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## Effects of providing total cost of ownership information on consumers' intent to purchase a hybrid or plug-in electric vehicle



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### ABSTRACT

Energy-saving technologies have a difficult time being widely accepted in the marketplace when they have a high initial purchase price and deferred financial benefits. Consumers might not realize that, in the long-run, the financial benefits from reduced energy consumption offset much or all of the initial price premium. One strategy to address consumer misconception of this advantage is to supply information on the “total cost of ownership”, a metric which accounts for the purchase price, the cost of the fuel, and other costs over the ownership period. In this article, we investigate how providing information on five-year fuel cost savings and total cost of ownership affects the stated preferences of consumers to purchase a gasoline, conventional hybrid, plug-in hybrid, or battery electric vehicle. Through an online survey with an embedded experimental design using distinct labels, we find that respondent rankings of vehicles are unaffected by information on five-year fuel cost savings. However, adding information about total cost of ownership increases the probability that small/mid-sized car consumers express a preference to acquire a conventional hybrid, plug-in hybrid, or a battery-electric vehicle. No such effect is found for consumers of small sport utility vehicles. Our results are consistent with other findings in the behavioral economics literature and suggest that further evaluation of the effects of providing consumers with information on the total cost of vehicle ownership is warranted.

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## 1. Introduction

Conventional hybrid and plug-in vehicles are usually more expensive to purchase because of higher production cost associated with the battery pack and the powertrain. Although energy-saving technologies have lower operating cost and have the potential to be net-cost savers in the long-run, consumers may decline to purchase such technologies, a phenomenon which is referred to as the “energy-efficiency paradox” or the “energy-efficiency gap” (Gillingham et al., 2009; Allcott and Greenstone, 2012; Gillingham and Palmer, 2013). This paper intends to assess the effect of presenting the consumer with monthly cost of ownership in addition to five-year fuel expenditure savings as part of the U.S. Environmental Protection

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Agency (EPA) fuel economy labels and experimentally assess the impact of this information of stated vehicle purchase choice. Adding the monthly cost of ownership to the label could potentially circumvent the issues arising from the energy-efficiency gap and thus, stimulate the effectiveness of the energy security policies.

As a response to provisions in the Energy Independence and Security Act of 2007, significant federal and state resources have been made available to incentivize production and to promote the purchasing of alternative fuel vehicles among consumers. The federal government provides grants and loans to companies and institutions that develop plug-in electric technology (CBO, 2012; Carley et al., 2013). In addition, car manufacturers are subject to increasingly stringent corporate average fuel economy (CAFE) standards with a target of 54.5 miles per gallon by 2025. The most significant incentive for consumers is a federal income tax credit of up to \$7500 for the purchase of a qualified plug-in electric vehicle. In some states, additional monetary incentives such as sales tax exemptions and lower licensing fees are in place as well as non-monetary incentives including access to high occupancy vehicle (HOV) lanes or exemption from public parking meters. The policy measures that are of interest to this analysis are related to the fuel economy labels on new cars. The EPA in consultation with the U.S. Department of Transportation (DOT) recently implemented new fuel economy labels to “help consumers to make more informed vehicle purchase decisions, particularly as the future automotive marketplace provides more diverse vehicle technologies from which consumers may choose.” In our research design, we assess the effect of adding a measure of monthly cost of ownership on the fuel economy labels to supplement the current information supplied on the label.

Several motivational factors have been identified in the literature to explain purchasing decisions about conventional hybrid and plug-in vehicles. Research suggests that fuel economy, government incentives, environmental concerns, and general interest in technological innovations are influential in driving vehicle purchasing decisions (Caulfield et al., 2010; Ozaki and Sevastyanova, 2011). Although Diamond (2009) finds that gasoline prices are a much stronger determinant of hybrid vehicle adoption than policy incentives. Gallagher and Muehlegger (2011) conclude that the type and magnitude of tax incentives as well as the immediacy of the tax policy is also a strong driver, i.e., a rebate at the point of sale is more effective than an end-of-year tax credit. A related social science literature shows that non-economic factors, such as political ideology or broader societal values, may play a role in consumer evaluation of energy-efficiency opportunities (Axsen and Kurani, 2012; Sexton and Sexton, 2014; Gromet et al., 2014).

Obstacles to the widespread adoption of plug-in electric vehicles are the limited range, the long charging time, the limited availability of recharging stations, and the higher purchase price compared to similar conventional gasoline vehicles (Nixon and Saphores, 2011; Egbue and Long, 2012; NAS, 2013; Carley et al., 2013). Furthermore, consumers may lack an intuitive understanding for the relative prices of gasoline and electricity as well as the different amounts of these two energy sources that are used by vehicles over their lifetimes. For example, Krause et al. (2013) find that 70% of consumers underestimate the fuel savings for a plug-in electric vehicle. Focus groups with car buyers demonstrate that few engage in any calculations comparing the elevated cost of purchasing the fuel-saving technology with savings in overall fuel expenses over the ownership lifetime (EPA, 2010; Axsen and Kurani, 2012). Although consumers might not engage in the calculations, surveys indicate that the vast majority of respondents believe that fuel economy is an important vehicle attribute (Nixon and Saphores, 2011) and is either a major or somewhat of an advantage of battery electric vehicles (Carley et al., 2013).

The literature on behavioral economics leads to the question of whether a greater appreciation of total cost of ownership (TCO) would change the purchasing decisions of consumers. In this context, TCO encompasses information about the initial purchase price, fuel expenses, and other operating cost of the vehicle over the lifetime of the vehicle. In the industry, TCO information is increasingly used for marketing purposes to compare different vehicles, e.g., for a comparison of different hybrids.<sup>1</sup> TCO information is often expressed on an average monthly basis, taking into account the need for a car loan, the interest rate and payback period of the loan, and a discount rate for future fuel savings over an assumed vehicle ownership lifetime. The TCO information can be seen as providing a heuristic (fast thinking) or as a way of doing the calculations for consumers, thus removing a barrier to rational decision-making.

Without providing information about TCO, a recent stated-preference survey found that each \$1000 premium in the purchase price of an AFV must be compensated for by \$300 per year (or for each 12,000 miles of travel) savings in fuel costs to the consumer (Nixon and Saphores, 2011). Since a vehicle will typically last 10–15 years (120,000 miles or more), the preferences found in this survey seem quite unfavorable to AFVs that have an advantage in fuel savings. The implication is that it may not be sufficient to simply inform consumers about the extent of a vehicle's fuel savings; they need assistance about how to weigh the total amount of money saved in fuel expenses, in conjunction with information about vehicle purchase price. Research also indicates that people apply a high discount rate to future savings associated with lower operating costs, i.e., they value current outlays much more than long term savings (Loewenstein and Thaler, 1989; Frederick et al., 2002; Greene, 2011).

One possible strategy is to simplify the decision problem through more informative designs of product labels. In the case of household appliances, choice experiments have demonstrated that product labels that focus on the economic value of energy efficiency have a stronger impact on consumer choice than do labels that supply information on energy use in physical units or that emphasize the amount of carbon emissions (Newell and Siikamäki, 2013). Kaenzig and Wüstenhagen (2009) review studies of consumer choice with respect to purchasing decisions of household appliances and cars. They find that in most studies “the purchase likelihood of products with higher initial and lower operating costs increases when life

<sup>1</sup> See for example the 2013 Hybrid Analysis. <http://vincentric.com/Home/IndustryReports/HybridAnalysis.aspx> accessed 11 March 2014.

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