

A Study on Replacing Motor Fuel Tax Revenues Not Collected from Plug-In Electric Vehicles

Conducted pursuant to Section 28 of Act 12 of 2013

1. Introduction

This report is submitted in accordance with Section 28 of Act 12 of 2013, which requires a written report from The Commissioner of Public Service and the Commissioner of Taxes, in consultation with the Public Service Board, the Commissioner of Motor Vehicles, the Joint Fiscal Office, and any other persons or entities the Commissioners deem appropriate, regarding

“the feasibility, alternative implementation mechanisms, and timeline for replacing, in whole or in part, motor fuel tax revenues not collected from operators of plug-in hybrid and all-electric vehicles.”

In addition to the analysis of options, this report contains recommendations as to the most reasonable and efficient mechanisms, and a realistic time frame, to charge operators of plug-in hybrid and all-electric vehicles for their use of transportation infrastructure so as to contribute to the Transportation Fund. In addition, this report identifies that all of the discussed mechanisms would require legislative action. Appendix A includes text of potential legislation that would implement the Commissioners’ recommendations.

Underlying our recommendations and analysis in this report is the assumption that some sort of alternative funding structure for transportation will be developed nationally or state by state over the next decade or so. Increasing vehicle efficiency, as well as behavior and demographic changes, imperil sufficient revenue collection via traditional fuel tax mechanisms, regardless of the deployment of electric vehicles. Therefore, in developing our recommendations we highly valued flexibility and the avoidance of stranded costs in collecting revenue from electric vehicles during this transition period.

The evaluation of operation funding alternatives does not explicitly consider the additional revenue designated for the Transportation Fund that accrues from electric vehicles purchases due to the higher price of these vehicles. A survey of the manufacturer suggested retail prices (MSRPs) of comparable all-electric and plug-in hybrid vehicles indicates an average price premium of about \$7,000 for plug-in hybrid electric vehicles and an average price premium for all-electric vehicles of about \$16,000¹. With

¹ We examined the MSRPs for the plug-in and all-gasoline-powered versions of the Ford Focus, Ford C-Max, Ford Fusion, Toyota Prius, Toyota Rav4, and Smart fortwo.

4% of the purchase price of each vehicle going to the Transportation Fund through the Purchase and Use Tax, purchase of these vehicles results in increased revenue for transportation of about \$280 for an average plug-in hybrid vehicle and about \$640 for an average all-electric vehicle. Given that more than three-quarters of all electric vehicle purchases in Vermont have taken place in the last 18 months², these values indicate that, for the moment, the Transportation Fund has received greater funding due to electric vehicle adoption than it would if no such vehicles had been adopted in Vermont. This is not a permanent feature, but it does lessen the urgency to enact an immediate solution for raising revenue from electric vehicle operation.

This report is structured as follows. Section 2 summarizes relevant portions of the report required by Section 39 of Act 153 of 2012, submitted by the Agency of Transportation in late 2012. Section 3 describes and evaluates three potential mechanisms for the collection of revenue: a volumetric fee on electricity, a fee based on vehicle miles traveled, and a registration fee. Section 4 summarizes the Commissioners' recommendations.

A note on terminology: In this report, we use the terms "electric vehicle" or "EV" to refer to both plug-in hybrid and all-electric vehicles. Where distinctions between plug-in hybrids and all-electric vehicles are necessary, we adopt those terms.

2. Section 39 study

The Section 39 study submitted last year assessed three potential mechanisms for the collection of revenue from electric vehicles and vehicles powered by compressed natural gas: a volumetric fee on the fuel, a fee based on vehicle miles traveled, and a registration fee. These are the same mechanisms discussed in this report. That study also provided background material related to the definition of different kinds of vehicle and adoption of these vehicles in Vermont. It evaluated each of the mechanisms based on several criteria, including the ability to create stable revenue, whether the mechanism is practical and easy to understand, and whether it would advance state energy policy as embodied in the 2011 Comprehensive Energy Plan. Finally, it estimated the monetary amount or rate that could be used for each mechanism in order to achieve Transportation Fund revenue neutrality when comparing an all-electric vehicle to a typical gasoline-powered vehicle. This report relies heavily upon the Section 39 study, making adjustments where better or more recent data enable improvement.

3. Evaluation of alternatives

Electric use volumetric fee

An electric use volumetric fee would maintain a structure similar to that established with gas and diesel tax funding for the Transportation Fund: establish a per-unit tax or fee and levy that charge at the time of sale. In the case of plug-in hybrid and all-electric vehicles, this would be a per-kilowatt-hour (kWh) fee or tax. In determining the amount of such a fee, there is one primary decision: whether to establish the fee as equivalent to the gas tax in terms of tax per unit energy or in terms of revenue. Given the

² See <http://driveelectricvt.com/blog/post/drive-electric-blog/2013/10/30/demand-growing-for-electric-cars-in-vermont>

dramatic increase in energy efficiency represented by electric vehicles, levying a fee on an energy-equivalent basis would not substantially replace lost revenue to the Transportation Fund. The vehicles' use of the transportation infrastructure, moreover, is not highly related to the efficiency of its energy conversion (aside from the relationship between efficiency and weight). Therefore, we recommend that, if this mechanism were adopted, the fee be designed to replace lost revenue rather than be equivalent on a per-unit basis. Based on current data, we estimate that the revenue-replacement rate would be \$0.034/kWh.

One advantage of this mechanism is that it would collect appropriate revenue from both fuels in the case of plug-in hybrid vehicles – gas tax on gasoline purchases and this volumetric fee on electricity used.

We do not, however, recommend the adoption of this mechanism to collect revenue from plug-in hybrid and all-electric vehicles. This is primarily because of the difficulty in determining the correct amount of revenue to collect from each vehicle owner. Electric vehicle charging is expected to take place primarily at home, overnight. From an electric standpoint, therefore, electric vehicles are essentially large mobile home appliances. It is not typical for electric utilities to meter the energy use of any one appliance. Typical electric meters measure only the customer's entire energy use, and the meter cannot distinguish which energy measured is used by which appliance. In order to correctly determine the amount of electric energy use by the vehicle, therefore, an alternate mechanism to measure its use is required. We have investigated three alternatives: 1) installation of a second utility meter in the home of each EV owner, measuring only the EV charging circuit, 2) utilization of the advanced capabilities of newly-deployed "smart meters" to collect data directly from the vehicles via wireless communication, and 3) collection of vehicle energy use data directly from vehicle manufacturers, many of which maintain ability to remotely communicate with the vehicles through technologies such as OnStar, or at the time of annual inspections.

Installation of a dedicated meter: Deploying a dedicated meter for electric vehicle charging would have the following advantages and disadvantages.

Advantages:

- Utility revenue-quality data regarding energy use, including capturing the difference in electricity utilization between different vehicles and between different kinds of electric vehicles (plug-in hybrids vs. all-electric vehicles).
- Captures electric energy at public or workplace charging stations by billing the host of those stations for the transportation fee.

Disadvantages:

- The typical cost of a second meter, including installation, is \$130. This cost could take multiple years to recover through the fee if paid by the State; if it were an additional cost imposed on the EV purchaser it would become a disincentive for EV purchase.

- If the meter is not a remote-read meter, there would be additional cost in staff time to read the second meter.
- Would require an additional meter installation in the event in which the owner of an electric vehicle moves to a different home or sells the vehicle; may strand an unnecessary meter at a home if the owner moves away or sells the vehicle.
- Some small-battery EVs can charge effectively using a standard outlet; it would be unclear in such a case which circuit or plug to meter for the EV. Customers could also avoid the fee by using a different outlet.

Direct data collection with smart meters: Based on our investigation of the capabilities of smart meters recently deployed in Vermont, it appears that the meters cannot report data acquired via Zigbee or other short-range wireless technologies to the utilities via the established meter reading protocols. As a result, implementation of such a mechanism to collect electric use data for electric vehicles, if possible at all, would require retrofitting of these meters and development of new protocols for reporting data to the utilities. In addition, not all Vermont electric utilities have deployed smart meters, and some customers have opted not to receive these meters. In light of these facts, we deemed this mechanism to be impractical enough to not warrant further consideration.

Data collection from the vehicle at inspection or manufacturer: Data on vehicle electric use collected on a periodic basis (e.g. annually) either via the vehicle's manufacturer or at inspection, would have the following advantages and disadvantages.

Advantages:

- Likely low cost.

Disadvantages:

- Electrical metering in the vehicles is not utility-revenue quality.
- Similar to the VMT-based options discussed below, it would be unclear which electricity used by the car was charged in Vermont.
- There is no established mechanism to collect this data, either at inspection or from vehicle manufacturers.

If a volumetric fee on electricity were adopted, it would take more than one year to develop the necessary systems to collect the necessary information regarding electric energy use by each vehicle. If second meters were deployed at the home of each electric vehicle owner, there would be significant time required to acquire and deploy the meters, and time to develop systems at each electric utility to collect and process the data, update billing software, etc. Collecting data from manufacturers would require development of agreements with each manufacturer; collecting data via inspections would at best require completion of electronic inspection reporting and amendment to the inspection requirements and tools to collect the necessary data. On a longer timescale, adoption of a volumetric fee opens the state to the risk that EVs will become more efficient over time, resulting in decaying revenue to the Transportation Fund. In addition, development of a complicated system in Vermont

alone leaves the state at risk to significant stranded costs if other funding mechanisms are adopted nationally or regionally at a later time.

Vehicle miles traveled (VMT) fee

A fee based entirely or in part of the miles traveled by each vehicle was examined in both the Section 39 study previously referenced and the Section 40 study, also completed by AOT in 2012. The Section 40 study provides a summary and calculation:

“Implementing a VMT fee system will be technologically, administratively, and politically complex. VMT user fees are far from accepted or well understood by the general public, legislators, and transportation professionals. There are no general purpose mileage-based user fees in any U.S. jurisdiction, and state policymakers would have to consider many factors in shifting to a VMT fee system. These include:

- How to enroll vehicles
- How to collect the VMT revenues
- How to collect revenue from non-residents travelling in Vermont and share revenue across state lines for Vermonters travelling in other parts of the country
- How to develop the functional and technical requirements of the system; and
- How to develop authorizing legislation

Costs associated with administering a VMT fee system are uncertain for a number of reasons. The implementation is likely to occur well in the future, and involve many unknowns about available future technologies and what they will cost. The NCHRP report on “*Costs of Alternative Revenue-Generation Systems*”^[4] estimated that, if implemented now, average administrative and collection costs for motor fuel taxes to be just under 1% of total fuel tax revenues, compared to a lowest percentage of 4.1% for mileage-based user fees.

Were Vermont to shift from a fuel tax to a VMT fee in the long run, revenues equivalencies would be needed. Agency of Transportation staff calculated that the shift would translate to approximately 1.51 cents for every vehicle mile traveled. This calculation was arrived at by determining annual VMT (7,141,039,000) minus the portion of VMT that is non-resident (10% according to data contained in the Vermont Travel Demand Model). The resident VMT of 6,426,935,100 was then divided by the total revenue from state gasoline and diesel taxes, and TIB assessments (\$97,205,829) in 2011, which translates into 1.51 cents per mile traveled.”

The Section 39 study instead calculated a rate of 1.3 cents per mile traveled. If such a fee were adopted, a precise calculation would be required.

^[4] http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_689.pdf

As discussed in the Section 40 study, the transition to a VMT-based funding source for transportation would be a complicated endeavor and not one likely to take place soon or quickly. In the course of this report, however, we did consider the pros and cons of an EV-specific implementation of a VMT fee. We examined the possibility that EVs could pilot a simple VMT-based fee system, enabling the state to learn from the experience of a relatively small number of drivers and vehicles. As a pilot, it would be limited in time and not interfere with the deployment of other transportation funding policies in the future. Here are advantages and disadvantages of such an EV VMT pilot.

Advantages:

- Develop mechanisms that could be used in future if VMT fees become a primary source of transportation revenue.
- Revenue collected from each vehicle could closely reflect the actual utilization of the transportation system and the costs incurred by that vehicle.
- Many all-electric vehicles have limited range and are therefore less likely to have driven significant portions of their miles outside of Vermont.

Disadvantages:

- EV driving patterns, especially all-electric driving patterns, are not typical of all light-duty vehicles, limiting the value of the pilot.
- Not all EV drivers may agree to participate in such a pilot, citing privacy or other concerns.
- Treatment of plug-in hybrid vehicles, which drive some of their miles on gasoline

Given these advantages and disadvantages, we do not recommend an EV-based VMT pilot. If a VMT pilot were developed for other purposes, the State could consider encouraging EV drivers to participate.

Registration fee

Collecting Transportation Fund revenue from electric vehicles via an additional registration fee was well-described in the Section 39 study:

“A registration fee would be administratively easy and inexpensive to administer but could be viewed as less equitable than other options, because it is not linked in any way to use (vehicle miles traveled) or vehicle efficiency. This fee may be an ideal short-term means of ensuring that electric vehicles (and possibly other AFVs) contribute to the state transportation fund while not overly discouraging adoption of these vehicles.

We suggest that the most equitable and revenue neutral way to calculate an appropriate fee level would be to determine the mean amount of gas tax paid annually by the average Vermont driver using average rates of annual vehicle miles traveled, fuel economy, gas prices and gas taxes in the state: \$146.

Thus, an annual fee of \$146 levied on EV users at the time of annual registration would replace lost revenue while also ensuring that these users contribute approximately the same amount to system maintenance as the average driver in the state.”

Based on updated data, we have calculated the gas tax lost due to the electric-mode operation of both all-electric and plug-in hybrid vehicles. For all-electric vehicles, this amount is \$120; for plug-in hybrid vehicles this amount is \$71. The calculation of these values is based upon:

- the fuel economy of average new light-duty vehicles (CAFE-rated 34.2 MPG, de-rated by 20% for real-world driving conditions);
- average vehicle miles traveled in Vermont (about 12,400 miles/year);
- the gas tax rate of 31.26 cents/gallon (not including the one cent petroleum clean-up fee); and
- a factor that accounts for the miles driven on electricity based on the electric range of the vehicle.

The assumed electric range factor is 0.85 for all-electric vehicles and 0.5 for plug-in hybrid vehicles. These values are based on the “utility factor” calculations by the Electric Power Research Institute found in their report *Transportation Statistics Analysis for Electric Transportation*³. This factor accounts for (in the case of all-electric vehicles) the reduction in miles traveled by the electric vehicle, and increase in use of alternate gasoline powered vehicles, resulting from the limited range of the electric vehicle and (in the case of plug-in hybrid vehicles) the fraction of total miles traveled powered by electricity rather than by gasoline. We have assumed an electric range for plug-in hybrid vehicles of about 20 miles (longer than that for a Toyota Prius plug-in – Vermont’s most popular plug-in – and shorter than a Chevrolet Volt) and a range of 80 miles for all-electric vehicles. In effect, this factor accounts for the use of electricity for short trips and gasoline for longer trips. As plug-in vehicles of varying electric ranges become available in Vermont and elsewhere, we may gain additional data enabling refinement of this number.

We have chosen single point values for each class of electric vehicles (all-electric and plug-in hybrid vehicles), rather than proposing a range of values depending on make and model, for simplicity of implementation. This registration fee could be adopted and implemented quickly because it would require little more updating the registration fees charged by the Department of Motor Vehicles. It would also require some updating of the DMV’s data structures to accurately distinguish between gasoline-only, plug-in hybrid, and all-electric vehicles.

4. Recommendations

All options for raising Transportation Fund revenue from electric vehicles would require legislative action to implement. The authors of this report have concluded that the registration fee funding mechanism is the most reasonable and efficient to implement at this time, and could be implemented relatively quickly. It is not, however, a long-term solution, which would be developed in the context of longer-term solutions for transportation infrastructure funding as a whole.

³ Downloadable from

<http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=00000000001021848>

The state's only current policy incentive for the purchase of electric vehicles is the absence of payments into the Transportation Fund.⁴ If such a registration fee option is adopted it would serve to effectively remove this incentive for the purchase or lease of electric vehicles. Meanwhile, the increased use of these vehicles is an essential component of the state's energy and environmental policy, as evidenced by their central position in the implementation of the 2011 Comprehensive Energy Plan (developed as required by 30 V.S.A. §202b) and implementation of vehicle air quality rules. Given the net positive effect of electric vehicles on the Transportation Fund for the present, the authors recommend that an increased registration fee for electric vehicles only be adopted if paired with establishment of a vehicle purchase incentive program. The recommended size of the additional registration fee is \$120/year for all-electric and \$71/year for plug-in hybrid vehicles. The coupled incentive program need not be funded from the Transportation Fund.

⁴ Ignoring the current \$1/year difference in vehicle registration fee.