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What Factors Drive Commuters' Demand for Electric Vehicle Charging Infrastructure?

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Issue

Government agencies, utilities, automakers, and charging network companies are increasingly investing in charging infrastructure to encourage the adoption of plug-in electric vehicles (PEVs), which include both battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs). Public infrastructure is particularly important for those without access to home charging and for vehicles with driving range limitations. However, it is difficult to quantify the optimal number and location of public chargers needed for a growing number of PEVs. Finding the answer will depend on a mix of behavioral and economic factors that drive charging demand. Much is at stake. Too little infrastructure could cause congestion at the chargers and inhibit the adoption and use of PEVs, while developing more infrastructure than is needed would create unnecessary costs. For example, Level 2 public chargers can cost up to 15 times more than Level 2 at-home chargers.

Researchers at UC Davis analyzed the choice of charging infrastructure of more than 3,000 PEV commuters who had access to home, work, and public locations to understand the importance of various factors driving demand for charging infrastructure at the three locations. Key factors include the cost of charging, driver characteristics, accessibility of charging infrastructure, and vehicle characteristics.

Key Research Findings

Most day-to-day charging events occur at home. Workplace or other commute location charging is the next-

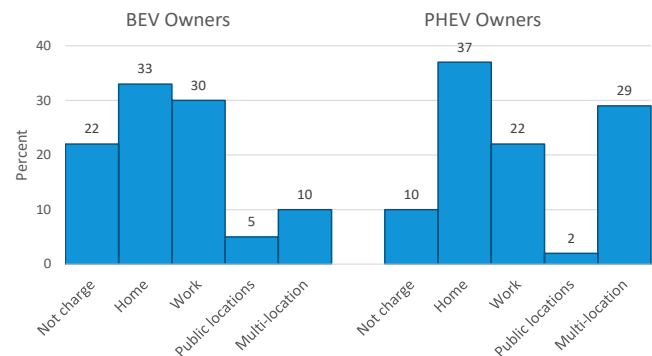


Figure 1: Percentage of BEV and PHEV commuters' weekday charging events that occurred at a home, workplace, or public charger, or some combination of the three

most-used option, with 30% of charging events occurring at the workplace for BEV owners. For both BEV and PHEV commuters, public charging locations are used the least (Figure 1).

Residential electricity rates play a role in the decision of whether to charge at home. Cheaper nighttime electricity rates encourage consumers to charge their vehicles at home overnight.¹ On the other hand, high residential electricity prices disincentivize charging at home and increase the probability of not charging at all or charging at work (especially if workplace charging is free). A 10% increase in the cost of home charging decreases the probability of home charging by 3.6 percentage points for BEV commuters and 2.2 percentage points for PHEV commuters. It increases the probability of workplace charging by about one percentage point for both types of commuters.

Availability of a home Level 2 charger can encourage home charging. All else constant, the availability of faster Level 2 charging at home increases the probability of home charging by 14.7 percentage points for BEV commuters and 1.6 percentage points for PHEV commuters. Incentives for Level 2 charger installation in detached homes and initiatives to install Level 2 chargers near multi-unit dwellings can help reduce the need for more expensive public charging infrastructure and reduce congestion at charge points in the future.²

While free workplace charging can encourage PEV adoption, it may ultimately discourage some commuters from using these vehicles. Free workplace charging increases the probability of charging at work by 9.9 percentage points for BEV drivers and 5.7 percentage points for PHEV drivers, while reducing the probability of home charging and public charging. Free workplace charging can encourage PEV drivers to plug in even if they can complete their daily drive without recharging, creating congestion at chargers. Charger congestion could discourage BEV drivers from commuting with their BEV if they need to charge at work to complete their daily trip.³ It may also prevent PHEV drivers from maximizing their electric miles. Moreover, free charging is not financially sustainable and may discourage future charging investments by employers.

The demand for charging infrastructure will adjust as PEV range improves. Higher electric range reduces by approximately 25 percentage points the probability that PHEV drivers will use multi-location charging. For BEV drivers, higher electric range incentivizes regular charging at home or work. Future infrastructure investment plans need to account for changes in charging needs of long-range PEV drivers. While the importance of public charger availability may increase with market penetration, the number of public and workplace Level 2 and direct current fast chargers needed may ultimately be lower than is currently anticipated.

More Information

This policy brief is drawn from the report “Factors Affecting Demand for Plug-in Charging Infrastructure: An Analysis of Plug-in Electric Vehicle Commuters” prepared by Debapriya Chakraborty, David S. Bunch, Jae Hyun Lee, and Gil Tal with the University of California, Davis. The report can be found here: www.ucits.org/research-project/2019-42.

For more information about findings presented in this brief, please contact Debapriya Chakraborty at dchakraborty@ucdavis.edu.

¹ Dunckley, J. and Tal, G., 2016. Plug-In Electric Vehicle Multi-State Market and Charging Survey. EVS29, pp.1-12.

² Hardman, S., Jenn, A., Tal, G., Axsen, J., Beard, G., Daina, N., Figenbaum, E., Jakobsson, N., Jochem, P., Kinnear, N. and Plötz, P., 2018. A review of consumer preferences of and interactions with electric vehicle charging infrastructure. Transportation Research Part D: Transport and Environment, 62, pp.508-523.

³ Nicholas, M. and Tal, G., 2015. Charging for charging at work: increasing the availability of charging through pricing. Transportation Research Board 94th Annual Meeting (No. 15-6025).

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