

# Battery Electric Vehicles: Travel Characteristics of Early Adopters

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## Introduction

Do U.S. households with battery electric vehicles (BEVs) drive less or more than U.S. households with internal combustion engine vehicles (ICEVs)? Answering this question is important to policymakers and transportation planners concerned with reducing vehicle miles traveled (VMT) and the emissions of greenhouse gases from transportation. So far, this question has not been answered satisfactorily, possibly because of the relatively low number of EVs in the U.S. until recently, but also because of methodological issues. This project fills this gap by analyzing data from the 2017 National Household Travel Survey (NHTS) to examine the differences in self-reported annual mileage and calculated daily mileage for various trip purposes among households with only BEVs, households with both BEVs and ICEVs, and households without BEVs.

## Study Methods

This project included a literature review and analysis of a 2017 National Household Travel Survey (NHTS) dataset. The NHTS data provides a comprehensive picture of travel by U.S. residents in all 50 states and the District of Columbia and includes data on trips made by all modes and for all purposes. The

2017 NHTS public dataset is organized in four files (households, persons, trips, and vehicles), which contain data from 129,696 households corresponding to 264,234 individuals who undertook 923,572 trips in 256,115 vehicles on their assigned survey day. We extracted and combined data from each of those files and added variables about the availability of public EV charging infrastructure after requesting location data for the states with the most BEVs.

In our analysis, we considered three groups of households: BEV-only (households that only own BEVs), BEV+ (households with multiple vehicles of which at least one is a BEV, and at least one is a non-BEV), and non-BEV (households that do not own a BEV but own at least one vehicle).

To control for self-selection bias in analyzing the impact of BEVs on household travel, we used a method called propensity score matching (PSM). With PSM, a group of observations with a treatment (here, the ownership of a BEV) from an observational (nonrandomized) dataset is matched with a group of observations without the treatment based on their probability of being in the treatment group on the

condition of observed treatment variables. Put simply, the technique mimics the conditions of a randomized control study to more accurately show the real impact of owning a BEV without bias.

### Findings

Results include increased understanding of variables related to the different household categories (e.g., whether a household owns a BEV). For example, results show that BEV-only households were less likely to have members of older generations, and more likely to be non-White with a higher annual income, and to own their home. BEV+ households were less likely to have only one adult or to include children. Compared to non-BEV households, we found no statistically significant differences in their annual VMT. On average, they took slightly more daily trips, although their daily VMT was lower by 9.1 miles in our multi-state sample. We found, however, very few differences in their weekday or weekend travel compared to non-BEV households.

Overall, BEV-only households did not drive significantly less than non-BEV households, except in California. We also found no statistical differences in the number of daily trips, travel time, or travel duration, except for California BEV-only households who took almost 1.5 fewer daily trips (this difference is not significant) and spent on average almost 27 fewer minutes driving. Differences in daily travel include taking a few more trips to work on weekdays, resulting in 7.2 extra daily miles, but fewer trips for shopping. The small number of BEV-only households in our sample did not allow us to assess differences in weekend travel. Ultimately, results align with microeconomic theory: since EVs have a lower marginal cost of driving compared to ICEVs, BEV owners drive at least as much as ICEV owners unless they have concerns about their ability to conveniently recharge their BEVs.

### Policy/Practice Recommendations

Understanding BEV household travel behavior, including for specific purposes, is important to transportation planners and policymakers so they can better plan the transition to EVs and proactively address unintended effects, such as the risk of a sharp increase in VMT. Stakeholders need to understand 1) the potential impact of VMT on transportation infrastructure and energy systems and 2) the impact

of BEV VMT on the electricity grid and emissions of greenhouse gases.

The project's findings indicate that households with BEVs drive fewer annual miles than non-BEV households, but typically travel no less than they do for daily activities. This apparent discrepancy is likely due to taking fewer longer trips because the public charging infrastructure was still in its infancy in 2017, and its reliability was questionable. As technological progress is helping to overcome current battery limitations, policymakers may consider measures for fostering fast charging technologies while pondering new measures to fund both the charging infrastructure and the road network.

### About the Authors

Dr. Yunwen Feng received her PhD from the University of California at Irvine in 2021. Dr. Jean-Daniel Saphores is an MTI Research Associate and Professor of Civil and Environmental Engineering at the University of California at Irvine, where he also serves as Chair of the Department of Civil and Environmental Engineering. Dr. Hilary Nixon is Deputy Executive Director of the Mineta Transportation Institute and a faculty member in the MS Transportation Management program at San José State University. Dr. Monica Ramirez Ibarra is an Assistant Project Scientist with the Institute of Transportation Studies at the University of California at Irvine.

### To Learn More

For more details about the study, download the full report at [transweb.sjsu.edu/research/1905](https://transweb.sjsu.edu/research/1905)



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