

# Transportation Electrification Infrastructure Needs Analysis (TEINA)



**Oregon  
Department  
of Transportation**

# Foreword

This report was produced by the Oregon Department of Transportation's Climate Office under the guidance and direction of Mary Brazell (Agency Project Manager), Amanda Pietz (Climate Office Director), and Zechariah Heck. Collaborative support and guidance were also provided by the Oregon Department of Energy through Jessica Reichers and Rebecca Smith.

The consultant project team that assisted the Climate Office in the production of this report included Wayne Kittelson (project manager), Susan Mah, and Christopher Bame, Kittelson & Associates (prime contractor); Chris Nelder, Shenshen Li, Britta Gross and Lynn Daniels, RMI; Stacy Thomas and Alexander Nelson, HDR, Inc.; and Rhett Lawrence, Jeanette Shaw, Jeff Allen, Eric Huang, Whit Jamieson, and Kelly Yearick, Forth.

The project received additional feedback and suggestions from an Advisory Group consisting of Greg Alderson, Portland General Electric; Tom Ashley, Greenlots; Phil Barnhart, Emerald Valley Electric Vehicle Association; Chris Chandler, Central Lincoln Public Utility District; Marie Dodds, AAA Oregon; Judge Liz Farrar, Gilliam County; Ingrid Fish, City of Portland; Stu Green, City of Ashland; Jamie Hall, General Motors; Zach Henkin, Cadeo Group; Joe Hull, Midstate Electric Cooperative; Juan J Serpa Muñoz, Eugene Water and Electric Board; Vee Paykar, Climate Solutions; Cory Scott, Pacific Power; Jairaj Singh, Unite Oregon; Charlie Tracy, Oregon Trail Electric Cooperative; and Dexter Turner, OpConnect. The Oregon Department of Transportation and the consultant project team acknowledge with sincere appreciation the feedback and suggestions provided by the Advisory Group members while also noting that the members were not asked and have not formally endorsed the content of this report either individually or collectively.

## August 2022 Updates

The TEINA report was updated in August 2022 and replaces the original version released in June 2021.

This updated report incorporates the results of a refined methodology used to calculate charging port requirements for light-duty vehicles in 2025, 2030, and 2035 under all analysis scenarios. The major findings of the study are unchanged, illustrating the exponential growth needed for EV charging infrastructure in Oregon. Graphics in the report have been updated where necessary.

The refined methodology used to calculate charging port requirements provides a more accurate distinction between urban and rural areas, and their associated charging port requirements. The methodology also:

- Distributes public Level 2 and DC Fast Charging ports based on the number of currently owned passenger vehicles.
- Distributes workplace Level 2 ports based on the number of jobs.
- Corrects the Corridor Light-Duty Vehicle use case by removing duplicative counting of charging ports needed in each of the milestone years.

Charts, figures, tables, and text have been revised throughout the report and the appendices to reflect the refined methodology, and to present the revised analysis results for these light-duty vehicle use cases: Urban, Rural, Corridor, Disadvantaged Communities, and Transportation Network Companies.

The use cases for Local Commercial and Industrial Vehicles, Transit and School Buses, and Long-Haul Trucking did not require updates and remain consistent with the original report.

## Intended Use of Report

Governor Kate Brown called for a needs analysis on transportation electrification infrastructure in Executive Order 20-04. Transportation electrification goals set forth in Senate Bill 1044 (2019) are specifically referenced as a guide for the analysis. Thus, the modeling assumptions and, subsequently, the results, are based on targets provided in Senate Bill 1044 - not actual real-world data (e.g., electric vehicle registrations or electric vehicle chargers installed today). This report is intended to give policymakers an idea of the needs and potential policies required to achieve Oregon's electrification goals as called for in Senate Bill 1044. While the modeling used to inform the report findings is granular to the census tract or county level (as appropriate for the various use cases modeled), the report is not intended to be used as the implementation plan for the deployment of transportation electrification infrastructure.

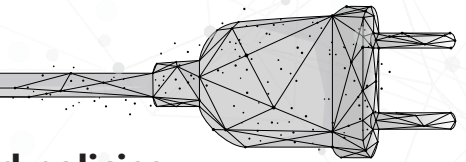
# 1. Executive Summary

The move toward electrically powered vehicles is well underway, and the speed of their adoption is accelerating at a dramatic pace. Oregon is fast approaching an inflection point of zero emission vehicle (ZEV) adoption, driven by market forces, manufacturer commitments, technology improvements, and federal and state climate policies. Public, private, and utility investments in transportation electrification infrastructure are therefore needed to serve Oregonians and businesses using electric vehicles today and in the future.

The goal of Oregon's Transportation Electrification Infrastructure Needs Analysis (TEINA) study is to evaluate the likely future charging infrastructure needs of all modes of electric transportation. As such, it is a needs analysis intended to set the stage for development of a follow-up deployment strategy. TEINA focuses on light-duty vehicle (LDV) charging needs while also including transit, delivery, freight,

and micromobility vehicles during the modeling period of 2020–2035. Directed by Oregon Governor Kate Brown's Executive Order 20-04 on climate action, the TEINA study is designed to evaluate charging infrastructure needs to meet the light-duty zero emission vehicle adoption goals articulated under 2019 Oregon Senate Bill 1044 (Senate Bill 1044) while also examining charging needs for other vehicle types and use cases. Charging needs of rural drivers, and those residing in historically marginalized communities, are of particular note. Additionally, the study recommends policies and implementation priorities required to accelerate infrastructure deployment, with special emphasis on the near-term to ensure Oregon sets an appropriate pace to achieve all of its midterm and longer-term milestones. Both the TEINA goals and Oregon's Senate Bill 1044 light-duty zero emission vehicle (ZEV) goals are reflected in the following graphic.

## Oregon's Transportation Electrification Infrastructure Needs Analysis

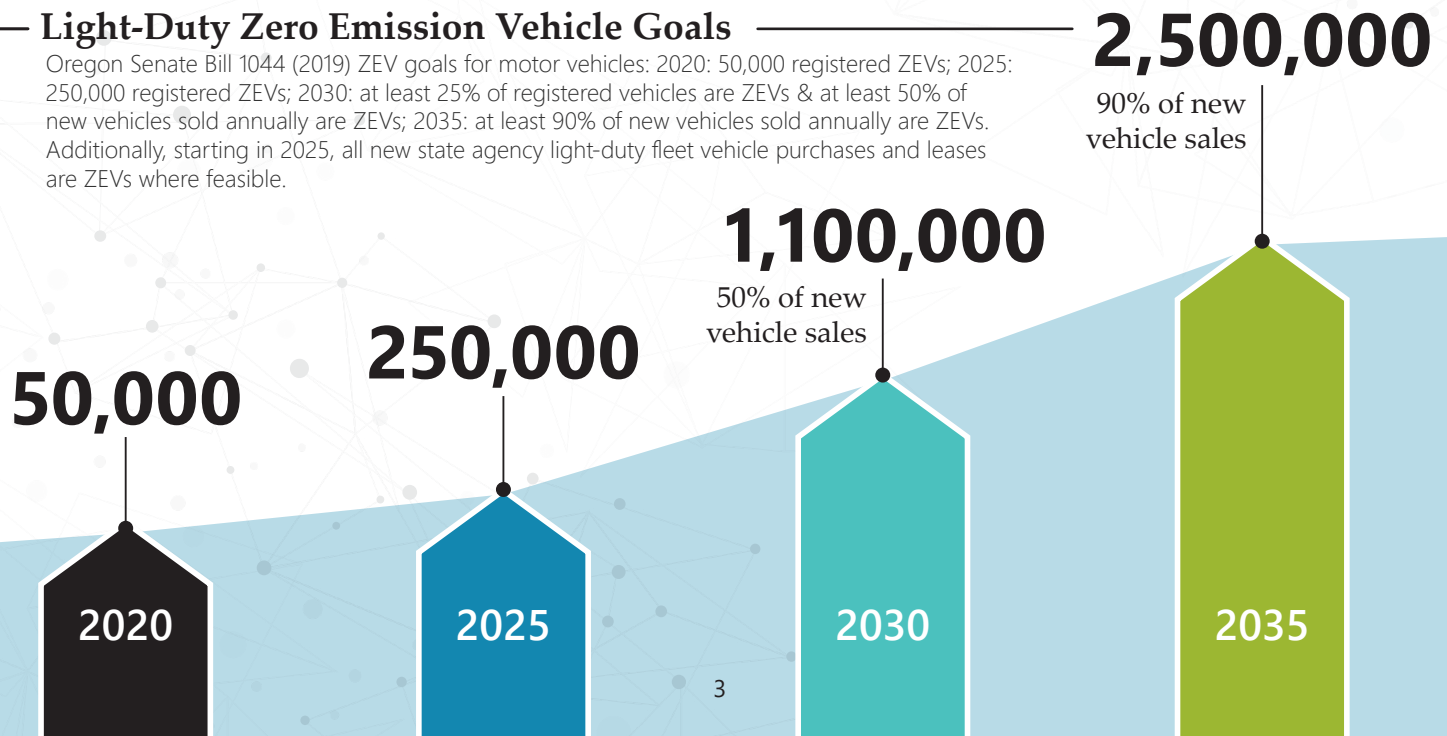


**Evaluate future charging infrastructure needs of light-duty vehicles and other modes of electric transportation.**

**Recommend policies and implementation priorities to accelerate charging infrastructure.**

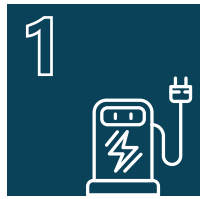
### Light-Duty Zero Emission Vehicle Goals

Oregon Senate Bill 1044 (2019) ZEV goals for motor vehicles: 2020: 50,000 registered ZEVs; 2025: 250,000 registered ZEVs; 2030: at least 25% of registered vehicles are ZEVs & at least 50% of new vehicles sold annually are ZEVs; 2035: at least 90% of new vehicles sold annually are ZEVs. Additionally, starting in 2025, all new state agency light-duty fleet vehicle purchases and leases are ZEVs where feasible.



To achieve the vision of ubiquitous zero emission vehicle (ZEV) charging access, six overarching electric vehicle (EV) infrastructure goals emerged from the Transportation Electrification Infrastructure Needs Analysis (TEINA) study.

## Electric Vehicle Infrastructure Goals



**Support rapid deployment of EV charging infrastructure in homes, along travel corridors, at work and fleet depots, at travel destinations, and in multi-unit dwellings.**



**Ensure EV charging infrastructure is equitable and accessible to all Oregonians (including all communities, income levels, and geographic locations).**



**Ensure the public charging experience is user-friendly, convenient, safe, and consistent.**



**Ensure that EV charging offers all consumers and fleets the benefit of lower electric fueling costs.**



**Ensure utilities are positioned for rapid expansion of EV charging statewide. Utilities must plan for and supply increasing demands for electricity while exploring resiliency in the event of power outages.**



**Develop foundational policies and provide resources to support community members, businesses, local governments, and tribes to build and benefit from a ZEV future, including educational and technical resources, EV-ready residential and commercial buildings, a skilled workforce, and increased support for micromobility solutions.**

The study was primarily focused on the sizeable and thus critically important light-duty vehicle (LDV) sector; however, a total of nine different use cases were modeled: Urban LDVs, Rural LDVs, Corridor LDVs, Local Commercial and Industrial Vehicles (also referred to as medium-duty vehicles), Transit and School Buses, Transportation Network Companies (such as Uber and Lyft), Long-Haul Trucking, Micromobility, and the specific infrastructure needs

of Disadvantaged Communities. Broadly speaking, and as expected, the public charging needs of the Urban and Rural LDV sectors are an order of magnitude greater than for the other transportation sectors (use cases). Across all sectors, there is an extraordinary need for charging infrastructure growth, not only by 2035 and well in advance of the large volume of EVs anticipated, but also a significant near-term need for growth over the next four years.

# Modeling Results

Number of Charging Ports Needed by Use Case (Business as Usual Scenario)

	2020	2025	2030	2035
Urban Light-Duty Vehicles (LDVs)	1,489	7,254	33,062	71,676
Rural LDVs	1,176	6,037	27,988	60,892
Corridor LDVs	406	1,614	2,104	2,713
Local Commercial and Industrial Vehicles	10	371	949	1,836
Transit and School Buses	15	893	3,318	7,407
Transportation Network Companies (TNC)	0	23	183	207
Long-Haul Trucking	0	39	219	690
Disadvantaged Communities	171	852	3,917	8,506
<b>Total Number of Charging Ports</b>	<b>3,267</b>	<b>17,083</b>	<b>71,740</b>	<b>153,927</b>
<b>Increase Over 2020 Level</b>		<b>523%</b>	<b>2,196%</b>	<b>4,712%</b>

Note: Modeling assumes 50,000 electric vehicles in 2020. Projections reflect optimized Business as Usual results.

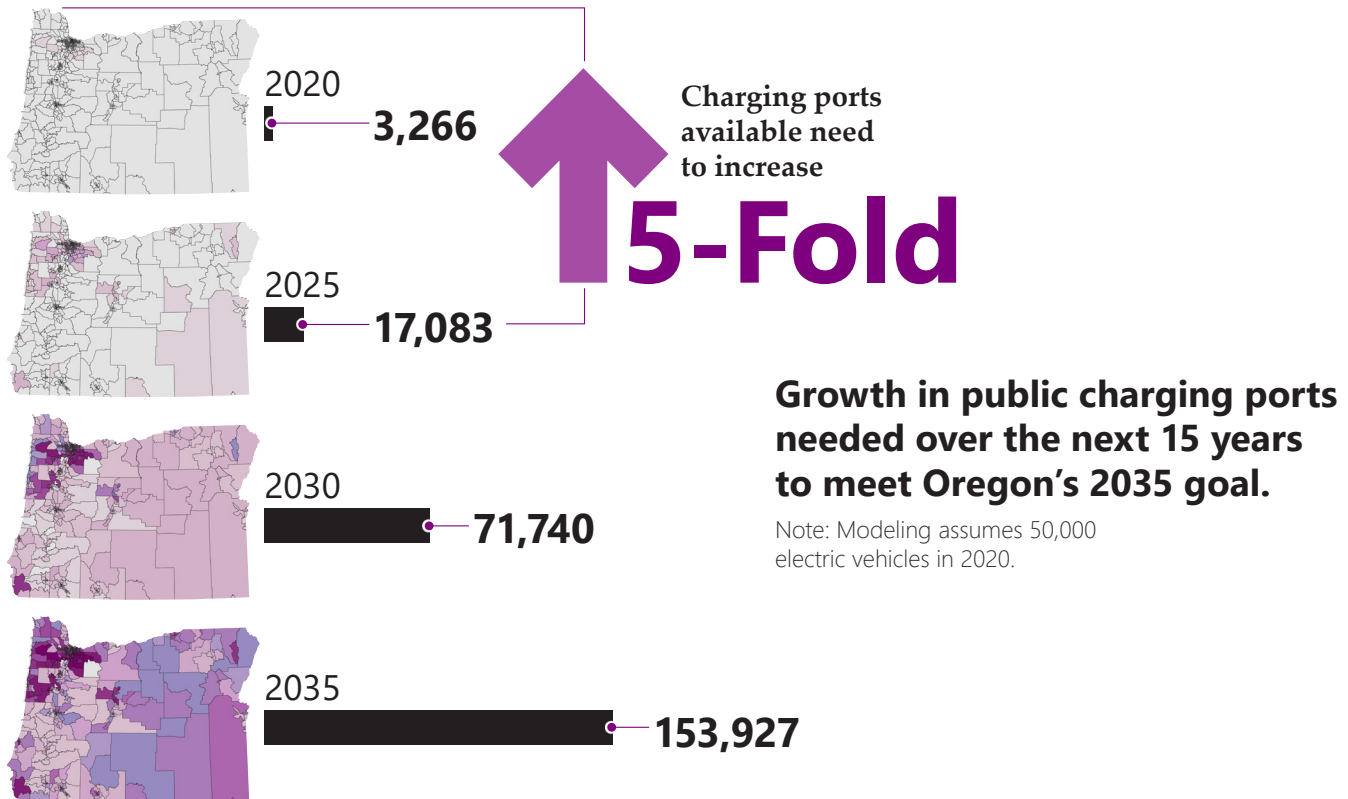
Light-Duty Vehicle Charging Ports Needed by Type of Charging Port (Business as Usual Scenario)

	2025	2030	2035
Workplace Level 2	7,220	33,304	72,379
Public Level 2	4,512	20,784	45,162
Public Direct Current Fast Charge (DCFC)	4,048	13,166	26,453

Note: LDV includes the Urban, Rural, Corridor, TNC, and Disadvantaged Communities Use Cases

As shown in the first graphic above, in the optimized Business as Usual scenario, 153,297 charging ports will be required by 2035—a 47-fold increase from required 2020 levels. In order to meet just the light-duty vehicle charging needs across all use cases, the second table summarizes the need for Level 2 workplace charging, public Level 2, and public DCFC. These figures highlight the rapid growth in EV charging infrastructure required over the next 5, 10, and 15 years.

The analysis assumes that in 2020, 90% of light-duty urban and rural electric vehicle (EV) charging takes place at home, but by 2035, this shifts to 60% of Urban and Rural light-duty vehicle (LDV) charging at home and takes into account that a significant portion of Oregonians live in multi-unit dwellings (MUDs) (e.g., apartments, duplexes, townhomes) where access to convenient overnight on-site charging can be a challenge.\* The need for public charging grows exponentially from 2020 to 2035 and can be seen in the following heatmaps that show available charging ports across all use cases need to increase five-fold just from 2020 to 2025.



Though this study is largely focused on an assessment of the future public charging needs for light-duty EVs, it is worth noting the vast majority of light-duty EV charging today is accomplished by home charging and will remain the case for the foreseeable future. Today, a majority of early EV owners live in single-family homes with easy access to a Level 1 outlet or a Level 2 charging port. However, MUD residents often do not have access to a dedicated parking space, let alone an electrical outlet where they can reliably charge an EV. This study points to several policies to address MUDs charging needs, including public Direct Current Fast Charge (DCFC) community hubs as well as on-site Level 2 and off-site Level 2 public charging.

Home Charging Ports Needed (Business as Usual Scenario)	2020	2025	2030	2035
Note: Each cell identifies the number of home charging ports needed by year and, in parentheses, the percentage of homes assumed to have access to a home charging port.	45,000 (90%)	200,000 (80%)	770,000 (70%)	1,500,000 (60%)

Policy initiatives recommended in the Transportation Electrification Infrastructure Needs Analysis (TEINA) study address the critical need for significant public charging investments to meet demand and develop confidence among the driving public that EV charging will be as easy as refueling a gasoline vehicle. Rapid growth in public charging is essential to achieve mainstream adoption of EVs. However, the TEINA study also describes the need for broadly adopted building codes that will ensure all homes and MUD in the future are built with an EV-ready charging capability, so that owners and renters alike have more equitable access to home charging—and aren't solely reliant on potentially more costly public charging solutions.

\* According to the U.S. Census Bureau's 2014-2018 American Community Survey, about one-quarter of Oregonians live in multi-unit dwellings.

# Policy Recommendations

The near-term policy priorities are described below.

Zero emission vehicle (ZEV) infrastructure deployment strategy—  
2 to 5 year focus, including opportunities for targeted state investment



## Target equity in charging

- Ensure charging access for those eligible for Charge Ahead rebate.
- Incentivize workplace charging at employers, emphasizing women and minority-owned businesses and similar groups.
- Incentivize investment in charging deserts in rural areas.



Update Oregon's building codes and parking ordinances to make them electric vehicle (EV) ready



## Develop and fund a statewide educational and technical assistance program for charging

- Develop fact sheets, technical resource documents, and website content.
- Create proactive outreach program that is comprehensive, is hands-on, and targets high priority markets.
- Serve as an initial point of contact, referring individuals to utilities and other resources.
- Provide guidelines and model processes for streamlining permitting.



Lead by example: install charging at state buildings and offices for employees and visitors



The Transportation Electrification Infrastructure Needs Analysis (TEINA) identifies Oregon's urgent need to increase EV charging infrastructure to meet the state's goals for growth in EVs, which will create an unprecedented shift in the way Oregonians fuel their vehicles. TEINA sets out EV infrastructure goals to provide Oregonians with confidence that EV charging will be as ubiquitous and convenient as fueling with gasoline, and recommends policies to achieve these goals.

Looking forward, TEINA points to priorities for both policies and implementation actions to achieve these goals. Priority EV infrastructure deployment actions in the near term fall into three focus areas: (1) **targeting light-duty EV charging needs**, while (2) **supporting depot charging for fleets of all types**, and (3) **planning for charging needs of local commercial and industrial vehicles and long-haul trucking**. A series of next steps is needed, to turn the recommendations identified by TEINA into realizable results. To implement TEINA's findings, a statewide ZEV charging infrastructure deployment strategy is being developed, with a 2–5 year focus, to fine tune and prioritize specific infrastructure actions needed to accelerate ZEV adoption—incorporating concerns for equity and geographic balance. In addition, three areas of study will be pursued: (1) A supplemental inquiry into the refueling needs of hydrogen fuel cell ZEVs; (2) An assessment of the barriers impeding accelerated adoption of electric micromobility (e.g., eBikes, eScooters, eTrikes), including concerns beyond charging infrastructure; and (3) Addendums to TEINA to facilitate stakeholder planning. These next steps will keep Oregon charging ahead, preparing for an electric future.



*Prepared for:*  
**Oregon Department of Transportation**  
355 Capitol Street NE  
Salem, Oregon 97301-3871

*Prepared by:*  
**Kittelson & Associates, Inc.**  
851 SW 6th Avenue, Suite 600  
Portland, Oregon 97204

*In association with:*  
**RMI**  
**HDR, Inc.**  
**Forth**

**August 2022**

This report is an update  
of the June 2021 report.