TRANSPORTATION ELECTRIFICATION

BACKGROUND BRIEF

LPRO: LEGISLATIVE POLICY AND RESEARCH OFFICE

INTRODUCTION

In Oregon, several pieces of legislation and the Governor's Executive Order 20-04 have set goals for the state to address climate change. The transportation sector accounts for the largest proportion of energy consumption – 30.4 percent in 2019.[1] One of the proposed methods for reducing greenhouse gas (GHG) emissions to mitigate climate change is to support electrification of the transportation sector and development of alternative vehicles and fuels.

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Transportation electrification (TE) is the use of electricity from external sources to provide power to all or part of a vehicle, and includes **programs** and **infrastructure investments** to support using electricity to power vehicles.[2] Transportation electrification is driven in part by adoption of zero-emission vehicles (ZEVs), widely available charging infrastructure, environmental benefits when compared to internal-combustion-engine (ICE) vehicles, and supportive policies. Projections show a potential for transportation to make up almost 25 percent of total electricity use by 2050,[3] compared to less than one percent in 2020.[4]

ELECTRIC AND ALTERNATIVE FUEL VEHICLES

Oregon has between two and four times the national average of electric vehicle (EV) ownership. The total number of EV registrations for publicly and privately owned vehicles in Oregon has steadily increased each year in the past decade and saw a seven-fold increase from April 2014, when there were approximately 5,000 registered

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[1] U.S. Energy Information Administration, *Oregon Energy Consumption by End-Use Sector, 2019*. <https://www.eia.gov/state/?sid=OR#tabs-2> (last visited June 9, 2021).

[2] ORS 757.357.

[3] Muratori, M., & Mai, T, 2020, The shape of electrified transportation. *Environmental Research Letters, 16*(1), 011003.

[4] U.S. Energy Information Administration. *Use of energy explained: Energy use for transportation*. https://www.eia.gov/energyexplained/use-of-energy/transportation.php (last visited June 27, 2021).

EVs, to just over 35,000 in March 2021.[5,6] Senate Bill 1044 (2019) established a biennial reporting requirement by the Oregon Department of Energy (ODOE) to assess the progress of the state's ZEV goals, with targets of 50,000 ZEVs by 2020 (the original goal of Executive Order 17-21) and 250,000 ZEVs by 2025, with an ultimate goal of at least 90 percent of all new motor vehicles sold being ZEVs by 2035. The measure also directed state agencies to make at least 25 percent of new vehicle purchases or leases ZEVs by 2025; beginning in 2029, state agencies will be directed to purchase or lease only new light-duty ZEVs.

There are several types of EVs on the market today, including passenger, medium- and heavy-duty vehicles that are partially or fully powered by electricity or other fuels, as well as other modes of transportation such as scooters, motorcycles, trains, and airplanes. Depending on the model, EVs can be powered exclusively by energy stored in batteries or can have a hybrid system, generating battery power from an on-board internal-combustion engine and regenerative braking. The type of charger that can be used, an EV's range, and its tailpipe emissions are dependent on the EV's make and model (see Table 1).

Table 1. Features of Electric Vehicles

Type of electric vehicle (EV)	Electric motor?	Internal-combustion engine?	Plug-in charging?	Zero emissions?
Hybrid Electric Vehicle (HEV)	✓	✓		
Plug-in Hybrid Electric Vehicle (PHEV)	✓	✓	✓	
Battery Electric Vehicle (BEV)	✓		✓	✓
Fuel Cell Electric Vehicle (FCEV)				✓

Source: Legislative Policy and Research Office

Fuel Cell Electric Vehicles (FCEVs) are powered by hydrogen stored in tanks. While refueling with hydrogen is currently available commercially at only a few stations, Senate Bill 333 (2021) directed ODOE to study the benefits of, and barriers to, renewable hydrogen production and use in Oregon.

Electric and Alternative Fuel Vehicle Incentives

In May of 2016, the Legislative Assembly appointed the **Joint Committee on Transportation Preservation and Modernization** to gather information regarding transportation needs and concerns in communities across Oregon. Formation of the Committee was driven in part by the Governor's **Transportation Vision Panel**. The

[5] Email from Lindsay Baker, Assistant Director of Government and External Relations, Oregon Department of Transportation (June 24, 2021, 8:22am PST) (on file with LPRO analyst Patrick Brennan).
[6] State of Oregon, Go Electric Oregon <https://goelectric.oregon.gov/2020-goal> (last visited June 24, 2021).

Committee developed House Bill 2017 (2017), creating, in part, a new funding track: a motor vehicle privilege tax to provide funding for EV rebates. Under this legislation, the Department of Environmental Quality (DEQ) created the **Oregon Clean Vehicle Rebate Program** to provide a cash rebate for the purchase or lease of Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs) to Oregon drivers. The measure placed a 0.5 percent tax on the privilege of selling new passenger motor vehicles, which was expected to generate $12 million per year to provide rebates for purchase of ZEVs, with excess revenue accruing to the Connect Oregon Fund for grants to nonhighway freight infrastructure projects. The measure created two separate rebate programs: the **Zero-Emission Vehicle rebate** provides up to $2,500 for the purchase or lease of new BEVs, PHEVs, or zero-emission motorcycles; the **Charge Ahead rebate** provides up to $2,500[7] for the purchase or lease of a new or used BEVs and PHEVs for individuals who qualify as low- or moderate-income. Both programs prorate the rebate amount based on the battery capacity of the vehicle, and qualifying applicants may be eligible for both rebates.

As of the first quarter of 2021, DEQ reports that 10,334 rebates have been awarded through the Zero-Emission Vehicle rebate and 1,456 through the Charge Ahead rebate programs, totaling $28.4 million, with more rebates expected in 2021 than in previous years.[8] The Charge Ahead rebate was not launched until nearly a year after the Zero-Emission Vehicle rebate due to the need to secure data collected as part of the application process for the Charge Ahead rebates, which, along with the additional requirements for the Charge Ahead rebate, accounts for the disparity between the two programs. House Bill 2165 (2021) eliminated the sunset on Oregon's two EV rebate programs, which were set to expire on January 1, 2024, and will continue to fund the programs from vehicle privilege tax revenues at the current rate. Federal incentives are also available for the purchase of eligible vehicles and some utility companies offer local financial incentives.

CHARGING INFRASTRUCTURE

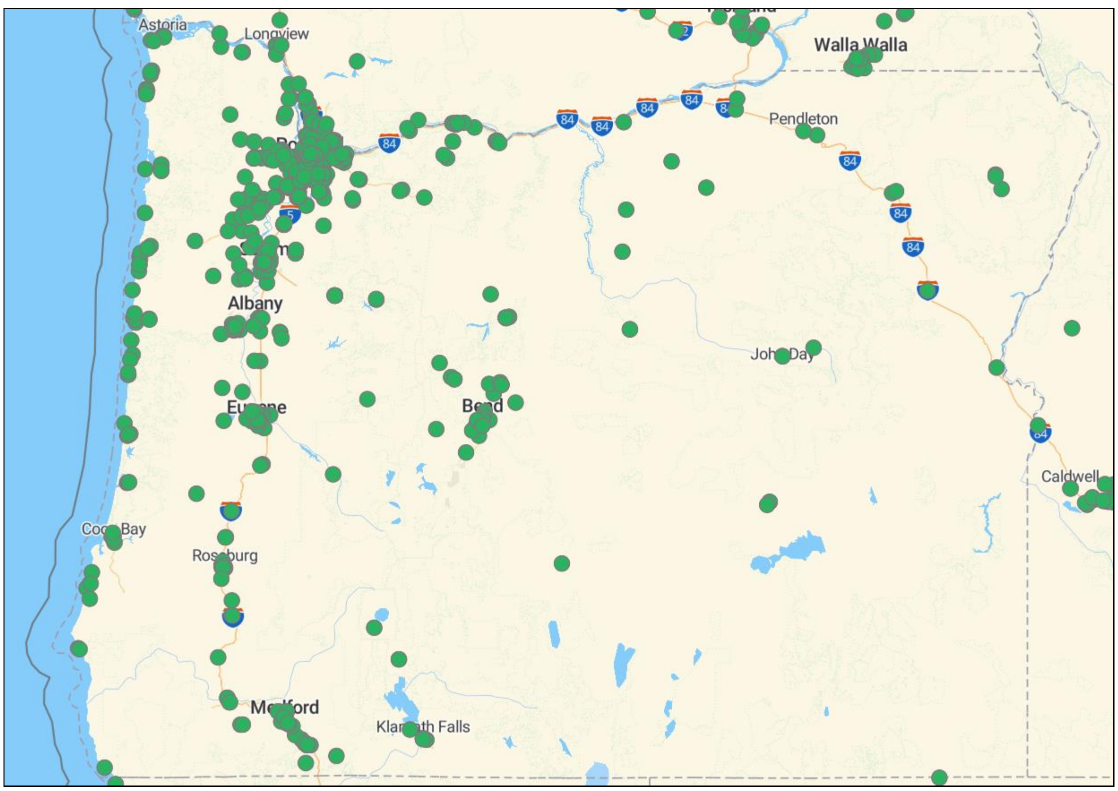
Oregon has encouraged the increased ownership of EVs by partnering with California, Washington, and British Columbia, Canada, to create the **West Coast Electric Highway**, which is a connected network of EV charging stations along Interstate 5. Originating as a multi-state memorandum of understanding signed in September of 2008, charging stations were placed throughout all four states and provinces. As of December 2020, there were over 1,900 public charging units in over 800 locations across Oregon.[9] However, the Transportation Electrification Infrastructure Needs Analysis (TEINA) report estimates that the number of charging ports needed to support the state's ZEV goals would have needed to be 3,525 in 2020 and, in a business-as-usual scenario, will need to be over 150,000 by the year 2035.

[7] House Bill 2165 (2021) doubled the maximum rebate from the Charge Ahead Oregon program from $2,500 to $5,000 and made hydrogen fuel cell vehicles that cost up to $60,000 eligible for rebates.
[8] Email from Matthew Davis, Senior Legislative Analyst, Oregon Department of Environmental Quality (June 29, 2021, 11:39am PST) (on file with LPRO analyst Patrick Brennan).
[9] State of Oregon, Go Electric Oregon <https://goelectric.oregon.gov/2020-goal> (last visited June 24, 2021).

Public charging stations in Oregon are typically located in parking lots, parking garages, or at on-street parking spaces, and generally have pay stations; some include Level 3 fast-charging stations (which can fully charge a vehicle in about 30 minutes). Drivers can use a pay-as-you-go model or, in some cases, can join a charging network that offers a charging plan. Not all charging stations are compatible with every EV, however; each automobile manufacturer uses one of three different, incompatible plugs for charging.

Seven different charging networks allow continuous operation of EVs along the entire Interstate 5 corridor from Washington to California, along Interstate 84 from Portland to The Dalles, and along U.S. 101 from Astoria to Brookings (see Figure 1). In addition, there are connections on five corridors between the Oregon Coast and the I-5 corridor, and along three corridors to Central Oregon. Governor Brown's **Electric Vehicles Roadmap Initiative** outlines expansion of public and private EV charging stations, including more in low-income residential neighborhoods and rural areas that may lack networking capabilities.

Figure 1. Public charging stations in Oregon as of June 2021[10]



Source: United States Department of Energy

The Western Governors' Association (WGA) describes a paradox between needing enough consumers to adopt EVs before charging infrastructure is built and vice

[10] United States Department of Energy, Alternative Fueling Station Locator <https://afdc.energy.gov/stations/#/find/nearest?country=US&fuel=ELEC> (last visited June 24, 2021).

versa. House Bill 2165 (2021) allowed electric companies to recover costs for infrastructure related to TE and required certain large electric companies to increase retail consumer rates by 0.25 percent to fund TE. House Bill 2180 (2021) required the Director of Department of Consumer and Business Services to amend the state building code to require new construction of certain commercial, residential, and mixed-use buildings include provisions for electrical service capacity for at least 20 percent of parking spaces for EVs. It also allowed municipalities to adopt a local percentage of parking space requirements higher than state building code requirements.

STATE AND REGIONAL PLANNING EFFORTS

In 2010, Senate Bill 1059 tasked the Oregon Transportation Commission and other stakeholders with adopting a **statewide transportation strategy** (STS) to reduce GHG emissions 75 percent below 1990's levels by 2050. The STS was updated in 2019 by the Oregon Department of Transportation, Department of Land Conservation and Development, DEQ, and ODOE to adopt ZEV requirements for medium- and heavy-duty trucks and to develop a roadmap for increasing awareness of ZEVs while also increasing access to charging infrastructure and expanding the state's use of ZEVs in its fleet.

Collaborative efforts that cross jurisdictions help make TE accessible and affordable to consumers. In 2013, Oregon was one of eight states that established the **Multi-State ZEV Task Force** to support state ZEV program implementation. The participating states committed to the collective goal of putting at least 3.3 million ZEVs on their roadways by 2025. Oregon is also a founding member of the **International ZEV Alliance**, which has set a goal of making all passenger vehicles sold zero-emission vehicles by 2050. The **Pacific Coast Collaborative**—a partnership of West Coast states, cities, and provinces—set a goal in 2014 to accelerate market adoption of ZEVs and to achieve a goal of 10 percent ZEV fleet procurement.[11] Executive Order 17-21 (2017) established the interagency **Zero-Emission Vehicle Interagency Working Group** composed of the Departments of Administrative Services, Energy, Transportation, Environmental Quality, and the Public Utility Commission.

ENVIRONMENTAL AND ECONOMIC BENEFITS

Transportation electrification produces benefits that extend beyond the transportation sector, including:[12]

- transitioning away from imported fossil fuels to reduce GHG emissions and other pollutants while also increasing community resilience;
- transitioning to ZEVs to benefit drivers through reduced ownership costs; and
- reducing pollution, resulting in cleaner air as well as health and environmental benefits.

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[11] State of Oregon, Go Electric Oregon <https://goelectric.oregon.gov/2020-goal> (last visited June 24, 2021).
[12] Executive Order 20-04 (March 10, 2020).

Environmental benefits

States can use TE as a way to reduce GHG emissions and support climate change mitigation goals, such as those outlined in Executive Order 20-04 (2020). The 2007 Legislative Assembly enacted House Bill 3543, adopting the goal of reducing GHG emissions in Oregon as follows: (a) by 2010, limit the growth of Oregon's GHG emissions and begin to reduce GHG emissions; (b) by 2020, achieve GHG levels that are 10 percent below 1990 levels; and (c) by 2050, achieve GHG levels that are at least 75 percent below 1990 levels. The largest percentage decreases in GHG emissions in the transportation sector could be achieved by decarbonizing electricity through expansion of renewable sources of energy.[13]

The Renewable Portfolio Standard (RPS), which was enacted in Senate Bill 838 (2007), directed Oregon utilities to meet a percentage of their retail electricity needs with qualified renewable resources. Fueling EVs with electricity generated by renewable resources instead of fossil fuels is estimated to have the potential to reduce GHG emissions in the transportation sector up to 80 percent[14] while meeting RPS standards at the same time. Hybrid EVs' regenerative braking and battery storage allow for reduced emissions and improved fuel efficiency by powering vehicles for short distances at low speeds and allowing the motor to shut off when stopped.

Economic benefits

While production costs for ZEVs are higher than ICE vehicles due to the high cost of batteries, ZEV lifetime maintenance costs for the consumer are lower because there are fewer moving parts and the vehicles use fuel more efficiently. The cost comparison between ZEVs and ICE vehicles depends on many factors, including petroleum fuel costs versus electricity costs, how vehicles are operated, and the life expectancy of the vehicles. Future economic recovery may be possible as TE supports clean energy jobs, and, as EV adoption increases, communities may see increased economic activity and tourism. There are also cost savings for electric utilities; as demand for electricity increases, there is a potential for grid flexibility while the overall cost of the service decreases. According to the Western Governors' Association, improved load management and battery technologies, as well as flexible energy pricing structures, can reduce strain on the existing grid and mitigate the need to upgrade hardware, while also defraying demand-charge costs for operators of charging networks.

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[13] Kroposki, B., Johnson, B., Zhang, Y., Gevorgian, V., Denholm, P., Hodge, B.M. and Hannegan, B., 2017, Achieving a 100% renewable grid: Operating electric power systems with extremely high levels of variable renewable energy. *IEEE Power and Energy Magazine*, *15*(2), pp. 61-73.

[14] National Research Council, 2013, *Transitions to alternative vehicles and fuels* (Washington, DC: The National Academies Press) (https:// doi.org/10.17226/18264).

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