Vehicle Feebate and Vehicle Incentive Programs Funding Report

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submitted to

The Vermont House and Senate Committees on Transportation

**Vermont Agency of Transportation
Policy, Planning, and Intermodal
Development Division**

Report Preparation

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Authorizing Legislation

Sec. 46. Vehicle Feebate and Vehicle Incentive Programs Funding Report

The Agency of Transportation, in consultation with the Joint Fiscal Office, shall complete a study and submit a written report to the House and Senate Committees on Transportation on or before October 15, 2019 concerning whether Vermont should establish a time-of-acquisition vehicle feebate program to act as a self-funding incentive program. For purposes of this section, a "vehicle feebate" provides rebates to individuals who purchase or, if applicable, lease efficient vehicles that are funded by fees levied on individuals who purchase or, if applicable, lease inefficient vehicles. The report shall, at a minimum, consider whether vehicle feebates should be structured in steps—one or multiple—or as a continuum; whether there should be separate vehicle feebates for different classes of vehicles and, if so, whether there should be different pivot points for where a fee crosses over to a rebate; and if vehicle feebates should apply to both new and used vehicles and purchased and leased vehicles. The report shall also consider how a time-of-acquisition vehicle feebate program or other funding mechanism could function with the vehicle incentive programs established in Sec. 34 of this act and the level of investment, incentives, feebates, and other monetary incentives and disincentives needed to reach the number of plug-in electric vehicles in Vermont's Comprehensive Energy Plan.

Table of Contents

List of Tables

List of Figures

Executive Summary

Purpose

In June 2019, the Vermont General Assembly enacted Act 59 relating to the Transportation Program and miscellaneous changes to laws related to transportation. In Section 46, the Legislature directed the Agency of Transportation to complete a study concerning whether Vermont should adopt a time-of-acquisition vehicle feebate program to act as a self-funding incentive program. This report fulfils the requirements and also explores related options. The aims of this incentive program include encouraging Vermonters to purchase cleaner vehicles to reduce greenhouse gas (GHG) emissions, as well as encouraging the purchase of electric vehicles (EVs), consistent with the State's Comprehensive Energy Plan.

This report briefly covers the following contents:

- An overview of feebate program mechanisms, including the functional and administrational elements key to their implementation.

- Exploration of how other governments (state and Federal, domestic and international) have attempted to use feebate and other incentive programs to catalyze clean energy transitions and reduce transportation-related emissions. These examples are summarized in the main report and detailed in Appendix A: Detailed Literature Review.

- Description and evaluation of five program options for potential further discussion by the Vermont Legislature.

- General information for advancing the consideration of feebate and incentive program designs for application in Vermont.

What is a Feebate?

A feebate is a market-based policy approach aimed at lowering transportation-related fuel consumption and carbon emissions using two primary elements:

- A fee assessed on the purchase of vehicles that emit more GHGs and are less energy efficient.

- A corresponding rebate awarded to purchasers of low-emissions vehicles.

Feebate programs are typically designed to be self-funding, so that the cost of incentivizing cleaner vehicles is offset by the corresponding fee portion of the policy. The feebate programs explored would apply to light-duty vehicles—those with a gross vehicle weight rating (GVWR) of 8,500 pounds (lbs) or less. Feebates can be applied in conjunction with incentives targeted at specific technologies. For example, EVs could be awarded higher rebate levels than internal combustion engine (ICE) vehicles to explicitly encourage their adoption.

Summary of Findings from Other Programs and Research

Feebates have been considered in the past by Vermont and other U.S. States, but true feebate programs have, to date, only been implemented in other countries. One of the most successful applications has been

in France, where average carbon dioxide (CO_2) emissions of the new vehicle fleet dropped by 6 percent in the first year following implementation. In the U.S., many states as well as the Federal government have offered incentives for EV purchases, which have been effective but only influence a small fraction of new vehicle purchases. Programs with limited applicability, such as the U.S. gas guzzler tax and a program implemented in Ontario in the 1990s with fees and rebates targeted at only the worst and best performing vehicles, have been less effective at shifting consumer choices. The challenge has been to find a sustainable funding source for meaningful clean vehicle incentives that broadly cover the entire light-duty vehicle market.

Alternatives for Consideration in Vermont

A feebate and/or vehicle incentive program could be implemented in Vermont in many ways. For this report, five illustrative alternatives were created to show the general range of possibilities. These include:

- Alternative #1: An all-vehicle feebate.

- Alternative #2: A feebate differentiated by vehicle class.

- Alternative #3: An EV rebate paired with short-term other revenue.

- Alternative #4: An EV-focused feebate that includes a feebate system for all vehicles, with a larger rebate for EVs.

- Alternative #5: A program that applies to leased and/or used vehicles as well new vehicle purchases.

Each one of these alternatives could have multiple variations depending on the details of how it is implemented. Evaluation criteria for alternative program options include:

- Effectiveness at achieving program goals (reducing GHGs and increasing EVs).

- Administrative cost/level of effort.

- Equity and other consumer acceptance considerations.

While each of these alternatives could be developed in various ways, the literature review suggests different strengths in the three criteria among the five alternatives. A summary of comparative strengths is shown in Table ES.1. A description of each alternative with its advantages and disadvantages is provided in Table ES.3 at the end of this Executive Summary, with more detail provided in Section 3.0 of the main report.

Table ES.1   Summary Evaluation of Sample Feebate Alternatives

Policy Alternative	Effectiveness at Achieving Program Goals		Manageable Administrative Cost/ Level of Effort	Fair and Equitable
	Reducing GHGs	Increasing EVs		
Alternative #1: All-Vehicle Feebate	+++	+	++	++
Alternative #2: Categories of Vehicles Feebate	++	+	++	+++
Alternative #3: EV Rebate Paired with Other Short-Term Revenue	+	+++	+++	–
Alternative #4: EV-Focused Feebate	++	+++	++	++
Alternative #5: Wider Net Leased and Used Vehicles	+++	+	+	– / +++[1]

Notes: +++   =   Strongly supports criterion.

  ++   =   Supports criterion.

  +   =   Somewhat supports criterion.

  –   =   Does not support criterion.

  1   Expanding the program to include leased vehicles clearly improves the equity of the program but covering the used vehicle market could be viewed either as more equitable (everyone pays/benefits) or less equitable (lower income people with older vehicles might end up paying more).

Sample Data and Program Designs

Data on vehicles registered in Vermont with model years between 2016 and 2019 was obtained from the Vermont Department of Motor Vehicles (DMV) in July 2019. The data was analyzed for context and then used to illustrate the five program alternatives. Vehicles were matched with fuel economy, CO_2 emissions, and GHG ratings from the U.S. Environmental Protection Agency and U.S. Department of Energy *Fuel Economy Guide*. In Vermont, new vehicles registered in this period had a median mile-per-gallon (MPG) rating of 25.3 and a median CO_2 emission of 352 grams per mile. As shown in Figure ES.1, the vast majority of new vehicle purchases are clustered between 18 and 30 MPG. Between model years 2016 and 2019, average MPG improved from 24.9 to 26.4. The percentage of battery electric vehicles (BEVs) in new registrations increased from 0.2 percent in 2016 to 1.3 percent in 2019; in addition, 1.6 percent of newly registered vehicles over this period were plug-in hybrid electric vehicles (PHEVs). The total EV market share in Vermont is on par with Massachusetts, and somewhat higher than in other New England States and New York.

Figure ES.1 Model Year 2016 to 2019 Registrations in Vermont by MPG(e)[1]

Number of Registered Vehicles

MPG(e) (rounded to nearest integer)
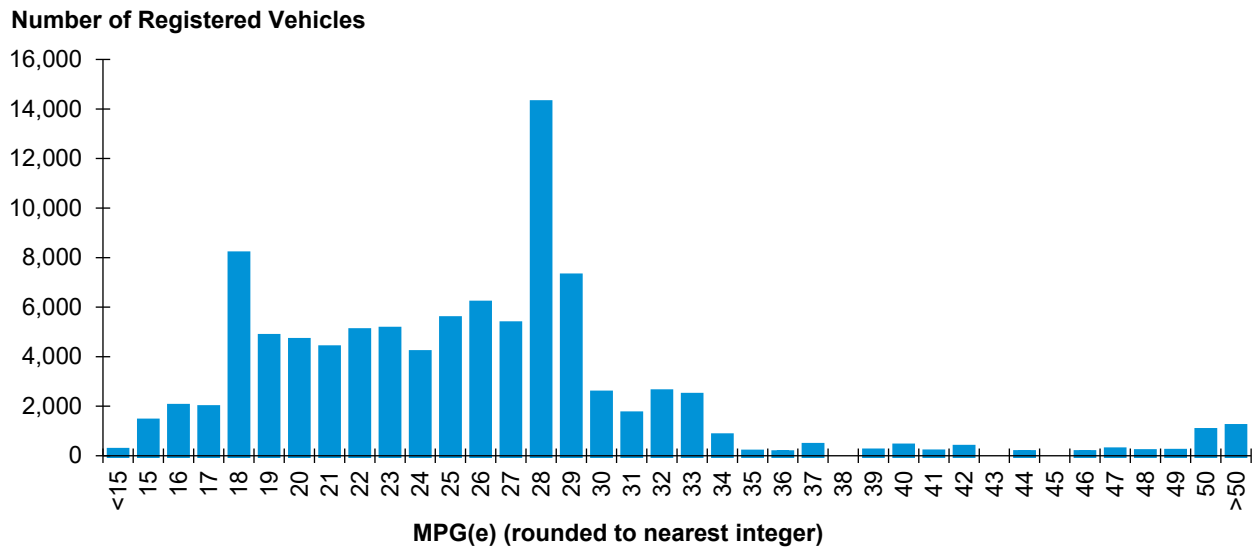
1   Data as of July 2019. MPG(e) is the MPG-equivalent rating provided by the Environmental Protection Agency (EPA) for electric vehicles, based on the energy consumption of the electric vehicle "at the plug." MPG(e) denotes that MPG and MPG(e) are both included in the chart.

Table ES.2 provides an illustrative program design in which new vehicles are categorized into "bins" of 5 MPG increments. Given the distribution of new vehicles by model year observed over the 2016 to 2019 period, this feebate schedule would be approximately self-funding. Alternative schedules could be developed that would provide a greater or lesser incentive to purchase more efficient vehicles. Over time, as the efficiency of new vehicles increases, the schedule would need to be adjusted. The data is based on 2016 to 2019 model year vehicles as of July 2019, so it covers approximately 3½ years of a sample program.

Table ES.2   Example of a Feebate Program Design

DMPG(e) Bin	Percentage of New Vehicles	Fee or Rebate	3 ½-Year Revenue
< 15	0.2%	$1,500	$307,500
15 to < 20	23.7%	$800	$17,276,000
20 to < 25	25.5%	$200	$4,658,600
25 to < 30	39.1%	-$200	-$7,134,000
30 to < 35	8.0%	-$1,000	-$7,302,000
35 to < 40	0.7%	-$1,500	-$961,500
40 to < 45	0.3%	-$2,000	-$590,000
45 to < 50	1.3%	-$2,500	-$2,885,000
>= 50	1.2%	-$3,000	-$3,315,000
Total			**$54,600**

Issues for Consideration

This report addresses the following questions that were required to be addressed in Act 59, plus other considerations that were identified through the research.

1. **Should Vermont implement a vehicle feebate program?**

   The feasibility of implementing a vehicle feebate program in Vermont will ultimately depend on the ability to address the administrative, level of effort, equity, and consumer acceptance considerations detailed in this report. Additional program design work, as well as outreach to the public and key stakeholders, would be required to ensure that Vermonters understand the potential benefits and impacts of such a program before finalizing and implementing it.

2. **What metric should the feebate be based on?**

   The Federal government reports three metrics of new vehicle emissions and fuel economy: the MPG rating, CO_2 emissions in grams per mile, and a GHG emissions indicator on a relative 1 to 10 scale. An effective program design could be developed using any of these indicators. MPG is most familiar to consumers. However, using the MPG or CO_2 metric would require adjusting the fee schedule regularly to keep the program self-sustaining. In contrast, the scale for the GHG rating is reset at the Federal level every year based on comparison with other vehicles of the same model year, so the fee schedule would not need to be updated regularly by the State.

3. **Should the feebate be structured in a linear or stepwise manner?**

   A linear feebate (e.g., based on CO_2 emissions or 1-MPG increments) would provide the most consistent incentive and avoid arbitrary large distinctions between vehicles with small differences (e.g., 30 versus 29 MPG). However, it may be more difficult for consumers to understand and consider in their purchase decisions. A stepwise feebate in relatively small increments would likely provide most of the benefits of a linear program and be easier to understand and implement.

4. **Should the fee/rebate schedule be applied uniformly to all light-duty vehicles, or should different rates be used for different classes of vehicles?**

   A program that applies uniformly to all types of light-duty vehicles would be the most effective, as it provides an incentive to shift between different vehicle classes, in addition to choosing more efficient vehicles within a class. It would also avoid arbitrary distinctions between vehicles with similar functionality (e.g., midsize wagon versus small sport utility vehicle). However, effectiveness considerations must be balanced with the concerns of consumers who require a larger vehicle for business or personal reasons.

5. **Should the program include special incentives for electric vehicles?**

   Stand-alone EV-focused incentive programs are common but are not self-funding. They do not affect the vast majority of today's new vehicle purchases and may not be sustainable as EV sales continue to increase. A sustainable, self-funded feebate/incentive program could be designed that provides a larger incentive for EVs in the short term while still providing incentives to shift to cleaner gasoline and diesel vehicles for consumers who are not ready for an EV.

6. **How should the program be administered?**

A feebate program in Vermont is probably best implemented at the point of sale (consumer level) rather than at the manufacturer level, since it provides a more direct incentive to consumers. New vehicles purchased in Vermont are registered directly by the dealer, so after verifying residency, the dealer could collect the fee or provide the rebate. Alternatively, there could be a separate rebate application process. The Department of Motor Vehicles would broker and verify fee payment at the time of registration for vehicles purchased from out of state dealers. Processes and who would do them would be a consideration in level of administrative cost/level of effort. Further evaluation of Vermont's administrative capacities would be needed to determine the most expedient implementation design. Administration for any of the alternatives would include coordination with surrounding states.

7. **Should leased vehicles be included in the program, in addition to new vehicle sales?**

The inclusion of new leased vehicles should be considered. Nationwide, about 30 percent of new vehicles are leased, and excluding these from the program would leave a major gap in program coverage as well as a way for users of less-efficient new vehicles to avoid the fee.

8. **Should used vehicles be included in the program?**

Nationwide, the volume of used car sales is more than double that of new car sales. However, expanding a feebate program to cover used vehicles would significantly increase the administrative complexity. One approach could be to apply a sliding regular registration fee based on the vehicle's MPG. Further evaluation of Vermont's administrative capacities would need careful consideration. An option could be a phased program that starts with new cars and expands building on experience and enhancements to administrative capacity Questions remain about the effectiveness of a program that influences transfers within the market of existing used vehicles, rather than bringing new, more efficient vehicles into the system.

9. **What is the administrative cost/level of effort for feebate/incentive programs?**

The level of effort required would depend upon the details of the program design, including initial program design as well as education and outreach, program reviews, any refinements based on evaluation or redesign to balance revenues, ongoing administrative time to process fee payments and rebate requests, and any enforcement that might be needed to ensure compliance with the program. It is important for program development to evaluate and set aside program revenue to support necessary ongoing staffing.

10. **What equity concerns might exist with a feebate/incentive program and how might these concerns be mitigated?**

The application of a fee or rebate to all new vehicle purchases would be a significant change for vehicle consumers. The greatest impact would be on purchasers of new vehicles who require larger vehicles for business or personal reasons, and the greatest benefit would be received by purchasers of new, fuel-efficient or electric vehicles. Experience with feebate programs elsewhere suggests that feebate programs provide a modest net benefit to lower-income consumers, who are more likely to purchase less costly, more fuel-efficient vehicles. EV-focused incentives, in contrast, tend to benefit high-income consumers, although this could be mitigated by the income-based incentives that Vermont is developing pursuant to Section 34 of Act 59.

11. **How should a feebate/incentive program relate to other state and Federal clean vehicle incentives?**

A feebate could work in conjunction with other state and Federal incentive programs, including Vermont's program to provide rebates to low- and moderate-income households for EV purchases (Section 34 of the 2019 Act 57), as well as existing Federal tax credits. Program designs for state incentives should minimize administrative burdens by integrating different incentives or fees into a single payment.

12. **What coordination is needed with neighboring States?**

Coordination with neighboring states should be undertaken, especially given the possibility of Vermont vehicle owners purchasing or registering new vehicles in other states in order to avoid penalties for purchasing inefficient vehicles. Either state policies must be harmonized or there must be checks built into the system to account for cross-state transfers.

13. **Are there short-term versus long-term implementation options?**

If it is not feasible to agree on an immediate implementation of a feebate program covering all light-duty vehicles, an EV-only incentive program could still be implemented quickly and easily, if an alternative revenue source could be identified.

Next Steps

This report provides an initial assessment of options for a feebate and/or vehicle incentive program in Vermont. To fully develop such a program the following next steps should be considered:

- Undertake a robust, inclusive discussion of what basic approach to pursue, if any. This process should include a range of stakeholders, including auto dealers, manufacturers, municipal officials, environmental community, partner agencies, and neighboring state officials, to gather feedback on alternatives and options.

- Develop specific program designs and implementation options in greater detail and consider administrative level of effort by examining the specific implementation activities that would need to be conducted both up front and on an ongoing basis.

- Conduct additional data analysis to more fully simulate the impact of each potential alternative on GHG emissions, EV adoption, and consumer costs.

- Once a program design is fully developed and adopted, continue education efforts for a range of audiences, including auto dealership staff, the public at large, and other key stakeholders.

Table ES.3   Feebate and Related Alternatives[a]

Program Alternative	Description	Options	Advantages	Disadvantages
Alternative #1: All-Vehicle Feebate	Apply a technology-neutral incentive to all light-duty vehicles purchased in Vermont. The feebate would be based on a standard of fuel efficiency or emissions. A pivot point would be set to determine whether the individual gets a rebate or contributes a fee. The pivot point would be based on new vehicle purchases registered in Vermont over the past three years.	Rebate and fee amounts could be assessed on a linear basis, with all new vehicle purchases subject to either a fee or rebate proportional to emissions or MPG; or through a stepwise function (e.g., incentive or fee values grouped into bins of 5 MPG). This would apply to any fuel/engine technology type.	A linear or stepwise feebate could provide an incentive across the market for all vehicle buyers to choose at least slightly more efficient vehicles.	Depending on how it is structured, this alternative might provide a weaker incentive for vehicle buyers to choose EVs, compared to an EV-focused incentive. A linear function or stepwise function with small bins might be more difficult for consumers to understand and slightly more complicated to administer than a system with a few large bins.
Alternative #2: Categories of Vehicles Feebate	Like Alternative 1, this feebate policy would be based on a measure of efficiency or emissions, and not fuel source. However, a different fee/rebate schedule would be set for different categories of vehicles (e.g., cars versus light trucks) rather than a single schedule applying to all vehicles.	Grouping into two categories—cars and light trucks—would be the simplest approach, but a larger number of categories could be defined based on weight, body style, or footprint (wheelbase times track width). Similar to Alternative 1, the feebate structure within each category could vary from a more linear to more stepwise.	A category-based feebate system would have less impact on people who require larger vehicles. It also would incentivize consumers of larger vehicles (whether needed or desired) to choose more efficient vehicles.	A category-based vehicle feebate may reduce or remove the incentive for new vehicle purchasers to shift from less-efficient vehicle categories to more efficient vehicle categories.
Alternative #3: EV Rebate Paired with Short-Term Other Revenue	Expansion of the income-qualified EV purchase credit in Section 34 of the 2019 Transportation Bill to all purchases of EVs. New York's "Drive Clean" rebate, in which each purchaser of a new EV is awarded a rebate of up to $2,000 at the point of sale, could serve as a model.	Rebates for EVs could vary on the type of technology used (battery electric, plug-in hybrids, etc.). Different rebate amounts or fees could be awarded based on income level, in order to ensure that low- and moderate-income Vermonters are benefiting from the program. This option would build on knowledge gained from the Sec. 34 Income-Qualified EV Incentives Program.	This program would explicitly incentivize Vermonters to purchase EVs. This style of broad-based EV purchase incentives has proved popular and effective in several States. Funding through other revenues instead of levying a fee on purchases of new less-efficient vehicles might make the program more acceptable to consumers.	This program is not self-funding as it relies on other funding sources. This program would likely only influence vehicle purchases by a small percentage of Vermonters, at least at the outset.

Program Alternative	Description	Options	Advantages	Disadvantages
Alternative #4: EV-Focused Feebate	A fee is applied to purchases of all new internal combustion engines (ICE) that funds rebates applied to all new EV purchases. At first, the fees applied to ICEs would likely be relatively small in magnitude, while EV rebates would be relatively high. As EVs gain in popularity, the ICE fee amount would be adjusted upward and the rebate downward.	A uniform feebate could be applied. For example, a $300 fee on all new ICE purchases and a $3,000 rebate on all new EV purchases. Different fees could be applied to ICEs as described in Alternative 1. For the EV rebates, different amounts could be awarded for fully electric versus plug-in hybrid electric vehicles.	This program would explicitly incentivize Vermonters to purchase EVs, with intent to reach the number of plug-in EVs in in the state's Comprehensive Energy Plan.	The current relative lack of diversity in EV offerings might make this alternative less desirable since not all consumers might find an EV that suits their needs or price point. The diversity of EV options is expected to increase in the near term. If all ICEs are subject to the same fee there is no incentive to purchase a higher-efficiency ICE compared to a lower-efficiency one.
Alternative #5: Wider Net: Leased and Used Vehicles	To reach ambitious GHG reduction goals, it may be necessary to incorporate not just new car purchases, but also leases and possibly purchases of used cars.	There are various options such as adding only leased vehicles, sales of used vehicles only by dealers, moving beyond a point-of-sale model to one that occurs at vehicle registration, or other options. This could be phased in building on program experience and enhancements in administrative capacity.	This alternative would have more effect to reduce GHG emissions. Nationwide, leases are approximately 30% of new car transactions. The volume of used car sales is more than double that of new car sales. A more-encompassing approach might be less subject to "gaming," or less distorting of markets among new, leased, and used vehicles, and across state lines.	This alternative would be significantly more complicated to design and administer than the other ones. The option with the most question marks about methodology and value is incorporating used car sales.

[a]Issues that will need to be considered for all alternatives include:

- Regional cooperation: It will be important to coordinate with surrounding states and/or build mechanisms into the program to avoid creating incentives for Vermonter to buy less-efficient vehicles in other states.

- Program administration: Any alternative will require some level of ongoing involvement on the part of the State to administer and evaluate.

- Keeping the program current: Depending upon the metric selected, any alternative may require periodically adjusting the fee and rebate levels or "pivot point" to ensure the programs remains approximately revenue-neutral.

- Alignment with existing programs: Any program should align with the 2016 Vermont Comprehensive Energy Plan's goals, which include making 10 percent of the State's fleet EVs by 2025. The program should also align with California vehicle emissions regulations, which requires vehicle manufacturers to produce and offer for sale a growing proportion of vehicles that comply with the regulation's zero and near-zero emission standards.

1.0   Purpose

1.1   Authorizing Legislation

In June 2019, the Vermont General Assembly enacted Act 59 of the 2019 Legislative session ("Act 59") relating to the Transportation Program and miscellaneous changes to laws related to transportation. In Section 46, the Legislature directed the Agency of Transportation to complete a study concerning whether Vermont should adopt a time-of-acquisition vehicle feebate program to act as a self-funding incentive program. The legislation also stipulated that this report should consider how a feebate program would be structured (linear or stepwise), and whether it should be applied uniformly or if different rates should be used for different classes of vehicles. Furthermore, the legislation calls for the report to address if a feebate program should be applied to new and used, as well as purchased and leased vehicles, while considering how such a program would interact with other incentive programs enacted in Section 34 of Act 59.

1.2   Program Goals

The goals of a feebate/vehicle incentives program are proposed to include:

1. Encourage the purchase of cleaner vehicles to reduce greenhouse gas (GHG) emissions, both in the short and long term.

2. Advance toward the goals of the State's Comprehensive Energy Plan, including increasing the number of plug-in electric vehicles (EV) in circulation.

The program would apply to light-duty vehicles—those with a gross vehicle weight rating (GVWR) of 8,500 lb. or less. These include cars as well as light trucks, which include most sport utility vehicles (SUV), pickup trucks, and smaller vans. Larger pickups and vans exceeding the 8,500 lb. rating are classified as medium-duty trucks. Larger vehicles are regulated differently than light-duty cars and trucks and would not be subject to the program.

The transportation sector is the largest contributor to greenhouse gas emissions in Vermont, accounting for 47 percent of the State's emissions. A feebate program that awards incentives for consumer who purchase cleaner vehicles, while assessing fees on purchases of high-emitting vehicles, could serve to reduce transportation-related emissions in Vermont, while simultaneously promoting increased adoption of EVs among Vermont's drivers.

1.3   Relationship to Other Policy Goals and State Programs

The Vermont Comprehensive Energy Plan, adopted in 2016, aims to increase the share of renewable energy in Vermont's transportation sector to 10 percent by 2025 and 80 percent by 2050, while reducing GHG emissions from the transportation sector by 30 percent by 2025. In order to meet these goals, the plan states that at least 50,000 EVs will need to be registered by 2025, compared to a statewide total of 3,288 in July 2019 per Drive Electric Vermont. For the purposes of this report, EV refers to both PHEVs and BEVs. Additionally, Vermont, along with California and nine other states, has adopted a Zero-Emission Vehicle Program to promote zero-emission vehicles (ZEVs) such as battery electric and hydrogen fuel cell vehicles. Vermont and eight other States have committed to having 3.3 million of these vehicles on the road by 2025.

A feebate or vehicle incentive policy can help Vermont achieve its electrification and ZEV goals by providing significant incentives for consumers to purchase lower-emission and zero-emission vehicles. Pursuant to Sec. 34 of Act 59, Vermont currently is developing a program that attempts to offer the benefits of EV incentives to lower-income consumers by providing rebates to low- and moderate-income households for plug-in EVs with a base manufacturer's suggested retail price (MSRP) of $40,000 or less.

A self-funded feebate/incentive program would provide consumer incentives without requiring an additional funding source. Such a program, however, would not address the projected declines in motor fuel tax revenues. The I-95 Corridor Coalition, a group of States of which Vermont is a member, is considering options for mileage-based user fees. The Vermont Public Utilities Commission is investigating the collection of revenue from owners and users of EVs to ensure an appropriate contribution to the costs of Vermont's transportation infrastructure. This work will be published in 2020 as an investigation into potential fees associated with electric vehicle charging in Vermont in response to Act 59.

In addition, Vermont is working with 11 other northeast and mid-Atlantic States and the District of Columbia, as part of the Transportation and Climate Initiative (TCI), to consider a regional cap-and-invest program to support clean transportation. This program, if adopted, could potentially provide another funding source to support implementation of incentives for clean vehicles.

Feebate and incentive policies must be designed thoughtfully in order to help meet Vermont's ambitious energy and emissions goals. This report examines existing literature on feebate and incentive programs and recent vehicle registration data to inform potential policy approaches that would be feasible, fair, and effective.

2.0   Summary of Literature Review

This section considers lessons learned on vehicle feebate and incentive programs based on experience in other states and other countries, as well as academic studies on these programs. A detailed literature review, including references, is found in Appendix A.

2.1   Feebate Definition

A feebate is a market-based policy approach aimed at lowering transportation-related carbon emissions using two primary elements: (1) a fee assessed on the purchase of high-emitting, energy-inefficient vehicles; and (2) a corresponding rebate awarded to purchasers of low-emissions vehicles, together forming a "feebate." The fee component of the policy can dissuade prospective buyers from purchasing high-polluting vehicles while the rebate is aimed at encouraging drivers to choose more fuel-efficient vehicles.

2.2   Feebate Advantages and Disadvantages

One of the key advantages of feebate policies is that they are self-funded, as the cost of incentivizing cleaner vehicles can be completely offset by the corresponding fee portion of the policy. Feebates can be contrasted with stand-alone incentive programs such as rebates and tax credits for clean and electric vehicles. While these programs have become increasingly commonplace over the past decade, they are increasingly costly to operate as the number of clean vehicles purchased increases, and a lack of guaranteed funding has hampered such programs in States like Massachusetts. In contrast, a self-funded feebate is completely self-sustaining if maintained properly. Furthermore, feebates are based on the polluter-pays principle, the idea that actors responsible for pollution should bear the costs of mitigating the damage done to the natural environment. Feebate programs can correct a social externality (the undervaluation of fuel efficiency) without imposing any net tax. All consumers have the ability to avoid fees by shifting their choice in new vehicles.

Another key benefit of feebate policies is that they can help defray the higher upfront costs of clean technology vehicles, allowing more consumers to benefit from the relatively low operation and maintenance costs of low- and zero-emission vehicles. A feebate program can help ease the upfront cost burden of buying cleaner vehicles and make the value of owning a more efficient vehicle more transparent to consumers. Finally, in contrast with command-and-control policies like mandatory emission standards, feebate policies have the potential to shift consumer demand towards cleaner vehicles.

While there are a number of opportunities inherent in a feebate program, there also are potential limitations and drawbacks. The degree of reduction of fuel consumption and emissions that can be achieved from feebate policies is still uncertain and is highly dependent on the specific design of the policy. While the feebate is easier to implement than other environmental regulations like fuel efficiency standards, determining the optimal fuel economy or GHG emissions level to switch from rebates to fees (the pivot point), and deciding on a standardized metric for measuring emissions, still loom large as critical implementation challenges. An initial pivot point value must be set based on the distribution of fuel economy within the targeted vehicle fleet, which requires access to new sales or registration data. And as vehicle efficiency improves throughout the timeframe of the program, it is necessary to adjust the pivot point to reflect changing conditions. Finally, feebate schemes have only been applied to new vehicle purchases, thus leaving the vast majority of the vehicle fleet not directly impacted (although fees paid, or rebates credited to new vehicles may carry through to affect prices on the used vehicle market). Applying fees and rebates to used vehicles is more complicated that just applying them to new vehicles.

2.3   Feebate Design

Point of application. Fees and rebates can be imposed either at the consumer or manufacturer level, but the vast majority of programs have been targeted towards customers, in an attempt to more directly influence consumer choices.

Timing. An important element to consider is the timing of the implementation of the feebate. Announcing the implementation of a feebate with significant prior notice given to manufacturers and consumers allows time for manufacturers to adapt to the new system.

Price structure. The most straightforward price structure is to set the fee/rebate in proportion to the amount of fuel consumed by a vehicle, or in proportion to its GHG emissions. Different metrics have been used by each governmental entity that has imposed a feebate scheme. In the United States, most proposals have suggested using miles per gallon (MPG), the standard American fuel economy measure.

Consideration of alternative fuel and electric vehicles. One of the features of feebate programs is that they are agnostic to specific technologies, rewarding any technologies that deliver more fuel efficient or lower emission vehicles, although this may depend on the specific measure used. None of the handful of feebate programs that have been adopted around the world have been explicitly geared towards electric or other alternative fuel vehicles. However, given Vermont's Comprehensive Energy Plan goals and other commitments towards increasing the number of EVs, a feebate program could be structured to specifically encourage EV uptake. For example, a larger rebate value could be established for electric, plug-in hybrid electric, or other clean-fuel vehicles. Examples of EV-specific incentive programs are numerous in the U.S. and other countries.

Pivot point. Feebate policies generally require a "pivot point," a benchmark where the policy changes from assessing fees to awarding rebates on new vehicle purchases. Options for pivot points include:

- A single pivot point (applies to all vehicles that are covered).

- Double pivot points (one for passenger vehicles, one for light-duty trucks).

- Multiple pivot points (e.g., segmenting pickups, vans, sport utility vehicles, and two-wheel vehicles).

- A footprint-based pivot point. Footprint-based benchmarks are assigned based on the vehicle's footprint (wheelbase times track width), a system that could result in numerous benchmarks.

The single pivot point is both the most computationally simple benchmark while also resulting in the largest efficiency improvements. With the popularity of today's "crossover" vehicles, the functional distinction between cars and light trucks is becoming more and more blurred. The single pivot point avoids making artificial distinctions among different vehicle types (such as station wagons versus small sport utility vehicles) that may serve similar functions. However, using a single pivot point may be perceived as unfair to users who need larger vehicles for business or personal reasons. Using a double or multiple pivot point system could reduce fairness concerns without adding too much operational complexity or detracting too much from the program's effectiveness.

The footprint-based approach is the basis for the Federal government's fuel efficiency and GHG standards. Auto manufacturers are held to an average MPG level that varies based on the average footprint of the

manufacturers' vehicles. While this works well for the Federal program, such an approach would mostly likely be difficult for consumers to understand and overly complex to implement at the state level.

Functional form. Feebate schemes can either be "continuous," where fees and rebates are assessed at different rates for each vehicle based on its exact GHG emissions, or "stepwise," where vehicles are sorted into buckets based on an MPG or emission range, and all vehicles in each range are assessed or rebated at the same rate. Step function programs are most likely easier for consumers to understand, but can create arbitrary fee/rebate distinctions between two vehicles that are nearly identical in terms of carbon emissions or fuel consumption, especially if the steps are set in large increments.

2.4   Feebate Precedents

A bill containing a feebate provision passed the Transportation Committee in 1999, but was not passed by the full Vermont Legislature. In 2005, H-444 was proposed in front of the House Transportation committee. Vermont utilities also have begun offering incentives for EVs and charging equipment, including incentives for purchasing or leasing new EVs, offering free or discounted residential chargers, and incentives for workplace charging stations for employers. These incentives are offered under Tier III of the State's Renewable Energy Standard (RES) program, which is intended to encourage the State's utilities to undertake initiatives to reduce fossil fuel consumption.

Vermont's Public Utility Commission published a report in June 2019 on opportunities for promoting EV usage within the State. The report recommends that, in addition to providing Tier III incentives, the State take on a larger role in providing incentives for purchasers of EVs. H.529, the Transportation Program authorizing legislation passed the same month, instituted an EV incentive program where low and moderate-income Vermont households are provided incentives for EV purchases of $40,000 or less. Additionally, the report urges consideration of a sales tax waiver on purchase of new EVs or a waiver which allows dealerships to retain a certain percentage of the forgone sales tax.

Two of Vermont's neighbors, New York and Massachusetts, have implemented state-backed universal EV credits. New York's Drive Clean Rebate for Plug-in Electric Cars, implemented by the New York State Energy Research and Development Authority (NYSERDA), award rebates up to $2,000, with rebates varying based on the vehicle's battery-only range. Massachusetts launched its Massachusetts Offers Rebates for Electric Vehicles (MOR-EV) program in 2014 with the goal of getting 300,000 EVs on roads by 2025. Initially, the program offered rebates of $2,500 on all electric vehicle and plug-in hybrid purchases or leases. However, since its inception, the program has struggled to retain sufficient funding.

California and Maryland are among the states that have considered implementation of a feebate program over the past two decades, although neither has progressed beyond draft legislation. The closest existing precedent to state-level implementation is Ontario's Tax for Fuel Conservation, which was implemented in the Canadian province between 1991 and 2010. The program was eventually terminated due to changes in the political climate. A 2017 study from the University of Western Ontario found that between 2000 and 2010, the program had a welfare-enhancing effect, but actually increased lifetime CO_2 emissions by a small amount (Rivers, 2017). By 2010, the program had made $21 million CAD in revenue for the Ontario Government, which suggests that insufficient rebates were issued through the program to encourage clean vehicle adoption. The study estimates that an optimally designed, truly revenue-neutral policy would have reduced emissions by 2.5 million tons compared to a no-feebate scenario (Rivers, 2017).

The Canadian Federal Government also has implemented a feebate-like program, the Vehicle Efficiency Incentive (VEI) program, which contained an "ecoAuto" rebate for up to $2,000 CAD for purchases of fuel-efficient vehicles and a "Green Levy" on inefficient vehicles of up to $4,000 CAD. The ecoAuto and Green Levy programs were administered separately, with Transport Canada assuming responsibility for processing rebate forms, which were available online for consumers who purchased eligible vehicles. While the Green Levy tax is still operational, the VEI program did not meet its goal of creating a revenue-neutral feebate system to shift consumer preferences towards greener vehicles (ICCT, 2010). The program was hindered by a large "donut hole" (i.e., it did not apply to most vehicles) and its fragmented implementation by different agencies.

The U.S. Federal Gas Guzzler Tax represents an example of the fee portion of a feebate program. While not a true feebate, the Gas Guzzler Tax is equivalent to the "fee" half of a feebate program. In effect since 1980, all passenger cars that achieve a Corporate Average Fuel Economy (CAFE) MPG below 22.5 are subject to the fee. The fee steps down depending on the deviation from the 22.5 MPG standard. Compared both the Ontario and French feebate programs, the U.S. Gas Guzzler Tax sends a relatively strong price signal. According to the International Council on Clean Transportation (ICCT), the Gas Guzzler Tax has not resulted in substantial changes in consumer demand, as manufacturers have adapted to avoid the tax on many popular models, but has resulted in improvements on the manufacturer side (ICCT, 2010).

The most successful and prominent feebate policies have been implemented outside of North America, and the French program stands out as an especially successful example. France introduced the "bonus/malus" feebate program in 2008, making it one of the only countries to implement a coordinated feebate system, rather than separate implementation of a fee and a rebate. France's system was implemented in stepwise fashion, but uses a high number of different gradations between the CO_2 grams per kilometer (g/km) equivalents of 21 MPG and 96 MPG (the outer bands of the program), and completely covers the new automobile market in the country. In 2017, the French Government modified the fee portion of the program to approximate a continuous function, while still retaining a stepwise form for the vehicle rebates (Yang, 2018).

Denmark provides another example of a CO_2 g/km feebate program; however, the feebate schedule it is expressed to the public in terms of fuel economy and therefore differs by fuel type. The rebate rate is equivalent to $320 per MPG and the tax rate is equivalent to $85 per MPG (Bunch et al., 2010).

2.5   Impacts of Feebate Programs

While the body of evidence on feebate systems is relatively small, there have been a number of academic studies exploring the impact of these programs, both on economic welfare and GHG emissions. Attempts at modeling the impacts of feebates have shown that changes in consumer demand (vehicle choices) account for a relatively small proportion of the changes in fuel economy achieved by feebate systems, with changes in manufacturer technology accounting for most of the fuel economy benefits. However, these dynamics would be different at the state level versus the Federal level. If a feebate program was applied only to a state like Vermont in isolation, manufacturers would likely not respond significantly by providing new vehicle technologies. As a result, Vermont vehicle consumers might be more likely to buy more fuel-efficient vehicles that already are on the market. A 2010 University of California Study found that higher-income households purchase the vast majority of new vehicles in California, and thus would be disproportionately impacted by both new vehicle fees and rebates. Their model also found that the average feebate for the lowest income households (under $10,000 annually) would either be zero or positive, as low-income households are more likely to buy small, inexpensive vehicles (Bunch et al., 2010).

Since its implementation in 2008, the French "bonus/malus" feebate program has appeared to succeed in reducing emissions in the Nation's passenger vehicle fleet. Average fleet CO_2 emissions of the new vehicle fleet in France dropped by 6 percent in one year. Between 2008 and 2016, the average CO_2 emissions from passenger cars in the French fleet declined from 150 g/km to approximately 110 g/km; and between 2012 and 2017, the market share for plug-in hybrid and electric vehicles in France increased from slightly above 0 percent to nearly 2 percent. The feebate program alone cannot be credited, however, as many of the same trends in average emissions and fleet mix have been present in other European nations as well. The Denmark feebate also was estimated to have a significant impact, as average fuel economy of the Danish fleet improved from roughly 38 MPG to 43 MPG following implementation (Bunch et al., 2010).

2.6   Administrative Costs

The administrative costs of a feebate program largely depend on the method of implementation. According to the International Council on Clean Transportation, feebates can either be implemented as "consumer-based programs" or "manufacturer-based programs." Consumer-based programs include the fee or rebate in the purchase price at the consumer level. Manufacturer-based programs assess the fee or rebate at the manufacturer level. Because feebates have generally been targeted at consumers, not manufacturers, proposals and programs have generally collected fees and given rebates directly to consumers.

Consumer-based feebate programs have higher administrative costs than manufacturer-based programs, but these costs are dependent on how fees and rebates are assessed. For example, some programs require customers to apply for rebates, instead of the rebate being directly built into the purchase price, which requires more administrative overhead. However, a program that assesses fees and rebates at the dealer level will also require significant coordination with dealers, which can add an administrative burden. It is important for program development to evaluate and set aside program revenue to support staffing necessary to administer the program at involved agencies and departments.

Administrative requirements on the part of the implementing entity or entities would depend upon the design of the program but would generally include:

- Initial effort to design the program—establishing a feebate function, including pivot point; setting up an implementation mechanism, and educating consumers and auto dealers about the program.

- Program evaluation, reset of the pivot point and potentially of fee/rebate levels, every one-to-three years based on assessment of revenues versus fees paid and actual and projected MPG levels, with corresponding changes to informational/educational materials.

- Ongoing administrative time to process fee payments and rebate requests for each new vehicle sale or and/or registration (depending upon implementation details). This would include verification of the correct fee or rebate amounts based on the vehicle's MPG or GHG rating.

- Any enforcement that might be needed to ensure compliance with the program.

Administrative options for a consumer-based program would include:

- Point-of-purchase: The fee and/or rebate would be built into the purchase price of the vehicle at the dealership. The state would collect fee revenue from dealers and reimburse dealers for rebates paid out.

The dealers would need to keep records of vehicles sold by MPG level, along with fees collected and rebates paid.

- Post-purchase rebate application: The consumer would pay any fee at point of sale to the dealer, but would apply for a rebate through a separate process, e.g., a mail-in form provided by the dealer, or an electronic form on the state's website. Rebates would be paid directly by the state.

- Point-of-registration: The consumer would pay any required MPG fee along with their other registration fees, or apply for a rebate at the time of registration.

3.0   Assessment of Program Alternatives

A feebate and/or vehicle incentive program could be implemented in Vermont in many ways. For this report, five illustrative alternatives were created to show the general range of possibilities. Each one of these alternatives could have multiple options depending on the details of how it is implemented. Each alternative is presented and evaluated according to the following factors:

- Description of the alternative.

- Options for program design within the alternative.

- Effectiveness at achieving program goals (reducing GHGs and increasing EVs).

- Administrative cost/level of effort (considering effort to the state to implement, as well as requirements for consumers and auto dealers).

- Equity and other consumer acceptance considerations.

Table ES.3 in the Executive Summary provides a summary evaluation of the advantages and disadvantages of each alternative. That table includes notes relevant to all alternatives, such as need for regional coordination.

3.1   Alternative #1: All-Vehicle Feebate

Description

Under this alternative, Vermont would implement a feebate program that would subject all new vehicle purchases to either a fee or rebate, the amount of which would be decided by predetermined criteria, based on an objective measure of emissions or fuel efficiency, such as CO_2 grams per mile (g/mi), MPG or MPG-equivalent (MPG(e) rating, or U.S. Environmental Protection Agency (EPA) GHG rating (a scale of 1 to 10, relative to other vehicles in the same model year). This alternative would be, in effect, a fuel-neutral incentive, awarding rebates to owners of high-efficiency ICE vehicles as well as EV owners. A pivot point would be set to determine whether the individual gets a rebate or contributes a fee. If an absolute metric (MPG or CO_2) were used, the pivot point could be based on the median value for new vehicle purchases registered in Vermont over the past 3 years. If the GHG rating were used, the pivot point would not need to be reset, since this is a relative metric (compared to all vehicles sold in the U.S.) that changes every year.

Options

Rebate and fee amounts could be assessed on a linear basis, with all new vehicle purchases subject to either a fee or rebate proportional to emissions or MPG, or through a stepwise function (e.g., incentive or fee values grouped into bins of 5 MPG). The same scale would apply to ICE vehicles, EVs, or vehicles with other fuel sources such as hydrogen, based on the EPA's MPG or MPG(e) rating.

Consistency with Program Goals

This program would have direct impact on transportation-related GHG emissions, as it would apply to *all* new vehicle purchases in Vermont. Every prospective car buyer in Vermont would be incentivized to make at least a marginal improvement in their purchase decision, depending on the magnitude of the fee and rebate.

However, an all-vehicle feebate program would be unlikely to significantly increase the adoption of EVs in Vermont, in line with the State's Comprehensive Energy Program. Evidence from other all-vehicle feebates has shown that classic feebate programs mostly incentivize consumers to choose marginally more fuel-efficient vehicles. While most electric vehicles and plug-in hybrids would be awarded high levels of rebates under this scheme, the difference in the rebate amount compared to an efficient ICE might not be enough to offset the additional purchase price and performance considerations of the consumer.

Administrative Cost/Level of Effort

Section 2.6 describes the general administrative requirements of a feebate program, including initial program design, annual or regular program updates (fee/rebate schedule, evaluation, informational materials, etc.), processing of fee payments and rebates, and enforcement. Any alternative would require some additional administrative time on the part of one or more state agencies/departments. The feebate program design could include a set-aside of revenue to cover these additional administrative costs.

The State would need to decide which agency or entity would be responsible for processing tracking payments and rebates, and which agency or entity would be responsible for program design and updates.

- Point-of-purchase option: The fee and/or rebate would be built into the purchase price of the vehicle at the dealership; the State (most likely the Department of Taxes) would collect fee revenue from dealers and reimburse dealers for rebates paid out. This option would probably require the least effort for the state, since one set of payments would need to be processed per dealer (on a frequency to be determined, such as monthly or annual), rather than processing payments for each individual consumer. However, the dealers would need to keep records of vehicles sold by MPG level, along with fees collected and rebates paid.

- Post-purchase rebate application: The consumer would pay any fee at point of sale to the dealer, but would apply for a rebate through a separate process, e.g., a mail-in form provided by the dealer, or an electronic form on the State's website. Rebates would be paid directly by the State, most likely the Department of Taxes. This would require somewhat more effort since each rebate application would need to be processed.

- Point-of-registration: The consumer would pay any required MPG fee along with their other registration fees, or apply for a rebate at the time of registration. The dealer takes care of all registration requirements for vehicles purchased from Vermont dealers, so this option would only apply to new vehicles purchased by Vermont residents from out-of-state dealers. This would be a necessary provision to reduce Vermont residents traveling to neighboring states to purchase low-MPG vehicles. It would require some additional administrative effort by the DMV, in the form of another step in the registration process to verify payment of any required fee and track the disposition of fees paid. A single payment would still be processed that includes all required titling, licensing, and registration fees.

Under any alternative, the Department of Motor Vehicles would most likely need to add fields to its registration database indicating whether the vehicle was purchased new by a Vermont resident (and therefore subject to the fee/rebate), the MPG of the vehicle, and acknowledging that the appropriate fee or rebate was paid. The Vermont Registration, Tax, and Title application form would need to be modified on a one-time basis. There would be an incremental level of effort required to manage and verify data entry for this additional item.

For any fees or rebates provided at the dealer level, the dealer would need to verify residency.

Equity and Consumer Acceptance Considerations

The application of a fee or rebate to all new vehicle purchases would be a significant change for vehicle consumers. If the program is applied in linear fashion or in a stepwise program with smaller bins, consumers might have difficulty understanding the program. Significant work in terms of outreach both to dealerships and consumers would likely be necessary in order for the program to have its intended effect. Fairness concerns might be expressed by consumers requiring larger vehicles (e.g., trucks or vans for contractor work or larger families).

3.2   Alternative #2: Feebates by Vehicle Category

Description

This feebate policy would also be based on a measure of efficiency or emissions, but would instead apply a different set of fees and rebates for different categories of vehicles, like cars and light trucks, rather than a single feebate that applies to all vehicles.

Options

Grouping into two categories—cars and light trucks—would be the simplest approach, but a larger number of categories could be defined based on weight, body style (e.g., sedan, sport utility, van, pickup), or footprint. Two-wheeled or light vehicles, such as motorcycles, scooters, and possibly electric bikes, could also be considered as a separate category.

Similar to Alternative #1, the feebate structure within each category could vary from a more linear to more stepwise.

Consistency with Program Goals

Similar to Alternative #1, this program would be likely to incentivize shifts in vehicle purchase decisions towards cleaner vehicles. However, this program would provide a diminished incentive for purchasers to move between different vehicle classes, e.g., to choose a more efficient sedan or wagon over an SUV.

Administrative Cost/Level of Effort

This alternative would require a slightly higher level of effort than Alternative #1 to design and implement. The effort in designing and regularly updating the program would increase slightly as more vehicle classes are defined. However, the ongoing effort for administration, enforcement, and education would be similar.

One potential challenge is that the appropriate classification of a vehicle is not always clear, especially for "crossover" and smaller SUVs, which may have similar body styles built on either car or truck platforms. Even the EPA fuel economy certification database is not entirely consistent about which models are classified as cars versus light trucks, with some models being identified as both in different records. Dealers and consumers would need to be provided a listing of models at the beginning of each model year that defines the category into which the model falls and the corresponding fee or rebate.

The basic program administration requirements would be the same. The level of effort for the implementing state entities would be impacted slightly by the need to additionally verify the class of the vehicle and ensure that the appropriate fee or rebate is paid.

Equity and Consumer Acceptance Considerations

Using different vehicle categories could serve to enhance acceptance of a feebate program among vehicle customers. Owners of SUVs and light trucks, for example, might feel that a class-based system does not punish them for their choice in vehicle type the way that a classic one-size-fits-all feebate would. Conversely, people who want to purchase a larger car rather than a small or midsize SUV with the same MPG rating might feel like the program is discriminating against their preferences.

3.3   Alternative #3: EV Rebate Program

Description

This program would only include a rebate for electric vehicles, with no concurrent fee on high-emitting vehicles. State-run EV incentive programs have been implemented in a number of other states. This option could be implanted through an expansion of the income-qualified EV purchase credit in Section 34 of the 2019 Transportation Bill to all purchases of EVs. New York's "Drive Clean" rebate, where each purchaser of a new EV is awarded with a rebate of up to $2,000 at the point of sale, could also serve as a model.

Options

Rebates for EVs could vary on the type of technology used (all-electric, plug-in hybrid, etc.). Different rebate amounts could be awarded based on income level, in order to ensure that low- and moderate-income Vermonters are benefiting from the program.

This alternative should be designed in coordination with ongoing work to implement Sec. 34 which authorizes the Agency of Transportation to spend $2 million in fiscal year (FY) 2020 on an electric vehicle incentive program that applies to both of purchases and leases of EVs. The program is intended to provide incentives to low- and moderate- income households, defined as at or below the State's median household income level, for purchases of EVs with a base MSRP of $40,000 or less. These stipulations limit the number of residents who would be eligible. One potential method for maintaining the intended purpose of Section 34 while applying the incentive more broadly would be a parallel program that creates incentives for all drivers of vehicles over $40,000 MSRP, at lower levels than the Section 34 incentives. According to Cox Automotive, the average sale price of an electric vehicle in 2019 was $55,600, although this dropped by 13 percent, from over $64,000 in 2018. Creating this parallel program would make incentives available for a much larger set of EV models. Rebate values could still be capped or reduced for more expensive vehicles, helping to mitigate concerns about subsidizing high-income consumers.

Consistency with Program Goals

The primary benefit of this program is that it would explicitly encourage higher uptake of EVs among Vermont residents by creating a direct incentive to buy new EVs and could significantly reduce the cost barriers that dissuade many consumers from avoiding EV purchases. This program most explicitly addresses the goals of the State's Comprehensive Energy Plan. However, electric vehicles only accounted for 0.75 percent of all new vehicle registrations in Vermont between 2016 and 2019, while only 1.6 percent were plug-in hybrid electric vehicles. Therefore, even if the program succeeds in dramatically increasing the number of EVs or PHEVs on the road, it will not affect the vast majority of new vehicle purchases.

One outstanding question is how an EV incentive program might interact with the sales mandates under the California ZEV Program, in which Vermont is participating. The ZEV program assigns each automaker "ZEV credits" based on the type of ZEV and its battery range. The credit requirement is 7 percent in 2019, which will require about 3 percent of sales to be ZEVs. The credit requirement rises to 22 percent in 2025, which will likely require less than 8 percent of sales to be ZEVs (Union of Concerned Scientists). If automakers knew that consumers were being offered an EV incentive, they might be less inclined to discount EV purchases to encourage enough sales to meet the credit requirements. However, The ZEV Rule percentages are not aggressive enough to meet the State's goals. State incentive programs may be critical to help generate higher demand for EVs, which will help the auto manufacturers bring this class of vehicles up to scale.

Administrative Cost/Level of Effort

The level of administrative effort for this alternative would be less than a program in which both fees and rebates are provided. Only rebates would need to be processed, and the rebates would be provided for a much smaller number of vehicles (less than 1,000 in 2018). Most likely the administrative effort would fall to the Department of Taxes; the DMV would not need to modify its database or registration procedures. As with other alternatives, a small set-aside may be needed to cover administrative costs. The processes for rebate implementation already are fairly well established, and procedures from other States that have implemented an EV program could be adapted easily. Income verification could add complexity to the program.

Unlike the other alternatives considered in this report, this program is not self-funding and would require an external funding source. It might be challenging for the State to identify a source sufficient to provide meaningful rebates for all EVs, especially as the number of EVs sold grows. The funding side may have administrative costs and a level of effort that would need exploration.

Equity and Consumer Acceptance Considerations

The implementation of rebates for EVs around the country has been met with concerns that these programs primarily benefit a limited number of consumers, as the cost of most electric vehicles is comparatively high compared to ICEs even with rebates factored in. The Section 34 program addresses this directly by only providing rebates to low- and moderate-income households for plug-in electric vehicles with an MSRP of $40,000 or less. Expanding the Section 34 program to all consumers or all models of PEVs could undermine these equity considerations, but keeping income restrictions will limit the impact of the rebate program.

3.4   Alternative #4: EV-Focused Feebate

Description

In this alternative a fee is applied to purchases of all new ICEs that funds rebates applied to all new EV purchases. At first, the fees applied to ICEs would likely be relatively small in magnitude, while EV rebates would be relatively high, given the current imbalance in market share between the two vehicle types. As EVs gain in popularity, the ICE fee amount would likely be adjusted upward and the rebate downward.

Options

This program could be implemented by applying uniform fees and rebates on all vehicles, with all EV purchasers receiving the same rebate and a singular fee applied to all ICE purchases. For example, at a 3 percent market penetration of plug-in EVs, a $150 fee on all new ICE purchases would fund a $5,000 rebate on all new EV purchases. Alternatively, different levels of fees could be applied to ICEs as described in Alternative #1. For the EV rebates, different amounts could be awarded for BEVs, PHEVs, and hybrid electric vehicles that do not plug in. Rebates could also be scaled based on income levels of buyers.

Consistency with Program Goals

Much like Alternative 3, this alternative would explicitly incentivize Vermonters to purchase EVs, with the intent to reach the number of EVs in in the State's Comprehensive Energy Plan. Moreover, by applying a fee on ICEs, this program would do more to encourage consumer shifts to cleaner vehicles than Alternative 3. If a sliding scale, rather than a uniform fee, is applied to ICEs, then this alternative also has the potential to catalyze consumers to also make marginal shifts in the efficiency of their new vehicles, like the more classic feebate mechanisms included in Alternatives 1 and 2.

Administrative Cost/Level of Effort

The administrative costs and level of effort of this alternative would be similar to Alternatives 1 and 2, and would depend on how the fees and rebates are collected as discussed under Alternative 1. The level of effort for program design and administration would depend on the complexity of the fee schedule, requiring slightly more effort if a sliding scale were used (since MPG would need to be verified), rather than a single uniform fee on all ICEs. If the EV rebates were based on income level, some additional administrative level of effort would be required (probably by the Department of Taxes) to verify income.

Equity and Consumer Acceptance Considerations

One of the advantages of a pure EV rebate (Alternative 3) is that drivers would not see a disincentive, but only a reward for choosing a cleaner vehicle. Morphing this into a feebate-like program returns the disincentive element. However, a feebate-like system is arguably fairer, as Vermonters who are choosing lower-efficiency vehicles are subsidizing incentives for cleaner vehicles, while a rebate-only system would be funded from revenues collected from a larger swath of Vermonters, some of whom may bear little to no responsibility for transportation-related emissions. If the EV-focused feebate is implemented with a sliding scale based on MPG(e) or GHG emissions, the fairness rationale is even stronger.

3.5   Alternative #5: Inclusion of Leased and/or Used Vehicles

Description

To reach ambitious GHG reduction goals, it may be necessary to incorporate not just new car purchases, but also leases and possibly purchases of used cars. This alternative might also include additional focus on regional cooperation beyond the level that should be incorporated in all alternatives.

Options

Options include adding only leased vehicles, including all used vehicle transactions, or moving beyond a point-of-sale/resale model to one that occurs at the regular renewal of vehicle registration. New, leased vehicles would be covered in a similar manner to new sales; it would need to be determined whether the lessee pays a one-time fee or gets a rebate, or whether this is built into the monthly lease cost through the dealer. Building the incentive into the monthly lease cost (e.g., over a period of two years) would ensure that a short-time lessee does not obtain a one-time windfall or make a disproportionately high payment. However, it could introduce additional administrative constraints or requirements.

Applying the feebate concept to the used car market could be done either through a time-of-sale fee or rebate, or through a regular registration fee that is scaled proportional to MPG or GHG emissions. A sliding registration fee could be made self-funded, within limits, if it were set to pivot around the current annual registration fee; introduction of larger fees would make the program revenue-positive, unless some consumers were given "rebates" (possibly through a tax credit system) on their registrations.

Any of these options could continue to build on the income-qualified model from Section 34, for example, exempting lower-income households from any fee.

These options could be dependent on results of a new-vehicle option or phased in. This would support building on knowledge gained and administrative capacity built by new vehicle alternatives.

Consistency with Program Goals

This alternative would potentially have a greater effect on reducing GHG emissions. At a minimum, to cover the entire new vehicle fleet, it would be important to include leased vehicles. Nationwide, leases are approximately 30 percent of new car transactions. An even more expansive version of the program would cover used cars, either based on transactions (sales) or ownership (registrations). The volume of used car sales is more than double that of new car sales.

A more-encompassing approach might be less subject to "gaming," or less distorting of markets among new, used, and leased vehicles, and also across state lines. However, it is not clear to what extent expanding the feebate to the used vehicle market would actually affect fuel economy. Used vehicles already are on the road, so the incentive to introduce cleaner vehicles into the fleet would be very indirect—for example, through lower resale values for less-efficient vehicles that might discourage consumers from buying these vehicles new.

Administrative Cost/Level of Effort

By including a significantly higher volume of vehicles and situations, this alternative would be significantly more complicated to design and administer than alternatives applying only to new vehicle sales. For leases, there would need to be a translation of fee and rebate amounts to match the duration and terms of the lease. For example, if a vehicle would be awarded a $1,000 rebate under a sales-based scheme, what would the rebate amount be for a five-year lease of the same vehicle? If applied as part of the lease, would the dealer pay the fee or apply for the rebate and then be required to explicitly disclose the fee or rebate value as part of the lease terms? Would the dealer decide to pass on only part of the costs or savings to the consumer?

For used vehicles, the administrative challenges increase, as used vehicle purchases take place in many different venues besides car dealerships. The fee or rebate would mostly likely need to be applied by the state upon transfer of title. There would need to be a system for looking up the MPG or GHG rating of any vehicle that might be registered, not just new vehicles. As an alternative to a transfer feebate, a fee or rebate could be assessed as part of the regular registration renewal process. This would also require a one-time assignment of MPG or GHG rating to each vehicle (which would be stored in the State's registration database). A study currently is underway by New Hampshire to consider an MPG-based "road user fee" applied at the time of annual registration; this study, planned to be completed in the winter of 2020, will provide additional insights into program design options and administrative level of effort.[1]

Equity and Consumer Acceptance Considerations

Expanding the feebate to include leased vehicles would likely increase the perceived equity of the system since consumers would not avoid the fee or rebate through leasing instead of purchasing. Expanding the system to used vehicles might also increase the perceived equity, but more research on consumer opinions would be needed on this topic. It is likely to depend on the structure of the fee/incentive program. For example, a fee on used ICE registrations or transactions that was used to subsidize EV registrations or transactions would likely be perceived as inequitable and regressive. As new vehicles become more efficient over time due to Federal and state standards, a "sliding scale" that considers age of the vehicle might be necessary to avoid concerns that owners of older vehicles (more likely to be low income) are disproportionately impacted. Exempting lower-income households from additional fees could also make the program more acceptable.

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[1] Note that New Hampshire's fee program has very different objectives. The proposed program would apply an increasing fee on higher-MPG vehicles, with the goal of making up lost motor fuel tax revenue and keeping revenue to the Highway Fund constant over time as vehicles become more efficient; the idea being that all road users would pay a similar total amount for transportation services, considering fees and gas taxes.

4.0   Data Analysis

To illustrate the potential impacts of different feebate and incentive program designs, data on model years 2016 through 2019 vehicles registered in Vermont as of July 2019 was obtained from DMV and evaluated. This data is compiled in a slightly different way than the Drive Electric Vermont data.

4.1   Description of Data

For this analysis, the Vermont DMV provided registration data on all vehicles registered as of July 2019 with model years between 2016 and 2019. This is an approximate representation of new vehicles that would have been sold and/or registered in the State over that period. Each vehicle had a unique vehicle identification number (VIN), along with codes for the make, model name, year of manufacture, body style, and fuel type. For this analysis, only vehicles where the owner's State was marked as "Vermont" were considered, leaving a total of 93,528 vehicles.

4.2   Analysis Methods

In order to match each vehicle with its respective fuel economy and emissions values, every entry in the DMV database was matched to a corresponding vehicle from the U.S. EPA and U.S. Department of Energy (DOE) *Fuel Economy Guide*. Due to some discrepancies between the naming conventions in the DMV and EPA/DOE datasets, not all vehicles could be matched. A total of 91,224 vehicles were successfully matched, with each vehicle assigned a value for MPG(e),[2] CO_2 g/mi, and EPA GHG rating.[3] Some factors that could affect fuel economy, including engine displacement, transmission, and trim level, could not be accounted for in this analysis due to incomplete information. There were a large number of cases where one vehicle entry in the DMV database could be matched to multiple different vehicle entries in the EPA/DOE dataset. This is due to the EPA/DOE, including more details on the differences between variants of specific models than the DMV dataset, which only included a three-letter code for each model, along with the year of manufacture. In cases of multiple matches, the fuel economy and emissions values were simply averaged to represent a composite value for each vehicle entry.

4.3   Profile of New Vehicles Registered in Vermont

Table 4.1 shows summary statistics on the 2016 to 2019 vehicles for the three MPG and emissions ratings assigned by EPA and DOE. Figure 4.1 shows the distribution of vehicles by MPG(e) rating. The vast majority of new vehicle purchases are clustered between 18 and 30 MPG(e). While the median MPG(e) is just over 25, the 90th percentile of MPG(e) is just 31. Between 2016 and 2019, average MPG(e) has improved from 24.9 to 26.4.

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[2]   MPG(e) is the MPG-equivalent rating provided by EPA for electric vehicles, based on the energy consumption of the electric vehicle "at the plug." MPG(e) is used here to denote either MPG or MPG(e) depending on the type of vehicle.

[3]   The EPA's GHG rating assigns a rating between 1 to 10 to each vehicle based on tailpipe CO_2 emissions in g/mi, with 10 representing the cleanest vehicles and 1 representing the highest emitting vehicles, relative to other vehicles of the same model year. For example, all vehicles with a rating of 6 in Model Year 2018 emit between 302 and 335 g/mi of CO_2. One advantage of designing a program using this rating is that since it is relative to all vehicles in a model year, the pivot point would not need to be reset over time.

Table 4.1   Median Measures of Fuel Economy and Emissions for New Vehicle Registrations in Vermont
Model Years 2016 to 2019

Median MPG	25.3 MPG(e)
Median CO2 emissions (g/mi)	352 g/mi
Median GHG Rating	5.33

Figure 4.1   Model Year 2016 to 2019 Registrations in Vermont by MPG(e)[1]
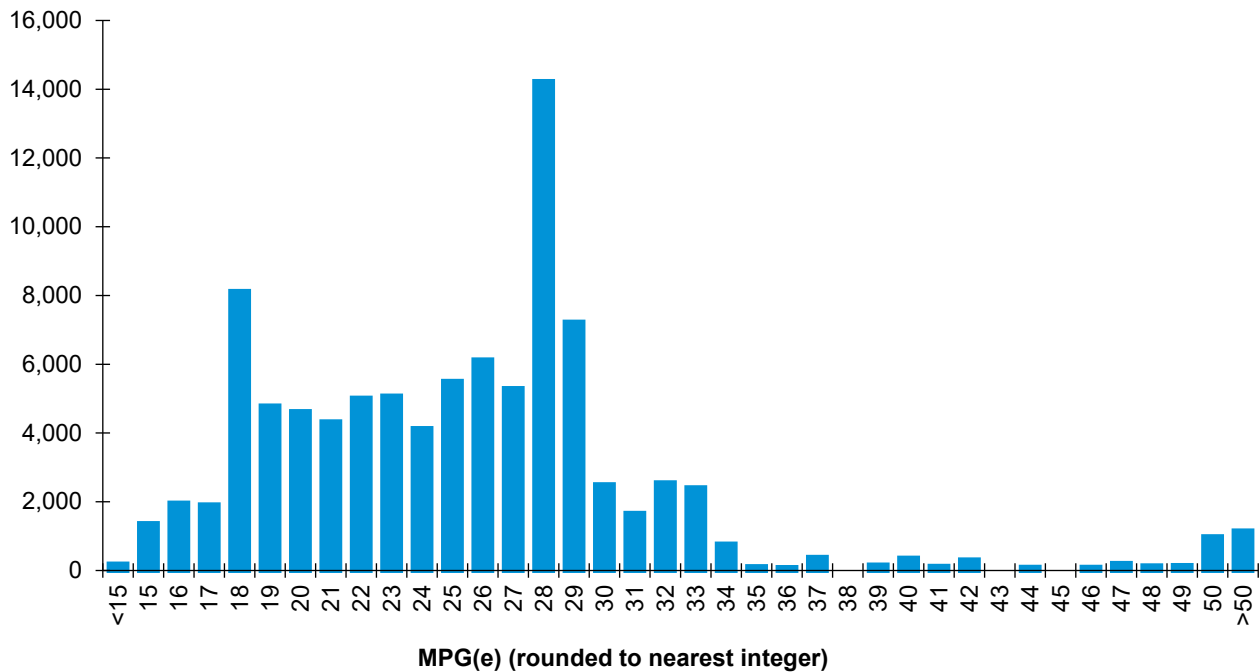
Number of Registered Vehicles

MPG(e) (rounded to nearest integer)

1   Data current as of July 2019. Estimate based on matching Vermont vehicle registration data to U.S. EPA/DOE certification data; some matches are approximate and averaged across make/model variations.

The distributions of GHG rating and CO_2 g/mi are shown in Figure 4.2 and Figure 4.3. Between model years 2016 and 2019, average CO_2 emissions have declined from 377 to 368 g/mi. The median GHG rating is just over 5, as might be expected. The average EPA GHG rating for new vehicle purchases has worsened, declining from 5.6 to 5.2 from model years 2016 to 2019. One explanation is that Vermont vehicles might have decreased in efficiency compared to the national average over this period. However, it also is possible that EPA did not correctly forecast the mix of vehicle sales, and that the overall distribution of GHG ratings might have declined nationally over this period.

Figure 4.2   Model Year 2016 to 2019 Registrations in Vermont by GHG Rating[1]

Number of Vehicles

1   Data current as of July 2019. Estimate based on matching Vermont vehicle registration data to U.S. EPA/DOE certification data; some matches are approximate and averaged across make/model variations.

Figure 4.3   Model Year 2016 to 2019 Registrations in Vermont by CO₂ Emissions[1]

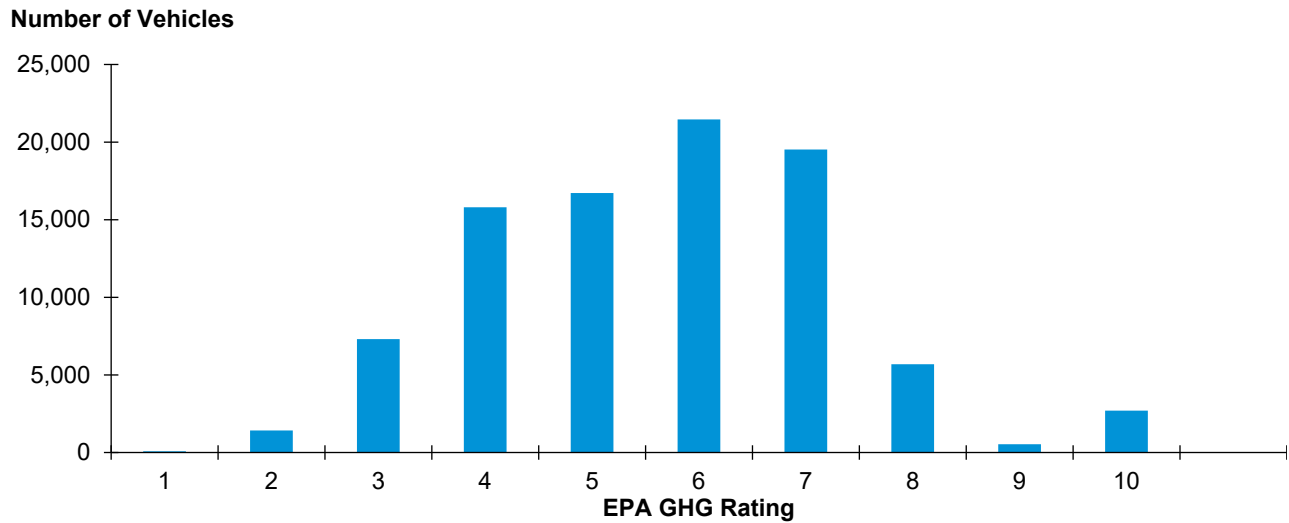**Number of Vehicles**

1   Data current as of July 2019. Estimate based on matching Vermont vehicle registration data to U.S. EPA/DOE certification data; some matches are approximate and averaged across make/model variations.
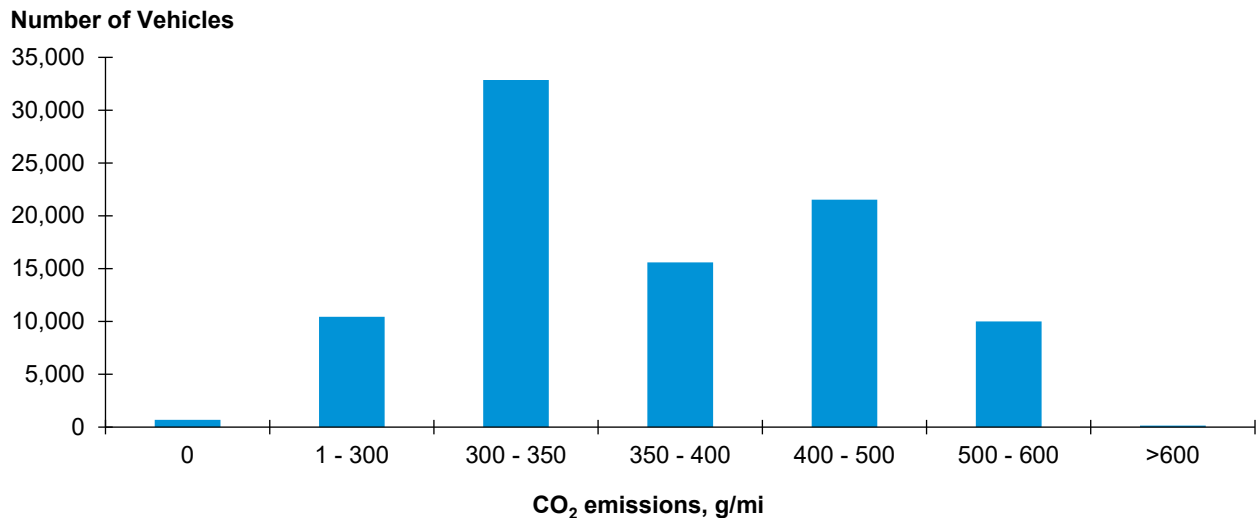
The percentage of BEVs in new Vermont registrations increased from 0.2 percent in 2016 to 1.3 percent in 2019; in addition, 1.6 percent of newly registered vehicles over this period were PHEVs.

Vermont's EV market share can be compared with other states. Information on 2017 to 2018 shares (including all-electric and PHEV) shows Vermont around 2 percent for both years, compared with

Massachusetts increasing from 1.4 to 2.5 percent, and New York increasing from 1.0 to 1.6 percent. Other New England states had market shares around 1 percent, increasing slightly from 2017 to 2018 (EVAdoption, 2019).

4.4   Sample Program Designs and Illustrative Impacts

Linear Feebate on CO_2 Emissions

Using the 2016 to 2019 Vermont DMV data, a linear feebate on CO_2 emissions, measured in g/mi, was modeled to show what it might look like for Vermont car buyers. For this simulation, the average (mean) of CO_2 emissions, 373 g/mi, was used as a pivot point. While a different pivot point could be used, revenue-neutrality would not be achieved. Using the mean value of the data ensures no net revenue, although this value could be adjusted to account for future trends in the automobile market. Once a pivot point is set, a price per CO_2 g/mi (or "slope") can be decided. While any slope could be used, the program would likely want to choose a value that would result in a reasonable level of fees and rebates awarded. One way to ensure this is by setting a cap on either the maximum rebate or fee. For example, if a cap of $5,000 is set on vehicle fees (i.e., no customer can be assessed a fee greater than $5,000), then the corresponding feebate slope is $14.55 per gram/mi. Table 4.2 illustrates this scenario.

Table 4.2   Illustrative Linear Feebate Scenario

Pivot Point	373 g/mi CO_2
Carbon Price (feebate slope)	$14.55 per g/mi
Maximum Fee	$5,000
Maximum Rebate	$5,419
Fee for equivalent of 20 MPG vehicle (2019 Dodge Grand Caravan)	$1,059
Rebate for equivalent of 30 MPG vehicle (2019 Mazda CX3)	$1,379

In this scenario, every new vehicle buyer is assessed a fee or rebate depending on the emissions value of their vehicle, providing a universal incentive for drivers to select cleaner vehicles. However, one potential drawback that is illustrated here is that the reward for driving a slightly cleaner vehicle than average is very high, while the fee for driving a slightly below-average emissions vehicle is fairly steep. This can be remedied by changing the price of carbon emissions, but since the program is linear, this would also reduce the reward for the highest performing vehicles. A nonlinear approach could allow reducing the impact on the majority of drivers while still rewarding buyers of the cleanest vehicles and assessing inhibitory fees on the worst performing vehicles.

Stepwise Feebate on MPG Rating

A stepwise feebate can be implanted in a variety of ways but one of the most straightforward methods is to create "bins" based on MPG(e). Table 4.3 illustrates how a feebate might be implemented using bins of 5 MPG. Note that the number of vehicles and net revenue is based on 2016 to 2019 model year vehicles as of July 2019 and therefore covers about 3½ years of the sample program.

Table 4.3   Illustrative Stepwise Feebate Program
Example 1

MPG(e) Bin	Number of Vehicles	Percentage of New Vehicles	Feebate Amount	3 ½ Year Revenue
< 15	205	0.22%	$1,500	$307,500
15 to < 20	21,595	23.67%	$800	$17,276,000
20 to < 25	23,293	25.53%	$200	$4,658,600
25 to < 30	35,670	39.1%	-$200	-$7,134,000
30 to < 35	7,302	8.00%	-$1,000	-$7,302,000
35 to < 40	641	0.70%	-$1,500	-$961,500
40 to < 45	295	0.32%	-$2,000	-$590,000
45 to < 50	1,154	1.27%	-$2,500	-$2,885,000
>= 50	1,105	1.21%	-$3,000	-$3,315,000
Total[1]				**$54,600**

1   The goal would be to have a "total" net revenue as close to $0 as possible, but since the feebate schedule must be set before the actual distribution of vehicles is known, the net is unlikely to be exactly $0 in practice. Also, a small amount of revenue will need to be reserved to cover administrative costs.

This approach is relatively simple to implement and the feebate amounts can be changed relatively easily to reflect policy preferences. One issue that arises using an approach with relatively large MPG bins is fairness. It might seem arbitrary to many buyers that buying a car with an MPG of 24 results in a fee, while buying a car with an MPG of 26 would earn a rebate. In order to neutralize this fear, this scenario utilizes relatively low fee and rebate values for the majority of vehicles that fall between 20 and 30 MPG (about 65 percent of the new vehicle fleet). The downside of this approach is that it sends a relatively weak signal to the majority of car buyers.

Another approach is shown in Table 4.4. This approach sends a much stronger price signal and distributes much higher rewards for the cleanest vehicles. However, the primary drawback is that there is a substantial difference between purchasing a 24 MPG and a 26 MPG vehicle in this scenario, which may seem arbitrary and unfair to both customers and dealers.

Table 4.4   Illustrative Stepwise Feebate Program
Example 2

MPG(e) Bin	Number of Vehicles	Percentage of New Vehicles	Feebate Amount	3 ½ Year Revenue
< 15	205	0.22%	$5,000	$1,025,000
15 to < 20	21,595	23.67%	$1,500	$32,392,500
20 to < 25	23,293	25.53%	$1,000	$23,293,000
25 to < 30	35,670	39.10%	-$1,000	-$35,670,000
30 to < 35	7,302	8.00%	-$1,500	-$10,953,000
35 to < 40	641	0.70%	-$2,000	-$1,282,000
40 to < 45	295	0.32%	-$2,500	-$737,500
45 to < 50	1,154	1.27%	-$3,000	-$3,462,000
>= 50	1,105	1.21%	-$5,000	-$5,525,000
Total[1]				**-$919,000**

1   As can be seen in this example as well as in the example in Table 4.7, even a small variance in the feebate schedule can have nontrivial net revenue effects. Setting the rebate amount for the 20 to 25 MPG bin at $974 results in a net total revenue of $0; setting it at an even $1,000 results in a net revenue of -$919,000 or about -$262,000 a year.

Class-Based Feebate

Another potential approach would be to implement different feebate schedules for different classes of vehicles. There are a number of methods for dividing up vehicles based on class, but one of the most straightforward would be to follow the EPA approach of differing standards between light-duty vehicles (LDV), or passenger cars, and light-duty trucks (LDT) or SUVs, vans, and pickups under 8,500 lbs weight rating. While distinguishing between LDVs and LDTs is mostly straightforward, minivans and smaller SUVs can either be classified as LDVs or LDTs, which makes a complete classification of the fleet difficult. This analysis used data from the EPA's Light-Duty Vehicle and Truck Certification to make distinctions between models that are classified as LDVs or LDTs. Some vehicle models were classified by the EPA as LDVs in some records and LDTs in others, and therefore some estimation had to be used in order to formulate this distribution. Using this methodology, approximately 64 percent of the vehicles in the Vermont DMV sample were classified as LDVs with the remaining 36 percent classified as LDTs. This split is somewhat inconsistent with DOE Annual Energy Outlook national data showing a split of about 52 percent LDV to 48 percent LDT in 2017, so questions remain about the classification data.

Table 4.5 and Table 4.6 show how a separate feebate schedule could be implemented for LDVs and LDTs, respectively. The average MPG(e) value for Vermont LDVs in this sample is 27, and over half of all LDV MPGs fall between 25 and 30. The average MPG(e) of the sample Vermont LDT fleet is about 20. Because the MPG(e) distributions are tightly packed (over half of LDTs have an MPG(e) between 16 and 20 and 98 percent of LDTs have an MPG(e) between 15 and 30), using 5 MPG bands is impractical. Therefore, this scenario uses smaller MPG bands for the vehicles that are applied fees and larger bands for vehicles that are awarded rebates. In the sample schedule, the majority of vehicle buyers only pay modest fees or receive

modest rebates, while those who purchase the most inefficient vehicles still see a relatively steep fee. Under this scenario, an LDT with an MPG(e) of 19 would pay an $800 fee, while an LDV with the same MPG(e) would pay $1,500.

Table 4.5 Illustrative Class-Based Feebate Program
LDVs

MPG(e) Bin	Number of Vehicles	Percentage of New LDVs	Feebate Amount	3 ½ Year Revenue
< 18	1,703	2.90%	$2,000	$3,406,000
18 to < 21	2,924	4.98%	$1,500	$4,386,000
21 to < 24	8,540	14.53%	$1,000	$8,540,000
24 to < 27	16,078	27.36%	$300	$4,823,400
27 to < 30	20,427	34.76%	-$500	-$10,213,500
30 to < 35	7,198	12.25%	-$1,000	-$7,198,000
35 to < 40	418	0.71%	-$1,500	-$627,000
>= 40	1,477	2.51%	-$2,000	-$2,954,000
Total				**$162,900**

Table 4.6 Illustrative Class-Based Feebate Program
LDTs

MPG(e) Bin	Number of Vehicles	Percentage of New LDTs	Feebate Amount	3 ½ Year Revenue
< 16	2,412	7.15%	$1,500	$3,618,000
16 to < 18	9,501	28.16%	$800	$7,600,800
18 to < 20	7,580	22.47%	$200	$1,516,000
20 to < 22	5,808	17.22%	-$400	-$2,323,200
22 to < 26	4,233	12.55%	-$800	-$3,386,400
26 to < 28	3,771	11.18%	-$1,500	-$5,656,500
>= 30	430	1.27%	-$3,000	-$1,290,000
Total				**$78,700**

EV-focused Incentive and Fee

There are two potential scenarios using categorical feebate models where EVs could be especially privileged. One would be to keep the overall structure of the feebate from Scenario 2, while simply adding in bins specifically for EVs, which would be awarded rebates of much higher magnitudes. For example, such a feebate could be structured to ensure that all new EV purchases are provided with a rebate of $5,000, while other vehicles are assessed lower fee and rebate amounts. Over time, as the popularity of EVs increases, fee amounts could be lowered even further. An example is shown in Table 4.7.

Table 4.7 Illustrative EV-Focused Incentive and Fee
Example 1

MPG(e) Bin	Number of Vehicles	Percentage of New Vehicles	Feebate Amount	3 ½ Year Revenue
< 15	205	0.22%	$2,500	$512,500
15 to < 20	21,595	23.67%	$1,100	$23,754,500
20 to < 25	23,292	25.53%	$500	$11,646,000
25 to < 30	35,669	39.10%	-$500	-$17,834,500
30 to < 35	7,302	8.00%	-$1,000	-$7,302,000
35 to < 40	641	0.70%	-$1,500	-$961,500
40 to < 45	295	0.32%	-$2,000	-$590,000
45 to < 50	1,154	1.27%	-$2,500	-$2,885,000
>= 50	421	0.46%	-$3,000	-$1,263,000
Electric	687	0.75%	-$5,000	-$3,435,000
Total				**$1,129,500**

Given the low fleet penetration of EVs to date, an EV-focused program that charges all non-EVs would be somewhat more difficult to formulate, as only low amounts could be charged at first, even if the rebate amount is relatively high. For example, a small fee of $57 on all non-EVs would completely cover a rebate of $7,500 on all fully electric vehicles in Vermont at the current penetration rate of 0.75 percent, while a $38 fee would cover a $5,000 rebate. A potentially fairer approach might be to assess fees only on vehicles falling below the median fuel efficiency level of about 25 MPG(e). An illustration is provided in Table 4.8.

Table 4.8 Illustrative EV-Focused Incentive and Fee
Example 2

MPG(e) Bin	Number of Vehicles	Percentage of New Vehicles	Feebate Amount	3 ½ Year Revenue
< 15	205	0.22%	$1,000	$205,000
15 to < 20	21,595	23.67%	$175	$3,782,900
20 to < 25	23,292	25.53%	$50	$1,164,600
Electric	687	0.75%	-$7,500	-$5,152,500
Total				**$0**

5.0   Issues for Consideration

Feebate and incentive programs have been successfully implemented in a number of other jurisdictions, both in the United States and internationally. In the U.S., most experience has been with EV incentive programs, rather than feebates. These rebates have proved successful in increasing the number of EVs on the road, although sustaining sufficient funding for these programs has been challenging. International examples of feebate programs in places like France and Denmark have successfully decreased the average GHG emissions of the vehicle fleet in these countries.

A vehicle feebate or incentive program would provide Vermont with an opportunity to both reduce transportation-related emissions and increase the market penetration of EVs. However, the success of any feebate or incentive program will depend on the details of its implementation. Therefore, this report proposes a number of key considerations for policymakers to consider for an effective, equitable, and sustainable feebate or incentive policy.

This report addresses the following questions that were required to be addressed in Act 59, plus other considerations that were identified through the research.

1. **Should Vermont implement a vehicle feebate program?**

    The feasibility of implementing a vehicle feebate program in Vermont as a self-funding incentive program. However, feasibility will ultimately depend on the ability to address the administrative, level of effort, equity, and consumer acceptance considerations detailed in this report. A vehicle feebate and incentive program would provide Vermont with an opportunity to reduce transportation-related emissions and increase the market penetration of EVs—supporting State and regional energy and environmental goals, with a built-in revenue source. With sufficient model availability of EVs, expected in a few years, the feebate would allow consumers to avoid paying the fee and to benefit from the feebate without having to sacrifice the size, power, or comfort of their vehicles. However, a feebate system would require administrative effort on the part of the state, consumers and auto dealers, and will have distributional effects on Vermont consumers that must be considered. Outreach to the public and key stakeholders should be undertaken to ensure that Vermonters understand the potential benefits and impacts of such a program before finalizing and implementing it.

2. **What metric should the feebate be based on?**

    The Federal Government reports three metrics of new vehicle emissions and fuel economy: the MPG rating, CO_2 emissions in grams per mile, and a GHG emissions indicator on a relative 1 to 10 scale. An effective program design could be developed using any of these indicators. MPG is most familiar to consumers. However, using the MPG or CO_2 metric would require adjusting the fee schedule regularly to keep the program self-sustaining. In contrast, the GHG rating has the advantage that the scale is reset at the Federal level every year based on comparison with other vehicles of the same model year, so the fee schedule would not need to be updated regularly by the State.

3. **Should the feebate be structured in a linear or stepwise manner?**

    A linear feebate (e.g., based on CO_2 emissions or 1-MPG increments) would provide the most consistent incentive and avoid arbitrary large distinctions between vehicles with small differences (e.g., a $1,000 difference for a vehicle that is rated at 30 versus 29 MPG). However, it may be more difficult for

consumers to consider in their purchase decisions. A stepwise feebate in relatively small increments (3 to 5 MPG) would likely provide most of the benefits of a linear program and be easier to understand and implement.

4. **Should the fee/rebate schedule be applied uniformly to all light-duty vehicles, or should different rates be used for different classes of vehicles?**

A program that applies uniformly to all types of light-duty vehicles would be the most effective, as it provides an incentive to shift between different vehicle classes, e.g., to choose a more efficient sedan or wagon over an SUV, in addition to choosing more efficient vehicles within a class. However, effectiveness considerations must be balanced with the concerns of consumers who require a larger vehicle for business or personal reasons. Additional research is needed to develop a sample program differentiated by vehicle class. Options could include cars versus light trucks; additionally, separating pickups, vans, and/or SUVs; and distinguishing vehicles registered for personal versus commercial use. Consideration should also be given to how two-wheeled vehicles (e.g., motorcycles, scooters, electric bikes) might be covered.

5. **Should the program include special incentives for electric vehicles?**

EV-focused incentive programs are common, but without the "feebate" component applying to non-EVs, would not be self-funded, and would not affect the vast majority of new vehicle purchases. A self-funded feebate/incentive program could easily be designed that provides a larger incentive for EVs while still providing incentives to shift to cleaner gasoline and diesel vehicles. A feebate program could also be applied as a permanent, sustainable program at the same time as other state and/or Federal EV incentive programs, which may not be permanent, are in effect. Program design should be coordinated with activities underway to implement Section 34 of Act 59.

6. **How should the program be administered?**

A feebate program in Vermont is probably best implemented at the point of sale (consumer level) rather than at the manufacturer level, since it provides a more direct incentive to consumers. Both fees and rebates could be processed at the dealership, or consumers could pay the fee at the dealership and apply for a rebate directly from the state. A verification and fee/rebate payment mechanism would be needed as part of the registration process for vehicles that are purchased by Vermont residents from out-of-state dealers, to reduce "leakage," whereby consumers travel to a neighboring state to purchase a vehicle not subject to the fee. Conversely, residency verification would be required by the dealer or state at the time of rebate application to prevent residents of neighboring states from traveling to Vermont to buy a vehicle that comes with a rebate. These are examples of considerations for level of administrative cost/level of effort. Further evaluation of Vermont's administrative capacities will be needed to determine the most expedient implementation design.

7. **Should leased vehicles be included in the program, in addition to new vehicle sales?**

The inclusion of new leased vehicles should be considered, perhaps by spreading the fee or rebate value over the first two years of the vehicle's lease. One administrative option would be to apply the fee or rebate at the dealer level and require that it be included and disclosed as part of the terms of the lease. Nationwide, about 30 percent of new vehicles are leased, and excluding these from the program would leave a major gap in program coverage.

8. Should used vehicles be included in the program?

Expanding a feebate program to cover used vehicles would further increase the administrative complexity. No examples of a program that apply a rebate upon the sale/transfer of a used vehicle have been identified. Furthermore, it is not clear to what extent expanding the feebate to the used vehicle market would affect fuel economy. Used vehicles already are on the road, so any incentive to introduce cleaner vehicles into the fleet would be indirect. A question to explore would be whether excluding used vehicles from fees would encourage buying a less efficient used vehicle rather than a more efficient new one of similar size and performance. An alternative to a rebate upon sale of a used vehicle, and probably a more feasible approach from an administrative standpoint, would be to apply a sliding regular registration fee based on the vehicle's MPG.

9. What is the administrative cost/level of effort for feebate/incentive programs?

The level of effort required would depend upon the details of the program design. The program would require a modest level of effort by consumers and auto dealers to understand information on the program, apply for rebates, and pay fees. The effort to the state to design and administer a feebate/incentive program would include:

– The initial effort to design the program—establishing a feebate function, including pivot point, setting up an implementation mechanism, and educating consumers and auto dealers about the program.

– Regular program review and refinement to evaluate net revenues, reset the pivot point and potentially fee/rebate levels, and revise informational/educational materials.

– Ongoing administrative time to process fee payments and rebate requests for each new vehicle sale and/or registration in the state (and/or process net payments to and from dealers).

– Any enforcement that might be needed to ensure compliance with the program.

10. What equity concerns might exist with a feebate/incentive program, and how might these concerns be mitigated?

The application of a fee or rebate to all new vehicle purchases would be a significant change for vehicle consumers. The greatest impact would be on purchasers of new vehicles who require larger vehicles for business or personal reasons, and the greatest benefit would be received by purchasers of new, fuel-efficient or electric vehicles. Impacts resulting from vehicle size requirements could be somewhat mitigated through the use of a multitiered system.

Experience with feebate programs elsewhere suggests that feebate programs provide a modest net benefit to lower-income consumers, who are more likely to purchase less costly, more fuel-efficient vehicles. Lower-income households are more likely to purchase used vehicles, and thus are less directly affected by a new vehicle feebate program, although over time price differentials may transfer into the used vehicle market.

EV-focused incentives, in contrast, tend to benefit high-income consumers. Vermont is addressing this issue by developing and implementing a program to provide rebates to low- and moderate-income households for lower-cost electric vehicles as directed by the Legislature in Section 34 of Act 59.

11. **How should a feebate/incentive program relate to other state and Federal clean vehicle incentives?**

A feebate could work in conjunction with other state and Federal incentive programs, including Vermont's newly adopted program to provide rebates to low- and moderate-income households for EV purchases, as well as existing Federal tax credits. Program designs for state incentives should minimize administrative burdens by integrating different incentives or fees into a single payment.

12. **What coordination is needed with neighboring States?**

Coordination with neighboring States, including Massachusetts, New Hampshire, and New York, is recommended, especially given the possibility of Vermont vehicle owners purchasing or registering new vehicles in other States in order to avoid penalties for purchasing inefficient vehicles. Either state policies must be harmonized or there must be checks built into the system to account for cross-state transfers.

13. **Are there short-term versus long-term implementation alternatives?**

If it is not feasible to agree on an immediate implementation of a feebate program covering all light-duty vehicles, an EV-only incentive program could still be implemented relatively quickly and easily, if an alternative revenue source could be identified, including a set-aside to support additional administrative efforts by agencies/departments.

6.0   Next Steps

This report provides an initial assessment of alternatives for a feebate and/or vehicle incentive program in Vermont. To fully develop such a program the following next steps are recommended:

- Undertake a robust, inclusive discussion of what basic approach to pursue, if any. This process should include a range of stakeholders, including auto dealers, manufacturers, municipal officials, environmental community, partner agencies, and neighboring state officials, to gather feedback on alternatives and options.

- Develop specific program designs and implementation options in greater detail and consider administrative level of effort by examining the specific implementation activities that would need to be conducted both upfront and on an ongoing basis.

- Conduct additional data analysis to more fully simulate the impact of each potential alternative on GHG emissions, EV adoption, and consumer costs.

- Once a program design is fully developed and adopted, continue education efforts for a range of audiences, including auto dealership staff, the public at large, and other key stakeholders.

Appendix A.   Detailed Literature Review

Alternative revenue sources, including feebates, are becoming of greater interest to states as they seek to make up the gap in state and Federal highway funding created by increasing motor vehicle fuel efficiency and failure of fuel taxes to keep up with inflation. At the same time, states are looking for ways to incentivize clean vehicles to meet electric vehicle adoption targets and support energy and GHG reduction goals. As the Federal government attempts to roll back Corporate Average Fuel Economy (CAFE) standards, jurisdictions are increasingly interested in market-based approaches to reducing fuel consumption. Feebate programs, which combine rebates for fuel-efficient vehicles with offsetting fees on fuel inefficient vehicles, represent an intriguing path forward for state-level attempts to encourage clean vehicle technologies and reduce CO_2 emissions. This appendix contains a literature review of "feebate" theory and practice, reviewing the rationale, structure, and impacts of feebate programs, and their relationship to vehicle incentive programs.

A.1   What is a Feebate?

A feebate is a market-based policy approach that combines two key elements to lower emissions and encourage uptake of cleaner technology vehicles. These two policy elements are:

- Fees assessed on the purchase of new vehicles with high CO_2 emissions (low fuel economy).

- Money collected from fees used to subsidize rebates for vehicles with low CO_2 emissions or cars with specific clean vehicle technologies.

A.2   Advantages of Feebates

Literature on feebate programs suggests they have the following advantages:

- Feebates can be designed to be revenue neutral, with the fees charged on fuel inefficient vehicles used to defray the cost of providing rebates for cleaner vehicles. Rebates for clean technology vehicles (like PEVs) are costly; the fee element of the feebate provides a dedicated revenue stream for rebates in perpetuity.

- Feebates are based on the polluter-pays principle, the idea that actors responsible for pollution should bear the costs of mitigating the damage done to the natural environment. Feebate programs can correct a social externality (the undervaluation of fuel efficiency) without imposing any net tax. All consumers have the ability to avoid fees by shifting their choice in new vehicles.

- Low and zero-emission vehicles (ZEV) enjoy low operating and maintenance expenses, but their high upfront costs can serve as a deterrent to ownership. A feebate program can help ease the upfront cost burden of buying cleaner vehicles and make the value of owning a more efficient vehicle more transparent to consumers.

- When implemented at the point-of-sale, feebate programs incorporate fuel efficiency into the consumer's vehicle purchase decision-making process in a way that command-and-control approaches like CAFE standards do not.

- Market-based policies like feebates offer an opportunity to affect consumer-driven shifts, in contrast to policies such as fuel efficiency standards (like CAFE) to which auto manufacturers will respond largely with improved technology. The consumer incentive approach provides another lever available to States, which have limited autonomy to set fleetwide standards, to influence fuel economy within the existing array of vehicle choices on the market.

A.3   Feebate Challenges

Literature also identifies the following challenges:

- The degree of reduction of fuel consumption and emissions that can be achieved from feebate policies is still uncertain and is highly dependent on the specific design of the policy.

- While the feebate is easier to implement than other environmental regulations like fuel efficiency standards, determining the optimal fuel economy or GHG emissions level to switch from rebates to fees (the "pivot point"), and deciding on a standardized metric for measuring emissions, still loom large as critical implementation challenges. An initial pivot point value must be set based on the distribution of fuel economy within the targeted vehicle fleet, which requires access to new sales or registration data.

- As efficiency of vehicles improves (the policy's intended consequence), the revenues collected from fees should decline. Therefore, the pivot point must be reset periodically to reflect new market conditions.

- Political difficulties make implementation of a true, continuous feebate policy challenging. So far, no jurisdiction has actually imposed a fully continuous regime of both fees and rebates.

- Feebates can also have the perverse effect of inducing more vehicle travel by making cleaner vehicles, with better mileage, more attractive to consumers. Savings on fuel could allow consumers to take longer trips than they would have with less economic vehicle models.

- Feebate policies only apply to newly purchased vehicles. The vast majority of the fleet would not be impacted by a feebate policy for a number of years. A 2019 study of the impact of Trump administration CAFE standard rollbacks estimated that it takes nearly 20 years for the new technology to account for 90 percent of the on-road fleet (Keith, 2019).

A.4   Feebate Design and Structure

A number of program design and structure options must be considered, as described below.

Point of application. Fees and rebates can be imposed either at the consumer or manufacturer level, but the vast majority of programs have been targeted towards customers, in an attempt to move consumer preferences. However, implementation at the consumer level can add to administrative costs, especially in terms of managing rebate applications. While some programs have applied the rebate at the time of purchase, others have required owners to send applications to a governmental agency in order to receive rebates. No matter the exact mechanism used for a consumer-based feebate system, the administrative costs would likely be high, as fees and rebates need to be exchanged on an individual level for thousands of distinct customers at different times.

Application at the manufacturer level would result in fewer transactions, and the fee or rebate would still be present as a line item in the purchase price. Instead of collecting the fee or awarding the rebate to a consumer, the manufacturer could pay the fees and collect the rebates for each vehicle sold on a periodic base (perhaps annually), greatly simplifying the administrative process. However, it would likely dull the consumer response, as the incentive to buy a cleaner vehicle would be more subtle. In some systems, like Denmark's feebate program, all of the costs are handled at the dealership level. While creating a program that handles all transactions at the manufacturer or dealer level is more straightforward administratively, doing so renders the feebate less visible to customers, therefore likely dampening any demand effects.

Timing. Another important element to consider is the timing of the implementation of the feebate. Announcing the implementation of a feebate with significant prior notice given to manufacturers and consumers allows time for manufacturers to adapt to the new system. However, a waiting period before implementation could lead to a run on fuel inefficient vehicles in the lead up and could also cause prospective buyers of efficient vehicles to wait to make their purchase.

Price structure. The most straightforward price structure is to set the fee/rebate in proportion to the amount of fuel consumed by a vehicle or in proportion to its GHG emissions. Different metrics have been used by each governmental entity that has imposed a feebate scheme. In the United States, most proposals have suggested using MPG, the standard American fuel economy measure. However, the International Council on Clean Transportation (ICCT) claims that using MPG or other fuel economy measures as a benchmark hinders the effectiveness of the feebate program because it is not a linear representation of fuel consumption. Incremental fuel consumption decreases as fuel economy increases, so that the amount of fuel saved decreases for each successive one-MPG differential in fuel economy. In effect, a feebate program based on fuel economy would assign progressively more value to decreasingly effective fuel saving technologies. Thus, proper selection of the vehicle performance parameter is a critical element of an effective feebate program design.

Ontario's "Tax and Credit for Fuel Conservation" program utilized a benchmark metric of liters per 100 kilometers, a measure of fuel efficiency rather than fuel economy. The French program uses a measure of CO_2 emissions, "grams/km," which can be calculated from a fuel efficiency/consumption rating, a measure that also is used in the fees imposed by other European countries like Germany and Ireland (ICCT, 2010).

Consideration of alternative fuel and electric vehicles. One of the features of feebate programs is that they are agnostic to specific technologies, rewarding any technologies that deliver more fuel efficient or lower emission vehicles, depending slightly on the specific standard measure used. None of the handful of feebate programs that have been adopted around the world have been explicitly geared towards electric or other alternative fuel vehicles, although increasing the absorption of EVs in their fleet has certainly been a goal of many of these projects. Similarly, there is scant material in the academic literature about how to specifically promote electrification through a feebate. However, it may be possible to structure a feebate program in such a way to encourage adoption of specific technologies, like electric vehicles. For example, the usage of a GHG emissions-based standard, rather than a mileage-based standard, could serve to favor electric or other clean-fuel vehicles in the rebate portion of the feebate. Additionally, a feebate program could be structured to award the most significant rebates to vehicles with extremely high MPG ratings (or an equivalent metric). There are a number of possible ways of including EVs in the feebate system:

- Use the published DOE/EPA MPG equivalent or MPG(e) ratings. This places EVs within the feebate system without explicit special treatment; however, it does provide EVs an advantage as compared with using life-cycle GHG emissions, since the MPG(e) only considers electricity used "at the plug" and not

electricity generating and transmission losses. Most EVs currently for sale have an MPG(e) rating of over 100, or 3 to 4 times as high as a conventional vehicle, but typically have life-cycle GHG emissions on the order of at least half of a gasoline powered vehicle (depending on the local generating mix).

- Use the published DOE/EPA GHG rating—a numerical rating on a scale of 1 (worst) to 10 (best) comparing with other vehicles of the same model year.

- Use the EPA estimate of tailpipe CO_2 emissions (which will be zero for EVs).

- Use a calculated estimate of actual life-cycle GHG emissions. If this is done, decisions need to be made regarding the source of factors to use for different types of fuel, and whether current year or some average future-year emission rates are assumed for electricity generation (which may change over time).

With respect to the treatment of other alternative fuel vehicles, such as natural gas, ethanol (E85), or hydrogen, choice of the metric based on MPG, tailpipe CO_2, or life-cycle CO_2 may tilt the incentives in somewhat different ways for different types of fuels.

Pivot point. Feebate policies generally require a "pivot point," a benchmark where the policy changes from assessing fees to awarding rebates on new vehicle purchases. Options for pivot points include:

- A single pivot point (applies to all vehicles that are covered).

- Double pivot points (one for passenger vehicles, one for light-duty trucks).

- A footprint-based pivot point. Footprint-based benchmarks are assigned based on the vehicle's footprint (wheelbase times track width), which could result in many different benchmarks.

The single pivot point is both the most computationally simple benchmark while also resulting in the largest efficiency improvements. However, using a single pivot point can be politically unpopular, especially among users who claim that they need larger cars out of economic or social necessity. Using a two-pivot point system can potentially make the program somewhat more politically palatable without adding too much operational complexity.

Functional form. Feebate schemes can either be "continuous," where fees and rebates are assessed at different rates for each vehicle based on its exact CO_2 emissions, or "stepwise," where vehicles are sorted into buckets based on an emission range, and all vehicles in each range are fined/rebated at the same rate. Step function programs have been touted as easier for consumers to understand, but a key drawback is the creation of seemingly arbitrary fee/rebate distinctions between two vehicles that are nearly identical in terms of carbon emissions or fuel consumption. According to the ICCT, a stepwise program is "less effective than a continuous feebate as there is no incentive to improve the performance of vehicles that are not close to the next step."

Many stepwise programs have focused rebates on the highest-performing vehicles and fees on the lowest-performing vehicles, thus exempting the majority of vehicles, which lie in the middle of the spectrum, also referred to as a "donut hole." For example, the 2017 California proposal proposed rebates for the 15 percent cleanest new vehicles and fees for the 15 percent highest emitting new vehicles.

Additionally, many programs have different fee and rebate schedules for different classifications of vehicles. For example, the province of Ontario's feebate program distinguishes between "passenger cars" and "SUVs," establishing different rate schedules for each category, while exempting passenger vans.

A.5   Feebate and Incentive Program Precedents

Vermont

A bill containing a feebate provision passed the Transportation committee of Vermont's legislature in 1999, but was not passed by the full legislature. In 2005, another bill, H-444 was proposed in front of the House transportation committee. H-444 proposed a gas guzzler tax of $500 on all vehicles under 10,000 lbs. that achieve under 21 MPG in city conditions. In addition, consumers who purchased vehicles that achieve over 35 MPG would receive rebates up to $5,000. The bill proposed to finance rebates 95 percent with fee revenues (Langer, 2005).

In 2017, Richard Faesy from the Vermont-based Energy Futures Group proposed a generalized feebate program for the State at the Vermont Energy and Climate Summit, hosted by the Energy Action Network. The proposal called for implementing a feebate not just on motor vehicles, but also on buildings and heating appliance purchases. Faesy argued that implementing a self-financing, revenue-neutral system could "discourage harmful choices while providing funds for beneficial choices," and speculated that a feebate on vehicles could be applied by reducing registration fees or sales tax on electric or highly efficient vehicles.

Vermont utilities also have begun offering incentives for EVs and charging equipment, including incentives for purchasing or leasing new EVs, offering free or discounted residential chargers, and incentives for workplace charging stations for employers. These incentives are offered under Tier III of the State's Renewable Energy Standard (RES) program, which is intended to encourage the State's utilities to undertake initiatives to reduce fossil fuel consumption. Under Tier III, however, projects are required to be cost effective, which limits the scope of these incentives (Vermont Public Utility Commission, 2019).

Vermont's Public Utility Commission published a report in June 2019 on opportunities for promoting EV usage. The report recommends that, in addition to providing Tier III incentives, the State of Vermont take on a larger role in providing incentives for purchasers of EVs. H.529, the Transportation Program authorizing legislation passed the same month, already instituted an EV incentive program where low- and moderate-income Vermont households are provided incentives for EV purchases of $40,000 or less. Additionally, the report urges consideration of a sales tax waiver on purchase of new EVs or a waiver which allows dealerships to retain a certain percentage of the forgone sales tax. Splitting the sales tax windfall between the consumer and dealer could address the problem of under enthusiasm among dealers in promoting EV sales.

In July 2017, Governor Scott issued Executive Order No. 12–17 to create the Vermont Climate Action Commission (VCAC), directing the commission to "draft and recommend, for the Governor's consideration, an action plan aimed at reaching the State's renewable energy and greenhouse gas reduction goals while driving economic growth, setting Vermonters on a path to affordability, and ensuring effective energy transition options exist for all Vermonters." After releasing preliminary recommendations in December 2017, the VCAC issued its final Resources for the Future recommendation report to the governor in July 2018, which detailed 50 policy recommendations over five policy areas, including "Getting Around." Specific recommendations included appropriating Volkswagen settlement funds to provide a State-funded or facilitated incentive for the purchase of new or used EVs.

Earlier this year, Resources for the Future (RFF) published "An Analysis of Decarbonization Methods in Vermont," which estimated quantitative emissions reduction estimates from the non-pricing policies in the VCAC report, including a statewide electric vehicle purchase program. In its analysis, RFF found that plug-in vehicles account for less than one percent of all new vehicle sales in Vermont. Specifically, the report modeled the impact of statewide EV incentives of $1,000, $3,000, and $5,000 that would be offered in addition to the Federal Government's tax credit. Their model found that a $1,000 rebate resulted in a 10 percent increase in sales, while a $3,000 rebate increased EV sales by 38 percent, and a $5,000 rebate by 78 percent. Higher subsidies make EVs more attractive to a larger share of the market, which explains the disproportionate growth in sales as the rebate increases.

A study by MJ Bradley & Associates entitled, "Decarbonizing Transport in Vermont," prepared in conjunction with the Regulatory Assistance Program, modeled three strategies that could be used to achieve "80 by 50," reducing GHG emission to 80 percent of 1990 levels by 2050, by achieving 1) increased fuel efficiency of new gasoline and diesel vehicles; (2) widespread vehicle electrification; and (3) decarbonization of traditional liquid transportation fuels. Their modeling shows that the combination of these policies would reduce on-road transportation sector emissions in Vermont by 44 percent below 1990 levels in 2030 and 93 percent below 1990 levels in 2050. Of the 3 policy strategies, light-duty electrification was the most significant contributor to emissions (29 percent), while increased overall light-duty vehicle efficiency accounts for 21 percent of emissions reductions. The authors estimate that a $0.02-per-gallon fee on gasoline and fuel used in Vermont would provide sufficient revenue to cover the costs of public investments required to put Vermont "on a path toward significant electrification of the light-duty fleet," and speculate that the revenue generated from a per-gallon fee could be invested in EV purchase incentives, alongside charging infrastructure rebates and grants. The study estimates that the revenue required to fund public investments necessary to incentivize high levels of transportation electrification could range from $70 million (light-duty vehicles only) to $560 million (light-, medium-, and heavy-duty vehicles) through 2030. While the study does not include details about the structure of potential EV incentive programs, it suggests cash rebates (point of sale or after purchase/lease of new vehicles), dealership-level EV incentives, tax credits for EV purchases, excise tax credits, and low-interest car loans based on income levels as potential ways that Vermont can incentivized increased electrification of passenger vehicles.

Neighboring States

While many of the State's utilities offer credits for electric vehicles, until the passage of Sec. 34, Vermont lacked a government-backed EV credit. Two of Vermont's neighbors, New York and Massachusetts, already have implemented universal EV credits. New York's Drive Clean Rebate for Plug-in Electric Cars, implemented by the New York State Energy Research and Development Authority (NYSERDA), awards rebates up to $2,000, with rebates varying based on the vehicle's battery-only range. While battery-only range is an important metric for the utility of electric vehicles, it does not always align with fuel efficiency measures. For example, under the NYSERDA Drive Clean program, a BMW i3 REx with an MPG(e) of 100 is awarded a higher rebate than a Volkswagen e-Golf (116 MPG(e)). Additionally, the NYSERDA caps rebates on more expensive vehicles (MSRP > $60,000) at $500. Therefore, although Tesla vehicles have the longest all-electric range of any EVs currently on the market, all Tesla models receive the lowest level of rebate due to their high price (Loveday, 2017).

Massachusetts launched its Massachusetts Offers Rebates for Electric Vehicles (MOR-EV) program in 2014 with the goal of getting 300,000 EVs on the State's roads by 2025. Initially, the program offered rebates of $2,500 on all electric vehicle and plug-in hybrid purchases or leases. However, since its inception, the program struggled to retain sufficient funding, and required frequent infusions of new money from the State's

legislature, mostly drawn from Regional Greenhouse Gas Initiative proceeds. With funds running low again in December 2018, the legislature lowered rebate levels to $1,500 and removed hybrids from the program. As a result, participation dropped sharply, from 1,500 rebate applications in December to just 248 in June 2019. In June, the State declared that the program would be extended through September, but would lapse permanently thereafter. Members of the State's Zero-Emission Vehicle Commission claimed that a boom in program usage during 2018 combined with the lack of a dedicated funding source made the program difficult to continue. (LeMoult, 2019). However, a new climate bill passed by the State's House of Representatives in August would revive the MOR-EV program, increasing rebates to between $2,5000 and $5,000 for vehicles priced under $40,000 MSRP (Shmekus, 2019). Between June 2014 and August 2019, the program has issued nearly 15,000 rebates worth a grand total of $30.5 million, with an estimated 37,000 metric tons of GHG emissions saved (MOR-EV, 2019).

California and Maryland

State legislatures in California and Maryland both passed feebate programs into law in the early 1990s. In California the legislation was vetoed by the Government, while in Maryland the legislation was signed, but never implemented (Langer, 2005).

The scoping plan of the California Global Warming Solutions Act of 2006 (AB 32) explicitly called for the evaluation of a feebate policy to complement the State's GHG standards. A study from University of California researchers in 2010 estimated that even a modest feebate program (average fees of $700 and average rebates of $600) would yield a 3 percent improvement in CO_2 emission compared to a no-feebate scenario (Bunch et al., 2010).

The University of California's Institute of Transportation Studies released a report in 2017 proposing a new feebate policy for California, in which the top 15 percent and bottom 15 percent of new vehicles in terms of fuel efficiency would be assessed rebates and fees, respectively. The 5th and 95th percentile of vehicles would be assessed a fee and rebate of $2500 respectively, while the 15th and 85th percentile would be assessed a fee and rebate of $500 (Jenn and Sperling, 2017).

Ontario

Ontario introduced North America's first feebate program in 1991. The Tax for Fuel Conservation (TFC) provided a rebate of CAD $100 for passenger cars with fuel consumption of less than 6.0 liters per 100 kilometers (/100km), and an increasing tax for vehicles with fuel consumption above 6.0 liters/100km. The province eliminated the program in 2010 during a wave of tax reform instituted by a new Conservative provincial Government.

Critics charge that the program is much more like a gas guzzler tax than a true feebate, as 90 percent of vehicles are subject to a $75 tax. Given the low fees charged and rebates rewarded, there is likely little impact on consumer behavior (Antweiler and Gulati, 2013).

A 2017 study from the University of Ottawa found that between 2000 and 2010, the TFC program had a welfare-enhancing effect, but actually increased lifetime CO_2 emissions by approximately 0.2 million tons per vehicle class (passenger vehicles and SUVs). By 2010, the program had made $21 million CAD in revenue for the Ontario Government, which suggests that insufficient rebates were issued through the program to encourage clean vehicle adoption. The study estimates that an optimally designed, truly revenue-neutral policy would have reduced emissions by 2.5 million tons compared to a no-feebate scenario (Rivers, 2017).

Canadian Federal Feebate

In March 2007, the Canadian Government announced the Vehicle Efficiency Incentive (VEI) program, which contained an "ecoAuto" rebate for up to $2,000 CAD for purchases of fuel-efficient vehicles and a "Green Levy" on inefficient vehicles of up to $4,000 CAD. Much like the Ontarian provincial program, the majority of the Nation's new vehicles fell in the "donut hole" and were not eligible for either the ecoAuto or the Green Levy. ecoAuto is no longer in effect, but the Green Levy program remains active (Antweiler and Gulati, 2017).

Under the ecoAuto rebate, passenger cars with fuel consumption ratings better than 6.5 liters per 100 kilometers (l/100km), or 36.2 MPG, and light-duty trucks better than 8.3 l/100km, were eligible for rebates up to $1,000 plus an additional $500 for every additional 0.5 l/100km below the benchmark. The Green Levy imposed a tax of $1,000 CAD for passenger vehicles (cars, minivans, SUVs) with fuel consumption ratings of 13.0 l/100 km (18.1 MPG) and above, increasing by $1,000 CAD for each liter per 100 km above 14 l/100 km to a maximum of $4,000 CAD (ICCT, 2010).

The ecoAuto and Green Levy programs were administered separately, with Transport Canada assuming responsibility for processing rebate forms, which were available online for consumers who purchased eligible vehicles. After processing applications, Transport Canada mailed rebate checks to qualified applicants. The Green Levy was a Finance Ministry program, and took the form of an excise tax on dealers, and was not necessarily publicized to consumers (Bunch et al., 2010).

While the Green Levy tax is still operational, the VEI program did not meet its goal of creating a revenue-neutral feebate system to shift consumer preferences towards greener vehicles. The program was hindered by a large donut hole and its fragmented implementation by different agencies. Contrary to expectations, manufacturers were more resistant to the rebate part of the policy, as they felt the thresholds were arbitrary and they had not been sufficiently consulted by the Canadian Government prior to implementation (Bunch et al., 2010).

U.S. Gas Guzzler Tax

While not a true feebate, the Federal Government's Gas Guzzler Tax is equivalent to the "fee" half of a feebate program. In effect since 1980, all passenger cars that achieve a CAFE MPG below 22.5 are subject to the fee. The fee steps down depending on the deviation from the 22.5 MPG standard. Compared both the Ontario and French feebate programs, the U.S. Gas Guzzler Tax sends a relatively strong price signal. However, the Gas Guzzler Tax covers only a small proportion of the overall U.S. fleet. Light trucks are completely exempted from the tax, thus reducing the efficacy of the policy (ICCT, 2010).

France

France introduced the "bonus/malus" feebate program in 2008, making it one of the only countries to implement a fee and rebate system in conjunction (ICCT, 2010). In 2010, the ICCT claimed that the French feebate program is arguably the closest of any existing program to the idealized design features of an optimal feebate program. France's system is stepwise, but uses a high number of different gradations between the CO_2 g/km equivalents of 21 MPG and 96 MPG (the outer bands of the program), and enjoys complete coverage of the new automobile market in the country. The shape of France's feebate function can be seen in Figure A.1 (ICCT, 2010).

Figure A.1   French Feebate Program
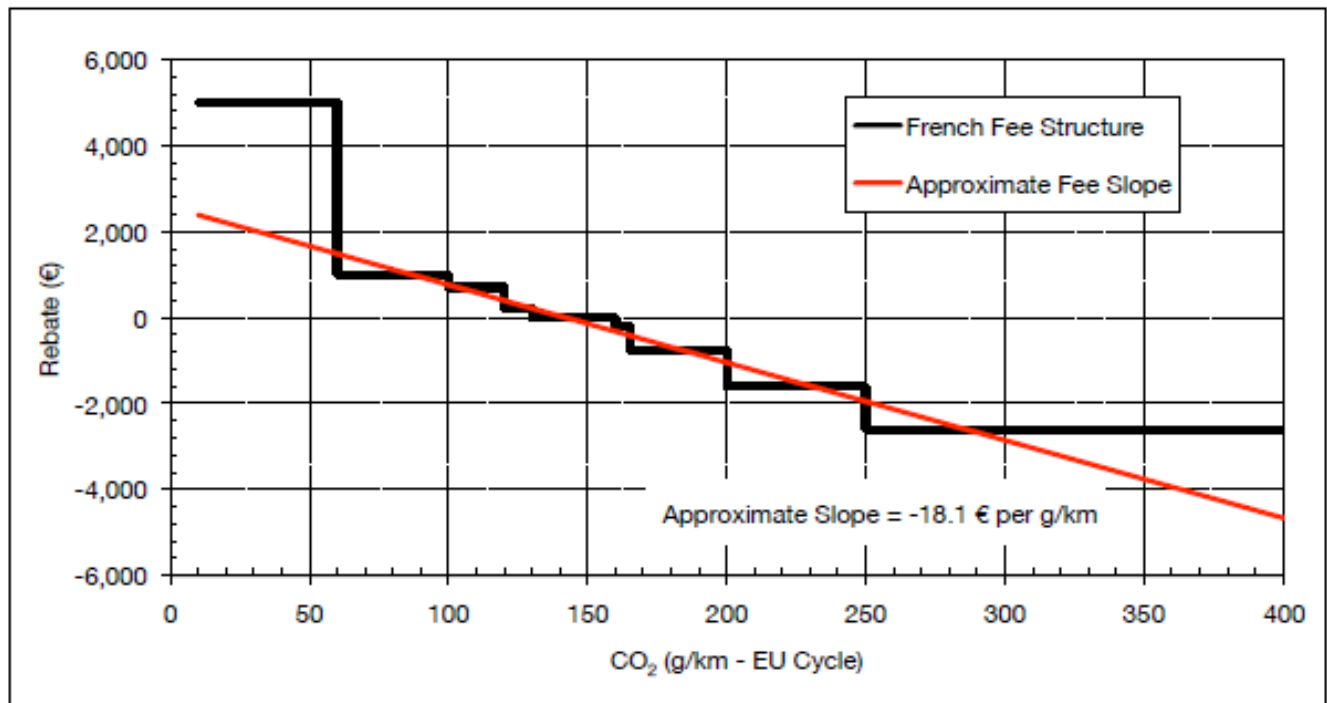
Source: ICCT, 2010.

After implementation of the feebate system in 2008, average fleet CO_2 emissions of the new vehicle fleet in France dropped by 6 percent in one year. Between 2008 and 2016, the average CO2 emissions from passenger cars in the French fleet declined from 150 g/km to approximately 110 g/km. Between 2012 and 2017, the market share for plug-in hybrid and electric vehicles in France increased from slightly above 0 percent to nearly 2 percent (ICCT, 2019). However, many of the same trends in average emissions and fleet mix have been present in other EU nations, not all of which have been as active in implanting incentives and disincentives based on vehicle emissions. Heightened CO_2 standards in the EU are another factor that has likely caused improvement in France's fleet mix.

Since its implementation a decade ago, the French Government has been continually modifying the system as the new vehicle market has shifted. As buyers increasingly preferred cleaner vehicles, the Government shifted the pivot point on an annual basis to catch up with demand. Reacting to auto manufacturers gaming the step system by manufacturing cars that conformed to the lowest emission standard of each step, the French Government has modified the system by creating more steps and reducing the size of each step, bringing the scheme closer to the idealized linear feebate form (Yang, 2018).

Denmark

In June 2007, the Danish Government instituted a feebate program with a benchmark set at 150 g CO_2/km; however, it is expressed to the public in terms of fuel economy and therefore differs by fuel type. This benchmark translates to 16 km/liter (36 MPG) for gasoline and 18 km/liter (41 MPG) for diesel. Vehicles that exceed these thresholds receive a rebate of 4000 DKK ($750) per km/l above the threshold and vehicles below the threshold pay 1000 DKK (U.S. $200) per km/l shortage. The rebate rate is equivalent to $320 per MPG and the tax rate is equivalent to $85 per MPG.

The slope of the Danish feebate becomes increasingly steep as fuel consumption decreases, and more lenient as fuel consumption increases, which heavily incentivizes only small improvements in fuel consumption, and does not strongly encourage manufacturers to reduce fuel consumption of high-emitting vehicles.

In the Danish system, all costs and rebates are handled at the dealership level, and the price shown at the dealership is the net of all applicable taxes and rebates payable at the time of registration, which renders the program less visible to consumers. According to a UC Davis analysis, the Danish program has nonetheless successfully reduced average of CO_2 emission of the new vehicle fleet. Between 2007 and 2008, average fuel economy of the Danish fleet improved from approximately 38 MPG to 43 MPG.

A.6   Equity Impacts

The 2010 University of California Study found that higher income households purchase the vast majority of new vehicles in California, and thus would be disproportionately impacted by both new vehicle fees and rebates. Their model also found that the average feebate for the lowest income households (under $10,000 annually) would either be zero or positive, as low-income households are more likely to buy small, inexpensive vehicles. Finally, their model tested consumer surplus under a proposed feebate policy and found that on average consumer surplus increases as annual household income decreases (Bunch, 2010).

A 2018 analysis of the French feebate program found that depending on the exact structure of the tax component of the program (the French program has not been truly revenue-neutral), either the middle class benefits the most from the program or the program is fully progressive, with the very rich experiencing the greatest welfare loss no matter the structure (Durrmeyer, 2018).

A.7   Real and Theoretical Impacts

While there have been only limited examples of successful feebate programs to date, there has been significant academic research into the predicted impacts of such program, especially using econometric modeling. These analyses typically examine supplier (manufacturer) and consumer responses separately.

Early attempts at modeling feebate policy impacts from Oxford University focused on understanding how different levels of feebates would impact the fuel economy of the fleet. Michaelis (1996) used a single pivot point of 9 liters/100km, and tested the impacts of equivalent fees and rebates at levels of $250, $500, $1,000, and $2,000 (in 1996 USD), and found a proportionate relationship between feebate level and new vehicle fleet fuel economy, as shown in Table A.1.

Table A.1   Impact of Different Feebate Levels

Feebate Level Per Liter/100 kms	New Vehicle Fuel Economy Increase
$250	10%
$500	14%
$1000	20%
$2000	28%

Source: Michaelis, 1996.

An important note about older studies is that market-based mechanisms may have different results in the context of today's technologies and fuel economy standards. For example, the increasingly stringent Federal standards are requiring manufacturers to introduce the lower-cost fuel savings technologies, meaning that incremental improvements will be progressively more expensive, and a given incentive level may have less impact in the future than it did two or three decades ago.

Oak Ridge National Laboratory (ORNL) conducted a landmark study of feebates in 2005, examining both manufacturer and consumer responses to a variety of feebate policies. In terms of manufacturer response, the study found that short-term effects would be limited as manufacturers need time to adjust their technologies. Using a discrete choice model, the ORNL study estimated consumer response based on purchase price and fuel economy of new vehicles. Their analysis shows that a feebate of $500 per 0.01 gallon per mile would reduce new vehicle consumption by 14 percent relative to a no-feebate scenario and a reduction of 22 percent would be achieved with a feebate value of $1,000 (Greene et al. 2005). These results are based upon the supposition that most consumers only consider the first 3 years of fuel costs when purchasing a vehicle. Feebates can help correct this market failure, although a rate of $2000 per 0.01 gallon per mile is needed to cause consumers to make the same decision they would make if they fully valued fuel costs throughout the vehicle's life. The ORNL study concluded that manufacturer improvements would be the dominant cause of fuel economy improvements over the long term. The ORNL study built off an earlier study from the Lawrence Berkeley National Lab (LBNL) that focused more on short-term consumer impacts, using household characteristics. The LBNL study estimated that a higher proportion of feebate impacts (10 percent) would be caused by vehicle choice compared to the ORNL study, but both studies show a marginal role for vehicle shifts in improving fuel economy compared to shifting manufacturer technologies (Langer, 2005).

The ORNL and LBNL studies do not address subnational feebate schemes, but a 2005 American Council for an Energy-Efficient Economy (ACEEE) study attempted to adapt these analyses for regional submarkets. Their analysis indicates that the manufacturer response in a small state would be negligible, but consumer response could be even more robust (Langer, 2005). If a feebate program was applied only to a state like Vermont in isolation, manufacturers would likely not respond significantly by providing new vehicle technologies. As a result, Vermont vehicle consumers might be more likely to buy more fuel-efficient vehicles that already are on the market.

Both the ORNL study and a 2011 University of California at Irvine report found that changes in the vehicle mix induce only a small proportion of the change in average fuel efficiency from a feebate program (roughly four percent), therefore making a class-based feebate system more attractive due to political administrative advantages (Small, 2011). The report also concluded that comparing California's Pavley CAFE standards adopted for 2017 to 2020 with an aggressive feebate policy (starting at $2,000 per 0.01 gallons per mile), the results in terms of fuel efficiency are similar, but the feebate policy achieves more of its efficiency gains through higher use of hybrid and diesel vehicles. This study also notes that vehicle-miles traveled (VMT) would likely increase after feebate implementation due to a rebound effect, where consumers drive more as fuel costs are lowered due to less pressure on world fuel resources. While both CAFE standards and feebates have this effect, the feebate rebound effect has a slightly higher magnitude.

In a 2013 National Energy Policy Institute (NEPI), Yale's Kenneth Gillingham uses the NEMS-NEPI model to demonstrate how feebates policies can be structured to be equivalent to CAFE standards in terms of fuel economy. Despite these equivalencies, Gillingham concludes that feebates have significant advantages over command-and-control policies like CAFE, because they can complement state-level subsidy policies, and provide a continual incentive for manufacturers to improve fuel economy.

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