



THE FUTURE OF  
transportation  
is electric





There is no greater imperative right now than to rapidly reduce greenhouse gas emissions to fight climate change.



Portland General Electric is helping drive Oregon's transformation into a clean energy economy by decarbonizing our own electricity supply. This transformation is especially critical in the transportation sector, where GHG emissions are growing every year. Using clean energy to power electric cars, buses, trucks, and maritime transportation can reverse this trend. It's a revolution that can't come soon enough.

Whether it's taking the bus to school or the grocery store, taking transit or driving to work or shipping products to stores and homes, transportation is a critical part of our economy and everyday lives. It's also a fundamental part of addressing climate change. At Portland General Electric, we want affordable, clean electricity to become the fuel of choice for transportation needs — something that is absolutely critical to meeting Oregon's clean energy goals.

To do this rapidly, and at scale, we and other state-regulated electric utilities must have the tools and partnerships to make it happen. Working alongside policymakers, business leaders, environmental groups, social justice advocates and our customers, we can create an ecosystem of carefully crafted policy, programs, pricing and infrastructure to make this vision a reality.

### A time of transition

We're at a pivotal point in one of the most transformative periods in transportation. Consider these trends:

- In 2018, the millionth electric vehicle in the United States hit the road<sup>1</sup> and global automakers announced they would invest \$90 billion in EVs and batteries.<sup>2</sup>
- Car ownership may have already hit its peak,<sup>3</sup> and driver's licenses are declining among younger generations.<sup>4</sup>
- There's a growing adoption in car-sharing, like ReachNow and car2go,<sup>4</sup> and ride-sharing, such as Uber and Lyft.<sup>5</sup>
- A recent pilot for electric scooters in Portland resulted in fewer car trips.<sup>6</sup>
- As autonomous vehicles are introduced, many people may opt to take driverless cars instead of driving themselves.<sup>4</sup>

As trends and technologies continue to change the way we move, we're preparing for a dramatic evolution over the next few decades.

### EVS AND CLEAN ENERGY: A POWERFUL PAIR

The transportation sector is the largest and fastest-growing contributor of Oregon GHG emissions. Electricity is the cleanest and most cost-effective source of fuel available. Transitioning to electric transportation is the best way to reduce air pollution caused by vehicles, reduce our GHG, and ensure the sustainable movement of goods and people.





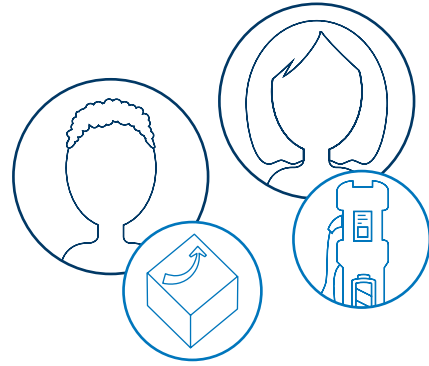
## Environmental benefits

GHG emissions from the utility sector are declining, and in PGE's case, are ahead of our proportional share of Oregon's GHG reduction goals. The same can't be said of the transportation sector. It is the largest and fastest-growing contributor to GHG emissions in Oregon at nearly 40 percent.<sup>7</sup> PGE can help power a transformation in transportation so that this sector can meet or beat its GHG reduction goals.

The burning of fossil fuels also has significant impacts on our air quality, including the generation of regional haze, lung-affecting particulate matter and cancer-causing substances. Electrified transportation significantly reduces local air pollution caused by vehicles. It also helps the power grid, aiding with the integration of more renewable energy sources.

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Whatever the path to transportation electrification, we must ensure the clean air, climate and mobility benefits are experienced by all customers, whether they live in urban, suburban or rural communities. As we create this new path, we must also ensure that the needs of traditionally underserved populations, including people with disabilities, communities of color and low-income families, are met.



## MEETING NEEDS TODAY AND TOMORROW

People are changing the way they commute, run errands and buy goods. Electric transportation can address all of these needs while reducing carbon emissions. Let's look at how this works with two examples.

Alex does not own a car and gets to work by taking public transportation, using a ride-sharing service or riding an e-bike — all powered by electricity. Most of Alex's purchases are online, which means packages are delivered several times a week by an electric truck.

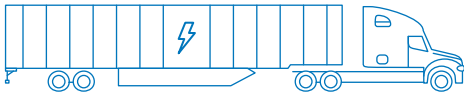
Morgan purchased an electric vehicle to save money and go green. Without a dedicated parking space at home, Morgan charges at work and looks for quick public charging while running errands or having a meal at a restaurant.

## EQUITABLE PEOPLE MOVEMENT

The transportation needs of our customers are evolving quickly. We want to be partners in supporting them and transportation providers in accelerating the transition to clean, electric mobility.

## Options for everyone

To meet our region's goals for decarbonization, all new bus sales in Oregon should be zero emissions and powered by renewables.<sup>8</sup>



We envision that by 2030, 10,000 medium- and heavy-duty trucks in our service area will be electric and powered by renewables.

### Options for everyone

People should be able to seamlessly move around Oregon however they choose, powered by clean, renewable electricity. This means going beyond just personal vehicles, which may be either inaccessible or unfeasible for many people. School and transit districts move many people, and the vehicles currently in use, primarily powered by diesel engines, impact air quality across the state. In many cases, electrified buses can serve as the backbone of a system in which commuters can take electric public transit, an electric car share (or, eventually, an autonomous vehicle), a shared electric scooter or an e-bike.

To meet our region's goals for decarbonization, all new bus sales in Oregon should be zero emissions and powered by renewables.<sup>8</sup> PGE is ready to support this transition. Currently, PGE is installing and maintaining bus chargers to support the first all-electric bus line from TriMet, the mass transit operator for the Portland metro area. The line features a 450 kW on-route charger and two 100 kW depot chargers. The project is TriMet's first step in removing diesel from its fleet. TriMet plans to purchase 80 battery electric busses in the next few years. Our involvement gives us a better understanding of the grid impacts of heavy-duty charging, helping us build a foundation that will support truck fleets and other medium- and heavy-duty vehicles in the future. Outside the urban core, our partners like Wilsonville's SMART Transit, which is deploying several electric buses in its fleet, are leading the way to a decarbonized future.

Those who drive should have confidence in a robust and healthy network of EV charging that's as available and reliable as gas stations are today. To help achieve this, PGE will support programs that empower drivers to easily and affordably charge at home, in public or at work. This is especially important for people living in multifamily housing units, where drivers may not have access to individual vehicle charging.

Since PGE installed our Electric Avenue charging stations at the World Trade Center in 2015, we've powered about 1.7 million miles of EV driving — all with 100 percent renewable energy. We're taking the next step by building six new community charging sites by 2020. Our stations will accommodate all vehicle types and offer a 30- to 45-minute fast-charge with 50 kW DC quick chargers (DCQC). With five chargers at each site, drivers will be able to get a charge when they need it. Our stations will also be upgradeable to 300+ kW so that the community charging sites can adapt to changes in standards over time.

However, much more charging infrastructure is needed as the number of EVs surges over the next five years. It is critical for us to work with city planners, communities, transportation partners, workplaces and other partners to build the infrastructure need to meet upcoming demand.

#### A SMOOTHER CHARGING EXPERIENCE

PGE is working with companies like Chargeway, a software and mobile platform that supports EVs, to make it easier for drivers to understand how and where to charge. We've implemented Chargeway's simple-to-understand system at our Electric Avenue stations, helping drivers choose the right type and speed of charging. In addition, we've helped place Chargeway kiosks in local car dealerships, offering a valuable tool to show EV buyers where they can find a station.

#### Affordable choices

Accessible transportation is a critical facet of enabling all Oregonians to live healthy and productive lives. Equitable access to clean, safe, affordable and reliable electric transportation fueling infrastructure is at the core of our values around equity and inclusion. Our transportation system must work for everyone, with fair solutions that empower communities to realize the benefits of electric transportation. With the average Oregon family spending \$640 on transportation each month,<sup>9</sup> electrified options empower consumers to save money while making the right environmental choice.

Low-cost, multi-modal transportation options let customers move fast, affordably and reliably. When families do not have to sacrifice to make electric their first choice for transportation, choosing electric will be an easy decision.

#### RESIDENTIAL EV CHARGING PILOT

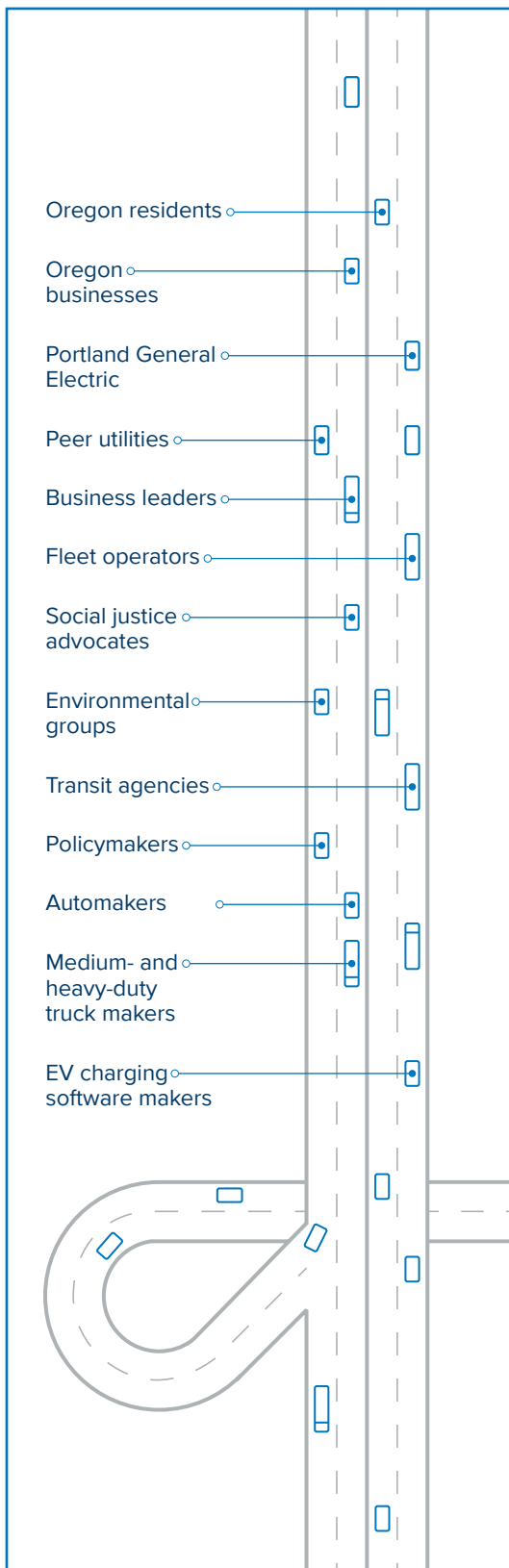
As part of our three-year residential EV charging pilot program, PGE will provide rebates to 3,600 customers who have EV chargers in their homes. In exchange, we'll lower costs by charging EVs at optimal times, such as when electricity demand is low.

Today, EV costs are coming down and battery technology is becoming more efficient. Automakers, including medium- and heavy-duty truck makers, are committing to electrify their vehicles. There are several new passenger EV models that can be purchased for less than \$30,000, and tax credits and rebates lower the total cost even further. There are also recent model years of used EVs on the market for well under \$10,000. After purchase, drivers will realize significant savings. The cost to charge an EV is less than half as much as fueling a gasoline-powered car.<sup>10</sup> Because there are fewer components, maintenance costs are also lower.

#### FREIGHT TRANSPORTATION

In freight transportation, each journey makes an impact. With the proliferation of home-delivered goods through companies like Amazon, we must address the growing impact of goods movement on our climate: the average carbon footprint of a typical good delivered to a customer's home is 3.3 lbs. of GHG emissions.<sup>11</sup> Each freight trip has a significant ability to impact the fight against climate change and the reduction of GHGs in the transportation sector.

We envision that by 2030, 10,000 medium- and heavy-duty trucks in our service area will be electric and powered by renewables. Working with fleet operators, peer utilities and other partners, we can ensure that local Oregon businesses have the tools they need to benefit from low-cost, clean and reliable electricity to power their fleets.



### Making electric competitive

Before fleet operators will transition to electric medium- and heavy-duty trucks, they'll need to see compelling benefits. First, there must be a variety of vehicle models to meet their needs. Second, these vehicles must be more affordable to purchase and operate than diesel alternatives.

Finally, EV charging rates must be easy to understand, stable and suitable for fleet operators' needs. PGE sees fleet operators as our energy partners. Working together, we can ensure they are charging at the best times for the grid so they realize meaningful cost savings while helping us maximize grid efficiency.

### Reliable, fast-charging infrastructure

Charging infrastructure will play a critical role in electrifying freight transportation. Operators will need help planning how to deploy charging infrastructure smoothly. High-powered charging equipment will require innovative solutions like battery buffering to reduce costs and ensure grid reliability. They'll also need to ensure that vehicles can charge fast, so they can spend more time in service of their primary function — delivering goods.

PGE can contribute what we've learned by electrifying our own fleet and sharing our planning as a road map for others to follow. With one of the largest fleets in the state, PGE is developing an electrification plan for vehicles, charging infrastructure, facilities and distribution. In addition, we're continuing to learn from the charging infrastructure we've already deployed for light-duty vehicles. This will help us align on a common charging standard and ensure interoperability.

### Start with the backbone

Interstate 5 is a lifeline for goods transportation from Mexico to Canada, creating a large opportunity for the heavy-duty EV market.





## WHILE EACH INDIVIDUAL EV MAY BE A SMALL RESOURCE, WHEN AGGREGATED THEY CAN HAVE A BIG IMPACT

PGE is partnering with peer utilities up and down the I-5 corridor to ensure an adequate network of high-powered charging stations needed for medium- and heavy-duty trucks that is beneficial to both the grid and transportation systems. This joint utility planning effort will help us understand fleet electrification schedules, vehicle manufacturers' technology road maps and road infrastructure development timelines.

### EFFICIENT GRID INTEGRATION

As PGE continues to modernize and integrate our grid, we're preparing to unlock the full value of new transportation technologies. EVs offer unique benefits to the grid since their charging can be managed as a large flexible load.

#### Smart charging

PGE envisions that by 2030, EVs in our service area will host 10,000 MWh of flexible energy storage resources that we can use to better manage the overall system and the variability of renewable energy sources. If these EVs are networked together, they would account for hundreds of MW of capacity, equal to or larger than a power plant. So, while each individual EV may be a small resource, when aggregated they can have a big impact. We'll adopt new technologies that support seamless interconnectivity between EVs and new charging infrastructure, as well as two-way communication between the grid and vehicles.

Flexible loads help us balance power supply with power use by shifting loads to non-peak time. This is a critical component of our

clean energy future. By communicating with our customers about the best time of the day to charge EVs — when energy costs are lower due to low demand or high renewable output — we can integrate more renewables onto the grid at a lower cost. In this way, our customers can help us integrate renewables and manage prices, keeping energy affordable for everyone.

#### Vehicle-to-grid systems

In the future, we can also use EVs to improve the reliability and resiliency of our grid. Electric buses and cars can be used as large-scale storage in the event of an outage or emergency, much like a battery. On an individual basis, customers can use a two-way charger in their homes to use EVs as backup if they lose power.

For more information about how PGE plans to use flexible loads to manage costs and enhance reliability, see our strategy paper on our modernized grid.

#### TESTING VEHICLE-TO-GRID TECHNOLOGY

PGE is testing a two-way, vehicle-to-grid charging station. This lets us explore how we might best discharge power from a vehicle battery to the grid. Although this technology is not yet commercially available, we envision integrating with thousands of EVs in the near future to increase flexibility and integrate renewables.

#### Integrated planning

As we plan for widescale transportation electrification, PGE will work closely with partners to ensure the right infrastructure and systems are in place to maximize value to both the grid and transportation systems. For example, by analyzing data about congestion and traffic patterns, we can optimize our distribution system to deliver greater benefits to our grid and drivers.

## SUMMARY

The bottom line for decarbonizing the transportation sector requires that customers have affordable and accessible charging solutions, however they choose to travel. Oregon is making progress in adopting electric transportation for personal, public and commercial use, and it is urgent that our region continues to electrify our transportation sector moving forward. This is a vital step in decarbonizing our energy economy and enhancing the quality of life in Oregon. And it can only happen through a robust, safe and accessible electric mobility network that is fully integrated into the operations of the electric grid.

PGE embraces our role as the convener of all things clean energy. By connecting and integrating charging infrastructure with our grid, we can help maximize the benefits of electric transportation for all customers. As the EV market evolves, it is imperative that PGE and other utilities work to build infrastructure, rates and programs to accelerate a smooth transition to electrified transportation. At the same time, collaboration is key to our shared success. A vibrant and healthy ecosystem requires stakeholders to raise awareness, enable EV adoption, create charging networks and establish meaningful rates, policies and customer solutions.

Finally, the customer experience is a critical element in this transition. To that end, PGE is working with local communities, businesses, regulators and lawmakers to make electricity the easy, equitable and affordable transportation fuel of choice for all customers. Through these efforts, we can lead the way and make an enormous impact on Oregon's clean energy future.



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  7. Oregon Greenhouse Gas Sector-Based Inventory Data, <https://www.oregon.gov/deq/aq/programs/Pages/GHG-Inventory.aspx>.
  8. PGE Decarbonization Study Report, [portlandgeneral.com/deepdecarbstudy](http://portlandgeneral.com/deepdecarbstudy).
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## ADDITIONAL RESOURCES

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### **PGE Clean Energy Vision**

[portlandgeneral.com/energyvisionpdf](http://portlandgeneral.com/energyvisionpdf)

### **PGE energy strategy**

[portlandgeneral.com/energystrategy](http://portlandgeneral.com/energystrategy)

### **PGE Integrated Resource Plan**

[portlandgeneral.com/resourceplanning](http://portlandgeneral.com/resourceplanning)

### **PGE strategy papers**

The path to a decarbonized energy economy,  
[portlandgeneral.com/decarbonizationpdf](http://portlandgeneral.com/decarbonizationpdf)

A modernized grid platform for a clean energy future,  
[portlandgeneral.com/modernizedgridpdf](http://portlandgeneral.com/modernizedgridpdf)





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