

FINAL REPORT

**VERMONT ROAD USAGE
CHARGE STUDY**

Prepared by CDM Smith

for

Vermont Agency of Transportation

March 14, 2022



Table of Contents

EXECUTIVE SUMMARY.....	1
PART ONE INTRODUCTORY MATERIALS.....	5
PART TWO ROAD USAGE CHARGE ADVISORY COMMITTEE.....	13
PART THREE MILEAGE-BASED USER FEE AND ANNUAL FLAT FEE.....	24
PART FOUR PER-KILOWATT HOUR FEE.....	47
CONCLUSION.....	64

List of Figures

Figure 1. What type of vehicle is your first household vehicle? 20

Figure 2. Why did you purchase an electric vehicle?..... 21

Figure 3. What are your main concerns about purchasing or leasing a fully electric vehicle? 21

Figure 4. The States with Annual Flat Fees 35

Figure 5. Annual Flat Fee of \$117, Set at 50th Percentile of Driving 37

Figure 6. Annual Flat Fee of \$260, Set at 90th Percentile of Driving 38

Figure 7. Capital Cost Recovery Comparison for Odometer Only versus Automated Methods 42

Figure 8. Average Vehicle Miles Traveled of All Household Personal Vehicles by Household
Income, US Households (N = 123,447) 43

List of Tables

Table 1. 2016 Survey of Work Commute Distance and Weekday Driving in Vermont 11

Table 2. Membership of the 2021 Road Usage Charge Advisory Committee..... 14

Table 3. Do you agree or disagree fees based on miles traveled are fair?..... 22

Table 4. How fair are annual flat fees?..... 22

Table 5. What is your initial reaction to introducing road usage charges on fully electric, plug-
in hybrid electric, or other highly fuel-efficient vehicles?..... 23

Table 6. EV Purchase Likelihood with Road Usage Fees 23

Table 7. MBUF System Cost Estimates..... 41

Table 8. Characteristics of Vermont’s Most Used Public Charging Networks 51

Table 9. Per-kWh Fee Revenue Estimation for 2021..... 61

Table 10. Summary Revenue Table..... 69

Appendices

- Appendix A Road Usage Charge System Financial Analysis
- Appendix B Road Usage Charge Stakeholder Outreach Summary

EXECUTIVE SUMMARY

In alignment with its climate change goals, the State of Vermont has implemented policies and programs to reduce emissions from the transportation sector over the past decade, many of which incentivize the purchase of all-electric vehicles (AEVs) and plug-in hybrid electric vehicle (PHEVs). The state's transportation system depends upon significant fuel-tax revenues. However, as Vermont experiences increasing success in electrifying transportation, it has become clear to Vermont's Agency of Transportation (AOT) that alternative funding strategies need be explored to offset the lost fuel tax revenues.

Though at present minimal—a revenue loss of \$300,000 per year relative to total state transportation fund revenues of \$283 million in state fiscal year 2021—industry experts expect the impact will grow to unsustainable levels once AEVs and PHEVs come into competitive parity with internal combustion engine vehicles (ICEVs) later this decade. This would grow the electric vehicle (EV) fleet substantially in a short time. The Vermont Climate Council approved a Climate Action Plan (CAP) in December 2021 that is based on significant increases in registered EVs. To meet the greenhouse gas reduction goals established in the 2020 Global Warming Solutions Act, the CAP depends on the number of Vermont-registered EVs to increase from approximately 4,300 in 2020 to 47,500 in 2025 and 172,000 in 2030. The CAP assumes 658,000 EVs in 2050, which is almost all Vermont-registered vehicles. If the CAP targets are achieved, the resulting loss in fuel tax revenues will be \$5, \$19, and \$81 million in 2025, 2030, and 2050 respectively. Therefore, it has become necessary to identify an alternative revenue source to offset the decline in fuel tax revenues.

Various states have explored and experimented with alternative revenue mechanisms over the course of the past 20 years. Most of these mechanisms relate to each driver's responsibility for road usage under the user-pays philosophy; thus referred to as *road usage charges*.

Vermont's Road Usage Charge Analysis

This report evaluates the feasibility of adding an assortment of road usage charges paid by owners/drivers of AEVs and PHEVs who pay little or no fuel taxes. *Road usage charges* are assessments on a vehicle for usage of the road system.

To evaluate a road usage charge (RUC) concept made up of a mileage-based user fee (MBUF), an annual flat fee and a per-kilowatt hour fee (per-kWh fee), the AOT assembled the RUC Advisory Committee and interviewed stakeholders. The RUC Advisory Committee met three times in the second half of 2021. Subcommittees of the RUC focused on the MBUF and per-kWh fee.

Mileage-Based User Fee

A *mileage-based user fee* is a per-mile fee based on measurement of the actual distance traveled by a vehicle registered in Vermont and owned by a Vermont resident. The revenue-neutral MBUF rate for Vermont is estimated as 1.3 cents per mile. The formula for calculating a revenue-neutral MBUF rate is the state gas tax rate divided by the combined average miles per gallon (MPG) per light-duty vehicle in Vermont.¹

If the state does not offer a gas tax credit for PHEV usage, then the rate for PHEVs should be less than the rate for AEVs. Applying the US Department of Energy's estimated PHEV combined fuel efficiency rating of 37.9 MPG results in a PHEV per-mile rate of half a cent per mile (0.5 cents/mile). A state legislature may desire to update the PHEV MPG figure when setting the PHEV rate because of the rapidity of change in the EV market

The analyses determined that the State of Vermont has the advantage of already collecting the basic mileage data required to calculate the MBUF. Odometer readings are currently collected during annual vehicle safety inspections for all vehicles. The RUC Advisory Committee process described in this report revealed that the DMV could access this mileage data to impose a per-mile fee on EV drivers at low administrative cost. Since the state of Vermont already gathers this mileage data, no privacy issues emerge. Furthermore, without a privacy concern, there is no reason to offer an alternative payment option such as an annual flat fee or a different data reporting method.

The remaining policy question is whether to offer refunds of MBUFs paid for driving out of state. Refunds are expensive to manage and generally minimal in size. Also, other resident drivers currently pay the fuel tax on miles driven out of state. AOT and the RUC Advisory Committee does not recommend offering refunds for out-of-state travel.

Per-kilowatt Hour Fee

A *per kWh fee* is an assessment on use of the road system based on the amount of electricity charged into an EV. The per-kWh fee is being evaluated as a potential way to collect fees from out-of-state EV owners driving in Vermont. Conceptually, nonresidents who charge their EVs at public charging stations in Vermont would pay a per-kWh fee on top of the base charging rate.

Based on the RUC Advisory Committee investigation, the AOT concluded too little is known about how to technically implement a per-kWh fee and its cost implications to go forward at this time. The potential revenue generation for the foreseeable future is also insignificant. Given the limited knowledge on the maturity of the technology required to reliably capture information on electricity transferred to vehicles at public charging stations across the state, the project team recommended that AOT undertake a research program before proceeding with any formal action to implement a per-kWh fee.

Stakeholder Engagements

Across the stakeholders interviewed, there was a general understanding of the need for alternative revenue mechanisms to make up for the loss of fuel tax revenues because of the shift to EV usage.

¹ The calculation is $\$0.30/22.7 = \0.013 .

There was disagreement, however, on which revenue mechanisms to rely upon. Local governments supported the RUC concepts, while environmental groups preferred other alternatives owing to concern about deterring purchase of EVs. However, they note that if EV purchase prices decrease, this concern may disappear.

A targeted survey was conducted of people associated with stakeholder groups such as Drive Electric Vermont, Capstone Community Action, regional planning commissions, and environmental groups. It revealed that 60% of survey participants support establishing MBUFs for EVs. If a mileage-based fee is established, 72.3% preferred sharing access to an odometer reading during an annual vehicle inspection, even though they would pay for all miles traveled whether on or off Vermont public roads or outside Vermont. Establishment of a MBUF or a flat fee would not affect the willingness to purchase an EV for 84% of those surveyed.

Conclusion

The pathway forward for the Vermont Road Usage Charge Concept has become clearer. Vermont can feasibly implement a simple MBUF on AEVs and PHEVs by using odometer readings now captured at annual vehicle inspections. Exactly how Vermont will implement this system still requires additional research and development, but from a policy perspective, the vision for how Vermont can implement a MBUF is now clear. The Vermont Climate Action Plan includes a recommendation from a 2016 State of Vermont legislative study on EV registration fees that a road user fee for EVs should not go into effect until the number of registered EVs represents 15% of vehicle sales or approximately 18,835 new registered passenger vehicles.² This threshold was forecasted to be achieved by 2025. The actual timing is uncertain, but given that efforts to encourage EV adoption will be increasing to meet the Climate Action Plan goals, the AOT should move forward with designing and testing the odometer-based system now so that the system is in place when the threshold is met.

² Source: Sec. 15 Plug-in Hybrid and Electric Vehicle Registration Fees, December 2016, Vermont Agency of Transportation

This page intentionally left blank.

PART ONE

INTRODUCTORY MATERIALS

Introduction

Two developments over the past 2 decades have emerged that motivate the State of Vermont to pursue analysis of road usage charging as a funding alternative for the transportation system:

- All-electric vehicles (AEVs) have reached a point of market viability that will continue for many years until they become the dominant vehicle type. These vehicles do not rely upon liquid fuel and therefore the drivers do not pay a usage charge for traveling on Vermont roads.
- Various states have pursued defining and implementing an assortment of approaches to road usage charging funding methods that Vermont may find useful in solving its rising transportation funding problem.

In preparation for the analysis of road usage charging (RUC), the state's Agency of Transportation (AOT) has engaged in deep research of RUC's elements and potential. The results of this research have led to creation of a conceptualization of RUC specifically designed for the State of Vermont.

To evaluate Vermont's RUC concept for new user fees for electric vehicles (EVs) traveling on Vermont's highways, the AOT assembled the RUC Advisory Committee. This report (1) describes the process undertaken by the RUC Advisory Committee, including the information gathered and the analysis undertaken and (2) presents the results in four parts:

- Part One introduces the reader to the topic of road usage charges and the Vermont RUC concept. Part One tells the story of the motivation, the investigation, and the progress of newer user-pays concepts—mileage-based user fees (MBUFs), annual flat fee, and per-kilowatt hour fees (per-kWh fee)—for funding transportation systems in the United States.
- Part Two describes the RUC Advisory Committee process for analyzing Vermont's RUC concept, including stakeholder outreach and survey results.
- Part Three presents the MBUF concept and the annual flat-fee concept, including the design options, associated policy and system issues, and each option's financial and practical realities. This part presents a preferred way to collect the MBUF and an assessment approach for implementation.
- Part Four presents the per-kWh fee and the research program going forward.

The Context

In alignment with its climate change goals, over the past decade the State of Vermont has implemented policies and programs to reduce emissions from the transportation sector, many of which incentivize the purchase of AEVs and plug-in electric vehicle (PHEVs). The state's transportation system depends upon significant fuel-tax revenues. However, as Vermont experiences increasing success in electrifying transportation, it has become clear to Vermont's Agency of Transportation (AOT) that alternative funding strategies need be explored to offset the lost fuel tax revenues.

Though at present minimal—a revenue loss of \$300,000 per year relative to total state transportation fund revenues of \$283 million in state fiscal year 2021—industry experts expect the impact will grow to unsustainable levels once EVs come into competitive parity with internal combustion engine vehicles (ICEVs) later this decade. This would grow the EV fleet substantially in a short time.

The Vermont Climate Council approved a Climate Action Plan (CAP) in December 2021 that is based on significant increases in registered EVs. To meet the greenhouse gas reduction goals established in the 2020 Global Warming Solutions Act, the CAP depends on the number of Vermont-registered EVs to increase from approximately 4,300 in 2020 to 47,500 in 2025 and 172,000 in 2030. The CAP assumes 658,000 EVs in 2050, which is almost all Vermont-registered vehicles. If the CAP targets are achieved, the resulting loss in fuel tax revenues will be \$5, \$19, and \$81 million in 2025, 2030, and 2050 respectively. Therefore, it has become necessary to identify an alternative revenue source to offset the decline in fuel tax revenues.

Numerous states have explored and experimented with alternative revenue mechanisms over the past 20 years. Most of these mechanisms are based on each driver's responsibility to pay for road usage under the user-pays philosophy, referred to as *road usage charges*.

The most common types of road usage charges developed or implemented by the states are a flat-fee equivalent to an estimation of the annual fuel taxes paid by ICEVs and a flat rate based on actual miles driven (MBUF). Having conducted pilot programs or implementation of operational programs, many states have deemed the flat fee and the MBUF as technically feasible.

Recently, two state legislatures enacted a per-kWh fee, but the states have yet to implement it. In 2020, the Vermont Public Utility Commission found that a widely applied per-kWh fee had significant obstacles. A per-kWh fee applied only to nonresident drivers of EVs appears to have technical feasibility, while a per-kWh fee applied to home charging is infeasible because metering wall-socket charging is impracticable.³ The remaining question is whether implementation of such a fee on nonresident EV drivers has practicality.

To examine road usage charging for applicability to Vermont, the AOT created the RUC Advisory Committee. The RUC Advisory Committee undertook a formal process for evaluation of a RUC concept that was proposed by the AOT for replacing or augmenting fuel taxes not paid for EV use in the state.

Why Road Usage Charging for Funding Transportation

Throughout the 20th century, the fuel excise tax provided the primary means of funding the maintenance and modernization of the nation's roadway system. Across the country, state legislatures periodically increased fuel taxes to (1) expand the roadway system and (2) fund walking and biking infrastructure and transit service to accommodate population growth and prevent the erosion of revenues from the effects of inflation.

³ Source: Memorandum on Per Kilowatt Hour Fees System Definition to Vermont Agency of Transportation from CDM Smith dated September 27, 2021.

Based on the *user-pays principle*, the legislatures' choice of the excise fuel tax for road funding was an attempt to make the roadway users responsible for roadway upkeep. This strategy worked well for nearly one hundred years.

In the early 21st century, another erosion factor emerged: the entry into the marketplace of highly fuel-efficient vehicles that operated using little or no fuel. This new erosion factor could only be allayed by fuel tax increases for a temporary period before the inequity of putting the entire burden of roadway funding needs onto only conventional vehicles would face strong resistance. To solve this erosion problem, the states would have to create a new method of funding roadways that did not rely upon the purchase of fuel.

The fuel efficiency erosion factor in particular has undermined the user-pays nature of the fuel excise tax nationally. The amount of fuel taxes the users paid varied widely depending upon the fuel efficiency of the vehicle. Drivers of fuel-inefficient vehicles tend to pay four or five times the amount of fuel tax per mile as the drivers of fuel-efficient vehicles. Indeed, drivers of AEVs paid no fuel tax at all, although they do pay other fees that contribute to the State's transportation fund, such as license and registration costs and vehicle purchase and sales taxes.

In an attempt to stabilize revenues, state legislatures explored potential future mechanisms to replace the heretofore robust fuel tax. Preferring to maintain the user-pays principle, some state legislatures mainly explored MBUFs for replacing or augmenting the excise fuel tax. Alternatively, other state legislatures implemented flat fees on EVs to cover revenue losses. Some experimented with both.

Vermont's Road Usage Charge Concept

The State of Vermont has begun evaluating options to replace declining fuel tax revenues—adding an assortment of road usage charges paid by owner/operators of AEVs, PHEVs, and possibly highly fuel-efficient ICEVs for use of the state's road system.

Under Vermont's RUC concept, drivers of AEVs and PHEVs registered in Vermont would have the choice of paying either an annual flat fee or an MBUF. Out-of-state EV drivers recharging at Vermont public charging stations would pay a per-kWh fee on the electricity transferred to the vehicle.

Annual Flat-Fee Option

An *annual flat fee* is an assessment for driving on the Vermont road system, which is not based on vehicle usage but rather set at a fixed amount per year. The flat fee would be revenue neutral, meaning the average revenue raised per vehicle would equate to the total fuel tax or diesel tax paid in a year by the average ICEV. The flat-fee amount for each vehicle type—EV, PHEV, high mileage ICEV—will depend upon their relative fuel efficiencies, the typical annual miles traveled by the average Vermont resident, and other factors. The expected fee amount per year in Vermont has been estimated in previous studies⁴ to be about \$120 for an AEV and \$71 for a PHEV and is verified as part of this study.

⁴ Source: Act 12: Section 28 Report (2013). A Study on Replacing Motor Fuel Tax Revenues Not Collected from Plug-In Electric Vehicles.

Mileage-Based Fee (MBUF)

A *mileage-based user fee* is a per-mile fee based on measurement of the actual distance traveled by a vehicle registered in Vermont and owned by a Vermont resident. The mileage-based fee would be revenue neutral, meaning the average revenue raised per vehicle would equate to the total fuel tax or diesel tax paid in a year by the average ICEV, adjusted for each EV type. The expected MBUF rate has been estimated in previous studies to be between 1.3 and 1.5 cents per mile⁴ to achieve revenue neutrality. The total fees paid for an individual vehicle may be capped at the annual fee amount.

Per Kilowatt Hour Fee (per-kWh fee)

A *per-kWh fee* is an assessment on use of the road system based on the amount of electricity charged into an EV. Under Vermont's initial RUC concept analyzed in this study, nonresident owners of EVs charging at public charging stations in Vermont would pay a per-kWh fee on top of the base charging rate. The expected charging rate as estimated in previous studies would be 3.4 cents per kilowatt hour.⁴ Vermont owners of AEVs or PHEVs would pay the fee if using a public charging station unless there is a mechanism identified that can credit Vermont residents. The concept did not include a fee on charging an EV at a residence.

Rate Setting for Road Usage Charging

Development of a fee structure for different road usage charging policy options is both defined by and informs the design decisions for the system. A fee structure should ensure generation of sufficient revenue for the fee's purpose, but it should also consider impacts on those who pay and avoid distorting the choices of those affected (for example, encouraging undesirable behavior). It should be considered dynamic, adaptable to changes in policy and external conditions. Fee structures directly inform revenue modeling and cost modeling, as well as communication to stakeholders about how much road users might pay, on what basis, and why.

The consultant CDM Smith provided seven criteria that may be used for setting rates for the flat fee, MBUF, and the per-kWh fee:

- **Revenue generating potential:** The ability of the rates to raise sufficient *net* revenues to be worthwhile.
- **Financial sustainability:** The potential for the rate schedules to be responsive to changes in vehicle ownership and usage.
- **Flexibility:** The rate schedule should be sufficiently flexible to be adapted to changes in policy to meet changing conditions over time.
- **Equity and revenue neutrality:** The rates should be broadly commensurate to what other types of vehicle drivers are charged to use the roads, so that those paying any of the three types of fees are not burdened, on average, greater than other drivers. This may also take

https://publicservice.vermont.gov/sites/dps/files/documents/Transportation_LandUse/Goal1/Act12%2C%20sec28%20EV%20fees%20study.pdf

into account avoiding imposition of a sudden increase in fees for members of vulnerable communities.

- **Avoid negative impacts on AEV and PHEV adoption:** The objective of raising revenue should be balanced by wider policy interest in maintaining growth in adoption of AEV and PHEVs both in ownership and usage.
- **Economic efficiency:** The rate structures should not distort economic activity or encourage transportation use decisions that are less efficient than those that apply to other drivers. The rate structures should seek to raise revenue from drivers reflecting their usage of the road system and reflecting their contribution to what is spent on the network.
- **Operational feasibility:** Rate structures should be ready for application, precluding opportunities for evasion or fraud.

This range of criteria balances out the priority of raising revenue with the sustainability of introducing potential new sources of revenue and the impacts of those sources on vehicle ownership, usage, and the subject communities.

Important to rate setting are the equity impacts of a fee on drivers from different locations in Vermont or with widely varying incomes.

Equity Impacts of Road Usage Charging

Comparison of Urban and Rural Road Usage

Concerns over the possible impacts of fees on rural drivers compared to urban drivers have been raised in previous RUC programs. The issue was addressed in Oregon in the final report for Oregon's RUC program (OReGO).⁵ A study conducted by Oregon State University indicated that rural drivers drive further per trip than urban drivers but take fewer trips and in total drive only slightly more than urban drivers. The conclusion on the impact of a MBUF was that rural drivers would pay proportionately less fuel tax than their urban counterparts because *rural drivers, on average, drive lower fuel-efficient vehicles than drivers in urban areas.*⁶

For Vermont, where urban drivers are more likely to own AEVs and PHEVs, a similar hypothesis appears credible.⁷ The RUC West consortium of states undertook an additional study that indicated the daily mileage traveled in nine states (when comparing urban and rural drivers) varied by state. This variation suggested the impact of a MBUF on rural drivers was unlikely to be significantly different from urban drivers.⁸ Federal Highway Administration statistics indicate that around 71% of miles driven in Vermont are on roads in rural areas, compared to 30% for the national average, but this does not necessarily indicate that rural vehicles travel significantly more miles per year

⁵ See https://www.oregon.gov/odot/Programs/RUF/IP-Road%20Usage%20Evaluation%20Book%20WEB_4-26.pdf

⁶ P.55, Oregon's Road Usage Charge, The OReGO Program, Final Report, ODOT, February 2017 (https://www.oregon.gov/odot/Programs/RUF/IP-Road%20Usage%20Evaluation%20Book%20WEB_4-26.pdf) Sourced from https://www.oregon.gov/ODOT/Programs/ResearchDocuments/SPR774_RoadUsageCharge_Final.pdf

⁷ This report is regularly updated with trends on locations of EV ownership per head of country population: https://www.driveelectricvt.com/Media/Default/docs/maps/vt_ev_registration_trends.pdf

⁸ See Table 17 in https://www.ebp-us.com/sites/default/files/project/uploads/FINAL-REPORT---Financial-Impacts-of-RUC-on-Urban-and-Rural-Households_Corrected.pdf

than equivalent urban vehicles.⁹ This is because Vermont has around 65% of residents living in rural areas, which would indicate that it is appropriate for such a higher proportion of miles to be driven in rural areas.¹⁰ These statistics include heavy-duty vehicles, which travel, on average, much more miles per annum than light duty vehicles.

A statewide public opinion survey of 2,496 residents, prepared for AOT in 2016 to update the Long Range Transportation Plan, offers a closer view of driving behavior in Vermont, albeit prior to the pandemic. Though self-reported, and therefore not independently verified, the survey indicates that rural drivers of passenger vehicles drive 45% to 90% longer distances for commuting and on weekdays than do urban or suburban drivers. Rural and suburban drivers also live farther from work than urban drivers. See Table 1.

Table 1. 2016 Survey of Work Commute Distance and Weekday Driving in Vermont¹¹

Which of the following best describes the place where you live?	Thinking about your travel on the most recent weekday, not weekend, about how many miles did you travel by passenger vehicle?	Approximately how many miles do you live from work?
	Mean	Mean
Urban	35.48	8.98
Suburban	47.05	13.68
Rural	68.17	19.21

There is insufficient data on the urban/rural distribution of AEVs and PHEVs in Vermont, but given available data on vehicle ownership distributions, proportions of distance traveled and evidence from other states, it appears likely that any new fees on AEVs and PHEVs would have a greater impact on urban areas in Vermont. Flat fees have equivalent impacts in urban and rural areas as they are unaffected by usage patterns. Given the very high proportion of AEV and PHEV charging undertaken at home, fees on public charging stations are unlikely to have significant impacts on AEV and PHEV owners in urban or rural areas. Nevertheless, a subset of such owners that undertake longer trips to locations further from home are likely to pay more (except if they are excluded as Vermont residents from the per-kWh fee at public charging stations). Additional research might be undertaken to understand the demographics of public charging station users. An MBUF would likely have no disproportionate impact on rural owners of AEVs and PHEVs than urban owners, particularly in comparison to the current impact of the fuel tax on gasoline-powered light-duty vehicle owners.

⁹ Source: <https://www.fhwa.dot.gov/policyinformation/statistics/2019/vm2.cfm>

¹⁰ Source: Pg. 12 <https://lifo.vermont.gov/assets/Subjects/Commission-Resources/05a742b874/Population-Changes-and-Vermont-State-Revenue-FULL-REPORT.pdf>

¹¹ Source: Vermont Statewide Public Opinion Survey Report, conducted by Resource Systems Group, Inc. (RSG), 2016

Impacts by Income Category

The two key influences on the impacts of a flat fee, MBUF, or per-kWh fee on lower income households are (1) the profile of owners of AEVs and PHEVs and (2) the profile of road usage of such owners.

AOT's surveys¹² indicate that the main barrier to ownership of AEVs and PHEVs is high up-front costs, particularly given that the supply of such vehicles is relatively new, and there is not yet an extensive market in used AEVs and PHEVs.

Data on the zip codes with the highest proportions of AEVs and PHEVs in Vermont¹³ correlate with the highest income zip codes in the state.¹⁴ Nationwide, 79% of AEV purchases are undertaken in households with incomes of over \$50,000 per annum (57% of over \$100,000), and 80% of PHEV purchases, with 87% purchased by buyers who identified as white.¹⁵ A total of 78% of AEV or PHEV owners live in households with two or more vehicles. Significantly, there is no apparent change in the income profile of AEV/PHEV buyers since 2012.¹⁶

The conclusion is that the likely equity impacts of MBUFs on AEVs and PHEVs is neutral to positive if it accounts for the contribution of net revenues toward the costs of the state's transportation system. At present, owners of such vehicles pay significantly less than owners of fuel vehicles, and there is some evidence that the average mileage of such vehicles is not necessarily less than that of gasoline-powered vehicles. This suggests that flat fees based on average vehicle miles traveled (VMT) or MBUF based on average MPG would have no net-negative impacts on more vulnerable households in Vermont.

Keeping Road Usage Charging Fees Current

Fee rates may be appropriate for a particular moment, but over time the state's demographics may change and inflation may reduce the rate's relative value. To manage these changes in advance, the state could adopt policies to keep the fees current.

The primary objectives for ensuring fees remain current are (1) revenue sustainability and (2) equitable allocation of costs among road users.

The best practices for keeping fees current include two broad approaches:

- Automatic adjustment based on inflation and factors such as average fleet fuel efficiency
- Determining cost responsibility by vehicle type by revenue modeling based on projected spending, inflation, vehicle miles traveled, vehicle weight, and fleet changes

¹² Source: <https://legislature.vermont.gov/assets/Legislative-Reports/2016-Legislative-EV-Study-FINAL-formatted.pdf>

¹³ Source: Pg. 3 https://www.driveselectricvt.com/Media/Default/docs/maps/vt_ev_registration_trends.pdf

¹⁴ Source: <https://www.zipdatamaps.com/economics/income/agi/state/wealthiest-zipcodes-in-vermont>

¹⁵ Source: Pg. 10 <https://www.fuelsinstitute.org/Research/Reports/EV-Consumer-Behavior/EV-Consumer-Behavior-Report.pdf>

¹⁶ Source: Pg. 17 <https://www.fuelsinstitute.org/Research/Reports/EV-Consumer-Behavior/EV-Consumer-Behavior-Report.pdf>

PART TWO

ROAD USAGE CHARGE ADVISORY COMMITTEE

The Road Usage Charge Advisory Committee Process

This part of the report presents the RUC Advisory Committee process for examination of the Vermont RUC concept. This includes formation of the advisory committee, its role, its public meetings, and the stakeholder engagement process that fed into the advisory committee's deliberations.

Formation of the Road Usage Charge Advisory Committee

In mid-2021, the AOT assembled an advisory committee made up of high-level government officials and interested stakeholders to analyze and evaluate the Vermont RUC concept (see Table 2 for advisory committee membership). This RUC Advisory Committee met from late summer into early winter to engage in a process to examine the feasibility of the concept's various elements, focus on preferences for collection methods, and offer advice on whether to proceed with either pilot programs or implementations of RUC programs.

Table 2. Membership of the 2021 Road Usage Charge Advisory Committee

Member	Organization	Position
Michele Boomhower (Advisory Committee Chair)	VT Agency of Transportation	Policy, Planning and Intermodal Development Division Director
Wanda Minoli	VT Department of Motor Vehicles	Commissioner
Rebecca Sameroff	VT Department of Taxes	Deputy Commissioner
Philip Picotte	VT Public Service Department	Utilities Economic Analyst
Dave Roberts	VT Energy Investment Corp	Senior Consultant
Chris Jolly	Federal Highway Administration	Planning and Programming Engineer
Jim Sullivan	Regional Planning Commissions (RPCs)	Executive Director, Bennington County RPC
Gwynn Zakov	VT League of Cities and Towns	Director, Public Policy and Advocacy
Samantha Hurt	Capstone Community Action	Mileage Smart Program Manager
Monica McDonald	Head Start Policy Council	Member
Trish Hendren	The Eastern Transportation Coalition	Executive Director

Role of the RUC Advisory Committee

The AOT charged the Committee with the duty to examine and offer it advice on road usage charging in the following subject areas:

- Policy design
- System design
- Management and operational structure for implementation
- Rate recommendations
- Perspectives on operational feasibility and financial sustainability of road usage charging in Vermont
- Whether the designed system is ready for implementation of road usage charging or if the road usage charge system, or some component of it, should be piloted

Public Meetings of the RUC Advisory Committee

The RUC Advisory Committee held three online public meetings on August 19, September 29, and December 22, 2021. At these meetings, the RUC Advisory Committee received a description of the project's scope and the role of the committee.

Upon review of guiding principles adopted in the states of Oregon, California, and Washington for making RUC policy and system choices, the RUC Advisory Committee adopted guiding principles specifically for Vermont to assist in consideration of the options and issues presented. The committee understood that the members may find that during deliberations, some of these principles may conflict in some applications and agreed to give conflicting principles due weight in those moments.

Guiding Principles for Road Usage Charging Policy and System Design

- **Do No Harm**
 - Revenue neutrality
 - Sustained EV uptake
- **Equitable and Fair**
 - User-pay system
 - Users have choices
 - Privacy and security data protected
 - Equitable cost distribution
- **Feasible and Efficient**
 - Ease of administration/minimal government burden
 - Enforceable
 - Simplicity of compliance and ease of use
 - Understandable
 - System accuracy
 - High performing system
- **Transparent and Accountable**
 - Open system
 - Open to competing vendors
 - Accountable oversight
- **Adaptive for the future**
 - Integration with other state policies
 - Interoperability with other state systems
 - Flexible, secure, and scalable

The consulting firms CDM Smith and RSG gave briefings on the topics discussed in this report. The RUC Advisory Committee members engaged in discussion and offered opinions on MBUF systems, the annual flat fee, and per-kWh fee systems, as well as the stakeholder engagement plan. Individual members often voiced their preferences for certain policies and systems.

The RUC Advisory Committee met as an ad hoc working group on October 27, 2021, to examine in detail the feasibility of systems in Vermont for per-kWh fees. Several representatives from VT's electric distribution utilities participated in the October 27 meeting to provide feedback on challenges with a per-kWh fee at public charging stations. Some members of the RUC Advisory Committee also met as a small group on November 10, 2021, as a subcommittee on MBUFs and annual flat fees to debate preferences for systems.

From discussion at first RUC Advisory Committee meeting:

Revenue neutrality. Is the objective to break even with current fuel tax revenue? *AOT response:* The goal overall is to be revenue neutral and to collect fees equitably and cost-effectively. AOT does not want electric vehicle owners paying more than the average driver pays in fuel tax.

Frequency of payments. Paying a RUC fee once per year may be more difficult for vehicle owners to absorb compared to collecting fees monthly or quarterly. *AOT response:* AOT must focus on equitability in the administration of any new RUC system.

Presentations and Analysis Reviewed

The RUC Advisory Committee reviewed the following documents and presentations prepared by CDM Smith and RSG:

- Overview document entitled *Road Usage Charging in the United States*
- Presentation entitled *Vermont Road Usage Charging Advisory Committee, August 17, 2021*
- Presentation entitled *Stakeholder Engagement Plan* (August 17, 2021)
- Memorandum entitled *Per Kilowatt Hour Fees System Definition* (September 27, 2021)
- Memorandum entitled *Flat Fee and MBUF System Definition* (September 29, 2021)
- Memorandum entitled *Road Usage Charge Fee Structure* (September 28, 2021)
- Presentation entitled *Vermont Road Usage Charging Advisory Committee* (September 29, 2021)
- Memorandum entitled *Framework with Scenarios for Flat Fee/MBUF Decision-making* (October 10, 2021)
- Document entitled *MBUF/Flat Fee Decisions Framework with Scenarios*
- Presentation entitled *Vermont Road Usage Charging Advisory Subcommittee on MBUF/Flat Fee* (November 10, 2021)
- Presentation slide decks entitled *Vermont MBUF Subcommittee Scenarios 1 to 7*
- Memorandum entitled *Road Usage Charge System Financial Analysis* (December 1, 2021)
- Financial model for *Road Usage Charge Revenue Forecast*
- Memorandum entitled *Work Program for per Kilowatt Hour Fees* (December 1, 2021)
- Memorandum entitled *MBUF Recommendation for Plug-in Electric Vehicles* (December 10, 2021)
- Presentation entitled *Vermont Road Usage Charging Advisory Committee* (December 22, 2021)

Stakeholder Engagement

Concurrent with the RUC Advisory Committee meetings, CDM Smith and RSG conducted four stakeholder discussions in September 2021 to solicit feedback for the RUC Advisory Committee to consider and administered a website survey.

At the second RUC Advisory Committee meeting on September 29, RSG presented the results of the stakeholder outreach results. The stakeholders represent perspectives the project team considered to be particularly valuable to inform the analysis and design of any future RUC system from a mix of industry, nonprofit, and government perspectives.

Drive Electric Vermont Stakeholder Meeting

Drive Electric Vermont invited the project team to its quarterly meeting on September 8, 2021. Nearly 70 people attended.

The project team covered the outline and basics of the AOT RUC concept. Attendees provided the following input:

- The State could use the sales tax as a road funding source to pay for miles traveled by EVs. Using the manufacturer's suggested retail price rather than the actual final sale price of the vehicle (which is likely lower after applicable tax credits and other discounts), the State could collect the sales tax on a higher value than what the user pays. This *excess tax* could be directed to fund the transportation system and pay for the mileage in fees or the avoided motor fuel tax.
- Attendees expressed concern about the technical logistics of a per- kWh fee and how to address resident versus nonresident issues. These included questions regarding who is responsible for collecting the fee, who manages accounts, who will handle errors or technical glitches, which electric vehicle supply equipment (EVSE) will be required to comply, what to do if the equipment does not have a meter, etc. The project team explained that the study is at an exploration phase to work out those details and that a per-kWh fee paid at public charging stations has not been implemented anywhere else to date in the United States.
- A comment was made about the interstate commerce clauses and how the per-kWh fee would have to be consistent to remain in legal compliance. The project team responded by citing a study in Washington state.¹⁷ Its finding was that fees applied to out-of-state registered vehicles must be similar to those that a vehicle driver registered in state would pay. This is an additional design detail that the project team is aware of and will be considered in subsequent tasks.
- EV adoption is currently incentivized by state and federal dollars and attendees questioned why the government would impose a fee on driving these same vehicles. Regardless of whether they are consuming transportation capacity or not, attendees noted the larger environmental goals that these vehicles are achieving. Attendees suggested that the state should consider using fees to incentivize the purchase of EVs to also fund the gap associated with the avoided motor fuel tax.
- Several attendees suggested an increase in the state motor fuel taxes to pay for the costs of increasing EVSE availability as well as pay for the avoided taxes from EV drivers. They said

¹⁷ Source: *RUC and The Commerce Clause and other provisions of the United States Constitution (unpublished)*, a report prepared for the Washington Road Usage Charge Steering Committee, March 14, 2019.

this should be the mechanism adopted, at least in the short term, as the State looks to increase adoption of EVs and build the necessary supporting infrastructure.

Vermont League of Cities and Towns

The project team met with a representative of the Vermont League of Cities and Towns (VLCT) for a virtual discussion on September 15, 2021. The VLCT is a nonprofit, nonpartisan organization with the mission of serving and strengthening Vermont local government. The discussion focused on understanding a diverse set of municipal and local government perspectives.

VLCT stated general support for developing alternatives to the motor fuel tax given their understanding of the eroding power of the motor fuel tax. Increasing revenues available to the state—and subsequently, to local governments—will deliver financial resources to communities. This, in turn, will allow these local governments to improve their transportation systems while also adapting to and mitigating the effects of climate change.

Most local governments are unlikely to take issue with the RUC concepts; however, some communities may be interested in how their vehicle fleets may be affected. VLCT did note that identifying how and if these RUC concepts are consistent with town plans will be one concern for any local governments. It is not obvious how the fee concepts would contradict any goals, but there may be something less obvious that arises in future conversations.

Vermont Natural Resources Council, Conservation Law Foundation, and Sierra Club of Vermont

The project team invited the three environmentally focused organizations (the Vermont Natural Resources Council, Conservation Law Foundation, and Sierra Club of Vermont) to a virtual online stakeholder meeting on September 10, 2021, to discuss the RUC concepts. The organizations reviewed the materials that were presented at the advisory committee meeting and gave an overview of the proposals being considered.

Generally, the three entities expressed universal support for the idea that EV adoption should be supported and expressed concern that an additional tax or fee would be a deterrent for some. They recommended that the State consider looking wider than simply “plugging a hole”—that an opportunity may exist to improve the current transportation funding system. More specific topics of the discussion included the following:

- Two attendees noted studies referencing a state goal to achieve an EV 15% market share of vehicles before any changes to fees or costs are imposed on EV drivers. An attendee from Vermont Electric Cooperative referred to a study from Bakersfield that mentioned that EV purchasers would be less interested in an EV if there is a cost per mile that reduces the current cost savings of owning an EV compared to an ICEV. It was posited by the group that if EV initial purchase prices decrease, the concern with the per-mile fee may diminish.
- One attendee advocated for a MBUF adopted across the board for all vehicles as a substitute for the motor fuel tax. The project team mentioned that other states such as Utah and Oregon, among others, do have intentions to implement MBUF across all vehicle types; however, implementation is a lengthy process and the approach being considered by AOT could be a more manageable step because of the focus on a smaller number of vehicles.

- One attendee suggested a wholesale review of transportation funding in Vermont and said that maybe user fees are not the best solution. This person suggested that if boosting EV adoption is the goal, then the state should prioritize that and find other ways to find the revenues it requires. The project team noted the concepts under consideration are bounded by the assumptions of maintaining a user-fee system and evaluating the pros and cons of creating the system with a limited user base in Vermont.
- Attendees noted additional disincentives are needed on ICEVs and that motor fuel taxes should continue to fund the system in the near term. A carbon tax can be designed as an additional fee on ICEVs; however, it is not a viable long-term option given the shift to EVs. AOT staff stressed that it is necessary to find long-term solutions and get them started now given the time it takes to design, pilot, and implement. The project team mentioned how carbon fees can be collected along with MBUF, and as carbon fees increase, there would be an incentive to drive fewer miles.

Vermont Auto Dealers Association

The project team met virtually with a representative from the Vermont Auto Dealers Association (VADA) on September 13, 2021, to review the RUC concepts. All VADA members acknowledge that funding has to change, and dealers are getting prepared for more EVs. VADA's position is not to avoid raising the motor fuel tax; however, these alternative fees are helpful to have more than one idea to progress and evaluate.

VADA has to consider how the process can be implemented fairly across its membership. The move to new fees along with shifting vehicle types affects dealerships differently and changes who purchases vehicles and how. This is an opportunity to educate dealers on an alternative approach to transportation funding.

VADA is interested in supporting and understanding the supplemental investments that the AOT will have to make, including computer upgrades at the DMV that will affect driver licensing, purchasing information, registration, titling, etc. These changes, along with the payment of any initial fees, are of interest.

Takeaways from the Stakeholder Outreach

Across the stakeholders interviewed, there was a general understanding of the need for alternative revenue mechanisms to make up for the loss of fuel tax revenues because of the shift to EV usage. There was disagreement, however, on which revenue mechanisms to rely upon. Local governments supported the RUC concepts, while environmental groups preferred other alternatives owing to concern about deterring purchase of EVs. However, they note that if EV purchase prices decrease, this concern may disappear.

Website Survey

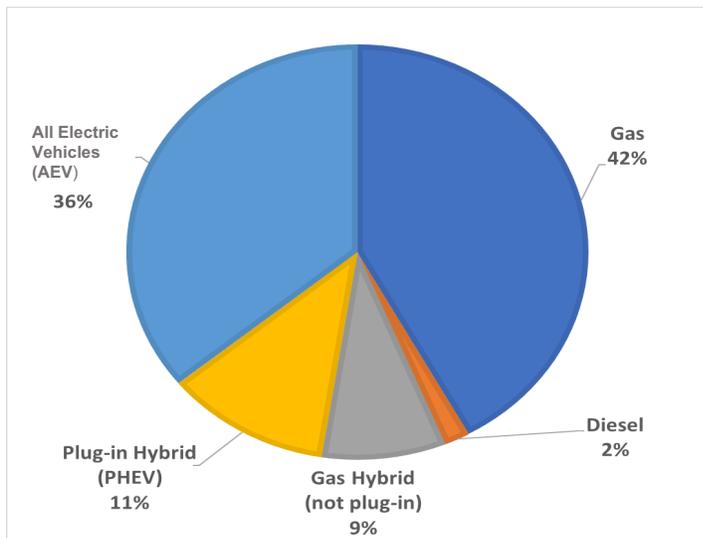
Amid the second advisory committee meeting, RSG conducted a nonrandom, nonscientific website survey to study the view of participants about RUCs on the use of EVs. Survey participants were

RUC Advisory Committee Reactions to Stakeholder Outreach

"As the RUC initiative moves forward, it will be important to align with the new DMV [Vermont Department of Motor Vehicles] system. For example, if a new fee is assigned to collection at registration, it would be critical for this to be built into the DMV modernization effort." DMV Commissioner Wanda Minoli

invited from email lists provided by the organizations involved: Vermont Auto Dealers, Vermont Natural Resources Council, Sierra Club of Vermont, Conservation Law Foundation, the RPCs, VLCT, Drive Electric, and AOT. There was a total of 282 participants in the survey. The auto dealers completed 4 surveys, the environmental organizations completed 24, the community organization (RPCs and VLCT) members completed 53, and Drive Electric members completed 201.

Overall, as summarized in Figure 1, of the households surveyed, 36% (99 households) have a AEV and 11% have a PHEV as their primary vehicle. They estimate driving these EVs an average of 10,400 miles per year. Of the households, 14 have two or more EVs. They estimate average miles driven in the second EV as 8,443.



- A total of 99 households have an AEV as their primary vehicle and 31 additional households have an AEV as their secondary vehicle.
- A total of 14 households have two or more AEVs.
- One household has three AEVs.

Figure 1. What type of vehicle is your first household vehicle?¹⁸

Most of those surveyed indicated they purchased an EV primarily for environmental benefits. Savings on fuel costs ranked second and lower maintenance costs third (Figure 2 below).

¹⁸ Question 3 of the survey for the Vermont Electric and Highly Fuel-Efficient Vehicle Road Usage Charge Study (2021)

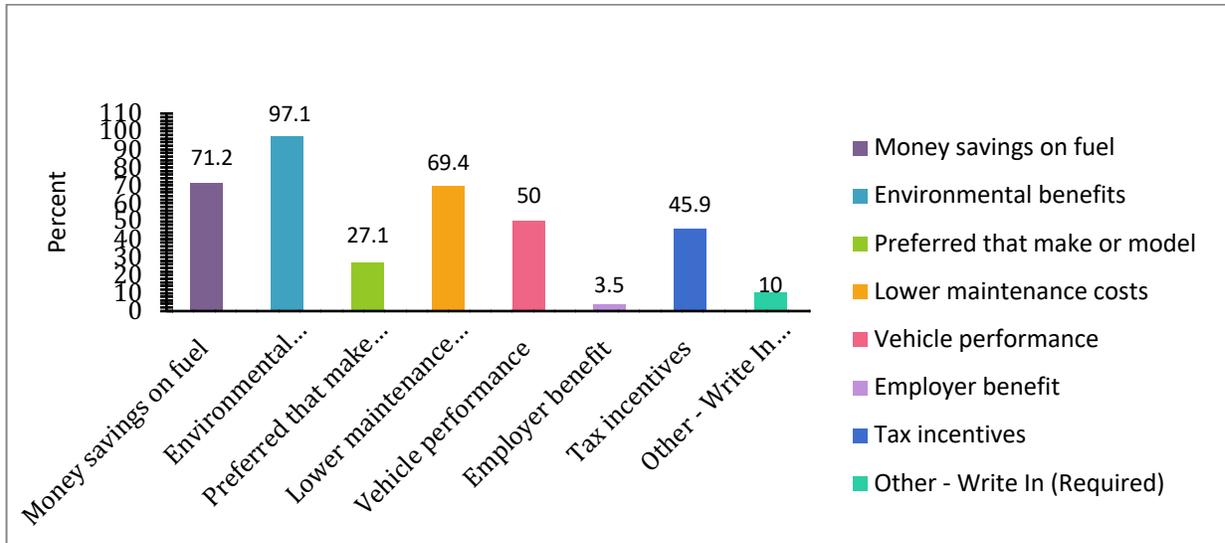


Figure 2. Why did you purchase an electric vehicle?¹⁹

As indicated in Figure 3, the respondents’ main concerns about purchasing or leasing a fully electric vehicle included limited driving range (first), lack of charging facilities (second), expensive purchase price (third), battery charging time (fourth), and cost of installing charging equipment in their residence (fifth).

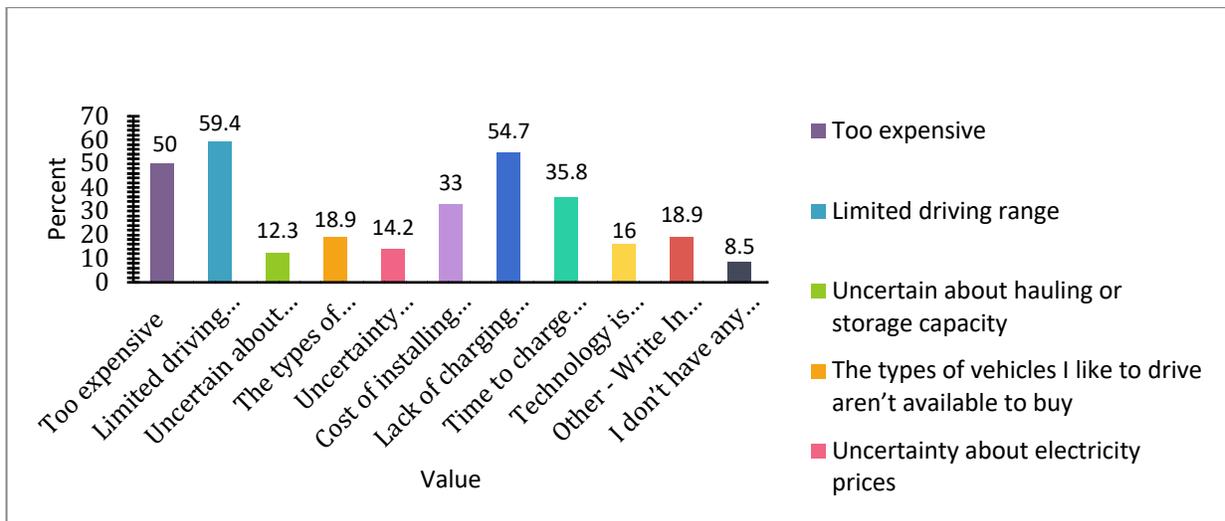


Figure 3. What are your main concerns about purchasing or leasing a fully electric vehicle?²⁰

As summarized in Table 3, survey participants showed some agreement with the statement that EVs do not contribute their fair share to the transportation system (47.1 percent agree; 19.9 percent neutral; 33 percent disagree). Even so, there was a sentiment that EV drivers should pay

¹⁹ Question 30 of the survey for the Vermont Electric and Highly Fuel-Efficient Vehicle Road Usage Charge Study (2021)

²⁰ Question 31 of the survey for the Vermont Electric and Highly Fuel-Efficient Vehicle Road Usage Charge Study (2021)

fewer fees because of less emissions (52.1 percent agree; 11 percent neutral; 36.9 percent disagree) and a plurality agreed with the statement that MBUF only for driving EVs would penalize them more than drivers of fuel vehicles (48.6 percent agree; 20.2 percent neutral; 31.2 percent disagree).

Those surveyed generally agreed with a statement that MBUFs are fair (73.1 percent agree; 6 percent neutral; 21 percent disagree) even though they perceived that MBUFs penalize drivers who must drive longer distances (53.9 percent agree; 19.1 percent neutral; 25.9 percent disagree).

Table 3. Do you agree or disagree fees based on miles traveled are fair?²¹

	Agree (Strongly agreed or somewhat disagreed)	Neutral	Disagree (Somewhat agreed or Strongly disagreed)
Fee based on vehicle miles traveled are fair because drivers pay according to how much they use the road	47.1%	19.9%	33%
Drivers of fully electric or plug-in hybrid electric vehicles do not pay their fair share for road upkeep.	73.1%	6%	21%

Survey participants saw the annual flat fee as unfair to people who drive less (74.1% agree; 12.8% neutral; 13.2% disagree). See Table 4.

Table 4. How fair are annual flat fees?²²

	Agree (Strongly agreed or somewhat disagreed)	Neutral	Disagree (Somewhat agreed or strongly disagreed)
Flat fees are unfair for people who drive less	74.1%	12.8%	13.2%
Flat fees would encourage people to drive more	27.3%	25.5%	47.2%

As summarized in Table 5, survey participants tended toward opposition of an annual flat fee (38.7% supportive; 59.5% opposed). They tended to support a per-kWh fee at public charging stations for nonresident vehicle charging (72.7 percent supportive; 23.8 percent opposed). The relative difference of support/opposition between EV owners and non-EV owners was minimal for all three types of road usage charges.

²¹ Question 46 of the survey for the Vermont Electric and Highly Fuel-Efficient Vehicle Road Usage Charge Study (2021)

²² Question 46 of the survey for the Vermont Electric and Highly Fuel-Efficient Vehicle Road Usage Charge Study (2021)

Table 5. What is your initial reaction to introducing road usage charges on fully electric, plug-in hybrid electric, or other highly fuel-efficient vehicles?²³

	Supportive (Strongly or somewhat supportive)	Neutral (No opinion)	Opposed (Somewhat or strongly opposed)
Mileage based user fees for Vermont registered vehicles	61.2%	37%	1.8%
Annual flat fee for Vermont registered vehicles	38.7%	59.5%	1.8%
Kilowatt per hour fee on public charging stations for out-of-state	72.7%	23.8%	3.5%

When asked how they would share mileage data for a MBUF, 72.3% of survey participants said they would prefer sharing access to an odometer reading during an annual vehicle inspection, even though they would pay for all miles traveled whether on or off Vermont public roads or outside Vermont. However, 27.7% said they would prefer to give access to locational data (through a global positioning system (GPS) or a mobile application) to avoid being charged for miles traveled off Vermont public roads.

A mileage-based or flat fee assessed on EVs would not decrease the likelihood of purchasing an EV by 84% of the respondents (Table 6).

RUC Advisory Committee reactions to website survey results:

Chair Boomhower commented on the need for equitability of survey engagement and the necessity of reaching households with lower incomes and more diverse demographics. *Project Team response:* From the equity perspective, if we conclude the sample is not representative, we can always field a survey in the future to get a different perspective, measure impacts, and design a system that specifically addresses equity concerns.

Table 6. EV Purchase Likelihood with Road Usage Fees

If mileage-based fees or flat fees are implemented in the state of Vermont for electric vehicles and highly efficient fuel vehicles, how likely are you to purchase an electric vehicle in the next few years?	Percent	Count
More likely	6%	8
About the same	78%	109
Less likely	16%	22
Total	100%	139

Takeaways from Website Survey

There is general support among those surveyed for a MBUF paid by EV owners. Regarding the reporting method applied for an MBUF, the bulk of those surveyed preferred to allow the MBUF to be based on access to the odometer reading provided during the annual vehicle inspection. Establishment of a MBUF or a flat fee would not affect the willingness to purchase an EV for 84% of those surveyed.

²³ Question 42 of the survey for the Vermont Electric and Highly Fuel-Efficient Vehicle Road Usage Charge Study (2021)

PART THREE

MILEAGE-BASED USER FEE AND ANNUAL FLAT FEE

Mileage-Based User Fees

This part of the report discusses MBUFs, one of the three features of the Vermont Road Usage Charge Concept. This part will present background of MBUF, analyses of the MBUF systems and policy choices, and the financial realities that will impact making those choices. Next, this part will discuss annual flat fees and the possibility of offering an MBUF and annual flat fee as alternatives for EV drivers. Finally, this part presents the preferred scenario for collection of an MBUF, the rationale for the preferred scenario, and the recommended system assessment to prepare the DMV for adoption of the MBUF as state policy.

A MBUF has the central characteristic of a *usage*-based fee. It varies entirely by distance traveled. As a usage-based fee, MBUF rises and lowers in revenue based on the amount of road travel, independent of vehicle ownership, but it is more susceptible to changes in economic activity. Similar to the fuel tax, which is also a proxy fee for usage, MBUF revenue is limited to the consumption of the relevant unit—in this case, miles traveled.

History of Mileage-Based User Fees in the United States

For over two decades, states have investigated and tested the concept of paying per mile or a flat fee as an alternative to the fuel tax to make up for lost revenue from greater usage of electric and other high-mileage vehicles. At least 31 US states have engaged in policy or technical research on distance-based road usage charging (MBUF) for light vehicles,²⁴ 25 7 of them running formal public pilots,²⁶ 12 participating in a multistate coalition's demonstration,²⁷ and 3 enacting operational programs²⁸ (with 2 of those actually running program operations).²⁹ These pilot tests and operational programs have revealed functional systems for per-mile fee collection.

In the early years, only four states funded their own research. Once Congress authorized financial support for state investigation of transportation funding alternatives in 2015, many more states rushed to investigate road usage charging at a faster pace.

Following more than a decade of research and pilot testing, in 2013 the Oregon Legislature enacted a permanent per-mile RUC of 1.5 cents per mile for participating drivers of light vehicles. This RUC became operational in 2015. Branded OReGO, the state legislature mandated this program to provide an offset of the fuel tax paid by the driver of the participating vehicle. Only residents of Oregon were eligible to volunteer for participation in the OReGO program. Drivers not volunteering

²⁴ The term *mileage-based user fee* (MBUF) means charging for distance traveled within a jurisdiction's road network. In some states, distance-based charging is referred to by other terms, such as per-mile road usage charging (RUC) or Vehicle Miles Tax (VMT) or mileage fee.

²⁵ A total of 17 of the states are members of the RUC West coalition (Oregon, California, Washington, Utah, Hawaii, Colorado, Nevada, Wyoming, Idaho, Arizona, New Mexico, Texas, Oklahoma, Montana, North Dakota, Nebraska, Alaska); 12 are members of the Eastern Transportation Coalition (Delaware, Pennsylvania, New Jersey, Virginia, North Carolina, Vermont, New Hampshire, Massachusetts, Connecticut, Rhode Island, Maryland, Florida), and Minnesota and Kansas.

²⁶ Oregon (2006–07, 2012–12), Minnesota (2006, 2012), California (2016–17), Colorado (2016–17), Washington (2019–20), Hawaii (2019–21).

²⁷ Delaware, Pennsylvania, New Jersey, Virginia, North Carolina, Vermont, New Hampshire, Massachusetts, Connecticut, Rhode Island, Maryland, Florida (2018, 2019, 2020).

²⁸ Oregon (2013), Utah (2018) and Virginia (2020).

²⁹ Oregon (since 2015) and Utah (since 2020)

continue to pay the fuel tax. Having no ability to volunteer for participation in OReGO, nonresident drivers therefore continue to pay the fuel tax while driving in Oregon.

After Oregon's enactment of an operational per-mile RUC, other states continued the investigating options similar to the OReGO program but with improvements such as expanded options for mileage reporting and systems for interoperability with other states. California tested a pilot program with 5,000 participants and six mileage reporting options in 2016–17. Washington did the same with 2,000 participants and four reporting options in 2018–19. In 2018, Colorado conducted a demonstration as did The Eastern Transportation Coalition (TETC). The TETC demonstration included participation from member states, a majority coming from Pennsylvania and Delaware, many of whom were senior officials, and some were staff from the United States Congress. Only Washington's pilot program included out-of-state vehicles, collecting real money in a financial interoperability test with OReGO and mock-billing tests with residents of Idaho and British Columbia, Canada.

In 2020, Utah launched the nation's second operational per-mile fee program. Also in 2020, the Virginia Legislature adopted the third operational per-mile fee program but Virginia DMV has yet to launch this program.

The federal government has engaged in research of road usage charging, but has not undertaken any formal testing or pilot program. Congress did create the Surface Transportation System Funding Alternatives (STSFA) grant program in 2015, which has provided numerous states a total of nearly \$74 million in federal funding for innovative road funding development efforts with per-mile fees as the primary conceptual beneficiary. (Prior to the STSFA grants, only four states proceeded with per-mile fee development with only state funding.) The role of the federal government with respect to road usage charging will change with enactment of the 2021 federal Infrastructure Investment and Jobs Act, which not only continues a modified STSFA grant program but also includes a directive for a national MBUF pilot program.

Mileage-Based User Fee Analyses

CDM Smith presented a technical memorandum at the second RUC Advisory Committee meeting of the following design options for MBUFs.

Mileage-Based User Fee System Definition

This section explains system design options and the policy options that impact MBUF system design from the state perspectives, based on research and pilot work by states over the past 20 years, notably by Oregon, Washington, California, Utah, and Hawaii. This section also provides a range of costs for the most desirable system and policy configurations.

Account Management

MBUF account management can have different structures. Operation of simple systems, such as manual odometer reporting or flat-fee collection, requires only in-house state account management. Operation of more sophisticated systems, such as automated mileage reporting, typically requires private sector account management operated by commercial account managers (CAMs). Some states use multiple account managers in an open system to facilitate competition by allowing drivers to choose an account manager based on the services provided.

State government agencies provide account management oversight, program outreach, vehicle registry database, enforcement, and overall program management. Private industry commonly provides technologies, mileage reporting services, accounting, and customer service.

The typical system architecture for account management of a MBUF is as follows:



State systems, such as DMV registries, are typically not well suited for supporting more sophisticated mileage data collection technologies like OBD-II plug-in devices (described on page 33). Commercial account managers can provide and support such technologies. By contrast, many states may be able to support less technically sophisticated means of mileage reporting, such as self-reporting or reporting based on safety inspections.

MBUF account management systems in the United States tend to be designed as open systems, which are defined in openly available specification documents and allow entrance by new market players. By contrast, closed systems—systems not specified by openly available documents but rather proprietarily provided by a single vendor—have the disadvantages of locking in one vendor, reducing price competition, and halting innovation. Closed systems were used in early electronic tolling implementation with such predictable results.

As a step beyond open system, open markets allow new vendors to begin providing account management services in a state at any time, so long as they are certified to provide the systems in the open specification documents. This provides for regular ongoing competition among vendors, ideally lowering costs and improving service. Smaller MBUF systems, such as Utah’s, begin with procurement of just one vendor, but plan to grow as an open system as the MBUF user base grows.

Mileage-Based User Fee Functions

CDM Smith discovered from its work in other states the following basic functions that must be completed by any MBUF system:

- **Identify subject vehicle and its owner/lessee**—using the state vehicle registry, create a list of vehicle identification numbers of the vehicles subject to MBUF. Providing the vehicle registry is a role of a state DMV or equivalent; the check can be performed by the state or a private entity.
- **Generate distance traveled data for subject vehicle over designated time**—reporting mileage data on vehicles. This is a function of the account manager, which can either be the state or a private company.

- **Access distance data**—this means receiving the reported mileage data from vehicles and storing it in an accounting system. This is a function of the account manager.
- **Apply distance fee rates**—processing the mileage data to determine the amount of fees owed. This is a function of the account manager.
- **Provide invoice to owner/lessee**—provide vehicle owner a notice of the fee owed. This is a function of the account manager.
- **Collect payment**—support various payment options, including credit cards and in mandatory systems, cash. This is a function of the account manager, but not all account managers need to support all payment options. For example, a state account manager may support cash payments, while private ones do not.
- **Issue acknowledgement of payment**—provide receipts for payment. This is a function of the account manager.
- **Enforce payment**—provide means of fraud detection and consequences to ensure most everyone pays. Fraud detection is a shared role of account managers and the state, but serious consequences (for serious fraud) is a role of the state.
- **Remit revenue to appropriate fund**—this is a shared role of the account manager and the state. The account manager typically remits all funds to a single account, and the state treasury then routes those funds further as required by law.

Roles State Government Always Provides

State government provides the following roles in MBUF systems:

- Account manager oversight
 - Run the state MBUF accounting system and use it to monitor account manager data.
 - Regularly verify that account managers are performing their duties of charging miles and remitting funds.
 - Oversee certification and audits of account managers.
- State-level program outreach—public education to ensure that vehicle owners are aware of and know how to respond to the MBUF/flat-fee system.
- Provision of vehicle registry database—providing the base data needed to check that all eligible vehicles are enrolled in the MBUF or flat-fee program.
- High level enforcement and adjudication—provide penalty notices and more severe consequences, such as vehicle registration holds, in cases of significant fraud, and provide a means of appeal (adjudication) in cases in which suspected violators feel they have been incorrectly targeted.
- Overall program management—leadership of the MBUF/flat fee program.

Roles for Private Industry

The following are roles commonly fulfilled by private companies in MBUF systems:

- Mileage reporting technology vendor—the company can provide the on-board mileage reporting device and/or software. This role may be coupled with provision of account management services, but that is not necessary.
- Commercial Account Manager (CAM)—the company acts as CAM, including mileage reporting, accounting, and customer service for one or more mileage reporting methods.
- Audit/certification—an organization certifies and/or audits CAMs on behalf of the state. Technology audits may be provided by a technology auditor, such as Underwriter’s Laboratories or OmniAir; financial audits would be provided by an accounting firm.

Policy Choices Impacting System Design

Which Vehicles Should MBUF Cover?

While EV usage has the greatest negative impact on highway revenues, a greater number of vehicles paying a MBUF would result in a lower administrative cost per vehicle. Yet, a MBUF program for plug-in EVs only would be simpler for an agency to implement.

The state should consider all these factors in applying a MBUF to light vehicles. Furthermore, the state could start small, such as with only AEVs, then add PHEVs, gasoline hybrid vehicles, other high-mileage vehicles at later dates. At some point, the state could consider application of a MBUF to all light vehicles.

Credits or Refunds for Vehicles without GPS Reporting

State MBUF programs tend not to charge its residents for driving out of state. Resident drivers reporting mileage using location-aware

From discussion at second RUC Advisory Committee meeting:

Refunds. DMV Commissioner Wanda Minoli said refunds are very challenging to administer. Commissioner Minoli said, “When I see refunds, I see a team of 25 having to handle this.”

Another member agreed with the general desire to avoid refunds but wonders if someone moved out of state or sold their EV if there should be consideration of refunds. A third member said he would go for the *no refund* option.

devices are not charged for out-of-

state miles driven. For vehicles without location-aware devices, states can offer standard exemptions of, for example, 1,000 miles per year, perhaps varied by location in Vermont, or refunds requiring some proof of driving on out-of-state roads. The primary question is whether Vermont drivers without location-aware devices should have the option of applying for refunds/credits for miles driven off public roads or if there should be no refunds.

From discussion at first RUC Advisory Committee meeting:

A member asked, “Should not mileage-based user fees apply to all vehicles and not simply AEVs and PHEVs?” *AOT’s response:* AOT is trying to approach the RUC framework for Vermont cautiously, focusing on EVs first to start with most urgent needs.

From discussion at second RUC Advisory Committee meeting:

Chair Michelle Boomhower asked how other states plan to apply MBUF to all vehicles. *Project Team’s Response:* Oregon has proposed to transition to all new vehicles with a rating of 30 MPG and above starting in a certain year. Utah has focused on transition to all vehicles but looked at various options for phasing in vehicles by model year and MPG. Generally, states have been loath to try to transition everyone in the whole fleet to an MBUF system in a small amount of time. Utah decided to space transition over 10 years.

Privacy

For many drivers, the use of GPS systems that record the location on miles driven raises concerns about protection of privacy. Privacy protections can be built in to an MBUF system through both policy choices and technical requirements. States can offer non-location aware mileage reporting options and guarantee privacy protection rights in law. A privacy law can require destruction of location data after a designated period and prohibit use of data aside from MBUF without express user permission.

The primary technical means of ensuring privacy is through enacting robust data security measures, requiring that every actor in the MBUF system—both the state and private vendors—have robust information technology security practices.

Mileage Reporting Technologies

State governments approve mileage reporting technologies used in any MBUF program. The commonly used mileage reporting technologies include as follows,

- **Vehicle inspection** uses odometer mileage data recorded at regular vehicle safety inspections to compute the amount owed. Vermont is one of 13 states that requires an annual vehicle safety inspection, and this transaction offers an ideal way for many residents to report miles traveled, as no additional activity on their part is required.



Vehicle inspection has some limitations. The mileage data is currently manually keyed in by vehicle inspectors, meaning there may be entry errors, but in the future this could be replaced by odometer image capture on the inspectors' tablets. In cases of erroneous data, vehicle owners would need the opportunity to correct it. Further, vehicle inspection does not capture odometer readings at the time of vehicle sales or moving in or out of state. In instances of sales, the state could simply require the new

vehicle owner to be responsible for all miles driven or access the odometer readings in the ownership transfer document submitted to the DMV. To address the issue of moving out of state, the state could require submission of an odometer image capture or self-reporting.

- **Self-reporting** allows vehicle owners to report their vehicle's odometer reading on a tax form or over the internet. Given that Vermont has annual inspections, which can serve as an annual true-up, there should be less concern about self-reporting fraud. Audits could be done through vehicle inspection, through a requirement to submit an odometer image, or simply through combining self-reported data with safety inspection data.

From discussion at second RUC Advisory Committee meeting:

Privacy. One member stated, "Politically, this whole initiative might get derailed if we're talking about tracking where people are."

From discussion at second RUC Advisory Committee meeting:

Self-reporting. DMV Commissioner Minoli disagreed that self-reporting of odometer readings is an easy reporting method because there will be DMV complexities involved. Vermont DMV would have to develop and modify the system to capture this information.

- OBD-II plug-in devices** plug into vehicle data ports, usually under the steering wheel, which have been manufactured into all light vehicles sold in the US since 1996, except the Tesla 3 and Y models. Some can use GPS technology to enable location-based mileage reporting, while others simply count total distance. OBD-II devices with GPS are the only currently viable technology for excluding miles driven out of state or on private roads from paying the per-mile fee. The mileage data from OBD-II devices can be automatically transmitted to account managers in real time using wireless technology and therefore allows invoicing to occur at any defined intervals such as monthly, quarterly, or annually.



- Native automaker telematics** uses data from connected vehicle systems built into newer vehicles to compute the MBUF. Currently, automakers do not directly support this method, leaving it to third-party providers to provide interfaces (Application Program Interfaces) to their systems to facilitate the transfer of data (such as OBD-II devices). Support of OEM telematics directly by the automaker will allow for precise location information for RUC computations, and future developments by automakers could even allow the third-party API services to get such information. Once this development occurs, this technology may be optimal for MBUF collection, as it is precise and requires no equipment in the vehicle. However, many vehicles are not appropriately supported by this technology yet.
- Odometer image capture** uses smartphones or tablets with cameras to take odometer image for submission to an account manager.
- Smartphone applications** can record and report distance traveled data, but the experience lacks a link to the vehicle and thus does not create a truly seamless experience. An application with a reliable vehicle link and seamless user experience for MBUF reporting may yet be developed.

From discussion at second RUC Advisory Committee meeting:

A member asked whether a smartphone image capture of odometer option can be paired with self-reporting. *Project Team Response:* Yes, this technology has been tested before. It is simple to take a picture of the odometer. There would have to be extra validation by looking up DMV or CARFAX data to make sure there is no odometer fraud.

Enrollment and Withdrawal Processes

If the state offers mileage reporting options other than odometer-based reporting, vehicle owners must enroll with an account manager. There are two account management processes: vehicle enrollment and withdrawal.

Enforcement

State governments typically provide enforcement and adjudication for MBUF/flat-fee programs. Initial consequences for minor infractions may include a warning letter or a penalty fine. Significant consequences for prolonged or high-value violations may include registration holds, which should provide a backstop in case of serious violations. Other significant consequences could include the use of collections agencies or even wage garnishment.

States are generally responsible for detecting failure to register vehicles directly, while other types of evasion are detected by the account manager. The state is generally responsible for all enforcement consequences.

Rate Setting for a Mileage-Based User Fee

In addition to consideration of rate setting elements discussed in Part One, an appropriate basis for initially setting MBUF rates for AEVs and PHEVs is to establish rates comparable to what drivers of equivalent gasoline-powered light-duty vehicles pay in state fuel tax in Vermont. For AEVs this is a relatively simple calculation, but for PHEVs there are two possible approaches. One is to charge a MBUF equivalent to the gap between what average PHEV drivers pay in fuel tax when driving using gasoline and what an average fully gasoline-powered light-duty vehicle driver would pay. Another approach is to implement the same fee for AEVs and PHEVs, but enable PHEVs to obtain a credit based on actual fuel tax paid, by calculating the actual consumption of gasoline using technology on board the vehicle. This would provide a more accurate and fairer way to get closer to revenue neutrality between PHEVs, AEVs, and gasoline-powered vehicles, but could increase administrative costs and potentially lower net revenues.

From discussion at second RUC Advisory Committee meeting:

Lower PHEV rate. A point was raised regarding applying an MBUF to PHEVs: it must be considered that PHEVs already pay the fuel tax. The problem of PHEVs goes away if all vehicles pay the MBUF. *Project Team Response:* Utah applies a separate MBUF rate with an intermediate value for PHEVs to factor in this difference.

Updated Mileage-Based User Fee Estimates

Using the rate setting criteria set forth in Part One of this report, one may calculate the rate for a MBUF. Given the average MPG of such vehicles is 22.7 MPG,³⁰ the average state fuel tax paid per mile is \$0.013 per mile. Therefore, the formula for calculation of revenue-neutral MBUF rate is the state gas tax rate divided by the combined average MPG per light-duty vehicle in Vermont.³¹ The result is an MBUF revenue-neutral rate of \$0.013 per mile.

If the state does not offer a gas tax credit for PHEVs, then the rate for PHEVs should be less than the rate for AEs and based on the difference between the average gas tax paid by PHEVs per mile and that for the average light-duty vehicle. Applying the US Department of Energy's estimated PHEV combined fuel efficiency rating of 37.9 MPG results in a PHEV per mile rate of \$0.005 per mile.³²

Financial Realities of Mileage-Based User Fees

While policy and system issues may have logical preferences, the financial realities of the cost to implement, operate, and administer the system may ultimately drive policy and system choices.

Operational Costs for an MBUF System

The cost of operating an MBUF system depends on key policy and operational program choices:

- **Annual flat-fee rate setting.** When the annual flat fee and MBUF are offered as alternatives, the relative rates at which an annual flat fee is set will impact the choice drivers will make

³⁰ Source: *The Vermont Transportation Energy Profile*, Vermont Agency of Transportation, November 2019, Table 3-4. P. 31.

³¹ The calculation: $\$0.30/22.7 = \0.013 .

³² Source: https://afdc.energy.gov/vehicles/electric_emissions_sources.html

between the annual flat fee and the MBUF. For example, if the annual flat fee is equal to the amount that the driver of the median vehicle would pay in MBUF, then we would expect half of vehicle drivers to choose MBUF and the other half to choose the annual flat fee. Those choosing MBUF would be the 50% who reason to save money by driving less than average and therefore saving money compared to the flat fee.

- **Mileage reporting methods**, including how many and which methods to offer. Relying upon the existing DMV vehicle inspection and odometer mileage collection process will be low cost to implement, whereas relying on automated technology for mileage reporting would be more costly. A hybrid approach would fall in between, with the per-vehicle costs of operating a manual approach offsetting the higher cost of offering an automated reporting option.
- **Vendor service fees.** Should the state choose to offer automated mileage reporting, the state must also decide who will pay for it. The state could allow third-party vendors providing mileage collection services to charge customers directly for the service of measuring and collecting MBUF, or the state could subsidize some or all of the cost, possibly by building the costs into the fee.

The table to the right provides cost estimates relative to gross revenues for five operating cost scenarios. These cost scenarios were developed by the project team.

The cost of these five scenarios hinge upon the annual flat-fee amount and the method of mileage reporting. The term *hybrid* means offering a choice of odometer reporting and automated reporting.

Each scenario presumes a per-mile MBUF rate of 1.3 cents. As these scenarios illustrate, the major cost-driver is the number of vehicle owners choosing automated reporting.

Future System Needs

A state MBUF system implemented in Vermont may serve the state well in the present moment. Over time, however, interaction with other states that implement an MBUF system may present additional considerations, technologies may change, and the transitioning MBUF to other vehicle types may become attractive. In this context, the State of Vermont will need to consider the following issues that will arise in the future.

Interoperability. States with MBUF will need to enter into interoperability agreements so that vehicle owners driving across state borders can experience similar mileage reporting requirements.

Five Flat Fee/MBUF Operational Cost Scenarios

- **Scenario 1 (hybrid):** Assuming a flat fee 1.5 times the average value paid in MBUF (\$209 per year flat fee), 83% of vehicle owners will choose MBUF over flat fee. The annual cost of operations in year one will be \$270,000, or **15% of revenue.**
- **Scenario 2 (odometer):** Assuming a flat fee of double the average value paid in MBUF (\$278 per year flat fee), 97% of vehicle owners will choose MBUF over flat fee. The annual cost of operations in year one will be \$136,000, or **6% of revenue.**
- **Scenario 3 (odometer):** Assuming a flat fee equal to the average value paid in MBUF (\$139 per year), 50% of vehicle owners will choose MBUF over flat fee. The annual cost of operations in year one will be \$92,000, or **6% of revenue.**
- **Scenario 4 (hybrid):** Assuming a flat fee equal to the average value paid in MBUF (\$139 per year), 50% of vehicle owners will choose MBUF over flat fee. The annual cost of operations in year one will be \$316,000, or **20% of revenue.**
- **Scenario 5 (automated):** Assuming a flat fee of 1.5 times the average value paid in MBUF (\$209 per year flat fee), 83% of vehicle owners will choose MBUF over flat fee. The annual cost of operations in year one will be \$483,000, or **25% of revenue.**

Native automaker telematics. As location data becomes available on such systems, states may want to support them, so account managers should be encouraged to integrate with automakers directly or via third-party services.

Transition to all vehicles. Transitioning all vehicles from fuel taxes to MBUF requires examination of technical, revenue, and political risks. A sudden transition magnifies these risks, while a gradual transition softens them.

Commercial fleets. Having different needs, commercial fleets need the ability to enroll and withdraw vehicles frequently and easily.

Annual Flat Fees

As the states began exploring MBUFs to respond to the shift to new highly efficient vehicle types in the early years of the 21st century, other states took what was regarded as a temporary measure by imposing annual flat fees on EVs. An annual flat fee is one of the three features of the Vermont RUC concept.

The inherent characteristic of an annual flat fee is imposition on *ownership* of a vehicle in the state. An annual flat fee does not vary according to usage and cannot be imposed on vehicles from out of state. An annual flat fee inherently charges some vehicle owners more than they would pay if the same fee were converted into a per-mile fee or per-kWh fee and some less. The annual flat fee advantages those traveling the most miles, as the cost is spread over much more road use, than for those traveling the fewest miles.

History of Annual Flat Fees in the United States

During the first decade of the 21st century, states began to augment fuel taxes with annual flat fees on AEVs to offset the loss of revenue from the fuel tax revenue that AEV drivers do not pay. The National Conference of State Legislatures reports that, as of November 2020, 28 states had laws requiring a special fee for AEVs (states colored in green in Figure 4), nearly all of them on an annual basis. Only 14 of these states also assess a slightly lower special fee on PHEVs. Generally, these fees are added to traditional motor vehicle registration fees. For AEVs, these special fees range from \$50 to \$225 per year across the various states. At least five states structure the additional registration fees to grow over time by tying the fees to the consumer price index or another inflation-related metric.³³

³³ Source: <https://www.ncsl.org/research/energy/new-fees-on-hybrid-and-electric-vehicles.aspx> (accessed July 19, 2021)

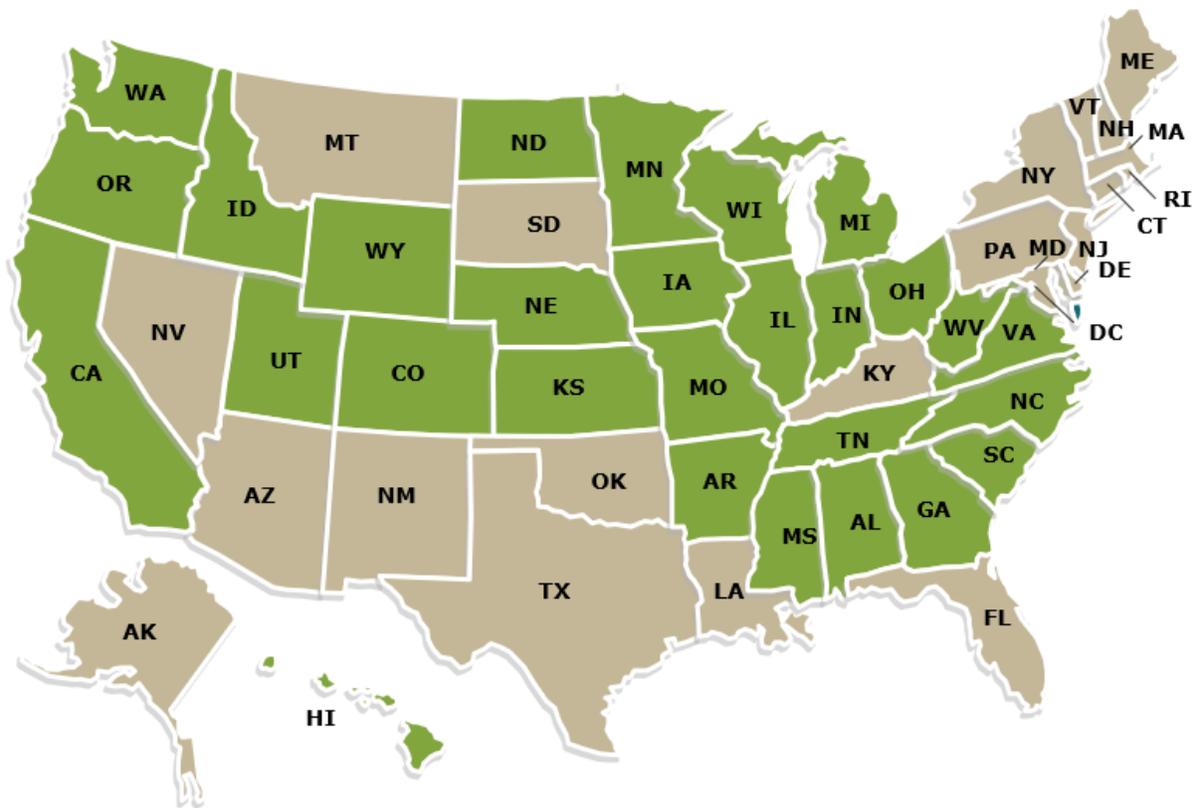


Figure 4. The States with Annual Flat Fees³⁴

Only Utah and Oregon allow vehicle owners of AEVs and PHEVs to avoid the annual flat fee if they opt into paying a MBUF. In 2017, Oregon allowed AEV owners the option of choosing to pay the 1.8 cents per-mile fee in lieu of an annual flat fee of \$100 by enrolling in OReGO. In 2018, the Utah Legislature followed suit by allowing EV owners the option of paying a 1.5 cent per-mile fee in lieu of an annual flat fee of \$90, which rose to \$120 in 2021.

Systems for Annual Flat Fees

An annual flat fee can be handled by the state without technology or involvement by outside CAMs. Most state vehicle registries, such as the one operated in Vermont by the DMV, already assess vehicle fees based on a variety of factors including age, weight, value, and other characteristics.

³⁴ Source: The National Conference of State Legislatures, December 1, 2020.

States commonly impose annual flat fees on AEVs and often PHEVs as well. Annual flat fees for conventional hybrids are less common. Oregon and Virginia impose annual flat fees on ICEVs with above-average fuel efficiencies. Annual flat fees are not proportional to road use.

Annual flat fees are typically assessed as part of the vehicle registration and renewal processes. The rates tend to vary by vehicle type. AEVs typically have the highest rate because the drivers pay no fuel tax. PHEVs, hybrids, and high-efficiency ICEVs have lower rates because the drivers of those do pay some fuel tax.

Rate Setting for Annual Flat Fees

An annual flat fee's revenue is based on the *number of registered vehicles*, which broadly reflects scale of ownership of those vehicles. When ownership rises, revenue increases; at stable ownership levels, it does not vary. (Similarly, at times of economic downturn the annual flat fee, from a revenue perspective, does not respond quickly to such changes, as fewer miles traveled or less energy consumed does not affect revenue, although sustained downturns may result in small reductions in the numbers of registered vehicles.)

Updated Annual Flat-Fee Estimates

Revising estimates from 2013 AOT study, calculating the light duty vehicle fuel economy at 22.7 MPG and an average vehicle miles traveled of 10,497 per year, the annual flat fee for AEVs should be about \$139 per year. Given that drivers of PHEVs pay on average about 60% of what the average drivers of gasoline powered vehicles pay in fuel taxes, the annual flat rate for PHEVs should be about \$55 per year.³⁵

MBUF and Annual Flat Fee as Alternatives

The States of Oregon and Utah allow AEV, PHEV, and hybrid vehicle drivers to choose between paying an annual flat fee or a MBUF. Virginia enacted a law to do the same but has not completed procurement for its MBUF system. MBUFs can be capped by the amount of the annual flat fee, thus limiting the amount of revenue an MBUF system can generate. Low caps induce lower amounts of revenue coming to the state, while high caps increase it.

From discussion at first RUC Advisory Committee meeting:

Annual flat fee amount. A member asked, "How is the notion of a flat fee versus MBUF reasonable given that the flat fee approach essentially lets high-mileage drivers pay a set fee for a certain number of miles and then get free rides?" *Project Team response:* This is correct. A flat fee can be set at an amount which "rewards" high-mileage vehicle users with lots of free miles above the flat fee amount.

From discussion at second RUC Advisory Committee meeting:

Flat Fee and MBUF as alternatives. One member does not support a flat-fee alternative because, "If I hit the flat-fee amount, I keep driving for free. If we have to have a flat fee, we'd need a high flat fee to encourage people to use MBUF." *AOT's Response:* The flat-fee alternative is a way for the driver to protect privacy.

³⁵ This is a calculation as follows. The average gas tax paid by a light-duty vehicle is just under \$139 per annum. When multiplied by the weighted average of PHEV MPG (sourced from Source: https://afdc.energy.gov/vehicles/electric_emissions_sources.html) it is around 60% of that figure).

Setting the Annual Flat-Fee Amount

The financial well-being of offering an MBUF and annual flat fee as alternatives is heavily determined by the amount of the flat fee. As shown in Figure 5, if the flat-fee amount is set at the 50th percentile of driving in Vermont—about 9,000 miles per year—the annual flat fee would equal \$117³⁶. If every driver acts in their own best interest, those driving less than 9,000 miles would elect to pay per mile and those driving more than 9,000 miles would pay the flat fee. That result leaves a large proportion of miles uncharged and the transportation fund with a gaping hole.

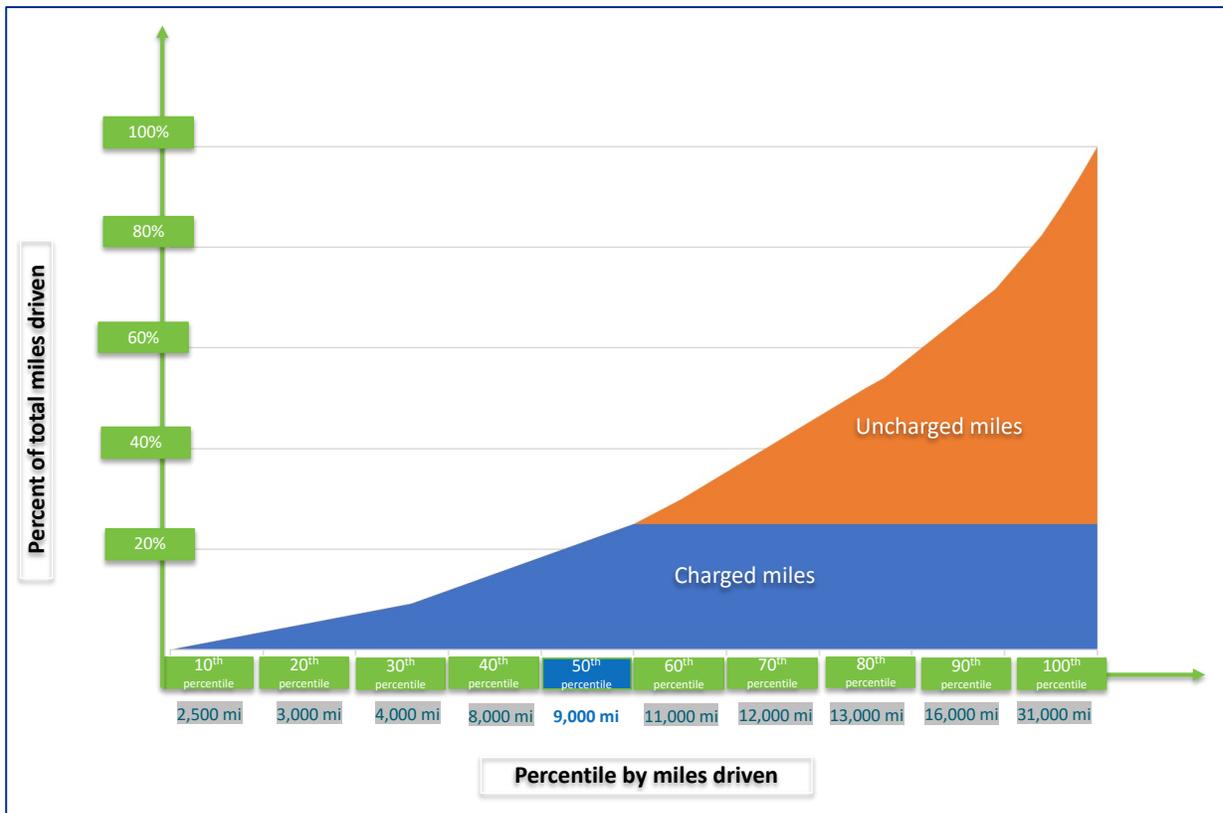


Figure 5. Annual Flat Fee of \$117, Set at 50th Percentile of Driving

As shown in Figure 6, if the flat fee is set at the 90th percentile of driving—about 20,000 miles per year—the annual fee would equal \$260³⁷. The result would leave a much smaller number of miles uncharged and the transportation fund in much better shape, albeit not whole.

³⁶ 9,000 miles x 1.3 cents
³⁷ 20,000 miles x 1.3 cents

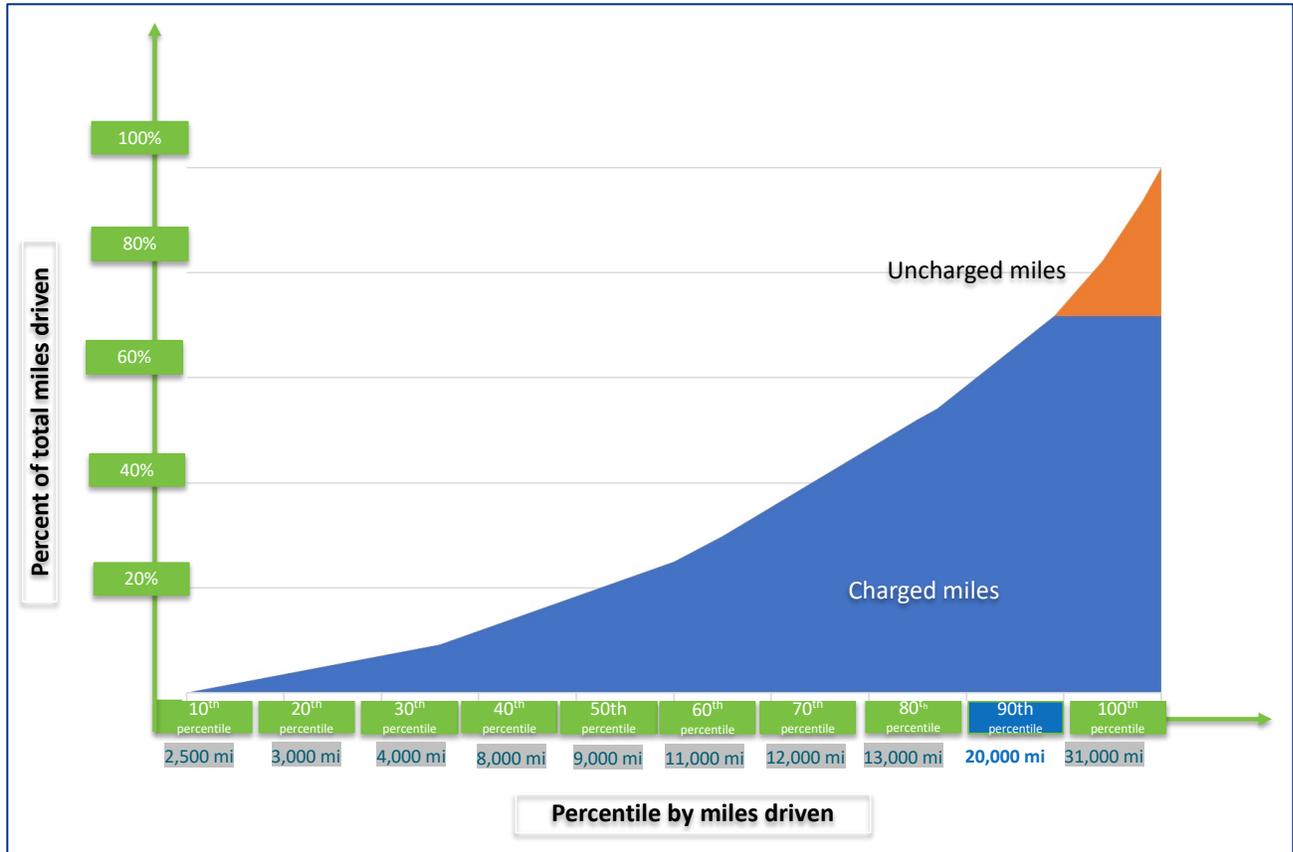


Figure 6. Annual Flat Fee of \$260, Set at 90th Percentile of Driving

Discovering a Preferred System for MBUF and Flat Fee

As the second RUC Advisory Committee meeting proceeded, it appeared to AOT that the process of choosing the system for collecting an MBUF or a combination of MBUF and flat fee required deeper, more focused investigation by a subcommittee of members. AOT committed to forming a subcommittee of members to investigate the various options for an MBUF/flat-fee system and recommend a preference to the full RUC Advisory Committee at its third meeting. It was necessary for DMV involvement in the subcommittee process to discuss technical systems and how to interface with the DMV modernization process.

Focused Investigation on the Preferred System for MBUF and Flat Fee

The subcommittee met on November 10, 2021, with the intention of identifying a preferred system for either a MBUF, an annual flat fee, or a combination of both, as alternatives. Conversations among members occurred for several days afterward as participants worked toward achieving a consensus.³⁸

³⁸ Participants in the MBUF subcommittee included Joe Segale of AOT and RUC Advisory Committee members Jim Sullivan, Matthew Kostik, Trish Hendren, Michael Smith, Deputy Commissioner of DMV, and DMV Commissioner Wanda Minoli.

The subcommittee considered the seven scenarios (see text box below) for collection of an MBUF and/or an annual flat fee from vehicle owners. The seven scenarios were prepared CDM Smith.

DMV Commissioner Wanda Minoli initially favored scenarios 1, 3 and 7, which favor automated reporting over odometer reporting, because she saw issues with integration into other DMV systems, presenting issues such as assurance of validation of odometer reporting, collection of odometer information (which the DMV does not currently do), and the cost of set up and administration. Commissioner Minoli and DMV Deputy Commissioner Michael Smith said an MBUF administered by the DMV would have to be supported by a third party, as the DMV does not have the additional capacity.

Other subcommittee members supported odometer reporting (scenarios 2, 4, 5, and 6), pointing out that that automated reporting has intriguing issues as well. For example, use of automated GPS devices to report mileage raises perceptions of invasion of privacy, although TETC Executive Director Trish Hendren noted that offering an automated plug-in device without GPS could provide an acceptable alternative. Furthermore, to manage automated reporting, the state would have to hire commercial account managers at a higher operational expense. Commissioner Minoli responded by emphasizing the importance of comparing the costs of both automated and odometer reporting systems.

There was some support for offering a flat-fee alternative to MBUF. Commissioner Minoli commented that the whole issue of privacy goes away with choice. Some drivers may want to pay the flat fee to avoid having an automatic reporting device within their vehicle. One subcommittee member opined that, from his perspective, the RUC Advisory Committee is moving away from combining MBUF and flat fee, toward an MBUF-only system.

DMV Commissioner Minoli also raised the issue of affordability. Commissioner Minoli said, “If we want to encourage people in the lower income bracket to buy EVs, we need to have a solution that reflects disparities.”

Near the end of the meeting, Commissioner Minoli suggested engaging in conversations with the contractors that assist the DMV with the vehicle registration program (FAST Enterprises) and manage the Vermont vehicle inspection program (Parsons). Following the subcommittee meeting, the AOT, DMV, and project team met with FAST Enterprises and Parsons about the feasibility of using mileage data collected during vehicle inspection. Both firms agreed that basing an MBUF on the collection of odometer readings through the vehicle inspection program is feasible.

The Seven Scenarios for MBUF and Flat Fee

1. Flat fee only
2. MBUF only, Odometer reporting only
3. MBUF only, Automated reporting only
4. MBUF only, Hybrid reporting (odometer and automated)
5. Both FF/MBUF, Hybrid reporting (odometer and automated)
6. Both FF/MBUF, Odometer reporting only
7. Both FF/MBUF, Automated reporting only

By the end of the engagement of the subcommittee, the concept of an MBUF-only program collected via odometer reporting through the state's vehicle inspection program (scenario 2) appeared as a feasible approach to subcommittee members.

Since the second RUC Advisory Committee meeting, the project team sorted through the various issues related to implementation of an MBUF system in Vermont, including feasibility and cost. The project team assembled what they regard as the consensus recommendation for a preferred scenario.

The Preferred Scenario

The project team perceives a consensus among advisory committee members that an MBUF-only approach collected through odometer reporting at Vermont's annual vehicle safety inspection program is the preferred scenario. Even so, other odometer reporting methods may have application in certain circumstances, such as a midyear sale of a vehicle.

While feasible, according to the vendor for Vermont's vehicle safety inspection program, DMV cited concerns about additional cost and operational burden to the existing vehicle inspection and DMV systems. DMV requested further examination before the state considers implementation.

The full RUC Advisory Committee met a third and final time on December 22, 2021, to consider the consensus recommendation on the preferred scenario for MBUF and flat fee. Considering practicalities, capital and administrative costs, and potential net revenues, among other issues, the consensus recommendation has five elements:

- AOT should proceed with an MBUF-only RUC system.
- AOT should develop an odometer-based mileage reporting system with odometer readings collected during annual vehicle inspections as the preferred system for generating the necessary road usage data.
- The MBUF should apply only to AEVs and PHEVs and based on all miles driven.
- AOT should consider this MBUF system as feasible for implementation.
- AOT should begin an assessment process involving DMV and its key stakeholders, information technology vendors, and end users to design the optimal system to implement.

No subcommittee member objected when AOT presented this recommendation.

Other issues discussed during MBUF/flat-fee subcommittee meeting:

Types of vehicle drivers to pay an MBUF. On the issue of which vehicles to include in an MBUF program, the subcommittee appeared to prefer to have AEVs and PHEVs in the program. Some subcommittee members thought that MBUF should apply at some point to all vehicles. Another subcommittee member said he would like to see all the vehicles after a set model year in the MBUF program.

Should public and private miles be covered by an MBUF? Members regarded this as an unimportant issue because Vermont highways are overwhelmingly publicly owned.

Rational for Preferred Scenario

Operational Feasibility

Research in other states proves that all seven scenarios have operational feasibility. At least 25 states have enacted an annual flat fee on EVs; two of these states provide an alternative MBUF system to avoid paying the flat fee. Oregon and Utah have implemented operational programs with automated wireless reporting from an on-board device as the only means of reporting mileage data. Hawaii has developed and tested use of mileage data collected by reading odometers at annual vehicle safety inspections. The State of Washington tested an odometer reporting method as part of the vehicle registration process. Thus, all the scenarios presented are operationally feasible.

Questions from the third RUC Advisory Committee meeting:

A member asked whether there is a different rate for PHEVs as opposed to AEVs, given that PHEV drivers pay the fuel tax and AEV drivers do not? *Project Team's Response:* there should be different rates for EVs and PHEVs, consistent with the similar MBUF policies developed for EVs and PHEVs in Oregon and Utah.

A representative of the Vermont Agency of Natural Resources asked whether there was consideration in the preferred scenario of a multiplier applied to the MBUF rate relative to the vehicle's gross weight? *Project Team Response:* The recommendation is the MBUF apply not to medium or heavy trucks; it would only apply to passenger vehicles. The difference in weight at that level is not sufficient to warrant a multiplier. Only with larger vehicles does a multiplier make sense. Chair Michele Boomhower added: "This is one of the areas we need to think about going into the future. How do we capture heavy duty EVs that are coming into the fleet?"

Financial Feasibility

Operational feasibility notwithstanding, not every scenario is financially feasible or desirable for Vermont. Some scenarios simply cost too much to provide adequate net revenues without increasing the MBUF rate. The financial model prepared for this project shows that the operational costs of hiring CAMs to provide automated wireless reporting technology and fee collection as much higher than using odometer readings currently reported at the DMV's vehicle safety inspections.³⁹

The capital costs are also high for the CAM model yet vary by complexity. Because the DMV already collects odometer readings at annual vehicle safety inspections, the capital costs for the odometer approach should be lower but if the user experience is not designed appropriately, there may be additional development costs and potentially additional operational costs in the form of staffing. CDM Smith provided the following order of magnitude MBUF system cost estimates in Table 7 below.

Table 7. MBUF System Cost Estimates

MBUF Mileage Reporting Method	Capital Costs (estimated)	Operational Costs as a Percentage of Revenue (2030)
Automatic wireless reporting (CAM model)	\$2 to 4 million	22% (\$2.4 million)
Odometer reporting at vehicle inspections	\$1 to 3 million	3.5% (\$0.4 million)

Capital Cost Recovery

Recovery of capital costs will come quickly for the preferred scenario of MBUF-only with odometer reading method (see Figure 7). The break-even point is year two of operations. This assumes a

³⁹ See Appendix A for a description of development of the financial model.

moderate scenario for EV adoption, reaching just over 70,000 vehicles in Vermont by 2030, or 12% of the total fleet, and driving an average of 11,600 miles per vehicle per year.

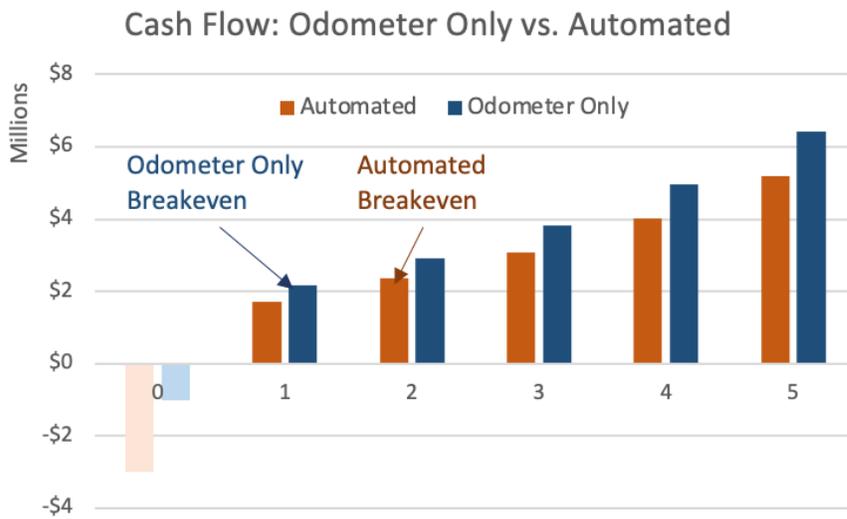


Figure 7. Capital Cost Recovery Comparison for Odometer Only versus Automated Methods

Additional Policy Choices

The simplicity of the preferred scenario yields a minimal number of policy issues for resolution. The remaining policy choices involve protection of privacy, ensuring equity, and whether to provide refunds for MBUF paid for travel out of state.

Protection of Privacy

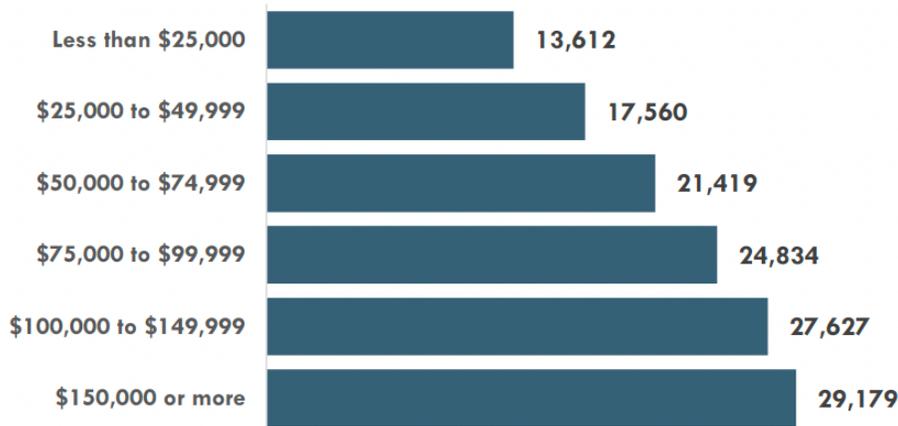
Some MBUF scenarios raise the challenge of protecting sensitive travel data from improper use. While automated wireless technologies with location awareness provide the ability to identify whether miles were traveled within Vermont or outside Vermont, they must generate precise vehicle locations to do so. While other states have identified technological ways to protect data and policies developed in Oregon and Washington show that legislatures can enact legal protections for sensitive data, mere surrender of an odometer number at annual vehicle safety inspections renders the issue moot. Reporting odometer readings cannot generate precise vehicle locations. Furthermore, since mileage data are currently being collected at annual vehicle inspections and are included on inspection reports, this approach will not increase the amount of information being collected.

Many regard the flat-fee approach as a solution to the privacy question. A driver paying a flat fee rather than an MBUF would not have to report any mileage data. An MBUF system that accesses only odometer readings, however, does not need the option of a flat fee because the privacy issue does not arise.

Equity

The subcommittee found the flat fee inequitable, although the simplest and the least expensive to implement and operate. Because the flat-fee approach charges the same amount for every driver notwithstanding how much they drive, those driving very little—many with low incomes—would

essentially subsidize those driving a lot, as shown in Figure 8 below. However, the tendency of drivers with high incomes to own more vehicles upon which to pay the flat fee may offset the subsidization somewhat.



Note: Households without vehicles have been removed from this analysis.

Sources: National Household Travel Survey, 2017; BERK, 2021.

Figure 8. Average Vehicle Miles Traveled of All Household Personal Vehicles by Household Income, US Households (N = 123,447)

Refunds for Travel Out-of-State

From an administrative standpoint, providing refunds for miles driven outside Vermont is prohibitively expensive. The preferred scenario applies an MBUF model similar to collection of the fuel tax in that Vermonters pay the fuel tax whether the miles are driven in Vermont. Vermont should collect the MBUF in the same way, with no concern for the location of the miles driven.

System Assessment for the Preferred Scenario

To ensure the preferred MBUF system for odometer reporting at annual vehicle safety inspections will operate efficiently, with wide public acceptance and at the lowest feasible cost, the project team recommends that AOT should first engage in an assessment process to understand the DMV’s and vendor’s capabilities, stakeholder impacts, end-user impacts and the best ways to manage them. This approach would allow AOT to design the optimal experience for end-users, DMV agents, and vehicle inspection station operators who support the program. The assessment phase should set up AOT for a successful implementation phase to prepare the new MBUF system for operations. The assessment phase would comprise three key activities that run concurrently:

- **A DMV impact assessment** to understand how best to align an odometer-based mileage reporting system implementation with DMV initiatives underway for optimal service delivery (and to avoid disruptions to existing services). The assessment has three main objectives. One, understand organizational capabilities, constraints, and needs to minimize the burden on the DMV and supporting entities such as vehicle inspection station businesses. Two, understand the DMV’s suite of services to identify opportunities to best integrate MBUF so it is simple to administer from the DMV perspective and simple to interact with from the

end-user perspective. Three, understand the DMV's technology roadmap to inform recommendations on how to align MBUF implementation with other initiatives to minimize MBUF implementation efforts and ensure MBUF features can evolve to meet future DMV needs. This activity involves interviews and workshops with DMV representatives and its vendors.

- **A technology assessment** to understand vendors involved and systems that could be leveraged to support odometer-based MBUF reporting. This assessment involves interviews and workshops with the DMV vehicle-registry system vendor (FAST Enterprises) and the vehicle inspection system vendor (Parsons) to understand functions their systems support and the ways their systems could interface to support an odometer-based MBUF program. The technology assessment seeks to answer key questions prior to implementation. Some of the key questions are as follows:
 - **Odometer data collection.** Confirm that the most viable option to collect odometer readings from vehicles, with minimal disruption to vehicle inspection businesses and end users, is the fully manual method of a reading taken by the vehicle inspector with confirmation by photograph. Compare this method with other plausible options for viability.
 - **Odometer data verification.** What are the most effective methods to verify validity of odometer readings collected at inspection stations to minimize the administratively costly dispute processes?
 - **Vehicle engine propulsion type identification.** What methods are available to reliably identify vehicle engine propulsion types, in particular AEVs and PHEVs?
 - **End user validation.** What are the optimal processes for end users to acknowledge or confirm odometer readings that will be used to compute the MBUF? What are the processes for end users to report alternative odometer readings if they dispute readings collected or under unordinary circumstances (e.g., vehicle sale, vehicle loss/theft/destruction)?
 - **Invoicing.** How to present MBUF clearly and simply on the invoice (potentially with other fees)? Which invoicing process to implement that provides simple touchpoints for end users and MBUF administrators?
 - **Payment collection mechanisms.** Which choice of payment means, modes, and frequency could be offered to end users in a cost-effective way? Which payment collection mechanisms could be set up to support different payment options offered?
 - **Payment enforcement.** What are the best mechanisms for enforcement? How are outstanding payments communicated across systems to initiate consequences, such as a hold on renewal registration of the vehicle within the registration system?
 - **Remit fees collected.** Which mechanisms for remitting fees collected to the DMV and reporting data are needed for financial reconciliation?

- **Financial reconciliation and audit.** How will parties involved in payment collection report data to state entities for reconciliation and auditing purposes?
- **Data exchange specifications.** Which data to transfer and between which systems (vehicle inspection system, DMV system)? What is the format and frequency of the data exchanges?
- **Prototype testing** to design and test a minimal viable product that supports an optimal and equitable customer journey. This involves engaging a selection of users across the state in focus groups and participatory design activities to design an MBUF experience that is accessible, simple to use, and easy to comply with. Participatory design means involving a few volunteer users to get their direct feedback on a system prototype built around plausible MBUF workflow and systems from a usability perspective. Prototype testing of a minimal viable product reduces the risk of specifying and implementing a system that is disconnected from user needs. Early user feedback gathered during prototype testing allows for the design and specification of a system that is most suited to end user needs and easy for end-user compliance and thus ready to be implemented with minimal risk for the agency. Besides offering a positive user experience, a user-oriented system design helps minimize customer support costs and unnecessary enforcement costs. This activity will also investigate introduction of relevant equity measures to make MBUF payments more accessible to different population segments (for example, payment plans). This engagement should answer preliminary questions on the best ways to engage with end users during the following touchpoints:
 - **Data collection and acknowledgment.** What are the best ways to capture an odometer reading in ordinary circumstances (regular inspection checks) and unordinary circumstances (for example, vehicle sale)? Should end users be offered the opportunity to dispute odometer readings collected at vehicle inspection stations, and if so, which process flows should be offered?
 - **Invoicing.** Who should distribute the invoices? How should the invoices be distributed? Should MBUF be combined with other fees? Which invoice layouts convey the MBUF in the simplest and clearest way possible? What messaging should be included on invoices to make it easy for end users to comply with payment requirements?
 - **Payment.** Where should payments be collected? What payment choices should be offered for equity purposes?

The outcomes of the assessment phase are design documents for a ready-to-implement odometer-based system for the implementation phase. These design documents include the following, which technology vendors will use to develop the odometer-based system:

- **Concept of Operations:** based on the minimal viable product tested during the prototype testing phase. It describes how the overall system should be operated. It includes key usage scenarios that involve end users and agency staff members;
- **System Requirements Specifications:** describes key technical functions of the system.

- Interface Control Documents: specifies data exchanges between the different systems that have to be integrated for a cohesive user experience.

The implementation phase includes validation of system specifications, development, testing, and communications with impacted stakeholders prior to launch.

PART FOUR

PER-KILOWATT HOUR FEE

Per-Kilowatt Hour Fee

This part discusses a per-kWh fee, one of three features of the original Vermont RUC concept. Note that Vermont AOT will not move forward with the per-kWh feature because its revenue-generating potential is too low and knowledge on required technology's maturity is too limited to pursue implementation at this time.

This part will present background, analyses of systems and policy choices, and the financial realities that motivated AOT to move away from a per-kWh implementation and instead recommend a research program to further understand choices and impacts to inform future decision-making.

A per-kWh fee on electricity transfers at public charging stations has the characteristics of a proxy-based usage fee. It varies by electricity used to charge a vehicle and can be imposed on vehicle drivers from out of state. However, because public charging stations are not the only source of electricity (or for PHEVs, not the only source of energy), a state cannot feasibly apply a per-kWh fee universally to all road usage.

Accordingly, the Vermont per-kWh fee concept would impose a per-unit assessment on the amount of electricity transferred into an EV at all public charging stations in the state, or a specially selected grouping of stations, as an additional charge on top of a base electricity rate. Because other revenue mechanisms do not allow the capture of nonresident EV travel in Vermont, the original design of the per-kWh fee was expected to enable capture of RUC on such travel.

History of Per-kilowatt Hour Fees in the United States

Several RUC concepts have emerged to charge electricity, rather than impose an annual flat fee or MBUF for road use by EVs, to allow supplementation or replacement of traditional fuel taxes. This idea has slowly developed because conceptual application of a per-kWh fee to a state's residents' EVs revealed impracticalities. While a state can easily impose a per-kWh fee at public charging stations, applying the same fee to *at-home charging*—the place where most EV charging occurs—proved expensive, invasive, and ineffectual because of electric rate structure and technical challenges to segregating EV charging from all other residential electric uses.⁴⁰ Still, by applying the per-kWh fee only at public charging stations, the principal payers may well be nonresident drivers who need access to charging before heading home across state lines.

Two states have recently enacted laws imposing per-kWh taxes specifically on EV charging.⁴¹ Iowa and Oklahoma enacted legislation imposing per-kWh taxes on electricity charging for EVs, but neither state has implemented such a tax to date. Enacted in 2019, the Iowa law imposes per-kWh taxes on all nonresidential EV charging beginning July 1, 2023. The Oklahoma Legislature passed legislation in 2021 imposing per-kWh taxes on all public electric vehicle charging beginning

⁴⁰ Source: Vermont Public Utility Commission, Report to the Vermont State Legislature: Supplemental Electric Vehicle Report Submitted Pursuant to Section 35 of Act 59 of the 2019-2020 Vermont Legislative Session, December 13, 2019. Available from: https://puc.vermont.gov/sites/psbnew/files/doc_library/EV-Supplemental-Report.pdf.

⁴¹ Pennsylvania and Ohio have general electricity taxes broadly applied across nearly all electricity uses rather than a particular type of electricity usage. Neither is well utilized.

January 1, 2024. The information released about how these two states will actually implement these laws is limited or nil at this point.

Iowa's enacted legislation (HF 767) primarily focuses on extracting revenues from EV owners by imposing special annual registration fees on AEVs and PHEVs in addition to the standard annual registration fee. Iowa's law also authorizes collection of a \$0.026 per-kWh fuel excise tax for EV charging at nonresidential locations. The law requires collection of this new fee at the point of sale and paid by licensed electric fuel dealers and users (also known as dispensers) "in a manner prescribed by the department [of revenue]."⁴² The law requires computation of the tax by multiplying the tax rate by the number of kilowatt-hours delivered or placed into the EV.

This policy intends for collection of Iowa's per-kWh excise tax in a manner similar to the state's excise fuel tax.⁴³ This law does not prohibit dispensers from passing the cost of the per-kWh tax on to end customers (EV owners charging their vehicles), nor does it prescribe how to pass along such costs. This law does not differentiate electricity charging of resident EVs from nonresident EVs. Thus, both resident and nonresident drivers would pay the cost of the per-kWh tax should the station operator pass it on in some form of increased prices.

The Oklahoma-enacted legislation imposes a tax of \$0.03 per-kWh on the electric current used to charge the battery of an AEV or PHEV at public charging stations beginning January 1, 2024. This law does not differentiate treatment of resident EV owners from nonresident EV owners, as both must pay the per-kWh tax at point of sale. The Oklahoma law requires public charging stations to use a metering system capable of imposing the cost for the charging service using a unit per kWh hour or a comparable measurement such as time elapsed while charging. The law exempts legacy charging stations in operation prior to November 1, 2021, from tax collection if these stations never had a metering system in place capable of measuring the transfer of electricity to the vehicle or never charged a fee for use of the charging session.

Per-Kilowatt Hour Fee Analysis

The consulting firm CDM Smith presented a technical memorandum at the second RUC Advisory Committee meeting on the per-kWh fee design options. The presentation included the challenges, opportunities, and options for the per-kWh fee, providing analysis on key policy and system design choices and the feasibility of the per-kWh fee for Vermont.

Per-Kilowatt Hour Fee System Definition

The Vermont Public Utilities Commission (PUC) prepared a report to the state legislature at the end of 2019 on the feasibility of levying a per-kWh fee on all EV charging in Vermont.⁴⁴ The PUC report revealed impracticalities of applying a per-kWh fee to EVs registered in Vermont. However conceived, applying a per-kWh fee to at-home charging—the place where most EV charging

⁴² Section 24 of House File 767 of the 2019 Iowa Legislature.

⁴³ Source: Iowa Department of Transportation, *2018 Report on the Impact of Electric Vehicles to the Road Use Tax Fund*, available at <http://publications.iowa.gov/29142/1/EV%20RUTE%20Impact%20Report%20123118.pdf>.

⁴⁴ Source: Vermont Public Utility Commission, Report to the Vermont State Legislature: Supplemental Electric Vehicle Report Submitted Pursuant to Section 35 of Act 59 of the 2019-2020 Vermont Legislative Session, December 13, 2019. Available from: https://puc.vermont.gov/sites/psbnew/files/doc_library/EV-Supplemental-Report.pdf.

occurs—remains expensive and ineffectual because of the technical challenges of segregating EV charging from all other residential electric uses.

Owing to these practical obstacles and the impossibility of equitable enforcement, the Public Utilities Commission recommended the state not impose statewide per-kWh fees on EV charging by Vermonters. Rather, the PUC raised the possibility of “having a per-kWh fee apply to charging performed at publicly available charging stations, where out-of-state drivers are most likely to recharge their cars.” National EV charging network operators own and operate many of the public charging stations in Vermont. Sometimes the public charging offered is free.

Evaluation of the feasibility of imposing a per-kWh fee at public charging stations must consider Vermont’s ability to meet its greenhouse gas emission goals, including the essential component of increasing purchase and usage of EVs in the state. Accordingly, implementation of a per-kWh fee must not hamper the deployment of EV charging infrastructure in the state. Presumably, imposing a fee on EV owners would meet this test if it was no more costly than the fuel tax for those driving a standard ICEV and did not differ much in ease of compliance.

Levels of Charging Equipment

Recharging EV batteries occurs at three levels of energy transfer. Level 1 is 120 volts, the slowest and typically found as electrical outlets in homes. Level 2 is 208 to 240 volt, at medium speed and found to power clothes dryers. Level 3 is 480 volt to 900 volt, Fast Charging and Supercharging (the fastest charging available).

EV public charging stations generally employ a mix of level 2 and 3 charging equipment. These stations also price electricity transfers under different business models. Some price electricity transfers based on kWh while others on time of use of the charging equipment. Beneficial charging stations offer electricity charging for free. Characteristics of Vermont’s most used public charging networks are summarized in Table 8 below.

From Second RUC Advisory Committee meeting:

Chair Michele Boomhower reported that the state of Vermont spent a couple of years trying to determine whether there was a reliable way to collect this per-kWh fee from all EV charging but could not come to a technological viable solution because some people would choose Level 1 charging that would be undetectable.

Table 8. Characteristics of Vermont’s Most Used Public Charging Networks

Public Charging Network	Charging Speed Level	Charging Time (up to 80% of battery capacity)	Pricing/Cost of Charge		Payment Options Basis
			Electricity used	Per-Minute	
			[\$/kWh]	[\$/min]	
Blink	AC Level 2 (240 volt)	65 miles per hour	Blink Member: \$ 0.2–0.49 per-kWh Blink Guest: \$0.59 per-kWh	Not applicable	Easy payment* via Radio Frequency Identification (RFID), Apple Pay, Google Wallet, and all major credit cards
	DC Fast Charging (Level 3)	10-30 minutes	Not applicable	\$0.35 per minute	Authentication Method-RFID: MI-FARE ISO/IEC14443A/B, ISO/IEC15693, ISO/IEC18000-3, FeliCa, NFC. Optional contactless or 3-in-1 (region dependent)
Tesla	DC Fast Charging (Level 3)	15 miles per minute	\$0.28 per-kWh (most common for Tesla network) Idle fees apply to any full charged car occupying a supercharger Fee of \$0.50 per minute if the station is at least 50% full, and a fee of \$1.00 per minute when the station is 100% full	When billing per minute, there are two tiers to account for changes in charging speeds, called tier 1 and tier 2 Tier 1 applies while cars are charging at or below 60 kW and tier 2 applies while cars are charging above 60 kW. Tier 1 is half the cost of tier 2.	Tesla app for iPhone and Android to control and remotely monitor Tesla's products
Charge Point	AC Level 2	25 miles per hour	Not applicable	\$0.52 per hour	RFID card, mobile app, calling customer support and contactless debit and credit cards
	DC Fast Charging (Level 3)	30–60 minutes	The pricing across the network is very inconsistent; \$2 per charging session + \$0.35-0.53 per-kWh	Not applicable	
	DC Fast Charging (Level 3)	10 minutes		Not applicable	
EVGo	AC Level 2	20 miles per hour	Not applicable	Pay as you go (\$1.5 per hour)	Credit and debit cards
	DC Fast Charging (Level 3)	75 miles per 30 minutes	Not applicable	Pay as you go (\$0.35 per minute, 60 minute time limit); Membership: \$0.31 per minute but save 10% off per minute with charging commitment of \$7.99 per month (60 minute session time limit)	

Public Charging Network	Charging Speed Level	Charging Time (up to 80% of battery capacity)	Pricing/Cost of Charge		Payment Options Basis
			Electricity used	Per-Minute	
			[\$/kWh]	[\$/min]	
Electrify America	AC Level 2	25 miles per hour		Pay as you go (\$0.03 per minute with idle fee of \$0.40 per minute)	Credit and debit cards
	DC Fast Charging (Level 3)	30–50 miles per 30 minutes (25 kW charger); 80–180 miles per 30 minutes (150 kW)	Not applicable	Pay as you go and Pass Member (\$0.43 per-kWh); Pass+ Member: 1-90kW: \$0.31 per-kWh plus \$4 monthly fee 1-350kW: \$0.24 per-kWh plus \$4 monthly fee; Idle fee: \$0.40 per minute	Guests: swipe or tap credit card to pay; Members: contactless payment using cell phone

Charging Infrastructure Business Models

The market for EV charging infrastructure follows two primary business models:

- Owner-operator of charging station infrastructure
- Third-party owned and operated charging station infrastructure

In the owner-operator business model, the site host owns and operates the charging station infrastructure. The owner-operator has complete control over the kWh price to charge EVs and is also responsible for working with their electric utility company, obtaining permits, coordinating station maintenance, and covering any operating costs associated with the charging infrastructure.⁴⁵

In the third-party owned and operated business model, the site host leases space to a third-party (for example, Tesla, Volta, and others) who installs and operates the charging infrastructure. In this case, the site host collects rent from the third party but otherwise typically has limited or no control over the per-kWh price for customers to charge their vehicles and is not responsible for station maintenance, utility coordination, or other operational costs.

For the owner-operator business model, the pricing management and customer payment (collection of per-kWh fees) requires a charging station management software that is typically purchased from a charging service provider such as Blink, ChargePoint, or Electrify America. This software allows network access for owner-operators to track charging station usage and makes the station locatable via mobile application-based software.

Site-host owners or the charging network owners typically establish pricing rates for EV charging. Common pricing structures include by kilowatt-hour, by session, by time of use, or through a subscription. While public charging stations now commonly charge a fee for the use of charging infrastructure, more than 50% of public charging is free to use.

⁴⁵ Source: Charles Satterfield and Nick Nigro, Atlas Public Policy, Washington DC, Public EV Charging Business Models for Retail Site Hosts: A Financial Analysis of Common EV Charging Business Models for Retail Site Hosts, April 2020. Available from: <https://atlaspolicy.com/wp-content/uploads/2020/04/Public-EV-Charging-Business-Models-for-Retail-Site-Hosts.pdf>

Challenges and Opportunities

The challenges to implementing the per-kWh fee concept are:

- What are the business processes for paying the per-kWh fee?
- How does the money flow from the payer to the government agency?
- How to ensure the accuracy of per-kWh measurement?
- How to recover the added cost of new data collection and billing system upgrades for per-kWh measurement and fee collection?
- How to maintain a low cost of collection?
- How to ensure only nonresident EV drivers are responsible for the per-kWh fee?
- How to protect the privacy of sensitive personal information?

Business Processes for Paying the Per-kWh Fee

The per-kWh fee concept is a transaction-based process rather than the account-based process required for MBUFs. The obligation to pay the per-kWh fee occurs as a result of electricity transfer to an EV.

Per-kWh Fee Functions

The following basic functions prepared by CDM Smith compose the business process for a per-kWh fee collection system at public charging stations:

- **Identify subject vehicle and its owner/lessee**—the owner/lessee of an EV presents themselves as a payer when accessing electricity at a public charging station.
- **Generate kWh data for subject vehicle at public charging station**—the public charging station equipment accurately measures the data for kWh transferred at a public charging station event. This is a function carried out by the owner/operator of the public charging station.
- **Access per-kWh data**—this means receiving the kWh consumption data from the electricity transferred to EVs vehicles and storing it in an accounting system. This is a function of the entity obliged to pay the per-kWh fee.
- **Apply per-kWh rates**—processing the kWh data to determine the amount of taxes owed. This is a function of the entity obliged to pay the per-kWh fee.
- **Provide invoice to EV owner/lessee (if end user payment model is adopted)**—provide vehicle owner a notice of the tax owed. If the EV owner pays the per-kWh fee at retail, this is a function of the owner/operator of the public charging station.
- **Collect payment**—support various payment options, including credit cards and, in mandatory systems, cash. If the EV owner pays the per-kWh fee at retail, this is a function carried out by the owner/operator of the public charging station.
- **Issue acknowledgement of payment**—provide receipts for payment. If the EV owner pays the per-kWh fee at retail, this is a function of the owner/operator of the public charging station.

- **Enforce payment**—provide means of fraud detection and consequences to ensure most everyone pays. Fraud detection is a shared role of the owner/operator of the public charging station and the state, but serious consequences (for serious fraud) is a role of the state.
- **Remit revenue to appropriate fund**—this is a shared role of the entity obliged to pay the per-kWh fee and the state. The entity obliged to pay the per-kWh fee typically remits all funds to a single account, and the state treasury then routes those funds further as required by law.

Who Pays the Per-kWh fee and How does the Money Flow?

The options for who pays the per-kWh fee are:

- **EV owner pays fee at point of sale.** If the EV owners pay the per-kWh fee at point of sale, a number of issues arise. Many public charging stations do not bill EV owners by kWh in every instance because they have business reasons to bill otherwise. Instead, they may bill by time of use, which cannot be converted into kilowatts because EVs receive electricity at different speeds, depending on the technology of the vehicle and charging station, the age of the battery, and how full the battery is when charging. Requiring a public charging station to implement a per-kWh fee at the point of sale may require billing system upgrades and installation of dedicated meters at each charging stall (technically known as a pile) because research shows discrepancies between the electricity measured by the utility-owned revenue-grade meters and the electricity measured by EV charging equipment.⁴⁶ According to the PUC, “These discrepancies could . . . affect the accuracy of a customer’s EV-specific electricity usage calculations when applying . . . a per-kWh fee.”⁴⁷

While costly to the charging station owner, this option has the advantage of offering the EV owner accurate detailed receipts indicating the per-kWh fee paid, which could facilitate a refund or credit program for resident owners of Vermont-registered vehicles against the MBUF or flat-fee RUC they pay.

- **Charging station owner/operator pays fee.** The Vermont PUC recommended in its 2019 report to the legislature that since the per-kWh fee would be a volumetric levy with the kWh as the unit of volume, the state could collect the fee in a manner similar to collection of the fuel tax. The fuel tax model would be appropriate because it obligates the operator of the [EV charging] station to collect and remit that tax. This would require either a dedicated utility meter or an accurate submeter to measure the electricity consumed by EV charging at the station.”⁴⁸ In other words, the state would charge the fee on the charging station owner, who would then make the

Discussion from Second RUC Advisory Committee meeting:

Requirement to display per-kWh price. One member noted that Vermont state law requires that the kWh-hour price must be displayed. To complicate things, it appears public charging stations can still charge a hookup fee and time fee. There is a good argument to disallow this as it makes it difficult for customers to compare prices.

⁴⁶ Source: Vermont Public Utilities Commission, *Report to the State Legislature*, June 27, 2019. Available from: https://puc.vermont.gov/sites/psbnew/files/doc_library/EV-Supplemental-Report.pdf

⁴⁷ Ibid.

⁴⁸ Source: Vermont Public Utilities Commission, Report to the Vermont State Legislature: Supplemental Electric Vehicle Report per Section 35 of Act 59 (H.529) of the 2019-2020 Vermont Legislative Session, December 13, 2019. p 18. Available from: https://puc.vermont.gov/sites/psbnew/files/doc_library/EV-Supplemental-Report.pdf

likely decision of building the fee amount into the electricity rate at the point-of-sale.

This approach does not generate detailed receipts of the actual per-kWh fee paid. Instead, the system could allow resident EV owners to use the electricity purchase receipts to present as evidence a calculated estimation of the per-kWh fee embedded in the electricity price to obtain a credit against the MBUF or flat-fee RUC they pay.

- An alternative is for the EV owner to present an official card or other identification, such as a Vermont driver's license, legally exempting them from payment of the per-kWh fee embedded in the electricity price and receive a discount on the price. The station owner could accumulate data of the number of discounts granted to receive a credit against the per-kWh fee the station owes to the authorized agency once per month, and the station operator could receive a rebate of such an amount from the state.
- **Electric utility pays fee.** The simplest approach would apply the per-kWh fee at the utility level based on the amount of electricity consumed at the public charging station. As the per-kWh fee should not apply to electricity uses other than EV charging, the utility or stations would have to add dedicated metering capabilities to the stations or perhaps deduct an approved standard offset for charging station operations unrelated to directly charging vehicles and adjust the fee rate accordingly. This approach would not generate the necessary detailed receipts as evidence for a resident EV owner credit for per-kWh fees paid against an MBUF or flat-fee RUC. The alternative of the EV driver presenting an official tax exemption card for a discount does not seem viable either as the utility is not involved in the electricity charging transaction.

Discussion from second RUC Advisory Committee meeting:

Billing wholesale processors. Chair Michelle Boomhower reported that, in agreement with utilities, AOT is going to pursue the notion that there are 26% of fuel tax paid by non-Vermonters and it may be a similar percentage for EV charging. Vermont's utilities talked about the potential of billing wholesale processors a fee because they know the per-kWh they deliver to charging stations. A further deep dive with utility partners would be useful.

What about Free Charging Stations?

If the commercial public charging stations collect or pay per-kWh fee, the question arises whether the free public charging stations should also collect or pay the fee. Presumably, the charging stations offering free power for EVs would not pay the per-kWh fee because there is no sale for the transfer of electricity into the EV. Legislation could mandate that free charging stations collect the per-kWh fee anyway, requiring operators to acquire all the necessary point-of-sale transaction equipment and software, as well as accurate metering infrastructure to enable the fee collection. This seems unlikely given the benevolent motivations of the for-free charging station sponsors in the context of Vermont's climate change goals.

A decision not to include the free public charging stations in the mechanism for collecting per-kWh fees should be evaluated for its impact on fee avoidance on the part of nonresident EV drivers. Depending on the size of the collection of nonresident EV drivers able to avoid the fee, allowing no-fee charging could undermine application of the per-kWh concept.

Even if Vermont decided to include free public charging stations in the obligation to pay a per-kWh fee, certain stations may deserve an exemption because they serve only Vermont residents. Eligibility for special treatment may include those stations sponsored by churches, libraries, or certain workplaces. Ideally, businesses that serve tourists would not receive exemptions. The legislature would have to specifically define these exemptions.

Exemptions for Legacy Charging Stations

Should Vermont want to minimize the disruption of requiring all public charging stations to update existing business processes to implement collection of the per-kWh fee, the legislature could exempt legacy charging stations currently without the necessary equipment from application of the per-kWh fee, as the state of Oklahoma did with its pre-kWh tax, and establish a date certain for compliance for all new charging stations and those adding charging capacity.

Discussion from Second RUC Advisory Committee meeting:

Exemptions for resident EV drivers. One member was not sure the state can exempt Vermonters from paying this fee. It is unclear if there will be enough Vermonters charging their EVs at public charging stations for this to be a concern.

Which Agency Collects the Per-kWh Fee and Provides Enforcement?

Regardless of how collection of the per-kWh fee occurs, the arrangement will be similar to collection of the fuel tax in that collection occurs upstream from the end consumer in a volume-based retail transaction. On a monthly basis, the owner/operators of public charging stations (or utilities) would remit the fees collected to the state. In this case, the Vermont PUC expects the DMV would receive the fee revenues.⁴⁹ Enforcement of the per-kWh fee would happen in a manner similar to the fuel tax. The PUC has opined that enforcement authority for the per-kWh fee should rest with the DMV and the Attorney General.⁵⁰

Discussion from Second RUC Advisory Committee meeting:

Sales tax alternative. Some members suggested that because a per-kWh fee seems complicated and impractical with all the different systems and metering, maybe a sales tax (based on percent of dollars paid for charging) is best way to go. Retailers can provide a Vermont resident discount if they so choose.

Another possibility for the collection of per-kWh fees is the Department of Taxes, which already collects an assortment of taxes from various businesses. The Department of Taxes has available statutory collection and enforcement tools for those evading their obligation or late on payment.

Policy Questions for Per-kWh Fee Implementation

How will residents owning EVs registered in Vermont be assured they will not endure the responsibility of paying the per-kWh fee?

Possibilities for assuring that only nonresident EV drivers pay the per-kWh fee:

⁴⁹ Source: Vermont Public Utilities Commission, Report to the Vermont State Legislature: Supplemental Electric Vehicle Report per Section 35 of Act 59 (H.529) of the 2019-2020 Vermont Legislative Session, December 13, 2019, p 18. Available from: https://puc.vermont.gov/sites/psbnew/files/doc_library/EV-Supplemental-Report.pdf.

⁵⁰ Ibid, p 19.

- **Input of discount code.** Resident EV owners could input a discount code (similar to retail advantage programs) at the point of charging and receive a discount equal to the fee.
- **Present official exemption ID.** Resident EV owners could present an official card or other identification, such as Vermont driver's license, exempting them, by law, from payment of the per-kWh fee embedded in the electricity price. The public charging station would offer a discount on the price of electricity to the EV owner equal to the amount of the embedded fee.
- **Present receipts to obtain credit.** Resident EV owners present receipts for payment of electricity charges at public EV charging stations to the authorized agency to obtain a credit of per-kWh fees paid toward the MBUF or annual flat-fee amount owed.

Discussion from third RUC Advisory Committee meeting:

A member commented that the challenge here is segregating in-state and out-of-state drivers. "Can you just call it a convenience fee for using public charging stations to avoid the complexity?" *Project Team Response:* It is possible, but equity issues come up because many of the local drivers visiting public charging stations may do so because they do not have a charging system at home.

Application of the Commerce Clause

This different treatment of nonresident EV drivers from resident EV drivers should not run afoul of the US Constitution's Commerce Clause because the resident EV drivers will pay either the MBUF or annual flat fee instead of the per-kWh fee, while the nonresident EV drivers will pay only the per-kWh fee. As long as the fee rates are similar in impact, based on previous rulings, the U.S. Supreme Court should find that payment of different fees by nonresident drivers and resident drivers does not violate the Commerce Clause.⁵¹

Avoidance of the Per-kWh Fee

Unlike the flat fee and MBUF, drivers can *avoid* a per-kWh fee on public charging stations by sourcing energy from alternative electricity sources such as private residences. As a usage-based fee, a per-kWh fee will increase and decrease in revenue based on the amount of road travel, particularly for vehicles traveling far from the home of the owner, or from state borders (beyond which there are public charging stations without such a fee). However, a per kWh fee is likely to be more sensitive to price levels changing behavior than either an MBUF or a flat fee. That is because the taxed behavior has more readily available alternatives. To avoid a flat fee would require not owning the vehicle in the state, and to avoid the MBUF would require not driving within the state (evasion of both would be more onerous, but still possible). To avoid a per-kWh fee for AEVs means avoiding public charging stations subject to the fee in Vermont or for PHEVs to use gasoline instead.

Updated Per-kWh Fee Estimates

The basis for a per kWh fee for public charging facilities only is fundamentally different from that for a flat fee or a MBUF. Given that the majority of charging (perhaps as high as 80%, or even higher if including workplace charging) of AEVs and PHEVs is done at home, such a fee is not able to recover a similar proportionate level of revenue from such vehicles *on average* as it could only

⁵¹ Source: *RUC and The Commerce Clause and other provisions of the United States Constitution (unpublished)*, a report prepared for the Washington Road Usage Charge Steering Committee, March 14, 2019.

recover revenue for a subset of vehicle charging.⁵² Such a fee applying only to non-Vermont registered AEVs and PHEVs would also be unable to recover a proportionate level of revenue, although it is unclear what proportion of fuel refueling and AEV/PHEV charging in Vermont is undertaken for out-of-state registered vehicles.

Previous analysis proposed a rate of \$0.034 per kWh in Vermont as a revenue replacement rate; inflation adjustment of that rate would update it to \$0.04 per kWh. If such a fee were to apply to *all* AEVs and PHEVs, then it would only apply to around 20% or less of charging (as a proportion of total charging) by Vermont residents. If only applied, however, to non-Vermont AEVs/PHEVs, then the per-kWh fee should capture most of such users unless there were exceptions for charging at hotels, resorts, offices, and similar businesses.

It is assumed that the purpose of any per-kWh fee for public charging facilities is *not* to seek to recover an equivalent proportion of revenue from AEVs and PHEVs as is done for gasoline-powered vehicles but rather to recover revenue for the fuel taxes avoided by nonresident AEV and PHEV drivers. The appropriate per-kWh fee depends on the amount of revenue sought from such vehicles and on the elasticity of demand for use of public charging stations instead of other alternatives. To establish this would require surveys of AEV and PHEV owners to indicate the proportions willing to pay different prices for public charging stations versus charging out of state or using gasoline (for PHEVs). A fee of \$0.04 per kWh might be efficient in recovering revenues from out of state AEVs/PHEV drivers, as it might be broadly equivalent to the fuel tax, as long as the costs of collection (and fraud mitigation) were kept sufficiently low.

Examining the Advisability of Proceeding with a Per-kWh Fee

At the second meeting, the AOT and the RUC Advisory Committee agreed upon the need for additional research and considerations before determining how to go forward, if at all, on a per-kWh fee system for public charging stations. AOT announced the agency would assemble an ad hoc working group made up of distribution utilities, the DMV, and other local experts to determine the advisability of a per-kWh system for Vermont. The ad hoc working group would meet with the objective of unravelling the issues discovered so that the project team could recommend a direction going forward.

The Utilities Weigh-In on Per-kWh Fee

The ad hoc working group met on October 27, 2021.⁵³ Although not part of the RUC Advisory Committee, several of Vermont's utilities offered opinions and local knowledge helpful to understanding the advisability of a per-kWh fee for Vermont. Utilities that participated in the meeting were Green Mountain Power, Burlington Electric Department, Stowe Electric, VT Electric Cooperative, and the Vermont Public Power Supply Authority, which represents 11 locally owned and democratically run municipal electric utilities in Vermont.

⁵² Source: <https://www.drivetricelectricvt.com/charging-stations/public-charging-map>

⁵³ Participants in the Ad Hoc Working Group on per-kWh fees included Michele Boomhower, Joe Segale, Patrick Murphy, Dan Dutcher of AOT and Micah Howe, staff attorney for the Vermont Public Utility Commission; Melissa Bailey, Government and Member Relations for the Vermont Public Power Supply Authority (VPPSA); Philip Picotte, Vermont Department of Public Service; Sarah Ludwin-Peery of Green Mountain Power; Michael Smith, DMV Director; and Tom Lyle, program and policy manager for Burlington Electric Department.

Burlington Electric Department is opposed to a per-kWh fee. Burlington Electric Department noted the per-kWh fee technical memo did not reference the municipal owned network. If Burlington Electric Department were to collect a tax, they would add the tax to the tariff set by the PUC.

Burlington Electric Department does not think the idea of exemptions and use of identification cards would work. The payment transaction would provide zip code data to identify most residents and nonresidents. However, public charging stations would miss the information when people pay by credit card or do not have the zip code information in their account.

The Vermont Public Power Supply Authority (VPPSA) representative said the EVSE owner could be charged the per-kWh fee through a straightforward process. Every public charging station could be required to have a utility-grade meter to provide the necessary kWh usage to collect the per-kWh fee. A surcharge could be added to a driver's bill and remitted to the DMV. An important concern is that not every EVSE has a utility-grade meter. Installing a utility-grade meter must be a requirement for the program. VPPSA estimates the meters range from \$600 to \$1,000 to install.

Philip Picotte of the Vermont Department of Public Service said he is still not convinced that the distribution utility is the best avenue to collect per-kWh fee compared to the public charging station operator. Picotte expressed concern about who bears the cost of outfitting with the utility-grade meters. The VPPSA representative thinks these costs could be passed on to drivers.

Picotte said that a small number of public charging stations are not connected to anything. They have level 2 charging stations, which are generally free or by donation. The town pays for the electricity through its electric bill.

The VPPSA representative said that as we “keep slicing the pie smaller and smaller,” the amount that gets collected for the per-kWh fee starts getting so small that it might no longer be worth the effort. Chair Michele Boomhower recommends that we “slice and dice to see how small the number is.”

After further discussion, the ad hoc working group agreed upon the following,

- If utilities are responsible for collecting the per kWh fee, every EVSE will need to be metered. Any regulatory or statutory requirements need to be determined.
- It is feasible to use revenue-grade meters in public charging stations and place a fee on the EVSE. The difficulty is cost recovery—who pays for the additional meters?
- As an alternative to utilities collecting the per-kWh fee, it may be possible for charging networks such as ChargePoint to collect the fee. This approach could eliminate the need for separate meters at each EVSE. Feedback from charging network companies is needed to determine if this option is possible.
- To inform understanding of the options, more information is needed about existing EVSEs, including how many are metered, how many are free, ownership, and current percentage of in-state and out-of-state users.
- AOT learned that because of the high cost of giving refunds and the uncertain administrative challenges, it appears there is no interest in giving refunds for the flat fee or MBUF payments for Vermont residents that use public charging stations.

Financial Realities of the Per-kWh Fee

Following the meeting of the Ad Hoc Working Group, AOT analyzed the current revenue potential of establishing a Per-kWh Fee for nonresidents to pay at Vermont charging stations. The purpose of this analysis was to determine whether it is sensible to establish a per-kWh fee in Vermont at this time, especially with limited knowledge on the maturity of the technology required to reliably capture information on electricity transferred to vehicles at public charging stations across the state.

To determine the estimated annual net revenue generated by a per-kWh fee on nonresident drivers, the analysis:

- Estimated the total annual electricity, by kWh, transferred at public charging stations in Vermont by multiplying an estimate of the average annual usage per charging station by the estimated number of public charging stations in Vermont
- Determined how much of this transfer to attribute to nonresident drivers
- Applied a per-kWh fee rate to the total assumed kWh transferred annually to nonresident vehicles to calculate the estimated revenue generated
- Determined the costs of measuring electricity consumption and administering the per-kWh fee to calculate whether assessing the fee is financially viable

Using optimistic assumptions,⁵⁴ the AOT's analysis estimates that a per-kWh fee on electricity transferred to nonresident vehicles will currently generate approximately \$5,000 in revenue per year (Table 9). Therefore, the AOT concludes, and the project team agrees, there is little value in establishing a per-kWh fee for nonresident drivers at this time.

⁵⁴ **1650 kWh transferred to vehicles annually on average per public charging station in Vermont.** This is the combined average of annual usage per public charging station for Green Mountain Power (GMP) and Burlington Electric Department (BED). The combined average is based on the average of BED's 17 stations of 4,610 kWh per year and the average of GMP's 81 charging stations of 972 kWh per year. BED's charging stations are located primarily in the Burlington area; whereas GMP charging stations are located throughout the state in smaller cities. $[(17 \times 4610) + (81 \times 972) = 1603]$.

311 public charging stations where a per-kWh fee can be collected. This is the current number of public charging stations shown on the Drive Electric website. This analysis assumes it is technically possible to collect a fee at all these stations, a status which is unknown at this point, but improbable.

25 percent of nonresident drivers currently using public charging stations in Vermont. This analysis uses 25 percent because it is consistent with reported gasoline sales by non-Vermonters based on credit card receipts. This assumption is greater than the percentage of nonresident drivers using public charging stations owned by GMP (13 percent)⁵⁴ and BED (16 percent)⁵⁴, but the consumption of electricity by nonresident drivers in Vermont may come up to par with current gasoline purchases.

3.4 cents per kWh is the assumed per-kWh fee rate. This is the fee rate identified in Act 12: Section 28 Report (2013). A Study on Replacing Motor Fuel Tax Revenues Not Collected from Plug-In Electric Vehicles.

Source: These assumptions were made by the Vermont Agency of Transportation in November 2021.

Table 9. Per-kWh Fee Revenue Estimation for 2021

Usage per Year per Station (kWh)	1,650
Number of Public Charging Stations 2021	311
Total Usage (kWh)	513,150
Percent Out of Stater Drivers	25%
Total Usage by Out of Stater Drivers	128,288
Per-kWh Fee Rate	\$0.034
Total Estimated Revenue Generated in 2021	\$4,362

The technical implications, and thus costs, to measure electricity usage from potentially heterogeneous public charging stations are largely unknown. In the absence of a structural framework and standards for public charging stations to measure and report electricity transferred to vehicles, it does not seem sensible to establish a per-kWh fee in the near term.

The AOT should continue to research the topic to better understand the key stakeholders involved and conditions which will indicate value for a per-kWh fee on nonresident drivers in the state. This research can aim to identify potential issues for a charging network to collect the fee and cost implications for the state. Research findings will ultimately inform the structural framework required to collect the per-kWh fee reliably and consistently.

Research Program for the Per-kWh Fee

The RUC advisory committee met a third and final time on December 22, 2021, to consider AOT's financial analysis of the per-kWh fee and discuss a research program on the per-kWh fee concept recommended by the project team.

As an outcome of the meeting of the ad hoc working group, the AOT concluded too little is known about how to technically implement a per-kWh fee and its cost implications to go forward at this time. Given the limited knowledge on the maturity of the technology required to reliably capture information on electricity transferred to vehicles at public charging stations across the state, the project team recommended that AOT undertake a research program before proceeding with any formal action to implement a per-kWh fee.

Research Program for Per-kWh Fee

To determine when conditions become appropriate for establishment of a per-kWh fee on nonresident vehicle charging, the State of Vermont should undertake a research program to inform future decision-making. Given the expected growth of EVs in Vermont and neighboring states later this decade, a per-kWh research program should reveal essential information relevant to the advisability of proceeding with a per-kWh fee in the state.

It may become financially viable to establish a per-kWh Fee on the transfer of electricity to nonresident vehicles at public charging stations in Vermont when the number of public charging stations in the state increases and the amount of electricity transferred to nonresident vehicles increases to a sufficient amount. A higher fee rate may also improve prospects for financial viability. To draw any conclusion on financial viability, the cost aspects must also be determined.

The research program should generate answers for the following issues by obtaining and evaluating the following information:

- **The adoption rate for EVs in surrounding states.** Helpful for determining this adoption rate would be:
 - The current number of EVs registered in surrounding states and forecasted EV adoption rates in those states
- **Impact on fuel tax revenues.**
 - The current impact of nonresident EVs on the state fuel tax, including at what point the revenue loss will become significant enough to warrant establishment of a per-kWh fee at public charging stations, or some other yet to be determined means
- **Setting the per-kWh fee rate for nonresident vehicles.**
 - Because the 3.4-cents-per-kWh rate was based on electricity usage by Vermont vehicles, the agency should gather the following information to determine whether a different, higher rate for nonresident vehicles would be warranted for recharging nonresident vehicles based on the relative impact of their driving on the state's road system.
 - *The nonresident EV travel patterns while traveling in Vermont, including total miles traveled in the state*
 - *The locations of places where nonresident EV drivers recharge their vehicles while in Vermont, including public charging stations and charging events at places of lodging or other businesses*
 - Since the 3.4-cents-per-kWh rate was proposed in a 2013 analysis, the agency should determine whether the recommended rate should be raised to account for inflation.

Upon invitation from Chair Michele Boomhower at third RUC Advisory Committee meeting, representatives from the utilities made the following comments:

Representative from Vermont Electric Cooperative: Generally supportive of the direction of the ad hoc working group on per-kWh fees. The cooperative recently did a survey of the membership and 136 people responded. A total of 62% of respondents drive EVs; others drive hybrids. The survey highlighted the equity issue. Home charging is expensive; EVs are expensive. Utilities have an income equity concern. Multifamily buildings and renters cannot install their own charging equipment. Very few of their members rely on public charging right now. A total of 40% of members say they sometimes run into trouble finding charging, and 38% use trickle-charging (level 1, not level 2 charging), at home.

Representative from Stowe Electric: The necessary billing system for the per-kWh fee is not available for Stowe and its partner ChargePoint.

Representative from Burlington Electric: Supportive of the ad hoc working group's direction on the per-kWh fee. Also expressed concerns about multifamily homes, equitable access for those places.

- **Determine the capability of existing public charging stations and plans for the future of public charging in the state.**
 - To determine the capability of public charging stations to accurately collect a per-kWh fee, the agency should obtain the following characteristics of nonresidential EV charging in the state:
 - *The number of existing public charging stations that have the technical capability—a dedicated revenue-grade meter—to collect a per-kWh fee and the feasibility and cost of adding dedicated revenue-grade meters to stations without them*
 - *Whether charging networks can collect a per-kWh fee with or without a dedicated meter*
 - *The number of nonresidential charging stations accessible to nonresident drivers at places of lodging or other businesses that are not considered public stations*
 - *The ownership and operational characteristics of these nonpublic stations*
 - *Whether the state can feasibly collect a per-kWh fee at these nonpublic stations and whether enough charging occurs at these stations to justify collecting the fee*
 - To determine the future capability of public charging stations to accurately collect a per-kWh fee, the AOT should consider the planned growth of public charging station networks in the state and project the nature of this growth. The future capability of public charging stations will be informed by the Statewide EVSE Plan that Drive Electric Vermont is currently preparing for the AOT.
- **Resident exemptions from the per-kWh fee.**
 - Whether Vermont residents should be exempt from paying the per-kWh fee at public charging stations. To determine this, the agency should gather the following information:
 - *How would paying the per-kWh fee impact Vermont-registered vehicle owners generally (quantify the impact).*
 - *How would paying the per-kWh fee impact Vermont-registered vehicle owners who are part of groups that have been economically and/or socially marginalized (quantify the impact).*

CONCLUSION

Conclusion

The quick uptake of EVs in Vermont warrants application of a new revenue system to offset the lost fuel tax revenues. While the situation is not yet dire, it will become imperative later this decade.

The path forward for the Vermont RUC concept has become clearer. Vermont can feasibly implement a simple MBUF on AEVs and PHEVs by using odometer readings now captured at annual vehicle inspections. Exactly how Vermont will implement this system still requires additional research and development, but the vision for how Vermont will implement a MBUF is now clear. As there are no privacy implications by using mileage data already collected by the state, Vermont does not need to offer a choice of flat fee or MBUF; MBUF is all that is required.

The per-kWh fee concept requires additional research to learn whether it is an advisable approach for capturing revenue lost from nonresident EV travel in Vermont. Currently, the impact of nonresident EV travel is minimal. It may take several years before out-of-state EV travel becomes serious enough to warrant the per-kWh fee. The recommended per-kWh fee research program should reveal if or when the per-kWh fee will become necessary and the best way to collect it.

Appendix A Road Usage Charge System Financial Analysis

Methodology

The purpose of the Vermont Agency of Transportation (AOT) Revenue Forecast is to model the financial outcomes of various Road Usage Charge (RUC) adoption scenarios and other transportation-related fees. The model employs Highway Performance Monitoring System (HPMS) data to establish a baseline statewide vehicle miles traveled (VMT) forecast and the split of these VMT between light and heavy vehicles. National Household Travel Survey data for the New England subregion are used to estimate annual vehicle VMT on a percentile and average basis. U.S. Energy Information Administration (EIA) data underpin vehicle fleet fuel economy forecast alternatives, and Vermont Electric Corporation analysis provides alternative forecasts for adoption of electric vehicles (EVs). Using these base data sources, model users may select from a range of policy options to construct a range of scenarios and corresponding outputs including estimates of revenue generated and cost of collection.

Policy Options

The model captures the implications of the following policy inputs, which are variables where the State of Vermont exercises control:

- Mileage-based user fee (MBUF) per-mile rate. A per-mile rate that would apply to all vehicles subject to an MBUF.
- Flat fee (FF) and percentile mileage for its determination. The model contains the option to collect an annual vehicle surcharge (flat fee) that is a function of the per-mile rate multiplied by the aggregate miles traveled by a vehicle in the 50th, 75th, 90th, or 98th percentile for annual miles traveled.
- Per-kWh fee rates at EV charging stations. The per-kWh fee rate at level 2 and 3 charging stations is an effort to collect revenues from EV drivers who would not be subject to an MBUF or flat fee within Vermont, because they are registered outside of Vermont or are not captured in the program.
- Start years for EVs and internal combustion engine vehicles by miles per gallon (MPG). Phase-in alternatives are offered in five classes in any year from 2024 to 2040. The classes are: EVs, 40+ MPG, 30–40 MPG, 20–30 MPG, and 0–20 MPG.
- MBUF collection methods. The odometer method assumes odometer data currently collected at annual vehicle inspection with fees assessed along with annual vehicle registration. The Commercial Account Manager (CAM) approach relies upon a third-party vendor to automatically report miles driven within the state of Vermont and collect the associated fees.
- Rate index for MBUF and flat fees, fuel taxes, and other existing vehicle fees. Each revenue source can be assigned a fixed rate of annual adjustment to account for inflation.

Technical variables are changes in the travel environment that are outside of the control of policy makers. In this model, they include vehicle fleet MPG and EV adoption. Low, medium, and high scenarios are provided for the distribution of the total number of vehicles across the five classes described above (four MPG bands and EVs). These values provide the basis for calculating the number of vehicles subjected or not subjected to a MBUF along with their fuel economy. The 2021 EIA forecast and June 2020 Vermont Electric Corporation analysis serve as the bases for these alternative scenarios.

Assumptions

Assumptions are baseline conditions based upon historical conditions or expert opinion. These assumptions can all be configured by the model user.

- Purchase and use tax annual growth rate – 1.39% (average of year over year rate from 2016–2020)
- Other revenue annual growth – 2.72% (average of year over year rate from 2016–2020)
- Vehicle population annual growth – 0.11% (average of year over year rate from 2016–2019, AOT Energy Book)
- Heavy duty as a percentage of vehicles – 0.77% (average of year over year rate from 2016–2019, Federal Highway Administration)
- Future average annual inflation – 2%
- Percentage of miles driven by out of state consumers – 15% (University of Vermont)
- Percentage of miles driven by Vermonters outside of Vermont – 18% (University of Vermont)
- Percentage of charging done at Level II and III stations – 50%
- Average kWh per 100 miles – 26 kWh/100 miles
- Credit card and MBUF related transaction costs
- MBUF CAM enrollment and transaction costs - \$5 and \$30 per vehicle, respectively.

Revenue Calculation

Total transportation revenue is calculated by summing the forecasted annual revenue from 2021 through 2040 from the fuel tax, MBUF and FF, diesel tax, purchase & use fees, and motor vehicle fees, then applying a 2% discount rate.

- Gas tax revenue is calculated by dividing the forecasted number of light vehicle miles driven each year by the estimated fleet fuel economy of vehicles not on a MBUF/FF for that year. Forecasted light vehicle miles is found by splitting total miles into light and heavy classifications based upon HPMS data. Light vehicle miles are then split between EV and gasoline classifications based upon the EV Growth Scenario, with gasoline miles divided further into 0–20, 20–30, 30–40, and 40+ MPG buckets as a function of the MPG Scenario. Fuel consumption, miles traveled, and revenue collected are calculated independently for each bucket and summed. If an MPG group transitions to MBUF/FF, their gasoline tax revenues are removed from the fuel tax revenue collection and those vehicles added to the MBUF/FF classification.
- Diesel tax revenue is calculated by dividing total heavy vehicle miles traveled, calculated based upon HPMS data, by EIA's forecasted heavy vehicle MPG for a given year, multiplied by the per-gallon diesel tax rate.
- Purchase and use fees are calculated based upon an extrapolation of historical data through the study period.
- Motor vehicle fees are based upon the historical per-vehicle average and the policy choice to index fees to the rate of inflation.
- MBUF and FF revenues are calculated based upon the per-mile rate, the annual miles driven percentile at which the FF is set, the MBUF and FF split, and the proportion of MBUF users

on CAM versus odometer collection methods. Cost of collection for FF, MBOF – Odometer, and MBOF – CAM were calculated independently and subtracted from revenue collected.

Cost Calculation

- FF and MBOF customer service center costs: These costs are a function of the total number of MBOF and FF participants and are meant to reflect additional labor and effort of the Department of Motor Vehicles (DMV) in processing additional transactions. The additional cost is reflected as an additional cost per vehicle transaction involving FF or MBOF of 25% for the first ten years of the program.
- FF Transaction Costs: The proportion of FF participants choosing to pay by credit card is selected, calculating the total number of credit card transactions. The total number of credit card payers is then multiplied by the calculated annual FF rate and the selected credit card transaction fee percentage.
- MBOF Transaction Costs: The proportion of MBOF participants choosing to pay by credit is selected, calculating the total number of credit card transactions. The value of transactions is calculated by multiplying the per-mile rate by the average number of miles traveled by an MBOF enrollee. The total transaction cost is a product of the total number of MBOF.
- Handoff Costs: For the scenario in which customers enroll and pay MBOF and/or FF through a CAM, an additional cost of \$5 is assumed to “hand off” the customer from the DMV to the CAM. This includes the assumed cost of additional customer support for those customers who need assistance navigating to a CAM and setting up their MBOF account.
- MBOF – CAM Cost: The increased cost of CAM participants is a product of the enrollment cost per user and the total number of participants.

Outputs

AOT can use the modeling tool to analyze many combinations of policy choices. Alongside the input assumptions and policy variables, the model features a range of charts illustrating key outputs such as number of vehicles enrolled in flat-fee/MBOF program, total revenue, and revenue per mile driven.

Table 10 below presents the results of the “status quo” scenario and three illustrative alternative policy scenarios. The status quo scenario assumes a moderate growth rate in EVs, from about 5,000 in 2020 to 20,000 in 2025, 70,000 in 2030, and just over 250,000 in 2040, constituting 39% of Vermont’s passenger vehicle fleet by that time. The remaining 61% of the vehicle fleet grows to an average of 30.5 miles per gallon in 2040.

Each scenario assumed the same per-mile rate (1.3 cents per mile), MPG and EV growth scenarios (medium), and technical assumptions (as presented above). What varied were the choices for mileage reporting and collection methodologies for the flat-fee/MBOF system: Flat Fee Only, MBOF Only via Odometer, and Flat Fee and MBOF via Automated Reporting (CAM). Also varying were the percentile used to calculate the fixed fee rate (50th in scenario 1 and 98th in scenario 3). Net Present Value was calculated at a 2% discount rate for the years 2021 to 2040 inclusive.

Table 10. Summary Revenue Table

Scenario	Policy Assumptions	Net Present Value	Fee Rate per Mile
Status Quo	Existing policy	\$4.897 billion	N/A
Flat Fee Only	Rate set at 50th Percentile EV only beginning 2024	\$ 5.073 billion	\$ 0.013
MBUF – Odometer	EV only beginning in 2024	\$ 5.124 billion	\$ 0.013
Flat Fee/MBUF – CAM	Rate set at 98th Percentile EV only beginning in 2024	\$ 5.141 billion	\$ 0.013

Flat Fee Only

The flat fee scenario, set at the 50th percentile for annual miles driven, generated \$5.073 billion (Table 10). Whereas a driver in the 50th percentile travels 9,000 miles per year, a driver in the 90th travels 20,000. The total miles driven by users in the 50th percentile and lower only account for 25% of total miles driven. For this reason, a flat-fee only scenario at the 50th percentile among EVs leaves a substantial number of miles uncharged.

MBUF Only with Odometer Charging

The MBUF scenario with odometer charging performed much better than flat fee, resulting in a net present value of \$5.124 billion. This is attributable to the higher volume of EV road consumers’ mileage effectively being charged.

Hybrid Flat Fee and MBUF

The hybrid approach collected the most revenue based on the assumption more people than only those traveling in the 98th percentile for mileage would buy an annual allotment, effectively paying more in a flat fee than they would pay in miles driven. Despite higher collection costs, this scenario resulted in a net present value of \$5.141 billion.

Appendix B

Road Usage Charge Stakeholder Outreach Summary

MEMO

TO: Jim Whitty, CDM Smith

FROM: Mark Fowler, Jonathan Slason, RSG

DATE: February 8, 2022

SUBJECT: Vermont Electric and Highly Fuel-Efficient Vehicle Road Usage Charge Stakeholder Outreach Summary

The Vermont Agency of Transportation (VTTrans) is evaluating a road usage charge (RUC) concept for replacing or augmenting fuel taxes not paid for electric vehicle use in the state.

The evaluation included a statewide engagement process consisting of stakeholder discussions and an online survey targeted toward Vermont residents. This memorandum summarizes the approach and findings from the statewide engagement process.

1.0 Stakeholder Discussions

CDM Smith (CDM) and RSG (hereafter referred to as the project team) conducted four stakeholder discussions in September 2021 to solicit additional feedback to supplement the feedback provided by the Advisory Committee and the web survey. The stakeholders represent perspectives the project team considered to be particularly valuable to inform the analysis and design of any future RUC system from a mix of industry, nonprofit, and government perspectives.

Drive Electric Vermont Stakeholder Meeting

Drive Electric Vermont invited the project team to a quarterly management meeting held on September 8, 2021. Nearly 70 people attended the Zoom meeting, which was moderated by David Roberts of the Vermont Energy Investment Corporation who also serves as the Drive Electric Vermont coordinator. Jim Whitty from the project team covered the outline and basics of the VTTrans RUC concept. Jim proceeded to take questions from attendees. The following topics were discussed:

- One funding source that could be used to pay the RUC for electric vehicles (EVs) is the sales tax that is currently collected by the state on the manufacturer's suggested retail price (MSRP) rather than the actual final sale price of the vehicle (which has been frequently lower after applicable tax credits and other discounts). It was suggested that the state is collecting sales tax on a higher value than what the user pays and that this

'excess' tax could be directed to fund the transportation system and pay for the mileage in fees or avoided motor fuel tax.

- Attendees expressed concern about the technical logistics of a per-kilowatt-hour (kWh) fee and how to address resident versus nonresident issues. These included questions such as who is responsible for collecting the fee, who manages accounts, about the possibility for errors or technical glitches, which electric vehicle supply equipment (commonly referred to simply as EVSE) will be required to comply, what if the equipment doesn't have a meter, etc.
- A comment was made about the interstate commerce clauses and how the per-kWh fee would have to be consistent to remain in legal compliance. Jim answered this point by citing a study that he was involved with in Washington State. The finding there was that the fees applied to out-of-state registered vehicles must be similar to those that a vehicle registered in state would pay.
- Generally, attendees noted EV adoption is currently incentivized by state and federal dollars and questioned why the government would impose a fee on these same vehicles. Regardless of whether they are consuming transportation capacity or not, attendees noted larger goals that these vehicles are achieving. It was suggested by the attendees that the state should consider using fees to incentivize the purchase of EVs to also fund the gap associated with the avoided motor fuel tax.
- Several attendees suggested that state motor fuel taxes should increase to pay for the costs of improving the availability of EVSE, as well as pay for the avoided taxes from EVs. This should be the mechanism at least in the short term as the state looks to increase adoption of EVs and build the necessary supporting infrastructure.
- Attendees requested additional information underlying the assumptions used in the charts that show the avoided motor fuel tax revenue for the future years based on the portion of EVs in the overall vehicle fleet.

Vermont League of Cities and Towns Stakeholder Meeting

The project team met with Gwynn Zakov from the Vermont League of Cities and Towns (VLCT) for a virtual discussion held via Microsoft Teams on September 15, 2021. The discussion focused on understanding a diverse set of municipal and local government perspectives.

VLCT stated they were in general support of developing alternatives to the motor fuel tax given their understanding of the eroding power of the tax. Increasing revenues available to the state—and, subsequently, to local governments—will deliver financial resources to communities. This, in turn, will allow these local governments to improve their transportation systems while also adapting to and mitigating the effects of climate change.

Climate change is one of the three topics being prioritized within VLCT. Others include American Rescue Plan Act funding and other federal spending and infrastructure bills. This topic may stimulate some conversation on funding, but most local governments are unlikely to take issue

with the concepts being discussed; however, it was noted that some communities may be interested in how their fleets of vehicles will be affected by the proposed concepts.

VLCT did note that identifying how and if these RUC concepts are consistent with town plans will be one concern for any local governments. It is not obvious how the fee concepts would contradict any goals, but there may be something less obvious that may arise in future conversations.

Vermont Natural Resources Council, Conservation Law Foundation, and Sierra Club of Vermont Stakeholder Meeting

The project team invited three environmentally focused organizations—the Vermont Natural Resources Council, the Conservation Law Foundation, and the Sierra Club of Vermont to a virtual online stakeholder meeting held via Microsoft Teams on September 10, 2021, to discuss the RUC concepts.

Generally, the three entities expressed universal support for the idea that electric vehicle adoption should be supported and expressed concern that an additional tax or fee would be a deterrent for some. The state should consider looking wider than simply “plugging a hole.” An opportunity may exist to improve the current transportation funding system. More specific topics of the discussion included the following:

- Two of the stakeholders noted previous VTrans’ studies referencing a goal to achieve 15% market share of vehicles as EVs before any changes to fees or costs such as those being considered here. The stakeholders also referred to a study from Bakersfield that mentioned that EV purchasers would be less interested in an EV if there is a cost per mile that reduces the current cost savings of owning an EV compared to an internal combustion engine (ICE) vehicle. It was posited by the group that if EVs become lower in initial purchase price, the concern with the per-mile fee may diminish.
- It appears that one of the stakeholders is advocating for a mileage-based user fee (MBUF) to be adopted across the board as a substitute for the motor fuel tax. Jim Whitty from the project team mentioned that other states such as Utah and Oregon (among others) do have intentions to implement MBUF across all vehicle types; however, it takes a while, and the approach being considered by VTrans could be a more manageable step to focus on a smaller number of vehicles.
- One stakeholder recommended a wholesale review of transportation funding in Vermont and suggested that user fees may not be the best solution. This person suggested that if boosting EV adoption is the goal, the state should prioritize that and find other ways to generate the required revenue.
- The stakeholders noted that additional disincentives are needed on ICE vehicles and that motor fuel taxes should continue to fund the system in the near term. A carbon tax is similar or can be designed as an additional fee on ICE vehicles. However, it is not a viable long-term option with the shift to EVs. Jim Whitty from the project team mentioned how

carbon fees can be collected along with MBUF, and as carbon fees increase there is a clear link to drive fewer miles.

Vermont Auto Dealers Association Stakeholder Meeting

The project team met via Microsoft Teams with Marilyn Miller from the Vermont Auto Dealers Association (VADA) on September 13, 2021, to review the road-user-fee concepts being considered. Marilyn stated that all the VADA members acknowledge that funding must change, and dealers are getting prepared for more EVs. VADA's position is not to avoid raising the motor fuel tax; however, these alternative fees are helpful to have more than one idea to progress and evaluate.

VADA has to consider how the process can be implemented fairly across its membership. The move to new fees along with shifting vehicle types affects dealerships differently and changes who purchases vehicles and how. This is an opportunity to educate dealers on an alternative approach to transportation funding.

VADA is interested in supporting and understanding the supplemental investments that the Agency of Transportation will have to make, including computer upgrades at the Vermont Department of Motor Vehicles that will affect driver licensing, purchasing information, registration, titling, etc. These changes, along with the payment of any initial fees, are of interest.

VADA will discuss the proposed concepts at their annual meeting on September 16, 2021.

2.0 Public Opinion Survey

The project team developed and implemented an online survey of Vermont residents to present the RUC System concept and assess initial reactions to the various features and options. The survey was used to establish a general understanding public sentiment and preferences to help guide policy and system design.

The project team collaborated with VTrans to develop the survey, including vehicle owners who would be directly affected by the proposed RUC policy. This population primarily consists of the registered owners of fully electric vehicles (battery-electric vehicles or BEVs), plugin hybrid electric vehicles (PHEVs), and high-mileage internal combustion engine vehicles (ICEVs). The survey established a baseline understanding of motorist behaviors, general familiarity with various road usage tax and fee concepts, and opinions about the policies under consideration. The questionnaire also collected a demographic profile of respondents to ensure broad representation from the statewide population.

Because transportation revenue is a topic of general public interest, the survey included a separate branch of questions for any drivers who currently own a standard ICEV vehicle. These respondents were also asked about their receptivity to EV ownership.

2.1 Survey Administration

Respondents were recruited into the survey using email invitations distributed to current Vermont BEV and PHEV owners. The contact list was developed by VTrans through their partnership with Drive Electric Vermont and served as the primary sampling frame for the survey. RSG also leveraged its relationships with local stakeholders, including regional planning commissions, community organizations, environmental organizations, auto dealers, and other interested organizations to help drive participation.

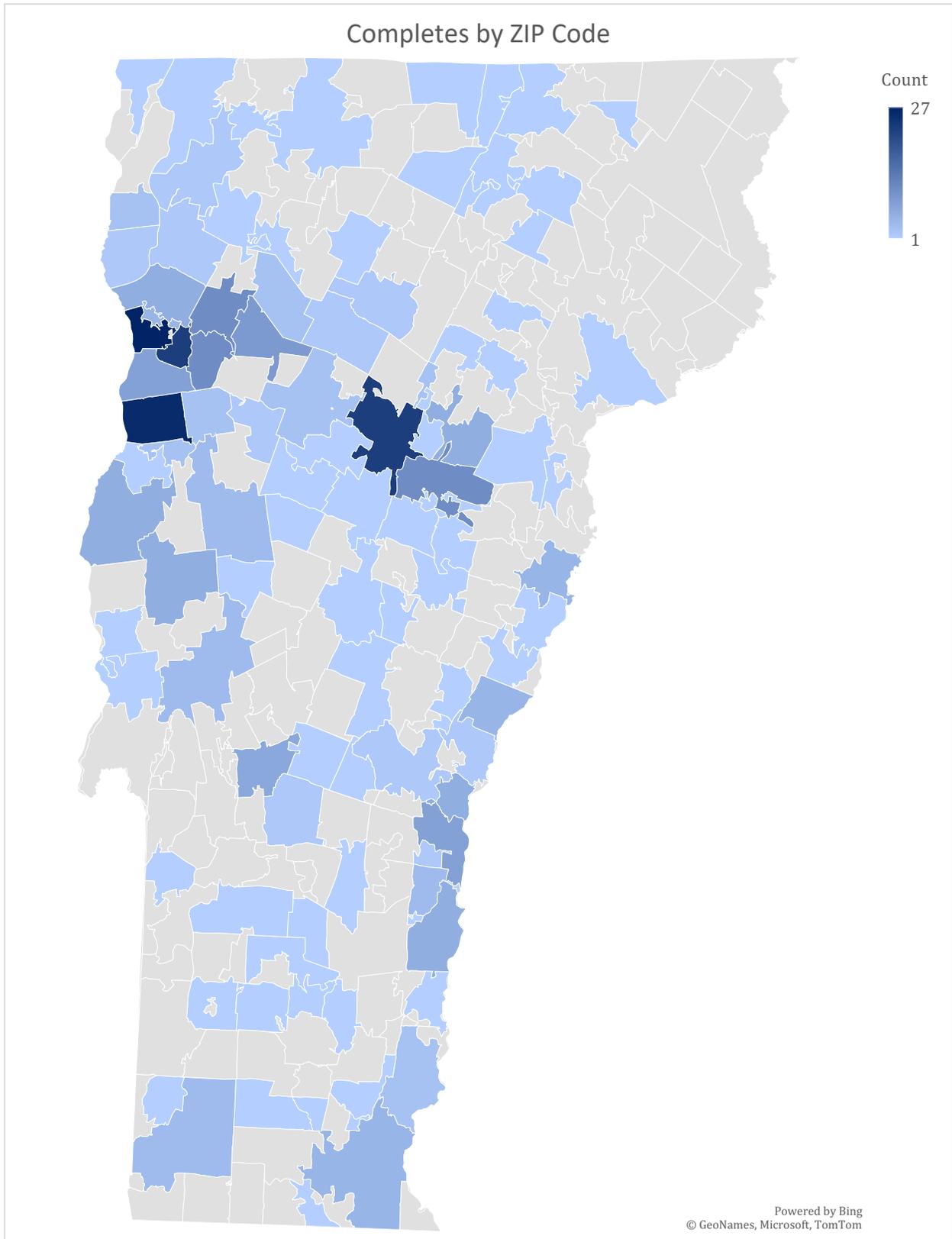
The survey remained open from Wednesday, September 8, 2021, until Tuesday, October 26, 2021. A total of 385 responses were received during the administration period. Table 1 presents the number survey completions from each key stakeholder.

TABLE 1: COMPLETES BY STAKEHOLDER GROUPS

Stakeholder Group	Complete Surveys
Drive Electric Vermont	169
Capstone Community Action	81
Regional Planning Commissions	54
Facebook	29
Environmental Organizations	21
Auto Dealers	4
Other	27
Total	385

Figure 1 shows survey completions by ZIP Code. Participants were recruited from regions across the entire state, but were more heavily concentrated in Chittenden and Washington Counties.

FIGURE 1: SURVEY COMPLETES BY ZIP CODE



2.2 Analysis

The descriptive analysis of the survey data presented in this section was performed on the final dataset of 385 responses. The analysis is divided into three sections:

- Household vehicles;
- Transportation funding and;
- Demographics.

Household Vehicles

The survey asked respondents to provide information about household vehicles that they currently own or lease. Almost half of respondents (48%) own or lease two vehicles (Table 2).

TABLE 2: HOUSEHOLD VEHICLES

How many vehicles does your household currently own or lease?	Percent	Count
0 (no vehicles)	2%	8
1 vehicle	29%	112
2 vehicles	48%	183
3 vehicles	16%	60
4 vehicles	5%	19
5 or more vehicles	1%	3
Total	100%	385

Table 3 shows the number of respondents who own a BEV or PHEV. Over half of respondents (54%) own an electric vehicle.

TABLE 3: ELECTRIC VEHICLE OWNERSHIP*

Does your household own any fully electric vehicles (BEVs) or plug-in hybrid electric vehicles (PHEVs)?	Percent	Count
Owns a BEV	41%	159
Owns a PHEV	16%	62
Does not own an EV	46%	177
Total	100%	381

**Select all that apply.*

Table 4 shows the reasons electric vehicle owners purchased an electric vehicle. The most cited reasons for purchasing an electric vehicle were environmental benefits (96%), money savings on fuel (71%) and lower maintenance costs (69%).

TABLE 4: REASONS FOR PURCHASING AN ELECTRIC VEHICLE*

Why did you purchase an electric vehicle?	Percent	Count
Environmental benefits	96%	200
Money savings on fuel	71%	147
Lower maintenance costs	69%	143
Vehicle performance	47%	98
Tax incentives	45%	93
Preferred that make or model	26%	54
Employer benefit	4%	9
Other	12%	25
Total	100%	208

**Select all that apply.*

Of the respondents who are electric vehicle owners, 91% primarily charge their vehicle at home (Table 5). The majority of respondents (97%) who own an electric vehicle have home charging equipment, with most (68%) electric vehicle owners using a level 2 charger (Table 6).

TABLE 5: PRIMARY ELECTRIC VEHICLE CHARGING LOCATION

Where do you primarily charge your electric vehicle? If you charge your vehicle in multiple locations, please tell us where you charge most often.	Percent	Count
At home	91%	189
At work	3%	7
At school	0%	0
At a public charger	5%	10
Other	1%	2
Total	100%	208

TABLE 6: ELECTRIC VEHICLE HOME CHARGING EQUIPMENT

Do you currently have home charging equipment?	Percent	Count
Level 1 charger	26%	54
Level 2 charger	68%	142
Direct Current (DC) Fast Charger	2%	5
No, I do not have home charging equipment	3%	7
Total	100%	208

Of those who do not own an electric vehicle, 82% have considered purchasing an electric vehicle (Table 7), and 79% are very likely or somewhat likely to purchase a fully electric vehicle or plug-in hybrid electric vehicle within the next few years (Table 8).

TABLE 7: ELECTRIC VEHICLE CONSIDERATION

Have you considered purchasing a fully electric vehicle (BEV) or plug-in hybrid electric vehicle (PHEV)?	Percent	Count
Have considered purchasing an EV	82%	139
Have not considered purchasing an EV	18%	30
Total	100%	169

TABLE 8: ELECTRIC VEHICLE PURCHASE LIKELIHOOD

How likely are you to purchase a fully electric vehicle (BEV) or plug-in hybrid electric vehicle (PHEV) within the next few years?	Percent	Count
Very Likely	45%	62
Somewhat Likely	34%	47
Somewhat Unlikely	17%	24
Very Unlikely	4%	6
Total	100%	139

Table 9 shows the concerns non-electric vehicle owners have about purchasing an electric vehicle. Most cited concerns about the limited driving range (58%), cost (56%) and lack of charging facilities (53%).

TABLE 9: CONCERNS ABOUT PURCHASING AN ELECTRIC VEHICLE*

What are your main concerns about purchasing or leasing a fully electric vehicle?	Percent	Count
Limited driving range	58%	98
Too expensive	56%	95
Lack of charging facilities	53%	90
Time to charge the battery	33%	56
Cost of installing charging equipment for your home	31%	52
Technology is still too new/unreliable	16%	27
Uncertain about hauling or storage capacity	12%	20
Uncertainty about electricity prices	11%	19
The types of vehicles I like to drive aren't available to buy	0%	0
Other	22%	37
I don't have any concerns	0%	0
Total	100%	154

*Select all that apply.

Transportation Funding

The next section of questions asked all respondents about prior knowledge of the Vermont State Gas Tax and support for future road usage charges. The majority of respondents (89%) were aware of the state gas tax prior to the participating in the survey (Table 10), and 63% of respondents strongly support or somewhat support the state gas tax as the primary way to fund Vermont's transportation system (Table 11).

TABLE 10: PRIOR KNOWLEDGE OF STATE GAS TAX

Did you know about the state tax on gas purchases before taking this survey?	Percent	Count
Knew about state tax on gas	89%	343
Did not know about state tax on gas	11%	42
Total	100%	385

TABLE 11: SUPPORT FOR STATE GAS TAX

Do you support or oppose the state gas tax as the primary way to fund Vermont's transportation system?	Percent	Count
Strongly support	32%	123
Somewhat support	31%	121
Neutral	20%	76
Strongly oppose	7%	27
Somewhat oppose	10%	38
Total	100%	385

Table 12 shows respondent support for introducing mileage-based user fees on fully electric, plug-in hybrid electric or other highly-fuel efficient Vermont registered vehicles. The majority of respondents (60%) are somewhat supportive or very supportive of implementing mileage-based user fees.

TABLE 12: SUPPORT FOR MILEAGE-BASED USER FEES

What is your initial reaction to introducing mileage-based user fees for fully electric, plug-in hybrid electric, or other highly fuel-efficient Vermont registered vehicles?	Percent	Count
Very Supportive	30%	116
Somewhat Supportive	30%	116
Somewhat Opposed	15%	58
Very Opposed	22%	85
No Opinion	2%	9
Total	100%	384

Table 13 shows respondent support for an annual flat fee on fully electric, plug-in hybrid electric or other highly-fuel efficient Vermont registered vehicles. The majority of respondents (58%) are somewhat opposed or very opposed to implementing flat fees.

TABLE 13: SUPPORT FOR ANNUAL FLAT FEES

What is your initial reaction to introducing an annual flat fee for fully electric, plug-in hybrid electric, or other highly fuel-efficient Vermont registered vehicles?	Percent	Count
Very Supportive	15%	59
Somewhat Supportive	25%	94
Somewhat Opposed	29%	109
Very Opposed	29%	111
No Opinion	2%	9
Total	100%	382

Three-quarters of respondents (75%) are very supportive or somewhat supportive of a per-kilowatt hour fee on all public chargers for out-of-state vehicles, as shown in Table 14.

TABLE 14: PER KWH FEES ON PUBLIC CHARGERS FOR OUT-OF-STATE VEHICLES

What is your initial reaction to introducing a kilowatt per hour fee on public charging stations for out-of-state vehicles?	Percent	Count
Very Supportive	43%	166
Somewhat Supportive	32%	122
Somewhat Opposed	9%	36
Very Opposed	12%	47
No Opinion	4%	14
Total	100%	385

If a mileage-based fee were implemented, respondents would prefer to share their mileage information by providing access to the odometer during their annual vehicle inspection rather than using sharing locational data collected while driving (Table 15)

TABLE 15: MILEAGE-BASED USER FEE REPORTING PREFERENCE

If you were given the following options to share your mileage information, which would you choose?	Percent	Count
Share access to the odometer reading during my annual inspection	71%	274
Share access to locational data while driving	29%	111
Total	100%	385

If a flat fee were implemented, most respondents (65%) would prefer to pay the annual flat fee during the annual registration for each vehicle (Table 16).

TABLE 16: FLAT FEE PAYMENT PREFERENCE

Suppose your household had to pay a flat fee for each fully electric or plug-in electric vehicle that you own. How would you prefer to pay?	Percent	Count
Pay with the annual registration for each vehicle.	65%	252
Pay with the annual inspection for each vehicle.	13%	49
Pay once per year for each vehicle.	12%	46
Pay once a month for each vehicle.	4%	17
Pay once every quarter for each vehicle.	5%	21
Total	100%	385

Table 17 presents respondents’ attitudes related to various road usage fees. The majority of respondents agree that fees based on vehicles miles traveled are fair because drivers pay according to how much they use the road and annual flat fees are unfair for people who drive less.

About half (51%) of respondents agree that drivers of fully electric or plug-in hybrid electric vehicles should pay less for road upkeep because they produce less vehicle emissions; conversely 47% of respondents agree that drivers of fully electric or plug-in hybrid electric vehicles do not pay their fair share for road upkeep.

TABLE 17: ROAD USAGE FEE ATTITUDES

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
Fees based on vehicle miles traveled are fair because drivers pay according to how much they use the road.	12%	11%	9%	31%	37%
Flat fees are unfair for people who drive less.	5%	7%	15%	37%	35%
Fees based on vehicle miles traveled only for fully electric and plug-in hybrid electric vehicles would penalize drivers of these vehicles more than drivers of gas vehicles.	14%	16%	21%	22%	27%
Fees based on vehicle miles traveled would penalize rural drivers or others who must drive longer distances.	12%	13%	17%	31%	27%
Drivers of fully electric or plug-in hybrid electric vehicles should pay less for road upkeep because they produce less vehicle emissions	20%	19%	10%	25%	26%
Drivers of fully electric or plug-in hybrid electric vehicles do not pay their fair share for road upkeep.	16%	17%	20%	27%	20%
Flat fees would encourage people to drive more.	21%	25%	26%	18%	9%

Of the respondents who currently own an electric vehicle, 91% said that they would continue to drive about the same as they do now if mileage-based fees or flat fees were implemented in the state of Vermont for fully electric, plug-in electric, or other highly fuel-efficient vehicles (Table 18).

TABLE 18: EV DRIVE FREQUENCY WITH ROAD USAGE FEES

If mileage-based fees or flat fees are implemented in the state of Vermont for fully electric, plug-in hybrid electric, or other highly fuel-efficient vehicles, would you...	Percent	Count
Drive more than you do now.	2%	5
Drive about the same as you do now.	91%	190
Drive less than you do now.	6%	13
Total	100%	208

Table shows that 84% of respondents who are considering purchasing an electric vehicle or high mileage vehicle are just as likely or more likely to do so if mileage-based fees or flat fees are implemented in the state of Vermont for electric vehicles and highly efficient fuel vehicles.

TABLE 19: EV PURCHASE LIKELIHOOD WITH ROAD USAGE FEES

If mileage-based fees or flat fees are implemented in the state of Vermont for electric vehicles and highly efficient fuel vehicles, how likely are you to purchase an electric vehicle in the next few years?	Percent	Count
More likely	6%	8
About the same	78%	109
Less likely	16%	22
Total	100%	139

Demographics

The final section of the survey collected demographic information from respondents. Table 20 shows the employment status of respondents. Half of respondents are employed full-time and about one fifth of respondents (22%) are unemployed.

TABLE 20: EMPLOYMENT

Which of the following describes your employment status as of today?	Percent	Count
Employed full-time	50%	192
Employed part-time	10%	37
Primarily self-employed	14%	52
Unpaid volunteer or intern	5%	18
Unemployed and looking for work	2%	8
Unemployed and not looking for work	20%	78
Total	100%	385

Table 21 illustrates the number of days per week employed respondents commute to work. About one-third of respondents (35%) commute to work five days a week and one quarter of respondents (27%) never commute to work.

TABLE 21: COMMUTE WORKDAYS

How many days per week do you commute to work?	Percent	Count
0 days	27%	77
1 day	9%	24
2 days	8%	22
3 days	9%	25
4 days	8%	23
5 days	35%	99
6 days	2%	5
7 days	2%	6
Total	100%	281

Table 22 shows the distribution of household size, about half of respondents (48%) live in two-person households.

TABLE 22: HOUSEHOLD SIZE

How many people live in your household?	Percent	Count
1 (I live alone)	19%	73
2 people	48%	185
3 people	14%	55
4 people	15%	58
5 or more people	3%	12
Prefer not to answer	1%	2
Total	100%	385

Table 23 shows the distribution of gender among survey respondents; 57% of survey respondents identify as Man.

TABLE 23: GENDER

What is your gender?	Percent	Count
Man	57%	219
Non-binary	1%	4
Woman	34%	132
Prefer to self-describe	1%	2
Prefer not to answer	7%	28
Total	100%	385

Table 24 shows the age distribution of survey respondents. The median age of survey respondents is in the range of 60 to 69 years old.

TABLE 24: AGE

What is your age?	Percent	Count
18-29	6%	25
30-39	10%	40
40-49	15%	57
50-59	18%	68
60-69	29%	110
70 or older	18%	71
Prefer not to answer	4%	14
Total	100%	385

Table 25 presents the distribution of household incomes. The median annual household income of the sample is between \$75,000 and \$99,999.

TABLE 25: 2020 HOUSEHOLD INCOME

What category best describes your 2020 household income before taxes?	Percent	Count
Less than \$15,000	4%	14
\$15,000-\$24,999	4%	16
\$25,000-\$34,999	4%	15
\$35,000-\$49,999	10%	39
\$50,000-\$74,999	16%	61
\$75,000-\$99,999	14%	52
\$100,000-\$149,999	18%	68
\$150,000-\$199,999	9%	33
\$200,000-\$299,999	5%	19
\$300,000 or more	3%	10
Prefer not to answer	15%	58
Total	100%	385

Table 26 and Table 27 show the Hispanic origin and race of survey respondents. Most respondents (87%) identify as white.

TABLE 26: HISPANIC ORIGIN

Are you of Hispanic, Spanish, or Latino origin?	Percent	Count
Yes	1%	5
No	88%	339
Prefer not to answer	11%	41
Total	100%	385

TABLE 27: RACE*

With which racial or ethnic groups do you identify	Percent	Count
American Indian / Alaska Native	0%	1
Asian	1%	4
Black / African American	0%	1
Native Hawaiian / Pacific Islander	0%	1
White	87%	334
Other	1%	5
Prefer not to answer	11%	43
Total	100%	385

**Select all that apply.*

