



How might potential future plug-in electric vehicle buyers differ from current “Pioneer” owners?



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ABSTRACT

The entry of various plug-in electric vehicles (PEVs) into the passenger vehicle sector provides novel opportunities to learn about the potential for future PEV markets. However, early PEV buyers (or “Pioneers”) can substantially differ from present conventional vehicle owners that have interest in purchasing PEVs in the future (or the “Potential Early Mainstream buyers”). To compare the characteristics, preferences, and motivations of Pioneers and Potential Early Mainstream buyers, we draw data from the Canadian Plug-in Electric Vehicle Study, a three-part mixed-mode survey with samples of PEV owners ($n = 94$) and conventional new vehicle buyers ($n = 1754$). We identify several significant differences in household characteristics, including income, education, and recharge access. In terms of preferences, Pioneers express extremely high valuation of PEVs and prefer pure battery electric vehicle (BEV) designs over plug-in hybrid electric (PHEV) designs. In contrast, Potential Early Mainstream respondents prefer PHEVs. Both Pioneer and Potential Early Mainstream respondents are similarly cautious about controlled charging programs, but Pioneers place five times as much value on using electricity generated from renewable sources than the Potential Early Mainstream. Pioneers also tend to have different motivations, including significantly higher levels of environmental concern, and higher engagement in environment- and technology-oriented lifestyles. Policymakers, automakers, and electric utilities that anticipate a transition to electric mobility ought to consider how potential future PEV buyers may differ in their vehicle preferences, usage and motivations relative to current PEV owners.

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1. Introduction

Despite much effort and policy support, alternative fueled vehicles have repeatedly failed to displace gasoline and diesel powered passenger vehicles in the vast majority of countries (Melton et al., 2016). In recent years, plug-in electric vehicles (PEVs) have shown promise in several markets, including “pure” battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs) that can be powered by gasoline and plugged into recharge. In 2015, PEV sales comprised less than one percent of new light-duty vehicle sales in the U.S. (Pontes, 2015) and Canada (Klippenstein, 2015), although a few regions have achieved much greater sales rates; in Norway, for example, market share was close to 25 percent in 2015, in the Netherlands it was close to 10 percent in 2015 (EAF0, 2016), and in California it was just over three percent in 2015 (Cobb, 2016).

Because increased PEV uptake may be signaling the beginning of a transition to widespread electric mobility, many stakeholders want to better understand PEV buyers, including their preferences, motivations and potential PEV usage patterns.

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Specifically, national and sub-national policymakers have sought to understand how best to incentivize and support further PEV market growth; automakers have sought to understand what PEV designs and attributes will be valued by consumers; and electric utilities have sought to understand how widespread PEV adoption might impact electrical load and how PEV charging might be integrated with intermittent, renewable sources of electricity.

This study explores several aspects of the potential PEV market, focusing on a comparison between current PEV owners (who we refer to as “Pioneers”) and “Mainstream” conventional new vehicle buyers. While there may be lessons to learn from current Pioneers, Mainstream buyers, especially those most likely to purchase PEVs in the future (who we refer to as the “Potential Early Mainstream”), are a particularly important target for analysis. Following modeling studies which suggest that plug-in electric or other alternative fuel vehicles must make up a majority of market share by 2040 to meet 2050 greenhouse gas reduction targets (IEA, 2015; Williams et al., 2012), PEV acceptance among Potential Early Mainstream Buyers may be necessary to displace fossil fuels and decarbonize the passenger vehicle sector. While there is little research that directly compares Pioneers and Potential Early Mainstream buyers, initial insights suggest that important demographic and contextual differences exist (Axsen and Kurani, 2013a; Tal and Nicholas, 2013), as well as differences in preferences for both PEVs and renewable electricity programs (Axsen and Kurani, 2013a).

This study uses samples of new vehicle buying households in Canada, with a focus on the Canadian province of British Columbia—a region with some PEV-supportive policy (subsidies and deployment of recharge infrastructure) but low PEV market share (one percent of new vehicle sales in 2014). Through in-depth data collected as part of the Canadian Plug-in Electric Vehicle Study, or CPEVS (Axsen et al., 2015), we compare Pioneers and Potential Early Mainstream respondents according to household demographics and context, PEV awareness and preferences, purchase and use motivations, as well as interest in controlled charging programs that could manage how and when electricity flows from the grid to a PEV (which could, in turn, support the use of intermittent, renewable sources of electricity). We next summarize previous literature on these topics, explain our methods and results, and conclude with implications for policy.

2. Background

2.1. Distinguishing consumers by PEV purchase and intention

Consumers can vary widely in their perceptions, tastes, preferences and motivations. It is therefore useful to identify different groups (or segments) of PEV buyers. Conventional approaches to PEV market segmentation tend to focus on “innovativeness” as the key segmentation parameter (Peters and Düttschke, 2014). One particularly popular framework for segmentation is Rogers' (2003) “diffusion of innovations” model, which separates potential buyers into innovators, early adopters, early majority, late majority, and laggards. Despite its popularity, researchers have criticized Rogers' model for being too limited in its representation of human motives (Axsen and Kurani, 2012a). Others have shown that PEV buyers can be driven by many motives other than technological innovativeness, such as symbolic meanings relating to environment and energy security (Heffner et al., 2007).

In this study we find it useful to segment the current and potential future passenger PEV market according to both actual behavior and stated behavioral intention, specifically the act or likelihood of purchasing a PEV, in contrast to segmenting the market based on a single motivation (e.g., innovativeness) that has not been shown empirically to be a central driver of purchase behavior. We consider three discrete segments of passenger vehicle buyers in this paper. We first divide the total population of new vehicle buyers into those that currently own a PEV (“Pioneers”), and those that do not (“Mainstream”). We then divide the Mainstream into those that state an interest or intention to purchase a PEV in the future (“Potential Early Mainstream”) and those that do not (“Potential Late Mainstream”), leading to the following three segments:

1. **“Pioneers”** consumers who own a PEV as of the study date (2015). Here we only consider PEVs commercially available in Canada in the 2000s.
2. **“Potential Early Mainstream”** consumers who currently own conventional gasoline-powered vehicles and have stated an interest in purchasing a PEV (as measured in our survey), and are thus the most likely to buy a PEV in the next 10–15 years.
3. **“Late Mainstream”** (or non-buyers) consumers who currently own conventional vehicles and have not stated an interest in PEVs (as measured in our survey), and are therefore not likely to buy one in the next 10–15 years; substantial changes in policy, costs, technology, and/or cultural norms would be required for these buyers to become interested (if at all) in PEVs.

We expected to observe the greatest differences in preferences and characteristics between the Pioneer segment and the two Mainstream segments, whereas the two Mainstream segments are anticipated to have relatively more similarities.

2.2. Previous literature on Pioneers versus the Mainstream

To the best of our knowledge, only three previous studies have directly compared Pioneers and Mainstream buyers. While these studies do not necessarily use the same terminology as that presented in our three-segment framework, they do

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