Title

Evaluating the Impact of High Occupancy Vehicle (HOV) Lane Access on Plug-In Vehicles (PEVs) Purchasing and Usage in California

Authors

Tal, Gil
Nicholas, Michael

Publication Date

2014-04-01

ITS UCDAVIS
INSTITUTE OF TRANSPORTATION STUDIES

Research Report – UCD-ITS-WP-14-01

Evaluating the Impact of High Occupancy Vehicle (HOV) Lane Access on Plug-In Vehicles (PEVs) Purchasing and Usage in California

April 2014

Gil Tal
Michael Nicholas

Institute of Transportation Studies ◦ University of California, Davis
1605 Tilia Street ◦ Davis, California 95616
PHONE (530) 752-6548 ◦ FAX (530) 752-6572
www.its.ucdavis.edu

UCDAVIS UNIVERSITY OF CALIFORNIA
UCDAVIS
PLUG-IN HYBRID & ELECTRIC VEHICLE RESEARCH CENTER
of the Institute of Transportation Studies

Evaluating the Impact of High Occupancy Vehicle (HOV) Lane Access on Plug-in Vehicle (PEV) Purchase and Usage in California

Gil Tal

Michael A. Nicholas

Working paper

UCD-ITS-WP-14-01

Background

High occupancy vehicle lane access can be an important non-monetary incentive for increasing advanced clean vehicle sales. This incentive needs to be balanced against the potential cost of increased congestion on those lanes, especially during peak travel periods.

In California, there are two types of HOV access: 1) White decals, which are available to an unlimited number of qualifying federal inherently-low-emission vehicles, mostly 100% battery electric and fuel cell electric vehicles (BEVs and FCVs) and 2) green decals, which are available to the first 40,000 applicants that purchase or lease cars meeting California's transitional zero emission vehicle (TZEV) requirement, mostly plug-in hybrid electric vehicles (PHEVs). The expiration date for both the green and white decals is 2019.

The green decal quota is expected to run out before June 2014 with more than 36,000 issued between 2011 and March 2014. Current discussion focuses on whether to add more green decals beyond the current limit of 40,000. More decals will sell more PHEVs but will also increase the number of cars on HOV lanes and may reduce the lane performance and the revenue of high occupancy toll lanes (HOT).

By developing a better understanding of the costs and benefits of HOV decals as an incentive, we can better understand how to tailor policy for maximum benefit. Our analysis shows that PHEVs with greater all-electric range provide much higher levels of zero-emission travel per HOV mile. Policy makers can take this factor into account when determining the level and duration of the HOV incentive.

Research Findings

We surveyed more than 3,500 PEV owners in coordination with the California Center for Sustainable Energy administering the survey on behalf of the California Air Resources Board. All of the respondents had received the State rebate for purchasing or leasing a PEV. Of those customers, about 3,000 have a white or green decal on their vehicle and 500 did not apply for any decal.

The percentage of those that applied for the HOV access decal include 95% of Plug-in Priuses, 89% of Volts and 79% of LEAFs. When asked about their primary motivation to buy the car 57% of Plug-in Priuses, 34% of Volts and 38% of Leafs identified it as the HOV decal (a more recent 4Q 2013 analysis shows somewhat lower percentages - 34%, 20%, and 15% respectively [1]). Figure 1 presents the regional distribution of HOV access as the main motivation for purchasing by vehicle type and location. As expected the motivation in the Los Angeles region and the Bay Area, areas with high benefit of using decals, is higher than other regions. We also notice that in the Los Angeles region, an area with longer average trips, the impact on the Plug-In Prius is higher than on other vehicle types. More than 80% of the PEVs are being used for commuting

which is highly correlated with applying for decals though only 58% commute with this car daily. Leaf drivers and "other" car drivers which are mostly BEVs have a lower commute frequency than PHEV drivers. Regions have minor impacts on commute frequency except from San-Diego with a few more non-commuters. Commute trips have an important impact on total miles, with more than 70% of households using their PEV for this purpose.

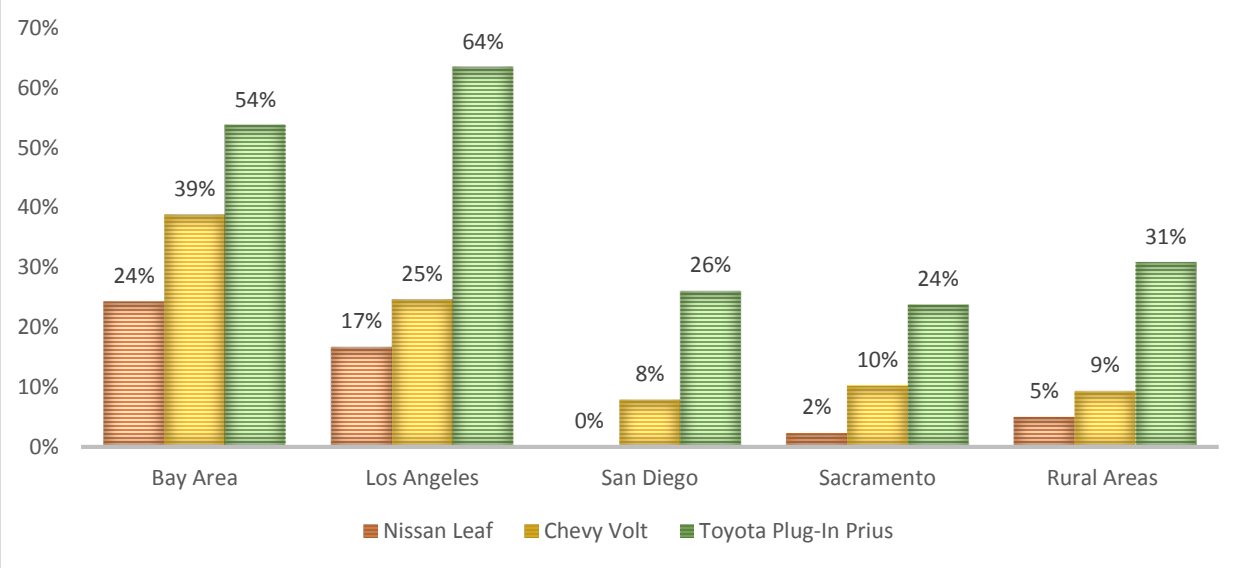

Figure 1: HOV Access as a Primary Purchasing Motivation

We observe in Figure 2 significantly higher household income of owners with HOV access decals comparing to owners without decals ($173,000 with a decal vs. $145,000 without a decal). Since different areas have different median incomes and HOV lanes are more likely to be in higher income regions, the income spread is also useful to examine. The difference of income between decal owners and non-decal owners is statistically significant across all region with the lowest difference, $13,000 per year in the San Diego region, and the highest $28,000 per year in the Sacramento region. We believe that the income difference reflects the higher value of time of PEV owners who obtained the decal and also the higher relative value of the state rebate to PEV owners who did not obtain the decal.

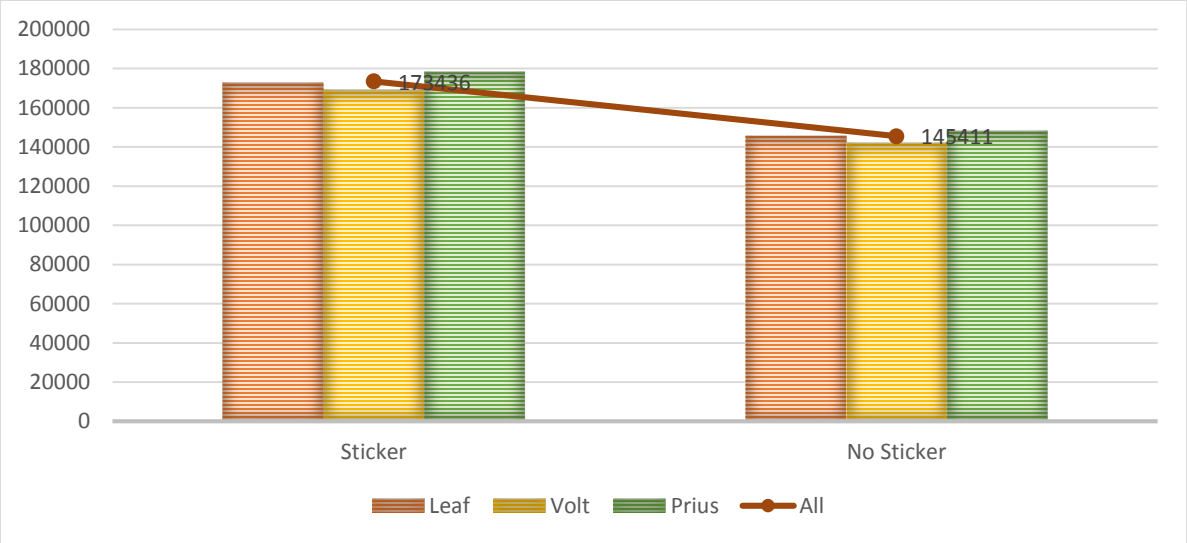

Figure 2: Household annual income by decal and vehicle type

The amount of zero emission usage of both BEVs and PHEVs can be measured in electric vehicle miles traveled or eVMT while the incentive performance of the HOV decals can be measured in terms of eVMT per mile of HOV usage. The vehicle usage is measured both by odometer reading and modeled home to work fastest route, and we estimated what share of the daily commute was electric and what part was gasoline powered based on reported home/work charging [3].

As expected, users with decals drive more and create more eVMT than those without decals except from Plug-in Prius drivers who show no significant change (Figure 3).

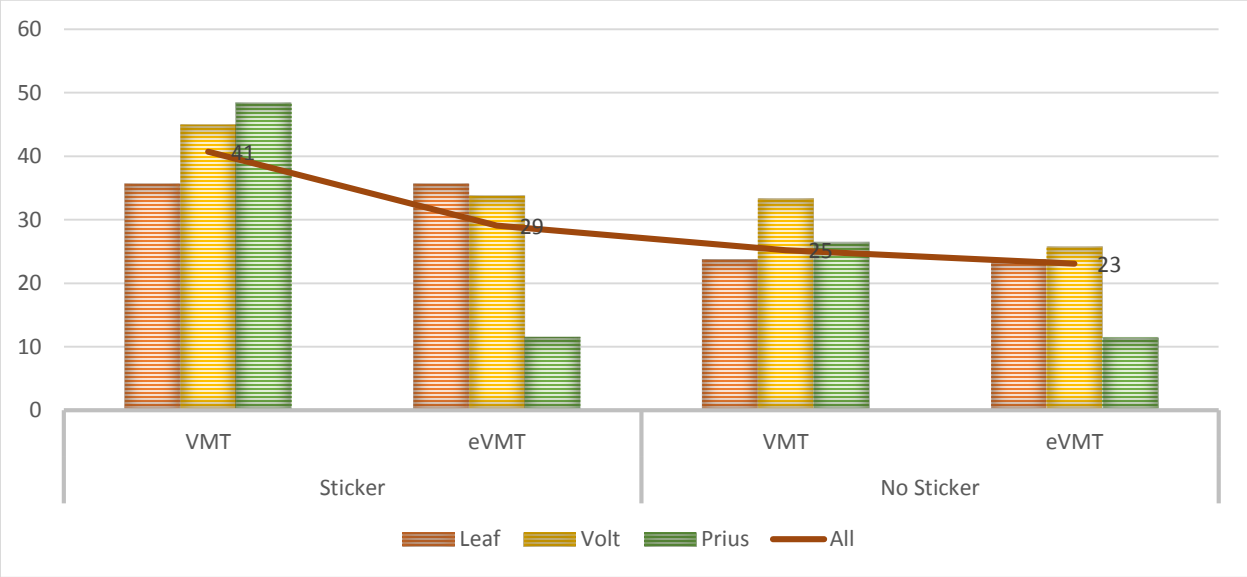

Figure 3: Commute Day Average VMT and eVMT

For every mile a LEAF is driven on an HOV lane we estimated more than 3 electric miles were driven (e.g 30 electric miles on a commute with 10 miles on HOV lanes). This compares to about

2 electric miles for the Volt and half an electric mile for the Prius (Figure 4). The results are correlated with the longer daily travel of the Prius mostly in regions with HOV lanes and the low electric range that together with charging variability and charging behavior limits the number of electric miles [3].

The HOV miles of PEVs are not distributed uniformly on all HOV lanes and are correlated with general traffic trends. Our analysis is based on self-reported commute patterns and does not include time of day but in general, every additional vehicle who uses the HOV lane may contribute to performance reduction especially if added to HOV lanes with usage close to capacity. While more quantitative analysis is needed to determine the amount of increased congestion due to PEVs, comparing areas with a high presence of plug-in vehicles to CALTRANS HOV lanes designated as close to capacity, we see many overlapping areas both in the Bay Area and in the Los Angeles area [4]. The reduced HOV lane speed in some areas highlights the potential cost of providing more HOV decals versus the benefit of the eVMT as shown in Figure 5.

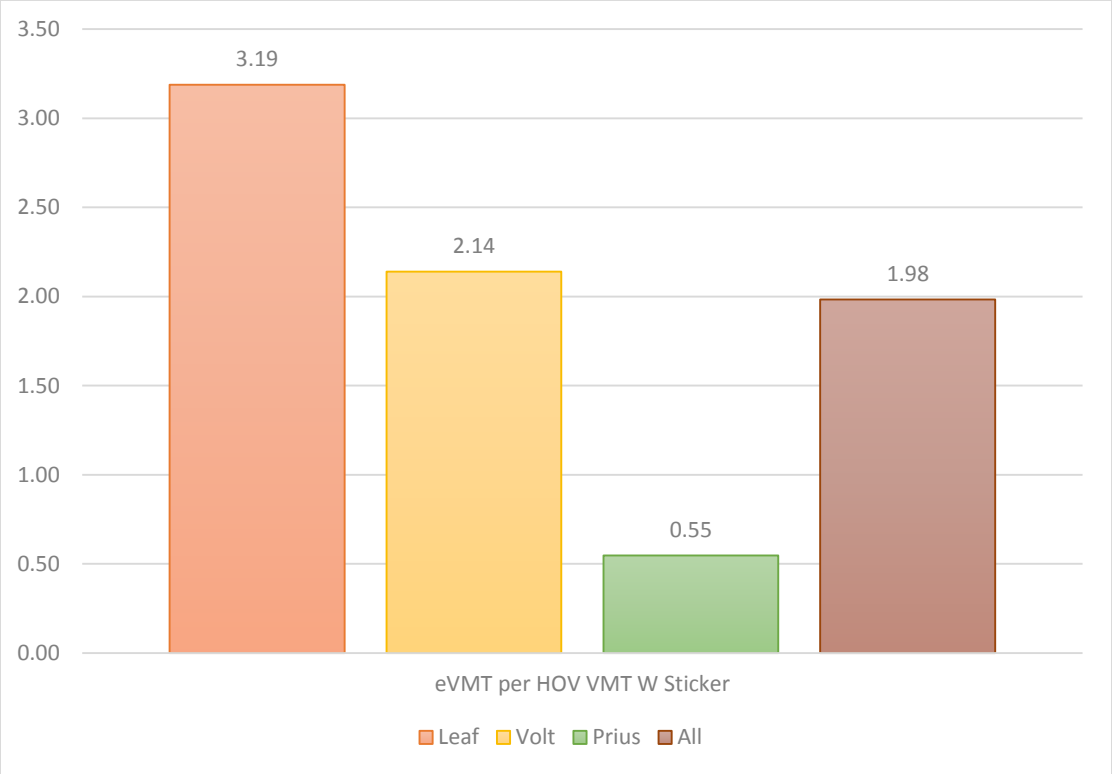

Figure 4: eVMT per HOV mile

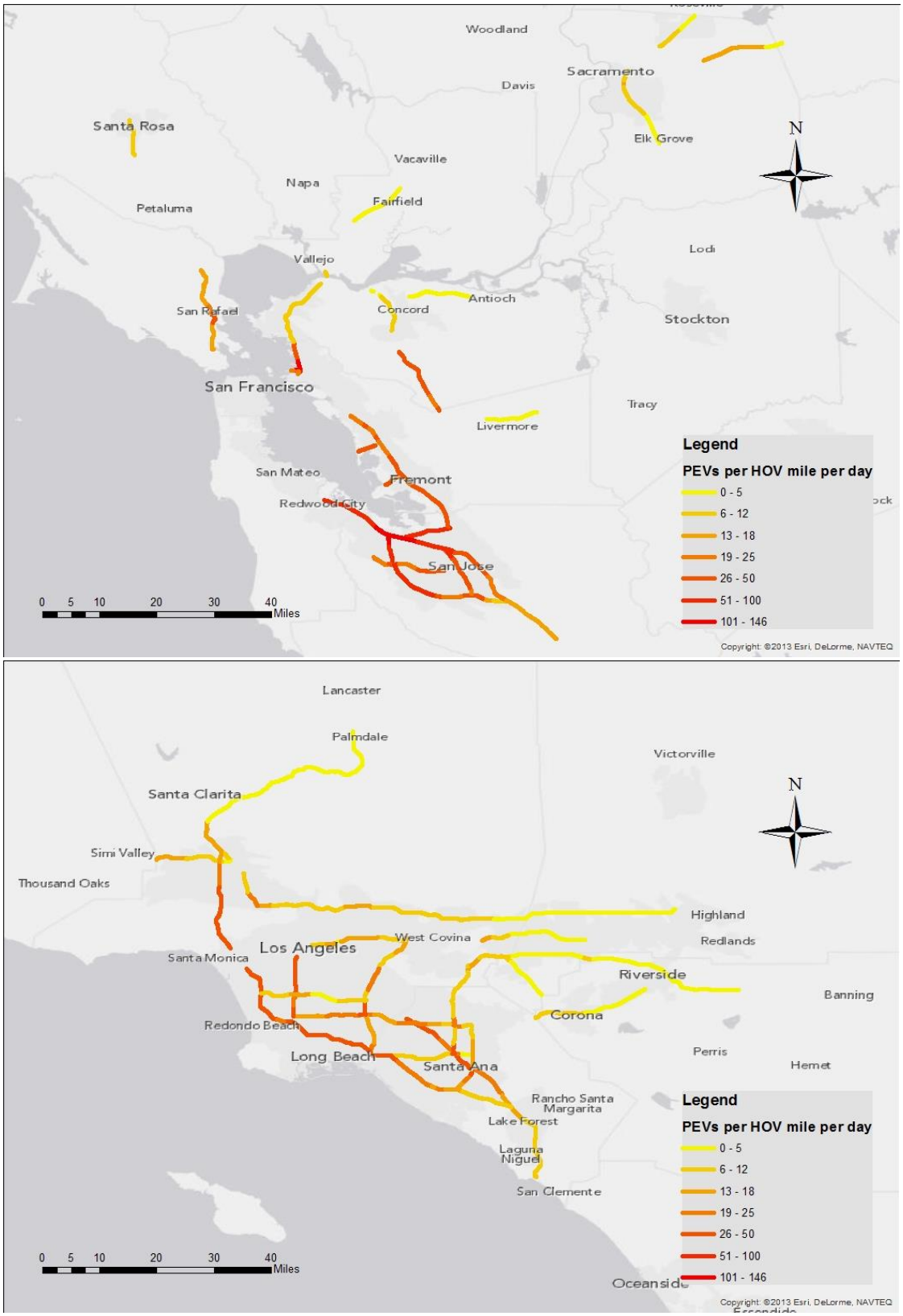

Figure 5: PEV daily miles on HOV lanes

Discussion

By using eVMT as a way to evaluate the benefit of HOV decals, we show the potential to maximize the impact of each additional green decal in terms of cost, (i.e. miles traveled on the HOV lane) and benefit (i.e. number of eVMT or zero emission miles created per day). Our data did not allows us to analyze the HOT lane revenue lost or the actual level of service reduction per PEV driven on the lanes but it is indicating the average effect and on potential policy recommendations. The total eVMT per HOV mile may change in the future if charging availability changes or if cost of charging changes. In case of better charging availability we expect higher eVMT for PHEVs, limited by the battery size and charging behavior and more importantly a higher number of BEVs who will use the HOV lanes. Pricing of public charging could reduce eVMT but also provide more reliable charging for BEVs thereby increasing eVMT for this group [5]. A second important benefit presented in this paper is the HOV decal as a motivation to purchase the vehicles. Almost third of Prius owners and fifth of Volt owners and 15% of LEAF owners stated that the decal is the main motivation but can we correlate these numbers with the number of households who will not buy the car without the decal? It may well be that the second or third motivations are strong enough so the household will purchase the vehicle anyway. On the other hand, the HOV decal may be second in importance but still the tipping point for making the purchasing decision. In both cases it is clear the impact of the decal is higher for shorter range PHEVs with lower eVMT performance.

Conclusions and Recommendations

HOV decals are a very strong non-monetary incentive and as such it is important to maximize its benefits on the alternative fuel market and on the impact of alternative fuel vehicles. First, the results suggest that the HOV decal may alone be enough to prompt a purchase of a PEV and that state monetary incentives could last longer if the rebate were not offered to them. The impact of the HOV decals as well as the state rebate is different for each household based on the location, travel needs, income and other socio economic variables. A combined policy can allow a choice between the different incentives based on the owners' preference, location and socio-demographics. Furthermore, we found that the different incentives have differential impact on the vehicle usage by vehicle type. Smaller battery PHEV10s are more likely to be purchased because of the HOV decal incentive but have fewer electric miles. Differentiating decal access between the PHEVs based on their electric range will maximize eVMT. This can be done by raising the minimum battery size requirement, creating a separate quota for each PHEV type or by creating a different sunset date for each vehicle type.

References

[1] Colin Santulli, (2014) CCSE, What Drivers are Saying, Governor's Office Summit on Zero Emission Vehicles

[2] Gil Tal, Michael Nicholas (2013) Studying the PEV Market in California: Comparing the PEV, PHEV and Hybrid Markets. *Presented at the EVS 27 Electric Vehicle Symposium* (November 2013) Barcelona, Spain

[3] Tal Gil, Michael A. Nicholas, Jamie Davies and Justin Woodjack (forthcoming 2014) Charging Behavior Impacts on Electric VMT: Who is Not Plugging in? *Transportation Research Record Journal*

[4] California High-Occupancy Vehicle Lane Degradation Action Plan, Division of Traffic Operations Office of Traffic Management, Submitted to Federal Highway Administration California Division July 31, 2013

[5] Nicholas, Michael A. and Gil Tal (2013) Charging for Charging: The Paradox of Free Charging and Its Detrimental Effect on the Use of Electric Vehicles. Institute of Transportation Studies, University of California, Davis, Working Paper UCD-ITS-WP-13-02