



Is awareness of public charging associated with consumer interest in plug-in electric vehicles?



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ABSTRACT

Policymakers often seek to increase the visibility of plug-in electric vehicle (PEV) chargers in public locations in effort to build familiarity and interest in PEVs. However, it is not clear if the visibility of public charging stations actually has an impact on PEV demand. The purposes of the present study are to (1) assess the current levels of visibility for public PEV charging infrastructure within Canada and (2) identify whether or not a statistically significant relationship exists between consumer awareness of public charging infrastructure and interest in purchasing a PEV. We use data collected from a sample of 1739 Canadian new-vehicle buyers in 2013. About 18% of Canadian respondents have seen at least one public charger, while the proportion is highest in British Columbia (31%). We find a significant bivariate relationship between public charger awareness and PEV interest. However, when controlling for multiple explanatory variables in regression analyses, the relationship is weak or non-existent. While perceived existence of at least one charger exhibits no significant relationship with PEV interest, perceived existence of multiple chargers can have a weak but significant relationship. Thus, public charger awareness is not a strong predictor of PEV interest; other variables are more important, such as the availability of level 1 (110/120-volt) charging at home.

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Introduction

Policymakers are increasingly promoting the adoption of plug-in electric vehicles (PEVs) to help combat the global rise in CO₂ emissions. Despite the potential environmental benefits of PEVs, several structural, social, and cultural challenges may need to be overcome before PEVs can be widely adopted (Egbue and Long, 2012). One of these challenges is thought to be the limited availability of non-home PEV charging infrastructure, i.e. chargers at work, public and commercial locations. In reality, however, the relationship between the availability of non-home charging infrastructure and the uptake of PEVs is not currently well understood.

Using consumer data from a survey of Canadian new vehicle buyers (the Canadian Plug-in Electric Vehicle Survey, CPEVS 2013) we assess consumer awareness of non-home vehicle charging locations and seek to identify if this awareness is associated with interest in purchasing PEVs. Specifically, our main objectives are to (1) assess the current levels of visibility for public PEV charging infrastructure within Canada and (2) identify if there is a statistically significant relationship between

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awareness of public charging infrastructure and consumer interest in purchasing a PEV. We introduce and explore the importance of two unique concepts of charger awareness: perceived charger existence as having seen a public charger in at least one location type, and perceived charger abundance as having seen PEV chargers in at least two location types, e.g. at a workplace and in a mall. For convenience, we refer to “public charging” as PEV chargers at any location other than the consumer’s home, including workplace and commercial charging locations. Our definition of PEVs includes pure electric vehicles (EVs), and plug-in hybrid electric vehicles (PHEVs) that can be powered by grid electricity and/or gasoline.

Background

Increasing the availability of PEV charging (home and public) is associated with two main social benefits. The first is to support the use of PEVs among current owners, allowing them to use their PEVs more extensively and ideally offsetting more gasoline-powered kilometers with electric-powered kilometers. The second benefit is to help promote PEV ownership in the first place. The idea is that widespread availability of PEV chargers will increase general awareness of PEV technology, increase perceptions of PEV functionality, and potentially allow for the development of green, innovative, and progressive “cultural branding” (Community Energy Association, 2013). It is this second benefit that we focus on here—the potential of public chargers to increase the uptake of PEVs by stimulating demand.

There is some evidence that the uptake of PEVs may depend on the availability of home charging infrastructure. Amongst PEV owners in the US in 2012, more than 80% of vehicle charging occurred at home (Smart, 2013). Home recharging can also be an important factor for those considering potential PEV ownership. A survey of 508 new vehicle buying households in San Diego, California in 2011 found that interest in PHEV and EV designs was much higher among respondents whom had identified recharge potential at their home (Axsen and Kurani, 2013). Further, home charging availability is already fairly widespread. One US survey found that over 50% of new-vehicle buying households are likely to already have Level 1 (110/120-volt) PEV charging access within 25 feet of where they park their vehicle at home, while just under one-third of households in one U.S. city (San Diego) have access to Level 2 charging (Axsen and Kurani, 2012). Although Level 1 charging may not be optimal for the operation of larger battery PEVs, it is likely to be functional for many PHEV designs.

Evidence supporting the necessity of public charging access in stimulating consumer uptake is less common and results are generally inconsistent. One well-known study was conducted by the Tokyo Electric Power Company (TEPCO), which studied the driving and charging habits of PEV users in Japan both before and after the addition of a public charger. TEPCO found that, although PEV drivers made very little use of the new public charging facility following its implementation, the cumulative distance travelled by PEV users increased more than sevenfold (Bakker, 2011). TEPCO also found that drivers returned from their trips with significantly less stored battery power than they had previously (Anegawa, 2010; Bakker, 2011). Both results suggest that the awareness of public charging infrastructure could give PEV drivers confidence to travel further on electric power, thus positively impacting those who feel limited by the range of their PEVs. This study is very limited, however, in that it only involved a small sample of PEV owners and operators. The study did not investigate changes in consumer interest, perception, or acceptance of the technology among non-PEV users.

Over the past decade, a variety of surveys have attempted to measure consumer valuation of recharge infrastructure as one of several PEV-related attributes. In particular, research with stated preference choice models suggests that consumers are willing to pay more for PEVs if public charging is widely available (Batley et al., 2004; Hackbarth and Madlener, 2013). Amongst a nationwide panel of 711 German new car buyers, willingness to pay values for a one percent expansion of refueling infrastructure have been estimated to range from \$65–\$134 CAD (Hackbarth and Madlener, 2013). In contrast, UK households have been estimated to value a 10% increase in fuel availability at \$1960 CAD – slightly higher than the estimates in Germany (Batley et al., 2004). Other stated preference studies simulate the impacts of public charging availability on interest in PEVs. Using a panel of 598 German potential car buyers, Achtnicht et al. (2012) estimate that increasing charger availability from 10% to 33% could increase demand for EV’s by up to 50%. Further, when the authors used respondent data to simulate a tenfold increase in charger availability, demand for EV’s increased roughly four times with estimated market share increasing from 2.2% to 8.9%. In another European study of 1903 car owners, Hoehn and Koetse (2014) demonstrate that increasing recharge availability increases willingness to pay for a new vehicle by ~\$165 CAD for each minute of avoided detour time—in other words, reducing time in search of charging infrastructure increases individual utility and the likelihood that someone may purchase a PEV. One drawback of the stated preference studies cited here is that they rely on hypothetical scenarios of charger availability, such as asking the respondent to imagine a world where 33% of gasoline stations also had PEV chargers (Achtnicht et al., 2012).

More closely aligned with our present research are two studies that used a large sample size of vehicle buyers, and also included a measure of survey respondents’ awareness of actual public PEV chargers to look for a statistical association with PEV interest. Both studies use data drawn from the same 2011 nationwide survey implemented with a sample of 2030 US drivers. One study found that 12% of respondents recall seeing public charging infrastructure in their community and that these respondents with charger awareness were 9% more likely to be interested in PEVs when controlling for a variety of factors (Carley et al., 2013). However, the second study used the same survey dataset and found that the awareness of public chargers was not a significant predictor of interest when considering interest in PHEVs and EVs separately (2013). Clearly, this association is still not well understood.

To further explore the relationship between awareness of public chargers and interest in PEVs, we presently use data from a large sample survey in Canada (CPEVS, 2013). Our study is unique in that we explore the role of two different types of

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