



مركز الملك عبدالله للدراسات والبحوث البترولية
King Abdullah Petroleum Studies and Research Center

Commentary

Understanding Latent Consumer Demand For Fuel-Efficient Vehicles

January 2021

Rubal Dua



This commentary highlights the findings from a recent KAPSARC paper published in the *Energy Efficiency* journal that explored whether and by how much consumers' purchasing motivations and their potential demand for fuel-efficient vehicles changed in the wake of such policies

Consumer adoption of electric vehicles (EVs) – including hybrids, plug-in hybrids and pure battery electric – is a crucial step in improving energy use and reducing emissions in the transportation sector. To promote adoption, policymakers have employed various demand- and supply-side policies, including incentives, corporate average fuel economy (CAFE¹) standards, zero-emission vehicle mandates,² among others. This commentary highlights the findings from a recent KAPSARC paper published in the *Energy Efficiency* journal that explored whether and by how much consumers' purchasing motivations and their potential demand for fuel-efficient vehicles changed in the wake of such policies. The findings were obtained by analyzing 11 years (2005-2015) of new vehicle buyer survey data in the United States (U.S.) as a case study (Dua and White 2020). The analysis revealed that the *valuation gap*³ between buyers of non-EVs and EVs for various purchase motivations – including fuel economy, environmental friendliness, technical innovation and price – narrowed over time. The narrowing of this valuation gap was found to indicate a higher potential demand for EVs. The analysis suggested that EVs had the potential to secure as much as ~11% of the U.S. market in 2015, but their actual market share was only one-third of this. This highlights the gap between apparent and actual consumer willingness to purchase high fuel-economy vehicles. The narrowing of the consumer valuation gap was also strongly correlated with policy instruments such as CAFE. These findings indicate that supply-side policies could be considered as viable tools, in combination with demand-side policies, if policymakers wish to nudge consumers toward purchasing fuel-efficient vehicles.

To understand consumers' demand for these fuel-efficient and zero-emission vehicles, the paper used a data mining approach, *ex-post counterfactual inference*, previously developed to examine the survey data of new vehicle buyers (Dua, White, and Lindland 2019). This approach aims to identify current adopter types, their reasons for adoption, potential adopters, the size of the potential market and factors that could induce potential buyers to adopt more fuel-efficient vehicles.

The new vehicle buyer survey data analyzed was from over 1 million respondents. It was used to estimate the potential market size and understand the relationship between observable macro factors and consumer motivation for adopting fuel-efficient vehicles. In terms of vehicle technologies, the paper primarily focused on hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs), collectively termed EVs.

¹ The federal CAFE program in the U.S., similar to the CAFE program in the Kingdom of Saudi Arabia, sets specific sales-weighted fuel economy targets for automakers with the goal of improving fleet fuel economy and reducing greenhouse gas emissions.

² A zero emission vehicle (ZEV) mandate, similar to the ZEV mandate in some U.S. states and the New Energy Vehicle (NEV) policy in China, requires automakers to sell a minimum share of ZEVs each year.

³ The term 'valuation gap' refers to the difference between the average rating given by non-EV and EV buyers for a particular purchase motivation question in the survey. The closer the ratings, the smaller will be the valuation gap.

In a counterfactual scenario, assuming optimistic growth, the paper found that the EV fuel types had the potential to secure about 11% of the U.S. new vehicle sales in model year 2015. In reality, the EVs achieved only one-third of this. The paper argues that the realization of the full potential would have depended on the public and private sector's ability to encourage fuel economy-conscious conventional gasoline vehicle buyers to adopt even more fuel-efficient EVs.

The paper further highlights that, in addition to fuel economy, environmental friendliness and technical innovation, potential EV consumers also desired other features and factors. These include exterior styling, safety, warranty coverage and better resale value, which are more common to conventional vehicles. The paper reasons that achieving a market share for EVs beyond the estimated potential share of 11% would have required features to be offered that mainstream gasoline vehicle buyers value, such as reliability, handling and value for money. Currently, both actual and potential EV buyers are willing to trade these features for fuel economy, environmental friendliness and technical innovation. Future mainstream EV buyers, however, may not be willing to make that trade-off. The addition of desirable features may increase the up-front cost of EVs, which could negatively impact their adoption as these potential buyers tend to have lower incomes.

The paper further reports that the estimated potential market share for EVs increased with the narrowing of the valuation gap for purchases motivated by fuel economy, technical innovation, environmental friendliness and price. It is worth noting that the potential market share was estimated by identifying non-EV buyers whose purchase motivations and demographics were very similar to those of EV buyers. Thus, as the gap in the valuation of these purchase motivations for non-EV and EV consumers narrowed, a higher potential market share for EVs was estimated.

The narrowing of the valuation gap was found to be strongly correlated with the CAFE target and moderately correlated with the gasoline price, two important macro factors exogenous to the model. The paper reported that the valuation gap for these purchase motivations reduced over time because the non-EV consumers' valuation increased, while that of EV buyers decreased. The paper contends that non-EV consumers may derive higher utility from the innovative fuel-efficient technologies added to non-EVs to meet the CAFE target, leading to their rising valuations. On the other hand, demand-side policies have made EVs more affordable and accessible for a larger proportion of mainstream consumers, leading to their devaluation. Accordingly, the paper summarizes that a combination of these supply-side and demand-side policies represent a viable tool if policymakers wish to nudge non-EV buyers' purchase motivations closer to those of EV buyers. The moderate effect of the gasoline price on the valuation gap for purchase motivations may be due to mandated targets for automakers to produce and sell increasingly fuel-efficient vehicles, irrespective of the gasoline price.

In a counterfactual scenario, assuming optimistic growth, the paper found that the EV fuel types had the potential to secure about 11% of the U.S. new vehicle sales in model year 2015. In reality, the EVs achieved only one-third of this

The paper further reports that the estimated potential market share for EVs increased with the narrowing of the valuation gap for purchases motivated by fuel economy, technical innovation, environmental friendliness and price

The narrowing of the valuation gap was found to be strongly correlated with the CAFE target and moderately correlated with the gasoline price



References

Dua, Rubal, and Kenneth White. 2020. "Understanding latent demand for hybrid and plug-in electric vehicles using large-scale longitudinal survey data of US new vehicle buyers." *Energy Efficiency*. doi: <https://doi.org/10.1007/s12053-020-09865-5>

Dua, Rubal, Kenneth White, and Rebecca Lindland. 2019. "Understanding potential for battery electric vehicle adoption using large-scale consumer profile data." *Energy Reports* no. 5:515-524. doi: <https://doi.org/10.1016/j.egy.2019.04.013>.

About the Project

Promoting the adoption of energy-efficient vehicles has become a key policy imperative in both developed and developing countries. Understanding the impacts of various factors on adoption rates forms the backbone of KAPSARC's efforts in the light-duty vehicle demand field. These factors include (i) consumer-related factors – demographics, behavioral, and psychographics; (ii) regulatory factors – policies, incentives, rebates, and perks; and (iii) geo-temporal factors – weather, infrastructure, and network effects. Our team is currently developing models at different levels: micro-level models using large-scale data comprising new car buyers' profiles, and macro-level models using aggregated adoption data to understand and project the effects of various factors that affect the adoption rate of energy-efficient vehicles.

About KAPSARC

The King Abdullah Petroleum Studies and Research Center (KAPSARC) is a non-profit global institution dedicated to independent research into energy economics, policy, technology and the environment across all types of energy. KAPSARC's mandate is to advance the understanding of energy challenges and opportunities facing the world today and tomorrow, through unbiased, independent, and high-caliber research for the benefit of society. KAPSARC is located in Riyadh, Saudi Arabia.

Legal Notice

© Copyright 2021 King Abdullah Petroleum Studies and Research Center ("KAPSARC"). This Document (and any information, data or materials contained therein) (the "Document") shall not be used without the proper attribution to KAPSARC. The Document shall not be reproduced, in whole or in part, without the written permission of KAPSARC. KAPSARC makes no warranty, representation or undertaking whether expressed or implied, nor does it assume any legal liability, whether direct or indirect, or responsibility for the accuracy, completeness, or usefulness of any information that is contained in the Document. Nothing in the Document constitutes or shall be implied to constitute advice, recommendation or opinion. The views and opinions expressed in this publication are those of the authors and do not necessarily reflect the official views or position of KAPSARC.



مركز الملك عبدالله للدراسات والبحوث البترولية
King Abdullah Petroleum Studies and Research Center

www.kapsarc.org