



## Hybrid cars and HOV lanes

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### ABSTRACT

The 2005 California Clean Air Access Sticker program offered stickers to owners of hybrid cars allowing unrestricted access to High Occupancy Vehicle lanes. The program was conceived as a zero-cost mechanism to encourage purchase of hybrid cars and to reduce air pollution. Information from sales of used hybrids allows us to estimate sticker market value. We then derive the value of excess HOV space the hybrids occupied, which is considerably greater than the air pollution benefits achieved. A more effective policy would sell space to drivers of any vehicle and use the revenue to stimulate hybrid demand, preferably via direct subsidy.

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### 1. Introduction

The California Clean Air Access program promoted the adoption of energy-efficient, low-emission hybrid vehicles by offering special stickers to hybrid car owners that allowed them to bypass congestion by driving in High Occupancy Vehicle (HOV) lanes without meeting minimum capacity requirements.<sup>1</sup> The program was conceived as a zero-cost mechanism to encourage the purchase of hybrid cars that would create less air pollution than conventional cars. The program was extended once in California and a new program has since been implemented for newer plug-in electric hybrid cars. Similar programs to encourage purchase of -green+cars have been implemented in other states. Because different states continue to consider similar programs, analysis of the California Clean Air Access program has specific policy relevance in addition to being intrinsically interesting.

We find consumers place a high value on the stickers and thus infer they have a high willingness-to-pay for access to the HOV lane. The number of stickers available was limited and not all eligible vehicles received stickers. This allows us to compare the price of used hybrids with and without stickers and estimate the willingness-to-pay for Clean Air Access stickers. Because the stickers provided access to the HOV lane only until a specified date, theory suggests that the value of the sticker should decrease over time, which is consistent with our findings. Extrapolating from the individual value of the sticker, we show that the 85,000 stickers could have been sold for \$5800 per sticker set in August 2005, indicating the program had an implicit cost of roughly \$490 million.<sup>2</sup> Additional calculations show the value of the air pollution reductions achieved by the program are worth

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<sup>1</sup> HOV lanes are also known as carpool lanes, express lanes, diamond lanes, commuter lanes, or transit lanes.

<sup>2</sup> Actual sale prices of hybrids with stickers were unavailable so this estimate relies primarily on used car asking prices. We have some sold prices and when we compare the two, we see asking prices are higher than sold prices however they do not yield larger estimates of sticker premiums. Furthermore, unless our estimates are very severely biased, our main conclusions are robust.

much less than the value of space in the HOV lane,<sup>3</sup> suggesting the state of California would have benefits by selling the stickers to any interested driver and using the revenue to reduce air pollution through more cost-effective approaches.

Previous studies have looked at the use of incentives to encourage the adoption of hybrid cars and have found that access to HOV lanes does not encourage the adoption of hybrid cars, but that tax credits and direct subsidies do (Ayala and Saphores, 2011; Gallagher and Muehlegger, 2011; Potoglou and Kanaroglou, 2007; Diamond, 2009). This is puzzling since it would appear the California stickers were more valuable than many of the tax credits and subsidies available.

Two other studies have looked at the unintended consequences of green car exemptions. Bento et al. (2013) use traffic sensor data from Los Angeles to estimate the welfare effects of the Clean Air Access program on carpoolers in the HOV lane. The authors find hybrids entering the one highway's HOV lane in Los Angeles slowed down the existing carpoolers and that the net welfare impacts were negative.<sup>4</sup> Similarly, Hultkrantz and Liu (2012) examine a program that exempts green cars from congestion pricing in Stockholm, Sweden. Hultkrantz and Liu find green car exemptions erode the gains of Stockholm's congestion pricing scheme. Our paper presents yet additional evidence that exemptions for green cars, whether it be from HOV or toll requirements, are not 'free' but instead come with hidden costs, unintended consequences, and missed opportunities.

The rest of the paper proceeds as follows. First we further explain the relevant specifics and the timing of the California Clean Air Access Sticker program, we then describe the hedonic method and our empirical strategy, followed by an explanation of the data, regression results, and finally a discussion and conclusion of what our results imply for other programs that allow hybrids access to HOV lanes.

### 1.1. The California Clean Air Access Sticker program

HOV lanes were built to induce drivers to carpool by providing a free-flowing lane with shorter travel times and greater travel time reliability. Proponents of HOV lanes assumed that all drivers would benefit from reduced congestion, as a result of higher carpooling rates and fewer cars on the road. Society would benefit from lower air pollution and lower fuel consumption. However, there is growing debate as to whether an HOV lane provides a sufficient incentive to carpool, and even if it does, whether more carpooling can really mitigate congestion (Shewmake, 2012; Legislative Analyst's Office, 2000; Dahlgren, 1998). Regardless, by 2004, California's HOV lanes suffered from "empty lane syndrome" – defined as under-utilized lanes (or sometimes public perception of lanes being under-utilized) that results in pressure to convert these HOV lanes to general purpose lanes. Officials understood that moving a small fraction of cars from general purpose lanes to the HOV lanes could theoretically relieve some congestion on the general purpose lanes without worsening traffic on the HOV lanes. The question then became how to best allocate this space on the HOV lanes.

The state of California decided to use this space to encourage clean air vehicles by allowing them to drive on HOV lanes without meeting the minimum-capacity requirement. The idea was that this was a zero-cost method of encouraging hybrid adoption (Sangkapichai and Saphores, 2009; Legislative Analyst's Office, 2000). California instructed the Department of Motor Vehicles (DMV) to issue 85,000 sets of yellow stickers to owners of qualifying hybrid vehicles. Sixty percent of the stickers were given to vehicles that had been purchased prior to the start of the program, leaving only 34,510 of the 85,000 stickers for new car purchases.

In September of 2004, Governor Arnold Schwarzenegger signed Assembly Bill 2628 (AB 2628). This bill allowed hybrids meeting the state's Advanced Technology Partial Zero Emission Vehicle (AT PZEV) standard and having a 45 mpg or greater fuel efficiency rating to use the HOV lanes without having to carpool.<sup>5</sup> Three hybrid vehicles met the requirements: the Honda Civic hybrid, the Honda Insight, and the Toyota Prius.

From August 2005 to February 2007, any California car owner with a Prius, Civic Hybrid, or Insight could write to the DMV and obtain a set of stickers for \$8.<sup>6</sup> The stickers and the privileges they conferred were transferable upon sale of the car. The 85,000 sticker sets were given out in three installments. The first installment of 50,000 sticker sets was issued starting in August 2005. Once those 50,000 sticker sets were issued, the DMV commissioned a study of the impact of hybrids on HOV lanes. The study found that hybrids had not created congestion in the HOV lanes, so the remaining 25,000 sticker sets were issued under AB 2628. In September 2006, another bill, AB 2600, expanded the number of sticker sets by 10,000 and extended the program end date to January 1, 2011. Stickers were available for issue until February 2007, when the 85,000 sticker limit was reached. After February 2007, a consumer could obtain a set of Clean Air Access stickers only by buying a used car that had a sticker on it.<sup>7</sup> On August 30, 2010, Senate Bill 535 (SB 535) was passed. SB 535 changed the expiration date for the yellow Clean Air Access stickers to July 1, 2011.<sup>8</sup> This added six months of HOV access to the stickers, which should have increased the value of a sticker set.

<sup>3</sup> These calculations are available in [Appendix A](#).

<sup>4</sup> Bento et al. examined HOV lanes in the greater Los Angeles metropolitan area, HOV lanes in other parts of California may indeed have had excess capacity.

<sup>5</sup> Additionally, 2004 model year or older hybrids with a 45-mpg or greater fuel economy rating that met either the SULEV, ULEV (ultra low emission vehicles), or PZEV standards were eligible.

<sup>6</sup> Multiple stickers were placed on each car so they could be visible from the front and the rear.

<sup>7</sup> Effective January 1, 2009, the California Department of Motor Vehicles was allowed to issue Clean Air Access stickers to the original owners of qualifying hybrids to replace hybrids declared nonrepairable or total loss salvage (AB 1209). This law allowed the owners of wrecked hybrids to place a sticker on a 2008 or 2009 hybrid car. As only one case was found in our data, it was not included.

<sup>8</sup> SB 535 bill was introduced on February 27, 2010, but the provision to extend to life of the yellow Clean Air Access stickers was not included until June 24, 2010.

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