loading conditions and 130.5% with the clustered electric vehicle adoption of 14% of registered vehicles. This overload is modeled to be 109.3% during summer loading conditions with electric vehicle adoption if 12% of registered vehicles and 120.1% with electric vehicle adoption of 14% of registered vehicles. The addition of private solar generation may reduce the overload by 1.1% for each scenario. This fuse feeds a three-phase tap and the overload condition can be mitigated by balancing the load beyond the fuse. This fuse location is shown in Figure 6.

- The 80E fuse at facility point 01417011.0247281 on feeder 5D238 is modeled to be overloaded to 134.4% during winter loading conditions. The addition of private solar generation may reduce the overload by 1.4% for this scenario. This fuse feeds a single-phase tap that would not benefit from load balancing. An evaluation of the fuse coordination and normal open point beyond this fuse would need to be performed to determine the ideal solution to this overload condition. This location is shown in Figure 7.

- The 100T fuse at 01417012.0317502 on feeder 5D241 is modeled to be overloaded during summer loading conditions to 106.3% in this scenario. The addition of private solar generation is expected to decrease this overload by 1.8%. This fuse feeds a single-phase tap that would not benefit from load balancing. An evaluation of the fuse coordination and normal open point beyond this fuse would need to be performed to determine the ideal solution to this overload condition. This fuse location is shown in Figure 8.

Figure 5. Potentially Overloaded Elbow, FP 01418012.0063782

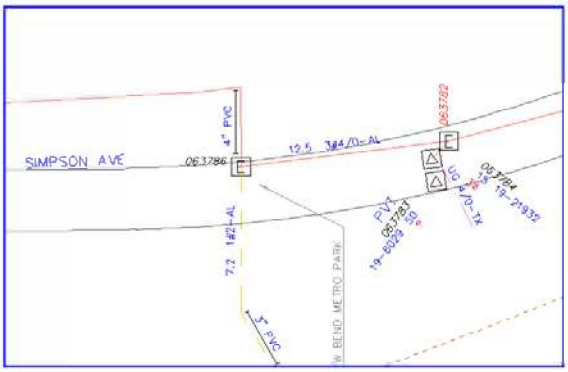


Figure 6. Potentially Overloaded Fuse, FP 01417011.0252800

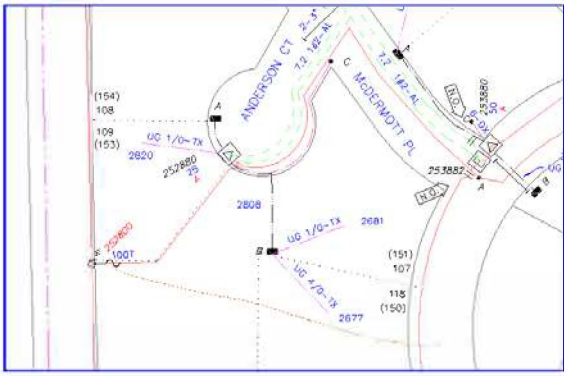


Figure 7. Potentially Overloaded Fuse, FP 01417011.0247281

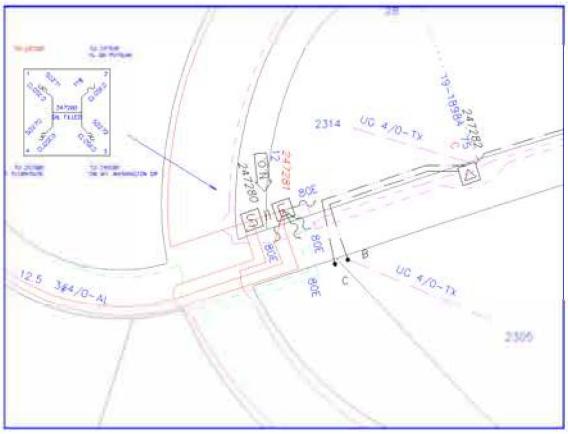
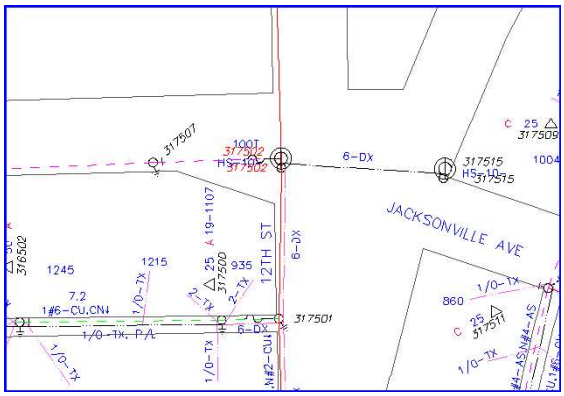


Figure 8. Potentially Overloaded Fuse, FP 01417012.0317502



14% Electric Vehicle Adoption: Clustered electric vehicle adoption ramping up to 14% market share is modeled to cause an overload condition of up to 102.1% on 200 A elbows between facility points 01418012.0063782 and 01418011.0019782 during summer loading conditions on B phase. This overload condition would be able to be corrected by balancing the load beyond the elbows. The addition of private solar generation may reduce this overload condition to less than 100%. This section of line is shown in Figure 9.

Figure 9. Potentially Overloaded Elbows, FP 01418012.0063782 to 01418011.0019782

Rural:

The rural Texum substation load examined in this study does not expect any load growth over the period ending in 2025. The assumption of between seven and 11 residential electric vehicle chargers connected to these feeders is not expected to cause any loading or voltage issues by 2025.