

**Potential Design, Implementation, and Benefits of a
Feebate Program for New Passenger Vehicles in California:
Interim Statement of Research Findings**

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EXECUTIVE SUMMARY

A team of researchers from the University of California completed a comprehensive study to assess the potential design, implementation, and benefits of a feebate program in California as well as possible stakeholder responses. This interim document summarizes the study's key findings. A forthcoming project final report will include a more detailed presentation of results, and complete documentation on modeling and analysis tools, study methods, and limitations.

The Global Warming Solutions Act of 2006 (AB 32) calls for California's greenhouse gas (GHG) emissions to return to 1990 levels by 2020. The Scoping Plan specifies the evaluation of feebates as a possible complement to or substitute for California's GHG standards limiting greenhouse gas emissions from new light-duty vehicles. Feebates are market-based policies for encouraging emissions reductions from new passenger vehicles by levying fees on relatively high-emitting vehicles and providing rebates to lower-emitting vehicles. Whether or not revenue neutrality is a requirement, a feebate policy would need procedures for adjusting fees and rebates to take into account the changes in vehicle offerings and new vehicle sales mix that occur over time.

This study finds that feebate policies can be used in California to achieve additional reductions in greenhouse gases from new passenger vehicles beyond those projected from emission standards alone. Specifically, feebate policies affect the average emissions levels (measured in grams of CO₂-equivalent per mile, or g/mi) for the new vehicle fleet sold in each model year. The amount will depend on the design features of the feebate policy and other modeling assumptions. A moderate feebate program based on a footprint system (similar to the proposed national emissions standards) with average rebates of \$600 and average fees of \$700 yields an average reduction of 9 g/mi versus a no-feebate scenario for the period 2011-2025 (a 3% improvement). This translates to 3 MMTCO₂E of total emission reductions in California in 2020, or about 2 percent of the reductions needed to achieve the AB 32 target. By way of comparison, these reductions are on a par with the Scoping Plan's combined expected reductions from two sources: the Million Solar Roofs program, and High Speed Rail. Alternatively, they are about 10 percent of reductions expected from the California Light-Duty Vehicle Greenhouse Gas Standards.

Different configurations of a feebate program could lead to greater reductions, but would require some tradeoffs. Specifically, the footprint-based system requires the smallest average levels of fees and rebates, but also yields the smallest emissions reductions. Of the alternatives considered in the study, a system based on a single benchmark for all new vehicles yields the largest emissions reductions, but also the largest levels of fees and rebates. The new vehicle sales shifts produced by this option also yield the largest reduction in consumer welfare. However, a more complete evaluation takes into account the cost of administering the program, as well as the social benefit from additional fuel savings over the full lifetime of a more efficient vehicle fleet (beyond those already included in the consumer welfare calculation). When all these factors are taken into account, there is a net *gain* in social benefit associated with all feebate programs we considered, with the largest gain coming from a program with a single standard system. In other words, feebate programs reduce emissions at a net *negative* social cost.

The automobile industry would also be affected differently depending on the program design. In general, model results suggest that new vehicle sales in California would decline under all feebate programs, resulting in industry revenues falling on the order of 1 percent or several hundreds of million dollars to one billion dollars per year. This decline is to be expected under the assumptions of our analysis, which require that feebate programs (1) cover administrative costs, (2) cover ZEV mandate vehicles that would receive rebates, and (3) be revenue neutral. Fees outweigh rebates, contributing to higher average new vehicle prices and lower new vehicle sales. Footprint-based feebates yield the smallest sales decreases, and single benchmark systems yield the largest sales decreases.

Factors beyond California’s direct control determine the effectiveness of feebates for producing additional emission reductions. For example, because California is roughly 10% of the domestic new vehicle market, a California-only feebate would lack the leverage to induce major vehicle design changes. Most of the reductions from California-only feebate programs would come from consumers purchasing greater volumes of lower-emitting vehicles through sales mix shifts. The study investigates the implications for feebate programs with greater market coverage using two cases: (1) California plus thirteen “Opt-in States,” and (2) a national feebate program. Results are summarized in Table ES-1.

Table ES-1. Effect of Feebate Programs For Three Levels of Market Coverage

Scenario	Reduction of Average New Vehicle Emission Rates in CA MY2011-2025 (g/mi)	Percent Change in Average New Vehicle Emission Rates in CA MY2011-2025	Average Fee per New Vehicle	Average Rebate per New Vehicle	Total Emission Reductions from Feebates in 2020 in CA (MMT _{CO₂E})
California-only	9 g/mi	3% reduction	\$700	\$600	3 MMT
California + 13 “Opt-In” States	12 g/mi	5% reduction	\$675	\$550	5 MMT
Entire U.S.	24 g/mi	10% reduction	\$600	\$500	9 MMT

Note: All scenarios assume a feebate program based on vehicle footprint. Fees and rebates are established based on a rate of \$20 per g/mi (roughly equivalent to a carbon price of \$200 per tonne of CO₂) and a benchmark that maintains revenue neutrality. Opt-in States are those that have adopted California’s GHG standards and together with California represent between 35% and 40% of the U.S. automobile market.

The study finds that expanding a feebate program to a broader market will induce manufacturers to design vehicles with lower emission rates, leading to greater emission reductions. For example, under a national feebate program the new vehicle emissions average in California would be reduced by an average of 24 g/mi, about a 10 percent reduction, versus 9 g/mi for a California-only program. Much of this improvement occurs due to vehicle redesign decisions, and these greater reductions can be obtained with lower levels of fees and rebates than with a California-only program.

Additionally, the stringency of the performance standards is an important factor in the additional reductions generated by feebates. The steeper the decline of allowable emissions over time, the smaller the incremental benefit from feebates. However, the lowest absolute emission levels occur through a combination of feebates with tighter standards. Feebates offer reduced incremental benefits with the tighter standards because the standards force the adoption of lower cost technology, leaving only the relatively more expensive technology available to the feebate program. The relative cost of technologies also results in the incremental benefit from feebates diminishing over time in any scenario where standards continue to tighten. Feebates could also be used to offset some of the shortfall in emission reductions if standards cannot continue to be tightened in later years.

The results from this study are consistent with lessons learned from Denmark, France, the Netherlands, and Norway that have already implemented similar programs. Consumer car purchasing behavior in these countries has demonstrated a clear shift towards lower emission vehicles following the establishment of their respective feebate programs. The extent to which consumers have differentially purchased lower emitting cars in these countries has varied somewhat with economic conditions (e.g., typically increasing with higher gasoline prices), but the net effect of reducing emissions has been unambiguous.

The stakeholder response portion of the study involved a survey and focus groups of households as well as interviews with automobile manufacturers and automobile dealers, which yielded additional insights related to implementing a potential feebate program. The statewide survey of 3,000 households indicates that consumers are generally concerned about climate change and energy independence and that three-fourths of respondents would be supportive of a feebate program. However, program design would need to consider the issue of fairness raised in focus groups.

Interviews with a sample of automakers representing 72 percent of US sales show they are more cautious in their support for feebates, the specific program design being a key determinant. Though in all cases, a national program would be favored over a state or regional program. Automobile dealers are generally opposed to feebate programs due to concerns about administrative burdens, potential revenue losses, and perceived reductions in consumer choice by the government.

Overall, our study suggests that feebates do have the potential to provide California with additional greenhouse gas emission reductions at negative cost, however this effect will depend on the design of the feebate program and stringency of concurrent GHG standards. Considerations in designing this program include not only incremental benefits but also impacts on consumer welfare, vehicle sales, and stakeholder concerns. Designing the program in a way to assure revenue neutrality in light of uncertain future economic conditions is also a key consideration. In addition, any program would need to be carefully coordinated with other state and federal policies to reduce greenhouse gas emissions from passenger vehicles.

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1 WHY FEEBATES? – BACKGROUND AND RESEARCH OBJECTIVES

This interim report summarizes results from a research project sponsored by the Air Resources Board (ARB or Board) on a specific type of economic incentive policy known as feebates. Although there are many possible types of feebate policies, for this project they all share the following basic definition:

A **feebate** is a market-based policy for encouraging greenhouse gas (GHG) emission reductions from new passenger vehicles by levying fees on relatively high-emitting vehicles and providing rebates to lower-emitting vehicles.

The purpose of the project is to provide a comprehensive study of feebates that meets the decision-making needs of ARB by addressing issues essential to the practical design and implementation of a feebate program for California. ARB commissioned a request for proposals in fall 2008. Proposals from two University of California research teams (Davis and Berkeley) were combined into a single research project, and work began in February 2009. Additional work, including the compilation of a Final Report, is still underway. The remainder of this section gives additional background, and reviews project tasks and objectives.

1.1 Motivation

The California Global Warming Solutions Act of 2006 (AB 32) calls for the state's greenhouse gas (GHG) emissions to return to 1990 levels by 2020. On December 12, 2008 the Board approved a Scoping Plan (Plan) that provides policy recommendations and estimates of emission reductions for individual sectors of the California economy. The largest contributor is the transportation sector, which produces 38% of GHG emissions in California. Passenger vehicles are estimated to produce 74% of the emissions from California's transportation sector.

The Scoping Plan specifically discusses two policies for reducing passenger vehicle emissions through improved vehicle technology. The first (Pavley) is based on legislation (AB 1493, Pavley) passed in 2002 that sets emissions standards for new vehicles sold in California through 2016. The second (LEV III-GHG)¹ would set additional restrictions for model years 2017-2025. The target for the combined policies is a 31.7 MMTCO₂E² reduction below 2020 business-as-usual (BAU) levels. However, these policies require waivers from the Environmental Protection Agency (EPA) under the Clean Air Act. At the time the Scoping Plan was developed, the existing Pavley I policy had not received a waiver. Because of uncertainty over these policies, the Scoping Plan also directed that an alternative policy option (feebates) be considered as a possible *replacement* for Pavley I and II. Feebates were also to be evaluated as a possible *complement* to these policies to achieve further GHG reductions. Because the Pavley I waiver was granted in 2009, use of feebates as a replacement for Pavley I is now of secondary importance.

Although not specifically discussed in the Scoping Plan, this study also explores potential implications of California's historic leadership role in areas related to emissions reduction policy. For example, at one point in time thirteen other states (Arizona, Connecticut, Maine, Maryland, New Hampshire, New Jersey, New Mexico, New York, Oregon, Pennsylvania, Rhode Island, Vermont, and

¹ More specifically, these light duty GHG standards are to be part of the California Low Emission Vehicle program, and are abbreviated as "LEV III-GHG".

² Million metric tons CO₂ equivalent.

Washington, collectively referred to as “Opt-In States”) indicated intent to exercise their option under the Clean Air Act to adopt California’s Pavley emissions standard. If California were to implement a feebate program and other states were to follow by adopting similar measures, this would be expected to have implications for the effectiveness of feebates within California, as well as reduced GHG emissions in other parts of the United States.

1.2 *Feebate Policy Options*

One simple description of the project’s main research objective is: (i) formulate alternative feebate policy options, and (ii) evaluate and compare the options. To provide a basis for discussion, we review basic design elements of feebate programs that, when combined, yield specific policies.

The first requirement is an *efficiency criterion* for defining a feebate. Our study uses the CO₂-equivalent emission rate of a vehicle, measured as grams of CO₂ per mile (or simply g/mi). Generally, a feebate policy requires the following:

- A **benchmark** that defines which vehicles receive fees and which receive rebates.
- A **functional form** and a **rate parameter** (or parameters) that determine payment amounts.
- A **locus of monetary transactions** to determine how and when rebates and fees are actually transferred at the time a new vehicle is purchased.

In addition, practical details of how a program is introduced and implemented are important. The following discussion provides a review of these design elements in more detail.

1.2.1 *Structure of benchmarks*

Perhaps the simplest possible feebate policy is to use a **single benchmark** for all vehicles, combined with a single rate parameter, so that a feebate amount is given by the simple equation:

$$\text{Feebate} = \text{rate} * (\text{emissions_rate} - \text{benchmark}),$$

where *rate* is in units of dollars per gram per mile (\$/g/mi), and the *emissions_rate* and *benchmark* are measured in grams per mile (g/mi). For example, consider a policy with a rate of \$20/g/mi and a benchmark of 300 g/mi (~ 30 mpg). A new vehicle emitting at a rate of 350 g/mi (~25 mpg) emits *more* than the benchmark, and would be assessed a *fee* of 20*(350-300) = \$1,000. A vehicle emitting 250 g/mi (~36 mpg) would be assessed a fee of -\$1,000, i.e., it would receive a \$1,000 rebate (a negative fee is the same as a rebate).

Simple movement of the benchmark changes the net flow of fees and rebates, and in many cases it would be politically attractive to set the benchmark so that **revenue neutrality** is attained. Options for benchmarks considered in this study include:

- Single benchmark
- Two benchmarks (one for passenger cars, one for light duty trucks)
- Footprint-based benchmark(s)

For a footprint-based benchmark, the benchmark is assigned on the basis of a vehicle’s size as measured by its footprint, defined to be: wheelbase x track-width. The new national emissions standards are based on two footprint curves (one for passenger cars, and one for light-duty trucks) that assign a benchmark for each footprint value (yielding literally hundreds of benchmarks).

There are arguments for/against the benchmark options. A single benchmark is “fair” in that it represents an absolute standard that is the same for all vehicles. In addition, theory suggests that this approach could yield larger improvements than the others. However, some consider it “unfair” because some consumers (e.g., large families, self-employed service providers) are forced to pay a fee because they “need” a larger vehicle. Moreover, there is a concern that a single benchmark could impact manufacturers in different ways, depending on the types of vehicles they sell. The footprint approach addresses both of these issues by establishing benchmarks as a function of size, although it increases the complexity of the program. The two-benchmark system can be viewed as lying between these two systems. An objective of this study is to examining the tradeoffs among these systems in more detail.

1.2.2 Functional form and rate

A second design element is how fees/rebates vary as a function of distance away from the benchmark. In the previous simple example, the functional form is a straight line and the rate represents the marginal value of reducing a vehicle’s GHG emissions by one unit. A straight-line functional form values every gram of CO₂ equally. Options for functional forms include:

- Straight line (linear)
- Piecewise linear (segments that change rate)
- Step function

These are illustrated in Figure 1.1 below. These forms can be combined to include specified maximum and/or minimum values, and also a “donut hole” where there are no feebates over a specified range. Some consider step functions to be easier for consumers to understand, and this has been a matter of some discussion. However, a drawback is that the feebate changes abruptly at certain specific values of the emissions rate, so that two vehicles that are almost identical could have very different feebate levels. The section on Lessons Learned gives examples of all three of these functional forms, and discusses tradeoffs among alternative functional forms.

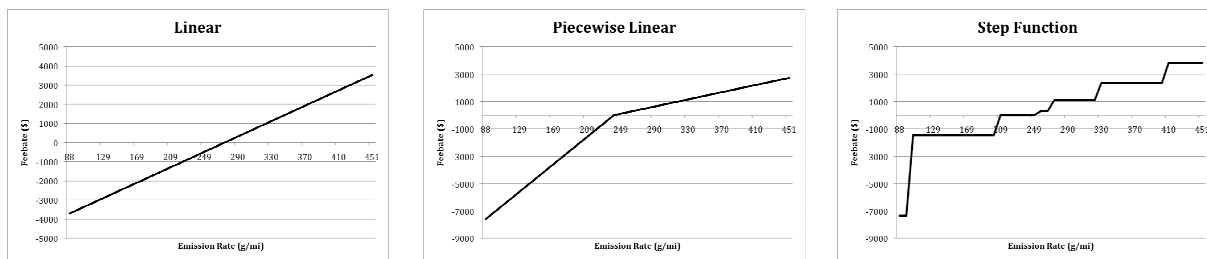


Figure 1.1 Three Feebate Functional Forms

When considering the effect of the feebate rate, the simplest case is the earlier example of a linear function with a single benchmark. The rate (denoted by R) represents the change in vehicle purchase price per unit of improvement in the emissions rate (in g/mi). Vehicles emitting more emissions than the benchmark will be assessed a fee that will cause sales to decline, and vehicles emitting less emissions than the benchmark will receive a rebate that will cause sales to increase. All other things equal, increasing R will magnify the effect on sales.

1.2.3 Point of regulation/locus of transaction

Another essential design question is the manner in which feebates will be transacted. Feebates may be enforced at the level of the vehicle manufacturer, in which case there will be a small number of parties involved and most “transactions” will be internal to the firm. However, this does *not* mean

that the feebate is being applied to the manufacturer rather than the consumer. Any feebate would appear as an additional line item on the vehicle label, and would effectively represent a change to the vehicle's purchase price.

Alternatively, feebates could be made a part of the transaction between dealers and customers. This would greatly increase both the number of transactions and the volume of revenue flows but could possibly have a greater impact on consumer decision-making. Finally, there could be systems where consumers are required to process their feebate transactions directly with a government agency.

1.2.4 Implementation strategies

Another element potentially affecting the success of a feebate policy is the way that it is introduced. A feebate policy could be implemented either abruptly, or with prior notice given to manufacturers and consumers. A delay between the announcement and implementation of the policy gives manufacturers time to adapt, but could also have the initial perverse effect (in the short term) of causing consumers to buy higher emission vehicles that would soon be charged a fee. Similarly, they could delay the purchase of lower emission vehicles until the rebates become available.

Other considerations include whether to phase in different elements of the system at different times, e.g., beginning with rebates and adding fees later (or vice-versa), gradually increasing the number of vehicles subject to the program, etc. Finally, there are practical issues on how to manage revenue flows, especially if conditions in the market change dramatically due to, e.g., volatility of energy prices, technology breakthroughs, etc.

1.3 Assumptions, Policy Environment, and Evaluation

The likely impact of feebate programs on greenhouse gas emissions for the study's planning horizon (2011-2025) depends critically on a wide range of factors that will affect the future new vehicle market. Quantitative projections require assumptions about the decision-making behavior of both consumers and vehicle manufacturers, and also the policy environment in which these decisions are being made. Specifically, future emissions performance standards can play a major role; however, the form and stringency of these standards through 2025 are far from certain at this time. In fact, current and expected near-term policy conditions have *already changed multiple times during the course of this project*. Details about the study's working assumptions for quantitative policy analysis appear in a later section. However, to provide additional background on the policy environment we review elements of the AB 32 Scoping Plan that were taken into consideration by our study.

Emissions standards can be summarized in terms of the *average emissions rate* of new vehicles sold for a given model year. The timing and amount of actual *emissions reductions* depend on how the vehicles are driven over their lifetimes. Evaluating feebate programs on basis of these same measures requires a baseline (or reference) policy for comparison. The Scoping Plan specifies anticipated reductions in terms of both measures. The following facts are relevant for establishing a reference policy scenario:

- Pavley uses two "benchmarks". It requires that new passenger cars and trucks up to 3750 lbs emit less than 205 gCO₂E per mile by 2016. For light-duty trucks 3750-8500 lb the limit is 332 gCO₂E/mi. ARB anticipates the fleet-wide average to be 243 gCO₂E/mi. The emissions reductions from this policy are estimated to be 27.7 MMTCO₂E.

- A national standard has been proposed that goes through 2016. It is based on two footprint curves (one for passenger cars, and one for light-duty trucks), and is expected to yield a new vehicle fleet-wide average of 250 gCO₂E/mi (roughly similar to Pavley).
- There is nothing in currently proposed policy to indicate what national emissions standards would be after 2016.
- A LEV III-GHG standard, if implemented, would start in 2017 and go through 2025. Although there are rough projections of emissions reductions from this standard (4 MMTCO₂E in 2020, growing to 27 MMTCO₂E by 2030), there is little information on what the form and new vehicle emissions averages might be. Moreover, LEV III-GHG would require a waiver from the EPA, so its future is uncertain.

To address the need for a reference policy scenario over the entire period (2011 to 2025), the study makes the following assumptions:

- The currently proposed national emissions standards are used for 2011-2016. Because the national standards were designed to harmonize with the California program, we consider them to be a reasonable substitute.
- The period 2017-2025 requires an assumption for national emissions standards. In consultation with ARB staff, our study adopts a Reference Policy that assumes a 2% reduction per year starting in 2017.

This reference policy scenario, denoted the *2% National Standard* scenario, is used to make baseline projections. Projections for the *2% National Standard plus a feebate program* are then compared to the baseline to evaluate how the feebate program might *complement* emissions standards. There is also an interest in the feasibility of using feebates as a *substitute* for future emissions standards. To examine this, we use an alternative scenario that assumes national standards *stay at 2016 levels* for 2017-2025. Because this corresponds to a 0% reduction starting in 2017, this is denoted the *0% National Standard* scenario. Details and results of quantitative analyses are provided in section 3.

We add a few final remarks about evaluation. As noted, one direct measure of feebate effectiveness is the reduction in average emission rates for new vehicles. The most obvious mechanism for achieving this is by inducing sales shifts to more fuel-efficient vehicles. However, the feebate literature has found that a potentially more important effect could be on manufacturers' vehicle redesign decisions over time. An important aspect of our study is that it specifically takes into account both of these mechanisms.

1.4 Overview of Research Tasks and Methodologies

The following is a brief overview of the research tasks performed in this study. Results of these efforts make up the remainder of this summary.

1. Compile case studies on real-world policies to identify any lessons learned. The team compiled ten case studies on a range of feebate-related policies (i.e., economic incentive-based policies related to vehicle purchase and use). Four studies of recently implemented “true feebate systems” are summarized here, with details on all cases appearing in the final report. These address the potential effectiveness of feebates, as well as providing insights on feebate design issues.

2. Develop specific feebate policy options to be evaluated. Feebate policy design elements are combined in different ways to generate specific policy options. There are virtually an infinite numbers of combinations that could be considered. The team developed and prioritized options based on input from a public forum, and consultation with ARB staff.

3. Compare policy options based on quantitative projections of future outcomes. A Feebate Analysis Model was developed specifically for this project. Vehicle redesign and pricing choices by manufacturers as well as consumer response in the new vehicle market are simulated under alternative policy options, yielding estimates of relative impact on average emissions rates of new vehicles, total emission reductions, and social costs and benefits.

4. Determine possible responses of key stakeholders to feebate programs. Focus groups and a statewide survey of consumers were conducted. Personal interviews were conducted with new vehicle dealers, vehicle manufacturers, and feebate program experts, and additional stakeholder feedback was obtained through public workshops early in the project.

5. Assess implications for feebate policies with larger market coverage beyond California. California represents only about 10% of the domestic automobile market, so the potential impact of feebate policies on manufacturer vehicle design decisions could be limited. However, if other states were to adopt feebate policies (or if there were a nationwide feebate policy), the potential could greatly increase. Our research explored this aspect of feebates.

Other research tasks include the estimation of administrative costs, economic and fiscal impacts, an exploration of equity implications, and potential interactions between feebates and other AB 32-related policy initiatives. Results of this work are summarized in the remainder of this report, followed by a discussion and conclusions.

2 HOW WELL HAVE FEEBATES WORKED ELSEWHERE?

Feebate policies have been discussed for quite some time, but until recently there has been very little real-world experience with them. Our final report includes ten case studies related to economic incentives for new vehicle sales. In this summary we focus on four “true feebate systems” (also called “bonus/malus” programs) from the following countries: Denmark, France, the Netherlands, and Norway. The remaining studies (which include Canada, Germany, Spain, Sweden, and the UK) primarily document various types of vehicle-related taxation schemes.³

It can be challenging to draw definitive, bottom line conclusions from case studies. For example, providing detailed quantitative estimates of emission reduction totals, fee and rebate amounts for different vehicle types, etc., would be challenging under the best of circumstances, and well outside the scope of our study. Moreover, in a complex policy environment it can be difficult to disentangle outcomes and identify which ones are specifically due to a feebate program. However, we do have aggregate level data on new vehicle emission rates from both before and after the introduction of feebate policies. In all four cases these measures provide at least some evidence to suggest that feebate policies played a role in reducing average vehicle emissions. Details are reviewed below. More generally, the four cases offer real-world examples of a variety of feebate design elements

³ The omitted cases include studies of various tax incentive plans that are not “true” feebate systems because they do not provide rebates/subsidies in conjunction with fees/taxes.

adopted by policy makers (e.g. type of benchmark, functional form, feebate rate), as well as subsequent events in response to these design elements.

2.1 European Context

All four cases involve European countries. The European context and the complex policy landscape faced in these countries can make a direct comparison with California a bit difficult. For example, three of the four countries belong to the European Union (EU), which has its own independent policy-making activities related to greenhouse gas emissions. Policymakers must contend with conditions in their own countries, as well as the implications of belonging to the EU. More generally, European countries have been much more aggressive in this arena than the United States with regard to greenhouse gas emissions standards.

In April 2009, the European Commission enacted *mandatory* CO₂ emissions standards for passenger vehicles of 130 g/km [209 g/mi, or 42.5 mpg] by 2012 after automakers failed to achieve their voluntary reduction targets. These standards apply to 65% of each manufacturer's new passenger cars in 2012 and will increase to 100% of passenger cars in 2015. From 2020 onward, the emissions target is 95 g/km [153 g/mi, or 58.1 mpg], though the details of the path to this target have not yet been defined.

As a point of comparison, the Pavley standard is 233 g/mi in 2012 for passenger cars and 361 g/mi for light-duty trucks (3751-8500 lbs).

2.2 Feebate Case Fact Summary

A detailed discussion of each case appears in the final report; for this summary we provide a short list of facts from each. These give a sense of the range of feebate program design features that have been adopted by policy makers to address their own particular concerns, and also add real-world context for the discussion in later sections.

Denmark

- Introduced June 2007 as a modified registration tax
- Single benchmark = 150 g/km (241 g/mi)
- Benchmark expressed to the public in terms of fuel economy
- Two straight lines (linear) -- different rates (slopes) for fees and rebates:
 - \$50/g/mi for rebates
 - \$13/g/mi for fees

France

- Introduced December 5, 2007 (rebate only)
- Fee part added January 1, 2008
- Benchmark in 2009: "Donut hole"⁴ from 130-160 g/km (193 – 257 g/mi)
- Benchmark in 2012: "Donut hole" from 130-140 g/km (193 – 225 g/mi)
- Functional form is a step function with 9 levels
- Shape of step function yields an approximate "rate" of \$16.5/g/mi

⁴ A donut hole is zone where vehicles would neither be charged fees nor awarded rebates.

Netherlands

- Introduced July 2006, revised February 2008
- Benchmarks based on footprint/class of vehicle
- Step function with 7 steps
- Complexity precludes simple description of a feebate rate
- While this study was being completed in 2009, it was announced that the system would be abandoned in 2010 in favor of a single benchmark

Norway

- Began taxing CO₂ in January 2007, with a rate change in January 2008
- Rebate added in January 2009 to yield a full feebate system
- Single benchmark = 120 g/km (193 g/mi)
- Functional form is four line segments with different rates
 - Rebate = \$52/g/mi
 - Initial fee rate = \$55/g/mi
 - Fee increases to a maximum rate of \$259/g/mi

2.3 Comparison of Design Features

The four cases provide an opportunity to compare and contrast the relative merits of a variety of feebate system design features.

Benchmarks

Three of the four countries opted for a *single benchmark* system. The Netherlands started out with a footprint-based system, but has since abandoned it for a single benchmark. It is interesting to note that this was done due to consumer sentiment. Their research indicated that consumers thought the footprint system was too confusing and complicated. In addition, they did not like the fact that a larger, higher emitting vehicle could receive a rebate, while a smaller, lower emitting vehicle would be charged a fee. In contrast, France's single benchmark system created concerns about fairness to large families that "need a larger vehicle," and the system has since been modified to include subsidies to address this issue. With regard to the benchmarks themselves, Norway currently has the most aggressive benchmark (120 g/km, or 193 g/mi), which corresponds to the EU's original voluntary 2012 target.

Functional Forms

France is the only country with a step function rather than straight lines. This choice was based on the belief that step functions are "easier for consumers to understand." In addition, France has a donut hole for the range 130-160 g/km (note that 130 g/km is the EU's mandatory target for 2012), where vehicles are exempt from both fees and rebates. One argument in the literature is that consumers might be more accepting of a feebate system if there is a range of vehicles that is unaffected by the feebate policy. A donut hole fits naturally within a step-function-based system (although it is not precluded by other functional forms).

In contrast to France, Denmark and Norway use straight lines. However, rather than use a single slope (feebate rate) both have opted for more complicated systems with multiple line segments with varying slopes. Interestingly, in Denmark fees have a lower rate than rebates, whereas in Norway rebates have a lower rate than fees. In Norway there are multiple segments for fees, with fee rates dramatically increasing for vehicles with higher emissions.

Figure 1.2 depicts the feebate systems of Denmark, France, and Norway (the complexity of the footprint-based Netherlands system precludes its inclusion in this comparison). Note that the fee rates for Norway are so steep that most of the function cannot be included in the figure. For comparison purposes, we have also added a linear feebate function with a \$20/g/mi rate and a single benchmark (274 g/mi) similar to those used in our quantitative modeling for California. This illustrates the general similarity between the type of feebate policies in our study and those currently in use.

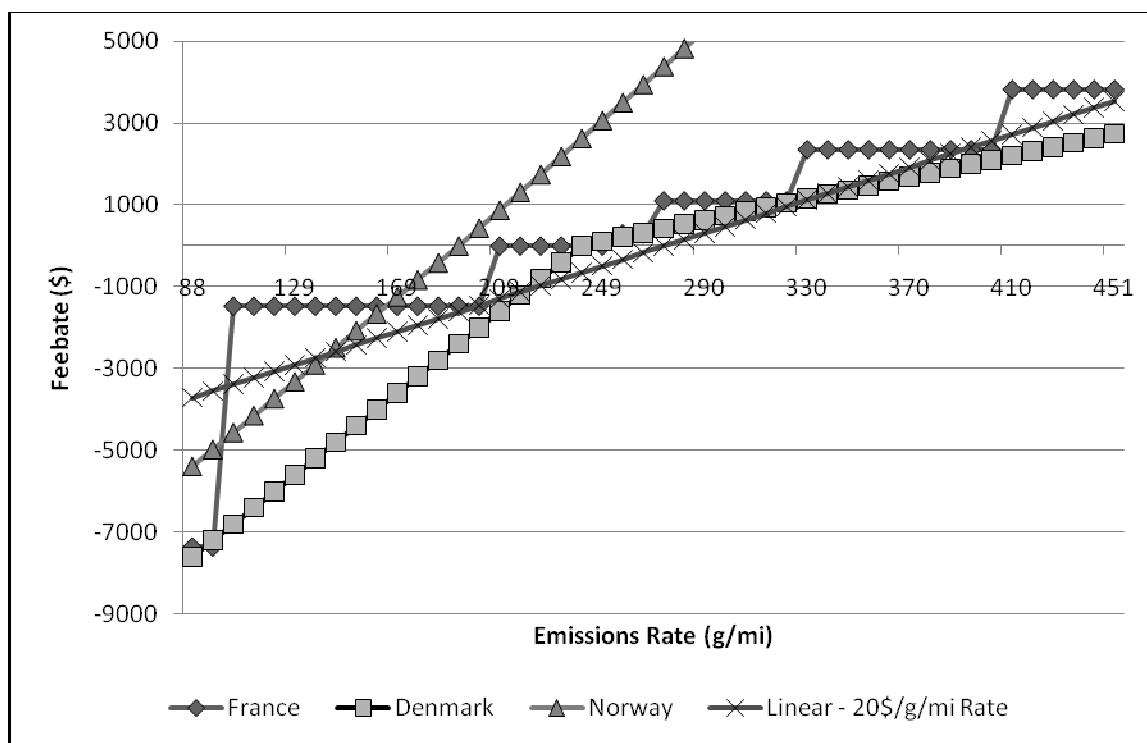


Figure 2.1 Comparison of Feebate Functions

2.4 Assessment of Effectiveness

Given available data, the most practical approach to assessing feebate program effectiveness uses average new vehicle emission rates. For the time frames considered here, a successful feebate program would yield a decrease in average new vehicle emissions by causing a shift in consumer purchases. The following figures show average new vehicle emissions before and after the introduction of feebate programs in Denmark, France, and Norway, respectively. One complication is that there were also sizeable changes in fuel prices during this period. Even so, the basic shapes of the curves suggest clear shifts associated with the introduction of feebate programs.

Emissions averages for Denmark are provided in Figure 2.2 for gasoline and diesel separately, and also combined. The shift is smaller for diesel than for gasoline, with the latter taking on a value of roughly 18 g/km (26 g/mi). Figures 2.3 and 2.4 for France and Norway suggest shifts of 7 g/km (~11 g/mi) and 10 gm/km (~16 g/mi) respectively. Note: The data for Norway correspond to the the conversion of the vehicle registration tax in January 2007 to include CO₂, followed by the offer of rebates beginning in January 2009. The case of the Netherlands is a bit more complicated, and

we leave the details to the final report. However, those results also suggest that their feebate policy helped to reduce greenhouse gas emissions.

So, to conclude: Our study has compiled data to support the position that feebate programs in other countries have led to a reduction in average new vehicle emissions.

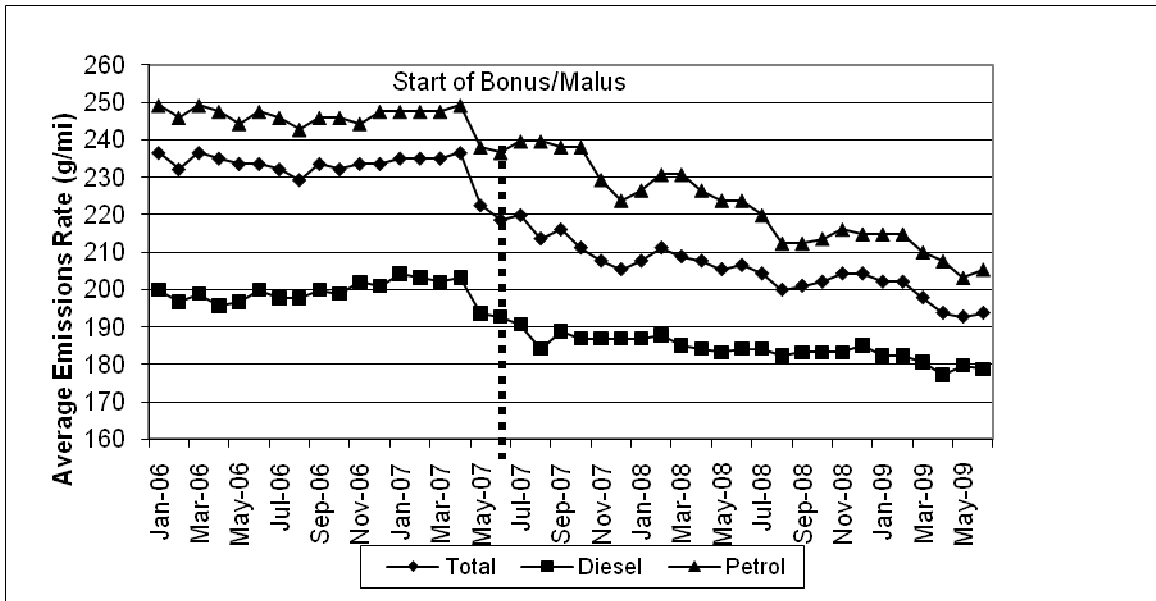


Figure 2.2 Effect of Bonus/Malus in Denmark on New Vehicle Average Emissions Rates

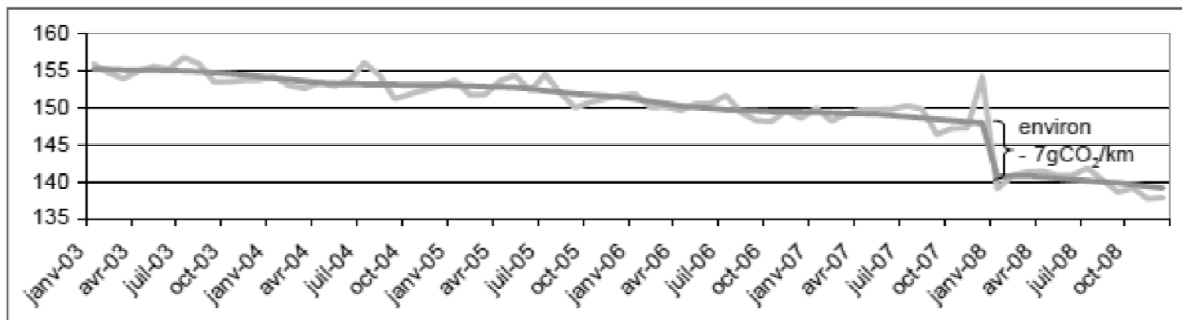


Figure 2.3 Effect of Bonus/Malus in France on New Vehicle Average Emissions Rates (grams CO₂ per km)

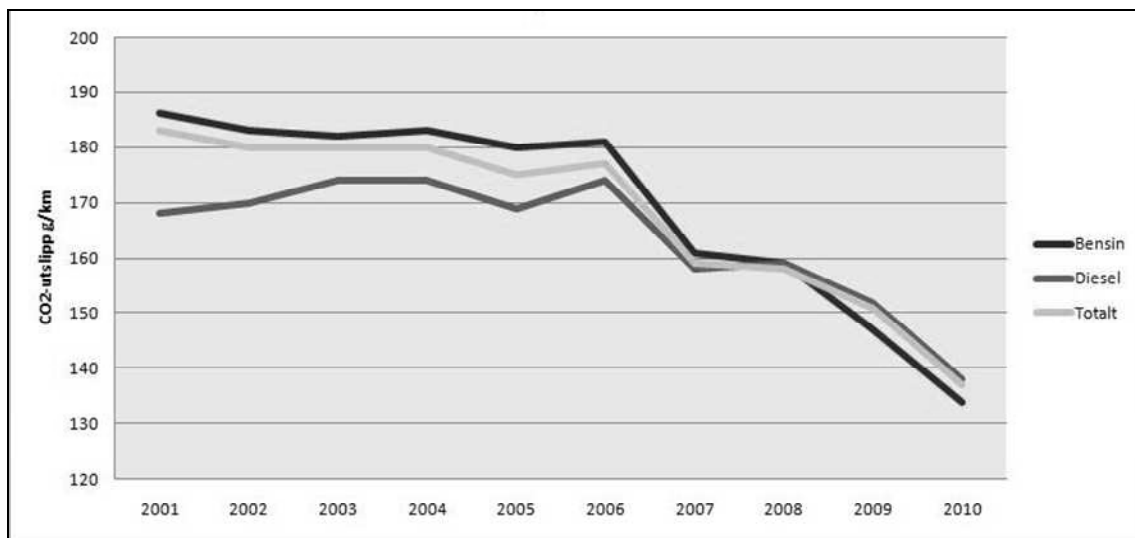


Figure 2.4 Effect of Conversion to CO₂ Registration Tax and Feebate Program on Average New Vehicle Emissions in Norway through January 2010 (Bensin = Gasoline)

3 HOW WELL CAN FEEBATES WORK TO REDUCE EMISSIONS IN CALIFORNIA?

Under the assumptions adopted in this study, feebate policies *can* be used in California to achieve *additional reduction of greenhouse gases* from new passenger vehicles beyond those projected under national emission standards alone. However, the size of the reduction is not large when compared to the impact of emissions standards. For example, the total reduction in 2020 from a feebate program is projected to be in the 3-4 MMCO₂E range, versus the 31.7 target for the combined Pavley I and II standards. A major finding is that, because California represents only 10% of the new vehicle market, a California-only feebate policy is likely to have minimal influence on vehicle design decisions. Conversely, our results highlight the critical role that national emissions standards would play in influencing manufacturers' decisions to reduce vehicle emission rates: the increased availability of improved vehicles creates more rebate options, contributing to the potential effectiveness of feebate programs. Finally, we emphasize again that these and other findings always depend on the modeling assumptions, which we discuss first before summarizing findings in more detail.

3.1 *Feebate Model Overview*

A Feebate Analysis Model was developed to provide quantitative projections of market behavior and emissions reductions in response to possible feebate policies in California. An important aspect of feebate (and other) policies is their potential to affect future vehicle technology adoption decisions by manufacturers. We assume that when manufacturers make these decisions they take into consideration the overall response of the entire domestic (United States) new vehicle market, and the national policy environment. For this reason the Feebate Analysis Model has a two-tier structure. The top tier is a Manufacturer Decision Model (MDM) that simulates design decisions for new vehicle offerings for the period 2011 to 2025. We also assume that manufacturers are unlikely to produce "California only" vehicle configurations. At the same time, manufacturers would be expected to take into account policy changes unique to the California portion of the market when making their overall design decisions. To include this effect the MDM divides the U.S. market into two sub-markets: California and "Rest of U.S." The bottom tier of the Feebate Analysis Model is a California-specific model that supports more detailed examination of policy impacts on the

California vehicle fleet (both new and used) for multiple consumer groups. It takes as given the vehicle configuration projections produced by the MDM.

In the MDM, manufacturers can use available conventional and/or hybrid technologies with specified cost curves to make emissions improvements to individual vehicles⁵. They decide on the timing and amount of these improvements. They can also choose to change vehicle *pricing* to shift the new vehicle sales mix. These decisions are made on the basis of anticipated consumer response, the requirement to meet specified emission performance standards, and any feebate program that might be introduced.⁶ The MDM provides projections of new vehicle attributes and offerings for the entire U.S., as well as projections on new vehicle sales, average emission rates, etc., for both sub-markets. Overall response to California feebate policies can be evaluated using these results. The bottom-tier California model can be used for more detailed analysis (e.g., the impact on individual consumer groups, or on the used vehicle market).

3.2 *Feebate Model Assumptions and Reference Policy Scenario*

As noted previously, results depend on modeling assumptions. Model development required adoption of base case modeling assumptions, including behavioral assumptions for both manufacturers and consumers, and a reference policy scenario to provide a baseline for policy comparison. Examples of base case assumptions for our model include cost curves for conventional and hybrid vehicle technologies, projections of future economic factors such fuel prices and new vehicle sales levels, and, importantly, behavioral assumptions on consumer preferences for new vehicles. Two key elements in an economics-based market response model are: the value placed on fuel savings by consumers, and their responsiveness to vehicle price changes.

The consumer demand model in the MDM assumes that consumers evaluate the first three years of fuel savings when deciding what vehicle to purchase. It also assumes the existence of vehicle market segments, where vehicles within the same segment are closer substitutes than those in different segments. This means that consumers responding to a price increase for their preferred vehicle are more likely to switch to another vehicle in the same segment. The MDM consumer demand model uses a pattern of price sensitivities (or, elasticities) based on values taken from the literature.

Finally, the model adopts a reference policy as a baseline for comparison. The defining element is a national emissions standard for 2011-2025. As discussed in section 1.3, we adopt the currently proposed national standard for 2011-2016, and assume that from 2017-2025 the emissions target continues to decrease at a rate of 2% per year. This reference policy scenario is denoted the *2% National Standard*. Because future standards remain uncertain after 2016, other scenarios can be conveniently specified by changing the post-2016 rate of reduction. One potentially interesting alternative assumes a 0% reduction rate after 2016 (the *0% National Standard*), i.e., the national standard stays flat at the 2016 rate for 2017-2025. This would occur if there are no future national policy changes beyond those currently proposed. The MDM can also model emission standards that apply only to California or the Opt-In states.

⁵ Cost curves were provided by K. G. Duleep.

⁶ The model also takes into account allowances for Air Conditioning and Flex Fuel Vehicle credits that can be used to meet emissions standards.

Figure 3.1 shows MDM projections of average new vehicle emission rates (in g/mi) in California for the 2% and 0% National Standards. For the 2% National Standard, average emissions from new vehicles in California decline from 303 g/mi in 2011 to 215 g/mi in 2025 (about 30%).⁷ New vehicle emission averages (not shown) are higher in the Rest-of-US than in California: they are 5 g/mi higher in 2011, with the gap shrinking to 1 g/mi in 2025. One finding we consider noteworthy is that under the 2% National Standard, manufacturers can be said to “run out” of cost effective technology in 2022. Starting in 2023, manufacturers choose to meet the emission standard by using vehicle pricing to change the sales mix of vehicles. The other option would be to redesign vehicles with additional emissions improvements; however, they chose not to do so for economic reasons.

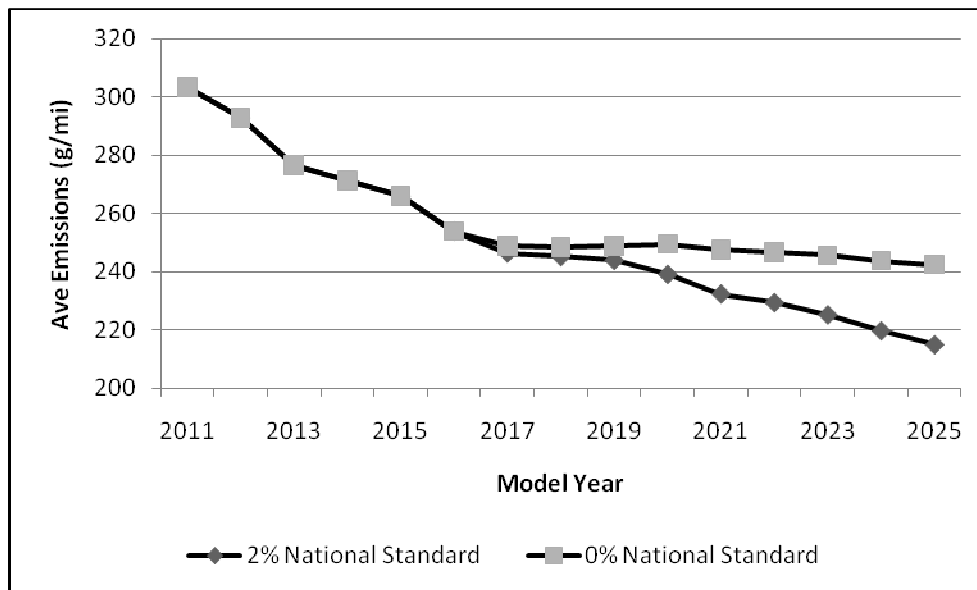


Figure 3.1. Average new vehicle emission rates in California for two national emission standards

The 0% National Standard scenario provides an interesting comparison. It represents the laxest possible post-2016 national standard that does not allow emissions levels to go back up. In later years technology becomes less expensive, and fuel prices are projected to increase. Under these circumstances there is at least the *possibility* that manufacturers might choose to design vehicles that yield emissions levels better than the national standard in response to consumer preferences. However, these results show that, even under a standard that “goes flat” in 2017, manufacturers would still design their vehicles to meet the standard. It is important to note that this outcome is a consequence of the entire set of base case modeling assumptions. For example, if consumers were to place a higher value on fuel savings, or if fuel prices were much higher, or if vehicle technology were less expensive, manufacturers might choose to design vehicles that would overcomply with the standard.

⁷ The 2016 average (254 g/mi) appears to be a bit higher than the national/Pavley targets. However, because the MDM incorporates provisions on air conditioning and flex-fuel vehicle credits, manufacturers are actually in compliance.

3.3 Evaluation and Comparison of Feebate Policies

Our study compares a large number of feebate policy options by combining various design elements described in the introduction. Two main design elements are: Type of benchmark, and feebate rate. As discussed previously, choosing a benchmark system requires consideration of tradeoffs, whereas the feebate rate primarily effects the strength of the response. In the next sections we evaluate feebate programs for three different benchmark systems using a baseline feebate rate of \$20/g/mi. Discussion of the sensitivity to higher or lower rates is reserved for the final report. Outcome measures for evaluating the overall impact of policies include:

- New vehicle emissions averages
- Sales mix and sales levels
- Effect on consumer welfare
- Total reduction of CO₂
- Social costs and benefits associated with CO₂ reduction

3.3.1 Emissions Reductions

A key design issue is the type of benchmark system to use. The literature suggests that they can differ in overall effectiveness, and on their impact on individual stakeholders. Although the level of the feebate rate is also important, it primarily magnifies (or reduces) the effect of a system if the rate were to be increased (or decreased). Results in this section address both the overall effectiveness of feebates as well as the relative effectiveness of different benchmark systems. Equity-related issues are addressed in other sections.

Figure 3.2 examines the effect on California average new vehicle emission rates of three feebate systems introduced under the 2% National Standard scenario. Results are reported as *changes* from the levels in Figure 3.1 (negative values imply a reduction in the rate). Each system uses the same feebate rate of \$20/g/mi, roughly equivalent to a carbon price of \$200 per tonne of CO₂. As mentioned earlier, this rate is comparable to those used in similar programs in Europe. The solid lines denote the total change. (Dashed lines are discussed below). The first is a footprint-based system patterned after the proposed 2011-2016 national emissions standard [diamonds]. Specifically, the system uses two benchmark curves: one for passenger cars, and one for light-duty trucks. The second system uses a single benchmark value for all vehicles [squares], and the third uses two benchmark values (one for passenger cars, and one for light-duty trucks)[triangles]. Note that when simulating these systems the MDM seeks a *revenue neutral* version of each system by allowing benchmark values to vary from year to year.⁸

These results are consistent with what has been found in other studies. The effect is largest for the single benchmark system (an average 14 g/mi reduction for the period 2011 to 2020, the year for which AB 32 targets are specified), and smallest for the footprint system (an average 10 g/mi reduction for 2011-2020). In later years the level of GHG emissions reduction relative to the standard diminishes as the standard becomes more stringent. These emissions *rate* reductions can

⁸ The MDM includes an estimate of program administrative costs (discussed in a later section), as well as rebates for ZEV vehicles mandated in California. Benchmarks are found so that these expenditures plus the net fees and rebates for new vehicle sales are revenue neutral over the entire life of the program.

be used to estimate *total* emission reductions in California (versus the Reference Standard case) for the year 2020 for comparison with AB 32 targets:

- Single benchmark => 4.4 MMTCO₂E reduction
- Car/truck benchmark => 3.9 MMTCO₂E reduction
- Footprint => 3.3 MMTCO₂E reduction

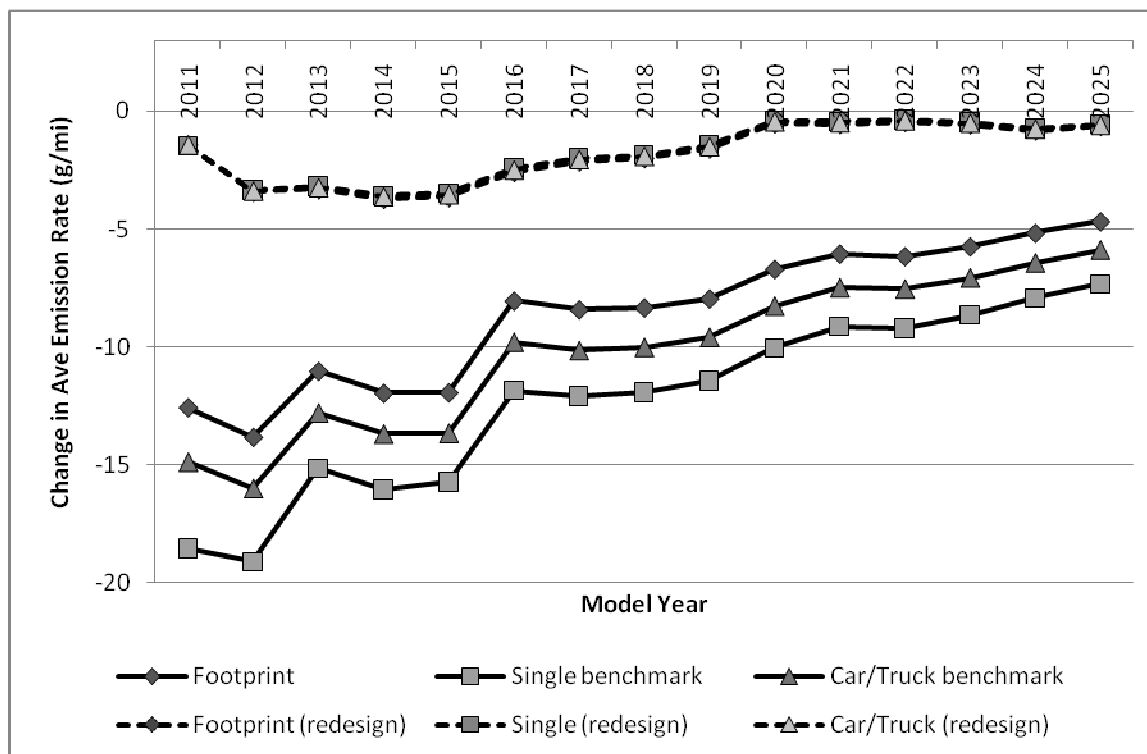


Figure 3.2. Change in California average new vehicle emission rates from feebates for three benchmark systems (total change, and portion of change due to vehicle redesign).

These totals are based on MDM projections of new vehicle sales for 2011 to 2020, the average emissions rates for new vehicles sold in those years, and assumptions on average miles driven in 2020 for new vehicles sold for 2011-2020. These figures are simple approximations that do not take into account other effects such as fleet turnover, etc., and should be viewed accordingly. These estimates suggest that feebate programs could be used to reduce emissions on a scale comparable to the discussions in the AB 32 Scoping Plan.

Another finding is that these feebate systems reduce average emissions *primarily by inducing sales-mix shifts*. The dashed lines in Figure 3.2 are estimates of the amount of change attributed to redesign. Although the feebate systems induce some redesign, the effect is rather small relative to the total. Moreover, the change due to redesign is about the same for all three systems, so that the differences are due to sales mix shifting. The average reduction for 2011 to 2020 model year vehicles due to design change is about 2.4 g/mi for all three benchmark systems, versus a 14 g/mi *total* reduction for the single benchmark (less than 20%). Moreover, *the effect becomes very small starting in 2020* (less than 5%). This is noteworthy because a widely-stated potential benefit of feebates is their potential to incentivize the introduction of new vehicle technology. Our view is that, because California is roughly 10% of the domestic new vehicle market, a California-only

feebate would lack the leverage to induce major design changes. Implications for feebate policies that extend beyond California-only are discussed in section 3.7.

To summarize, these results provide an evaluation of the three benchmark systems with respect to *emissions reductions*: Single benchmark yields the most, and footprint yields the least. However, a more complete comparison requires consideration of other factors. These include the overall impact on consumer welfare, and other social costs and/or benefits associated with the programs.

3.3.2 Consumer Surplus

One feature of the MDM is that it uses a consumer surplus (CS) measure in its calculations. CS can be viewed as a monetary measure of total consumer welfare (or utility) associated with the existence of the new vehicle market. It accounts for welfare from purchasing new vehicles (for those who do), as well as the opportunity to purchase (for those who do not). Changes in CS can be used to compare policies that alter market behavior.

Figure 5 shows the total change in CS for Californians under each benchmark system (versus the Reference Standard case). In all cases CS decreases, but there are systematic differences: the footprint yields the smallest CS reduction, and the single benchmark the largest. This is consistent with expectations: the footprint system has the most flexibility for producing patterns of fees and rebates that might satisfy the most consumers. The single benchmark is clearly the least flexible, and the car/truck benchmark is in between.

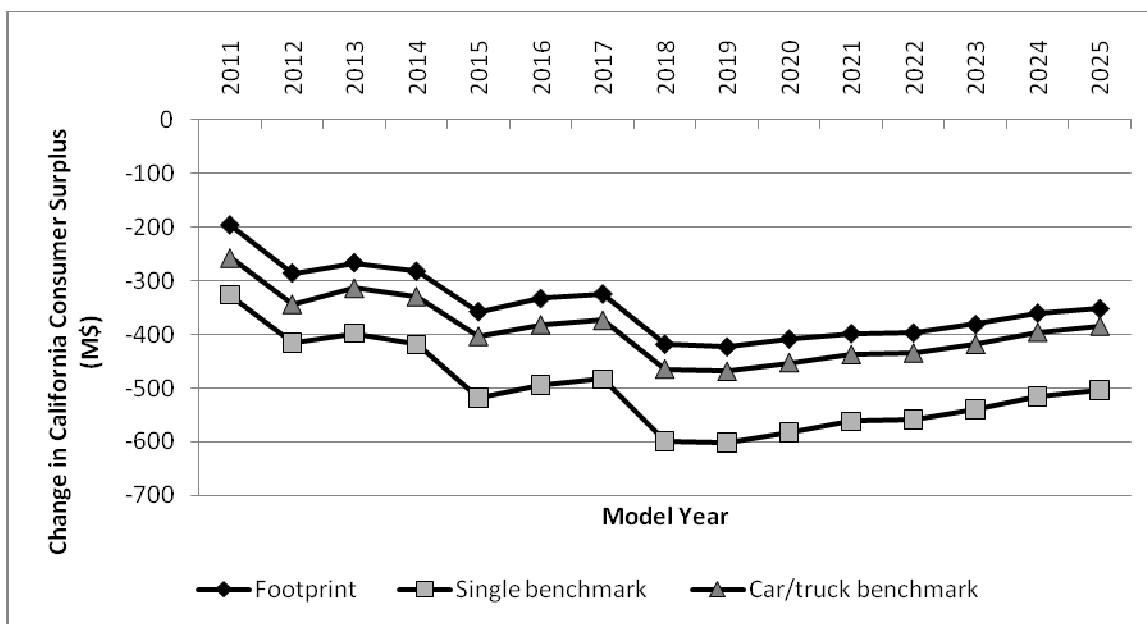


Figure 3.3. Change in California consumer surplus (\$M) for three benchmark systems (versus 2% National Standard scenario with no feebate policy)

In addition to emissions reductions and consumer surplus, another impact of feebate policies is the *social benefit associated with increased fuel savings*. Specifically, the MDM assumes that consumers value the first three years of fuel savings when making vehicle purchase decisions. This value therefore accrues to the consumer and is included in Consumer Surplus as a *personal* benefit. However, the expected lifetime of a vehicle is 14-16 years, and any additional fuel savings that accrue after the first three years will not be accounted for in the CS measure. The monetary value

of this additional fuel savings can be considered a *social benefit* for the purpose of making policy decisions, and it can be substantial.

Our analysis indicates that when all costs and benefits are taken into account, the monetary value of fuel savings outweighs other costs (including loss of consumer surplus, administrative costs, etc.) so that *all three feebate systems generate a net negative social cost*. In other words, in addition to reducing greenhouse gas emissions, feebates also generate net *positive* social benefits.⁹ Because emissions improvements are linked to fuel savings, the single benchmark system yields both the largest emissions reductions and the largest social benefit. Similarly, the footprint system yields the least. It is up to policy makers to evaluate whether this criterion should determine the choice of a benchmark system (if any), or whether other issues (e.g., equity considerations) should play a role.

3.4 *Feebates to Replace LEV III-GHG?*

To explore the concept of feebates as a replacement for LEV III-GHG we use the 0% National Standard scenario described earlier (see Figure 3.1). Specifically, we consider the case where the national standard is assumed to stay at 2016 levels through 2025, and a more stringent LEV III-GHG standard is introduced in California starting in 2017. The question is: What could be achieved if feebates were used as an alternative?

Our earlier findings suggest that manufacturers would be unlikely to respond with major emissions reductions in their vehicle designs. Figure 3.4 illustrates the effect on average new vehicle emissions of one of our previous feebate programs (a \$20/g/mi-footprint feebate in California starting in 2011) under a 0% National Standard. The 2% National Standard averages are included for comparison purposes. The feebate program averages prior to 2017 are the same for the 0% and 2% National Standard scenarios because the standards are the same during the period 2011-2016. For the period 2017-2020 the feebate yields larger emissions reductions than the 2% National Standard, providing an indication of the effectiveness of the feebate. For example, if the LEV III-GHG standard were roughly the same as the 2% National Standard, the feebate would be more than adequate as replacement during this period (particularly when cumulative effects are taken into consideration). However, obtaining emissions reductions that match (or exceed) the 2% standard would require higher feebate rates.

This example was provided to clarify the replacement issue. Using separate MDM runs, we also identified the schedule of feebate rates over time that would be required to *exactly match* a 2% emissions standard in California—see Table 3.1.

3.5 *Spillover and Leakage*

A frequently discussed issue for feebate systems is how they interact with markets outside the feebate region. There is the possibility of *spillover*, i.e., a feebate program within a region affects broader market conditions in ways that yield emissions reductions *outside* the feebate area. There is also the possibility of *leakage*, where emissions reductions inside the feebate region are offset by increased emissions outside the feebate region. One potential source of spillover would be a

⁹ Given that the usual objective is to find cost-effective policy options, it is noteworthy that these feebate programs yield negative costs.

feebate’s effect on manufacturer redesign decisions, which would alter vehicle offerings for the entire market. One possible source of leakage arises from the fact that consumers in different regions have different vehicle preferences. In this case, feebate policies could create a situation where the industry meets its overall *national* emissions requirement through sales mix shifts that balance emission reductions within the region with emissions increases outside the region.

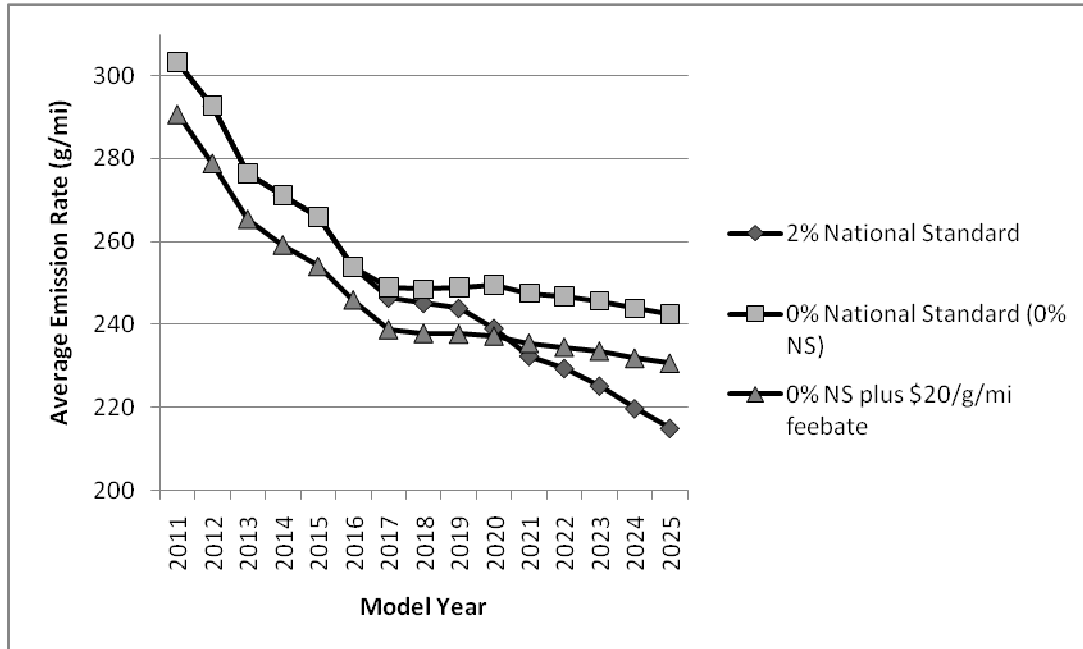


Figure 3.4. Effect of a \$20/g/mi footprint feebate program under a 0% National Standard scenario (2% National Standard included for comparison purposes)

Table 3.1 Feebate rates to replace a LEV III-GHG standard (2% annual reduction starting in 2017)

Model Year	2017	2018	2019	2020	2021	2022	2023	2024	2025
Feebate rate (\$/g/mi)	5	5	5	10	15	20	30	35	40

Note: In MY 2025, a \$40/g/mi rate translates to average fees of \$1400 and average rebates of \$1050.

Figure 3.5 shows the change in new vehicle average emissions for the Rest of the U.S. when feebate programs are offered *in California*. The line for Rest of U.S. is obtained for the footprint program; however, the lines for the other two programs are almost identical and are eliminated for readability. Figure 3.5 is a modification of Figure 3.2, so that averages for California are included for comparison purposes. There is evidence of spillover (for all years before 2018 except 2016) but also some leakage (for 2020 to 2025). The pattern suggests that spillover occurs when feebates induce the largest design changes. Note that, although Rest-of-US changes might be considered small compared to California’s, these are *per-vehicle changes* for 90% of the domestic market. If the

cumulative effects are calculated over the entire period, the spillover and leakage effects approximately cancel out.¹⁰

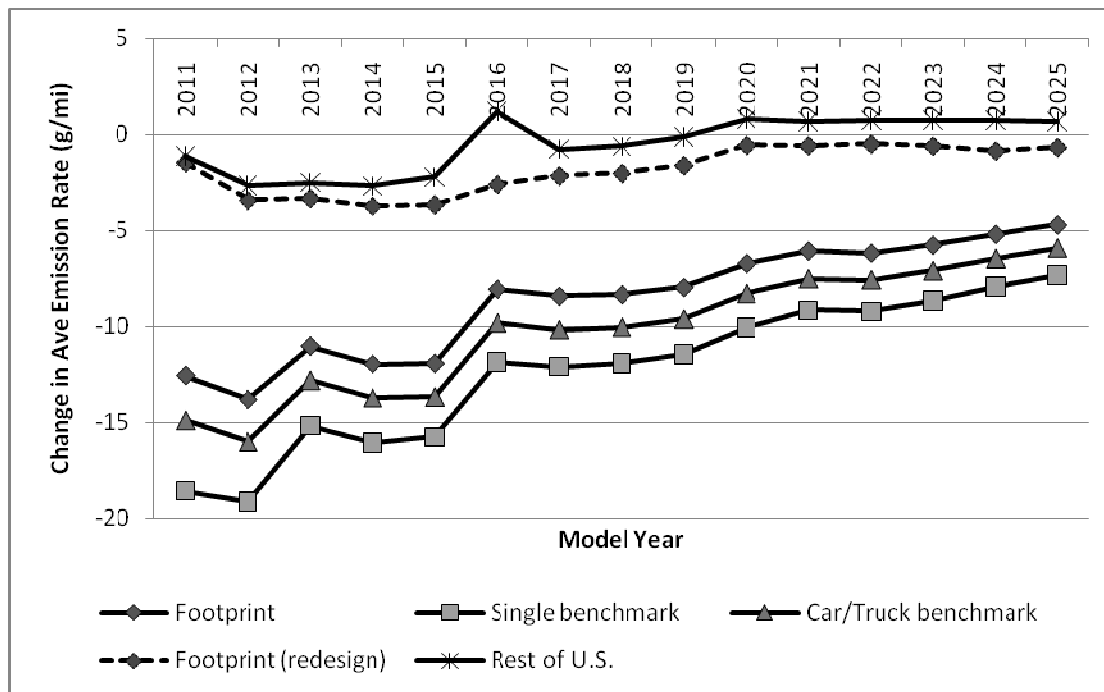


Figure 3.5 Change in new vehicle average emissions due to California feebate programs (includes change in Rest of United States).

3.6 Sensitivity to Assumptions

All findings summarized thus far use the same base case modeling assumptions previously described. Our study also includes scenarios to test sensitivity to changes in base case assumptions. Figure 3.6 shows what happens if consumers are assumed to fully value fuel savings over the lifetime of a vehicle when making their vehicle purchases. All three cases use the 2% National Standard, so the profile labeled “Three Years of Fuel Savings” (the base case modeling assumption) corresponds to the previous result for a 2% National Standard (with no feebate). When consumers are assumed to value fuel savings for the full lifetime of the vehicle, the results are dramatically different. Manufacturers *voluntarily* choose to sell vehicles with average emissions that are *much better* than the emissions standard because of consumer preferences. In this case an emissions standard would not be required. Adding a \$20 footprint feebate yields additional emissions reductions, but these are relatively small compared to the effect of changing the assumption.

¹⁰ Some readers might notice a small spike that occurs in the year 2016. Although it exists for all results, it is particularly noticeable for the Rest-of-US profile in Figure 3.5. The spike occurs due to the abrupt discontinuation of certain emissions credits. Manufacturers address the loss in credits (at least in part) by repricing their vehicles to produce sales-mix shifts that satisfy the emissions standard.

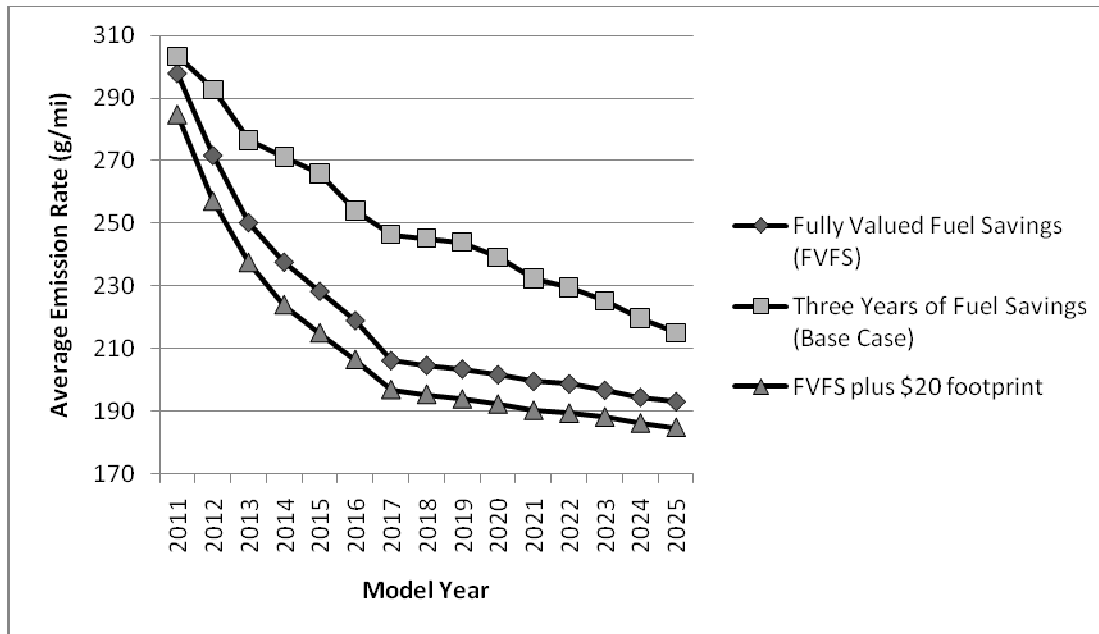


Figure 3.6 Effect of assumptions on consumer value of fuel savings.

Another sensitivity case (not shown) assumes that consumers are less sensitive to vehicle price. For this case consumers are much less responsive to feebate policies, so the emission reductions are lower than those in the base case. Sensitivity to other base case assumptions are explored in the final report. For example, the model requires projections on fuel prices, technology costs, etc. However, the two assumptions reviewed here appear to be the most important ones in terms of sensitivity.

Finally, we note that our base case assumptions on value of fuel savings and price sensitivity are, in a sense, “feebate friendly.” If consumers were to place a higher value on fuel savings then feebates would perhaps not even be necessary. If consumers were much less price sensitive, then feebates would not have the desired effects. However, it is important to note that the base case assumptions were developed using our best judgement based on experience with both the literature and industry practices, and were adopted prior to generating the results summarized here.

3.7 Effect of Feebate Programs Outside of California

The AB 32 Scoping Plan specifically calls for an evaluation of feebate programs in California. However, California has historically played a leadership role in the area of environmental policy whereby other states might choose to adopt the same or similar policies based on California’s example. In the case of the Clean Air Act, states are specifically given the option to adopt either national emission standards or California emission standards. If multiple states were to follow California by adopting its feebate policy, it would have significant implications for policy effectiveness. To explore this possibility, our study includes scenarios that assume other states adopt California’s feebate program, effectively increasing its geographic coverage. We consider two scenarios, where market coverage consists of: (1) California plus the thirteen Opt-In States (Arizona, Connecticut, Maine, Maryland, New Hampshire, New Jersey, New Mexico, New York, Oregon, Pennsylvania, Rhode Island, Vermont, and Washington), and (2) the entire nation (complete market coverage).

Figure 3.7 shows the *change* in new vehicle average emissions in California for a \$20/g/mi footprint program under three market coverage scenarios (California only, California plus Opt-in States, and National). The nature of the results is what would be expected, i.e., impact increases with larger geographic coverage. However, the size of the improvements is substantial. One key finding is that, as geographic coverage increases, a larger portion of the feebate's impact is due to its effect on the redesign decisions of manufacturers. Figure 3.8 includes separate lines for the portion of change attributed to redesign (California-only results were shown in Figure 3.2, and are omitted here for clarity). In the year 2018, the percentage of change due to redesign is 60% and 87% for the California/Opt-in and National coverage scenarios, respectively. The averages for the period 2011-2018 are 54% and 77%, respectively. After 2018 the relative amount of change due to redesign steadily falls (as does the total change).

Effects of increasing the market coverage of a feebate program are summarized in Table 3.2. In addition to the effects within California, there would obviously be important implications for what would occur outside California. In particular, for the California plus Opt-in States scenario, our results indicate that there could be spillover effects in the non-feebate states. These would most likely be due to the increased impact on vehicle redesign decisions induced by the larger market coverage.

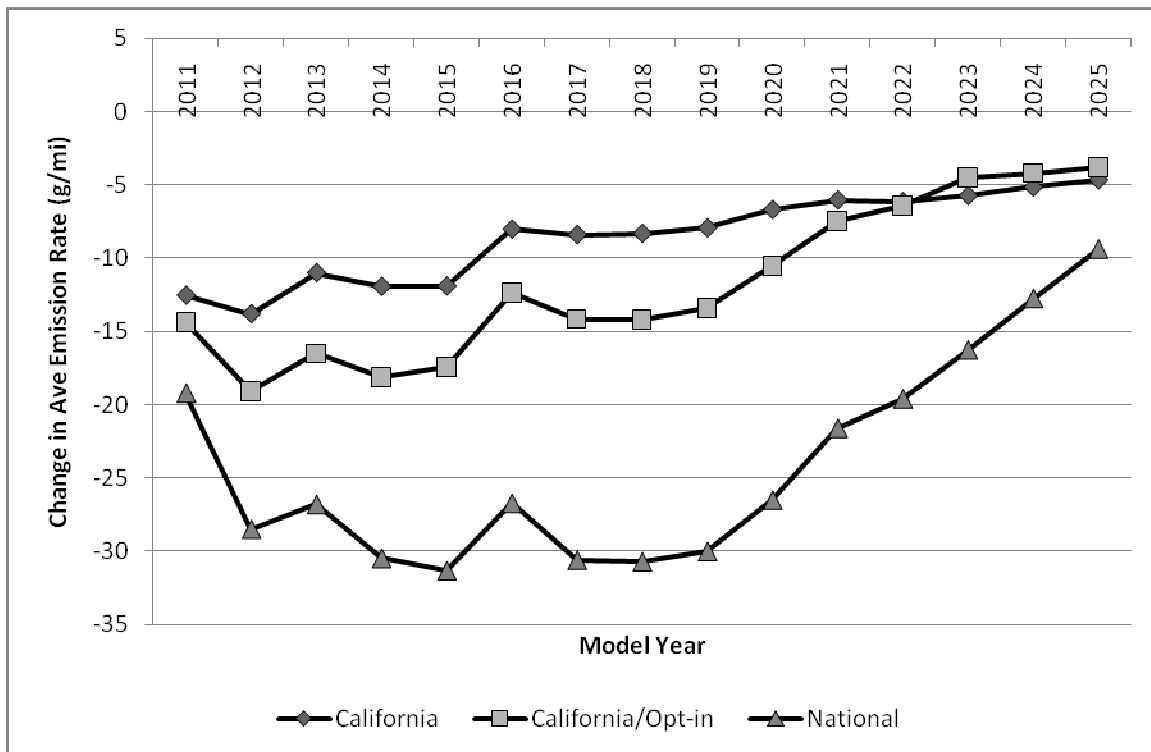


Figure 3.7 Effect of increasing geographic coverage on new vehicle average emissions for a \$20/g/mi footprint feebate program.

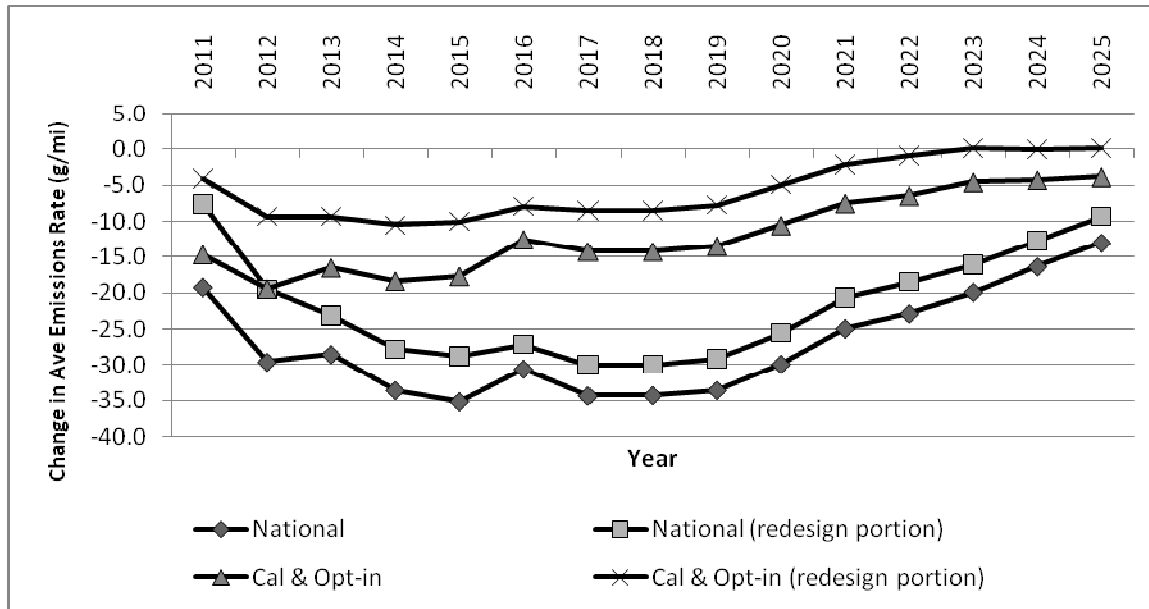


Figure 3.8 Change in new vehicle average emissions for a \$20/g/mi footprint program for two geographic coverage scenarios (including portion due to redesign).

Table 3.2 Changes Induced by a Footprint-based Feebate Program (\$20/g/mi) for Three Levels of Program Coverage (See text for the list of Opt-in States).

Program Coverage	Reduction of Average New Vehicle Emission Rates in CA (g/mi)	Percent Change in Average New Vehicle Emission Rates in CA	Average Fee per New Vehicle	Average Rebate per New Vehicle	Total Emission Reductions from Feebates in 2020 in CA (MMTCO ₂ E)
California-only	9 g/mi	3% reduction	\$700	\$600	3 MMT
California + 13 "Opt-In" States	12 g/mi	5% reduction	\$675	\$550	5 MMT
Entire U.S.	24 g/mi	10% reduction	\$600	\$500	9 MMT

4 WHAT WOULD BE THE ECONOMIC AND FISCAL IMPACTS OF A FEEBATE PROGRAM?

Programs that alter the behavior of the new vehicle market have the potential for a broad range of economic and fiscal impacts. These include effects on industry sales and revenues, dealer revenues, and state and federal tax revenues. Effects on overall consumer surplus in the new vehicle market were mentioned earlier. Ripple effects extending to the used vehicle would affect consumers as well, and also industry-related businesses such as auto parts suppliers and repair garages. These effects would play out in different ways -- some positive and some negative for various

stakeholders. Many of the primary effects are briefly summarized next, with a more extensive assessment included in the full project report.

4.1 Overall impact on vehicle sales and revenues

Consistent with previous studies, economic analyses derived from MDM results show that feebate programs can generally be expected to depress industry sales and revenues in California to some extent. The overall effect is expected to be small, but the relative effects across manufacturers could vary significantly, depending on the specific program design. This is further addressed in the section on equity issues. Findings related to the overall impact are:

- Feebate programs in California could reduce annual California sales by about 10,000 to 15,000 units per year. There are modest increases in sales in the rest of the country, but they offset no more than 1,000 units per year (on average). These sales declines imply a decrease in total industry revenues in the range of several hundred million to over one billion dollars per year (or about 1%). This translates into a negative impact on California dealers in the form of a *0.5% to 0.75% reduced sales volume*. These sales declines suggest that used vehicles would stay in the market longer, yielding secondary impacts related to the used vehicle market (repair shops, aftermarket sales, etc.). Many of these impacts would yield increased revenues for those businesses. For example, if consumers retain older vehicles for longer periods, they may spend more money at auto garages to maintain them.
- Increases in the feebate rate (\$10 to \$20 to \$30 /g/mi) would yield larger total sales declines, and magnify any disparities among manufacturers (and also dealers).
- Impact of a California feebate program on national employment in automotive manufacturing and related businesses would be very small. Typical industry practice is to measure impact per 100,000 vehicle sales lost, and the reductions projected by the MDM are only on the order of 10-20% of that level.

To provide additional perspective, we also consider scenarios where feebate programs cover larger portions of the market. Under a *nationwide feebate program*:

- Annual new vehicle sales in California would decline by up to 20,000 units. The sales-related effects discussed above for a California-only program would be similarly magnified.
- National new vehicle sales would decline by an average of 135,000 units per year. This could have a measurable impact on national employment in automotive manufacturing and related businesses. Depending on how the sales losses are distributed over manufacturers, the number of displaced workers could vary from 2,000 to 20,000. However, these job losses could be partially offset by changes in the market for used vehicle-related services.
- Total industry revenues would generally decline, up to several billion dollars per year (or about 1%).

4.2 Fiscal and Administrative Costs

Costs to the government from feebate programs would fall into two general categories: 1) the cost of administering the feebate program, and 2) other fiscal effects. A feebate program might be expected to cover its own administrative costs from revenue flows associated with the program itself. In this case a “revenue neutral” program would require more fees than rebates in order to offset administrative costs. Because the level of administrative costs could affect the feasibility of a feebate program, our project developed the cost estimates summarized below. Other fiscal effects would include lost vehicle sales taxes and tax revenues from vehicle-related goods and services. Additional results on fiscal effects are included in the final report.

In general, the administrative costs for feebate programs are estimated to be somewhat higher than those for similar previous programs; however they are still relatively modest in relation to the size of revenue flows in the program. We also note that there is precedent for placing a cap on total administrative costs at some percentage in the authorizing legislation, thus limiting the ability for these costs to creep up over time.

The program administrative cost estimates assume that the majority of the responsibility for designing and administering a California feebate program would be shared among various state agencies (ARB, DMV, Board of Equalization, and Dept. of Finance), rather than residing solely with one of them. The estimates are based partly on analysis done in 2007 for AB 493,¹¹ but were updated and extended based on additional research and analysis. In general, we estimate that there would be several million dollars per year in ongoing administration costs, depending on the design of the program, and that this would be on the order of 1% (ranging from about 0.5-2.0%) of the total fees collected or revenues paid under the program.

Feebate programs are estimated to have somewhat different costs depending on design:

- If automobile dealers are the collectors of fees and distributors of rebates, administrative costs are estimated as \$3.25 million in one-time startup costs followed by \$5.5 million in annual program costs.
- If the auto manufacturers (rather than dealers) are the contact point with the state for collection of fees and distribution of rebates (i.e., more “behind the scenes”) administrative costs are estimated as \$2.75 million in one-time startup costs followed by \$4.6 million per year in annual program costs.
- For a “hybrid” type design that involves fees being collected at the dealership but rebates being sent to consumers directly (on a delayed basis based in response to an application for the rebate), administrative costs are estimated as \$3.75 million in one-time startup costs followed by \$6.5 million per year in annual program costs.

These administrative cost estimates are somewhat higher than previously estimated for AB 493, primarily due to inclusion of estimates of Dept. of Finance cost recovery rates for their administrative functions and the fact that the proposed feebate programs would include more vehicles than were proposed to be included in AB 493. We also note that these cost estimates are small in comparison to the size of the program, as measured by the level of fees collected (or rebates distributed). For example, if the *average* fee were \$500 in a year with 1.5 million vehicles sold, total fees would be \$750M, and administrative costs would be less than 1 percent of this total.

¹¹ The “Clean Car Discount for California Families” bill that narrowly missed passage by the California legislature in 2006-07.

5 WHAT ARE THE EQUITY IMPLICATIONS OF FEEBATE PROGRAMS?

5.1 Manufacturer Equity

As noted above, total industry revenues would decline by a small percentage under feebate programs. However, because industry revenues in this sector are so large, this still amounts to a large amount of money and one potential concern could be whether feebate programs affect manufacturers and dealers in disparate ways.

The overall emission effects of three different benchmark systems (footprint, single benchmark, car/truck benchmark) were discussed previously in section 3. The single benchmark was found to create the largest reduction in greenhouse gases, a result that has been found in previous studies. In addition, we also determined that a California-only feebates program would have a relatively small effect on vehicle design decisions. The main effect would be sales-mix shifting in California.

Table 5.1 summarizes the sales mix for seven vehicle segments (Standard Small Car, Standard Midsize/Large Car, Prestige Small Car, Prestige Midsize/Large Car, Pickups, Vans, and SUVs) for the scenarios discussed in section 3 (2% National Standard, three benchmark systems using a \$20/g/mi feebate rate). The no-feebate results provide a reference case for comparison. Sales mixes are averages over the period 2011-2025; however, the year-to-year variation is extremely small. Raising or lowering the rate would be expected to magnify or shrink the changes that are observed. The Standard versus Prestige distinction is included due to its importance in determining consumer preferences and sales shares. Briefly, each vehicle brand is designated Standard or Prestige based its perceptual position in the market. For example, Standard brands include Chevrolet, Ford, Honda, and Volkswagen, and Prestige brands include Cadillac, Lincoln, Acura, and Audi. Assignment of a vehicle configuration to a category is therefore based on its brand and not, e.g., vehicle price or amenity packages. A detailed listing of Standard versus Prestige brands is included in the final report.

Table 5.1 Estimated Sales Mixes under Different California Feebate Programs

	Small Car	Mid/ Large Car	Prestige Small Car	Prestige Mid/ Large Car	Pickup	Van	SUV
Reference Case	28%	19%	7%	6%	10%	3%	27%
Footprint	16%	12%	14%	9%	12%	3%	35%
Single Benchmark	31%	20%	7%	6%	9%	3%	26%
Two Benchmark	30%	19%	7%	5%	9%	3%	27%

Note: Rows may not sum to 100% due to rounding.

The footprint system yields a dramatic shift away from standard passenger cars to prestige cars, pickups, and SUVs. This is consistent with expectations, because the footprint system links benchmarks to vehicle size. Any group of vehicles with a similar size will have some vehicles that receive rebates and other vehicles that receive fees, giving consumers that prefer larger vehicles better purchase options. SUVs and prestige cars are on average larger than standard passenger cars. In contrast the single benchmark on average assigns fees to larger vehicles and rebates to

smaller vehicles, thus shifting sales toward small and midsize/large cars (but not dramatically so). Similarly, the two-benchmark system shifts purchases toward the smaller vehicles in each of the two categories (passenger cars and light-duty trucks).

Manufacturers' product portfolios will determine how they are affected by these sales shifts. Portfolio mixes tend to be correlated not only with the prestige versus standard distinction, but also with country of origin. To provide a high-level comparison, we have added a regional dimension and assigned each manufacturer to one of six groups. (Details on group membership are included in the final report). The effect of feebate programs on revenue share is summarized in Table 5.2.

Table 5.2 Effect of Feebate Programs on Revenue Shares for Six Manufacturer Groups

	Domestic-Standard	Europe-Standard	Asia-Standard	Domestic-Prestige	Europe-Prestige	Asia-Prestige
Reference Case	30%	2%	43%	3%	11%	12%
Footprint	29%	1%	45%	3%	10%	12%
Single Benchmark	29%	1%	45%	3%	10%	12%
Two Benchmark	29%	1%	45%	3%	10%	12%

Note: Rows may not sum to 100% due to rounding.

The changes in share are not dramatic, but are consistent with expectations based on Table 5.1. The single benchmark that favors small and midsize standard cars yields an increase in share for Asian-standard cars. Prestige, European-standard, and Domestic-standard lose share under all three systems. Domestic-standard faces the smallest decrease under the two-benchmark system, and the largest decrease under the single benchmark. Finally, it is clear that the share changes are small in this comparison at least in part because of the aggregation over manufacturers. However, for this type of analysis attempting to predict results for individual manufacturers would be highly speculative and potentially misleading.

5.2 Consumer Equity

In section 3, the MDM was used to analyze changes in total Consumer Surplus under alternative scenarios. However, exploring consumer equity issues requires more detail than is available in the MDM. The lower tier of the Feebate Analysis Model is a California-specific model (called CARBITS) that supports this type of analysis. CARBITS simulates market behavior by modeling the choice of vehicle holdings for different household types. It explicitly models both the used and new vehicle markets, and requires a different methodological approach than the MDM. Because CARBITS is reasonably complex, a full discussion along with presentation of additional analyses are provided in the final report. Our results focus primarily on how policies affect households in different income categories.

To explore issues of consumer equity, we focus on results that show how feebate policies affect households in different income categories. One key finding from CARBITS is consistent with expectations: *It is the higher income households that purchase the large majority of new vehicles in California, and it is these households that would pay the large majority of fees, and also receive the large majority of rebates.*

This finding provides an opportunity to briefly compare some features of CARBITS versus the MDM. For the MDM the total amount of fees exceeds the total amount of rebates, so that the average feebate per household is negative. This occurs because fees must cover administration costs and rebates associated with the ZEV mandate; overall, the program is revenue neutral. Analysis with CARBITS takes the fee and rebate values from the MDM as is. Although CARBITS is completely

independent of the MDM, the pattern of fees versus rebates is qualitatively similar. However, there are some differences associated with the different approaches. On average, CARBITS consumers are less price-sensitive and place more value on fuel savings than the MDM. Together, these two features yield smaller sales shifts in response to feebate policies, with a higher level of fees and a lower level of rebates. A contributing factor is that CARBITS consumers find the more efficient vehicles produced under the national emissions standards in the reference case to be more attractive than do MDM consumers. Despite these differences, on an aggregate level the models behave similarly in many respects. For example, consumers pay the highest fees under the single benchmark system, and the lowest fees under the footprint system. However, for our purposes a key feature of CARBITS is that it allows a comparison of how policies affect different household income groups.

Returning to the issue of feebate payments, high-income households (>\$75K in 2001 dollars) pay an average feebate of -\$200 per new vehicle purchased. This declines to -\$75 for households in the \$10-\$25K range. However, for the lowest income category (<\$10K), if this type of household buys a new vehicle, the average feebate is about zero for the car/truck and footprint feebate systems, but is *positive* (\$75 per vehicle) for the single benchmark system. This is consistent with the idea that many low-income households purchasing new vehicles would be likely to purchase small, inexpensive vehicles with higher fuel economy that qualify for rebates.

The most definitive approach to assessing equity is based on consumer surplus (CS). First, in contrast to the MDM, CARBITS finds that feebate policies yield an *increase* in CS; however, these changes are extremely small. The reason for this difference is that, under feebate policies, there are some small improvements in fuel efficiency for vehicle offerings, and Californians value these improvements. This result is based on averages over the period 2011-2025. For the case of CS increases, a policy would be regarded as regressive if the distribution of CS were unfairly weighted toward higher income households. To test this, for each household type we compute the CS increase from a policy as a proportion of household income, and then compute the average for each income category. Using this measure, our analysis shows that benefits to households increase as income decreases under all feebate programs, so that these programs are not regressive.

Additional insight comes from exploring the pattern of CS change over time. A potentially interesting finding is that this pattern depends on income category. Specifically, in the early years (2012-2018), the higher-income households enjoy larger CS increases, and the lower-income households enjoy the least; however, these differences are very small. By 2020 the pattern reverses, and the differences become larger. The lower income groups have the largest improvement in CS after 2018, with the improvement in CS decreasing as income increases. Our view is that this increase in CS is due to the diffusion of increasingly efficient vehicles through the used vehicle market. However, again, these changes are very small, and the main value is the insight revealed by this pattern of CS change.

6 HOW DO STAKEHOLDERS VIEW FEEBATE PROGRAMS?

The Feebate Analysis Model results in Section 3 give some idea of how feebates might impact average emissions rates of vehicles sold in the new vehicle market. However, there are other practical issues to consider that fall outside the scope of quantitative modeling. The attitudes and views of various stakeholders affected by feebate programs could be important when making certain program design decisions. In the case studies from Europe (Section 2), attitudes of average consumers and the government's interaction with vehicle providers at times played important roles in policy makers' decision-making. To explore consumer-related issues, focus groups and a statewide survey of the general car-buying public were conducted. In addition, members of the

team interviewed representatives from vehicle manufacturers and auto dealerships. The following sections summarize key findings from this stakeholder opinion research.

6.1 Consumer Research

Consumer research was conducted in two phases. Exploratory research using focus groups was performed first to gain fundamental understanding of knowledge, perceptions, and issues of most concern to consumers regarding feebate program designs. A total of twelve focus groups were conducted in the Bay Area, the Central Valley, Los Angeles area, Sacramento, and San Diego; two of the focus groups were conducted in Spanish. Although focus group results cannot be used to establish specific statistically valid conclusions, they yield key qualitative understandings that provide a sound basis for developing questions for quantitative research using a large statewide survey. Administered by telephone, survey interviews were conducted with over 3,000 households through California, yielding an adequate sample of responses for valid statistical analysis.

6.1.1 Key Focus Group Findings

- When designing the focus group protocol, a major concern was how hard it might be for respondents to understand feebates. However, participants seemed to *quickly understand the concept of a feebate program*.
- In most cases, after discussion over the course of the focus groups, the overall response to feebate programs was *negative*.
- Many participants generally had a negative view of both manufacturers/dealers and government programs, and viewed feebate programs with suspicion. There was concern that manufacturers/dealers would find a way to manipulate feebate-related transactions to their benefit.
- Participants suggested alternative policy approaches to address vehicle fuel efficiency, including gas taxes and direct regulation of manufacturers. In addition, many proposed that fees and rebates should be targeted directly to manufacturers rather than consumers.
- Participants generally felt that a feebate program would be ineffective in influencing vehicle purchase decisions.
- When pressed to estimate the level at which feebates might be effective, they indicated that the fee or rebate would need to be 10-25% of the sticker price, or alternatively, in a range from \$1,000-\$5,000.
- Participant responses to the various feebate program design elements reflect, and were consistent with, trade-offs relating to issues of fairness and complexity that are well-known in the literature.
 - Respondents generally preferred a continuous feebate function to a step-based function, believing that the continuous was more “fair” (even if a step based function might be “easier to understand”).
 - Although there was substantial disagreement, the majority of respondents preferred a class-based system for (at least) cars and light-duty trucks for reasons of fairness to families and small businesses. Others found class or size based systems too complex and thought that consumers would find them confusing.
 - At the same time, there was an understanding that higher emitting vehicles could receive rebates while lower emitting vehicles could be charged fees under a class-based

- system. This also seemed “unfair” and, moreover called into question the purpose and effectiveness of the program.
 - The possibility of special exemptions or other breaks for large families or businesses was recognized as a way to address the fairness issue, but with concerns that it be administered fairly.
- There was considerable skepticism that a feebate program could be managed so as to meet the goal of revenue neutrality.

6.1.2 Key Statewide Survey Findings

The statistics below summarize key findings from the 3,000 household statewide survey administered between October and December 2009. The numbers shown are the raw survey results as well as a “weighted” sample that adjusts responses to make them more representative of the true demographic composition of the state.

- In contrast to the focus group results (which are not statistically valid), survey respondents were generally *positive and supportive of feebate programs*. Seventy-six percent of respondents either agreed (46%) or strongly agreed (30%) that they “would generally be supportive of this type of program to help slow the rate of climate change”. (See Figure 6.1) With the weighted results, the percentages were agree (50%) and strongly agree (26%), retaining a total percentage of 76% but with fewer in the strongly agree category.
- Support for feebate programs is highly correlated with perceptions and opinions on issues related to climate change and energy dependence. The large majority of all respondents:
 - Are aware of the terms:
 - “climate change” (92% / weighted 87%),
 - “greenhouse gases” (80% / weighted 71%).
 - Believe that:
 - The earth is experiencing climate change (41% strongly agree / 38% weighted; 45% agree / 47% weighted)
 - Human activity is a contributing factor (36% strongly agree / 35% weighted; 46% agree / 50% weighted)
 - Dependence on foreign oil is a serious problem (37% strongly agree, 43% weighted; 44% agree / 45% weighted)
- Consumers were asked what they would do “if a new vehicle that you were planning to purchase increased in price by \$2,000 due to an emission fee.”
 - 16% said they would buy the vehicle anyway,
 - 39% said they would buy a different vehicle,
 - 20% said they would buy a used vehicle,
 - 14% said they would save money to buy the same vehicle later,
 - 5% said they would not consider a vehicle with an emissions fee, and
 - 6% did not know how they would respond.
- The respondent’s self-described positioning on political issues was well-balanced among conservatives, moderates, and liberals:
 - 31% Liberal/Very Liberal
 - 7% very liberal
 - 24% liberal
 - 32% Moderate
 - 29% Conservative/Very Conservative

- 23% conservative
- 6% very conservative
- 4% Other / 3% Not sure / 2% Refused

As shown above, the weighted sample results differ from the raw survey results, but only by a relatively small amount of a few percentage points between categories. The overall conclusions remain unchanged.

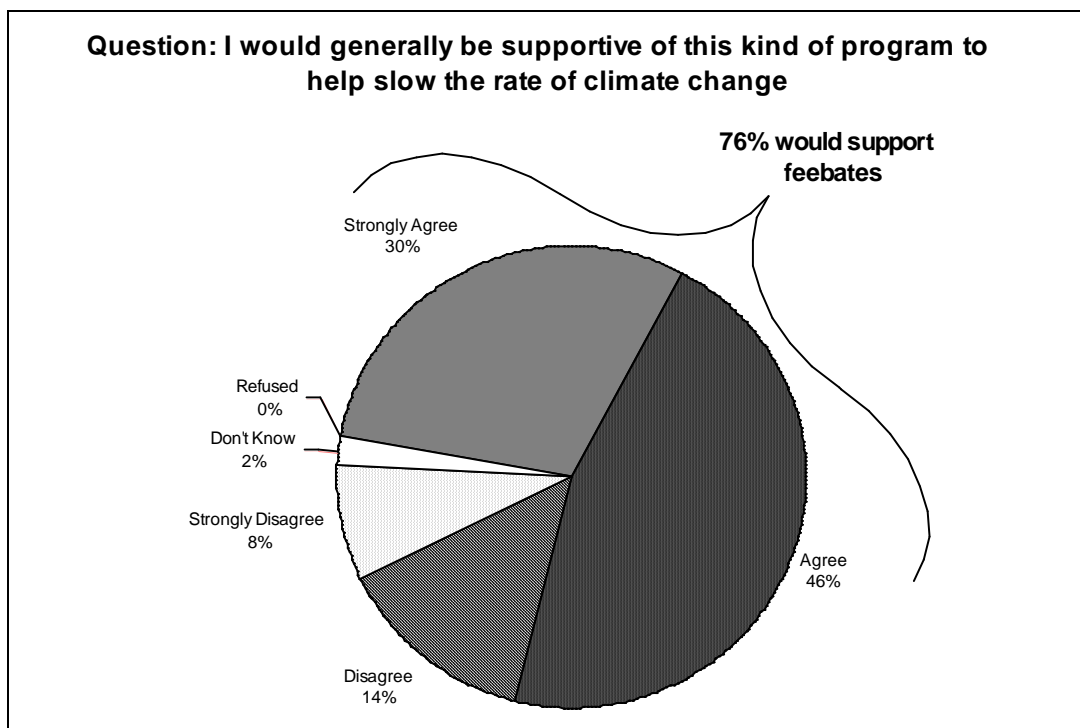


Figure 6.1 Breakdown of responses from telephone survey administered to 3,072 households in California in late 2009 (unweighted)

6.2 Dealer Interviews

In addition to consumers, auto dealers and automakers were interviewed to gain insights into their perceptions of feebate programs and their support or opposition to them. Key findings from the dealer interviews include:

- Dealers expressed both practical opposition to a feebate program related to potential loss of sales and increased administrative burden as well as more of an ideological opposition related to perceived restriction of consumer choice.
- When asked about preferred alternatives to the feebate program, three of the eight dealers expressed a preference for an increase in fuel taxes, arguing that higher fuel taxes are more likely to have a significant impact by influencing driving habits and reducing vehicle miles traveled.
- Regarding program administration, three of the eight dealers strongly opposed dealership-level administration, mostly because of the administrative burden.
 - One interviewee described his dealership as already "inundated as a business in handling the State's business."

- Two dealers also described past problems with other programs administered at the dealership—like the tire fee—which has resulted in steep fines when dealers make mistakes when reporting and making payments to the State.
 - Two of the eight dealerships, however, indicated that given the synergies with current reporting requirements, if set up correctly they may be able to undertake the administrative aspects without much trouble.
- When asked about compensation from the State for administration, four of the eight dealers provided estimates for acceptable reimbursement. Two dealers indicated that \$50-\$100 per transaction would be adequate, one dealer preferred a monthly compensation of ~\$1000 per month, and one dealer argued for a percentage reimbursement rather than a fixed per transaction or per month repayment.
 - Six of the eight dealers interviewed expressed willingness to set aside time to train salespeople about the program, if implemented. Five dealers stated that this training would not be a problem, since salespeople already undergo training on a regular basis, and one dealer indicated that they would comply if compelled by the State.

6.3 Vehicle Manufacturer Interviews

The team conducted six interviews with experts from five automobile manufacturers in the US and abroad during the period July to December 2009 (one company was interviewed twice, with two different perspectives). Also one additional automobile manufacturer provided a response to the interview questions in written form. Larger automakers were the primary focus but a few of the smaller ones were also interviewed. Overall, the six manufacturers queried represented about 72% of the US market based on 2009 sales.¹²

Automakers were generally opposed or “lukewarm” to potential feebate programs, particularly at the individual state level. The automakers interviewed clearly had various amounts of internal thinking and debate about potential feebate policies, but generally were very aware of them due to their previous application in other countries. They generally expressed that their potential support or opposition would hinge on the design of the programs, and were more supportive of federal programs than those instituted by individual or groups of states. Key points of opposition included restriction of consumer choice, and preference for fuel tax based policies that would more directly address consumers’ use of fuels rather than programs such as feebates that would be applied to the initial purchase of lower versus higher emitting vehicles but not directly tied to the ongoing production of greenhouse gas emissions based on vehicle use.

Key findings from the automaker interviews were that:

- Three of the six automakers interviewed were generally supportive of a feebate program, though all of the automakers indicated that their potential for support depends on the structure and design of the program.

¹² Note that the automaker interviews were conducted on a confidential basis, where the specific individuals interviewed are not identified.

- For two automakers, support stems from the belief that a feebate program sends a signal to the market and car buyers that the government supports a fleet-wide shift toward more fuel-efficient vehicles.
- One automaker supports feebates as part of the company's overall shift toward greater environmental stewardship.
- Two interviewees expressed general opposition to a feebate program. For one automaker, this sentiment stems from the belief that the program would be biased against consumers with large families or needs that require larger vehicles and trucks. Another automaker described feebates as "unnecessary and duplicative" and an "inefficient, expensive and complicated way to get small environmental benefits."
- Four automakers indicated a preference for a linear feebate structure as opposed to a step-based structure or a structure with a zero-band, and three of these indicated a preference for a single benchmark system that places all vehicles on the same scale.
 - Two automakers prefer a multiple-class system that would "compare vehicles that are really comparable;" for example, a class-based system that would compare SUVs to SUVs, and compact cars to compact cars.
 - One automaker that is generally opposed to feebates prefers class-based as the "lesser of two evils."
 - None of the automakers indicated a preference for a step-based function (one strongly opposed it), and two pointed out that the step-based structure could lead to market distortions, "gaming," and border issues.
- When presented with the concept of a footprint-based function, one automaker indicated that this kind of system would be too complicated for consumers to understand and another expressed dislike for footprint-based systems in general.
 - Two of the six automakers preferred footprint-based: one likened the footprint-based system to the shadow area-based program in the Netherlands (which this automaker favored), and another prefers a feebate system that aligns with CAFE (so thus also prefers footprint-based).
- Four of the six automakers indicated that a feebate program in California would likely impact product design and product planning.
 - Three of these indicated that the program would primarily result in product adjustments at the manufacturer level, while one indicated that feebates would result in a mixture of product design changes and shifts in production allocation.
 - One of the four argues that this impact on product planning will be largely negative and that the program will cause "planning mistakes" and "wasted resources."
- When asked about previous experience with similar incentive/disincentive programs, three of the five automakers indicated that they had had relatively *positive* experiences in the past.
 - One automaker felt that the Canadian feebate program—though relatively short-lived—was generally good and motivated the company to improve one model in order to make it eligible for the incentive.
 - Another automaker felt that Cash for Clunkers was successful at influencing consumer decision-making and also attracting new car buyers to the new car market.

- A third automaker described the Netherlands feebate program—which they described as a "multiple-class, vehicle shadow area-based program"—as a model for future feebate programs.¹³
- Four of the six automakers also described *negative* experiences with past programs.
 - Cash for Clunkers, according to two automakers, disrupted dealership cash flows and provided little lead-time for dealers and manufacturers to prepare for program implementation.
 - Two automakers used the Canadian program as an example of what “not to do” with a California feebate program, since they argue that the program was too short-lived and resulted in a lot of gaming and little technological change and environmental benefit.
- Three of the six automakers responded that the feebate program should be administered by the dealership, where they believe it would more effectively influence consumer decision-making. One automaker pointed out that administration by any entity other than the government (i.e. via vehicle registration) would dilute the signal from the government and incorrectly associate the feebate to the dealer or manufacturer.
- All automakers that were asked about national versus state-by-state feebates programs much prefer a national program. If a national program could not be developed and if state programs were adopted, manufacturers would prefer similarly designed and aligned state programs.

7 HOW MIGHT A FEEBATE PROGRAM BEST BE COORDINATED WITH OTHER STATE MEASURES AND GOALS?

The primary focus of this project was determined by the AB 32 Scoping Plan, which explicitly called for an evaluation of feebates as a substitute for (or complement to) emissions standards for new passenger vehicles. However, there are other policies in the transportation section of the Scoping Plan that, because they also impinge on emissions from passenger vehicles could require coordination with feebate policies. These include: 1) the Zero-Emission Vehicle (ZEV) program; 2) the Low Carbon Fuel Standard (LCFS); and 3) SB 375 – the “sustainable communities strategy” program. In addition, there are non-transportation AB 32 programs that could interact with the transportation sector, such as a potential statewide GHG “cap and trade” program. The most important of these interactions are briefly discussed below, with a larger discussion in the final report.

7.1 California Zero Emission Vehicle (ZEV) Program

This program requires increasing numbers of zero emission vehicles (ZEVs) and very low-emission “partial zero emission vehicles” (PZEVs) to be sold in California in the coming years. The rules of the program have become quite complex, as the program has evolved extensively since first introduced in 1990. The regulations now lay out multiple pathways by which automakers of various sizes may meet the regulation, to provide an element of flexibility. The gist of the current regulation is that major manufacturers must meet percentage requirements for advanced vehicle

¹³ After the interview was conducted, the Netherlands made the decision to drop a class-based program in favor of one with a single standard—see section 2.

introduction that increase over time. They can do so with various combination of ZEVs, “enhanced advanced technology-PZEVs,” “advanced technology-PZEVs,” and “PZEVs.” These ZEV rules are currently under revision but are expected to provide an ongoing stimulus for automakers to produce initially small but growing numbers of near zero-emission vehicles.

However, these vehicles would also be subject to any feebate policy introduced in California. Their emissions characteristics virtually ensure that these efficient and low-fuel cycle GHG vehicles would receive rebates, providing additional incentives for consumers and making compliance with the ZEV mandate easier. Under the feebate scenarios examined in this project, ZEVs could get up to a few thousand dollars in incentives. In this regard, it should be recognized that any feebate program should be coordinated with other ZEV-related incentive programs.

7.2 Low Carbon Fuel Standard (LCFS)

This is one of the “early-action” GHG emission reduction measures required for identification and implementation by AB 32. The LCFS limits the average carbon intensity of transportation fuels supplied by regulated parties for use in California. The LCFS requires a 10% average reduction in carbon intensity by 2020 relative to 2010 levels. This represents a 16 MMT reduction in GHGs or about 10% of the reductions needed to achieve the total AB 32 target.

Since the LCFS applies solely to fuels, and feebates apply only to the sale of vehicles, the potential interaction effects between the two programs are somewhat subtle. There are potential synergies between the two, to the extent that the two programs do reinforce the introduction of lower carbon fuels into the market (i.e., feebates also encourage the adoption of advanced technology vehicles using lower carbon fuels, such as plug-in hybrid and potentially biofuel-powered vehicles). Hence, the addition of a feebate program in California could help some fuel producers meet the LCFS requirements by making it easier for them to sell low carbon fuels. However, we note that many of the feebate scenarios we have analyzed mainly result in incremental improvements to conventional vehicles that would use reformulated gasoline. The scenarios do involve somewhat lower usage of gasoline overall, which would slightly reduce the amounts of lower-carbon fuels needed to meet the LCFS carbon fuel intensity targets, but otherwise have little implications for the LCFS program.

Other key but less direct policy interaction areas include those with other AB 32 related programs, such as SB 375 – related to smart growth and land use changes – and potential GHG cap and trade programs. These potential interactions are discussed in the full project report.

8 KEY CONCLUSIONS

Based on the collection of results, we provide an overall summary of some conclusions along with brief discussion.

1. There is evidence from case studies in four European countries to suggest that feebate programs *can* be effective in lowering the average emissions rates of new vehicles.

- This finding is based on average vehicle emissions data from both before and after the introduction of feebate systems.
- At the same time, this finding should be viewed with some caution for a number of reasons.
 - There are important differences between the policy and cultural environment of Europe versus California.
 - Introduction of these systems overlapped with fuel price increases in most cases. At the same time, even taking into account fuel price volatility, the data seem to indicate that feebates did have a measureable effect.

2. Quantitative models suggest that, under the right conditions, feebates can be used to reduce greenhouse gas emissions from new vehicles in California below national emissions standard levels. In addition, results indicate that feebates yield net positive social benefits aside from greenhouse gas reductions.

- A California feebate program could reduce average emissions from new vehicles by 3 to 5 percent, producing 3 to 5 MMTCO₂E of reductions in California in 2020, depending on the design of the policy.
- Results are subject to base case modeling assumptions on consumers' value for fuel savings, their responsiveness to price changes, fuel prices, and vehicle technology costs.
- If consumers were to value fuel savings over the full lifetime of the vehicle, the market would yield emissions levels below currently discussed targets without policy intervention.

3. The ability to affect vehicle design decisions is one of the frequently stated benefits of feebate programs. However, because California is about 10% of the domestic market, feebate policies based in California alone would only have a limited effect on vehicle design decisions.

- For scenarios involving California-only feebate programs, manufacturers' technology decisions are largely determined by national emissions standards.
- Because California-only feebates have limited impact on vehicle design decisions, they are also limited as a source of "spillover" and produce minimal co-benefits for non-feebate regions.
- *If feebates were implemented over a larger geographical area, the potential for spillover would increase.* If other states or the entire country adopted California's feebate policies, the impact could significantly increase.
- A nationwide feebate system could have a very large impact on emissions reductions from passenger vehicles due to its much greater impact on vehicle design decisions. Average emissions from new vehicles would be lowered by about 10 percent, and roughly three-fourths of these reductions would result from vehicle redesign as opposed to changes in purchasing behavior.

4. Quantitative models suggest that a single benchmark system (i.e. one that is not indexed to vehicle size or class) would yield the largest reduction in greenhouse gas emissions, but also the largest reduction in consumer welfare (measured by Consumer Surplus). However, when future fuel savings are taken into account, a single benchmark system would yield the largest net social benefit.

5. Quantitative models suggest that, under the right conditions, feebates could be used to reduce greenhouse gas emissions in lieu of more stringent performance-based standards beyond 2016. A properly designed feebate program could be used as a substitute for increasingly stringent GHG standards for new vehicles beyond 2016 (i.e. LEV III-GHG).

6. Although a single benchmark system would yield the largest net social benefit, issues of equity and fairness among stakeholders could require consideration of alternatives.

- In the project focus groups, there was sensitivity to the issue of "fairness" and a belief that a class-based (or footprint) system would be "fairer" than a single benchmark for people who "need big vehicles."

- This concern is consistent with experience with France’s single benchmark system. The system was recently modified to provide subsidies to large families who “need” larger vehicles.
- Some focus group participants understood that, under a class-based (or footprint) system, there would be instances where some large, higher emission vehicles would receive rebates while other lower emission vehicles would receive fees. This is confusing, and seems inconsistent with the stated purpose of feebate systems.
- This view is consistent with recent experience in the Netherlands, who introduced a footprint-based system. Consumer sentiment about the complexity of the system, and the possibility of higher emitting vehicles receiving rebates, caused the Netherlands to *abandon* its footprint system in favor of a *single benchmark* system.

7. Model results suggest that there would be a decline in new vehicle sales under all feebate programs, with an associated 1% drop in industry revenue for the California market. Although this is small in percentage terms, it is significant in terms of dollar amounts.

8. Different feebate systems yield different sales patterns. The single benchmark tends to favor non-prestige passenger cars (particularly small ones), whereas a footprint system favors vehicles *other than* non-prestige passenger cars (prestige cars and light-duty trucks, particularly SUVs).

9. Because product portfolios vary across manufacturers, different feebate systems will affect manufacturers in different ways.

- Although evaluating impacts on individual manufacturers would be unreliable, grouping manufacturers using two dimensions (prestige versus non-prestige, domestic versus Asian versus European) reveals small shifts in revenue shares that differ by type of feebate system.
- Revenue shares for non-prestige vehicles with Asian nameplates increase for all feebate systems.

10. Analyses of the impact of feebate policies on different income groups suggest that these policies are not regressive.

- In the new vehicle market, the majority of fees and rebates are applied to higher income groups because they purchase the majority of new vehicles.
- For households that purchase a new vehicle, the average feebate is negative for all households except for those in the lowest income group. For those income groups with a negative average feebate, the average gets smaller as income decreases.
- Analysis of consumer surplus changes indicates that, over the lifetime of the program, program benefits to households as a percentage of income increase with lower income. Results suggest that over time lower income households benefit from the increased availability of more efficient vehicles as they penetrate the used vehicle market.

11. Results from a large statewide survey (sample size of 3,000) indicate that consumers in California are generally concerned with anthropogenic climate change and energy independence, and would be supportive of a feebate system.

- In the survey, a total of 76% of survey respondents either strongly agreed (26%) or agreed (50%) that they “would generally be supportive of this type of program to help slow the rate of climate change.”

- Exploratory research using focus groups (total of about 100 participants) was conducted prior to the survey. The issue of program fairness was a major theme; for example, a household that really needs a large vehicle might be forced to pay a fee. We found that overall response to feebate programs was weakly or strongly negative in most groups. Although focus groups cannot yield statistically significant conclusions, this outcome is qualitatively different from the survey results and should not be summarily dismissed. One possible explanation is that, in the dynamic and interactive setting of focus groups, the presence of individuals with concerns about fairness or a dislike of government programs could influence the overall tenor and direction of discussions.
- With regard to program fairness, survey results generally indicate that the idea of providing feebate-like incentives is *not generally considered unfair* – although some respondents would rather see government programs targeted more directly at the automakers themselves.

12. Automobile dealers are generally opposed to feebate programs due to concerns about administrative burdens, lost revenues, and broader “ideological” opposition to government policies that are perceived to reduce “consumer choice.”

- Dealers have had mixed and often negative experiences with other types of grant and incentive programs (e.g., Cash for Clunkers) that come with state reporting requirements.
- Some (but not all) dealers are concerned with potential revenue losses under a feebate program. (This concern that is generally confirmed by quantitative modeling results.)

13. Automobile manufacturers are mixed in their support or opposition to feebate programs, some citing it as being in line with their corporate stance for “environmental stewardship” but others being concerned about potential negative effects on sales revenues that also could impact dealers.

- The automakers are generally knowledgeable about feebate programs and have a preference for linear as opposed to “step based” programs.
- The automakers had a mixed response to footprint and class-based programs, some suggesting that a footprint-based system would be well harmonized with CAFE and others suggesting that either type would be too complicated for consumers to easily understand and thus not “transparent” enough.
- The automakers expressed a clear preference for a national rather than individual state programs, and worst of all a “patchwork” of differing state programs – some suggested that individual state programs should be at a minimum, harmonized with each other in the absence of a federal program.

14. Administrative costs for feebate programs are estimated to range from \$4.6 to \$6.5 million annually (plus \$2-\$4 million in startup costs). This cost is relatively small when compared to the volume of revenue flow in a feebate program, on the order of 2% of total fees collected.

15. The potential effectiveness of feebate programs is affected by future events that in some cases can be unpredictable, such as gasoline price changes, cost evolutions for new technologies, or changes in automobile market structure. The future stringency of fuel economy or greenhouse gas emission standards is also found to be a key factor in the incremental benefits of a California-level feebate program. Policymakers should be aware of the potential for these events to interact with feebate program implementation and potentially affect overall effectiveness.