Feebates

A Legislative Option to Encourage Continuous Improvements to Automobile Efficiency

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I. Executive Summary

A feebate is an incentive policy that encourages the continuous improvement to automobile fuel economy and greenhouse gas emissions by providing incentives for manufacturers to build more efficient vehicles and rewarding consumers who purchase more efficient vehicles.[1] The feebate concept is simple in concept: inefficient vehicles receive a surcharge (FEE-), and efficient vehicles are granted a rebate (–BATE). The fees on the inefficient vehicles pay for the rebates on the efficient vehicles. Thus, the feebate has the potential to accelerate the production and adoption of more efficient vehicles, ultimately reducing the United States' transportation fossil fuel consumption.

The purpose of this paper is to provide information about feebates by discussing:

- What a feebate is,
- Why RMI believes a feebate is a valuable tool,
- Recent analysis that RMI had done on feebates,
- What the current status of the feebate is, and
- How the feebate could interact with existing laws.

RMI previously analyzed feebates in its 2004 publication *Winning the Oil Endgame,*[2] which provides a roadmap for weaning the United States of off oil by the 2040s. Since then, RMI has collaborated with researchers, industry and other non-governmental entities to determine what characteristics a feebate could have. Additionally, RMI built upon the 2004 analysis in this paper by conducting a static analysis on 2005 vehicle data to determine what impact certain attributes have on the feebate. Based on this collaboration and analysis, RMI has established the following recommendations for a fuel economy based feebate[3] that seeks to increase the efficiency of all vehicles, regardless of size.

[1] Approximately 90 percent of the effect of a feebate policy comes from a shift in the fuel economy of vehicles manufacturers provide. The remaining 10 percent of the effect comes from a shift in consumer behavior. Green, David L., Philip D. Patterson, Margaret Singh, and Jia Li. *Feebates, rebates and gas-guzzler taxes: a study of incentives.*

[2] Visit http://www.oilendgame.com to download a fee copy of *Winning the Oil Endgame.*

[3] For simplicity, we decided to frame our discussion of feebates in terms of fuel economy improvement, but it is important to remember that the GHG emissions reductions are an equally viable metric.

RMI Feebate Recommendations

- **Constant rate**: The rate is the component of the feebate that determines how much the fees or rebate for each vehicle will be. It is measured in a $X/XX gallons per mile. It is critical that the rate remains the same for every vehicle to ensure that all gallons of fuel saved are equally valued.
- **Self-financing**: The policy should be revenue neutral or slightly revenue generating (to pay administrative costs). This is achieved by setting the pivot point regularly and accurately.
- **Preserve consumer choice:** The policy should not interfere with consumer freedom of choice. Creating size classes with separate pivot points is one option to achieve this.
- **Continuous fuel improvement:** The policy should be dynamic and require constant innovation by a given vehicle manufacturer for them to continue to receive rebates on vehicles. This can be achieved by regularly evaluating the pivot point, which also ensures the policy is self-financing.
- **Optimize size classes:** The current passenger car class system and light duty truck categories used under CAFE may be the easiest way to introduce the feebate policy.

In addition to the recommendations listed above, RMI's analysis resulted in several potential research opportunities. This not a comprehensive list of research opportunities for the feebate, but a list of research ideas that emerged while RMI worked on this paper. For example, other interesting research ideas that are outside of the scope of this paper include: the implications and lessons learned from the international feebate policies enacted in Canada, France and Denmark; what a model feebate policy looks like; and, what information do legislators need to determine if the feebate is the best policy for there state or country?

Potential Feebate Research Opportunities

- **How many size classes:** What is the optimal number of size classes for a feebate policy?
- **Size classes**: Which has a greater fiscal impact on the manufacturers: the number of size classes or the attribute used to divide the size classes? Preliminary analysis indicates that the number of size classes creates a more significant fiscal impact than the attribute used to divide the vehicles into size classes.
- **Function for a one-size class feebate**: More research is necessary to determine what mathematical function should be applied to a continuous feebate for the all new vehicles sold. Possible options include using a size-adjusted pivot point or a moving average pivot point.
- **Existing attributes or new:** What are the advantages and disadvantages of continuing to divide the vehicles into the existing CAFE size classes for a feebate policy?
- **Feebate implementation point**: At what point should the feebate be implemented: the point of sale, with the manufacturer, when the vehicle is registered or at another time?

II. What is a Feebate?

The feebate concept is simple: inefficient vehicles receive a surcharge (FEE-), and efficient vehicles are granted a rebate (–BATE). For simplicity, we have framed our discussion of feebates in terms of fuel economy improvement, but it is important to remember that the GHG emissions reductions are an equally viable metric.

The feebate is a valuable policy tool because it creates an incentive for automobile manufacturers to continuously improve the automobile fuel economy by providing incentives for manufacturers to build more efficient vehicles and rewarding consumers who purchase more efficient vehicles. Thus, the feebate has the potential to accelerate the production and adoption of more efficient vehicles, ultimately reducing our transportation fossil fuel consumption.

Design Goals

Before discussing how the feebate policy should be crafted, it is important to clarify that the goal of the feebate policy strongly drives the way the policy should be crafted. For example, if the goal of the policy is to increase the efficiency of all vehicles (in terms of fuel consumption or GHG emissions), then it is imperative that the policy encourages manufacturers to produce efficient vehicles in every size class. However, if the goal of the policy is to reduce overall greenhouse gas emissions, it may be less important to encourage manufacturers to make all vehicles more efficient, as larger vehicles will likely produce more emissions – regardless of their efficiency – than small vehicles. In this case, the policy may achieve its goal of reducing overall GHG emissions by encouraging the adoption of smaller vehicles.

For the purposes of this paper, RMI has framed the goal of the feebate as increasing the efficiency of all vehicles on the market, using fuel economy as the metric. RMI has chosen to encourage the efficiency of all vehicles as the goal because it is a business-oriented solution to reducing oil consumption that preserves consumer choice (this is discussed in more detail in part IV, below). The fuel economy metric was chosen because it is what RMI has studied in the past, and this paper builds upon past findings.

Feebate Components

The rate and the pivot point are critical components of the feebate because they determine how much the rebate or surcharge will be, and which vehicles receive a rebate or a surcharge, respectively. The equation for the feebate is shown in Figure 1 below.

Figure 1. Feebate Equation

Equation	Variables
$\text{Feebate} = \text{Rate}\left(\frac{1}{PP} - \frac{1}{fe}\right)$ $PP = C\,\frac{\sum (1/fe)(\text{sales volume})}{\sum \text{sales volume}}$	**Feebate:** (+) rebate, (-) surcharge ($) **Rate =** value of a gallon of fuel ($/GPM*) **PP =** pivot point (MPG) **fe =** fuel economy of a given vehicle (MPG) **C =** constant, used to adjust for shift in consumer demand and money needed to fund administrative costs of program * GPM = 1/MPG = gallons per mile

Rate

The rate is critical to the feebate because it determines how much the rebate or surcharge will be by setting the value of a gallon of gasoline (using a gallon per mile metric). In RMI's *Winning the Oil Endgame* analysis, two scenarios were analyzed: one with a rate of $1000/0.01 gallons per mile and another with a rate of $2000/0.01 gallons per mile. For the analysis in this paper, RMI built upon its prior analysis and used these rates again. [4]

What is the Rate?

The rate is the value of a gallon of gasoline, and is used to determine **how much** the surcharge or rebate for each vehicle will be. The rate should:

- Allow consumers to realize some of the fuel savings potential over the lifetime of their vehicle
- Remain constant across vehicle classes to allow all gallons of fuel saved to be valued equally
- Account for the benefit associated with efficient vehicles reducing social costs such as pollution, oil dependence, congestion, health problems and climate change.

Policy makers must be thoughtful when calculating the rate of the feebate policy because it has significant fiscal impacts. For example, a vehicle that achieves 14 mpg in a vehicle class with a pivot point of 19.5 mpg would receive a $2000 surcharge with a rate of $1000/0.01 gpm rate, and $3000 surcharge with a rate of $1500/0.01 gpm

It is interesting to note that a rate of at least $4500/0.01 gallons per mile is required to allow consumers to realize the full fuel savings potential of a vehicle over its lifetime (150,000 miles).[5] However, a rate this high would result in very high fees and rebates,[6] which may be politically unacceptable. Also, as recent studies indicate

[4] There are other values that can be used to measure the rate as well, including grams of carbon/ mile, British thermal units/mile, or gigajoules/ mile. As noted here, RMI is using a $/GPM because it is building on past analysis.

[5] Consumers are able to realize the full fuel savings potential of a vehicle when they value the fuel savings of all 150,000 miles the vehicle will run. Most consumers only value the first three years of fuel savings when purchasing a new vehicle. The feebate makes the fuel costs (and savings) for a period of the vehicle lifetime transparent.

[6] For example, using the rate of $4500/0.01 gallons per mile, with a pivot point of 19.5 miles per gallon (0.051 gpm), a vehicle achieving 14 miles per gallon (0.071 gpm) would be assessed a fee of $9000.

consumers do not value the entire lifetime fuel savings of a fuel-efficient vehicle,[7] it may be more reasonable for policymakers to begin to allow consumers to recognize fuel consumption implications over the vehicle lifetime by using a lower rate for at least the first few years of implementation.

Although setting the rate this high would allow consumers to realize the full fuel savings potential, it is likely that a policy subjecting automobiles to surcharges and rebates this large would face serious opposition. It is therefore suggested that the feebate rate be set slightly lower to help purchasers realize the economic impact of at least the first five years of fuel consumption.

In addition, it is important to keep the feebate rate constant for each vehicle class, meaning the value of gallon of fuel remains constant regardless of vehicle utility. Changing the rate would imply that saving a gallon of fuel from one type of vehicle is more important than saving a gallon from another type of vehicle.

Pivot Point

The pivot point (PP) is the point that divides inefficient and efficient vehicles. Ideally, the pivot point is an annually defined fuel economy benchmark, allowing policymakers to adjust the pivot point annually, and have more control over the revenue neutrality of the policy. However, adjusting the pivot point annually may be disruptive to manufacturers, as it does not provide manufacturers with any insight about whether their vehicle will receive a rebate or fee before it is designed and produced. It is worth noting that prior analysis has indicated that automakers will design according to the rate, regardless of the pivot point because the actual fee or rebate is less significant to the manufacturers, particularly if the feebate is administered between automakers and the government, rather than consumers.[8]

What is a Pivot Point?

The pivot point is a miles per gallon number that determines whether or not a vehicle receives a rebate or a surcharge. There can be one pivot point for the all vehicles that are subject to the feebate, or multiple pivot points for each size class (see part IV below). When policymakers set the pivot point, particularly for multiple size classes, it is important that analysis be performed to ensure that the correct mpg number is chosen to ensure that the policy is revenue neutral.

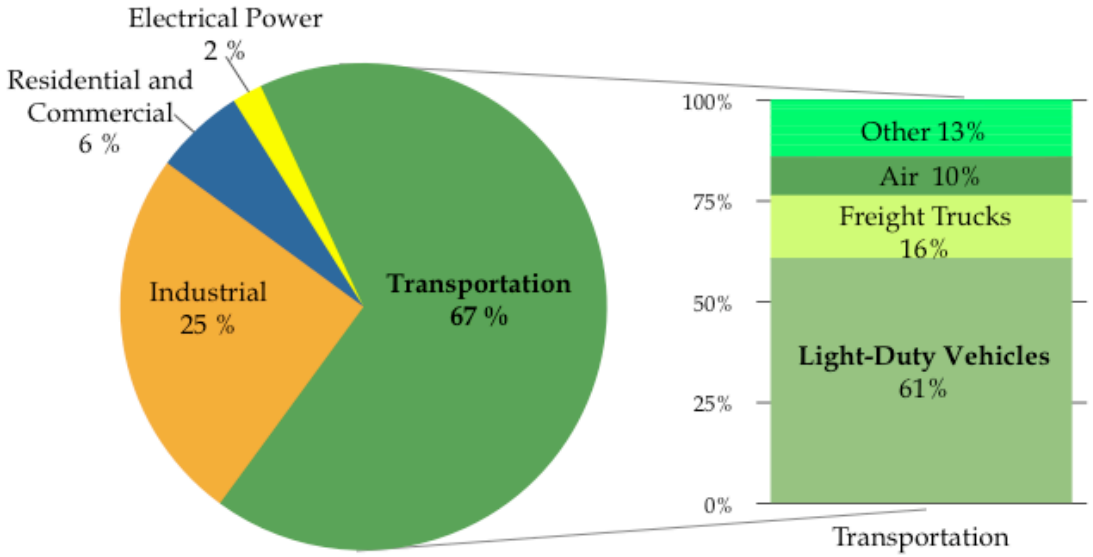
[7] Turrentine, Thomas S., and Kenneth S. Kurani. *Car buyers and fuel economy?* Energy Policy 35 (2007) 1213-1223. Turrentine and Kurani found that "…automobile buyers do not have the basic building blocks to make calculated decisions about better fuel economy, and most do not keep track of fuel cost over any significant time period, be that the life of the vehicle, their duration of ownership, annually or even monthly."

[8] Further discussion on feebate administration is found in section VI, implementation.

III. Why Feebates?

RMI first analyzed feebates in its 2004 publication *Winning the Oil Endgame*.[9] The book provides a roadmap for profitably eliminating oil consumption in the United States, by the 2040s without changing consumer behavior. EIA data shows that about 40 percent of the fuel used in the United States is consumed in light-duty vehicles (see Figure 2), and is projected to grow to 73 percent by 2030. [10]

Figure 2. Fuel Consumption by Sector in the U.S.[11]



However, fleet-wide fuel economy has not improved in the last twenty years[12] (as shown in Figure 3), because increases in fuel efficiency have been offset by weight gains (see Figure 4), as well as increases in vehicle performance. Light vehicles represent the significant proportion of fuel consumption, thus reversing this trend could have a significant impact on oil consumption in the United States. Therefore, RMI began to investigate tools to encourage manufacturers to start integrating fuel-efficiency technologies into new vehicle models.

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[9]Visit http://www.oilendgame.com to download a fee copy of *Winning the Oil Endgame*.

[10] EIA. *Annual Energy Outlook 2007 with Projections to 2030*. Tables 2 and 7. Report #:DOE/EIA-0383(2007). Retrieved on 6 August 2007 from http://www.eia.doe.gov

[11] EIA. *Annual Energy Outlook 2007 with Projections to 2030*. Tables 2 and 7. Report #:DOE/EIA-0383(2007). Retrieved on 6 August 2007 from http://www.eia.doe.gov

[12] On December 19, 2007, President Bush signed H.R. 6, the Energy Independence and Security Act of 2007 into law. The Act requires that CAFE standards be increased to 35 miles per gallon by 2020.

Figure 3. Light-Duty Vehicle Fuel Economy Trends[13]

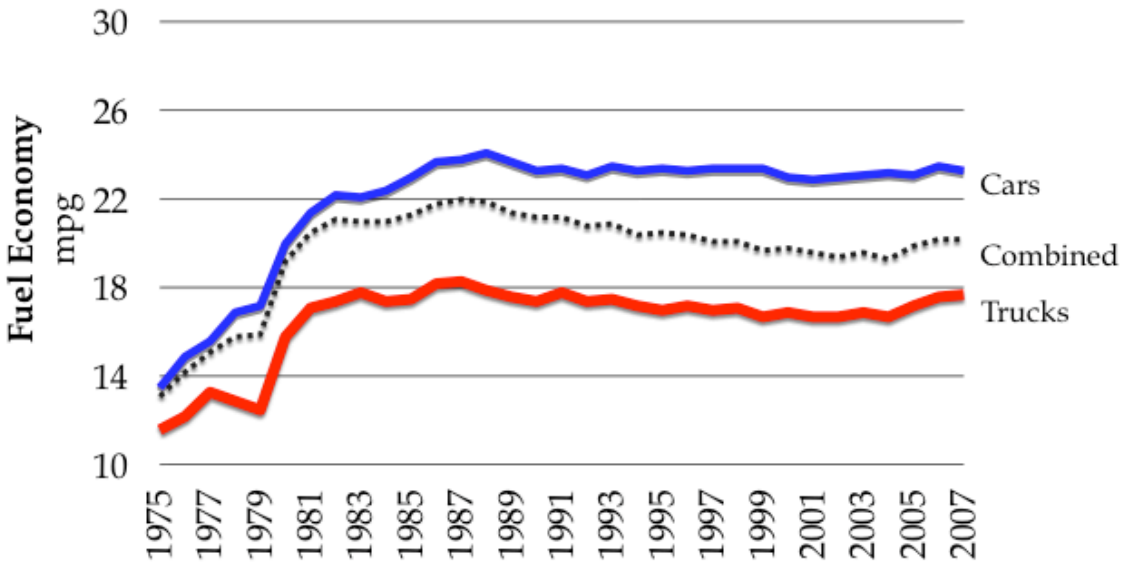
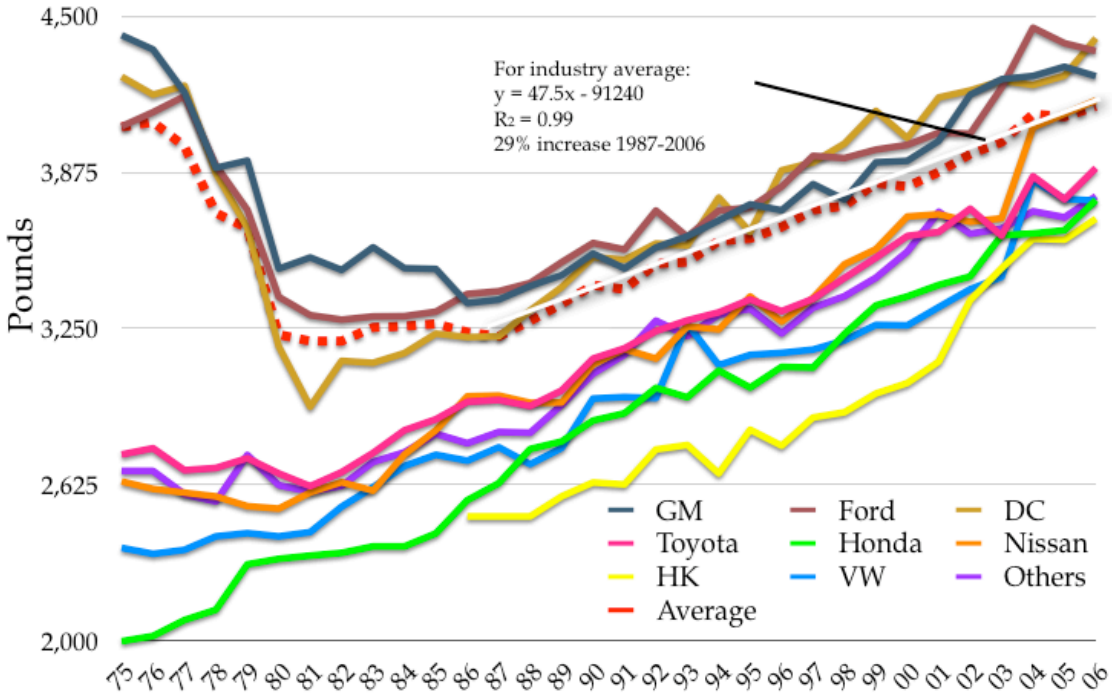


Figure 4. Weight Trend of All Vehicles Sold in the U.S.



[13] Fuel economy has not improved in the last twenty years. Source: US EPA Light-Duty Automotive Technology and Fuel Economy Trends: 1995-2007. (September 2007). EPA420-R-07-008.

RMI believes that the feebate is a policy that has significant potential to shift the new vehicle sales market towards offering more efficient vehicles, and has characteristics that align with the *Winning the Oil Endgame* vision of shifting the United States off of oil, profitably. The feebate characteristics are that the policy is:

- **Technology neutral** – The feebate does not promote one specific type of technology because the policy allows manufacturers to use any cost-effective technology available to make their vehicles more efficient.
- **Applies to all size classes** – Consumers can receive a rebate for any efficient vehicle they purchase; regardless of what size class it is in. That is, the feebate does not favor small cars but rather the most efficient car within a given size class.
- **Enables continuous fuel economy improvement** – The feebate is a dynamic policy that requires vehicles to achieve a progressively higher fuel economy/GHG emissions reduction in order to receive a rebate, and rewards all incremental improvement.
- **Provides equal playing field for manufacturers** – By comparing like-size vehicles, the feebate does not disadvantage manufacturers that produce large vehicles. The manufacturers that produce the most efficient vehicles in each class will benefit from policy, but all manufacturers have equal opportunity to become leaders in vehicle efficiency.

Despite the fact that feebates are a relatively old concept,[14] RMI noticed that they were rarely being discussed as a legislative option for improving fuel economy. As part of the *Winning the Oil Endgame* implementation project, RMI decided to stimulate the conversation about feebates as a viable legislative option for improving fuel economy. Opportunities for RMI to contribute to feebates arose in Washington D.C., and Hawaii as discussed in Appendix A. The pivot point (PP) is the point that divides inefficient and efficient vehicles. Ideally, the pivot point is an annually defined fuel economy benchmark, allowing policymakers to adjust the pivot point annually, and have more control over the revenue neutrality of the policy. However, adjusting the pivot point annually may be disruptive to manufacturers, as it does not provide manufacturers with any insight about whether their vehicle will receive a rebate or fee before it is designed and produced. It is worth noting that prior analysis has indicated that automakers will design according to the rate, regardless of the pivot point because the actual fee or rebate is less significant to the manufacturers, particularly if the feebate is administered between automakers and the government, rather than consumers.[15]

[14] For a brief history of the feebate see: Langer, Therese. "Vehicle Efficiency Incentives: An Update on Feebates for States." September 2005, American Council for an Energy- Efficient Economy Report number T051.

[15] Further discussion on feebate administration is found in section VI, implementation.

IV. Feebate Characteristics

A feebate is a complex policy that can be extremely effective at increasing the production and adoption of more efficient vehicles. However, it must be properly crafted if it is to successfully achieve its design goals. This section discusses the design characteristics that RMI suggests policymakers adopt when crafting a feebate policy.

These *characteristics* are different from the *components* of the feebate discussed above because these characteristics are variable policy design ideas. The components discussed above are necessary for any type of feebate – regardless of the goal of the policy. The characteristics that RMI suggests policymakers adopt are:

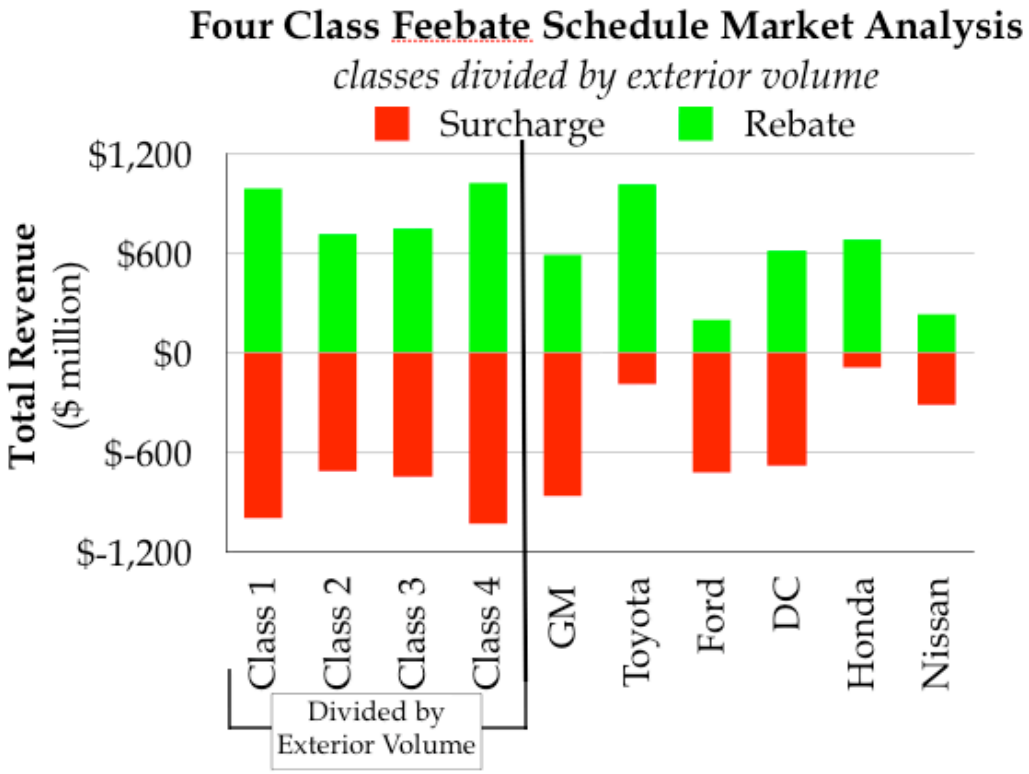
- **Self-financing**: the policy should be revenue neutral or slightly revenue generating,
- **Consumer choice preservation**: the policy should not force consumers to buy a smaller or larger vehicle than what they need, or manufacturers to serve different market segments,
- **Continuous fuel economy improvement**: the policy should be dynamic and require constant innovation (as opposed to Corporate Average Fuel Economy (CAFE) standards which are static and do not require change).

Self-Financing

A key characteristic of the feebate is that the policy is self-financing. This is achieved by using revenue generated from fees to fund rebates and all administration costs associated with the policy. Subsequently, taxpayers do not fund the policy. To ensure that the policy remains self-financing, the policy administrator adjusts the pivot point on a regular basis, making sure the pivot point is placed in just the right spot where fees fund rebates and administrative costs.

Figure 5 displays an example of a self-financing feebate. In this case, the feebate schedule has four size classes based on exterior volume. Surcharges and rebates are equally distributed among large and small vehicles, as shown in the first four bars on the figure. The last eight bars show that all manufacturers would receive both surcharges and rebates on their vehicles, though some fare better or worse than others.

Figure 5. Example of Self-Financing Feebate[16]



Preservation of consumer choice

A successful feebate preserves consumer automobile choice and does not distort it. Improperly crafted feebates may distort consumer choice by encouraging the consumer to purchase smaller or even larger vehicles. There are a few ways to avoid this issue:

- No size class: a mathematical function can be created that takes vehicle size into account and compares vehicles that are similar in size, using a constant rate (so all fuel savings are valued equally).
- Multiple size classes: the entire vehicle fleet can be broken into size classes. For example, in this paper, RMI looks at dividing the fleet into four different size classes.
- Zero-band: a mandate can be passed that some vehicles in each class are not part of the policy to ensure that consumers are able to purchase a vehicle in each size class that does not have a fee.

It is important to note that regardless of what type of size class divisions are made, the feebate will allow all manufacturers to receive both rebates and surcharges on their vehicles. However, because the policy is dynamic and requires increased efficiency over time, manufacturers that do not actively pursue efficiency improvements will likely fall behind competitors and they can expect to be assessed a surcharge in the long run.

[16] Based on 2005 sales data from Polk Automotive Profiles (2006). Vehicle sales data for 2005 prepared for RMI. www.claritas.com/claritas/Default.jsp?ci=3&si=1&pn=polkauto.

No Size Class

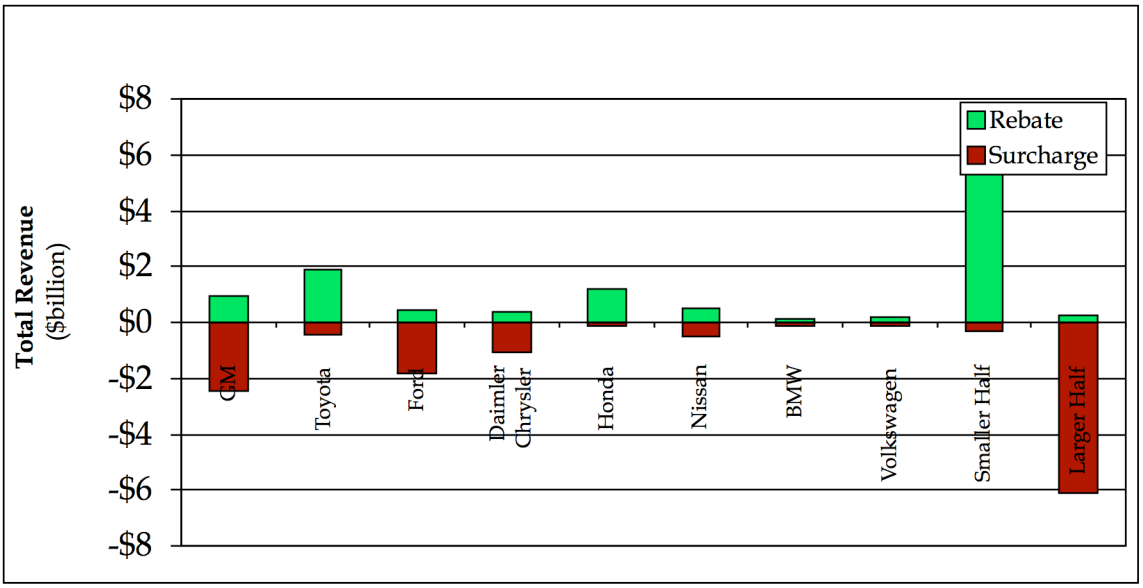
The feebate policy could preserve consumer choice by utilizing a mathematical function that takes vehicle size into account while continuously calculating surcharges or rebates ("continuous function"). The continuous function would allow like-sized vehicles to be compared to each other and would be applied to the vehicle fleet. The mathematical function would maintain a constant rate ($/gpm) regardless of the vehicle size. Further research is needed to derive the equation that could describe the continuous function. The mathematician that derives the equation may consider using a size-adjusted pivot point or a moving average pivot point.

There are advantages and disadvantages to not having a size class for the feebate policy. The advantage is that it may reduce manufacturer "gaming." Gaming occurs when manufacturers alter the vehicle weight or size of the vehicle to jump into a different vehicle class with a lower pivot point in an effort to receive a rebate instead of being charged a fee. In a feebate program that does not have a size class, no manufacturer can game the system as there is a single pivot point for all vehicles, or one pivot point for vehicles and one for trucks.

The disadvantage to not having a size class is the disproportionate impact that the feebate has on manufacturers who produce larger vehicles (see Figure 6). The last two bars on the right of Figure 6 represent the smaller and larger half of 2005 vehicle fleet sales. As shown, the majority of the rebates are allocated to the smaller half of the fleet. This coincides with Green et al.'s 2005 feebate study (based on a gallon per mile metric, not a grams of carbon per mile metric) that found that using one size class with one pivot point would not affect the outcome of the feebate policy, in terms of the amount of overall efficiency improvement, but would have a disproportionate impact on the automobile manufacturers.[17]

[17] Green, David L., Philip D. Patterson, Margaret Singh, and Jia Li. *Feebates, rebates and gas-guzzler taxes: a study of incentives for increased fuel economy.* (2005). Energy Policy. 33 (2005) 757-775

Figure 6. No Size Class Feebate



However, as further research is done on creating the mathematical function to be applied to a continuous feebate for the all new vehicles, a size-adjusted pivot point or a moving average pivot point may be used to mitigate the disproportionate effect the policy has on some manufacturers.

Multiple Size Classes

Another alternative to ensure consumer choice is to craft the feebate policy so that it compares like-sized vehicles. In this type of feebate, the vehicle fleet is divided into classes based on the vehicle size (interior volume is a common metric). Each size class is revenue neutral, has its own pivot point, and all classes maintain the same rate.

Class divisions should ensure that no consumer is subject to a fee when purchasing a large efficient vehicle as opposed to a small efficient vehicle. It is best to create vehicle classes based on vehicle size, *not on vehicle weight*. Size-based classes capture the intuitive divisions of vehicle function using simple metrics like footprint[18,19] exterior or interior volume, or rectangular shadow.[20]

Size is a better metric to divide vehicles into classes than volume because vehicles can get bigger or smaller without decreasing fuel efficiency. Also, using volume as a metric may encourage manufacturers to increase vehicle height, which makes the vehicles easier to rollover, reducing vehicle safety. A size-based system is preferable to a weight-based system because if manufacturers try to game a size-based system it is more likely that consumers will notice the size difference, as manufacturers will have to provide the consumer with added

[18] Footprint is calculated by multiplying the distance between the left and right wheels by the distance between the front and rear wheels.
[19] In 2007 CAFE reforms for light trucks, the National Highway Traffic Safety Administration (NHTSA) decided to classify vehicles based on footprint.
[20] Rectangular shadow is calculated by multiplying exterior length by exterior width.

benefits (i.e. more room) as opposed to adding weight without adding any benefit. Finally, a size-based system encourages reducing weight without reducing size, which decreases fatalities, while a weight based system does not.

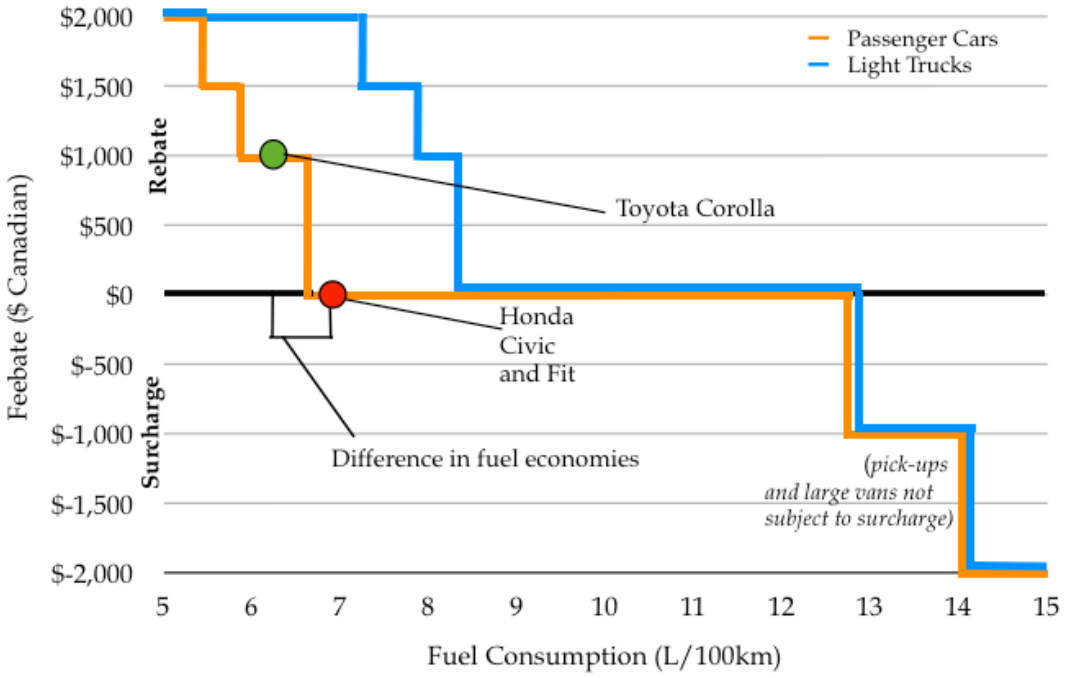
In addition, within each size class, the feebate must be a continuous function. If the policy is designed as a step function, it allows a discontinuity, or a jump in the amount of rebate or surcharge. This discontinuity is displayed in Figure 7 below, which represents the Canadian government's vehicle efficiency incentive (VEI) policy.

What is the VEI?

The VEI is an economic incentive policy that was implemented in March 2007 in Canada to promote the purchase of efficient vehicles in Canada. The VEI places a rebate on fuel-efficient vehicles, does not place any financial incentive on vehicles with average fuel efficiency, and places a surcharge on fuel-inefficient vehicles. The VEI resembles a feebate, in that it generates revenue from surcharges on inefficient vehicles, and allocates money to efficient vehicles. However, the system is far from the ideal feebate model.

As shown in Figure 7, the VEI policy has a step function. One of the problems with the step function is that the vehicles very close to the edge of the class are subject to very different financial incentives. For example, both the 2007 Honda Fit and the Honda Civic missed the 6.5L/100km class rebate by fractions of liters per kilometer while the Toyota Corolla met the fuel efficiency standard by 0.2 L/100 km. In response, Honda has retooled the Fit and Civic being sold in Canada to achieve the required L/km to receive the $1000 rebate in both 2008 models.

Figure 7. Canada Vehicle Efficiency Incentive Policy



Zero Band

Finally, another way to preserve consumer choice is to exempt a percentage of vehicles from participation in the policy, a strategy also known as a "zero-band." The advantage (and disadvantage) of the zero band is that it removes a percentage of the population from having to participate in the feebate policy, which can exempt many of the new vehicles sold from the feebate policy. Removing vehicles from the policy may be politically appealing, but it too many vehicles are removed from the policy, the incentive to improve vehicle fuel economy may be lost. Additionally, because the zero band does not need size classes, it is an option that generates only one pivot point for the entire fleet, which would reduce administrative complexity. However, this unique class would also impose create a disproportionate impact on certain manufacturers, as discussed above.

RMI did not conduct an analysis of what the impact a zero band would be on the feebate. For more information on the zero-band, see Dr. Walter McManus's May 2007 report, "Economic Analysis of Feebates to Reduce Greenhouse Gas Emissions from Light Vehicles for California."[21]

Continuous Fuel Economy Improvement

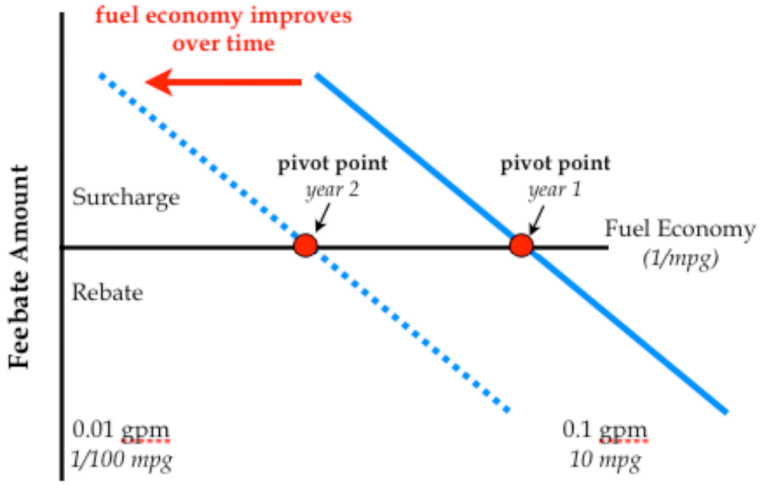
Calculating and adjusting the pivot point on a regular basis is crucial to maintaining a revenue-neutral policy that encourages continuous fuel economy improvement. The key to calculating the pivot point is to ensure that it divides the vehicles in a way that surcharges will fund rebates and all administrative costs, assuming that the policymakers desire a revenue-neutral policy. If, for example, a state favors a net subsidy or tax, maintaining revenue neutrality is less significant.

The policy administrator should take the previous year sales data and knowledge of how consumers respond to the feebate into account when calculating the pivot point. It may be difficult to predict how consumers will respond to the feebate policy for the first few years of the policy, but as the policy becomes more established, the administrator will have a better understanding of how consumers respond to the feebate and will be able to calculate the correct pivot point location with more precision.

If the pivot point is never adjusted, as vehicles become more efficient, the rebates being distributed will increase, and fees collected will decrease, creating a policy that will create a net subsidy or tax. It follows that the policy administrator will have to adjust the pivot point on a regular basis to ensure that surcharges fund rebates and the policy remains self financing. As sales shift towards more efficient vehicles, the pivot point will be placed at a higher and higher fuel economy level, and the vehicle fleet will continue to become more efficient (see Figure 8).

[21] Available at: www.umtri.umich.edu/content/UMTRI-2007-19-2.pdf

Figure 8. Shifting Pivot Point to Promote Continuous Fuel Economy Improvement



It is worth noting that a feebate policy may be more effective without a financial cap on the rebate or surcharge. Placing a financial cap on the feebate may be attractive to legislators who want to minimize the financial risk of the policy; however, capping the rebates or surcharges could discourage manufactures from bringing a truly transformational vehicle to market and could encourage manufactures to improve the vehicle just enough to receive the maximum rebate or avoid the surcharge. The main reason is that a capped feebate may not promote continuous fuel economy improvement. For example, if there is a cap on the rebate level, manufacturers would only install as much efficiency technology as can be achieved for the price of the cap. If there is no cap, the manufacturers could implement whatever cost-effective efficiency technology is available, knowing that the vehicle would receive a larger rebate. At the same time, the manufacturers would be able to anticipate the value of their efficiency technology because the rate would always remain the same, thus keeping the value of a gallon of gasoline constant.

IV. RMI Size Class and Attribute Analysis

As shown above in the discussion regarding consumer choice, there is much room for analysis to determine how to craft the feebate in a way that preserves consumer choice and does not disproportionately impact any one manufacturer. Thus, RMI performed a static analysis on 2005 vehicle data to determine:

- The effect that the number of vehicle size classes has on the feebate policy,
- The effect of using certain size attributes to divide the vehicle classes, and
- The effect of using equal sales volume or equal size vehicles to divide the size classes.

The major findings of RMI's analysis are discussed below.

RMI Size Class and Attribute Analysis Results

- As the number of vehicle size classes increase:
  - The volume range of vehicle in each class decreases,
  - The range of fuel economies in each class decreases, and
  - The magnitude of the fees or rebates a vehicle receives decreases.
- RMI did not perform comprehensive analysis to determine the optimal number of size classes for a feebate policy. However, based on preliminary findings, all class size divisions analyzed have a very large range of vehicles in the smallest and largest vehicle class.
- The size attribute (interior volume, exterior volume, footprint and rectangular shadow) used to divide vehicle classes does not have a significant impact on manufacturer revenue.
- Dividing size classes by equal sales volume results in average and maximum fees and rebates that are approximately equal for all classes.
- Dividing size classes by equal increments in vehicle size results in lower pivot points for each class, and a significant reduction of fees in Class 4 (the largest) vehicles.

Size Class

RMI sorted vehicles sold in 2005 by interior volume[22] and then divided the vehicles into classes of approximately equal sales volume. RMI divided the fleet into vehicle classes with

[22] For vehicles with exterior cargo capacity, mainly pick-ups, we added exterior cargo volume to the interior volume. Exterior cargo volume is defined as length of bed times width of bed between wheel wells times bed depth to top of gate.

1, 4, 8 and 12 size classes. For each scenario, the feebate has a constant rate and is applied as a continuous function in all size classes, thus the only metric that changes is the number of size classes. The primary findings of the class analysis are that as the number of vehicle size classes increase:

- The volume range of vehicle in each class decreases,
- The range of fuel economies in each class decreases, and
- The magnitude of the fees or rebates a vehicle receives decreases.

As the number of vehicle size classes increases the volume range of vehicles in each class decreases, and eventually the size range becomes so small that there is barely a distinguishable size difference between different classes. This is significant because the more size classes there are, the more administrative requirements there are to determine what vehicle goes into which class. Increasing the number of size classes may increase the ability of regulated entities to game the policy. However, as the number of size classes increases, the pivot points among classes become very similar and may reduce the incentive for regulated entities to game the policy.

It is important to recognize that increasing the number of classes has an impact on the magnitude of the surcharges and rebates. As the number of classes increases, the number of vehicles in each class decreases and so does the range of fuel economies that can be found in each class. The magnitude of the fees or rebates a vehicle receives depends on the distance from the pivot point and the vehicle fuel economy. Thus, the more size classes there are, the lower the magnitude of fees and rebates within each size class are.

RMI did not perform comprehensive analysis to determine the optimal number of size classes for a feebate policy. However, based on preliminary findings, all class size divisions analyzed have a very large range of vehicles in the smallest and largest vehicle class. For example, there is a 300 cubic foot interior volume range for vehicle in the largest class for all feebate systems analyzed (see Table 1). This problem needs more analysis to determine if it is best to use or modify the existing vehicle divisions, or if the optimal feebate only has one size class.

Finally, the more size classes there are, the lower the magnitude of the fees and rebates are. As discussed above, the rate determines how much the fee or rebate on a vehicle will be, but there is a correlation between the number of size classes and the magnitude of the fee or rebate on a vehicle. This likely occurs because as the number of size classes increase, the more homogenous the vehicles within the size class become, and the vehicles are more clustered around the pivot point. This is particularly true for the largest size classes where there is greater disparity between the largest and smallest vehicle (and fuel economy) in the size class (see Table 2). The analysis is static, therefore the impact that more size classes have on the magnitude of future vehicle fees and rebates was not projected.

Table 1. Class Size Division Data

		Pivot Point Fuel Economy	# types	#sold	min vol	max vol	min mpg	max mpg	Δ vol	Δ mpg
		mpg			ft^3	ft^3	mpg	mpg	ft^3	mpg
Undivided		20.85	346406.00	13538752.00	473.00	49.10	63.15	10.45	423.90	52.71
4 Classes	Class 1	25.50	279	3376637	49.1	109.2	10.45	63.15	60.1	52.71
	Class 2	23.44	211	3378617	109.46	127.2	13.19	55.59	17.74	42.4
	Class 3	19.16	150	3319050	127.6	150.4	12.17	41.23	22.8	29.05
	Class 4	17.36	191	3464448	151.94	473.	10.98	27.	321.06	16.02
6 Classes	Class 1	25.79	198	2222703	49.1	103.9	10.45	100.	54.8	89.55
	Class 2	24.75	137	2277896	104.	114.2	14.54	55.59	10.2	41.05
	Class 3	22.93	160	2280228	114.3	127.6	13.19	41.23	13.3	28.04
	Class 4	19.93	6787	2336092	128.2	142.6	12.17	41.23	14.4	29.05
	Class 5	17.03	2210	4176835	143.	167.05	10.98	23.32	24.05	12.34
	Class 6	17.38	155	2250540	168.03	473.	11.16	27.	304.97	15.84
8 Classes	Class 1	24.61	185	1686537	102.35	49.1	63.15	10.45	53.25	52.71
	Class 2	26.47	95	1691547	109.2	102.4	100.	16.06	6.8	83.94
	Class 3	24.03	117	1682884	118.5	109.46	55.59	14.54	9.04	41.05
	Class 4	22.86	98	1719859	127.6	118.6	41.23	13.19	9.	28.04
	Class 5	19.89	94	1658584	139.74	128.2	41.23	12.17	11.54	29.05
	Class 6	18.44	52	1636340	150.4	140.3	23.32	12.17	10.1	11.14
	Class 7	16.63	58	1630741	171.1	151.94	22.32	10.98	19.16	11.34
	Class 8	18.06	133	1833707	473.	172.34	27.	11.16	300.66	15.84
EPA Classification for Passenger Cars (divided by internal volume)										
Minicompact	< 85	22.05	62	211609	83.8	49.1	63.15	10.45	34.7	52.71
Subcompact	85 - 99	25.61	61	593877	99.8	85.	41.23	18.24	14.8	22.99
Compact	100 - 109	28.44	113	2065425	109.46	100.3	48.12	12.8	9.16	35.32
Mid-Size	110 - 119	25.64	114	2115330	119.6	110.	55.59	14.38	9.6	41.2
Large	120 - 130	22.74	67	725977	129.8	120.4	41.23	13.19	9.4	28.04
Extra Large	>130	21.30	33	167014	159.8	130.4	23.98	12.82	29.4	11.15
NHTSA Classification for Light Trucks (divided by footprint)										
1	≤43.0	23.41	31	508639	139.5	74.2	32.28	16.06	65.3	16.22
2	> 43.0–47.	20.97	37	977259	156.95	80.7	32.32	13.43	76.25	18.89
3	> 47.0–52.	18.92	100	1998915	282.8	57.4	22.32	13.52	225.4	8.8
4	> 52.0–56.	18.84	82	1497726	266.5	76.6	23.33	14.86	189.9	8.48
5	> 56.5–65.	16.58	55	1573260	367.	85.02	27.	10.98	281.98	16.02
6	> 65.0	15.05	76	1103721	473.	129.7	27.	11.16	343.3	15.84

Table 2. Fiscal Impacts of Size Classes

		Max Rebate	Max Fee	Average Rebate	Average Fee	Total Rebate	Total Fees	Net Revenue
		$	$	$	$	$ Million	$ Million	$ Million
Undivided		3213.22	4775.97	6316.45	-6322.94	862.77	-1016.94	-6.49
4 Classes	Class 1	2338	- 5651	663	- 851	1258.29	- 1259.62	-1.32
	Class 2	2467	- 3317	634	- 708	1128.98	- 1130.42	-1.44
	Class 3	2794	- 2994	648	- 801	1188.63	- 1190.36	-1.73
	Class 4	2057	- 3350	717	- 618	1148.6	- 1150.59	-2.00
6 Classes	Class 1	2878	5695	735	812	953.17	- 954.03	-0.86
	Class 2	2242	2837	723	946	796.9	- 797.82	-0.92
	Class 3	1936	3221	459	816	659.02	- 660.02	-0.99
	Class 4	2592	3197	511	967	780.58	- 781.75	-1.17
	Class 5	729	4094	270	1012	138.86	- 3707.03	-3568.17
	Class 6	1314	3944	290	1288	227.79	- 1888.36	-1660.57
8 Classes	Class 1	2479	5510	634	1112	680.78	- 681.46	-0.69
	Class 2	2778	2447	571	821	569.29	- 569.93	-0.64
	Class 3	2363	2716	845	671	629.05	- 629.75	-0.70
	Class 4	1949	3209	466	867	520.74	- 521.5	-0.75
	Class 5	2602	3187	585	1022	616.47	- 617.31	-0.83
	Class 6	1134	2791	600	615	496.83	- 497.72	-0.89
	Class 7	1531	3099	483	742	476.6	- 477.58	-0.98
	Class 8	1834	3424	632	852	665.25	- 666.26	-1.02
EPA								
Minicompact	< 85	2952	5037	611	- 608	64.43	- 64.52	-0.10
Subcompact	85 - 99	1479	1578	419	- 506	136.04	- 136.27	-0.23
Compact	100 - 109	1439	4296	441	- 571	513.42	- 514.15	-0.73
Mid-Size	110 - 119	2101	3052	507	- 488	525.65	- 526.48	-0.82
Large	120 - 130	1973	3185	311	- 446	132.8	- 133.12	-0.32
Extra Large	>130	523	3104	256	- 255	21.33	- 21.41	-0.08
NHTSA								
1	≤43.0	1174	1954	415	- 900	144.29	- 144.51	-0.22
2	> 43.0–47.	1675	2676	370	- 277	154.7	- 155.16	-0.47
3	> 47.0–52.	806	2109	411	- 515	456.04	- 457.09	-1.06
4	> 52.0–56.	1023	1422	502	- 774	455.86	- 456.66	-0.80
5	> 56.5–65.	2327	3080	408	- 278	259.46	- 260.41	-0.95
6	> 65.0	2941	2317	780	- 857	450.35	- 451.09	-0.73

Size Attribute Analysis

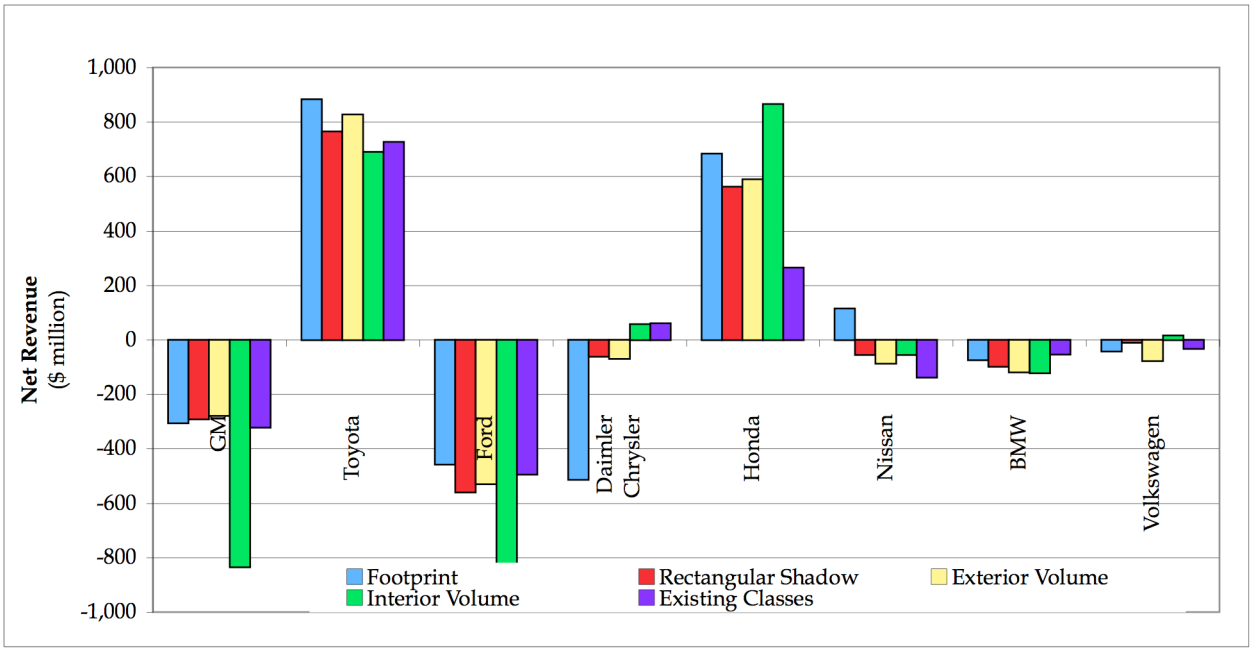
RMI looked at four size attributes to see if changing certain size attributes had significant effects on the feebate policy. The five metrics we evaluated were:

- Footprint – found by multiplying the distance between the middle of the left and right wheels by the distance between the middle of the front and rear wheels;
- Rectangular Shadow – found by multiplying the exterior length by the exterior width;
- Interior Volume – found by adding the volume inside the vehicle and the volume of exterior cargo
- Exterior Volume – found by multiplying the exterior length by the exterior width times exterior height, and
- Existing CAFE classes.

RMI evaluated the effect that these attribute had on dividing the size classes. Using each attribute to determine the class divisions (except Existing Class), the vehicle fleet was divided into four size classes. The feebate rate remains constant rate at $1000/0.01gpm for all size metrics.

Figure 9 illustrates that the size attributes has a minor effect on the revenue manufacturers generate or lose from the feebate policy, as all attributes generally result in a feebate policy that has negative impacts on domestic automobile manufacturers and a positive impact on some, but not all, foreign automobile manufacturers.

Figure 9. Size Attributes Impact on Manufacturer Revenue



Currently, the EPA uses interior volume to classify vehicles into size classes. However, as shown in the Figure 9, using interior volume to divide the vehicles into four size classes results in negative fiscal impact on domestic automobile manufacturers (it is the worst

scenario for both GM and Ford) and a positive fiscal impact on foreign automobile manufacturers.

Figure 9 also shows the impact that a feebate would have on existing size classes under CAFE, which is represented by the dark blue bar farthest right within each manufacturer category. Even though both of these divisions are based on interior volume, using CAFE standards to divide the vehicle classes is not as fiscally detrimental to domestic automobile manufacturers as using interior volume because there are more classes.

In conclusion, RMI did not find that any one of these size attributes is clearly better than another to divide the vehicle fleet into classes, and the number of classes appears to have a more dramatic impact on the outcome of the feebate than the criteria to divide the classes. Table 3 shows that average and maximum surcharges and rebates do not change significantly when different size metrics are used. We conclude that the size metric does not substantially affect the feebate finances. However, the size metric does impact how intuitive the vehicle classes are.

Table 3. Impact of Size Attributes on Feebate

size-based attribute	class	pivot point	minimim size	maximim size	min. fuel economy	max. fuel economy	Δ size	Δ fuel economy	maximim rebate	maximum fee	average rebate	average fee
		mpg			mpg	mpg		mpg	$	$	$	$
footprint (ft^2)	1	27.4	16.1	43.5	12.2	63.2	27.4	51.	$ 2,060	$ (4,584)	$ 546	$ (712)
	2	22.8	43.6	47.4	11.	32.1	3.7	21.2	$ 1,264	$ (4,735)	$ 455	$ (604)
	3	19.6	47.4	53.2	10.4	25.3	5.8	14.9	$ 1,150	$ (4,471)	$ 427	$ (624)
	4	16.4	53.3	90.6	11.	25.7	37.4	14.7	$ 2,217	$ (3,003)	$ 614	$ (593)
rectangular shadow (ft^2)	1	27.2	66.1	86.9	13.8	63.2	20.8	49.3	$ 2,087	$ (3,560)	$ 562	$ (760)
	2	22.7	86.9	94.9	11.	32.1	7.9	21.2	$ 1,283	$ (4,715)	$ 536	$ (640)
	3	20.1	94.9	107.6	10.4	25.7	12.7	15.3	$ 1,092	$ (4,589)	$ 485	$ (569)
	4	16.4	107.7	148.6	11.	27.	40.9	16.	$ 2,398	$ (3,010)	$ 539	$ (606)
exterior volume (ft^3)	1	27.7	262.7	436.2	10.4	63.2	173.5	52.7	$ 2,030	$ (5,959)	$ 525	$ (685)
	2	23.6	436.6	505.6	13.1	32.3	69.	19.2	$ 1,151	$ (3,402)	$ 451	$ (397)
	3	19.5	506.5	627.4	11.8	23.3	120.9	11.6	$ 843	$ (3,371)	$ 442	$ (448)
	4	16.3	627.8	1204.6	11.	23.	576.8	12.	$ 1,760	$ (2,994)	$ 566	$ (590)
interior volume (ft^3)	1	25.5	49.1	109.2	10.4	63.2	60.1	52.7	$ 2,338	$ (5,651)	$ 663	$ (851)
	2	23.4	109.5	127.2	13.2	55.6	17.7	42.4	$ 2,467	$ (3,317)	$ 634	$ (708)
	3	19.2	127.6	150.4	12.2	41.2	22.8	29.1	$ 2,794	$ (2,994)	$ 648	$ (801)
	4	17.4	151.9	473.	11.	27.	321.1	16.	$ 2,057	$ (3,350)	$ 717	$ (618)

Equal Vehicle Sales Volume or Size

RMI also analyzed the effect on the fee or rebate when the vehicle classes are designed such that each class has approximately equal sales volume or size range. As shown in Figure 10, Figure 11, and Table 4 the implications of dividing the fleet by equal sales or equal size range (based on exterior volume in cubic feet) are significant and both methods present their own challenges.

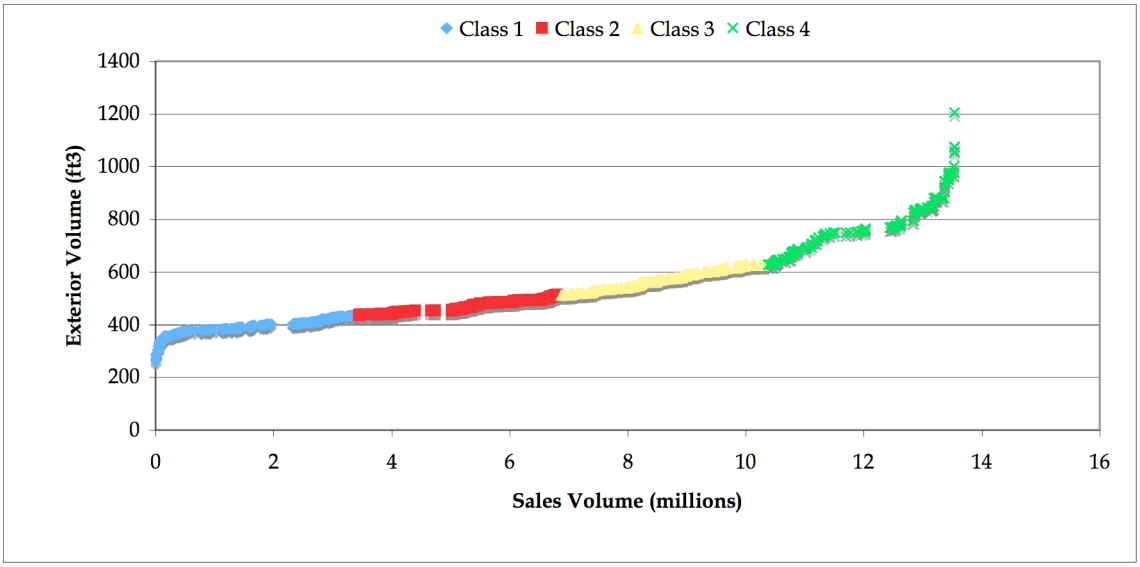
The main observations about dividing vehicles into four classes based on sales volume or size range are:

- Dividing the size classes by equal sales volume results in vehicles that are not the same size (based on exterior volume) being grouped together.
- Dividing size classes by equal sales volume results in a more even distribution of fees and rebates among all classes.
- Dividing size classes by equal size range, results in the smallest classes encompassing over eighty percent of the vehicles.
- Dividing size classes by equal size range results in the largest class having an extremely low maximum fee of $37 due to the class only having five models.[23]

Based on these observations, RMI recommends that vehicles be divided by equal sales volume as opposed to equal size range due to the extremely low maximum fee on the largest vehicles. However, more analysis needs to be done to determine the impact that more size classes would have on dividing vehicles by equal sales volume or size range. RMI analysis did not definitively show what the optimal number of size classes are to (1) only compare similar sized vehicles, and (2) ensure that inefficient vehicles are eligible for a sufficient surcharge to make the fuel inefficiency of the vehicle transparent to the consumer.

[23] One way to address this issue is to base the feebate program on a percentage of the vehicles manufactured. For example, the CAFE standard for light trucks only applies to 97 percent of light trucks market as inclusion of all manufacturers, even those with a very small market share, has the potential to skew the CAFE targets and decrease the overall stringency of the standards.

Figure 10. Size class division based on equal sales volume



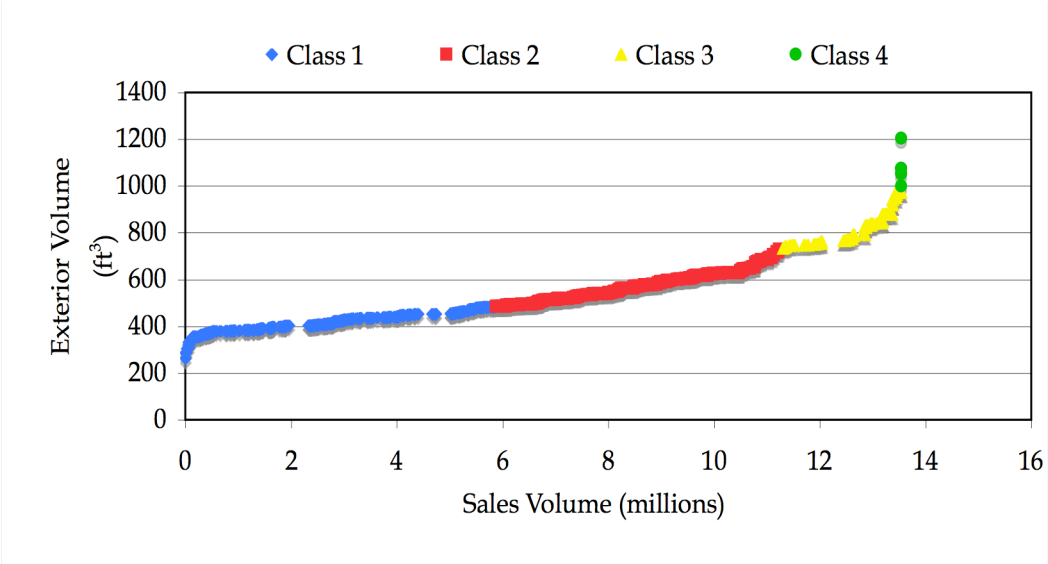
Equal Sales Volume

Figure 10 illustrates what the classes look like when the vehicles are divided by equal sales volume, meaning that all vehicles sold in 2005 were divided equally into four size classes. Class one vehicles are quite diverse, with the difference between the smallest and largest class one vehicles being 174 cubic feet, whereas class two vehicles are fairly homogeneous with only 69 cubic feet of difference between the smallest and largest vehicle. Class four is by far the most diverse, with 577 cubic feet of difference between the smallest and largest vehicle. This diversity in cubic feet within each size class results in vehicles that are not necessarily similar being placed in the same vehicle class. Additionally, dividing the vehicles by equal sales volume results in the fees and rebates for each class being more similar than if the vehicle class is divided by volume. Exact data for Figure 12 is in Table 3 in Appendix II.

Equal Size Range

Figure 11 illustrates what the classes look like when the vehicles are divided by equal volume range, meaning that within each vehicle class the range of exterior cubic feet is approximately the same. This class division results in class one and class two encompassing over eighty percent of vehicles, and class four containing 0.03 percent of vehicles. Subsequently, class four vehicles, which are the largest and likely consume the most fuel, have a maximum fee of $37. Exact data for Figure 11 is in Table 4 in Appendix C.

Figure 11. Class Division by Equal Size Range



V. Current Feebate Legislation

There is currently one active feebate bill in the country: Assembly Bill 493, the California Clean Car Discount Act (CCDA). The CCDA is in front of the California State Legislature and the goal of the bill is to reduce greenhouse gas emissions from cars and light trucks. AB 493 has several important characteristics:

- The feebate applies to passenger vehicles, light duty trucks, medium duty and other vehicles subject to existing state greenhouse gas emissions reduction laws (California Health and Safety Code §43018.5).
- The feebate components (rate) are based on GHG emissions, not GPM.
- The automobile dealer is responsible for placing the surcharge or rebate on the vehicle purchase receipt and collecting the additional surcharge or providing the appropriate claims form to receive a rebate.
- There are no size classes. The California Air Resource Board (CARB)[24] must calculate, using a linear scale, the rebate or surcharge to be applied to any motor vehicle subject to the policy.
- There is a required "zero band." The zero band is defined as "that portion of a linear scale of rebates and surcharges in which vehicles are assigned neither a rebate nor a surcharge." The zero band must be designed to ensure that vehicle buyers continue to have a variety of choices – including light-duty trucks – that are not assigned a surcharge.
- The maximum rebate and surcharge is $2500, not to exceed the sales tax on the vehicle.
- The schedule of rebates and surcharges must be designed to ensure the policy is self-financing and will generate enough revenue to fund rebates and surcharges, administrative costs, and provide a small reserve fund.

AB 493 will be heard in January 2008. If the bill successfully passes through the legislative process, it will be the first GHG feebate to be enacted. The status of the bill is available at http://www.leginfo.ca.gov/cgi-bin/postquery?bill_number=ab_493&sess=CUR&house=B&author=ruskin.

[24] The California Air Resource Board (CARB) is part of the California Environmental Protection Agency, an organization that reports directly to the Governor's Office. The mission of the CARB is to promote and protect public health, welfare and ecological resources through the effective reduction of air pollutants while recognizing and considering the effects on the economy of the state.

VI. Implementation Strategy

There are many issues to consider when designing a feebate implementation strategy. Three questions that are critical to consider are:

- Is the feebate being enacted at the Federal or State level?
- Who will be responsible for paying surcharges and collecting rebates?
- How will the policy transition into full operation?

Federal or State Level Enactment

Ideally, the feebate policy would be a federal policy, but state policies could be effective as well. A federal policy is best because it standardizes regulations for manufacturers and eliminates the element of policy failure from consumers gaming the system by purchasing vehicles out of state. The potential disadvantage of a federal feebate policy is that it may be weaker than what states want. If the federal government were to create a feebate, it is unclear if states would be able to alter the fuel economy standards. For example, if the federal government sets the rate too low, would states be able to increase it, or would it be preempted?[25]

Preliminary research by RMI indicates that under currently law, which does not authorize a federal feebate, states should be able to enact a feebate based on a gallons per mile metric without being federally preempted because a feebate program does not prohibit the enforcement of the CAFE standard. However, if new legislation were to establish a federal feebate, it is not clear whether states would be preempted from enacting regional variations.

The advantage of states setting their own policy is that the feebate could be dealt with in a state or regional market specific markets. However, different feebates in different states may dilute the manufacturer reaction, and as ninety percent of the benefits of the feebate are derived from the manufacturer, it may not be the best strategy to enact several state feebates. It is also important to remember that states may need to lead the feebate movement to push the federal government into creating one unified system. The disadvantage to each state setting their own policy would be that manufacturers may have a difficult time optimizing their profit and managing the many state regulations to which they are subject.

Surcharges and Rebates Implementation Point

There are many different ways to structure the feebate implementation point. The implementation point is when the consumer actually pays or receives a surcharge or rebate during the new vehicle purchase. In this paper, three options are discussed in terms of where to implement the feebate: at the automobile dealer (point-of-sale), at the manufacturer, or at the state registration.

[25] For more information on federal preemption of state feebates, see Section VII, p 32 of this report.

Automobile dealer

A feebate that requires the automobile dealers to implement the policy at the point of sale is advantageous because it allows the consumers to receive a rebate or surcharge when they are purchasing a vehicle. This would presumably raise consumer awareness about the fuel economy of vehicles and may persuade them to purchase a more efficient vehicle. However, the point-of-sale implementation requires the automobile manufacturer and dealer to educate the consumer as to why certain vehicles have a rebate or surcharge, and which vehicles do not.

Manufacturer

Although more research needs to be conducted in order to come to a definitive conclusion, it may be easier to implement the feebate at the manufacturer level. This is an attractive option as there are thousands of dealers but only a hand-full of major automobile manufacturers, thus, the administrative logistics – and therefore costs – would be much smaller if the manufacturer is responsible for implementing the feebate. It is up to the administrator whether or not manufactures would be required to pass the surcharge or rebate on to the consumer. A potential disadvantage to implementing the feebate at the manufacturer level is that it does not necessarily allow consumers to realize the fuel savings potential over the lifetime of their vehicle.

State Agency

An alternative to having the automobile industry implement the feebate is to have a state agency implement the policy. The department of motor vehicles (or comparable agency) may be a good agency to implement the policy because they could credit or charge the consumer at the point of registration. Using a state agency to implement the policy removes any perverse incentive the automobile manufacturer or dealer might have. Also, by implementing the feebate at the point of registration, the state agency could address some "leakage" issues because the vehicle would need to be registered in the home (implementing) state regardless of what state it was purchased in. However, it would be critical for automobile dealers to inform the consumer of the varying registration fees associated with the vehicle they are planning to purchase to allow transparency.

A potential disadvantage to implementing the feebate through a state agency is bureaucracy, which may slow the feebate policy. Also, it may be more costly and difficult to try and change state vehicle registration laws than to simply require the automobile industry to implement the feebate.

Transition

The feebate policy has to come into effect over time. Manufactures will need ample lead-time to adjust their vehicle line-up to optimize the benefit or minimize the losses they will incur because of the feebate policy. Typically, manufacturers need 2-5 years to make substantial changes to a vehicle, so legislators may consider making the policy effective 2-5 years after the time the policy is enacted.

It may also be prudent to increase the feebate rate over time. Starting the policy with a lower rate will minimize the financial risk of starting a policy without fully understanding how

consumers will respond to the policy. Once the policy is running at full rate, the administer will have a clear understanding of how to adjust the pivot points to ensure the policy is revenue neutral.

VII. Feebate Interaction with Other Laws and Policies

It is important to look at the impact that the feebate may have on existing laws and policies. Here, the feebates is discussed in the context of the:

- Corporate Average Fuel Economy (CAFE) standard
- Clean Air Act
- Carbon Policy

Corporate Average Fuel Economy (CAFE) Standards

In response to the Arab oil embargo and the subsequent oil crisis, Congress enacted the Energy Policy and Conservation Act (EPCA) in 1975. Title V of this act was the Motor Vehicle Information and Cost Savings Act, which established Corporate Average Fuel Economy (CAFE) standards for passenger cars and light trucks.[26] The intention of EPCA is to reduce and manage energy demand as well as to establish policies to minimize the nation's vulnerability to interruptions in the supply of petroleum imports.[27]

It follows that CAFE standards were first enacted to help mitigate the adverse effects of oil price volatility, rather than to protect the environment. When CAFE was enacted, the goal of the policy was to double the fuel economy of passenger vehicles from 13.1 mpg to 27.5 miles per gallon by model year 1985. This goal was successfully achieved in 1985, however as shown in Figure 4, the CAFE standards for passenger vehicles have not increased much since 1985.[28]

CAFE Standards and Feebates

EPCA specifically prohibits states from applying any law or regulation "related to" fuel economy standards to vehicles covered by a CAFE standard.[29] However, based on preliminary legal analysis, RMI believes that the National Highway and Transportation Safety Administration (NHTSA) – the agency that administers EPCA – could properly find, for several reasons, that state feebate programs do not violate this provision. The Supreme Court has been moving towards a broader interpretation of what "related to" means, and has only invalidated state laws that conflict directly with the Federal regulatory system, or conflict with the Federal system's achievement of its goals.[30] There is no formal inconsistency between a state feebate policy and CAFE as the implementation of CAFÉ would not be affected by the presence of a feebate.[31]

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[26] NHTSA. *CAFE Overview*. Retrieved on 9 Oct. 2007 from http://www.nhtsa.dot.gov.

[27] H.H. Rep. No. 94-340, at 1 (1975), reprinted in 1975 USCCAN 1762, 1763. Cited from Chanin, Rachel L. *California's Authority to Regulate Moblie Source Greenhouse Gas Emissions.*

[28] On February 27, 2007, the NHTSA published a request for comments to "acquire new and updated information regarding vehicle manufacturers' future produce plans to aid in implementing" the plan to reform and increase CAFE standards for passenger cars and further increase the light truck standards.

[29] 49 U.S.C. 32919

When an average fuel economy standard prescribed under this chapter is in effect, a States or a political subdivision of a State may not adopt or enforce a law or regulation related to fuel economy standards or average fuel economy standards for automobiles covered by an average fuel economy standard for automobiles covered by an average fuel economy standard under this chapter.

[30] Memo written for RMI by William Pedersrn, Esq analyzing the validity of a state feebate.

[31] Memo written for RMI by William Pedersrn, Esq analyzing the validity of a state feebate.

A moderate feebate program would not conflict with the goals of the CAFE program. Feebates do not attempt to place a standard on fuel economy; they create incentives for the production and purchase of efficient vehicles. Accordingly, NHTSA could find, and a court could rule, that the feebate is not "related to" fuel economy.

Clean Air Act (CAA)

The Clean Air Act requires, among many other things, that the Administrator of the EPA prescribe emission standards for any air pollutants from all motor vehicles that "in his judgment cause, or contribute to, air pollution which may reasonably be anticipated to endanger human health or welfare."[32] In 2003, the Administrator of the EPA determined that GHG emissions did not fit the criteria of an "air pollutant." Thus, the EPA did not have the authority to regulate GHG emissions. The EPA asserted, among other reasons, that the only feasible way to reduce GHG tailpipe emissions was to increase fuel economy, which the EPA could not do without interfering with the Department of Transportation (DOT) authority to regulate fuel economy.[33]

Several environmental groups challenged this decision. In *EPA. v. Massachusetts,* the Supreme Court found that the statutory definition of "air pollutant" was "unambiguous" and clearly included GHGs. In response to the EPA assertion that CAFE regulations would interfere with GHG regulations the Court said the obligation of the EPA to protect public health and welfare and the DOT obligation to promote energy efficiency "may overlap, but there is no reason to think the two agencies cannot both administer their obligations and yet avoid inconsistency."[34] The Supreme Court decision in *EPA v. Massachusetts* did clarify that GHGs are an "air pollutant" as defined by the CAA. The ruling also stated that EPA could regulate GHG emissions without necessarily interfering with existing fuel economy standards.

The CAA prohibits any state — with an exception for California — from adopting or enforcing emissions standards.[35] California, due to its unique geography and historic tendency to have stricter air quality standards than the federal government, is allowed to enact and enforce separate motor vehicle emission policy as long as the EPA grants California a waiver for the policy. The CAA Amendments of 1977 and 1990 made it legal for States to adopt the California motor vehicle emissions standards as long as the State policy is identical to the California policy that has received a waiver from the EPA. This means that there can be two motor vehicle emissions policies in the United States: the Federal policy and the California policy.

CAA and Feebates

The CAA is only relevant for feebates that are based on GHG emissions, as the EPA does not regulate fuel economy standards. It may be difficult for states to enact a feebate based on GHG emissions instead of a gallons per mile metric due to EPA's denial of California's

[32] 42 U.S.C. § 7561(a)(1)
[33] Supreme Court of the United States. Slip Opinion *Massachusetts et.al. v. Environmental Protection Agency et.al.* 549 U.S. _(2007).
[34] Slip Opinion at 29
[35] 42 U.S.C § 7543(a)

CAA waiver; however, as the feebate is an incentive mechanism, not a emissions standard, states may still be able to pass a GHG feebate policy.

Carbon Policy

Carbon regulation is relevant to feebates for two main reasons. First, there is a currently a feebate bill before the legislature in California that uses greenhouse gases (instead of gallons per mile) to determine vehicle efficiency, (see Section V, Current Feebate Legislation for more information) and second, the potential exists that the feebate could be part of a carbon cap-and-trade policy in California which will likely regulate vehicle emissions.

The California Global Warming Solutions Act of 2006 (Act) requires the State of California to dramatically reduce greenhouse gas emissions by 2020. Specifically, this statute requires the California Air Resources Board to adopt rules and regulations to achieve maximum technologically feasible and cost-effective greenhouse gas emission reductions. One of the tools that the CARB is considering for vehicle transport sector is the feebate.[36] The CARB plans to discuss recommendations more extensively in future planning meetings.

[36] The CARB staff presentation from the November 30, 2007 Scoping Plan is available at: http://www.arb.ca.gov/cc/cc-archive.htm

VIII. Conclusion

The feebate has the potential to accelerate the production and adoption of more efficient vehicles, ultimately reducing the United States' transportation fossil fuel consumption. There are several characteristics that the feebate has that make it an effective tool to shift the United States off oil, profitably, including:

- Technology neutral,
- Applies to all vehicle size classes,
- Enables continuous fuel economy improvement, and
- Provides an equal playing field for manufacturers.

There are a variety of ways to craft a feebate policy. Based on the research in *Winning the Oil Endgame* and this paper, RMI recommends the feebate contain the following characteristics:

- **Constant rate**: The rate is the component of the feebate that determines how much the fees or rebate for each vehicle will be. It is measured in a 0.0X/XX gallons per mile. It is critical that the rate remains the same for every vehicle to ensure that all gallons of fuel saved are equally valued.
- **Self-financing**: The policy should be revenue neutral or slightly revenue generating (to pay administrative costs). This is achieved by setting the pivot point regularly and accurately.
- **Preserve consumer choice:** The policy should not interfere with consumer freedom of choice. Creating size classes with separate pivot points is one option to achieve this.
- **Continuous fuel improvement:** The policy should be dynamic and require constant innovation by a given vehicle manufacturer for them to continue to receive rebates on vehicles. This can be achieved by regularly evaluating the pivot point, which also ensures the policy is self-financing.
- **Optimize size classes:** The current six passenger car class system and six light duty truck class system under CAFE may be the easiest way to introduce the feebate policy.

Washington D.C., has passed a policy similar to the feebate, but no states have introduced a policy that contains all of the characteristics listed above. It is important for states to examine the effect a feebate could have on existing state and federal laws and regulations. Preliminary legal analysis indicates that states should not be federally preempted from enacting a feebate that uses a gallon per mile metric because it does not invalidate or interfere with existing federal laws regarding fuel economy standards.

Finally, the feebate is policy that has many opportunities for further research. There are many variations of the policy that could be modeled to determine what fiscal impact – or other impact- that it may have on manufacturers and consumers.

Appendix A: RMI Feebate Experience

District of Columbia

The first feebate that RMI was involved in was the District of Columbia Motor Vehicle Reform Act. Through discussions with district officials, RMI testified before the DC mayor's environmental council on October 23, 2003 and helped the District of Columbia government to introduce the functional equivalent of a "feebate."[37]

On December 7, 2004, the DC City Council approved the Motor Vehicle Reform Act, which raised the excise tax to 8 percent on vehicles weighing over 5,000 pounds and simultaneously eliminated the vehicle registration fee and 6 percent excise tax on clean fuel and electric/hybrid vehicles in the District of Columbia. It retained the 6 percent tax on all other vehicles sold. Prior to passing the Act, the Council examined whether or not excise tax/registration fee amendments would have a negative fiscal impact on the District. They found that, in 2004, there were ten vehicles weighing over 5,000 pounds for every clean fuel or electric vehicle in the District, so the measure was assumed to be revenue generating.

The DC excise tax / registration fee amendments have been revenue generating as expected, and the excess funds are being deposited into the General Fund. The District does not have any reports or documentation of the effect of the excise tax amendments on consumer behavior; however, a representative from the D.C. DMV believes that the amendments have been successful in drawing consumer attention to clean fuel vehicles.

This Act is significant because it proves that states can implement a measure similar to a feebate without being federally preempted. Moreover, it demonstrates that this can be done at an administrative level that does not need federal legislation because the Act refines state tax laws, which are exclusively controlled by the states, not the federal government.

The feebate created in DC is not perfect, but it did clear the way for RMI to build upon on the experience that was gained. The imperfections, including that it does favor small vehicles – which does not preserve consumer choice – and that the increase in excise tax will not be an permanent change, prevent the policy from being as effective as it could, but it was still the first major feebate policy to be enacted since the 1991 Maryland feebate.

Hawaii

After providing valuable information on the feebate in Washington DC, RMI was providing information on the feebate for Hawaii state representatives during the 2005 and 2006 legislative sessions. In 2005, a feebate that was based on the DC feebate was introduced in Hawaii. The bill eliminated the Hawaii State excise tax (4.16%) from vehicles that weighed less than 3500 pounds GVW and increased excise tax on a sliding scale for vehicles that weighed 3501 – 10,000 pounds GVW. The bill made it to the Ways and Means Committee, where it died due to pressures from the automobile dealers and other constituents. There

[37] This testimony occurred before *Winning the Oil Endgame* was published, but after RMI researchers had identified the feebate was a legislative option to encourage fuel economy improvement that was not being seriously considered.

were three or four size classes, it would have generated excess revenue until 2012 and then started reducting the revenue until 2017 when the feebate would expire.

RMI also provided critical information for the 2006 feebate bill that during 2006 legislative session, trying to build on the experience gained during the 2005 legislative session. State Senator Kalanai English introduced a feebate (SB 3177) based on the Washington D.C. feebate model. SB 3177 increased the general excise tax 1% on vehicles weighing over 4000 lbs and 2% on vehicles weighing over 5000 lbs.

Additionally, the bill exempted "clean fueled vehicles" that achieved 40 miles per gallon from the total general excise tax paid on the vehicle. The revenue generated from the heavier vehicles was to be deposited into a Clean Vehicle Fund that would pay for the general excise tax on the clean fuel vehicles. RMI calculated that by 2013 the Clean Vehicle Fund would be expended and the feebate would expire. Thus, the bill was revenue-neutral in the long term.

RMI educated several elected officials on the merits of the feebate, and how it may be implemented by conducting an in-depth study on how many vehicles the feebate would affect in Hawaii, and the amount of money that would be generated. Additionally, RMI discussed why an ideal feebate could not be implemented at this time, due to preemption issues.

Other organizations in Hawaii also supported the feebate, including the Hawaii Energy Policy Forum (the Forum) and the Environmental Legislation Network. The Forum consists of 43 bipartisan members, including representatives from the electric utilities, oil and natural gas suppliers, environmental groups, renewable energy industry, and federal, state and local governments. The Forum members work together to bring all ideas and interests to the table to be researched, discussed, and analyzed in a civil, deliberative dialogue to address significant energy issues and options. The feebate was included on the Forum's agenda of concepts that it endorses and would like to be implemented in Hawaii.

Although the 2006 feebate made it through the majority of the legislative process, it was not passed into law. It was opposed by the same entities that opposed it in the first year, and 2006 was an election year, making it politically difficult to raise taxes. Additionally, the bill had a significant blemish: it favored smaller vehicles and did not preserve consumer choice.

Appendix B: The Canadian Vehicle Efficiency Incentive

On 19 March 2007, the Department of Finance Canada announced a vehicle efficiency incentive (VEI) to promote the purchase of efficient vehicles in Canada. The VEI places a rebate on fuel-efficient vehicles, does not place any financial incentive on vehicles with average fuel efficiency, and places a surcharge on fuel-inefficient vehicles (see figure TK). The VEI resembles a feebate, but it is far from the ideal feebate.

The program is similar to a feebate in that it generates revenue from surcharges on inefficient vehicles, and allocates money to efficient vehicles. However the program differs from an ideal feebate in the following ways:

- The VEI program does not have a constant rate for fuel savings. The program, instead, assigns a rebate or surcharge of $1000, $1500, or $2000 for a given range of fuel consumption. Rebates are calculated with a different rate than surcharges,
- The VEI program has a step-wise schedule. One problem with step-wise functions is that the vehicles right on the step can be subject to very different financial incentives. For example, the Honda Fit and the Honda Civic both missed the 6.5L/100km rebate by mere fractions so improving fuel consumption by tenths of a liter could have allowed both vehicles to qualify for the $1000 rebate.
- The VEI program does not include all vehicles. A large portion of the vehicles available are not subject to a rebate or a fee, so manufacturers are not encouraged to improve the fuel economy of vehicles that comprise the broad middle of the fleet. Additionally, pick-ups and large vans are exempt from surcharges, which could shift marked demand from efficient SUVs to inefficient trucks.
- Rebates and surcharges are capped at $2000, which could discourage manufactures from making transformational improvements to fuel economy.

Although the VEI program is not an ideal feebate program, it is similar enough to help inform the debate on how stakeholders may respond to a feebate policy.

Appendix C: Feebate

Table 4. Comparison of Size Class Division by Sales or Volume

Class Devision Description	Class	Pivot Point	Number of Models	Sales Volume	Δ Volume	Δ Fuel Economy	Maximum Rebate	Maximum Fee	Average Rebate	Average Fee
		mpg			ft³	mpg	$	$	$	$
Equal Sales Volume	1	27.7	294	3,317,386	173.5	52.7	2030	-5959	525	- 685
	2	23.6	175	3,363,428	69.	19.2	1151	-3402	451	- 397
	3	19.5	189	3,321,650	120.9	11.6	843	-3371	442	- 448
	4	16.3	173	3,536,288	576.8	12.	1760	-2994	566	- 590
Equal Volume Range	1	26.	422	5,865,873	222.8	52.7	2263	-5726	554	- 575
	2	19.5	295	5,362,680	243.8	20.6	2038	-3367	471	- 591
	3	15.5	109	2,306,694	240.8	16.	2729	-2678	399	- 927
	4	23.1	5	3,505	204.5	4.1	634	- 37	634	- 37