Impacts of Fleet Turnover Strategies on Passenger Vehicle Use and Greenhouse Gas Emissions

Policy Brief

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Policy Description

Fleet turnover strategies aim to encourage the scrappage of fuel-inefficient vehicles and/or the purchase of highly fuel-efficient vehicles, including hybrid electric vehicles and, more recently, plug-in electric vehicles. The strategies reviewed here target consumers or car dealers rather than manufacturers (Table 1). Most programs provide financial incentives, but others, like high-occupancy vehicle (HOV) lane access and free parking, provide incentives in the form of reduced travel time. These programs are intended to accelerate the penetration of more fuel-efficient vehicles and subsequently lower greenhouse gas (GHG) emissions and improve air quality.

Table 1. Types of Fleet Turnover Strategies

Type of Program	Description	Level of Government
Income tax credits	Credit to consumers who buy fuel-efficient vehicles; received after filing of taxes	National, state
Purchase Rebates	Rebate to consumers on the purchase of fuel-efficient vehicles at the point of purchase	National, state, province
Scrappage Rebates	Subsidy to car dealers for scrapping inefficient vehicles traded-in by consumers for new vehicles	National, state, province
HOV lane access	Fuel-efficient vehicles that are not high occupancy allowed to access HOV lanes	State, city
Parking fee exemption	Fuel-efficient vehicles exempted from parking fee	City

Note: Each program provides unique definitions of fuel-efficient and -inefficient vehicles (see Table 3 below for specific definitions).

Impacts of Fleet Turnover Strategies

The studies included in this review assess scrappage and purchase incentive programs in the U.S. and Canada and measure total reductions in GHG emissions for the population subject to the program. No studies were identified that measure impacts on GHG emissions of HOV lane access or parking fee exemptions.

Because scrappage and purchase incentive programs vary with respect to their scale and duration, effects are reported in terms of the fiscal cost per ton of GHG emissions reduced, where the fiscal cost is the amount the government contributed to the purchase of fuel-efficient vehicles through incentives.

The total reductions depend on the number of vehicles purchased as a result of the program, and the difference in GHG emissions between the new vehicles and the vehicles displaced by the program. Both components are challenging to estimate:

- Not all vehicle sales that benefit from incentive programs actually may result from those programs. Instead, incentive programs may simply provide a subsidy to consumers who would have bought a new fuel-efficient vehicle without the program. In addition, consumers may buy a vehicle eligible for the program incentive in place of an equally or almost equally fuel-efficient vehicle that they were already planning to buy. It is also possible that scrappage programs tend to attract owners of old vehicles that would have been scrapped soon anyway.

- Differences in GHG emissions are a function of the distances traveled and the fuel efficiency of the new and displaced vehicles. Older vehicles that are less fuel-efficient are likely to be driven less than new, more fuel-efficient vehicles both because of higher fuel costs and lower reliability.

Effect Size

The studies reviewed indicate that the fiscal cost of reducing one ton of CO_2 ranges from $101 to $640 for the Car Allowance Rebate System (CARS) scrappage program (described below) and from $177 to $189 per ton for purchase incentive programs (Table 2).

The wide variation in estimates for the CARS program is partly due to differences in assumptions. Li et al. (2013) assume that the scrapped vehicle would have been driven for seven more years at an average of 8,531 miles per year, in comparison to the assumption by Lenski et al. (2013) of only 2.5 years but 9,412 miles per year. Lenski et al. (2013) attribute 100 percent of the transactions to the rebates, but Li et al. (2013) analyze sales in the U.S. and Canada over a two year period to estimate that only 55 percent of the CARS transactions are attributable to the rebate, and that 45 percent would have been purchased anyway based on their statistical analysis.

Table 2. Impact of Fleet Turnover Strategies on Total CO_2 and Fiscal Cost per Ton of CO_2 Reduced

Study	**Study location**	**Study year**	**Program**	**Program type**	**Effects**	
					Total CO_2 reduced in million tons	*Fiscal cost in U.S. dollars per ton CO_2 reduced*
Lenski et al. (2013)	U.S.	2009	CARS	Scrappage rebate	4.4	$640
Li et al. (2013)	U.S.	2009	CARS	Scrappage rebate	25 -27	$101 to $113
Chandra et al. (2010)	Canadian provinces	2001-2006	Various provincial programs	Purchase rebate	Not reported	$189[a]
Beresteanu and Li (2011)	U.S. (22 metropolitan areas)	2006	Federal income tax credit	Purchase Credit	0.76	$177 per ton

[a] 2006 exchange rate 1 CAN dollar = 0.88155 U.S. dollar

The two studies of purchase incentive programs suggest that a relatively small share of the consumers receiving rebates or credits changed their decision about what vehicle to purchase because of the incentive: 26 percent of hybrid electric vehicle sales were attributable to provincial rebates in Canada (Chandra et al., 2010), while just 20 percent of hybrid vehicle sales were attributable the U.S. tax credit (Beresteanu and Li, 2011).

Evidence suggests that the effectiveness of fleet turnover strategies depend on the structure of the program and the setting in which it is implemented. Studies that evaluate variations in U.S. state-level policies find that rebates for hybrids provided immediately at the point of sale are significantly more effective than tax credits that are received at the end of the tax year (Gallagher and Muehlegger, 2011; Diamond, 2009). One study indicated that scrappage programs disproportionally benefit urban areas (Lenski et al., 2013).

Programs aimed at accelerating vehicle fleet turnover are likely to accelerate vehicle production and vehicle scrappage. GHGs are emitted from vehicle production, both in the production and transportation of the supplies, as well as the overall manufacturing of the vehicles and the delivery of those vehicles to the dealerships or end customers. Lenski et al. (2013) estimated that these effects offset total CO_2 reductions for the CARS program by about 15 percent. However, there are significant uncertainties associated with these estimates, and Li et al. (2013) did not include these effects in their study of the CARS program.

Evidence Quality

The quality of the evidence is sufficient to conclude that scrappage and incentive policies as implemented in the U.S. and Canada provide marginal reductions in GHG emissions, especially when compared to the cost effectiveness of fuel taxes. The studies included in Table 2 likely overestimate the effects of the programs because they do not capture all of the possible indirect effects, as discussed in the technical background memo on this topic. The studies, with the exception of Lenski et al. (2013), use time-series data and sophisticated econometric techniques to produce reasonable estimates of vehicle purchases that can be directly attributed to incentive programs. However, estimates of total GHG effects are highly dependent on assumptions about lifetime distance traveled by vehicles with and without the program, for which limited data are available.

Another significant source of bias is the overestimation of vehicle fuel economy ratings compared to actual on-road fuel economy for hybrid vehicles, resulting in overestimation of GHG emissions savings (Sallee, 2010). *Consumer Reports* magazine (August 2013) reports that fuel efficiency ratings for most hybrids overestimate actual-use fuel efficiency. As a result, GHG benefits of incentive programs, especially those that target hybrid vehicles, are likely overestimated.

Effects may be underestimated if indirect technology spill-over effects are not considered, that is, if more hybrid or plug-in vehicles are purchased because consumers see these vehicles in wider use as a result of the program and gain confidence in the new technology. The literature provides no evidence for the significance or magnitude of this effect and, given the very small market shares for these vehicles, the effect is unlikely to be substantial, at least in the short term.

Caveats

None of the studies focus specifically on California. Because California has a high market share of hybrid vehicles, fleet turnover strategies may produce a smaller increase in the purchase of fuel-efficient vehicles than found in the studies reviewed, since consumers are already more inclined to purchase such vehicles. On the other hand, vehicles in California tend to last longer than they do in cold-weather parts of the country, so that scrappage programs may have a larger impact.

Co-benefits

To the degree that they succeed in accelerating the penetration of more efficient vehicles, fleet turnover programs will also reduce exposure to criteria pollutants and thus provide health benefits to the public (Dill, 2004). New vehicle sales may promote job creation and growth in gross domestic product (GDP). Consumers benefit financially from receiving the rebates or tax breaks and from driving a more fuel-efficient car and they may also benefit from driving a safer and more comfortable car (Busse et al., 2012).

Examples

Many government incentives for vehicle scrappage and hybrid vehicle purchase have been enacted in North America (Table 3). For example, federal tax credit programs for hybrid vehicles have been in place since 2000. Canada has implemented similar programs nationally. U.S. states and Canadian provinces have also experimented with a range of incentive programs including HOV lane access, parking fee exemptions, tax credits, and rebates.

The CARS program, implemented by the U.S. Department of Transportation in 2009 for a period of three months, provided a one-time subsidy of $3,500 or $4,500 to dealers for scrapping inefficient vehicles traded-in for new, fuel-efficient vehicles. This $3 billion scrappage program provided subsidies for the purchase of 688,511 fuel-efficient vehicles nationwide in 2009, representing less than 1 percent of all registered vehicles (Zolnick, 2012).

Table 3: North American Taxes and Incentives to Encourage the Purchase of Fuel Efficient Vehicles

Name	Location	Time	Target Vehicles	Tax or Incentive
Gas Guzzler Tax[a]	U.S.	Phase in (1980-1991) to present	Passenger cars below 22.5 miles per gallon (mpg)	Minimum $1000 (22.5 mpg) to maximum of $7,700 (12.5 mpg) tax on manufacturers; No change since 1991 (even for inflation) so real value of tax has declined
Clean Fuel Tax Deduction[a]	U.S.	2000-2005	Hybrid	$2,000 above-the-line tax deduction
Hybrid Vehicle Tax Credit[a]	U.S.	2006 until each manufacturer sells 60,000 qualifying vehicles	Hybrid	As much as $3,400 credit for a new car depending on the fuel savings of the vehicle
Plug-in Electric Drive Motor Vehicle Credit[a]	U.S.	2009 until 200,000 qualifying vehicles sold (all manufacturers)	Plug-in Electric Drive Motor	$2,500 to $7,500 depending on kilowatt hour capacity of the vehicle's battery

Name	Location	Time	Target Vehicles	Tax or Incentive
Car Allowance Rebate System (CARS) (a.k.a. Cash for Clunkers) [a]	U.S.	2009 (July to August)	Passenger cars and light-duty trucks; eligibility based on fuel economy requirements	One time subsidy of $3,500 or $4,500 for trading in inefficient model for purchase of new vehicle with sufficiently high fuel economy
EcoAuto[a]	Canada	2007 (2006-2008 models)	All qualifying vehicles (9 of 28 models were hybrids)	Subsidy of up to $2,000 directly to consumers depending on vehicle fuel efficiency
HOV Lane Access[b]	U.S. States: AZ, CA, CO, FL, GA, NJ, NY, UT and VA	2000 forward	Alternative fuel vehicles	Single occupancy HOV lane access
Income Tax Credit[b]	U.S. States: CO, MD, NY, OR, PA, SC, UT and WV	2000 forward	Alternative fuel vehicles	Tax credits ranged from a low of $130 in SC to a high of $6542 in CO
Sales Tax Waivers[b]	U.S. States: CT, DC, ME, and NM	2000 forward	Alternative fuel vehicle	Sales Tax rebates ranged from a low of $300 in Maine and a high of $3294 in the District of Columbia
Sale Tax Rebates[c]	Canadian Provinces: BC, PE, ON, QC and MB	2000 forward	Alternative fuel vehicle	Various rebates on sales tax up to specified maximum ($500 to $3000 depending on province and year)
Parking Fees [b]	Select U.S. Cities: Albuquerque (NM), Austin (TX), Baltimore (MD), Ferndale (MI), Huntington (NY), Los Angeles (CA), New Haven (CT), Salt Lake City (UT), San Antonio (TX), San Jose (CA), Santa Monica (CA), Vail (CO), and Westchester (NY)	2000 forward	Hybrid	Parking fee reductions or exemptions

[a] Sallee, 2010; [b] Gallagher and Muehlegger, 2011; [c] Chandra et al., 2010

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