

## Evaluating the Impact of High Occupancy Vehicle (HOV) Lane Access on Plug-in Vehicles (PEVs) in California

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### Issue

High occupancy vehicle (HOV) 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 and reduced revenue of high occupancy toll (HOT) lanes, especially during peak travel periods.

In California, there are two types of HOV access: 1) White stickers 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). 2) Green stickers 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 stickers is 2019.

The green sticker 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 stickers beyond the current limit of 40,000. More stickers will sell more PHEVs but will also increase the number of single-occupant vehicles in HOV lanes and may reduce the lane performance and the revenue of high occupancy toll lanes (HOT).

### Policy Implications

By developing a better understanding of the costs and benefits of HOV stickers as an incentive for purchase and use of clean vehicles, the State can better tailor the 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

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PEV. Of those customers, about 3,000 have a white or green sticker on their vehicle and 500 did not apply for any sticker.

The percentage of those that applied for the sticker 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 Leaf's identified the sticker as the most important (a more recent 4Q 2013 shows somewhat lower percentages - 34%, 20%, and 15% respectively) [1].

We observed a significantly higher household income of owners with stickers comparing to owners without stickers (\$173,000 with a sticker vs. \$145,000 without a sticker). This difference may reflect the higher value of time of PEV owners who obtained the sticker and also the higher relative value of the state rebate to PEV owners who did not obtain the sticker.

The amount of zero emission usage of both BEVs and PHEVs can be measured in electric vehicle miles traveled or eVMT. The incentive performance of the HOV stickers 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. We estimated what share of the daily commute was electric and what part was gasoline powered based on reported home/work charging [3].

Drivers with either white or green stickers drive more and create more VMT and eVMT for each commute day than those without stickers. Plug-in Prius drivers show significant change in the total VMT but no significant change in eVMT (Figure 1). The total daily VMT of drivers with stickers is also correlated with daily HOV miles and range from 11 miles on average for LEAF drivers, 16 miles for Volt drivers, and 21 miles for Prius drivers. Overall Prius drivers have a larger share of their daily miles on HOV lanes and Priuses are more popular in regions with HOV lanes.

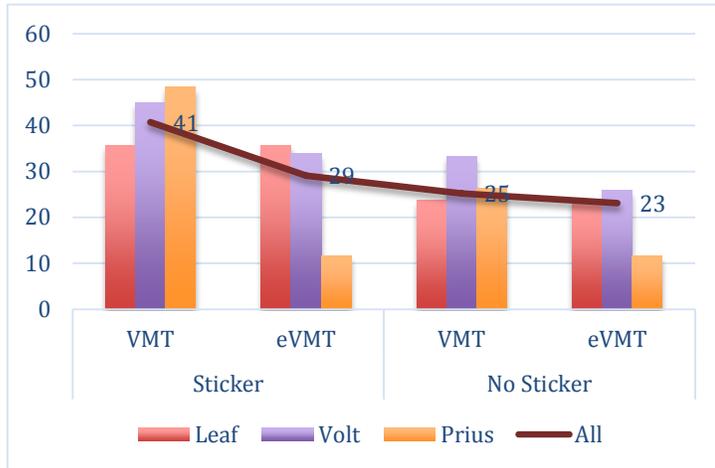


Figure 1: Commute Day VMT and eVMT

On average, for every mile a LEAF is driven in an HOV lane, we estimated more than three electric miles were driven (e.g 30 electric miles on a commute with 10 miles on HOV lanes). This compares to about two electric miles for the Volt and half an electric mile for the Prius (Figure 2).

The HOV miles of PEVs are not distributed uniformly on all HOV lanes and are correlated with general traffic trends as shown in Figure 3.

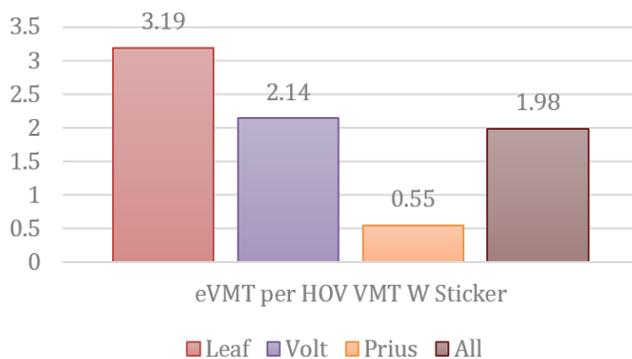


Figure 2: eVMT per HOV mile Traveled

Every additional vehicle that uses HOV lanes may reduce its performance especially if added to HOV lanes already 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 PEVs 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 to drivers of providing more HOV stickers versus the benefit to the State of the eVMT.

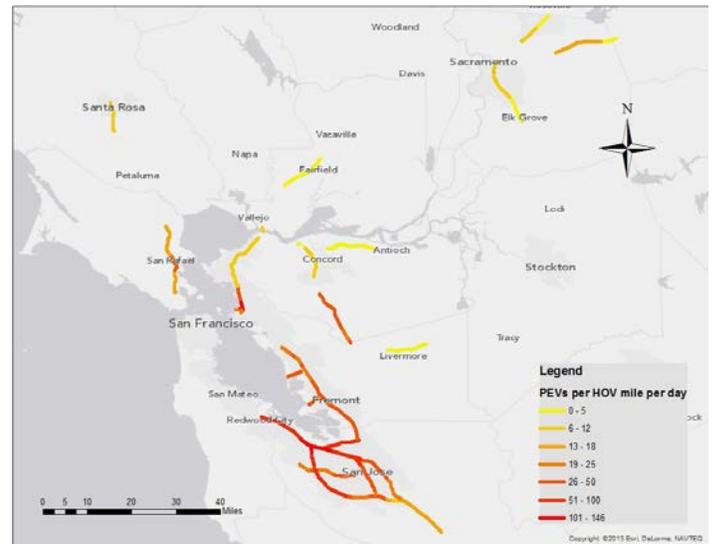


Figure 3: PEVs on HOV lanes per day (not weighted)

### Policy Considerations

Using eVMT as a way to evaluate the benefit of HOV stickers, we show the potential to maximize the impact of each additional green sticker by providing them to owners (and vehicle types) that create more eVMT and to owners who might be less likely to purchase the car otherwise. While more research is needed, a fine tuning of the HOV access policy for PHEVs together with the monetary incentives increase the impact and reduce the cost of both policies.

[Click here to read the full working paper.](#)

### 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) Charging Behavior Impacts on Electric VMT: Who is Not Plugging in? Transportation Research Record Journal
- [4] California High-Occupancy Vehicle Lane Degradation Action Plan (2103), Division of Traffic Operations Office of Traffic Management, Submitted to Federal Highway Administration California Division
- [5] Tal, Gil and Michael A. Nicholas (2014) Evaluating the Impact of High Occupancy Vehicle (HOV) lane access on Plug-In Vehicles (PEVs) purchasing and usage in California. Institute of Transportation Studies, University of California, Davis, Research Report UCD-ITS-WP-14-01