Washington State Transportation Electrification Plan

PACIFICORP
A BERKSHIRE HATHAWAY ENERGY COMPANY

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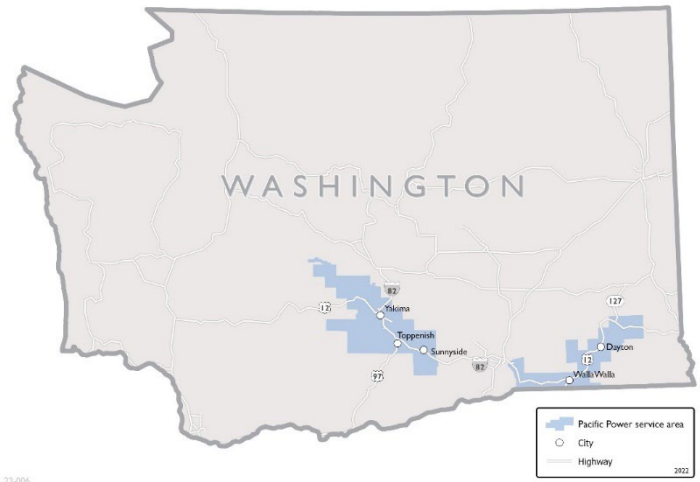
About PacifiCorp

PacifiCorp is a multijurisdictional, vertically integrated utility that serves nearly two million customers in six western states: California, Idaho, Oregon, Utah, Washington, and Wyoming. In Washington, PacifiCorp serves approximately 137,000 customers throughout Yakima, Walla Walla, Columbia, Benton, Cowlitz, and Garfield counties. The company's generation and transmission systems span the West and connect customers to safe, reliable, affordable, and increasingly renewable electricity. Our integrated transmission system connects thermal, hydroelectric, wind, solar, and geothermal generating facilities with markets and loads. The diversity of this integrated system benefits all of PacifiCorp's customers in all six states. PacifiCorp owns approximately 11,500 megawatts (MW) of generating capacity and about 16,500 miles of transmission lines.

PacifiCorp Service Area—Washington



PacifiCorp's large regional footprint enables delivery of low-cost generation from some of the best wind and solar sites in the country and the Company remains actively engaged in finding ways to leverage the benefits of geographic diversity for our customers as we develop and implement plans to deliver the targets set forth in Washington's Clean Energy Transformation Act (CETA).

Over the past 13 years, PacifiCorp has successfully reduced its greenhouse gas (GHG) emissions and improved reliability while simultaneously delivering energy cost savings to our customers. The company has achieved these results by collaborating with others and through the visionary and collaborative efforts of our own generation, transmission, information technology, and energy supply management teams. PacifiCorp has been a key player in the creation of an open and connected western grid. All these factors have brought PacifiCorp into a very favorable position to achieve Washington's decarbonization goals.

I. Executive Summary

PacifiCorp's vision for our Washington service area is unique. Washington has set aggressive targets toward a carbon-free future, including establishing a goal that, by model year 2030, all passenger and light-duty vehicles sold are electric.[1] By 2045 and consistent with CETA, all generation within Washington will be supplied by nonemitting resources.[2] In 2017, the Washington legislature passed legislation asking utilities to develop a portfolio of transportation electrification (TE) services that would support an electric future.[3]

PacifiCorp has responded to this call by developing our first Washington Transportation Electrification Plan in response to RCW.80.28.365,[4] which encourages utilities to submit TE plans that deploy electric vehicle supply equipment (EVSE) or provide electric transportation programs, services, or incentives to support electric transportation.

PacifiCorp is committed to supporting the equitable transition to electrification for all its Washington customers. The company will make TE investments judiciously, in line with the pace of customer demand and other market advancements. Over the next 10 years, PacifiCorp anticipates a gradual growth in EV[5] registrations in our Washington service area, which we expect will deliver modest but significant benefits to customers and result in relatively minimal impacts to the local distribution grid and utility operations. As of December 2021, there were 605 registered EVs[6] within the Washington service area.[7]

As PacifiCorp develops its TE program offerings for customers in Washington over the next several years, initial priority will be given to informing and educating customers and delivering equitable TE programs that best support highly impacted communities. Awareness and careful consideration will inform and direct the utility's considerations around infrastructure siting and planning, program design and implementation, and program performance evaluation.

Informed by state policies, PacifiCorp is committed to being responsive to customer needs for the sustainable, reliable, and affordable provision of essential energy services. Over the next five years, PacifiCorp currently anticipates TE program investments to be approximately $2 million to $4 million in EV charging programs/investments across our Washington service area to support the growing need of the customers and communities we serve. PacifiCorp shares further in Section VII: Program and Activities, the perceived likely outcome of program spending by programmatic type.

Current EV Penetration and Charging Infrastructure

EV adoption lags behind other areas of the state within PacifiCorp's Washington service area. Only about 1% of the state's 83,000-plus EVs reside within the service area.[8] In Washington as a whole, there are nearly 10.8 EVs per 1,000 residents, but in PacifiCorp's service there are only 2.1 EVs per 1,000 residents. However, this difference in EV adoption is not unique to PacifiCorp's Washington territory. Across the nation, rural areas and smaller cities and towns tend to lag behind urban areas in EV penetration.

1. 67th Legislature, House Bill 1287 (2021), 1287-S2.PL.pdf (wa.gov).
2. 66th Legislature, Clean Energy Transformation Act (CETA), SB 5116 (2019), http://lawfilesext.leg.wa.gov/biennium/2019-20/Pdf/Bills/Session%20Laws/Senate/5116-S2.SL.pdf.
3. Washington Utilities and Transportation Commission, "Policy and Interpretive Statement Concerning Commission Regulation of Electric Vehicle Charging Services" (2017), https://www.utc.wa.gov/sites/default/files/2021-02/Appendix%20A%20-%20UTC%20Policy%20Statement%20EV%20Charging%20Services.pdf.
4. Washington State Legislature, Revised Code of Washington, 2019 Acknowledgment, "RCW 80.28.365: Electric vehicle supply equipment, programs, or services—Electrification of transportation plan—Review—Issuance of acknowledgment (2019), https://app.leg.wa.gov/RCW/default.aspx?cite=80.28.365.
5. Electric vehicles include both battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs) in this report.
6. Washington State Electric Vehicle Population Data (December 31, 2021), https://data.wa.gov/Transportation/Electric-Vehicle-Population-Data/f6w7-q2d2.
7. Washington had 83,538 EVs as of December 20, 2021, or nearly 10.8 EVs per 1,000 state residents.
8. US Department of Energy, Office of Energy Efficiency and Renewable Energy, Alternative Fuels Data Center: Electric Vehicle Charging Station Locations (2021), https://afdc.energy.gov/fuels/electricity_locations.html#/find/nearest?fuel=ELEC.

Figure 1: Historical (2013–2021) and Future (2022–2031) EV Penetration in Washington Service Area demonstrates historical data and future modeling of EV penetration rates within PacifiCorp's Washington service area. Though the adoption rate is expected to accelerate over the next decade, the curve lags behind Washington as a whole by several years. Not only is EV adoption slow in PacifiCorp's Washington service area, but the charging infrastructure is relatively immature—an issue compounded by the fact that rural drivers often travel significantly greater daily distances than their urban counterparts. There are only a handful of charging stations outside Yakima and Walla Walla (Figure 2: Available Public Charging Sites in PacifiCorp's Service Area), and only one of those stations is a DC fast charger (DCFC). The remainder are Level 2 chargers. As of late 2021, there were a total of 25 charging stations offering 63 ports within PacifiCorp's Washington service area. Further background and current state information is provided in Section II: Introduction.

Figure 1: Historical (2013–2021) and Forecast (2022–2031) EV Penetration in Washington Service Area

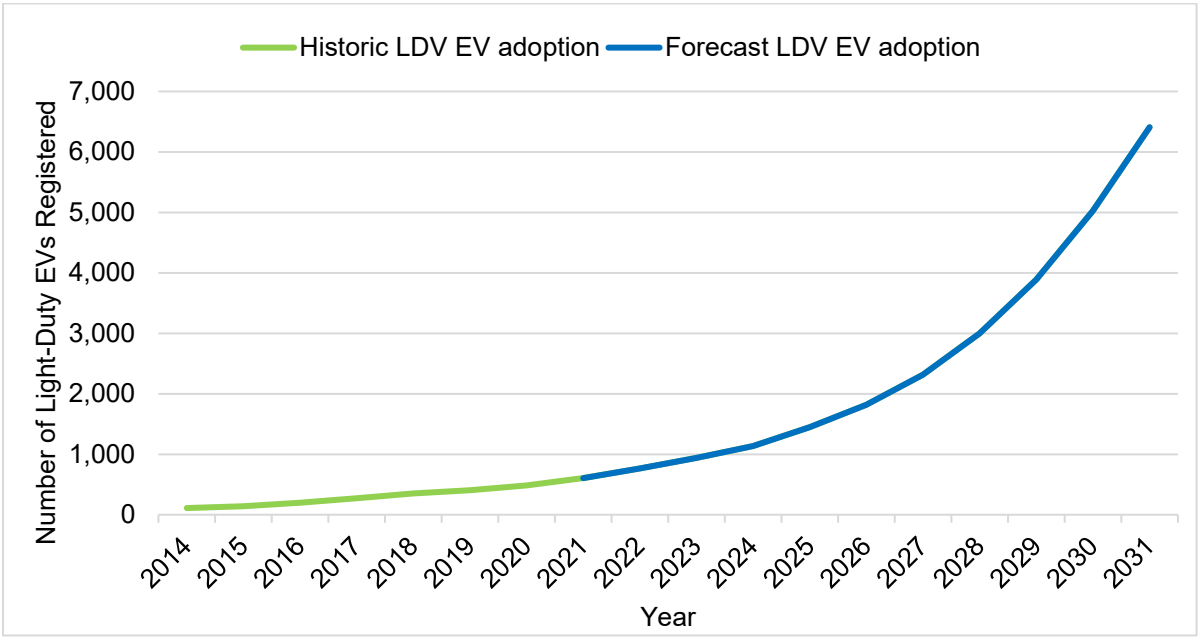
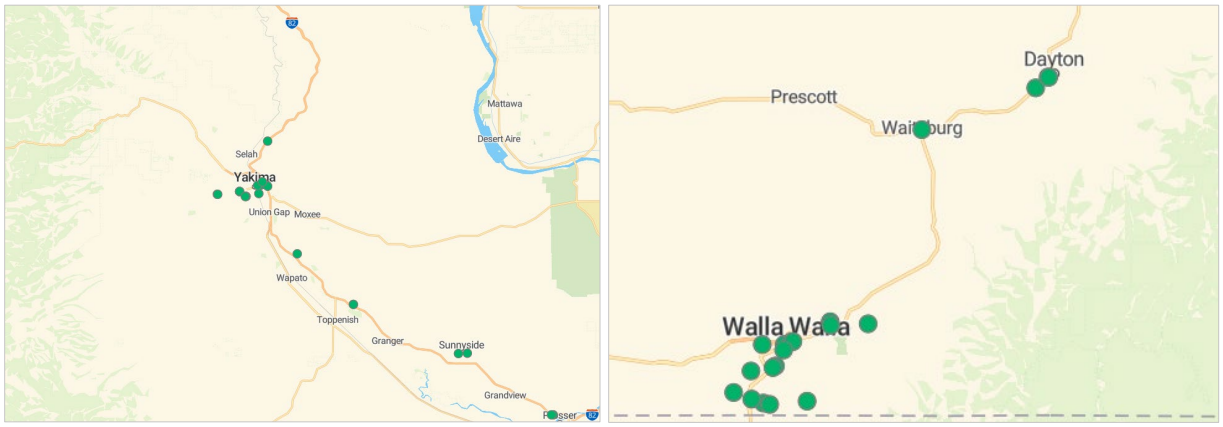
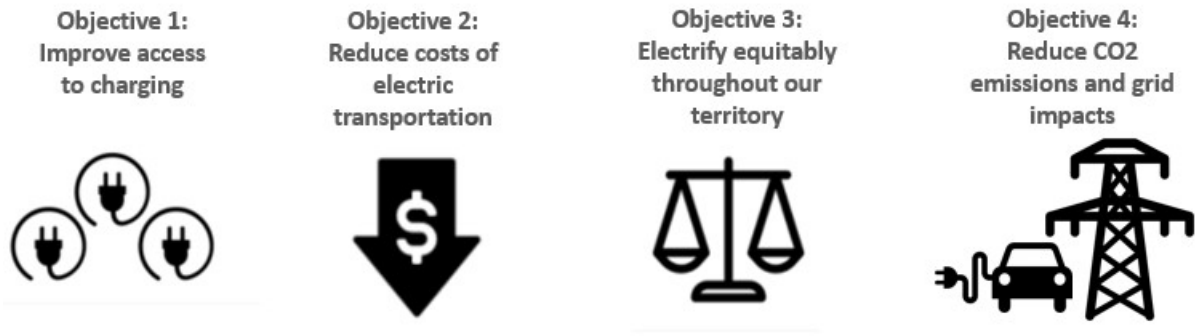


Figure 2: Available Public Charging Sites in PacifiCorp's Service Area



Objectives

To achieve the vision and goals defined by the state, PacifiCorp's Washington TE plan includes four primary objectives to ensure the advancement of electric transportation in the service area.



Objective 1: Improve Access to Charging. Access to EV charging varies by location. Charging infrastructure is also relatively immature within PacifiCorp's service area. In addition, several customer groups—including customers in named communities, customers living in multifamily housing, and those who need workplace charging—may face additional access hurdles. Improving access to charging is imperative to ensuring an equitable transition to EVs.

Objective 2: Reduce Costs of Electric Transportation. If the cost of owning and operating an EV is higher than that of a gasoline model, the barriers to adoption become too great for many car buyers to overcome. This means that customers who don't have access to low-cost at-home charging options may not be able to easily save money by owning and operating an EV. Reducing the cost to participate in electric transportation is a key objective of this TE plan.

Objective 3: Electrify Equitably. Just as some customers have limited access to EV charging infrastructure, not all customers can readily benefit from electrification or access the necessary resources to make this transition. Electrifying equitably requires deliberate planning and can necessitate significant resources. To help ensure that TE efforts are benefiting all communities, PacifiCorp will design programs with equity as a key consideration and continue to engage with its Equity Advisory Group, a key stakeholder group in the development of the Clean Energy Implementation Plan (CEIP).

Objective 4: Reduce CO_2 Emissions and Grid Impacts. EVs can be an important tool in reducing carbon dioxide (CO_2) emissions and can be managed in a way to ensure that grid impacts are minimized as new load comes on to the system. Emissions reductions come from electrifying vehicle miles traveled, but managing charging through customer programs, rate structures, and other mechanisms can encourage charging during off-peak hours, reducing a need for upgrades. Reducing emissions and grid impacts is a critical objective of PacifiCorp's TE actions.

Marketplace Review

The electric transportation sector—including the utility acting as fuel provider—is still in early stages; the market forces and consumer behaviors that shape future vehicle design and the supporting infrastructure remain difficult to predict. This makes it important for PacifiCorp to monitor the marketplace and proactively adapt to the evolving landscape by updating our TE plan on a frequent and ongoing basis. Some critical technological areas that are changing include declining battery prices, evolving end-of-life options for used

battery packs, increasingly rapid charging rates facilitated by higher-capacity DCFCs, and standards that are still emerging that could allow medium- and heavy-duty vehicles (MHDVs) to charge rapidly.

Market influences and customer needs will also help drive activities over the coming years. Currently, consumer awareness of EVs and their advantages is limited. This comes at a time when the variety and number of EV models available is rapidly growing and electrified car prices are declining. These trends will need to be considered within the Washington service area as it adopts electrified transportation equitably. Possible solutions may include supporting mass transit or micromobility options, investigating opportunities to support public charging infrastructure, and helping to overcome challenges in charging within multifamily settings. A deeper dive into the market trends is explained further in Section IV: Marketplace and Technology Overview.

Benefits and Costs

Transportation electrification has the potential to deliver significant economic benefits to PacifiCorp's customers. Over the next 10 years, PacifiCorp customers in Washington who own EVs will collectively enjoy more than $34 million in total operations and maintenance (O&M) savings, relative to operating a gas-powered vehicle. In addition, PacifiCorp estimates a modest growth in net benefits in the beginning years, building in the last 5 years and estimated to be around an additional $7.5 million in total over 10 years. Furthermore, regional benefits include the reduction in GHG emissions collectively of approximately 74,000 metric tons of carbon dioxide equivalent (CO_2e) over the next 10 years (Table 1: Estimated Benefits of EV Growth in PacifiCorp's Washington Service Area).

Table 1: Estimated Benefits of EV Growth in PacifiCorp's Washington Service Area

Year	Total Number of Light-Duty EVs	Customer Benefits (O&M Savings)	Net Benefits*	Regional Benefits (GHG Reductions in MT CO_2e)
2022	765	$1,255,266	$80,977	2,050
2023	938	$1,539,136	$56,349	2,580
2024	1,134	$1,860,747	$191,143	3,183
2025	1,445	$2,233,224	$308,613	4,604
2026	1,819	$2,681,182	$474,777	6,150
2027	2,318	$3,225,950	$581,794	7,884
2028	2,996	$3,934,806	$866,689	10,804
2029	3,887	$4,806,108	$1,161,540	14,196
2030	5,025	$5,851,342	$1,621,040	19,083
2031	6,408	$7,032,769	$2,203,481	24,982
Total	**6,408**	**$34,420,530**	**$7,546,402**	**95,516**

Notes: See Section V. Benefits and Costs for a discussion of the methodology and calculations.
*Net benefits are calculated as the estimated difference between utility billing and the cost to deliver and supply electricity, and they include estimated benefits from carbon reduction.

Distribution Impacts

Section VI: Distribution Grid Impacts discusses potential impacts of the increasing load on the system that is anticipated from the growth in EVs in PacifiCorp's service area. In summary, estimated EV energy consumption (mostly made of up of light-duty vehicles [LDVs]) is anticipated to reach a total of 23,000 megawatt-hours (MWh) by 2031 (Table 2: Estimated Load Growth on System Due to EVs). In some locations, normal load growth will cause isolated system component overloading issues, which will be compounded by additional EV load. However, PacifiCorp's traditional distribution planning process is designed to predict overload conditions that require system changes to mitigate. Barring a large increase in the installation of EV chargers in a short time period, this process will account for and prepare the system for the installation of residential EV charging.

Table 2: Estimated Load Growth on System Due to EVs

Year	Total Number of Light-Duty EVs	Total MWh (at Site)	Total Coincident MW (Winter)*	Coincident MW (Summer)*
2022	765	3,016	0.23	0.71
2023	938	3,650	0.28	0.87
2024	1,134	4,367	0.33	1.05
2025	1,445	5,519	0.42	1.34
2026	1,819	6,909	0.53	1.68
2027	2,318	8,755	0.67	2.14
2028	2,996	11,263	0.86	2.76
2029	3,887	14,549	1.11	3.57
2030	5,025	18,746	1.43	4.61
2031	6,408	23,840	1.82	5.88
Note: *Coincident peak impacts assume charging patterns remain the same over time. It's likely that managed charging and time-of-use rates will decrease coincident peak impacts from EVs over time.				

Most overload conditions created by the installation of residential EV charging can be mitigated by balancing the feeder load across all three phases. Residential EV chargers are typically connected to the distribution line on a single phase. When too many single-phase chargers are connected to a three-phase distribution line, a single phase can become thermally overloaded. To mitigate the thermal overload of the single phase, the load is transferred to the other two less loaded 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.

Programs and Activities

PacifiCorp aims to ensure equitable distribution of programming throughout the PacifiCorp service area by engaging with rural and underserved communities. PacifiCorp has adopted a planning horizon of five years for potential programs and activities. The reason for choosing the five-year time frame is to align with other utility TE plans as well as recognize that the TE space is a dynamic environment and changing quickly. Tactics have been categorized by the timing PacifiCorp believes will support prioritization of initiatives and activities: short-term tactics could occur over the next one to two years, medium-term tactics could occur over the next two to

three years, and long-term tactics could occur over the next three to five years (Table 3: PacifiCorp's TE Strategies and Tactics). PacifiCorp believes these strategies will support the achievement of objectives identified in this TE plan, although flexibility is also necessary as we look to balance programs and activities over time. Further detail regarding each of the tactics is provided in Section VII: Programs and Activities.

Table 3: PacifiCorp's TE Strategies and Tactics

Strategies	Tactics	Timing
1.0 Expand and improve past programs	1.1 Reestablish a grant program specific to named communities	Short term
	1.2 Expand and strengthen outreach and education programs	Short term
	1.3 Improve outreach for current time-of-use programs for EV-related charging and coordinate EV program design to potential program participation	Short term
2.0 Launch new program types that are relevant to customers	2.1 Develop workplace charging support for commercial customers	Short term
	2.2 Investigate opportunities to develop a multifamily charging program	Short term
	2.3 Investigate additional grid integration programs to manage load growth	Medium term
3.0 Establish a public charging and highways corridors initiative to support public EV infrastructure	3.1 Coordinate with statewide agencies and stakeholder groups to develop a robust public charging and highways corridors plan that includes key utility investments	Short term
	3.2 Build a blueprint to leverage additional federal and state funding to support public infrastructure	Short term
	3.3 Develop a public charging plan and program that will ensure investment in underserved communities	Medium term

Summary

Washington is already leading the way to an electric transportation future. PacifiCorp's TE plan is a step toward developing an empowered TE portfolio to support the state's vision. PacifiCorp's service area in Washington is unique. By developing a robust set of programs and activities, PacifiCorp can support increased adoption of EVs within our service area. PacifiCorp is committed to an equitable transition for transportation electrification and believes this TE plan lays the foundation to ensure all customers will benefit and become part of this future.

II. Introduction

Washington has made clear through programs and policies, executive orders, legislative mandates, statewide market creation, and interagency processes, that it is important to scale up TE markets. Within this changing environment, the role of the state's electric utilities as essential contributors to transforming the transportation market continues to emerge. Specifically, utilities can work with customers and communities to prepare for this change, to help accelerate the adoption of EVs in Washington, and to integrate and manage new electric load cleanly and efficiently.

From 2019 until the end of 2021, PacifiCorp invested to support EV adoption through outreach and education and grant programs. As of the end of 2021, PacifiCorp has supported 19 grant projects for the installation of 24 EV charging ports across the utility's Washington service area.[9]

Policy Drivers

In a 2017 directive, the Washington legislature stated that utilities are "fully empowered and incentivized to be engaged in electrification of our transportation system."[10] In pursuing this vision, the Washington Utilities and Transportation Commission (UTC) has offered the following guidance:

> "Utilities may offer a portfolio of EV charging services on a regulated basis, consistent with UTC interests and policies promoting load management and system benefits, consumer protection, service quality, direct benefits to low-income customers, interoperability, stakeholder engagement, regular reporting, and education and outreach. The portfolio approach is also meant to support consumer choice and allow a competitive market for these services to continue to develop."[11]

Numerous other state policies have sought to advance electrified transport and were considered when developing this plan, including:

- HB 1091, which sets a low-carbon fuel standard for Washington (May 2021).[12] An ongoing rulemaking started in July 2021 with a proposed program start date for a Clean Fuels Program of January 2023. PacifiCorp is closely monitoring this potential program and how to potentially participate in the future.
- SB 5811, which seeks to accelerate the rate of EV sales in the state (March 2020).[13]
- HB 1287, which requires all new construction in the state to include on-site EVSE (May 2021).[14]

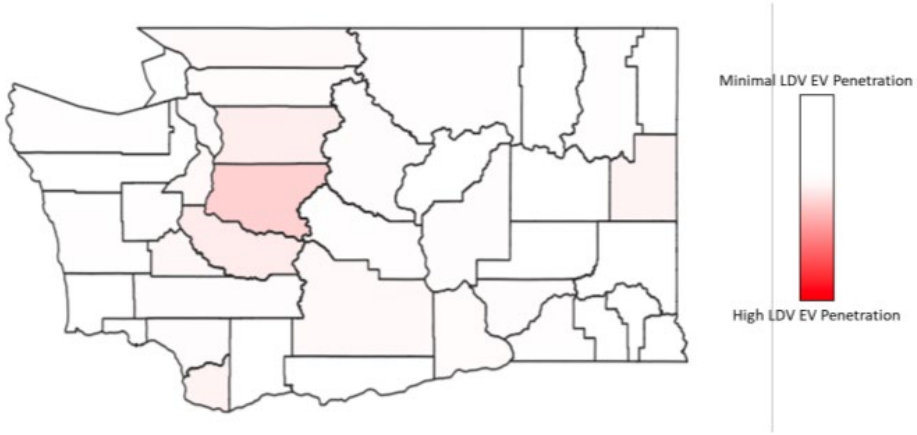
EV Penetration and Charging Infrastructure

Washington is one of the largest EV markets in the US.[15] Modeling by the Pacific Northwest National Laboratory estimates that of the 24 million light-duty EVs projected to be on American roads by 2028, almost 1 million will be registered in Washington. However, distribution of EV penetration is somewhat lopsided, with more-rapid adoption occurring in western Washington and urban areas. PacifiCorp's service area, by comparison, lies in the central and eastern portions of the state, almost entirely comprised of customers in rural

9. Washington Utilities and Transportation Commission, "Washington Pilot Program Final Report & Evaluation" (2021), www.utc.wa.gov/casedocket/2018/180757/docsets.
10. Washington Utilities and Transportation Commission, "Policy and Interpretive Statement Concerning Commission Regulation of Electric Vehicle Charging Services" (2017), https://www.utc.wa.gov/sites/default/files/2021-02/Appendix%20A%20-%20UTC%20Policy%20Statement%20EV%20Charging%20Services.pdf.
11. Washington Utilities and Transportation Commission, "Policy and Interpretive Statement Concerning Commission Regulation of Electric Vehicle Charging Services."
12. Christensen, E. L. et al., National Law Review, "Fourth Time's the Charm: Washington Enacts Clean Fuels Program, Creating West Coast Market for Low-Carbon Transportation Fuels" (2021), www.natlawreview.com/article/fourth-time-s-charm-washington-enacts-clean-fuels-program-creating-west-coast-market.
13. Washington State Legislature, "Reducing Emissions by Making Changes to the Clean Car Standards and Clean Car Program" (2020), https://lawfilesext.leg.wa.gov/biennium/2019-20/Pdf/Bills/Senate%20Passed%20Legislature/5811.PL.pdf. See also Berman, B., Electrek, "Washington State passes bill to become a ZEV state, pushes for ban of gas cars (March 11, 2020), https://electrek.co/2020/03/11/washington-state-passes-bill-to-become-a-zev-state-pushes-for-ban-of-gas-cars/.
14. US Department of Energy Alternative Fuels Data Center, "Electricity Laws and Incentives in Washington" (2021), https://afdc.energy.gov/fuels/laws/ELEC?state=WA.
15. Kintner-Meyer, M. et al., Pacific Northwest National Laboratory, "Electric Vehicles at Scale—Phase I Analysis: High EV Adoption Impacts on the Western U.S. Power Grid" (2020), www.pnnl.gov/sites/default/files/media/file/EV-AT-SCALE_1_IMPACTS_final.pdf.

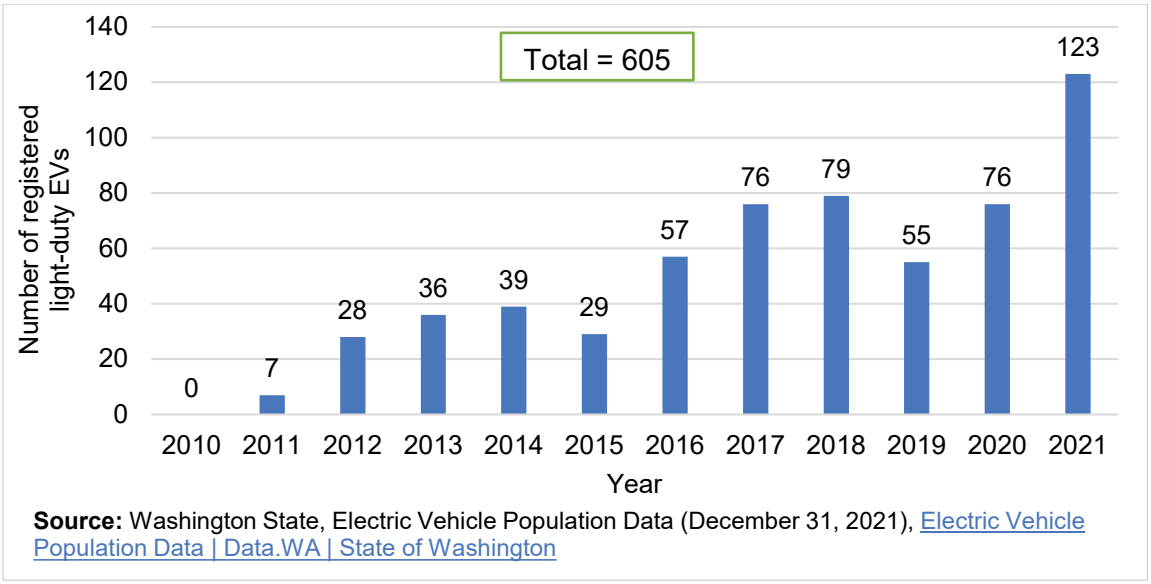
settings and smaller cities and towns. Light-duty EV penetration is highest in King County, home to Seattle (Figure 3: Penetration of EVs Throughout Washington).[16] Most of the other high-penetration counties are immediately adjacent to King County. The counties in PacifiCorp's service area currently have low EV penetration.

Figure 3: Penetration of EVs Throughout Washington



As of December 2021, there were an estimated 605 EVs registered in PacifiCorp's Washington service area (Figure 4: Historical Adoption of EVs in PacifiCorp's Service Area). EV adoption in PacifiCorp's service area lags behind other areas of Washington. Less than 1% of the state's 83,000-plus EVs reside within PacifiCorp's service area.[17] In Washington as a whole, there are nearly 10.8 EVs per 1,000 residents, but in PacifiCorp's service area there are only 2.1 EVs per 1,000 residents. However, this difference in EV adoption is not unique to PacifiCorp's Washington territory. Across the nation, rural areas and smaller cities and towns tend to lag behind larger urban areas in EV penetration.

Figure 4: Historical Adoption of EVs in PacifiCorp's Service Area

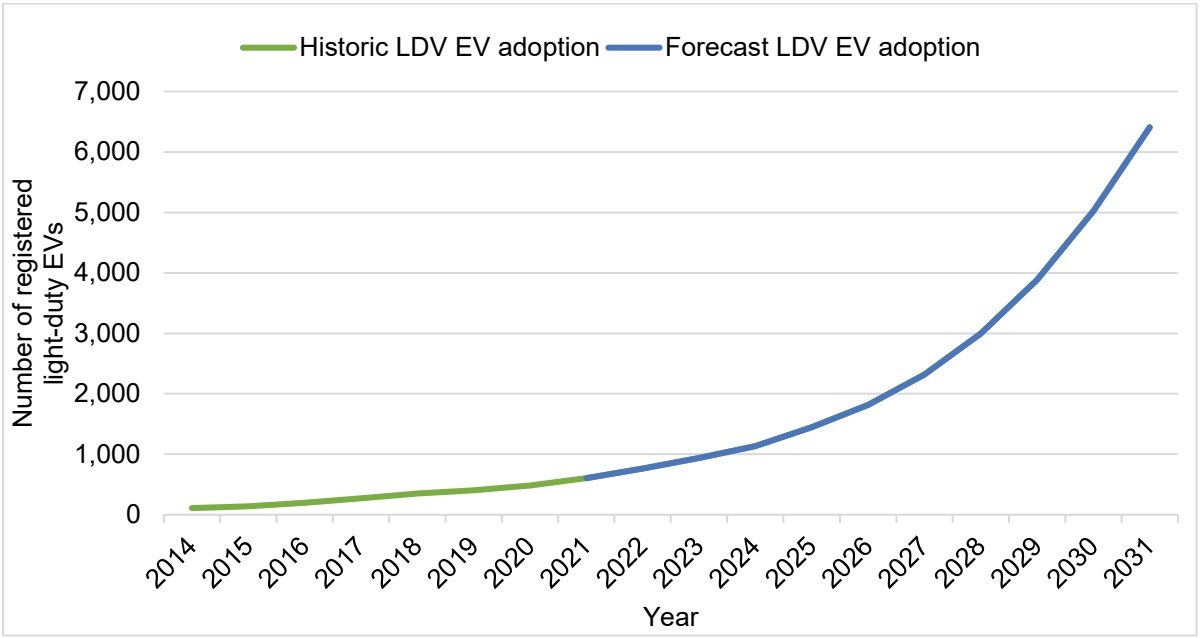


Source: Washington State, Electric Vehicle Population Data (December 31, 2021), Electric Vehicle Population Data | Data.WA | State of Washington

16. Kintner-Meyer, M. et al., Pacific Northwest National Laboratory, "Electric Vehicles at Scale—Phase I Analysis: High EV Adoption Impacts on the Western U.S. Power Grid" (2020), www.pnnl.gov/sites/default/files/media/file/EV-AT-SCALE_1_IMPACTS_final.pdf.
17. Atlas Public Policy, EV Hub, "State EV Registration Data (Version 12/20/2021) [Data from the Washington Department of Transportation]" (2010–2021, February 2–December 20), www.atlasevhub.com/materials/state-ev-registration-data/.

To estimate future EV adoption, PacifiCorp reviewed three separate scenario forecasts of varying aggressiveness for LDVs based on industry sources. For Washington, PacifiCorp used the previous year-end EV registrations and applied the growth rate from the medium scenario to estimate future adoption in the near term as well as a blend of the medium and high scenario after 2025. Figure 5: Historical (2013–2021) and Future (2022–2031) EV Penetration in Washington Service Area demonstrates historical data and future modeling of EV penetration rates within PacifiCorp's Washington service area.[18]

Figure 5: Historical (2013–2021) and Forecast (2022–2031) EV Penetration in Washington Service Area

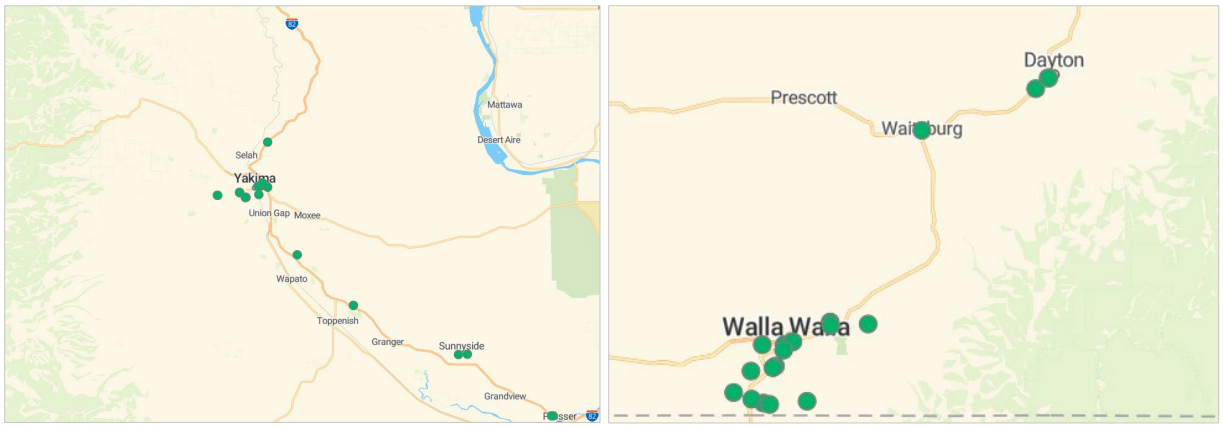


Not only is current EV adoption slow in PacifiCorp's Washington service area, but the charging infrastructure is also relatively immature—an issue compounded by the fact that rural drivers often travel significantly greater daily distances than their urban counterparts. Below are detailed maps of PacifiCorp's two primary Washington service areas. The green dots represent public charging stations included in the US Department of Energy's Alternative Fuels Data Center.

Within PacifiCorp's service area, nearly all EV charging stations are concentrated in or around two cities—Walla Walla and Yakima—and DCFCs are particularly rare (Figure 6: Available Public Charging Sites in PacifiCorp's Service Area).[19] Even within the larger towns in PacifiCorp's service area, Level 3 charging stations are relatively rare, with only a single port in Dayton and 14 ports in four stations within Yakima. Of those in Yakima, 8 of the ports are located at a single Tesla Supercharger station. Outside of Yakima and Walla Walla, there are only a handful of charging stations. And only one of those stations is a DCFC. The remainder are Level 2.

18. PacifiCorp engaged Applied Energy Group (AEG) to develop forecasts of potential EV adoption in PacifiCorp's Washington service area.
19. US Department of Energy, Office of Energy Efficiency and Renewable Energy, "Alternative Fuels Data Center: Electric Vehicle Charging Station Locations" (2021), https://afdc.energy.gov/fuels/electricity_locations.html#/find/nearest?fuel=ELEC.

Figure 6: Available Public Charging Sites in PacifiCorp's Service Area



As of late 2021, there were a total of 25 charging stations offering 63 ports within PacifiCorp's Washington service area (Table 4: Charging Infrastructure in PacifiCorp's Service Area).

Table 4: Charging Infrastructure in PacifiCorp's Service Area

	Greater Yakima Region	Greater Walla Walla Region	Total Washington Service Area
Level 2 Ports	28	20	48
DCFC Ports	14	1	15
Tesla DCFC Ports	8	0	8
CHAdeMO DCFC Ports*	5	1	6
CCS DCFC Ports	6	1	7
Total Number of Ports	**42**	**21**	**63**
Total Number of Stations	**14**	**11**	**25**

Source: Data from the US Department of Energy's Alternative Fuels Data Center. **Notes:** A few additional stations exist, categorized as Tesla Destination Chargers, and commonly located at hotels or other long-stay destinations. These chargers are often limited only to patrons of these specific businesses and are not considered public; therefore, they are not included in these totals. The number of CHAdeMO, Tesla, and CCS chargers may exceed the total number of DCFCs reported because one charger may be compatible with multiple plug types. *There are three plug configurations for DCFC commonly used across North America: CHAdeMO, CCS, and Tesla. CHAdeMO and CCS are not compatible, and Tesla vehicles cannot be fast charged using the CCS connector.

This may seem like enough for a region with only about 600 registered EVs, but there are several factors to consider.

First, it is not uncommon for individual chargers (and occasionally whole stations) to be off-line at any given time. Also, the total number of chargers includes those owned by private businesses, such as hotels, stores, wineries, and restaurants. While some of these are public, others are reserved for customers. (Tesla Destination Chargers have already been removed from this dataset because they're typically private.) And, finally, both the Walla Walla and Yakima Valleys lie on major transportation throughfares, moving thousands of additional vehicles into and through those regions every day.

As with LDVs, the status of MHDVs and associated infrastructure in PacifiCorp's Washington service area is in early stages of development. However, there is at least one project that has been both publicly popular and successful from a technical and financial standpoint. In 2021, Valley Transit, the public transportation authority in Walla Walla, began operating four electric trolley buses between downtown and the local community college. The original cost was just under $3 million for the four buses—about what the transit agency says comparable diesel buses would have cost.[20]

Customer Demographics

PacifiCorp customers exhibit unique attributes that lend themselves to a tailored TE portfolio. Within the Washington customer base of approximately 134,000 customers, residential customers make up 83% and commercial customers make up about 12%. Of the 107,817 residential households in our service area, 19% live in multifamily dwellings. A significant percentage of multifamily dwellings households are categorized as low income.[21]

Aligning with the Clean Energy Implementation Plan

It is important to note that while this TE plan contemplates equitable programming for customers, the programs, concepts, and initiative described further in this document are not specific commitments made as a result of CETA or identified in the CEIP. The one notable exception to this is the creation of a new EV grant program for named communities. This program is described further in Section VIII and is identified as a specific action in the CEIP. The CEIP commitment related to the grant program includes an expectation that the Company will work with its Equity Advisory Group to design the grant program. The following section discusses the development of named communities and the process undertaken by CETA to identify such named communities.

Elsewhere in this plan, additional pilots, programs, and considerations relevant to named communities are identified and discussed in further detail.

PacifiCorp's Named Communities

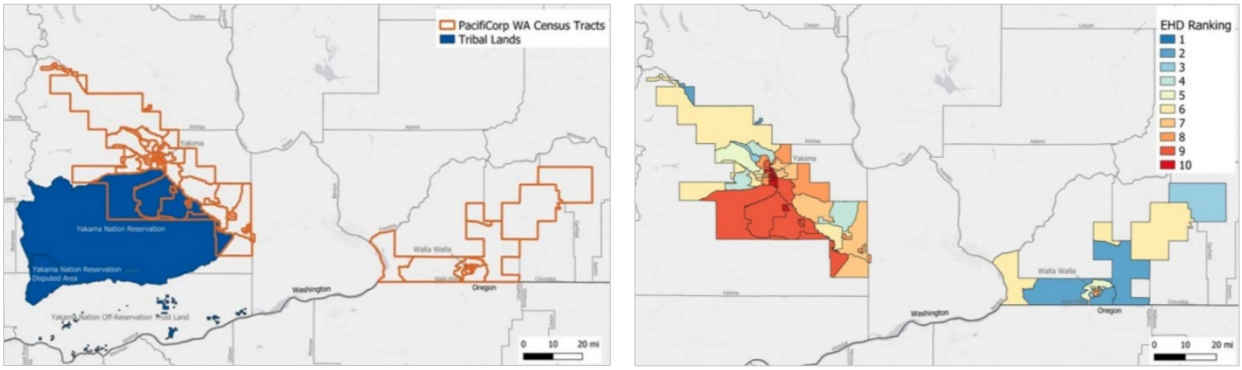
PacifiCorp's Clean Energy Implementation Plan[22] was developed in 2021 with the aim of advancing "a clean energy future with assurances that benefits from a transformation to clean power are equitably distributed among all Washingtonians." As part of the plan, PacifiCorp conducted a multistep stakeholder engagement process with public participation and community input to define named communities.[23] This included surveys, the establishment of an Equity Advisory Group, and comparison of available data with perspectives on lived experiences in PacifiCorp's service territory. Named communities include "highly impacted communities" and vulnerable populations.

The Washington Department of Health defines a highly impacted community as occupying a "census tract [that] is covered or partially covered by 'Indian Country'" or a "census tract [that] ranks a nine or ten on the Washington Tracking Network … Environmental Health Disparities Map, as designated by the Washington

20. Walla Walla Union-Bullet, "Valley Transit on cutting edge with new electric buses" (September 30, 2019), www.union-bulletin.com/opinion/editorials/valley-transit-on-cutting-edge-with-new-electric-buses/article_ced0f52c-e3c4-11e9-9ee2-8fe78920050c.html. See also, Fourth Revolution, "Public absolutely loves BYD electric trolleys in Walla Walla, Washington" (June 16, 2021), www.thefourth-revolution.com/buses/public-absolutely-loves-byd-electric-trolleys-in-walla-walla-washington/.
21. Overall, 69% of PacifiCorp's residential households are single-family homes, 12% are mobile homes, and 19% are multifamily residences, according to PacifiCorp 2021 CPA—Appendix A: Residential Market Profiles, www.pacificorp.com/energy/integrated-resource-plan/support.html.
22. PacifiCorp, "PacifiCorp Clean Energy Implementation Plan" (December 30, 2021), www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/ceip/PAC-CEIP-12-30-21_with_Appx.pdf.
23. Named communities are communities identified as being highly impacted communities identified by the Washington Department of Health census tract as covered or partially covered by "Indian Country" as defined and designated by statue (RCW 19.405.020) or a census tract ranking a nine or tine on the Washington Tracking Network Environmental Health Disparities Map, as designated by the Washington Department of Health. This is further overlaid with vulnerability characteristics defined by specific categories during the development of the CEIP.

[Department of Health].” The Environmental Health Disparities Map, in turn, defines a nine or a ten as a given census tract’s population falling, on average, within the lowest 20th percentile in certain environmental, socioeconomic, and health categories. Within PacifiCorp’s Yakima service area, there are a total of six census tracts that include tribal lands (there are no designated tribal lands within the Walla Walla region) (Figure 7: PacifiCorp’s Yakima Service Area). Overall, there are an estimated 30,365 PacifiCorp customers within highly impacted communities in the Washington service area, which is 27.1% of the total customer base.

Figure 7: PacifiCorp’s Yakima Service Area



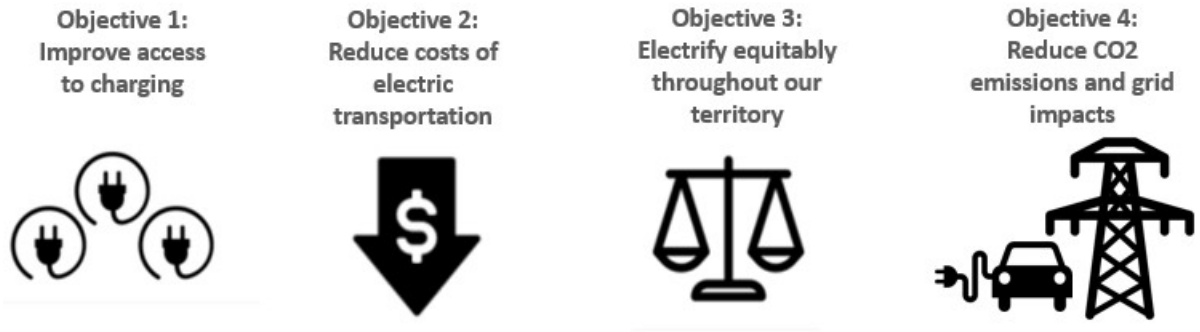
PacifiCorp used available data to determine the number of customers or percentage of the service area considered part of a vulnerable population. This analysis was compared to statewide estimates or percentages of these populations. For nearly all of these indicators, the PacifiCorp customer base in Washington lags behind state figures. Phrased differently, PacifiCorp’s customer base may be considered more vulnerable than Washington’s overall population, according to the metrics developed during the CEIP process.[24]

24. PacifiCorp, “PacifiCorp Clean Energy Implementation Plan” (December 30, 2021), www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/ceip/PAC-CEIP-12-30-21_with_Appx.pdf.

III. Objectives and Goals

The above policies and directives have guided PacifiCorp in the development of the four key objectives of this TE plan. These objectives exemplify PacifiCorp's commitment to be responsive to customer needs for the sustainable, reliable, and affordable provision of essential energy services.

PacifiCorp's TE plan has four primary objectives, with programs and initiatives that will support each one.



Objective 1: Improving Access

Access to EV charging varies by location. Charging infrastructure is also relatively immature within PacifiCorp's service area—an issue compounded by the fact that rural drivers often travel significantly greater daily distances than their urban counterparts. In addition, there are several customer groups that may face additional access hurdles, including:

- Members of named communities whose lower overall access to electrified transportation is likely further exacerbated by geographical and/or socioeconomic factors
- Customers living in multifamily housing who are less likely to have access to EV charging infrastructure at home (because the majority of EV charging occurs at home, this represents a significant gap in access)
- Customers whose employers do not offer workplace charging

While it is important to address these access gaps, it's also important to acknowledge that new evidence suggests that simply making EV charging infrastructure available is not sufficient to improve EV awareness.[25] So in addition to making charging infrastructure available, it's also important to invest in outreach and education for all customers, particularly those living in named communities.

Objective 2: Reducing Costs

If the cost of owning and operating an EV is higher than the costs for a gasoline model, the barriers to adoption become too great for many car buyers to overcome. The availability of a $7,500 federal tax credit and other potential monetary incentives for many vehicles will help to reduce the up-front incremental cost that exists between an EV and a comparable gasoline vehicle. However, fueling must also be less expensive for EVs to have maximum consumer appeal. As a utility, PacifiCorp can help reduce cost barriers by making it more affordable for customers to operate an EV in the following ways:

25. Hoogland, K., "More charging infrastructure may not mean more people see it [Slides]" (December 8, 2021), https://steps.ucdavis.edu/wp-content/uploads/2021/12/Session-3-Kelly-Hoogland.pdf.

- Offer incentives to lower the cost of EV charging equipment
- Offer make-ready programs to help reduce service-upgrade costs
- Reward customers for good charging behavior (for example, charging during off-peak hours, participating in demand-response [DR] events, and participating in managed charging programs)

Objective 3: Electrifying Equitably

Financial incentives to help ease the transition to electrification can be effective in general, but they are not always disseminated equitably. Just as some customers have limited access to EV charging infrastructure, not all customers can readily benefit from electrification or access the necessary resources to make this transition.

For example, federal tax credits for EVs are a common financial incentive, but only those purchasing new vehicles who have a sufficiently large tax burden have been able to take full advantage of the credit. In other words, the federal tax credit is structured in a way that may disproportionately benefit higher-income individuals. As another example, low- and moderate-income (LMI) customers are less likely to use traditional public charging infrastructure for reasons that include high-cost burden, limited schedule flexibility, and inability to accommodate a longer commute.

Electrifying equitably requires deliberate planning and can necessitate significant resources. To help ensure that TE efforts are benefiting the desired communities, PacifiCorp will continue to engage with its Equity Advisory Group, a key stakeholder group in the development of the CEIP.

Objective 4: Reducing CO_2 Emissions and Grid Impacts

EVs can be an important tool in reducing CO_2 emissions and can be managed in a way to ensure that grid impacts are minimized as new load comes on to the system. By encouraging its customers to adopt EVs, PacifiCorp will advance the goal of reducing GHG emissions. Reductions per EV charge (versus a tank of gasoline) will widen as PacifiCorp's generation mix continues to shift from fossil fuels to renewable energy resources such as wind and solar. Emissions reductions come from electrifying vehicle miles traveled.

Furthermore, managing charging through customer programs, rate structures, and other mechanisms can encourage charging during off-peak hours, reducing a need for upgrades. Reducing emissions and grid impacts is a critical objective of PacifiCorp's TE actions.

IV. Marketplace and Technology Overview

The electric transportation sector—including the utility acting as fuel provider—is still in early stages; the market forces and consumer behaviors that shape future vehicle design and the supporting infrastructure remain difficult to predict. This makes it important for PacifiCorp to monitor the marketplace and proactively adapt to the evolving landscape by updating its TE plans on a frequent and ongoing basis.

Despite major market uncertainties, there are specific interventions that PacifiCorp can undertake in the near term. There are also a handful of longer-term strategies the utility can begin developing now in anticipation of future industry growth. The most notable activities include:

- Enhancing consumer awareness of EVs (for example, outreach and education activities)
- Supporting the deployment of robust EV charging infrastructure or networks
- Promoting programs to customers that support installation of EV infrastructure and effective usage under various rate structures
- Coordinating with other market actors to help ensure that EVs are an increasingly appealing transportation option

To meet the evolving needs of the marketplace now and in the future, it's important for PacifiCorp to monitor key technologies and the evolving EV industry, as described in the following subsections.

Battery Technology

Declining Battery Prices

Perhaps the single largest driver for increasing EV adoption over time is the falling cost and increasing energy density of lithium-ion (Li-ion) batteries. As recently as 2010, battery pack prices were over $1,100 per kilowatt-hour (kWh). By the end of 2020, that same energy-normalized cost had fallen to $137 per kWh, with some industry-leading companies presumed to be pushing costs even lower.[26] Most battery experts agree that these downward pricing trends will continue and have the potential to further accelerate adoption of EVs. BloombergNEF estimates that by 2023, costs will drop to $100 per kWh,[27] which has long been targeted as the threshold below which EVs can achieve cost parity with gas-powered models.

However, pandemic-induced supply-chain disruptions, growing demand for batteries for transportation and stationary applications, and environmental constraints on Li-ion battery materials have created a near-term disruption to the battery energy storage system sector. Battery prices rose in 2021 and remain higher than in the recent past; by 2023, automotive battery prices are anticipated to drop to $103 per kWh.28

Improving Battery Chemistry

Advances in battery chemistry—including novel anode and cathode technologies—and battery thermal management systems are leading to significantly better-performing, safer, and more-affordable EVs. Improvements over the past decade have, for the most part, been modest and incremental, though frequent. Looking ahead, however, numerous experimental battery chemistries—solid-state lithium batteries being

26. BloombergNEF, "Battery Pack Prices Cited Below $100/kWh for the First Time in 2020, While Market Average Sits at $137/kWh" (December 14, 2020), https://about.bnef.com/blog/battery-pack-prices-cited-below-100-kwh-for-the-first-time-in-2020-while-market-average-sits-at-137-kwh/.
27. BloombergNEF, "Battery Pack Prices Cited Below $100/kWh for the First Time in 2020, While Market Average Sits at $137/kWh."
28. Jaffe, S. and Campbell, B., E Source, "Battery Forecast Database Q4 2021" (April 2022), www.esource.com/report/137221ha57/battery-forecast-database-q4-2021.

among the leading hopefuls—hold the potential to emerge as an alternative to Li-ion that can offer even greater safety, energy density, and longevity compared with current chemistries.[29] Though it may take another decade or more for the technology to be fully developed and successfully commercialized, solid-state batteries could significantly shake up clean-tech markets and usher in the era of electric transport dominance.

In addition to solid-state lithium batteries, there are scores of other promising, exotic battery chemistries just emerging from labs that could potentially displace Li-ion's dominance in the future. However, researchers working in the field of novel battery discovery and development have generally found it challenging to convert promising laboratory results shown by any new chemistry or form factor into a viable, commercial-scale battery system. This is especially the case in automotive applications because system design and performance specifications for cars are so stringent that even otherwise well-established battery chemistries often cannot compete.

Increasing Battery Life

Until the last few years, battery longevity for EV applications remained largely uncertain. Due to the highly dynamic and often harsh environments in which vehicles are operated, it was never entirely clear that EVs would have a useful life comparable to that of conventional gasoline vehicles. However, older generations of EVs are now proving that premature battery degradation is generally not a significant limitation of most Li-ion chemistries. Tesla has been carefully tracking battery cells on its vehicles for more than 15 years and has recently released data on degradation showing that batteries often retain 80% to 90% of their original energy storage capacity even after 200,000 miles (Figure 9: Capacity Retention of Tesla Vehicle Batteries Following 200,000 Miles of Usage).[30] Note that these are vendor-reported battery-degradation numbers. To PacifiCorp's knowledge they have not been independently validated.

The lifetime of EV batteries has been further extended over the past decade by improvements to battery thermal management and Li-ion chemistries. There are now EVs on the road with well over 100,000 miles that still retain a high percentage of the original range. Some automakers are even beginning to offer warranties on EV battery packs for as many as 150,000 miles. At one point, Tesla even went so far as to give some customers an "infinite miles" warranty. The company has discontinued the offering.[31, 32]

Better End-of-Life Options

When an EV reaches the end of its useful, intended life—whether due to degradation, a collision, or some other reason—the old batteries usually still hold significant residual end-of-life value. Two major opportunities exist: recycling or repurposing. In the last few years, several startups and established companies have significantly ramped up their recycling efforts. For example, in September 2021, Redwood Materials, a generously backed battery recycling startup founded by ex-Tesla executives, announced a major partnership with Ford to recycle used batteries ahead of the first deliveries of the all-electric F-150 Lightning.[33] A month later, CATL, one of the largest battery producers in the world, announced plans for a $5 billion recycling factory in China.[34]

29. Tvete, H. A., DNV, "Are solid-state batteries the holy grail for 2030?" (2020), www.dnv.com/to2030/technology/are-solid-state-batteries-the-holy-grail-for-2030.html.
30. Tesla Motors, "Tesla 2020 Impact Report" (2021), www.tesla.com/ns_videos/2020-tesla-impact-report.pdf.
31. Kane, M., InsideEVs, "Check Out This Official Tesla Model S/X Battery Capacity Degradation Chart" (June 20, 2020), https://insideevs.com/news/429818/tesla-model-s-x-battery-capacity-degradation/.
32. Tesla, "Vehicle Warranty" (November 16, 2021), www.tesla.com/support/vehicle-warranty.
33. Ford Motor Co., "Redwood Materials Teaming Up on Closed-Loop Battery Recycling, U.S. Supply Chain" (September 22, 2021), https://media.ford.com/content/fordmedia/fna/us/en/news/2021/09/22/ford-redwood-materials-battery-recycling.html.
34. Reuters, "EV battery maker CATL plans $5-billion China recycling facility" (October 12, 2021), www.reuters.com/world/china/ev-battery-maker-catl-plans-5-billion-china-recycling-facility-2021-10-12/.

Advances in recycling are certainly an enabler of EV proliferation, but recycling is not the only end-of-life option available to degraded EV batteries. Many battery packs have useful applications outside of EVs, even if they are significantly degraded. Several entities have demonstrated stationary utility-scale battery storage installations using second-life EV battery packs for grid-tied applications. Specific applications include DR pilots, voltage-regulation services, battery-boosted EV fast charging, and resiliency and emergency preparedness.[35] To date, these installations remain uncommon due to the limited availability of second-life batteries and the low price of virgin Li-ion cells relative to the effort and expense needed to deploy second-life installations. However, the supply of used EV battery packs will ramp up significantly over the next 10 years, enabling utilities to scale up activities in this area.

False Starts with Battery Swapping

Outside of faster charging, the only common solution for dramatically reducing the amount of time it takes to return a drained EV battery pack to a full state of charge is to remove that pack from the vehicle at a roadside station and replace it with a freshly charged battery. Though this approach sounds straightforward, execution has so far proven to be enormously challenging. Tesla abandoned efforts to operate battery swapping stations in 2015, but a few US startups are still trying to develop and deploy solutions.[36]

Most of the battery swapping activity occurring now is taking place in China, where initiatives to develop large swapping networks have been announced but development has been limited. The obstacles to battery swapping are numerous:

- Carmakers would need to make packs easy to remove and install
- The industry would need to establish standards that don't violate intellectual property rights
- Carmakers would need to develop new warranty structures
- The industry would need to address the liability of installing used and potentially faulty or damaged batteries

At this time, it's unlikely that battery swapping will emerge in the US as a viable and widespread alternative to traditional charging for at least five years.

Electric Vehicle Supply Equipment (EVSE) Technology

Faster Charge Times

One impediment to EV adoption is the fact that it takes electric cars longer to fully charge than it takes their gas counterparts to fuel up. This is, of course, a somewhat false comparison because many EVs can be plugged in overnight at home, during the day at work, or at other times or locations when the vehicle is not in use at minimal inconvenience to the driver. Nevertheless, the demand for rapid charging is significant and growing as EVs penetrate further into the mainstream market.

When EVs were first introduced to the US consumer vehicle market in 2010, Level 3 or DCFCs were more curiosity than must-have technology. Tesla's aggressive deployment of its Supercharger network—initially providing unlimited charging to its customers—sent a clear signal to the market that DCFCs can help eliminate

35. McCarthy, E., Canary Media, "Used EV batteries could get a second life storing clean energy on California's grid" (June 22, 2021), www.canarymedia.com/articles/batteries/california-is-closing-in-on-repurposing-ev-batteries-to-store-clean-energy-for-the-grid.
36. Bloomberg Green, "China embraces EV battery swap technology Tesla has cooled on" (January 17, 2021), www.bloomberg.com/news/articles/2020-01-17/china-embraces-ev-battery-swap-technology-tesla-has-cooled-on.

range anxiety and make EVs more convenient. In addition to Tesla's introduction of long-range EVs, this Supercharger network opened the door to long-distance travel for EV owners.

But not all DCFCs are created equal. Lower-power or "legacy" DCFCs operating at around 50 kilowatts (kW) are less expensive than higher-power models and produce a smaller demand spike on the distribution grid, but they also charge more slowly. The highest-power DCFCs currently in operation deliver up to 350 kW to the vehicle. MW-scale charging equipment is currently under development but not yet operational.

Though DCFCs are not necessary to fulfill the majority of LDV charging needs, for MHDVs operating in fleets, DCFCs represent the only practical option for recharging within a reasonable amount of time due to these vehicles' much larger battery packs and more-demanding usage profiles. To meet fleet electrification goals, more electrified models of MHDVs are needed, as well as more and improved DCFC options.

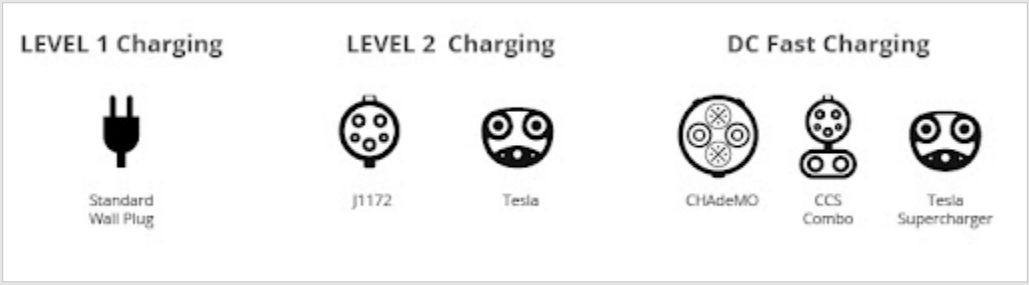
Recent technology developments aim to improve existing DCFC technologies, making them smaller, faster, and more energy efficient. One tech startup, Resilient Power Systems (RPS), originally set out to design terrorist-proof, solid-state transformers for the US Department of Defense. The company was successful in that endeavor, later discovering that the same technology could be applied to improve existing DCFC equipment. The RPS charging stations charge faster, require only about a tenth the physical footprint, and are more energy efficient than other leading DCFC units.[37] RPS also claims that EVSE installation takes only three days, with significantly less equipment to install and commission. RPS was one of a small group of startups that recently received $2 billion in financial support through Amazon's Climate Pledge Fund.[38]

Connector Standards for Passenger Vehicles

There are now three power levels and six connector standards commonly used to charge EVs in North America (Figure 8: Power Levels and Connector Standards for EV Charging in North America).[39] Although the EV industry was able to broadly adopt a common plug configuration for AC Level 1 and Level 2 charging using the J1772 standard, there are now three plug configurations for DCFC commonly used across North America: CHAdeMO, CCS, and Tesla. CHAdeMO and CCS are not compatible, and Tesla vehicles cannot be fast charged using the CCS connector. It's possible to purchase a special adapter for a Tesla to use a CHAdeMO charger, but this adapter is often out of stock and CHAdeMO currently limits power output to 50 kW, well below the 250-kW capacity of newer Tesla Superchargers. Given the three different DCFC connector standards, two developments have occurred that merit attention. One is the colocation of CHAdeMO, CCS, and Tesla EVSE all in the same charging station. One area for PacifiCorp to consider is the potential of partnering with or evaluation of charging station vendors to ensure that they offer all three standard plug configurations. This could provide the dual benefits of ensuring higher equipment utilization rates and more utility revenue. PacifiCorp already has a similar initiative in place within its Oregon service area, where stations include CHAdeMo, CCS, and J1172 chargers.

37. Srdic, S. and Lukic, S., IEEE Electrification Magazine, "Toward Extreme Fast Charging: Challenges and Opportunities in Directly Connecting to Medium-Voltage Line" (2019), 7(1), 22–31. https://doi.org/10.1109/mele.2018.2889547.
38. Toussaint, K., Fast Company, "Custom boxes and fast charging: The next companies funded by Amazon's $2 billion Climate Pledge Fund" (October 26, 2021). www.fastcompany.com/90690300/custom-boxes-and-fast-charging-the-next-companies-funded-by-amazons-2-billion-climate-pledge-fund.
39. Blink Charging, "Understanding EV Charging Plugs" (July 23, 2021), https://blinkcharging.com/understanding-ev-charging-plugs/.

Figure 8: Power Levels and Connector Standards for EV Charging in North America



Emerging Standards for MHDVs

There are several major efforts underway to develop technical standards for fast charging larger vehicles at a MW rate. The CharIN Megawatt Charging System (MCS) task force intends to support Class 6 through 8 commercial trucks in the near future.[40] Meanwhile, several national laboratories are working to develop "a megawatt-scale charging system for medium- and heavy-duty EVs, with the goal of enabling drivers to charge in less than 30 minutes at reasonable cost" (Figure 9: National Renewable Energy Laboratory Testbed for a Proof-of-Concept MW-Scale Connector).[41] These efforts are in addition to several startups like WattEV, which is attempting to enter this space independently.

Figure 9: National Renewable Energy Laboratory Testbed for a Proof-of-Concept MW-Scale Connector

Trucking manufacturers and electric utilities are also working to develop and deploy chargers, including the Electric Island charging station jointly opened by Daimler Trucks North America and Portland General Electric, where both entities are experimenting with MW-scale chargers.[42] Tesla also cannot be ruled out as an eventual player in this space, given the future launch of its own semitruck model and the fact that its passenger vehicles operate on a proprietary charging standard. Given the large amount of activity and relative immaturity

40. Charin Global, "Megawatt Charging System (MCS)" (2021), www.charin.global/technology/mcs/.
41. National Renewable Energy Laboratory, "Medium- and Heavy-Duty Electric Vehicle Charging" (2021), www.nrel.gov/transportation/medium-heavy-duty-vehicle-charging.html.
42. Ligouri, F., Daimler Trucks North America, "Daimler Trucks North America, Portland General Electric open first-of-its-kind heavy-duty electric truck charging site" (April 21, 2021), https://daimler-trucksnorthamerica.com/PressDetail/daimler-trucks-north-america-portland-general-2021-04-21.

of this sector, it's difficult to predict how many and which standards will eventually succeed. Without the federal government or at least multiple major states mandating a single standard, as has happened in Europe with passenger vehicles, it's possible that multiple standards may all compete over the long term.

Inductive Charging

Inductive charging for EVs works on the same principal as wireless charging for smartphones: a car or truck is parked directly above a large mat with a powerful magnetic field that induces the flow of electricity into the vehicle's batteries. Though the market for inductive chargers is relatively undeveloped, there are a few products currently available, mostly aimed at residential users who park over the induction pad in their garage, eliminating the need to manually plug in their EV. While inductive charging does offer a small measure of convenience, the energy losses associated with an induction pad are substantial compared with a plug-in charger. Large inductive chargers like those used to charge EVs may also potentially be hazardous to people with pacemakers, and even stepping near one in steel-toed boots can result in burns.

One variation on wireless EV charging is to embed inductive coils into the roadway itself, allowing a vehicle to charge while in motion. In addition to the potential problems with inductive mats, this approach has gained limited interest due to cost and logistics associated with electrifying portions of a roadway surface. Demonstrations in Europe are ongoing, but there does not seem to be much advancement of this concept in the US or Canada.

Market Trends

Lack of Consumer Education

Range anxiety remains a major consumer barrier. A 2020 E Source survey found that over 80% of Americans drive fewer than 30 miles a day, yet most respondents said they needed 350 to 500 miles of range.[43] Additionally, more than half of surveyed respondents did not know that it was possible to charge an EV at home with a simple three-prong plug.[44] Another barrier to adoption is that many people believe that all EVs are prohibitively expensive. While this was true a decade ago, when options under $70,000 were almost nonexistent, at least 7 models are now available at a price of less than $40,000. A total of 13 EV models now sell for under $50,000,[45] and most of these vehicles are significantly less expensive after incentives and rebates are applied (by comparison, the average cost across all new vehicle types is about $43,000, according to J.D. Power[46]). Addressing these knowledge gaps is an important role utilities can play through informational campaigns and stakeholder engagement.

Significant Near-Term Adoption Potential: Fleet Vehicles

In September 2019, Amazon announced plans to purchase 100,000 Rivian electric delivery trucks.[47] Two years later, Hertz announced tentative plans to purchase the same number (or more) of passenger vehicles from Tesla over 14 months.[48] Though fleet electrification on this scale is still rare, even a more modest, local business fleet has the potential to electrify dozens of vehicles over a relatively short period. These rapid fleet electrification efforts can represent the fastest-growing EV loads on any given utility feeder, presenting both

43. LeBlanc, B., E Source, "Why do people have electric vehicle range anxiety?" (July 15, 2020), www.esource.com/001202aicx/why-do-people-have-electric-vehicle-range-anxiety.
44. LeBlanc, B., E Source, "Why do people have electric vehicle range anxiety?"
45. Goodwin, A. et al., CNET, "Every electric car and its range for 2021" (November 17, 2021), www.cnet.com/roadshow/news/every-electric-car-ev-range-2021/.
46. Krisher, T., Associated Press via USA Today, "US vehicle sales tumble amid chip shortage, record prices" (October 2, 2021), https://eu.usatoday.com/story/money/cars/2021/10/02/chip-shortage-causes-slump-us-vehicle-sales/5968022001/.
47. Shama, E., CNBC, "Amazon is purchasing 100,000 Rivian electric vans, the largest order of EV delivery vehicles ever" (September 19, 2019), www.cnbc.com/2019/09/19/amazon-is-purchasing-100000-rivian-electric-vans.html.
48. Boudette, N. E. and Chokshi, N., New York Times, "Tesla Crosses $1 Trillion Value After Hertz Deal" (November 9, 2021), www.nytimes.com/2021/10/25/business/hertz-tesla-electric-vehicles.html.

opportunities and risks for a utility. The possibility of a business customer such as a food distributor or commercial laundry service growing from a small account to a large account overnight holds significant revenue potential and expanded customer engagement opportunities for the utility. However, major fleet purchases that are not coordinated with the utility can lead to a host of issues, including overtaxed utility infrastructure, high demand charges, and dissatisfied customers.

A Diversifying Marketplace

As of 2021, there were more than 20 EV models available in the US.[49] This ever-growing selection of vehicles is beginning to address the long-standing problem that buyers couldn't always find an EV model that met their needs and taste. Most notably, at least three pickups are now available or will be by the end of 2022—from Rivian, Tesla, and Ford. Until now, the complete lack of electric pickups—the second most popular vehicle type in the US—was likely hindering EV adoption. Additional market gaps are also beginning to close, such as the large SUV market, in which the Tesla Model X has been the only available model for years. But this market category will see the introduction of the GMC Hummer, Rivian R1S, and the Bollinger B1 in late 2021 and 2022. And among passenger cars and crossovers, the number and variety of products has increased significantly over the past five years. As EV options expand, there is an opportunity for PacifiCorp to work with dealerships to promote EVs. Currently many dealers are reluctant to sell or promote EVs due to lack of knowledge, limited models, or perceptions of high price or inferior performance.

In the MHDV market, the picture is similar, with a significant ramp up of delivery vehicles, semitrucks, and even some off-highway vehicles like tractors rapidly entering the marketplace and filling new TE niches.

V2G, Managed Discharging, and Managed Charging

It's possible that customers could be managing the discharge of electricity from their EV batteries onto the distribution grid—commonly referred to as vehicle-to-grid (V2G)—to help meet utility needs during times of peak demand. While this is certainly an interesting TE development, we're probably a number of years away from seeing V2G as a viable option for utility customers.

To date, there have been several V2G technology demonstrations but only a handful of pilot programs that could have the potential to scale to full customer incentive programs.[50] Most prior V2G demonstrations required custom engineering; there are only a few bidirectional chargers available for public stations or commercial customers so far.

Even though bidirectional charging equipment is technically commercially available today, that doesn't necessarily mean customers will be able to use it to manage discharging from their EV batteries. While a few manufacturers, like Ford, embrace the potential of V2G, others, like Tesla, do not allow for bidirectional charging and even state that customers' warranties will be voided if they manage to bypass the vehicle's safeguards against V2G functionality.[51]

There is also some early market evidence to suggest that, at least on the residential side, some utility customers are interested more in managing the discharge of the battery for their own use as a resiliency function during outages.[52] These are all trends utilities will be monitoring over time.

49. Goodwin, A. et al., CNET, "Every electric car and its range for 2021" (November 17, 2021), www.cnet.com/roadshow/news/every-electric-car-ev-range-2021/.
50. Ciampoli, P., American Public Power Association, "Public power utilities, others pursue vehicle-to-grid opportunities" (February 1, 2021), www.publicpower.org/periodical/article/public-power-utilities-others-pursue-vehicle-grid-opportunities.
51. Lambert, F., Electrek, "Tesla voids your warranty if you try to power your home with your electric car battery pack" (February 23, 2021), https://electrek.co/2021/02/23/tesla-voids-your-warranty-power-your-home-with-electric-car-battery-pack/.
52. PG&E, "EPIC 2.03b: Test Smart Inverter Enhanced Capabilities—Vehicle to Home. Electric Program Investment Charge (EPIC)" (February 2018), www.pge.com/pge_global/common/pdfs/about-pge/environment/what-we-are-doing/electric-program-investment-charge/PGE-EPIC-Project-2.03.pdf.

In the near term, rather than focusing on managed discharging for EVs, it seems more appropriate to consider managed charging program opportunities. Managed charging programs allow a utility or third party to remotely control vehicle charging by turning it up, down, or even off to correspond with the needs of the grid, much like traditional DR programs.[53] Just five years ago, managed charging was a new concept that utilities were just beginning to consider. Dozens of EV managed charging programs have since been fielded, and though the pilots and programs have experienced some technical complications, the consensus is that the approach can work and is often worth pursuing for utility customer programs.

EV managed charging is simpler and less expensive to implement than managed discharging, but it can still deliver several benefits to both the utility and its customers, including DR program participation, reverse DR programs, flexible load management, time-variant pricing, behavioral notifications, emissions-based management, rewards for slower charging, and dynamically adjusting voltage or current. The Smart Electric Power Alliance (SEPA) has written a number of reports on EV managed charging over the past few years, some of which are publicly available and free to download. Most recently, SEPA published a report focused on EV managed charging program design.[54]

Supply-Chain Constraints

The COVID-19 pandemic has led to a well-publicized shortage of semiconductor chips and other components that are essential for auto manufacturing. Major automakers are responding with temporary assembly line shutdowns, while the used car market has surged. Though the constraints are expected to resolve within a year or two, this shortage is creating instability in the industry and may hinder the adoption of EVs because a typical EV contains roughly twice the number of onboard processors as a standard internal combustion engine (ICE) automobile.[55] Indeed, in the first six months of 2021, EV sales in the US were about 10% lower than in the same periods from 2018 to 2020.[56] Certainly, other macroeconomic trends may also be at play, but some automakers are directly attributing slow sales to the shortage, including Ford, who told customers that "the global semiconductor chip shortages are affecting our ability to keep up with demand" of Mach-E Mustangs.[57] Still, industry observers have documented improvements in automotive semiconductor availability since its nadir in 2020 and expect supply to continue to increase until it reaches demand levels in 2023 or 2024.[58]

The short-term constraints of semiconductors aren't the only supply-chain challenge facing EVs. The massive ramp up in global battery production associated with EVs has created issues with battery makers acquiring lithium, cobalt, and nickel, among other raw materials. Furthermore, concerns over nickel supply have grown following Russia's invasion of Ukraine in February 2022, as Russia is the world's largest exporter of nickel ore. Nickel prices, which were already on the rise, jumped by some 50% after the invasion.[59] One probable upshot

53. Myers, Erika, Smart Electric Power Alliance, "Beyond Load Growth: The EV Managed Charging Opportunities for Utilities" (2017), https://sepapower.org/knowledge/beyond-load-growth-ev-managed-charging-opportunity-utilities/#:~:text=Managed%20charging%20%E2%80%93%20also%20called%20V1G,like%20traditional%20demand%20response%20programs.
54. Smart Electric Power Alliance, "Managed Charging Incentive Design: Guide to Utility Program Development" (October 27, 2021), https://sepapower.org/resource/managed-charging-incentive-design/.
55. Ferris, D., Scientific American, "Chip Shortage Threatens Biden's Electric Vehicle Plans, Commerce Secretary Says" (November 30, 2021), www.scientificamerican.com/article/chip-shortage-threatens-bidens-electric-vehicle-plans-commerce-secretary-says/.
56. McDonald, L., EV Adoption, "US Electric Vehicle Sales Report: 1H 2021" (August 31, 2021), https://evadoption.com/us-electric-vehicle-sales-report-1h-2021-now-available/.
57. Hiar, C., Scientific American, "Chip Shortage Could Slow Electric Vehicle Rollouts" (August 25, 2021), www.scientificamerican.com/article/chip-shortage-could-slow-electric-vehicle-rollouts/.
58. See, for example, Deloitte Touche Tohmatsu Limited, "2022 Semiconductor Industry Outlook: Analyzing Key Trends and Strategic Opportunities" (May 12, 2022), **Error! Hyperlink reference not valid.**www2.deloitte.com/us/en/pages/technology-media-and-telecommunications/articles/semiconductor-industry-outlook.html. See also Placek, M., Statista, "Global Automotive Semiconductor Shortage 2021—statistics & facts" (February 23, 2022), www.statista.com/topics/9062/global-automotive-semiconductor-industry/#dossierKeyfigures. See also LaChance, D., Repairer Driven News, "Chip shortages expected to last into 2023, auto execs say" (April 11, 2022), www.repairerdrivennews.com/2022/04/12/chip-shortages-expected-to-last-into-2023-auto-execs-say/.
59. Ewing, J. and Gandel, S., New York Times, "How the War in Ukraine Could Slow the Sales of Electric Cars" (March 18, 2022), www.nytimes.com/2022/03/18/business/energy-environment/nickel-russia-battery-electric-cars.html.

is an acceleration of the ongoing shift from lithium nickel manganese cobalt (NMC) chemistries to lithium iron phosphate (LFP) ones.[60]

Electrifying Transportation Equitably

Used EVs

Spending $35,000 to $100,000 (or more) on a vehicle is an option generally only afforded to individuals and families with significant financial resources. To address this equity gap, some electric utilities are beginning to provide rebates of their own for low-income customers to purchase EVs. For example, Clark Public Utilities in Vancouver, Washington, offers low-income customers a rebate of up to $2,000 to purchase a used EV.[61, 62] In its first nine months of operating (April 2021 to December 2021), the program granted 11 rebates for a total of $18,000 to low-income EV purchasers.[63] (Overall, Clark Public Utilities has provided some $141,000 in rebates and grants in the first year of its TE plan implementation.) Silicon Valley Power in Santa Clara, California, offers four rebate and grant programs for low-income purchases of EVs, including used vehicles.[64] There are a number of other utilities in California that provide incentives for the purchase of used (and new) EVs by qualified low-income residents.[65]

Ride-sharing and volunteer transportation programs using EVs are being pursued by numerous nonutility entities in California—efforts that utilities could potentially emulate. The California Air Resources Board's Low Carbon Transportation Investment (LCTI) funds equity-based initiatives to build up clean mobility options using EV transport options. One example is the Green Raiteros project in the Central Valley of California, which formalized a ride-sharing program that had existed for years to serve the area's (largely) Spanish-speaking farmworker population. After its founding in 2018, Green Raiteros acquired two EVs and two charging stations (one each in Fresno and Huron).[66] In 2021, LCTI provided $1 million in funding to expand Green Raiteros' fleet, which, by April 2022, had eight EVs and funds to procure three more EVs, eight e-trikes, and 50 e-scooters. Notably, Huron (population 7,290 with a medium household income of $25,060) had 30 EV charging stations as of April 2022, potentially the highest per capita for any US municipality. Utilities, too, are working to implement such EV ride-sharing programs. For example, Anaheim Public Utilities in Anaheim, California, has created a program to support EVs deployed as ride-sharing vehicles for residents of multifamily affordable housing developments.[67]

Key to any effort to support low-income adoption of EV-related transportation is to ensure that a community-based needs assessment is completed prior to committing to a specific solution. Additionally, program designers need to consider privacy issues among undocumented customers, non-English speakers, and digital divide barriers to creating and implementing programs targeted at low-income customers.

Electric buses offer another significant near-term equitable TE opportunity. Outside of walking or biking, riding an electric bus represents one of the most sustainable forms of transportation, with lower carbon and GHG emissions per person-mile than nearly any other mode of transportation. However, because the incremental cost of electric buses relative to diesel buses can be considerable, cash-strapped municipalities and school

60. Inverted Energy, "Lithium price is rising and LFP is overtaking the NMC market" (March 30, 2022), https://inverted.in/blog/lithium-price-is-rising-and-lfp-is-overtaking-the-nmc-market.
61. Clark Public Utilities, "Electric Vehicle Program" (January 5, 2022), www.clarkpublicutilities.com/residential-customers/reduce-energy-waste-and-lower-your-bill/all-rebates-incentives-and-low-interest-loans/electric-vehicle-program/.
62. Clark Public Utilities, "Electric Vehicle Program."
63. Dameon Pesanti, Media Specialist, Clark Public Utilities, personal communication (April 5, 2022).
64. Silicon Valley Power, "Incentives for Income-Qualified Households" (January 21, 2022), www.siliconvalleypower.com/sustainability/electric-vehicles/rebates-incentives.
65. DriveClean, "Incentive Search" (January 21, 2022), https://driveclean.ca.gov/search-incentives.
66. Shared-Use Mobility Center and The LEAP Institute, "The Story of Green Raiteros: A Shared & Electric Lifeline for California Farmworkers" (February 2020), https://learn.sharedusemobilitycenter.org/wp-content/uploads/GreenRaiteros_0220.pdf.
67. Anaheim Public Utilities, "EV Ride Sharing Pilot Program" (January 21, 2022), www.anaheim.net/5879/EV-Ride-Sharing-Pilot.

districts often lack the capital necessary to electrify their bus fleets. (However, federal funds often cover the additional cost of an EV bus, including the $5.6 billion dedicated to no-emission and low-emission buses and charging infrastructure in the Infrastructure Investment and Jobs Act.[68] Such funding will also reduce the need for transit agencies to increase rider fees due to electrifying their fleet. Though, to date, there apparently has not been any rider fee increases due to electrification.) Snohomish PUD, Portland General Electric, and Puget Sound Energy (PSE) have launched similar efforts over the past few years. PSE, for example, helped the Muckleshoot Tribe purchase an electric bus and EVSE near Tacoma, Washington. Elsewhere, school districts and transit agencies have partnered directly with third-party providers, as Montgomery County Public Schools in Maryland did when it partnered with Highland Electric Transportation to own and operate 300 buses on a 12-year contract signed in 2021.[69] Because school and municipal bus programs can be focused on underserved communities, these programs can be a significant tool in equitably electrifying the transportation sector.[70]

Multifamily Housing Programs

Because LMI utility customers are overrepresented in multifamily living arrangements, programs geared toward multifamily housing residents can be an effective tool in offering equitable TE incentives. This is particularly important because multiunit-dwelling EV owners face barriers that a utility can help them overcome, including:

- Lack of infrastructure
- Hesitancy of property owners to install chargers
- Lack of access to shared parking spaces where chargers are located
- The need to reserve charging stations for later use
- Difficulties navigating billing and payment complexities associated with shared chargers owned by a private party

Nonhighway Vehicles

Programs that encourage rental or purchase of smaller EVs, including e-bikes and e-scooters, present another opportunity to electrify transportation equitably because these modes of transportation require a more modest financial commitment and there are fewer restrictions on who can use them and where. These micromobility options are discussed in the next subsection.

Micromobility Opportunities

In the near term, electrified micromobility options, most notably e-bikes and e-scooters,[71] have significant potential, particularly in urban areas. Even though these individual loads are small compared with that of a car or bus, they're the first experience many people have with electric mobility. Several utility rebate programs exist to accelerate the adoption of these types of products. Most cooperative utilities in Colorado offer rebates for electric mountain bikes. Austin Energy incentivizes the purchase of individual or fleets of scooters, mopeds, motorcycles, and bicycles. And several programs in California offer funding for bicycles or scooters for income-eligible customers.[72] Because PacifiCorp's service area in Washington is largely rural, these more urban-friendly mobility options are less likely to gain wide traction there.

68. Federal Transit Administration, "Bipartisan Infrastructure Law" (April 1, 2022), www.transit.dot.gov/BIL.
69. Mufson, S. and Kaplan, S., Washington Post, "A lesson in electric school buses" (February 24, 2021), www.washingtonpost.com/climate-solutions/2021/02/24/climate-solutions-electric-schoolbuses/.
70. Solomon, G. et al., Natural Resources Defense Council, "No breathing in the aisles: Diesel Exhaust Inside School Buses" (January 2001), www.nrdc.org/sites/default/files/schoolbus.pdf
71. See, for example, Reppop, Wikimedia Commons, "LINK scooters by Superpedestrian in Downtown Los Angeles [Photograph]" (September 21, 2021), https://commons.wikimedia.org/wiki/File:Superpedestrian_Link_scooters,_2021.jpg.
72. DSMdat: A Searchable Database of Energy-Efficiency and Demand-Response Programs, E Source (2021), www.esource.com/dsmdat.

There are also more-rugged e-bike models available, sometimes used by hunters to reach and pack out game.[73] These may present a more attractive micromobility solution for some of PacifiCorp's customers.

Other Transportation Opportunities

The largest nonvehicle transportation market for electrification is aviation. Currently, the only area of aviation that is close to commercialization is electric drones for delivering packages, food, or other small payloads. A small ecosystem of companies is now racing to develop and deploy this technology, and the market could begin to emerge in the next few years. Over the medium term, small passenger aircraft may also reach commercialization. As early as 2026, electric planes seating under 20 people could enter the market (air carriers are already placing preorders). These aircraft will present significant logistic challenges because they will require high-capacity charging of 1 MW or more and will need to be able to refuel in an hour or less. Additionally, airline schedules often have little flexibility, which could mean that planes need to be charged at times of high grid demand. Though larger classes of aircraft are also a potential electrification opportunity, large electric passenger jets are likely still 20 or more years away due to low battery energy density, high weight, high cost, charging logistics, and development cycles that can last a decade or more.

73. See, for example, Wordpress, "Electric Hunting Bikes [Photograph]" (2019), https://electrichuntingbike.com/electric-hunting-bikes/.

V. Benefits and Costs

Transportation electrification has the potential to deliver significant economic benefits to PacifiCorp's customers. Over the next 10 years, PacifiCorp customers in Washington who own EVs will collectively enjoy more than $34 million in total cost savings, relative to operating a gas-powered vehicle (Table 5: Estimated Benefits of EV Growth in PacifiCorp's Washington Service Area). In addition, PacifiCorp estimates a modest growth in net benefits in the beginning years, building in the final 5 years. Furthermore, regional benefits include collective GHG reductions of approximately 74,000 metric tons of CO_2e over the next 10 years.

Table 5: Estimated Benefits of EV Growth in PacifiCorp's Washington Service Area

Year	Total Number of Light-Duty EVs	Customer Benefits(O&M Savings)	Net Benefits*	Regional Benefits (GHG Reductions in metric tons of CO_2e)
2022	765	$1,255,266	$80,977	2,050
2023	938	$1,539,136	$56,349	2,580
2024	1,134	$1,860,747	$191,143	3,183
2025	1,445	$2,233,224	$308,613	4,604
2026	1,819	$2,681,182	$474,777	6,150
2027	2,318	$3,225,950	$581,794	7,884
2028	2,996	$3,934,806	$866,689	10,804
2029	3,887	$4,806,108	$1,161,540	14,196
2030	5,025	$5,851,342	$1,621,040	19,083
2031	6,408	$7,032,769	$2,203,481	24,982
Total	**6,408**	**$34,420,530**	**$7,546,402**	**95,516**

Note: *Net benefits are calculated as the estimated difference between utility billing and the cost to deliver and supply electricity and include estimated benefits from carbon reduction.

The following sections describe the customer, utility, and regional impacts that PacifiCorp estimates will materialize in its Washington service area over the next 5 to 10 years.

Customer Impacts

Total Cost of Ownership

Numerous studies have been conducted over recent years that seek to compare the overall cost of EV ownership to that of an ICE vehicle. Though these studies vary slightly based on inputs and assumptions, they typically favor the economics of an EV—lower long-term costs of maintenance and fuel overcome the higher initial price tag. Table 6: Total Cost of Ownership summarizes the 2021 findings of researchers at Argonne National Laboratory[74] who conducted one such analysis. Current or shortly forthcoming EV models show modest lifetime savings over petroleum-fueled models. These modest savings are expected to grow

74. Burnham, A. et al., Argonne National Laboratory, "Comprehensive Total Cost of Ownership Quantification for Vehicles with Different Size Classes and Powertrains (ANL/ESD-21/4)" (May 2021), https://publications.anl.gov/anlpubs/2021/05/167399.pdf.

significantly over the next two decades as battery costs decline, with no significant reduction in ICE costs. Table 6 compares the total lifetime costs of a 2019 small EV and ICE SUV and a 2025 midsize EV and ICE delivery truck. Researchers used 2025 delivery truck data because of the relative immaturity of the MHDV market.[75]

Table 6: Total Cost of Ownership[76]

Small SUV, sales-weighted US sales in 2019, ICE versus 300-mile-range EV			Class 4 delivery truck, model year 2025, ICE versus 150-mile-range EV		
	ICE	EV		ICE	EV
Lifetime costs ($)			**Lifetime costs ($)**		
Vehicle	19,734	35,025	Vehicle	37,223	48,638
Financing	2,185	3,555	Financing	5,962	7,790
Fuel	19,766	6,747	Fuel	29,661	12,744
Insurance	12,510	12,274	Insurance	26,358	26,358
Maintenance	16,302	8,920	Maintenance and repair	43,216	25,930
Repair	6,039	5,389			
Tax and fees	4,630	6,759	Tax and fees	21,149	23,315
Total	**81,166**	**78,669**	**Total**	**163,569**	**144,775**
Per-mile costs ($)			**Per-mile costs ($)**		
Vehicle	0.1057	0.1876	Vehicle	0.2603	0.3402
Financing	0.0117	0.0190	Financing	0.0417	0.0545
Fuel	0.1059	0.0361	Fuel	0.2047	0.0891
Insurance	0.0670	0.0657	Insurance	0.1843	0.1843
Maintenance	0.0873	0.0478	Maintenance and repair	0.3022	0.1813
Repair	0.0323	0.0289			
Tax and fees	0.0248	0.0362	Tax and fees	0.1479	0.1631
Total	**0.4347**	**0.4213**	**Total**	**1.1411**	**1.0125**

Customer O&M Savings

Using multiple inputs, including the average fuel economy of standard, ICE LDVs (25 mpg),[77] annual vehicle miles traveled (11,000),[78] the average price of gasoline ($3.87/gallon),[79] the price of electricity used to charge EVs ($0.11/kWh),[80] the average savings in EV maintenance compared to ICE maintenance ($330/vehicle/year),[81] and the average annual amount of electricity consumed by an EV (3,563 kWh),[82]

75. Burnham, A. et al., Argonne National Laboratory, "Comprehensive Total Cost of Ownership Quantification for Vehicles with Different Size Classes and Powertrains (ANL/ESD-21/4)" (May 2021), https://publications.anl.gov/anlpubs/2021/05/167399.pdf.
76. Burnham, A. et al., "Comprehensive Total Cost of Ownership Quantification for Vehicles with Different Size Classes and Powertrains (ANL/ESD-21/4)."
77. US Department of Energy, "FOTW# 1177, March 15, 2021: Preliminary Data Show Average Fuel Economy of New Light-Duty Vehicles Reached a Record High of 25.7 MPG in 2020" (March 15, 2021), www.energy.gov/eere/vehicles/articles/fotw-1177-march-15-2021-preliminary-data-show-average-fuel-economy-new-light.
78. Alternative Fuels Data Center, "Maps and Data—Average Annual Vehicle Miles Traveled by Major Vehicle Category" (February 2020), https://afdc.energy.gov/data/10309.
79. AAA, "Gas Prices" (November 10, 2021) https://gasprices.aaa.com/state-gas-price-averages/.
80. PacifiCorp, "Washington Price Summary—Effective October 1, 2021" (2021) www.pacificpower.net/content/dam/pcorp/documents/en/pacificpower/rates-regulation/washington/WA_Price_Summary.pdf.
81. AAA, "True Cost of Electric Vehicles" (January 19, 2022), www.aaa.com/autorepair/articles/true-cost-of-ev.
82. From PacifiCorp modeling.

PacifiCorp has estimated the likely O&M savings for EV customers in its service area. PacifiCorp estimates O&M savings of $1,641 per EV per year compared to the O&M costs of an ICE vehicle. Over the next 10 years, total EV customer O&M savings will reach more than $34 million for PacifiCorp's Washington customers who adopt EVs (Table 7: Estimated EV Customer O&M Savings).

Table 7: Estimated EV Customer O&M Savings

Year	Total Vehicles	Customer O&M Savings
2022	765	$1,255,365
2023	938	$1,539,258
2024	1,134	$1,860,894
2025	1,445	$2,371,245
2026	1,819	$2,984,979
2027	2,318	$3,803,838
2028	2,996	$4,916,436
2029	3,887	$6,378,567
2030	5,025	$8,246,025
2031	6,408	$10,515,528
Total	**6,408**	**$43,872,135**

Noneconomic Benefits of EVs

Though economics are the usually largest driver for new vehicle purchases, it's worth noting that EVs have numerous additional advantages that may appeal to buyers.

Perhaps the most important aspect of EVs is that they're often safer than their gasoline counterparts. EVs typically score highly in collision safety testing because instead of an engine in the front of the car, the "frunk" of an EV is engineered specifically to act as a crumple zone. An ICE engine, by contrast, is far more rigid and therefore transfers more of the energy rearward in an impact. Additionally, because EVs have a heavy battery pack underneath the passenger compartment, the vehicle's center of gravity is significantly lower than that of an ICE vehicle, meaning EVs are less prone to rollovers. Finally, the elimination of combustible gasoline in a vehicle reduces the risk of fires and explosions. And although EV battery fires are a legitimate risk and have been well documented in recent years, data so far indicates that EVs are not significantly more prone to fires than ICE cars, though clear trends are still emerging.[83]

Non-LDV Mobility Costs and Benefits

As discussed above, e-scooters and e-bikes represent an inexpensive electric mobility opportunity for PacifiCorp's customers—particularly in Yakima and Walla Walla. Because rentals often cost just a few dollars—a low barrier to entry—these are an easy and often enjoyable way for people unfamiliar with electrified transportation to become comfortable with the concept.

83. See, for example, Insurance Institute for Highway Safety (IIHS) and Highway Loss Data Institute (HLDI), "With more electric vehicles comes more proof of safety" (April 21, 2021), **Error! Hyperlink reference not valid.**www.iihs.org/news/detail/with-more-electric-vehicles-comes-more-proof-of-safety. See also Bodine, R., AutoinsuranceEZ.Com, "Gas vs. Electric Car Fires [2021 Findings]" (December 28, 2021), www.autoinsuranceez.com/gas-vs-electric-car-fires/.

Mass-transit agencies and school districts also have an opportunity to electrify their fleets and realize major monetary savings. A typical electric city bus saves $50,000 a year in fuel and maintenance, leading to a five-year payback period of the initial cost difference between an EV and an ICE bus of $250,000.[84]

Costs and Benefits to Nonparticipating Customers

Even customers who don't use any form of electrified transportation can benefit. Most notably, a study by consulting firm E3 found that all utility ratepayers in the Pacific Northwest reap additional benefit from EVs on the road if utilities properly balance EVs loads and wholesale market pricing and use EVs to optimize low-cost fuels, as well as through grid-related emissions reductions.[85]

Utility Impacts

Consideration of utility impacts is critical in minimizing risk and maximizing benefits related to integration of new loads from transportation electrification. To integrate new TE load in the future, PacifiCorp seeks to design current programs to enable greater opportunities for managed charging, load shifting, and possibly other dynamic approaches. Planning for future advanced grid management opportunities will influence how PacifiCorp prioritizes technologies, program designs, and market interventions in the near term. Table 8: Forecasted Energy and Demand Impacts for EVs estimates total energy consumption of EVs as they are added to the system. The load impact will be slow over time and, as discussed in Section VI: Distribution Grid Impacts, impacts on the grid in the near-term will be minimal and easily addressed through traditional planning processes. The next section details how utility impacts and benefits are estimated.

Table 8: Forecasted Energy and Demand Impacts for EVs

Year	Total Number of Light-Duty EVs	Estimated Total Energy Consumption (MWh)	Total Coincident MW (Winter)	Coincident MW (Summer)
2022	765	3,016	0.23	0.71
2023	938	3,650	0.28	0.87
2024	1,134	4,367	0.33	1.05
2025	1,445	5,519	0.42	1.34
2026	1,819	6,909	0.53	1.68
2027	2,318	8,755	0.67	2.14
2028	2,996	11,263	0.86	2.76
2029	3,887	14,549	1.11	3.57
2030	5,025	18,746	1.43	4.61
2031	6,408	23,840	1.82	5.88
Note: Total MWh and MW impacts are inclusive of medium- and heavy-duty vehicles and account for utility line losses.				

84. Horrox, J. and Casale, M., US PIRG Education Fund and Frontier Group, "Electric Buses in America: Lessons from Cities Pioneering Clean Transportation" (October 2019), https://uspirg.org/sites/pirg/files/reports/ElectricBusesInAmerica/US_Electric_bus_scrn.pdf.
85. McKenzie, L. et al., Energy and Environmental Economics, "Economic & Grid Impacts of Plug-In Electric Vehicle Adoption in Washington & Oregon" (March 2017).

Annual Energy Consumption

Projected incremental EV adoption in PacifiCorp's Washington service area serves as the starting point for estimating utility impacts over the planning horizon. In 2021, it's estimated that 605 EVs are registered in PacifiCorp's Washington service area. Annual LDV actuals are derived using data from Washington and the department of licensing.[86] 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, educational campaigns, and charging station availability and visibility. PacifiCorp engaged Applied Energy Group (AEG) to develop forecasts of potential EV adoption in PacifiCorp's Washington service area.[87]

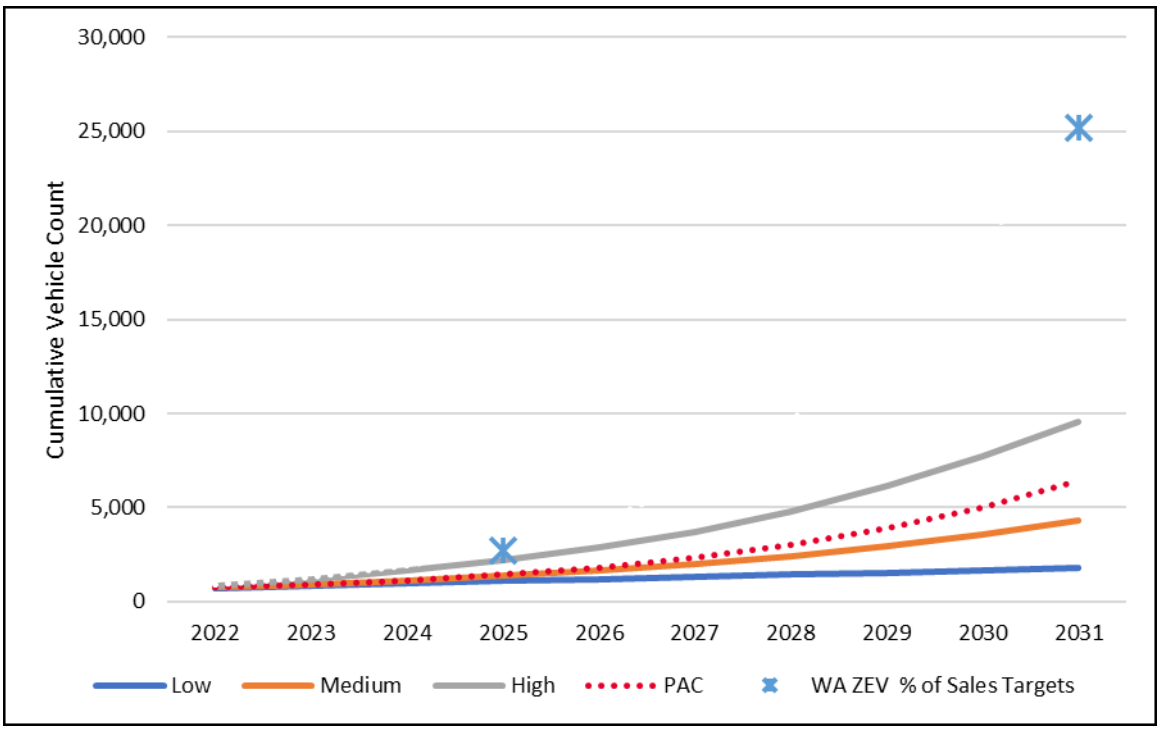
To accomplish this and to provide a range of potential outcomes, three separate scenario forecasts were created for EVs based on industry sources of varying aggressiveness (Figure 13: Washington LDV EV Stock Forecast [2022–2031]). The three scenarios differ greatly, with the high scenario reaching 9,590 EVs by 2031 and the low scenario reaching just 1,782 EVs the same year. Historical actuals and a blend of the medium- and high-case future forecast form the basis of estimates for customer benefits and utility impacts in Washington resulting from EV adoption. Beginning in 2025, the Company projects a more aggressive adoption of EVs in alignment with Washington law[88] requiring that 8% of new vehicle sales be zero-emission vehicles. PacifiCorp 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 Washington service territory. AEG conducted analysis on national forecasts of EV adoption from three industry sources:

- US Energy Information Administration Annual Energy Outlook (AEO) 2021
- Wood Mackenzie Electric Vehicle Outlook Data 2021
- BloombergNEF Electric Vehicle Outlook 2021

National EV market growth rates from each source for 2022 to 2031 were applied to estimated 2021 year-end light-duty EV registrations in PacifiCorp's Washington service territory to create the three potential forecasts of future EV adoption. The resulting forecasts of cumulative light-duty EV adoption in PacifiCorp's Washington service territory under the three scenarios are presented in Figure 10: Washington LDV EV Stock Forecast (2022–2031). In addition to these three scenarios, asterisks are included representing Washington's target of 8% of new vehicles sales being EVs in 2025 and growth trajectory to achieve 100% of new vehicles sales being EVs by 2035. As shown below, current adoption and expected growth rates in PacifiCorp's Washington service area lag the State's target of 100% EV sales by 2035. The Company will continue to monitor progress towards these targets and will update forecasts accordingly to reflect new trends in adoption as they occur. As shown, all four scenarios and PacifiCorp's selected forecast build off the same estimate for year-end 2021 EV registrations, applying source-specific growth rates beginning in 2022. The four scenarios produce extremely similar results through 2024.

86. Data.wa.gov, "Electric Vehicle Population Data" (December 2021), https://data.wa.gov/Transportation/Electric-Vehicle-Population-Data/f6w7-q2d2.
87. This memo uses the term "electric vehicle" or "EV" to encompass battery electric vehicles and plug-in hybrid electric vehicles alike.
88. Washington State Legislature, "RCW 70A.30.010: Department of ecology to adopt rules to implement California motor vehicle emission standards," https://app.leg.wa.gov/rcw/default.aspx?cite=70A.30.010#:~:text=RCW%2070A.,California%20motor%20vehicle%20emission%20standards. More information available at "ZEV - Washington State Department of Ecology," https://ecology.wa.gov/Air-Climate/Climate-change/Reducing-greenhouse-gases/ZEV.

Figure 10: Washington LDV EV Stock Forecast (2022–2031)



Note: Growth rates applied:
Low scenario: US Energy Information Administration Annual Energy Outlook (AEO) 2021
Medium scenario: Wood Mackenzie Electric Vehicle Outlook Data 2021
High scenario: BloombergNEF Electric Vehicle Outlook 2021
WA ZEV Target by percent of sales: Assumes 8% of new vehicle sales are EVs by 2025 and projects sales in 2031 with the trajectory of 100% of sales being EVs by 2035.

To estimate electric impacts for Washington, PacifiCorp used the previous year-end EV registrations and applied the growth rate from the medium scenario to estimate future vehicle adoption and then made the following assumptions:

- Average annual charging energy is estimated as 3,563 kWh per LDV (Table 9: Estimated Total Energy Consumption of EVs).[89]
- A relatively small proportion of MHDVs are also forecasted over the planning horizon. MHDV charging is combined and aggregated within annual forecasts. The annual consumption of these vehicles is used to inform charging impacts from these loads.
- While some charging of EVs registered in PacifiCorp's service area will take place outside of the service area, some EVs registered outside of PacifiCorp's service area will charge within the utility's service area. As such, 100% of charging for EVs registered in PacifiCorp's service area are assumed to take place in the service area.

89. Oregon Clean Fuels Program, "Calculating Residential EV Credits" (January 11, 2022), www.oregon.gov/deq/FilterDocs/cfp-resevcredits.pdf.

Table 9: Estimated Total Energy Consumption of EVs

Year	Total Number of Light-Duty EVs	Estimated Total Energy Consumption (MWh at Site) Inclusive of MHDVs
2022	765	3,016
2023	938	3,650
2024	1,134	4,367
2025	1,445	5,519
2026	1,819	6,909
2027	2,318	8,755
2028	2,996	11,263
2029	3,887	14,549
2030	5,025	18,746
2031	6,408	23,840

Timing of Charging

The timing of charging also informs utility impacts, specifically capacity impacts associated with EVs. EV charging can occur in a variety of locations using a variety of chargers (Level 1, Level 2, DCFCs, etc.). To understand grid impacts, Table 10: Timing of EV Charging Assumptions outlines the assumptions informing charging patterns for EVs.

Table 10: Timing of EV Charging Assumptions

Parameter	Value	Source
Energy Delivered by Home Charging	80%	2021 PacifiCorp Washington residential survey
Energy Delivered by Workplace, Fleet, or Public Charging	20%	2021 PacifiCorp Washington residential survey
Residential Hourly Impacts	Varies	Northwest Power and Conservation Council General Load Shapes—"R-All-Plug-EVSEChargeSave-All-All-U"
Nonresidential Hourly Impacts	Varies	Northwest Power and Conservation Council General Load Shapes—"Commercial-Public_EV_Charger"
MHDV Hourly Impacts	Varies	Northwest Power and Conservation Council General Load Shapes—"Commercial-Fleet_EV_Charger"

- Revenues are based on PacifiCorp's residential and small commercial retail rates.
- Hourly residential load shapes suggest 94% of energy use off peak and 6% on peak for charging.
- Coincident peak demand is assumed to be 0.80 kW for summer peak and 0.29 kW for winter peak based on residential charging patterns.
- Coincident peak demand is assumed to be 0.17 kW for summer peak and 0.09 kW for winter peak based on nonresidential charging patterns.[90]

Hourly charging impacts were determined using Northwest Power and Conservation Council Regional Technical Forum load shapes illustrated below for residential charging (Figure 11: Daily Weekend and Weekday Load Shapes for Residential EV Charging) and commercial public charging (Figure 12: Daily Weekend and Weekday Load Shapes for Commercial Public EV Charging). EV charging in residential settings predominantly occurs in the evening hours while EV charging in commercial settings predominantly occurs in the afternoon hours. As a result, EV charging is more coincident with summer peak hours than winter peak hours.

Figure 11: Daily Weekend and Weekday Load Shapes for Residential EV Charging

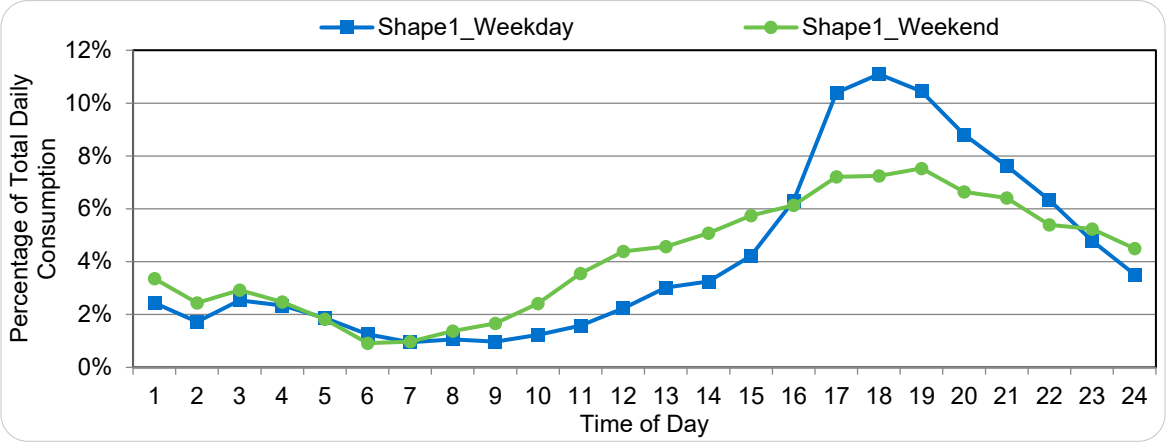
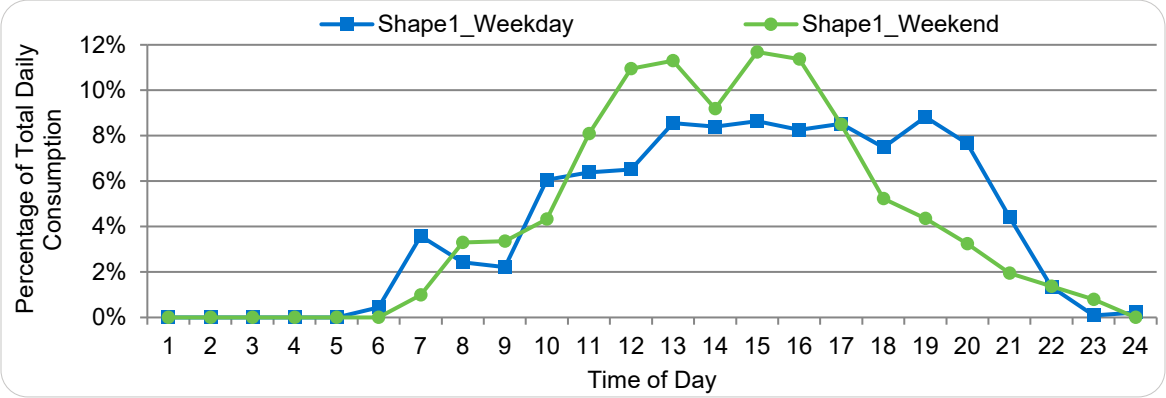


Figure 12: Daily Weekend and Weekday Load Shapes for Commercial Public EV Charging



90. Summer peak is assumed to be between 4:00 and 7:00 p.m. in July and August. Winter peak is assumed to be between 7:00 and 10:00 a.m. and 4:00 and 6:00 p.m. in January. Coincident peak demand is based on assumed per-LDV consumption values used in Table 9.

Incremental Generation, Transmission, Distribution, and GHG Costs

Utility electric system benefits or costs represent grid or ratepayer benefits that are attributable to PacifiCorp's Washington service area resulting from TE investments. These benefits can take the form of an avoided cost or a realized gain, which demonstrably leads to greater efficiencies, reliability, lower costs, or lower rates for the utility's electric system. Table 11: 2021 IRP Avoided Cost Parameters shows the avoided cost categories from PacifiCorp's 2021 Integrated Resource Plan (IRP) for Washington. In the 2021 IRP, PacifiCorp included the social cost of greenhouse gases (SCGHG) in the preferred portfolio; therefore, the accompanying energy supply price also includes the SCGHG. To maintain symmetry in evaluation of costs and benefits, the Company also estimated avoided emissions from transitioning from internal combustions engines to EVs. These costs, along with the Company's avoided costs, are used to represent the marginal energy and capacity costs to serve PacifiCorp customers in Washington.

Table 11: 2021 IRP Avoided Cost Parameters

Parameter
Generation Capacity Costs ($-kW/year)
Transmission and Distribution Costs ($-kW/year)
Energy Supply Costs ($/MWh)
Social Cost of Greenhouse Gases ($/Short Ton)

These costs are then applied to the assumed charging load and hourly shape of charging to estimate utility generation and delivery costs for serving new EVs. Table 12: Forecasted Costs and Benefits for EVs shows the anticipated energy consumption, potential gross billing revenue, and estimated net benefits for EVs in PacifiCorp's Washington service area.

Table 12: Forecasted Costs and Benefits for EVs

Year	Total Number of Light-Duty EVs	Estimated Total Energy Consumption (MWh)	Gross Billing Revenue	Estimated Net Benefits*
2022	765	3,016	$270,327	$80,977
2023	938	3,650	$326,595	$56,349
2024	1,134	4,367	$391,460	$191,143
2025	1,445	5,519	$494,032	$308,613
2026	1,819	6,909	$619,123	$474,777
2027	2,318	8,755	$785,503	$581,794
2028	2,996	11,263	$1,011,123	$866,689
2029	3,887	14,549	$1,307,580	$1,161,540
2030	5,025	18,746	$1,686,170	$1,621,040
2031	6,408	23,840	$2,146,435	$2,203,481

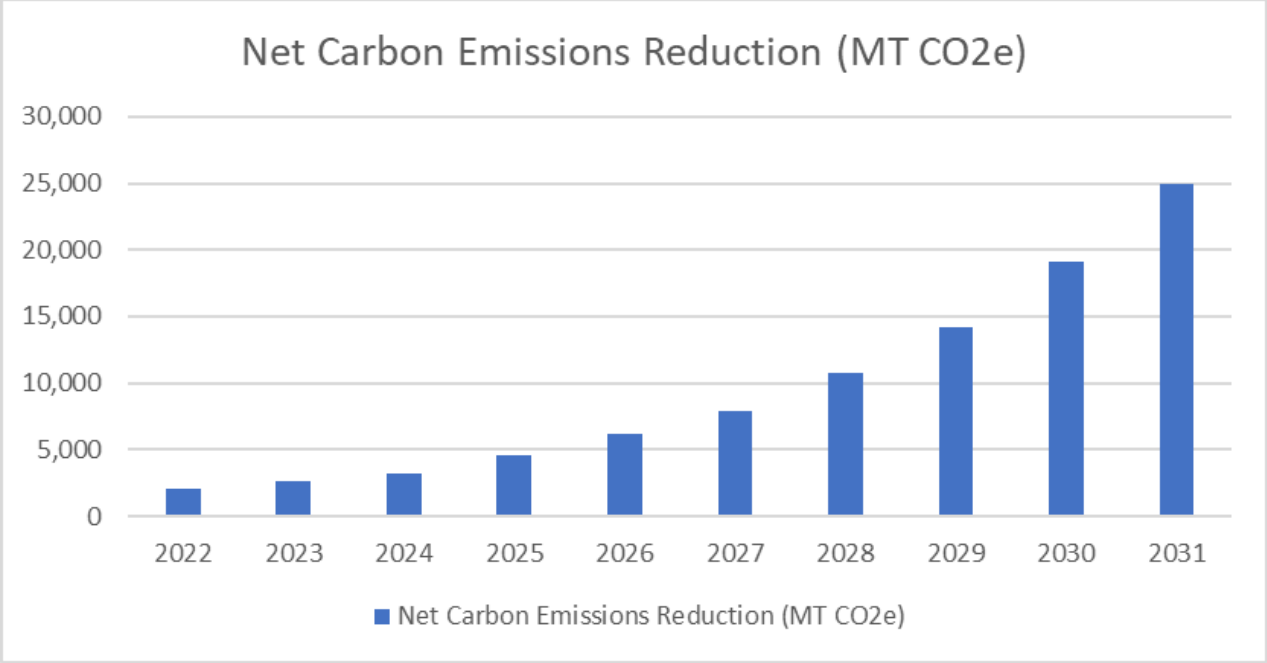
Note: *Net benefits are calculated as the estimated difference between utility billing and the cost to deliver and supply electricity, including estimated benefits from carbon reduction. Beginning in 2029, estimated net benefits become greater than gross billing revenues due to cumulative carbon impacts from vehicles in preceding years.

The system impacts—revenue, incremental energy, capacity, and local infrastructure upgrades—related to the increased charging load from TE are calculated based on the above assumptions. These assumptions will be reviewed and refined during reporting and subsequent planning activities.

Regional Impacts

As illustrated in Figure 13: Annual CO_2 Emissions Reductions Associated with Light-Duty EV Operation in Washington, PacifiCorp estimates that EV adoption in its Washington service area through 2031 will deliver cumulative emissions-reductions benefits of around 95,000 tons of avoided CO_2.

Figure 13: Annual CO_2 Emissions Reductions Associated with Light-Duty EV Operation in Washington



Beyond climate benefits, the regional benefits of EVs—including the reduction of certain air pollutants from mobile sources—are well understood and characterized. However, modeling and quantifying those benefits to local communities is a significant and complicated undertaking. EV volumes—both registered locally and estimated traffic flows—can serve as a proxy for air-quality benefits. EVs that replace "gross polluter vehicles" provide significantly more local air-quality benefits because gross polluters have been shown to contribute far more than average to poor local air quality.[91] To the extent that drivers of older and poorly maintained vehicles can be targeted with information and incentives to electrify, the overall environmental benefits could be significant.

91. Bohm, M. et al., Physics and Society, Cornell University, "Improving vehicles' emissions reduction policies by targeting gross polluters" (April 2021), https://arxiv.org/abs/2107.03282.

VI. Distribution Grid Impacts

PacifiCorp investigated the potential system impacts of residential EV adoption on the primary distribution system in the company's Washington service area, accounting for variations in the company's Washington service area such as seasonality, geography, demographics, and EV adoption through 2027. The system impacts included equipment thermal loading, voltage range, and imbalance.

Utilizing a state-level vehicle adoption forecast as described earlier, which considers many factors including vehicle availability, cost, tax credits, range, customer awareness, and technology familiarity, the number of EVs is expected to increase by approximately 383% by 2027. PacifiCorp anticipates that customers installing EV charging will contact PacifiCorp regarding load additions.

The total number of EVs is based on PacifiCorp's 2021 EV forecast and allocated to a zip code based on the number of EVs adopted. The total load added to PacifiCorp's service territory is based on the number of EVs added each year from PacifiCorp's 2021 EV forecast and allocating to a specific zip code based on 1.8 kW per plug-in hybrid electric vehicle (PHEV) charger and 3.5 kW per battery electric vehicle (BEV) charger. This was used to calculate the total load added in kW. The total load added to feeders is based on the total load from the EV forecast as described above and divides by the number of feeders that also serve the zip code the feeder is contained in (Table 13: Potential Estimated Feeder Load Due to EV Growth).

Table 13: Potential Estimated Feeder Load Due to EV Growth

Location–Substation	Feeder Type	Feeder Name	2021 EV Totals		2027 Estimated EV Totals		Total Load Anticipated with Future EVs (kW)	Total Load Added to Feeders (kW)
			BEV	PHEV	BEV	PHEV		
Yakima–Wiley	Urban	5Y631	7	15	73	166	1,168	45
	Suburban	5Y382	3	7	34	78	544	68
	Rural	5Y860	11	25	123	282	1,972	152

In some locations, normal load growth will cause isolated system component overloading issues, which will be compounded by additional EV 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 EV chargers in a short time period, this process will account for and prepare the system for the installation of residential EV charging. 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.

VII. Programs and Activities

In order for PacifiCorp to help facilitate TE adoption in Washington and ensure an equitable transition, PacifiCorp identified the following strategies and tactics to support the effort (Table 14: PacifiCorp's TE Strategies and Tactics). PacifiCorp adopted a planning horizon of 5 years for programs and activities, while (as seen above) integrating a 10-year analysis time frame for determining forecast, benefits, and costs. The reason for choosing the 5-year time frame is to align with other utility TE plans and recognize that TE is a dynamic, quickly changing space. Many tactics identified beyond 5 years may become obsolete and will require updating. Tactics have been categorized by the timing cadence that PacifiCorp believes will support prioritization of initiatives and activities.

- Short term: one to two years
- Medium term: two to three years
- Long term: three to five years

Table 14: PacifiCorp's TE Strategies and Tactics

Strategies	Tactics	Timing
1.0 Expand and improve past programs	1.1 Reestablish a grant program specific to named communities	Short term
	1.2 Expand and strengthen outreach and education programs	Short term
	1.3 Improve outreach for current time-of-use programs for EV-related charging and coordinate EV program design to potential program participation	Short term
2.0 Launch new program types that are relevant to customers	2.1 Develop workplace charging support for commercial customers	Short term
	2.2 Investigate opportunities to develop a multifamily charging program	Short term
	2.3 Investigate additional grid integration programs to manage load growth	Medium term
3.0 Establish a public charging and highways corridors initiative to support public EV infrastructure	3.1 Coordinate with statewide agencies and stakeholder groups to develop a robust public charging and highways corridors plan that includes key utility investments	Short term
	3.2 Build a blueprint to leverage additional federal and state funding to support public infrastructure	Short term
	3.3 Develop a public charging plan and program that will ensure investment in underserved communities	Medium term

The following sections share insights into where PacifiCorp concluded with the past pilot program and where PacifiCorp anticipates moving to support TE and achieve the objectives outlined in the TE plan.

Past Pilot Findings

In early 2019, PacifiCorp initiated several pilots to reduce TE barriers by addressing the high up-front costs. This consisted of launching three specific pilot programs to the market that were identified as key pathways to encouraging adoption of EVSE. The pilot programs added necessary infrastructure in the service area where low adoption of EVs existed with limited access to charging. The pilot programs uncovered key findings that highlighted the importance of TE programs in PacifiCorp's service area and identified ways these pilot programs could be expanded and improved to enable more robust programs. The final pilot report[92] was filed with the UTC on December 22, 2021, and provides a summary of the key findings by pilot program and recommendations on the next phase of TE programs for customers.

Key findings from the evaluation include the following.

Demonstration and Development Pilot. PacifiCorp provided grant funding toward nonresidential customer EV charging infrastructure projects. This included awarding 20 grants with a total of 10 projects completed to date. One project, as of November 2021, opted out, resulting in a total of 19 projects funded. Several projects were delayed due to COVID, and those projects are expected to be completed throughout 2022. Supply-chain issues continue to constrain the market and labor shortages continue to delay schedules, like the availability of electricians to install EVSE. Overall, the pilot expanded access to EVSE in PacifiCorp's service area and appears to have enabled earlier deployment of EVSE than would have otherwise occurred without the grant funding opportunities. Furthermore, this pilot program continues to see an increase in usage of EV charging stations since its inception, showing the growth and need related to charging. All EVSE equipment receiving grant funds are available for public use.

The pilot program set out to investigate three specific market barriers that a utility-sponsored grant funded to supplement the cost of private EVSE equipment:

1. *How the Program Addressed the High Up-front Cost of EVSE for Nonresidential Customers.* Results from the evaluation seem to suggest that the program was effective in reaching customers who either had not yet considered EV charging infrastructure or were in the early stages of planning. Respondents indicated that the program enabled them to increase the number of chargers at the site. One respondent indicated that the program expedited the installation of chargers.
2. *How the Program Addressed the Lack of Accessible EVSE in PacifiCorp's Service Territory.* The project sites were distributed among 11 municipalities across PacifiCorp's Washington service territory. More grants were awarded to customers in Yakima than any other municipality. This included seven projects with 29 charging ports, representing about 50% of the charging ports associated with all in-progress and installed projects. The types of projects include a mix of public, public/workplace, and public hotel. The charging is open for use to the public.
3. *How the Program Addressed the Lack of Awareness of Electric Transportation Options and Benefits.* Evaluators used the participant surveys and grant application files to collect information about how grant participants used their projects to spread awareness of electric transportation options. Three-fourths of survey respondents indicated they had not performed educational activities related to their

92. Washington Utility and Transportation Commission, "Washington Pilot Program Final Report & Evaluation" (2021), www.utc.wa.gov/casedocket/2018/180757/docsets.

EVSE grant projects, illustrating the need for greater awareness and outreach to become part of the pilot.

Outreach and Education Pilot. PacifiCorp deployed several EV marketing campaigns designed to boost awareness of EV technology and infrastructure, and to promote PacifiCorp's TE efforts. The primary objective of this pilot program was to test the utility's ability to increase awareness and understanding of TE through outreach and education tactics. The pilot consisted of four components:

- Customer communications
- Self-service resources
- Community events
- Technical assistance

Over the course of the pilot, outreach actions ensured that customers read outreach materials, attended ride-and-drive events, and increased their understanding of electric transportation. However, with the onset of the pandemic and limited ability to conduct in-person events, most outreach and education was done virtually. While the outreach and education seemed to reach a general population, with deeper dives from customers into content, results of how this increased TE understanding and awareness remains to be seen. Therefore, PacifiCorp believes that continuing to focus on education is key to support transformation of the transportation sector.

Publicly Available Charging Rate Pilot. PacifiCorp implemented a new optional transitional rate for publicly available DCFC stations. Customer-owned charging sites were eligible for this rate if they met the criteria proposed in tariff Schedule 45. Under the proposed rate, customers receive a discount from demand charges and pay an on-peak energy charge. Both the discount to demand charges and on-peak energy charge decrease as participating customers transition back to standard tariff rates over a 13-year period. By mitigating demand charges, Schedule 45 has helped reduce the cost to operate eligible DCFCs in PacifiCorp's Washington service area. Three sites, with a combined usage of 5 MWh, utilized this rate option in October 2021.

These three pilots enabled a number of learnings, ideas, and insights into how PacifiCorp should engage with Washington customers and how to better support the transformation of the electrification sector:

- *Grant Programs Enable Public Charging.* A total of 24 ports were supported by the projects with public-access charging as the primary use case. Nearly 700 sessions had been completed by the end of Q3 2021 (of the data received by PacifiCorp), with use of charging increasing over time. Most charging occurred during midday and early evening for an average of 3.2 hours. The demonstration and development pilot saw a significant uptick in charging sessions as more stations came online. PacifiCorp's service area still lacks adequate charging infrastructure, and this type of program has been critical in ensuring charging infrastructure gets built for public use.
- *Integrating Outreach and Education into Programs Is Key to Mobilizing Success.* Outreach and education as part of the pilot program reached the general population, with deeper dives from customers into EV content, but the results of how this increased understanding and awareness remains to be seen due to the impacts of COVID. PacifiCorp believes outreach and education is still a key strategy that should be integrated into programs in the future, explaining TE options and how PacifiCorp can support customers. PacifiCorp recommends the creation of an integrated outreach and educational component that would be part of the grant programs moving forward as well as the continuation of general EV marketing.

- *Effective Tariff Design Must Include Outreach Campaigns.* By mitigating demand charges, Schedule 45 has helped reduce the cost to operate eligible DCFCs in PacifiCorp's Washington service area. Schedule 45 is a valuable alternative rate schedule, but participation has remained low, because the qualification for the tariff option is limited. It is only available for publicly available DCFC stations. As part of the most recent general rate case, the UTC approved PacifiCorp's proposal for another alternative time-of-use (TOU) rate (Schedule 29) that is more broadly available and could help reduce the cost of demand charges for nonresidential TE customers. This new alternative became effective in May 2021 and provides a cap on the average cents-per-kWh cost to operate at a low load factor, which could significantly lower costs for DCFCs with low utilization and other customers with TE loads. PacifiCorp plans to continue to promote Schedules 45 and 29 and recommends pairing Schedule 29 and other relevant tariff schedules with outreach campaigns to ensure uptake by customers.

Strategy 1: Expand and Improve Past Programs

1.1 Reestablish a Grant Program Specific to Named Communities

Feedback from discussions with PacifiCorp's Equity Advisory Group during the drafting of the CEIP highlighted the potential impact of a grant program for named communities. PacifiCorp included that concept as a specific action in the CEIP. PacifiCorp anticipates that offering a grant program focused on named communities may achieve two main objectives:

- Activate TE projects more equitability throughout the PacifiCorp service area
- Ensure expansion of education and learning of what TE can mean for named communities

The grant program would be designed with the Equity Advisory Group and stakeholders to establish an inclusive grant program for named communities. Preliminary ideas for grant eligibility include covering 100% of costs and including all aspects of electric mobility projects—from infrastructure installation and adoption of different modes of electric transportation to outreach and educational campaigns and events. The proposed grant program could mimic the grant program delivered to customers during the first pilot discussed earlier:

- Grant cycle would occur annually throughout each year
- Charging would be available to the public
- Grants applications would be evaluated by a third-party independent evaluator
- Applications would be scored according to a set of criteria
- Projects would have two years to complete proposals
- Funding would be made available at the beginning of the project
- Quarterly and annual reporting would be completed by grant awardees

1.2 Expand and Strengthen Outreach and Education Programs

Awareness is the first step along the EV purchasing journey, and many customers are not aware of EVs and their potential benefits. As seen during the pilot, outreach and education is still critical to ensuring understanding and adoption of all modes of electric transportation. Potential outreach and education pathways could include:

- *Customer Communication Campaigns.* This may consist of several ways to reach customers, including social media advertising, radio traffic sponsorships, email marketing, newsletters, bill communications, and website/mobile app.

- *Technical Assistance.* PacifiCorp proposes to offer on-site technical assistance to nonresidential customers interested in installing charging infrastructure as well as expand these services to include technical assistance for customers pursuing fleet electrification. PacifiCorp would contract with a third party to provide this service at no cost to customers. Customers would apply via an online application on PacifiCorp's website. The assistance would consist of a desktop review, followed by a phone conversation to understand the customer's EVSE needs, followed by an in-person site walk. A final report would be issued to the customer. For fleet electrification, the technical assistance study would expand to include vehicle selection, goal mapping, and rate selection.
- *Dealership Engagement.* PacifiCorp would like to propose the idea of more-direct engagement with dealerships in the area through innovative tools such as Chargeway Beacons, dealership trainings, and in-person events. Working with dealers to ensure that they stock used EVs and market them to LMI customers is just one possible approach that may help overcome a barrier to adoption.
- *Online Tools.* PacifiCorp is investigating the use of several online self-service tools. PacifiCorp currently integrates the WattPlan tool into its website but understands that online tools evolve and the utility needs to continue to integrate useful tools for decision-making and information-sharing.

1.3 Improve Outreach for Current Time-of-Use Programs for EV-Related Charging, and Coordinate EV Program Design to Potential Program Participation

Rate design is a key strategy for encouraging optimal charging of EVs on the power system while also passing along those savings to further reduce the cost of EV ownership. While EV-specific rates are being explored nationally, PacifiCorp continues with a simplified approach of broadly available TOU rates to reduce the confusion that can result from a proliferation of rate schedules.

Beginning in May 2021, TOU rates became available to residential and nonresidential customers alike (Schedules 19 and 29, respectively). These TOU rates encourage off-peak charging and reduce costs for participating customers (Table 15: PacifiCorp's TOU rates).

Table 15: PacifiCorp's TOU rates

Customer Group	On-Peak Hours	Off-Peak Hours	Savings
Residential	June–September: 2:00–10:00 p.m. October–May: 6:00–8:00 a.m. and 2:00–10:00 p.m.	All other hours	6.675¢/kWh off-peak rate (compared to 10.198¢/kWh for usage over 600 kWh in a month)
Commercial	June–September: 2:00–10:00 p.m. October–May: 6:00–8:00 a.m. and 2:00–10:00 p.m.	All other hours	1.866¢/kWh off-peak credit

Furthermore, Schedule 45 is available to nonresidential customers to mitigate demand charges to reduce the cost to operate eligible DCFCs in PacifiCorp's Washington service area. Three sites with a combined usage of 5 MWh used Schedule 45 in October 2021.

As part of the most recent general rate case, the UTC approved PacifiCorp's proposal for another alternative TOU rate (Schedule 29) that could help reduce costs for DCFCs. This alternative became effective in May 2021 and provides a rate structure that reduces costs for customers who have a low load factor, which could significantly lower costs for DCFCs with low utilization. PacifiCorp will continue to promote Schedules 45 and 29. Over time, Schedule 29 may become more attractive, particularly as Schedule 45 transitions customers back to standard rates between November 2021 and October 2030. To date, EV customer programs have not required participation in TOU or actively marketed and communicated these rates as key opportunities for EV owners in the area.

PacifiCorp is interested in exploring how these rate schedules support better load management of existing EVs. Namely:

- Learn how effective a TOU rate may be—it's a low-cost approach with mutual benefits for the participant and the utility system.
- Assess the impact of the current rate schedules and evaluate the potential of integrating a requirement of participating in a TOU rate for residential EV customers. For example, one key consideration would be to determine whether the TOU rate structure encourages vehicle owners to start charging at a specific time (for example at 10:01 p.m.) in a manner that causes a big, sudden uptick in system energy use.
- As charging load increases on the system, if the data reveal a significant impact due to the increased load, PacifiCorp may look to deploy DR for cost-effective, coordinated, diversified managed charging control.

Strategy 2: Launch New Program Types That Are Relevant to Customers

2.1 Develop Workplace Charging Support for Commercial Customers

Boosting available EV charging capabilities can extend to commercial establishments, where employees (and potentially customers) can access EV charging equipment. In past surveys, EV-owning employees have expressed strong interest in workplace charging. However, employers can be hesitant to invest in EVSE and its installation cost given the uncertain benefits they will accrue, particularly if they also end up paying for the electricity such EVSE might draw. Still, workplace charging can provide a catalyst to employees to purchase an EV. One key is to minimize employer costs in establishing and operating a workplace charging capability. Commercial customers make up approximately 12% of the total customers served in the area and are a critical element of program offerings.

PacifiCorp suggests the following objectives:

- Encourage private businesses and public institutions to install EVSE at their locations by providing equipment rebates and potential make-ready incentives to lower the cost of installation
- Provide technical assistance to commercial customers to support decision-making processes related to installing EV supply equipment

PacifiCorp workplace charging could include a combination of identification and education of likely adoptees and support for workplace EVSE installations. Preliminary options include technical support to minimize the cost of EVSE installations, support of make-ready incentives that could be inclusive of all in-front-of-the-meter costs and rebates on EVSE purchases. Likewise, PacifiCorp would also explore the option of integrating TOU options into the program design for commercial customers. The EVSE infrastructure supported in this type of

program would most likely be Level 2 charging, and thus of relatively low capital cost for the equipment and its installation.

2.2. Investigate Opportunities to Develop a Multifamily Charging Program

Customers living in multiunit dwellings are less likely to have control over their ability to charge an EV at home than those living in single-family detached housing. At the same time, multiunit building owners may have limited incentives to install and operate EVSE, especially in situations where utility billing reconciliation or EV charging disaggregation is not a straightforward or simple process (that is, so building owners can bill tenants for the electricity their EVs consume).

Residents of multiunit dwellings face unique challenges to adopting EVs, and even though only 19% of PacifiCorp's Washington residential customers live in multiunit dwellings, a significant percentage of multiunit-dwelling households are considered low income.[93] To increase EV adoption among multiunit-dwelling residents, there are specific barriers that need to be overcome, including:

- Equipment expense
- Installation complications (including potential panel and service upgrades)
- Sharing or delegating charger ownership and management responsibilities among multiple stakeholders
- Handling residents' ability to reserve charging parking spaces and pay for charging

To better reach underserved communities, it's important for PacifiCorp to focus on residential multiunit-dwelling customers as an important segment for enabling EVSE adoption.

A multiunit dwelling charging program could be closely coordinated with the named communities grant program and be driven by three main objectives:

- Learn more about multiunit-dwelling residents' and owners' needs, goals, site conditions, and options for EVSE ownership, management, maintenance, and reservation/payment at multiunit sites
- Provide targeted education of multiunit-dwelling residents about EV options; education of building owners/property managers about where and how to site EV charging equipment; and informational resources related to ownership options that could minimize multiunit property owners' capital expenditures
- Investigate incentives and/or special rates for multiunit property owners to install site-appropriate EVSE options as well as incentives for residents to charge their EVs at their place of residence

PacifiCorp would initially conduct surveys of multiunit dwelling owners/managers and residents to obtain information about plans and perceptions that impact future EV adoption. A key activity would be to investigate how multiunit-dwelling-deployed EV charging options could influence resident EV purchasing decisions. The goal would be to ensure that chargers are convenient to residents, located near electric service access points, meet safety and other compliance requirements, and are properly maintained. To help building owners meet these installation requirements, PacifiCorp could consider developing and distributing a guide on equipment and installation.

Based on learnings from the above activities, PacifiCorp could investigate incentives for multiunit owners to install site-appropriate EVSE and for residents to charge EVs. PacifiCorp could also potentially integrate more

93. Overall, 69% of PacifiCorp's residential households are single-family homes, 12% are mobile homes, and 19% are multifamily residences, from PacifiCorp, "CPA—Appendix A: Residential Market Profiles" (2022), www.pacificorp.com/energy/integrated-resource-plan/support.html.

of a make-ready program. Given the diversity of multiunit dwelling structures and physical challenges, an array of flexible options is likely to prove more successful than a one-size-fits-all approach.

2.3 Investigate Additional Grid Integration Programs to Manage Growing Load

Growth in large DCFC stations—servicing LDVs as well as MHDVs—could place pressure on the distribution system. Even growth in privately owned passenger EVs could exacerbate the duck curve or otherwise be coincident to system peak demand as cars arrive at their home destinations and are plugged in to charge during the late afternoon and early evening.

To successfully manage this potential outcome, PacifiCorp may consider creating a managed charging program as part of its Washington TE portfolio to begin proactively managing the added EV-related load that will appear on the distribution system. Grid integration programs could be designed to achieve two main objectives:

- Ensure that current EV customers are participating in applicable TOU rates
- Investigate what grid integration programs can be seamlessly offered to residential and commercial EV owners as the market matures

Strategy 3: Establish a Public Charging and Highways Corridors Initiative to Support Public EV Infrastructure

In 2020, PacifiCorp was awarded funding from the US Department of Ecology to build a DCFC charging pod in Yakima via the Volkswagen settlement funds (four DCFC charging stations with one Level 2 charging station). PacifiCorp is currently partnering with entities in Yakima to place the fast chargers in downtown Yakima. In addition to supporting EV adoption in rural Washington, the location will support local business. The proposed chargers will be located near multiple restaurants and hotels. The Volkswagen grant will fund 50% of the project costs.

Yakima is a key high-traffic corridor in the eastern part of the state, intersected by multiple highways and thoroughfares. The proposed chargers are situated near US routes 12, 97, and 24; state route 821; and interstate 82. While this makes Yakima a critical connection point for southeast Washington, it also means that its residents are disproportionately affected by transit pollution. The census tract where the chargers are proposed scores a 9 out of 10 on the Diesel and Disproportionately Impacted Communities Index. By increasing the availability of charging infrastructure, this project will support EV adoption in the community and the associated value it brings. While this will add an additional four DCFC charging ports and one Level 2 dual-port charging station, more work to provide public charging is still needed in PacifiCorp's service area.

As of late 2021, there were a total of 25 charging stations offering 63 ports within PacifiCorp's Washington service area. However, of these 63 ports only 15 of those ports are DCFC and about 50% of those DCFC ports belong to Tesla's proprietary charging infrastructure, resulting in even fewer open-charging DCFC ports for non-Tesla drivers. In addition, discussions voiced during the November 2021 Washington UTC stakeholder meeting mentioned the need for more public charging ports available throughout PacifiCorp's area as well as a need to activate this area of investment.

3.1 Coordinate with State Agencies and Stakeholder Groups to Develop a Robust Public Charging and Highways Corridors Plan That Includes Key Utility Investments

PacifiCorp anticipates aligning with the current analysis, led by the Washington Department of Transportation (WDOT).[94] WDOT plans to develop and maintain a publicly available mapping and forecasting tool that will provide locations and essential information for infrastructure to support forecasted levels of EV adoption. In addition, engagement and discussions directly with local stakeholders would need to be coordinated to develop a public charging plan.

Furthermore, public charging can take the form of DCFC or Level 2. Another opportunity to explore is the role of right-of-way pole charging for Level 2 chargers. They have a significantly lower price tag than DCFC charging stations. Right-of-way pole charging can ensure that all residents receive the benefits associated with EV ownership. Customers must have reliable access to public charging infrastructure close to their residence, in locations where their vehicles are likely to dwell for long periods of time. Right-of-way pole charging places Level 2 chargers in the right of way, directly on utility poles near multifamily housing and in select residential neighborhoods where homes lack driveways or garages.

To ensure alignment and success, an engaged stakeholder process to develop a robust plan for exploring these possible solutions will be necessary.

3.2 Build a Blueprint to Leverage Additional Federal and State Funding to Support Public Infrastructure

The US Infrastructure Investment and Job Act (IIJA) presents a large opportunity for Washington to move quickly and rapidly toward an electric future. With about $71 million allocated to the state over the next five years, PacifiCorp anticipates working with stakeholders to leverage and apply this funding. The National EV Formula Program is to be directed to already designated alternative-fuels corridors within the Washington service area. Three of the eight existing fuels corridors pass through the PacifiCorp service area. In addition, the US Department of Ecology has plans to announce additional Volkswagen settlement funds over the next two years to support electric infrastructure. To prepare and plan for this, PacifiCorp suggests the development of a grant blueprint that would be coordinated and developed with stakeholders to ensure federal and state funds are leveraged to support public infrastructure.

3.3 Develop a Public Charging Plan and Program That Will Ensure Investment in Underserved Communities

While exact site locations will be an output of the public infrastructure planning process, PacifiCorp anticipates that the plan will be a mix of DCFC stations—either utility or third-party owned—as well as potential Level 2 charging within key areas of need throughout the area.

Programs and Activities Budget Targets

As discussed in Section V: Benefits and Costs, PacifiCorp does not see significant net revenue appearing with current EV adoption curves in the near term. However, when adding in both a carbon and societal cost into the overall net benefits calculation, PacifiCorp sees a noteworthy increase over time. There is a need to act sooner rather than later as forecasted EVs come to market. Anticipated programs and activities budgets take into consideration the need to act quickly over the next five years.

94. Transportation Research Board, “Analysis and Tools to Set Priorities for EV Charging Station Locations on WSDOT Corridors” (2022), https://rip.trb.org/view/1882798.

With all this said, PacifiCorp estimates a potential TE portfolio budget of approximately $2 million to $4 million over the next five years to fund capital and expenses of the TE portfolio. Table 16: PacifiCorp's Anticipated Cost Allocation for EVs, Through 2027, in Washington details the perceived likely outcome of program spending by programmatic type that PacifiCorp expects to see. In addition, spending is anticipated to start smaller in Year 1 as programs get off the ground and activities launch, ramping up over the next three years as the program portfolio matures. Administrative and management costs are part of the overall budget and estimated to not grow over 10%.

Table 16: PacifiCorp's Anticipated Cost Allocation for EVs, Through 2027, in Washington

Programmatic Type	Budget	Estimated Percentage of Budget
Named Communities Grant Program	$1,134,000	32%
Outreach and Education	$562,000	16%
Workplace/Multifamily Charging	$588,000	17%
Public Infrastructure Program	$858,000	24%
Grid Integration Initiatives	$378,000	11%
Total	**$3,520,000**	**100%**

PacifiCorp's proposed budget targets are initial estimates and subject to change as EV adoption shifts and other external factors that could influence budget targets enter the picture.

Furthermore, PacifiCorp estimates no less than 50% of investments will serve programs for named and underserved communities. Anticipated elements may include:

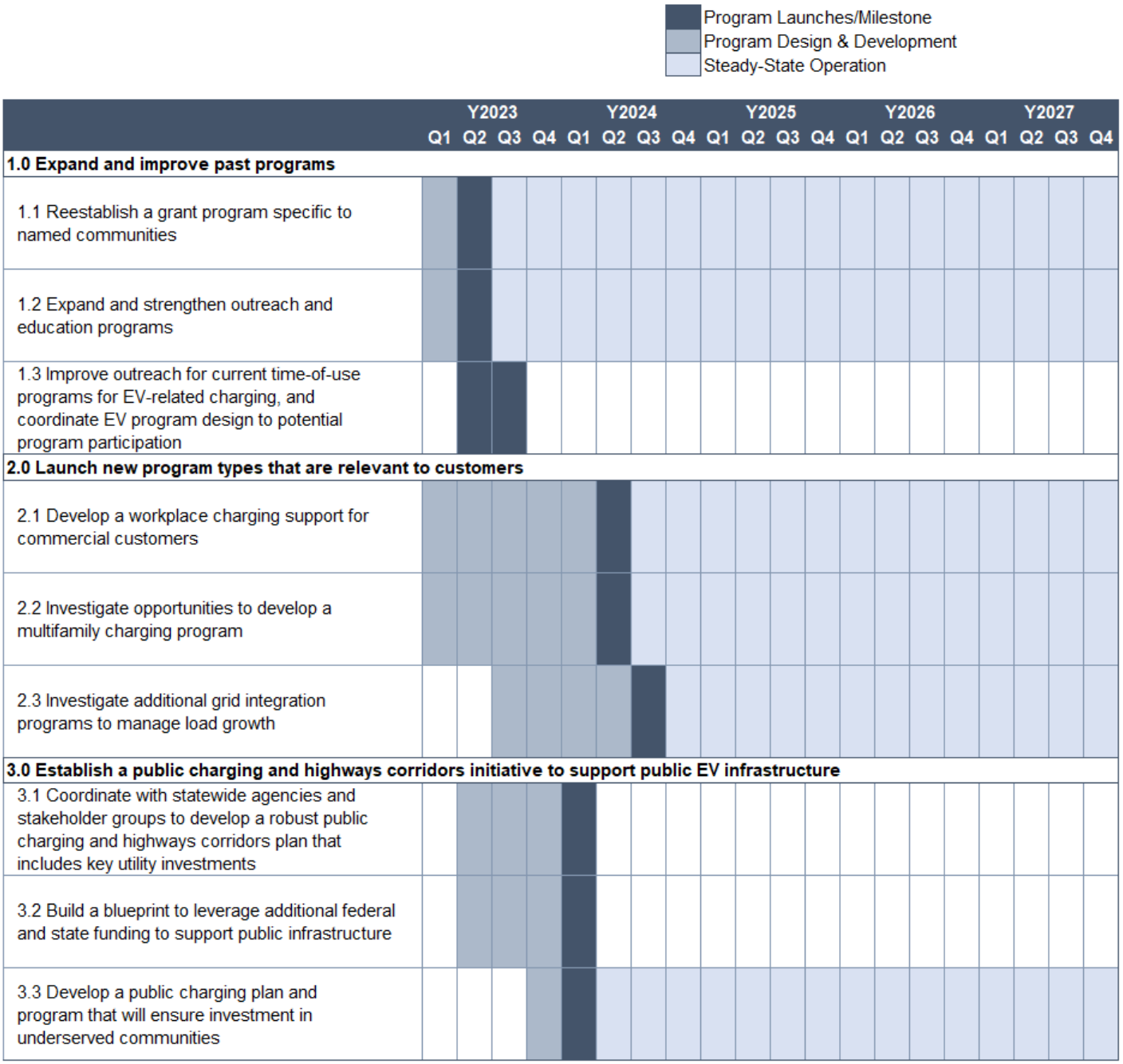
- Named communities grant program
- Targeted educational and outreach events in named and underserved communities
- Low-income multifamily-focused commercial charging program
- Infrastructure in underserved neighborhoods

Through collaborative design of programs with stakeholder groups (Equity Advisory Group, UTC, named communities, and others), PacifiCorp anticipates that this TE portfolio can support the transformation of the electric transportation sector in the service area while also reducing carbon emissions.

Program and Activities Proposed Schedule

PacifiCorp expects to activate the expansion and addition of new program activities as early as 2023 to make offerings available to customers (Figure 14: Proposed Schedule). PacifiCorp anticipates expanding and improving the grant program and outreach and education program as of Q1 2023. This is to be quickly followed by integrating new programs for customers by end of 2023.

Figure 14: Proposed Schedule



Integrating Equity

As laid out within the objectives of the TE plan, PacifiCorp understands the importance of making EV infrastructure accessible to all, that costs are reduced to allow for equal participation, and that electrification occurs equitably throughout the service area. These objectives guided PacifiCorp's strategies and tactics. PacifiCorp engaged with diverse stakeholders during the TE plan process (see Appendix B: Stakeholder Consultations) and proposes additional engagement to ensure that equity is consistently and constantly

integrated into program design and implementation. PacifiCorp suggests the following principles to continue to integrate equity within the TE portfolio.

Collaborative Program Design. PacifiCorp expects to continue meaningful engagement with stakeholders such as the Equity Advisory Group, Washington UTC EVSE Stakeholder Group, Low Income Advisory Group, local city and county councils, transit authorities, and local community-based organizations in developing equitable and innovative programs for underserved communities. PacifiCorp proposes to seek iterative feedback on program designs with stakeholders when developing new product offerings. This includes the development of the grant program, outreach and education program, workplace and multifamily charging program, and public infrastructure plan.

Collaborative program design is based on the ideals of engaging in meaningful dialogue, allowing stakeholders access to information to help with decision support, share the risk of product development, and engage in transparency to support a collaborative process.

PacifiCorp plans to continue to engage with the Equity Advisory Group during the design and development of the diverse program applications to ensure that equity is continually considered. The Equity Advisory Group includes members from the following organizations:

- Asian Pacific Islander Coalition
- La Casa Hogar
- Latino Community Fund
- NW Community Action Center
- Opportunities Industrialization Center
- Perry Technical Institute
- SonBridge
- Walla Walla Sustainable Living Center
- Yakima County Development Association
- Yakima Health District
- Yakama Power on behalf of the Yakama Nation

PacifiCorp also plans to engage with the following organizations on equity issues as the grant program is designed and implemented:

- Community Councils of Walla Walla and Yakima
- People for People
- Catholic Charities
- Yakima National Energy Assistance Program
- Neighborhood Health

Equity Check-ins. PacifiCorp expects to continue to engage with stakeholders on a monthly or bimonthly basis for iteration and program learnings to be shared on a consistent basis during the Equity Advisory Group schedule meetings.

Targeted Equity Budget. As shared in the programs and activities budget targets, PacifiCorp estimates no less than 50% of investments will serve programs for named and underserved communities.

VIII. Reporting and Analysis

PacifiCorp plans to update and reissue the TE plan every five years. The next plan update is anticipated to be 2027. PacifiCorp plans to submit new program filing applications and tariffs for regulatory review on an ongoing basis and will look to incorporate these program filings into future revisions of the TE plan.

PacifiCorp plans to provide one mid-period report and one end-of-period report over the next five years, which will include updates regarding progress toward achieving the objectives within the TE plan. PacifiCorp proposes that the reporting include the following:

- All spending in the previous two years
- All sources of funding for the TE plan portfolio in the previous two years
- An evaluation of each TE program in the portfolio
- A discussion of how the TE plan met the proposed metrics and performance areas
- An analysis of the costs and benefits of each program and ratepayer impacts over the last two years

Furthermore, PacifiCorp suggests the following performance categories to monitor the success of the overall TE portfolio over time. The first two categories proposed below align with those metrics identified in the CEIP. Further detail will be developed regarding relevant metrics for each category as program applications are developed.

- Community-focused efforts and investments (customer benefit indicator in the CEIP)
- Participation in PacifiCorp energy and efficiency programs and billing assistance programs (customer benefit indicator in the CEIP)
- Charging adequacy (equitable access)
- Infrastructure performance
- Grid benefits
- Environmental benefits

Appendix A: Detailed Distribution Impact Study

Executive Summary

In 2018, PacifiCorp filed its proposed Electric Vehicle Supply Equipment Pilot Program (EVSE Pilot Program) with the Washington UTC in response to the commission's EVSE policy statement. The policy statement requires utilities to take a portfolio approach and is meant to facilitate state TE goals. With approval of the program, PacifiCorp wanted to perform an independent load study to understand the potential system impacts of residential EV adoption on the primary distribution system in the Company's Washington service territory. This study accounts for variations in the service territory such as seasonality, geography, demographics, and EV adoption through 2027.

This study utilized a state-level vehicle adoption forecast provided by Applied Energy Group (AEG) (Section V. Benefits and Costs), which considers many factors including vehicle availability, cost, tax credits, range, customer awareness, and technology familiarity. Based on the forecast, it is expected that the number of EVs will increase by approximately 303% by 2027. The study analyzed multiple scenarios, which included private solar generation and no private solar generation, to understand potential interactions between generation and high levels of EV adoption.

The results of this study indicated that in some locations, normal load growth will cause isolated system component overloading issues, which will be compounded by additional EV 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 EVSE in a short time, this process will account for and prepare the system for the installation of residential EV charging.

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.

Study Scope

The study assessed distribution substation transformers and their associated distribution circuits in rural, suburban, and urban areas with the projected highest EV load adoption. The study starts with the expected loading in 2027 and then is adjusted with the additional increase from the EV load. The substation distribution transformers and associated distribution circuits in these areas include the following.

Yakima-Wiley area:

- Wiley substation (suburban)
    - Transformer T3256
        - Occidental 5Y382
- Gromore substation (rural)
    - Transformer T408850
        - Pippin 5Y860
- Voelker substation (urban)
    - Transformer T3930
        - Faraday 5Y631

Methodology

The study was performed using measured feeder loads and estimated load growth rates through 2027 as a baseline to evaluate the impacts of the AEG EV projection. After adjusting the baseline to reflect the impacts of potential new EV adoption, power flow analysis was performed using worst-case peak feeder loading to evaluate the impacts of increased adoption on existing equipment, devices, and voltage delivery.

EV penetration was studied using two scenarios: The first scenario assumed that the EV distribution was evenly spread across the entire feeder. The second scenario assumed clusters of EVs 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 EV 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 EV charging.

The study assumed that residents with PHEVs would use Level 1 chargers with an average peak demand of 3.5 kW and that residents with BEVs would use Level 2 chargers with an assumed average peak demand of 8 kW.

The assumed registered EV penetration was based on statewide penetration of EVs and adjusted by individual feeder population. The assumed registered EV penetration is shown in Table 17: Total Number of EV Chargers and Load Forecasted.

Table 17: Total Number of EV Chargers and Load Forecasted

Location-Substation	Feeder Type	Feeder Name	2021 Totals[a]		2027 Totals[a]		Total load (kW)[b]	Total Load Added to Feeder (kW)[c]
			BEV	PHEV	BEV	PHEV		
Yakima-Wiley	Urban	5Y631	7	15	97	222	1,558	60
	Suburban	5Y382	3	7	36	83	581	73
	Rural	5Y860	11	25	164	375	2,630	202

Notes: a. Total number of EVs is based on PacifiCorp's 2021 EV forecast and allocating the total to a zip code based on number of EVs adopted. Number of EVs per zip code is from the Washington light-duty EV adoption dataset. b. Total load added to PacifiCorp's service territory is based on the number of EVs added each year from 2021 to 2027 and allocating to a specific zip code based on note a. 8 kW per BEV charger and 3.5 kW per PHEV charger was used to calculate the total load added in kilowatts (kW). c. Total load added to feeder is based on the total load from the EV forecast as described in note b and divides by the number of feeders that also serve the zip code the feeder is contained in.

Results

Analysis on three 12.5 kilovolt distribution feeders in the Yakima area was conducted to demonstrate the impact of EV penetration across three circuit profiles: urban, suburban, and rural (Table 18: Summary of Feeder Loading Results). The analysis used the 2021 summer peak demands for all three feeders as a baseline for the study. Historical growth rates were used to forecast the 2027 peak demands for each feeder. Using the 2027 peak demands, the estimated EV demand for each feeder was added to each feeder.

Table 18: Summary of Feeder Loading Results

Location-Substation	Feeder Type	Feeder Name	Annual Growth	2021 Peak Demand		2027 Peak Demand Without EVs		2027 Peak Demand with EVs	
				kW	kVAR	kW	kVAR	kW	kVAR
Yakima-Wiley	Urban	5Y631	0.10%	6,128	1,373	6,165	1,381	6,225	1,381
	Suburban	5Y382	1.00%	7,939	767	8,428	811	8,501	811
	Rural	5Y860	0.50%	7,940	1,550	8,181	1,597	8,383	1,597

The total EV additions were analyzed using two scenarios. The first scenario distributed the total EV load addition from Table 17 across 10 equally spaced locations along the feeder mainlines, from the substation to the end of the furthest three-phase line. The second scenario installed the EV load addition from Table 17 at one location at the end of the furthest three-phase line from the substation. In both cases, due to the amount of EV load added to the feeder, no thermal overload or voltage issues were found and no network improvements were required.

It is expected that if EV load were to increase beyond levels that were forecasted, it would cause isolated system component overloading issues. In most instances, these overload issues can be 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.

Appendix B: Stakeholder Consultations & Local Outreach

Stakeholder Feedback Received on the TE Plan

Organization	Feedback Type
Green Transportation Program	Meeting
Washington State Office of the Attorney General	Written Comment
Tesla	Meeting
The Energy Project	Meeting
FlexCharging	Written Comment
Bidgley	Meeting
People for People	Meeting
WeaveGrid	Written Comment

Local Outreach Conducted to Receive Feedback on the TE Plan

Organization*
Valley Transit
City of Grandview
Blue Mountain Action Council
Blue Zones Walla Walla
Port of Walla Walla
Port of Walla Walla
Walla Walla Community Council
Pomeroy City Council
City of Dayton
City of Dayton
City of Pomeroy
Garfield County ADO, Washington Department of Commerce
City of Waitsburg
City of College Place
Walla Walla County
Walla Walla County Administration
People for People
City of Yakima
Port of Sunnyside
City of Zillah
City of Sunnyside
City of Zillah
Yakima Council of Governments
City of Selah
Yakima County
Yakima County

*Local outreach was conducted to various organizations at various levels; not all provided feedback

Appendix C: Stakeholder Feedback & Comments Received

Comment ID	Comment	Response
1	Clean Fuels Program – I know you said you're monitoring this, but how do you envision you'll fit in? I've got a suggestion below for turning credits into EV purchase rebates below.	PacifiCorp does continue to monitor the Low Carbon Fuels Rulemaking and is considering how this program might become part of the TE portfolio.
2	Are you planning to build DC fast chargers on highways around Yakima? I know you're doing rates to support it, and you might end up providing grants in that area, but have you considered building your own PacifiCorp-owned stations, like Rendall's team? Or are you encouraging private charging networks to fill this role?	Section VII: Programs and Activities (specifically Strategy 3.0) shares more detail regarding planned DCFC in Yakima. This project is 50% funded through the Volkswagen grant program from Washington. Furthermore, PacifiCorp does plan to own stations to be defined during the public infrastructure plan development process, as discussed in Strategy 3.3.
3	Just curious - what proportion of your drivers charge on L2 vs. L1 at home? Are panel upgrades an EV adoption barrier?	According to a 2021 survey of PacifiCorp's Washington residential customers, about 61% of EV owners reported having a Level 2 charger at home; the other 39% said they have a Level 1 (n = 65).
4	Fleets – have you thought about any technical solutions for helping fleets reduce demand charges by spreading out EV loads? The commercial rate schedules with lower demand charges are great, but they don't reduce your system cost. Coupling them with a technical solution could go even further.	PacifiCorp plans to expand the technical assistance services provide to nonresidential customers to include fleet electrification studies. PacifiCorp has added detail in Strategy 1.2 Expand and Strengthen Outreach and Education Programs.

5	EV adoption growth rates I know you have a modest number of EV's now, but the Tesla Model 3 changed the game completely for EV adoption in urban centers. Ford's F-150 Lightning may spur a similar adoption boom in rural areas, starting in the second half of 2022. Also, Washington has an enormous spread between the low cost of electricity and the high price of gasoline per mile driven. You may be surprised at how well this truck will be received. Between the F-150, Rivian's RT1 and Tesla's Cybertruck, 2023 may be a transformational year for rural TE. For PSE's service territory, an average of about 25% growth/year seemed right for a while, but this was slowed down by Nissan bungling the Leaf. Nationally, Bloomberg New Energy Finance is modelling a 30% annual growth rate for EV's, basically from now til 2035 or beyond. I know that's almost certainly the high forecast in Figure 13. It may still take 2 years before electric pickups get rolled out in enough volume for you to see this take off.	Our EV forecasts account for light-duty trucks separately within our territory. As such, we currently extrapolate greater growth rates for light-duty trucks, which captures future expected growth in this market.

6	Table 2 on page 11: Estimated Load Growth on System This is a good estimate. However, I see things a little differently, in two areas: • Vehicle energy efficiency leads to higher total energy needs • Load coincident with peak times. I hope you don't mind some math. Efficiency The energy efficiency of EV's is all over the map, in the same way that fuel economy varies widely between a Toyota Corolla and a Ford Expedition. Your service territory is very likely to adopt more EV pickup trucks when they become available. I see you're using about 3,600 kWh in your calculations – maybe that's great for a Leaf driving around town, but not for a pickup. For comparison: Wh/mile Driving 12,000 miles/yr Driving 15,000 miles/yr Tesla Model 3 250 3,000 kWh 3,750 kWh Ford F-150 Lightning 436 (estimated) 5,232 kWh 6,540 kWh Ford Mustang Mach-E 409 4,908 kWh 6,135 kWh GM Silverado EV 500 (estimated) 6,000 kWh 7,500 kWh These are using the automaker's EPA rates ranges. It may not fully reflect mountains, AC loads, heating loads, etc. We've seen those effects increase EV loads by 30%, at least during some seasons. We also haven't quantified towing nor carrying heavy loads in a pickup. So the numbers above may be conservative.	PacifiCorp agrees that per-vehicle energy needs vary considerably and are evolving with the marketplace. Because of this, PacifiCorp revisits per-vehicle charging assumptions periodically. Our charging average may appear low for an all-electric vehicle, but the average also accounts for PHEVs, which have lower kWh consumption relative to BEVs.

7	Combining Efficiency & peak loads Your service territory really does change many things. Let's assume your service territory have 25% of EV's as efficient as a Model 3, and 75% are pickups like the F-150 Lightning. That gives you an average efficiency of 390 Wh/mile. If vehicles drive 12,000 miles, that's 4,674 kWh/yr. Using your 2022 number of 765 vehicles, load will conservatively be 3,575 MWh. Coincident peak is more likely .78 MW in 2022 (assuming the electric pickups were available). And these numbers may be low by 25% if you assume rural drivers drive more, and an additional ~10% - 30% on some trips due to seasonal effects & geography. An anecdote: A friend of mine ran out of power 7 miles short of a Tesla Supercharger. This was late at night in a bitter-cold snowstorm, driving up Mount Shasta with kids in the car. He left the previous Supercharger with a 50% buffer, beyond the mileage required to make the trip! This is extreme, but the Columbia River Gorge's elevation, the winds on I-90 in Central WA, Mt. Rainier, and speeding have tangible effects that spark a new level of range anxiety. In 2031, this leads to 20,032 MWh, and about 4.39 MW coincident peak (again, potentially on the low side by ~35%). This isn't a huge difference, but if EV adoption is substantially faster starting in 2023, then this could become even more pronounced. We know TOU rates will help somewhat, if they're instituted with a high enough spread for people to care. But even then you might only move 30% of the total load. An automatic system to shift load to the best time of day could help increase compliance, and let EV drivers not waste brainpower on managing TOU rates. As utilities roll out TOU rates, solutions that do the right thing for them automatically will help reduce the pain of introducing a TOU rate in the first place.	Thank you for sharing this insight. PacifiCorp will take this into consideration in future planning.

8	Environmental Health Disparities On page 19 and 20, this is great that you're using the WA Environmental Health Disparities map in Figure 7. We've been very interested in the air pollution impacts as well. One thing we're able to do is look at the avoided tailpipe emissions for EV's driving through regions. This directly relates to human health. So if someone asks "what good are EV incentives doing in my legislative district?", we can quantify this in terms of reduced air pollution, which can then be translated into improved human health (less asthma & premature deaths). We're excited about helping utilities show this impact, to address equity. We just need to collect data on a lot of EV's in your service territory to get there.	Thank you for sharing this insight. PacifiCorp will take this into consideration in future planning.

9	Program Objectives Page 23, in Objective 2. The rewards here are good. For objective 3, have you looked at tax-equity financing, to transfer tax credits? I'm not sure this would be possible for low-income folks, but if you could partner with a bank and pull this off, you would make a big dent in this problem. On either Objective 2 or Objective 3, I suggest you could lower the up-front cost of an EV through some regulatory credit jujitsu. 1) Offer a rebate to people at time of purchase for an EV. 2) Require them to sign away all Clean Fuels Program credits to you. 3) Collect WA Clean Fuels Program credits (perhaps by using telematics to get the data on EV usage, or by regular surveys to the driver) 4) Over time, use the credit revenue to recoup the costs of the rebate. We've put a lot of thought into this, and at least in one version of the bill, the Legislature gave this opportunity solely to utilities. If we can help, let us know. Objective 4 – this is smart. Just for inspiration, let me share what we've built with Watt Time. We're using their marginal CO2 emissions forecast for each Balancing Authority in the US and Australia to optimize charging to reduce emissions. Flex Charging's smart charge app lets drivers specify whether to save money, use local solar, or minimize GHG emissions, in any order they prefer. There's a lot of potential here, and it's great that you've factored managed charging around CO2 reductions into your plans. If your energy dispatch & trading people publish your own authoritative marginal CO2 emissions forecast, we'd love to integrate with you.	PacifiCorp has not investigated tax equity at this time but will take this into consideration. In addition, PacifiCorp appreciates the comments regarding Objectives 2 and 3. We will consider this to reduce up-front costs.

10	Marketplace & Trends I fully agree with your need to keep up with changing market trends. We've quickly changed from short-range EV's like the original Nissan Leaf to long-range EV's like a Tesla Model 3, and the heavy, inefficient pickup trucks will change the EV landscape again. As Matt Stevens, former CEO of Fleet Carma once said, "EV data spoils over time, like milk". It's great to get a good feel on what's coming up. It would be a good time to start measuring or re-measuring what's going on in your service territory. And while Nissans might still lose 30% of their range after one or two hot summers, every other automaker has avoided Nissan's mistakes. I wouldn't be surprised if Tesla gets to $80/kWh for their battery packs with their 4680 cells. They have new a new chemistry for the cathode & anode, changed the form factor to increase energy storage density, designed the pack to put weight directly on the cells to eliminate other structural components, and redesigned the factory to require way less CapEx to build the machines to make the cells. Tesla's Battery Day talk was exciting if you haven't seen it.	Thank you for sharing this insight. PacifiCorp will take this into consideration in future planning.
11	Connector Standards On page 28, this is a hard problem. It's clear that CCS 2 has won and will be the standard for the US. Tesla will keep their walled garden for a while. There is someone selling a CCS – Tesla adapter, but from what I heard, it doesn't work yet. Last week, the Seattle Electric Vehicle Association just approved a resolution calling for Electrify America to dedicate 20% of new ports to CHAdeMO until 2042 or until less than 5% of EV's use CHAdeMO exclusively, because you can buy a Leaf today and you will expect it to be usable for up to 20 years. I'm attaching it if you're curious.	PacifiCorp continues to provide CHAdeMo as a key plug-in type for PacifiCorp-owned stations.
12	Carbon Emissions reductions (page 45) Managed charging could increase the net carbon emission reductions. Specifically, by charging at the best times of day, PacifiCorp could maximize charging on the most abundant renewable resources (hydro, wind, or even solar). This would reduce emissions at a faster rate than simply increasing EV adoption alone. I don't know if you all are a seller or purchaser of REC's for your WA loads. But a managed charging program can help PacifiCorp reduce REC purchases or enhance the market value of existing RECs, as state GHG emissions targets become more stringent. Laura has data on this for a few Washington utilities, and we should be able to demonstrate this as part of WestSmart EV@Scale too. We'd be happy to discuss further.	PacifiCorp generally agrees with this notion. Currently, emissions rates by hour for our system are not available to inform hour-by-hour reductions in emissions. PacifiCorp will take this into consideration in future planning.

13	TCO costs Figure 7 - These are really neat! I suspect we'll see something similar for Class 8 Semis in ~2 years, but of course, it's a little early for them. But you may need to start planning for charging stations of 20-50 MW at warehouses and truck stops. In Texas, Oncor started scouting out where they would need to build new substations around their clusters of warehouses & factories. Maybe one day you'll need a new substation in Yakima along the railroad tracks.	PacifiCorp participates in the West Coast Clean Transit Corridor Initiative that is looking to address the oncoming needs of MHDVs (https://westcoastcleantransit.com/).
14	TE Strategies For 1.3, have you considered starting a pilot for either EV data collection and/or managed charging would be a great idea. I know many EV's can schedule charging built in, but whenever someone tells me that, I ask them if they've done so. No one in Washington State who knew of these features was using them. This is both an incentive problem and an education problem. With AGL in Australia, we've monitored Tesla driver behavior for 8 months and just started doing managed charging for their drivers. This gives some good indications of summer & winter driver behavior, and now they'll be able to see the potential for an automatic managed charging system. I think we will see timer peaks where charging starts at say 10:01 PM. However, timer peaks are not hard to avoid with an automated managed charging system. I built a fix, but like you, AGL may want to see the timer peak start to understand how important it is to fix it. The managed charging program you need for 1.3 could also handle the managed charging program in 2.3, if you find a vendor who can think in terms of both global scheduling as well as working with distribution grid constraints. We were hoping to work with Michael Kintner-Meyer and Sid Sridhar at Pacific Northwest National Lab on incorporating their Gridlab-D software for modelling distribution grid impacts, but some grant funding didn't come through. However, if you're interested in a project in any of PacifiCorp's service territories, we'd be happy to talk about this. Also, if your named communities grant program involves buying vehicles, we could help quantify the avoided tailpipe emissions from those vehicles, so you can help demonstrate the effectiveness of this program on human health. That would really make your program stand out as a provable, beneficial program for environmentally disadvantaged communities.	PacifiCorp is interested in managed charging and does plan to integrate this as a new program type for customers. See Strategy 2.3 Investigate Additional Grid Integration Programs to Manage Growing Load.

	Strategy 1.2 is good. Using the Chargeway Beacons is a really clever idea to help with EV adoption. One thing I didn't see in your strategies was some sort of fleet electrification assistance, beyond creating Schedule 29 to reduce demand charges outright. Maybe there aren't that many fleets in your service territory. But something to help support them with the engineering & procurement work, then manage load to reduce demand charges would be a great idea. This could be as simple as the problems for fleet owners must consider & a list of solution providers. I don't know if there will be a significant number of fleets in your service territory though. School buses and police cars would be great places to start. And for DC fast chargers, thank you for both Schedule 45 and Schedule 29.	
15	Typos: Page 15 – you've got a typo in footnote 18. You've dropped an 'r' from Michael Kintner-Meyer's last name. (We've talked with Michael and Sid Sridhar several times.) Page 18, table 4. DFCF should be DCFC.	PacifiCorp agrees with this comment. It has been addressed.

16	At the top of page 12, the document states that overload conditions can be mitigated "by balancing the feeder load across all three phases." It's not clear to me what this means or what the three phases are. Could you clarify that?	Residential EV chargers are typically connected to the distribution line on a single phase. When too many single-phase chargers are connected to a three-phase distribution line, a single phase can become thermally overloaded. To mitigate the thermal overload of the single phase, the load is transferred to the other two less-loaded phases. This is known as load balancing since it is balancing the single-phase load across all three phases.
17	On page 18, you have a table with the different types of ports, including the CHAdeMO and CCS ports. The document explains these different ports, but not until page 28. It might be helpful for the reader to have a footnote referencing that later explanation/graphic.	PacifiCorp agrees with this comment. It has been addressed.
18	In the table on page 21, Item 19 of Table 5 lists "people living in different land statuses" as a vulnerable population. Could you provide a little more information about what this includes? Is it related to whether a property is tribal land and held in trust or owned by the tribe or others? The table says there is no data, but I'm just curious about what it means.	PacifiCorp's Equity Advisory Group in Washington defined 22 vulnerable populations as part of the 2021 CEIP process. This vulnerable population of "different land status" was defined as households on land trust or fee land, as suggested by this comment. In 2021, PacifiCorp made a Freedom of Information Act request for this data of the Bureau of Indian Affairs (within the Department of Interior) but was unable to obtain the data in time for the filing of the CEIP.
19	How might suggestions such as this one be incorporated to the existing draft plan? Would this type of suggestion be part of a make-ready program? I don't know if I saw a description of a make-ready program in the part of the document where you discuss the programs and activities starting around page 47.	PacifiCorp strengthened the language around make-ready programs in Strategy 2.1. Make-ready is an option to consider for supporting workplace charging, and PacifiCorp agrees that it should be integrated.
20	Also, what is PacifiCorp's timeline for filing the TEP? I know the UTC has 6 months to review after filing but wasn't sure when you all were thinking of submitting it for review.	PacifiCorp plans to file the document by the end of May for UTC review.

21	Adding Fleet Electrification Assessments into Technical Assistance	PacifiCorp plans to expand the technical assistance services provided to nonresidential customers to include fleet electrification studies. PacifiCorp has added detail in Strategy 1.2 Expand and Strengthen Outreach and Education Programs.
22	The EV adoption forecast appears to be very conservative. Would Pacific Power be able to run this again and incorporate Washington's adoption of CA's zero emission vehicle standards and Ecology's plan to adopt Advanced Clean Cars II (ACC II) in 2022? This could be filed as an update or report once you've completed the new forecast.	PacifiCorp has updated its forecast to better align with state policy goals for EV sales.
23	It would be great to see the timeline for programs and activities identified under "2.0 Launch new program types that are relevant to customers" moved up. Preferably with a timeline for starting implementation in 2023. Would this be possible?	PacifiCorp agrees with this comment. It has been addressed and a new schedule has been created and added to Section VII: Programs and Activities.
24	We appreciate that Pacific Power is working with the EAG to develop EV grant program design. Would Pacific Power also be able to work with stakeholders, customers, and the EAG to develop a system for prioritizing workplace and multi-family installation locations with the goal of providing direct and indirect benefits to named communities?	PacifiCorp agrees with this comment and will plan to work closely with stakeholders on identifying and prioritizing locations for workplace and multifamily charging.
25	When PacifiCorp does move forward with a managed charging program offering, we recommend that the managed charging program: • be designed to provide a good experience for drivers, recognizing that customers buy vehicles to meet their transportation needs first and foremost; • utilize a technology-neutral approach, including charging equipment and embedded vehicle telematics; • leverage the flexibility of the EV load: typically, customers charging with Level 2 equipment at home are plugged in for roughly ten hours and conduct charging sessions for approximately two hours, enabling the utility to shift charging to time periods when system costs are lowest; and • optimize for system needs, which vary by utility but can include avoiding generation and transmission capacity upgrades, renewable energy integration, and reducing distribution constraints.	Thank you for this feedback. These considerations will be integrated as we build out the program applications.

26	Finally, as PacifiCorp's TEP acknowledges, EV adoption is uncertain and could be significantly higher than the Company's forecast. We believe that utilities should have the ability to make adjustments to their plans. If adoption increases more quickly than anticipated, PacifiCorp should be able to introduce some of the planned programs earlier.	Comment acknowledged. PacifiCorp updates our EV forecast on an annual basis, bringing in the most recent trend/outlook information available. This forecast informs our TE plan, which can be updated with material changes between formal semiannual filing cycles.
27	Please provide the analysis (study, workpapers, etc.) underlying the EV forecast used to create the TEP.	PacifiCorp will provide its analysis and forecast in confidential workpapers to the UTC.
28	Staff's impression is that a good portion of the plan laid out in the TEP involves extending the PacifiCorp pilot programs (with changes in some places). Please be sure that the TEP justifies why extending the pilots is an appropriate course of action.	PacifiCorp added additional language into Section VII (Past Pilot Findings) to strengthen the narrative.
29	How has equity been considered in the creation of the plan? Please be sure this is outlined in the document.	PacifiCorp added a new section within Section VII. Programs and Activities discussing the integration of equity.
30	Please also explain any connections to the CEIP as necessary.	In Section II: Introduction, PacifiCorp shares language regarding the CEIP and alignment specifically around the usage of the term "named communities." Furthermore, named communities are referenced in development of Strategy 1, which directly links to actions made within the CEIP.
31	The TEP is mostly silent on the topic of medium- and heavy-duty electrification, particularly around transit. Has PacifiCorp conducted outreach to local transit agencies and other MD/HD users to look at whether a MD/HD program is warranted? If not, why not? If so, what have been the results, and why isn't the company proposing any programs/activities around this use case?	As seen in Appendix B: Stakeholder Consultations & Local Outreach, PacifiCorp did reach out to several local transit agencies as well as fleet operators within the PacifiCorp service area. MHDVs are considered in the forecast and, in fact, only amount to about 7% of the future projected load. MHDV programs come at a significant cost to utilities. With only one entity pursuing fleet electrification within our territory and the onset of additional federal funding, PacifiCorp believes a focus on light-duty programming as well as grant programs will further transportation

		electrification in our service area. PacifiCorp's line extension policy in Washington does support EV make-ready costs that could be associated with MHDVs.
32	What metrics does the company intend to track to evaluate program success, and how/when will the company report on those metrics? I don't see any indication of this in the plan. Please see the Avista and PSE plans for examples.	PacifiCorp added Section VIII: Reporting and Analysis, modeling this off the information shared by Avista and PSE. The section shares the performance metrics that PacifiCorp plans to monitor to determine success of the TE portfolio.
33	What are the company's plans to conduct outreach for the programs described in the plan? Please discuss if not outlined in the plan already.	Strategy 1.1 and Strategy 3.1 discuss how PacifiCorp plans to continue to engage with stakeholders including the Equity Advisory Group, local stakeholders, transit agencies, and more. Appendix B: Stakeholder Consultations & Local Outreach shares the local outreach completed, and PacifiCorp plans to continue to engage with those local representatives as development of program applications continue.
34	Several of the activities described involve investigating potential programs. It isn't clear how long those investigations might take, and when the company might expect to begin offering programs resulting from it. Please provide timelines for these activities	PacifiCorp has added Figure 14: Proposed Schedule, which discusses the proposed launch dates of each of the programs.
35	There doesn't appear to be specific budget data in the document. What does the company expect to spend as part of its TEP?	Within Section VII. Programs and Activities, PacifiCorp includes a table regarding anticipated spending, which is approximated to be about $3.5 million over the next five years. Further detail was added to Table 16.
36	Please consider and discuss other ways in which PAC will ensure programs are designed with equitable distribution in mind. There is one other sentence later in this plan that Staff has flagged that also says, "We'll ensure programs are designed well by working with the EAG," but in truth the EAG should be only one of many stops. For example, are there key studies PAC can leverage in understanding barriers to TE (you've referenced some in this plan)? Are there key partners you can collaborate with who have a history of working on equitable TE?	PacifiCorp has added an additional section in Section VII. Programs and Activities titled Integrating Equity. There, PacifiCorp discusses the concept of cocreative program design on how PacifiCorp plans to engage with stakeholders.

37	Can you define coincident peak here? Is it the estimated MW of charging expected to fall within peak hours?	Peak coincident impacts represent the average estimated MW during summer and winter peak hours.
38	Please rephrase; PAC cannot "guarantee" these communities are ready for and can benefit from TE growth, as there are many factors outside PAC's control.	Comment addressed. PacifiCorp removed “guarantee.”
39	It looks like Schedule 45 pilot only had 5 enrolled commercial customers as of October 21; is some caution around prolonging it warranted? Also, perhaps discuss some concerns around equity in TOU rates?	While not many are on Schedule 45, PacifiCorp still thinks it is a vital program for separately metered DCFCs and helps remove barriers. PacifiCorp’s Time of Use Pilot Program was designed to explore the way it may be of benefit to customers who experience lower-than-average income and who are part of vulnerable populations. The plan for the Time of Use Pilot has equity as a key benchmark for its evaluation.
40	Given only one specific action (creation of a grant program) from the CEIP is referenced in this plan and connected to named communities, Staff recommends omitting the named communities description from the previous pages--there is not enough in this plan to tie TE actions to named community location to arrant that. Instead, reference where to find more about named communities in the CEIP.	PacifiCorp agrees with this comment. It has been removed.
41	Is there also evidence suggesting that EV awareness is not sufficient to improve EV uptake and usage, which should be the ultimate goal?	PacifiCorp has not found evidence that supports this claim.
42	Please discuss other focused ways PAC might ensure TE efforts are benefitting named communities, other than working with the EAG. It is noted that Tactic 3.3 is "develop a plan...that will ensure investment in underserved communities," so Staff is assuming such things will be discussed further down the line. However, it's not too early to begin listing potential tactics.	PacifiCorp has added an additional section in Section VII. Programs and Activities titled Integrating Equity. A list of future stakeholders to work with has been included in this section.
43	Define managed charging here?	Addressed. Managed charging programs allow a utility or third party to remotely control vehicle charging by turning it up, down, or even off to correspond with the needs of the grid, much like traditional DR programs.

44	This section shows that PAC is doing good research to inform its objectives. Can you say something about the success of these efforts in CA and WA? Staff suggests looking into findings from regional efforts, for example: https://forthmobility.org/news/makingsmartelectricmobilityworkforunderservedcommunities. One of the findings from the study above is that undocumented customers fear private vehicle usage and by extension EV uptake, and Staff wonders about the population of undocumented customers in PAC's territory.	California's success has been mixed, with utility efforts gaining relatively little traction; nonutility efforts, though, are proceeding well, largely due to the vast number of financial resources being invested in it, as well as increased focus on community-based efforts. Clark Public Utilities' program statistics show significant participation.
45	Is there evidence that public transportation electrification significantly raises costs for riders?	PacifiCorp has not found evidence, to date, on the electrification of public transportation leading to increased costs for riders. Given the large amounts of federal (and in some cases, state) funding for public transport EVs and infrastructure, it is possible that sufficient funding exists for multiple years to cover capital costs, while savings will occur in transit agency operating costs.
46	Can you also draw preliminary conclusions here about the potential GHG emissions impacts of charging, as it is depicted in Figures 14 and 15? For example, can we draw the conclusion that given current residential charging estimates lining up well with residential peak, PAC might be more likely to rely on GHG-intensive "peaker" generation plants during that time? And might that contribute to why PAC is focusing on managed charging and peak-shifting efforts?	Though hourly emissions and peak resources are challenging to predict due to complex market relationships, it's possible that the Company may purchase a "cleaner" resource. However, as a general correlation, it is reasonable to assume higher GHG intensity during peak hours. Our 2021 IRP indicates increasing capacity needs during evening hours associated with solar coming off-line while demand peaks, similar to the duck curve seen in California. PacifiCorp is focused on managed charging and peak-shifting efforts to reduce peak capacity needs during those mostly evening hours.
47	In this row, is gross billing revenue defined as the total amount the utility expects to bill customers for this identified 2,738 MHw of consumption?	Gross billing revenue can be defined as the total incremental energy charge revenues from EV consumption (2,738 MWh for example).

48	Agreed, however, given the UTC is moving toward standardized cost-effectiveness evaluation of all DERs (see docket 210804 and WAC 480-100-620(3)(a)), as connected to the mandate to continuously update CBIs, what plans does PAC have to consider quantifying non-energy impacts of EVs, beyond emissions and monetary savings?	PAC is currently focused on improving O&M and emissions benefits for inclusion in cost-effectiveness analysis.
49	It seems like PacifiCorp is more or less saying that there is nothing to see here. However, I don't see much evidence showing that that's the case. Please provide some data/results that demonstrate whether/where there are places where grid upgrades could be needed due to EV growth, what those might cost, and how PacifiCorp is planning to reduce the impacts of overload. It seems like the table attempts to get at some measure of how much new load is needed, but it is only for one substation (I assume Pac has more than one) and it isn't clear what the read should ultimately take away from the table. In short, this section on distribution grid impacts seems like it should be far more than a single page. (In addition, the paragraph just above the table has some sentences that stop abruptly and generally isn't clear.)	PacifiCorp has created Appendix A: Detailed Distribution Impact Study that shares a detailed grid impact study completed in Washington.
50	From the TE policy statement: "Requests to recover the costs of pilot program investments must be accompanied with sufficient data and analysis to design a separate and specific rate for electric vehicle charging services...The Commission will consider requests to extend current pilot programs for good cause." No suggestions; just including this excerpt for PAC's consideration.	PacifiCorp thanks the commission for sharing this comment.
51	The pilot was limited: only three sites have been enrolled in schedule 45, only 4/19 survey responses were collected, and only 7/19 grant sites had usable data. As such, how will PAC be cautious about building a plan based on the findings of a limited pilot?	COVID significantly delayed the results of the pilot initiated in 2019. Due to this fact, many projects are still ongoing in their implementation. PacifiCorp feels that while pilot results may not be large in responses, the lessons learned are directional. More engagement is required within our territory as well as support for the installation of EVs.
52	What understanding/awareness/adoption metrics will PAC incorporate going forward, to gauge success of outreach and education? I understand that covid has limited outreach, but there's plenty PAC can do to measure results, regardless of whether there's a pandemic (e.g. Guidehouse's selective interviews from grant recipients)	PacifiCorp created Section VIII. Reporting and Analysis, which discusses the metrics that will be monitored for understanding, awareness raising, and adoption of metrics.

53	Perhaps a discussion of TOU impacts to named communities and/or low-income communities could be warranted here, i.e. another bullet for PAC to explore. There are studies showing that low-income and communities of color, who work multiple jobs at irregular hours and who live in multigenerational households, are less responsive to peak pricing, for example.	Optional time-of-use programs limit harm to participants and nonparticipants. PacifiCorp's Time of Use Pilot Program was designed to explore the way it may be of benefit to customers who experience lower-than-average income and who are part of vulnerable populations. The plan for the Time of Use Pilot has equity as a key benchmark for its evaluation.
54	The named community grant and multifamily program are great ideas, but I'm wondering, where did they come from? Why do they take precedent over other options for more equitably distributing TE, such as: undertaking a named-community specific study about EV barriers and opportunities, micro mobility programs, public transit-oriented programs, rideshare programs? Did these ideas come directly from EAG? From PAC staff? From customers?	During development of the CEIP, the Equity Advisory Group specifically directed PacifiCorp to consider the development of a grant program versus an incentive/rebate program for customers, alluding to the fact that grant programs can cover 100% of the costs, reducing barrier to entry. The grant program funds could also be used to support study work. This is ideal because of a grant's ability to support many different types of projects within the TE space.

Appendix D: Washington Equity Advisory Group Working Session Slides and Notes

February 2022 Equity Advisory Group Meeting

- Slides (PDF)
- Meeting Notes (PDF)

March 2022 Equity Advisory Group Meeting

- Slides (PDF)
- Meeting Notes (PDF)

April 2022 Equity Advisory Group Meeting

- Slides (PDF)
- Meeting Notes (PDF)