

REPORT TO THE VERMONT STATE LEGISLATURE

SUBMITTED BY THE VERMONT PUBLIC UTILITY COMMISSION TO THE SENATE AND HOUSE COMMITTEES ON TRANSPORTATION, THE SENATE COMMITTEE ON FINANCE, THE SENATE COMMITTEE ON NATURAL RESOURCES & ENERGY, AND THE HOUSE COMMITTEE ON ENERGY & TECHNOLOGY



PROMOTING THE OWNERSHIP AND USE OF ELECTRIC VEHICLES IN THE STATE OF VERMONT

June 27, 2019

Table of Contents

I. EXECUTIVE SUMMARY	1
A. ACTIONS BY STATE GOVERNMENT.	2
B. ACTIONS BY VERMONT’S ELECTRIC UTILITIES.	3
C. ACTIONS BY THIRD PARTIES.	4
II. INTRODUCTION AND STATUTORY BASIS.	4
III. ANALYSES AND RECOMMENDATIONS RE: TOPICS IDENTIFIED IN SECTION 25.	9
A. THE ROLE OF ELECTRIC DISTRIBUTION UTILITIES.	10
1. <i>Removal or mitigation, as appropriate, of barriers to EV charging, including strategies, such as time-of-use rates, to reduce operating costs for current and future EV users without shifting costs to ratepayers who do not own or operate EVs.</i>	10
2. <i>Strategies for managing the impact of EVs on and services provided by EVs to the electric transmission and distribution system.</i>	17
3. <i>Electric system benefits and costs of EV charging, electric utility planning for EV charging, and rate design for EV charging.</i>	20
4. <i>The appropriate role of electric distribution utilities with respect to the deployment and operation of EV charging stations.</i>	21
B. EV CHARGING STATIONS OWNED OR OPERATED BY PERSONS OTHER THAN ELECTRIC DISTRIBUTION UTILITIES.	22
1. <i>How and on what terms, including quantity, pricing, and time of day, such charging stations will obtain electric energy to provide to EVs.</i>	22
2. <i>What safety standards should apply to the charging of EVs.</i>	26
3. <i>The recommended scope of the jurisdiction of the Commission, the Department of Public Service, and other State agencies over such stations.</i>	27
4. <i>Whether such stations will be free to set the rates or prices at which they provide electric energy to EVs, and any other issues relevant to the appropriate oversight of the rates and prices charged by such stations, including the transparency to the consumer of those rates and prices.</i>	29
5. <i>The recommended billing and complaint procedures for such charging stations.</i>	34
C. OVERARCHING ISSUES.	35
1. <i>Options to address how EV users pay toward the cost of maintaining the State’s transportation infrastructure, including consideration of methods to assess the impact of EVs on that infrastructure and how to calculate a charge based on that impact, the potential assessment of a charge to EVs as a rate per kilowatt hour delivered to an EV; varying such a charge by size and type of EV; and phasing in such a charge.</i>	35
2. <i>The accuracy of electric metering and submetering technology for charging EVs.</i>	43

3.	<i>Strategies to encourage EV usage at a pace necessary to achieve the goals of the State’s Comprehensive Energy Plan and its greenhouse gas reduction goals, without shifting costs to electric ratepayers who do not own or operate EVs.</i>	44
4.	<i>Other issues relevant to ensuring a fair, cost-effective, and accessible EV charging infrastructure that will be sufficient to meet increased deployment of EVs.</i>	44
IV.	MOVING FORWARD	45
A.	INCENTIVES.	45
B.	EV CHARGING STATION DEPLOYMENT.	48
C.	OPPORTUNITIES ASSOCIATED WITH MASS TRANSIT ELECTRIFICATION.	49
D.	EDUCATION AND OUTREACH.	50
E.	STATE OPPORTUNITIES.	51
F.	FLEET AND COMMERCIAL VEHICLES.	52
V.	CONCLUSION	52
APPENDIX A 	HISTORY OF PUC CASE NO. 18-2660-INV	A-1
APPENDIX B 	LIST OF PARTICIPANTS IN PUC CASE NO. 18-2660-INV	B-1

I. Executive Summary

Scientists agree that the earth is experiencing a period of climate change that features an increase in average temperatures and an increase in severe, and in some cases permanent, adverse environmental consequences. Scientists are also confident that the cause of this climate change is mainly due to human activities, in large part the burning of fossil fuels, which releases greenhouse gases (“GHGs”) into the atmosphere, trapping heat.

Global climate change has already begun to have effects on the natural environment in the form of shrinking glaciers, earlier ice breakup on rivers and lakes, shifting plant and animal ranges, loss of sea ice, sea-level rise, drought, severe storms, and longer, more intense heat waves. Scientists are confident that temperatures will continue to rise for decades with associated long-term effects, including changes in precipitation patterns, a further increase in drought and heat waves, intensifying hurricanes, and accelerated sea-level rise.

How much the world’s climate will change depends on the amount of GHG emissions and exactly how they interact with the climate. Yet in spite of an increasing awareness regarding our GHG emissions and their impact on the climate, our emission levels continue to increase.

The transportation sector is the largest contributor to greenhouse gas emissions in Vermont. The increase in fossil-fuel emissions in the state is due in large part to emissions from cars and trucks. With its reliance on gasoline and diesel, transportation accounts for 47% of the state’s greenhouse gas emissions – outdistancing all other sectors, including residential and commercial heating. For this reason, Vermont’s Comprehensive Energy Plan (“CEP”) aims to increase the share of renewable energy in Vermont’s transportation sector to 10% by 2025 and 80% by 2050. The CEP also seeks to reduce greenhouse gas emissions from the transportation sector by 30% by 2025.

As of January 2019, there were 2,985 electric vehicles (“EVs”)¹ registered in Vermont. Estimates for how many EVs must be registered in Vermont to meet the goals set forth in the CEP range from 50,000 to 60,000 vehicles by 2025. The pace of EV adoption needed to reach 60,000 vehicles by 2025 from the 2,985 EVs registered in Vermont today is an approximately 54% compound annual growth rate.

¹ Electric vehicles, or EVs, include both vehicles powered exclusively by rechargeable batteries and plug-in hybrid electric vehicles.

This report analyzes barriers to achieving more widespread adoption of EVs in Vermont, as well as ways to eliminate or mitigate those barriers. The barriers identified include, but are not limited to, the price of new electric vehicles, the perceived limited distance that an EV can travel on a single charge, and the limited availability of public charging locations. Though not cited as often as these barriers, lack of vehicle choice and misconceptions about vehicle performance can also weigh as negative factors by some when considering the purchase of an EV.

This report concludes that we can and should take a variety of approaches to remove barriers to the accelerated adoption of EVs, including: more EV purchase incentives by manufacturers, dealers, electric utilities, and State government; easier pathways for the installation of public charging infrastructure around Vermont, both for extended daytime parking in public lots and fast charging for travelers; increased education and outreach efforts; and rate offerings by utilities that both encourage certain charging behavior by EV owners and benefit all ratepayers by increasing electricity sales at times that will result in lower costs for Vermont electric ratepayers.

Highlights of the report's recommendations include:

A. Actions by State Government.

- Financial incentives in the form of time-of-sale purchase incentives or tax credits to further encourage the purchase or lease of electric vehicles, especially as federal incentives begin to decline.
- Passage of additional legislation to make it easier to use public charging stations (detailed further in the report).
- Placement of public charging stations at locations such as Park and Ride lots, Interstate rest areas, and State employee parking lots.
- Procurement of EVs when replacing or expanding the State's motor vehicle fleet.
- Requiring or encouraging the deployment of charging infrastructure through zoning or building code modifications, especially for new construction.
- Support for the continued electrification of mass transit.
- Consultation between the Vermont Department of Public Service and Vermont's electric distribution utilities to develop rate structures for public charging stations in an effort to remove barriers to charging station deployment, including reducing the impacts from utility-imposed demand charges on fast-charging stations.
- Prompt consideration by the Public Utility Commission of proposals by Vermont's electric utilities to invest in infrastructure that would support

deployment of charging stations by third parties where such investment would be beneficial to the public interest.

- Support for education and outreach initiatives to inform the traveling public of the savings associated with driving EVs, including reduced costs to all electric ratepayers, and the environmental and health benefits that will accrue to all Vermonters from reduced emissions.

B. Actions by Vermont's Electric Utilities.

- Continued or new incentives to ratepayers for the purchase of EVs through Tier III of Vermont's Renewable Energy Standard program.
- Offering of incentives or equipment for in-home managed charging.
- Proposals for simple, well-designed rate plans, such as time-of-use retail rates to encourage EV charging at times when the demand for electricity is low to make more cost-effective use of the electric grid, thereby lowering costs for all Vermont ratepayers.
- Proposals for rates and rate structures specific to public charging stations owned by third-party operators to encourage their deployment (especially fast-charging stations).
- Proposals to invest in EV charging stations, either as a regulated investment subject to rate recovery or through an unregulated affiliate.
- Proposals to invest in make-ready infrastructure (e.g., line extensions) to support third-party development of charging stations, where the public interest would support recovery of such an investment by a utility in its rates.
- Seeking out opportunities to use non-ratepayer funds to encourage EV adoption in Vermont, thereby increasing electricity sales and lowering costs to Vermont ratepayers.
- Development of plans to accommodate the future growth of EV charging in Vermont and absorb surplus in-state renewable energy generation.
- Coordination with Vermont EV dealers to educate the public about the benefits of driving EVs and the various, combined incentives available to support their purchase (such as State, federal, and utility purchase incentives, plus utility charging incentives).
- Coordination with entities such as Drive Electric Vermont to promote better understanding of the economic, health, and environmental benefits of driving an EV.

C. Actions by Third Parties.

- Improved coordination between Vermont’s car dealers and Vermont utilities to educate the public about the benefits of driving EVs and the various incentives available to support their purchase.
- Improved coordination between Vermont’s car dealers and entities such as Drive Electric Vermont to promote better understanding of the economic, health, and environmental benefits of driving an EV.
- Increased efforts by Vermont’s car dealers to train sales staff to promote the sale of EVs, maintain an adequate inventory of various models to assist interested consumers in making purchase decisions, and train service staff to provide support for EV maintenance after a sale is made.
- Education and outreach by entities such as Drive Electric Vermont to continue to educate Vermonters about the economic, health, and environmental benefits of driving an EV.

The list above represents highlighted recommendations from the report. The report itself contains additional recommendations, along with further detail and analysis for each recommendation.

It is evident from the information gathered in support of this report that Vermont has made a commendable start in its efforts to support the adoption of electric vehicles and the deployment of EV charging infrastructure. However, it is equally evident that much more is required. The recommendations in this report reflect the significant efforts that are necessary for the State to achieve its emissions-reduction goals. Implementation of these recommendations will require a realization – and a strong commitment – by State government, Vermont’s electric utilities, the private sector, and Vermont’s citizens that strong, combined efforts must be made to support and accelerate the growth of clean, renewable transportation in Vermont.

II. Introduction and Statutory Basis.

Scientists agree that the earth is experiencing a period of climate change that features an increase in average temperatures. Scientists are also confident that the cause of this climate change is mainly due to human activities, in large part the burning of fossil fuels, which releases greenhouse gases (“GHGs”) into the atmosphere, trapping heat.²

² *Global Climate Change, Vital Signs of the Planet*, NASA, June 2018, at <https://climate.nasa.gov/causes/>.

Global climate change has already begun to have effects on the natural environment in the form of shrinking glaciers, earlier ice breakup on rivers and lakes, shifting plant and animal ranges, loss of sea ice, sea-level rise, drought, severe storms, and more intense heat waves. Scientists are confident that temperatures will continue to rise for decades with associated long-term effects, including changes in precipitation patterns, a further increase in severe weather events, intensifying hurricanes, and accelerated sea-level rise.³

How much the world's climate will change depends on the amount of GHG emissions and exactly how they interact with the climate. Yet in spite of an increasing awareness regarding our GHG emissions and their impact on the climate, our emission levels continue to rise. Combatting the effects of climate change in part requires mitigation strategies designed to curb the level of human-induced GHG emissions released into the environment.⁴

In recognition of this growing problem and the need to reduce GHG emissions, Vermont has established ambitious GHG emission reduction goals.

It is the goal of the State to reduce emissions of greenhouse gases from within the geographical boundaries of the State and those emissions outside the boundaries of the State that are caused by the use of energy in Vermont in order to make an appropriate contribution to achieving the regional goals of reducing emissions of greenhouse gases from the 1990 baseline by:

- (1) 25 percent by January 1, 2012;
- (2) 50 percent by January 1, 2028;
- (3) if practicable using reasonable efforts, 75 percent by January 1, 2050.⁵

Vermont has made significant progress in reducing GHG emissions in its production and consumption of electricity. As of the release of the Vermont Department of Public Service's ("Department") 2016 Comprehensive Energy Plan, a large portion of electricity consumed in Vermont was produced by renewable resources.⁶ According to the Department's 2019 biennial renewable energy programs report, in 2017 the Renewable Energy Standard had

³ *Id.* at <https://climate.nasa.gov/effects/>.

⁴ *Id.* at <https://climate.nasa.gov/solutions/adaptation-mitigation/>.

⁵ 10 V.S.A. § 578.

⁶ See *Vermont Comprehensive Energy Plan* 2016 at 189-94 for a detailed discussion of the sources of electric generation serving Vermont's electricity consumers.

the effect of reducing carbon dioxide emissions from the electric sector by approximately 579,000 tons compared to 2016.⁷

However, the transportation sector remains the largest contributor to greenhouse gas emissions in Vermont. Fossil-fuel emissions in Vermont continue to rise, due in large part to emissions from cars and trucks. With its reliance on gasoline and diesel, transportation accounts for 47% of the state's greenhouse gas emissions – outdistancing all other sectors, including residential and commercial heating. Vermont's Comprehensive Energy Plan ("CEP") aims to increase the share of renewable energy in Vermont's transportation sector to 10% by 2025 and 80% by 2050. The CEP also seeks to reduce greenhouse gas emissions from the transportation sector by 30% by 2025.⁸

As of January 2019, there were 2,985 electric vehicles ("EVs")⁹ registered in Vermont. Estimates for how many EVs must be registered in Vermont to meet the goals set forth in the CEP range from 50,000 to 60,000 vehicles by 2025. The pace of EV adoption needed to reach 60,000 vehicles by 2025 from the 2,985 EVs registered in Vermont today is an approximately 54% compound annual growth rate.¹⁰

The most often cited barriers to widespread EV adoption are the limited range an EV can travel on a single charge, limited availability of charging opportunities, and the cost of EVs compared to internal combustion engine ("ICE") vehicles.¹¹ Though not cited as often as the above barriers, lack of choice¹² and misconceptions about vehicle performance¹³ can also weigh as negative factors by some when considering the purchase of an EV. Additionally, Vermonters may face unique barriers not identified above due to the state's rural, mountainous landscape and cold winters.

Some of these barriers will be addressed as EVs and EV technology continue to develop. As the market expands to include more EV options, such as four-wheel drive EVs and electric

⁷ *Report on Vermont Renewable Energy Programs – A Biennial Report to the Vermont General Assembly Prepared by the Department of Public Service*, March 1, 2019, at page 11.

⁸ PUC Case No. 18-2660-INV, Department of Public Service comments dated 4/8/19 at 1.

⁹ As used in this report, EV refers to both plug-in hybrid vehicles and fully electric vehicles.

¹⁰ PUC Case No. 18-2660-INV, Drive Electric Vermont workshop 4 presentation, April 23, 2019 at slide 4; PUC Case No. 18-2660-INV, Department of Public Service comments dated 4/8/19 at 2.

¹¹ *See, e.g., The Barriers to Acceptance of Plug-in Electric Vehicles: 2017 Update*, National Renewable Energy Laboratory, November 2017 at 18-23.

¹² *See, e.g., Overcoming Barriers to Electric-Vehicle Deployment: Interim Report*, National Academy of Sciences, 2013 at 3, 22.

¹³ *See, e.g., Five Myths About Electric Cars*, Motavalli, J., March 23, 2010 at <https://phys.org/news/2010-03-myths-electric-cars.html>.

trucks, EVs will appeal to a wider consumer base. Increasing EV range capabilities will also expand the number of people willing to consider an EV for their next vehicle. While this market develops, however, there is plenty that the State can do to encourage its growth and prepare to accommodate the charging demands that will accompany that growth.

On May 21, 2018, Act 158 (H.917) of the 2017-2018 Vermont legislative session took effect upon its signing by the Governor. Section 25 of Act 158 (“Section 25”) directed the Public Utility Commission (“Commission” or “PUC”) to conduct an evaluation and submit a report by July 1, 2019, concerning the following issues related to the charging of EVs.

Section 25 requires the Commission’s report to include analysis and recommendations on the role of Vermont’s electric distribution utilities with respect to the following issues:

1. Removal or mitigation, as appropriate, of barriers to EV charging, including strategies, such as time-of-use rates, to reduce operating costs for current and future EV users without shifting costs to ratepayers who do not own or operate EVs;
2. Strategies for managing the impact of EVs on and services provided by EVs to the electric transmission and distribution system;
3. Electric system benefits and costs of EV charging, electric utility planning for EV charging, and rate design for EV charging; and
4. The appropriate role of electric distribution utilities with respect to the deployment and operation of EV charging stations.

Section 25 further requires the Commission’s report to include analysis and recommendations related to EV charging stations owned or operated by persons or entities other than Vermont’s electric distribution utilities with respect to the following issues:

1. How and on what terms, including quantity, pricing, and time of day, such charging stations will obtain electric energy to provide to EVs;
2. What safety standards should apply to the charging of EVs;
3. The recommended scope of the jurisdiction of the Commission, the Department of Public Service, and other State agencies over such stations;
4. Whether such stations will be free to set the rates or prices at which they provide electric energy to EVs, and any other issues relevant to the appropriate oversight of

the rates and prices charged by such stations, including the transparency to the consumer of those rates and prices; and

5. The recommended billing and complaint procedures for such charging stations.

Last, Section 25 requires the Commission's report to include analysis and recommendations on each of the following issues:

1. Jointly with the Secretary of Transportation, recommended options to address how EV users pay toward the cost of maintaining the State's transportation infrastructure, including consideration of methods to assess the impact of EVs on that infrastructure and how to calculate a charge based on that impact, the potential assessment of a charge to EVs as a rate per kilowatt hour delivered to an EV; varying such a charge by size and type of EV; and phasing in such a charge;
2. The accuracy of electric metering and submetering technology for charging EVs;
3. Strategies to encourage EV usage at a pace necessary to achieve the goals of the State's Comprehensive Energy Plan and its greenhouse gas reduction goals, without shifting costs to electric ratepayers who do not own or operate EVs; and
4. Any other issues the Commission considers relevant to ensuring a fair, cost-effective, and accessible EV charging infrastructure that will be sufficient to meet increased deployment of EVs.

As part of its report, the Commission must identify any issues listed above that may require enabling legislation.

If Vermont is to meet its GHG reduction goals, it is critical that barriers to the deployment of EV infrastructure and to the purchase and use of EVs themselves be addressed and eliminated to the extent possible. In response to the directive of Section 25, on July 9, 2018, the Commission initiated an investigation¹⁴ to explore the issues identified by Section 25, as well as any other related issues that arose during the course of the investigation. The purpose of the investigation was to gather the information necessary to provide the Legislature with a comprehensive report addressing issues surrounding the deployment of EV charging infrastructure and EV adoption in Vermont and to provide recommendations

¹⁴ Case No. 18-2660-INV. All of the documents issued by the Commission and filed by the various participants can be accessed via ePUC, the Commission's online filing and case management system.

to remove or mitigate barriers to the growth of EVs as an integral part of Vermont's transportation sector.

This report represents the product of the Commission's investigation and incorporates the thoughts and recommendations of many interested persons and entities.¹⁵ The Commission greatly appreciates the time and effort that the many participants put into the investigation and what ultimately became contributions to this report.

The report is organized into five main sections.

- Section I is the Executive Summary.
- Section II provides an introduction and the statutory basis for the content of the report.
- Section III contains the Commission's analyses and recommendations on each of the 13 topic areas identified by Section 25. Section III is divided into subsections that address: (1) the role of Vermont's electric distribution utilities in mitigating and removing barriers to EV use and EV charging station deployment in Vermont; (2) EV charging stations owned or operated by persons other than electric distribution utilities; and (3) overarching issues related to EV use and EV charging station deployment in Vermont.
- Section IV presents suggestions and proposals for moving forward to meet the State's goals with respect to reducing GHGs in the transportation sector.
- Last, Section V provides some concluding thoughts.

III. Analyses and Recommendations Re: Topics Identified in Section 25.

This section of the report responds to each individual topic identified in Section 25 and provides recommendations or identifies options where appropriate. The topics are addressed in the same order as they appear in Section 25.

¹⁵ Appendix A to this report sets forth the history of the Commission's investigation in Case No. 18-2660-INV, opened in response to Section 25. Appendix B to this report is a list of participants in the investigation.

A. The Role of Electric Distribution Utilities.

1. Removal or mitigation, as appropriate, of barriers to EV charging, including strategies, such as time-of-use rates, to reduce operating costs for current and future EV users without shifting costs to ratepayers who do not own or operate EVs.

EV charging takes place at home, at work, at businesses, and at public charging stations. There are barriers to installing, owning, and operating EV charging equipment at each of these locations. These barriers include installation costs associated with EV charging equipment, the availability of public charging stations and electric utility infrastructure to support them, electricity rates and charges, and a lack of public familiarity with EVs and EV technology.

Electric distribution utilities will play an important role in removing or mitigating these barriers. Specific actions that can be taken by Vermont's distribution utilities include:

- (a) Developing alternative rate designs that overcome the barrier presented by **demand charges** to EV-charging station operators;
- (b) Implementing **time-of-use rates** for home, workplace, and public charging;
- (c) Offering **incentives** for EV chargers through Tier III of the Renewable Energy Standard ("RES") program;¹⁶ and
- (d) Drafting **utility EV plans**, for Commission review and approval, that will address each utility's long- and short-term plans for advancing in its service territory EV ownership and charging.

These actions will facilitate the maturation of the EV market in Vermont. It will be important to design and implement these strategies so that operating costs for EV users will be reduced while utility customers who do not own or operate EVs will not unreasonably bear the associated costs.¹⁷ It will be similarly important to avoid stranded costs from utility investments as technologies and markets evolve. Each of these actions is discussed below.

¹⁶ Vermont's "RES" program is its statutory renewable energy standard that requires Vermont's electric distribution utilities to maintain specified minimum amounts of renewable energy as a percentage of their power portfolios. Tier III is designed to encourage Vermont's electric distribution utilities in part to support projects to reduce fossil fuel consumed by their customers.

¹⁷ While utilities are well positioned to implement strategies to help reduce the cost of EV ownership, it is the purchase cost of EVs, not operating or maintenance costs, that represents the biggest barrier to EV adoption today. Therefore, in addition to developing strategies to reduce operating costs for current and future EV users without shifting costs, it will be most important to develop policies and strategies to bring down EV purchase costs.

(a) Demand charges

As discussed elsewhere in this report, at present the vast majority of EV charging takes place at home, where EVs are typically parked overnight and can be charged at a relatively slow rate over many hours. This charging can be accomplished using a Level One (120 Volts) or Level Two (240 Volts) charger. However, in order to facilitate broad adoption of EVs, it will be necessary for the market to develop a network of charging stations where EV drivers can charge their cars relatively quickly, away from home, with an experience similar to making a short stop at a gas station.¹⁸

The fastest current technology for achieving a quick EV charge is known as “direct current fast charging” or “DCFC.” DCFC provides EVs with an 80% charge in 20-30 minutes. Access to DCFC is essential to long-distance travel, in emergency situations, and for customers who are without access to charging at their residence or workplace. It is also essential to overcome “range anxiety,” one of the most significant barriers to customer adoption of EVs. A network of DCFC enables EVs to go on road trips beyond their battery range.

DCFC stations draw relatively large amounts of power in a short period of time to rapidly charge EVs. The large power draws associated with DCFC are typically subject to utility tariffs that contain demand charges. In utility rates, demand charges are based on a customer’s maximum instantaneous power draw. Larger instantaneous power draws necessitate larger, and more expensive, distribution networks to serve customers. Demand charges serve an important function by sending efficient price signals to utility customers and help to ensure that the prudently incurred fixed costs of utilities are recovered in a reasonable way.

Because of demand charges, delivery of a kWh of energy at a public DCFC is more expensive than buying the same kWh of energy at home. Simply put, fast charging is a convenience service, and that convenience comes at a cost.

As Vermont’s EV fleet continues to develop, demand charges will represent a continuing barrier to the deployment of DCFC infrastructure. When DCFC usage is low, as it will be in the early phases of EV adoption, the demand charge can represent up to 90% of a station’s monthly electricity bill, which is a prohibitively high operating cost.¹⁹

¹⁸ This is especially imperative for EV drivers who do not have a dedicated parking spot for charging at their residence or place of work.

¹⁹ Tesla March 1 comments at 3-4, citing to a 2017 paper from the Rocky Mountain Institute, *EVgo Fleet and Tariff Analysis*.

Because DCFC systems can have a high demand charge yet low utilization, some states have introduced alternatives to demand charges for DCFC systems to encourage increased deployment rates. These alternatives include tariffs with higher volumetric energy rates but no demand charges for several years before reinstating or phasing in demand charges when utilization rates are higher, which makes DCFC systems more viable investments.

Recommendation

The Commission recommends that utilities consider new rate designs to address the challenges associated with demand charges that will meet both the utility's need to recover its costs and an EV charging station owner's need to provide an economically viable charging service that is attractive to EV drivers.

The utility role is to offer alternative rate design options that are conducive to sustainable, long-term growth in the EV and EV charging markets. At the same time, the alternative rate designs must provide enough compensation to the utility for system costs – incremental costs plus contributions to margin to cover joint, common, and embedded components of costs – without imposing additional costs on non-EV users. Participants in this investigation have provided examples of alternative approaches from other jurisdictions. The following list provides several of those options:

- Replace or pair demand charges with higher volumetric pricing, such as energy (kWh) charges, with the result being revenue neutral for the customer class;
- Provide a monthly bill credit to commercial customers to reduce charges associated with installed EV charging stations;
- Provide a unique EV charging rate that is metered separately;
- Levelize estimated demand charges over time;
- Offer a subscription plan for public DC fast chargers that would lower demand charges;
- Offer per-plug incentives that decline over time, similar in effect to reducing and then gradually increasing demand charges. Larger incentives could be offered for stations with larger supply capacity (kW). This would encourage deployment of faster-charging DCFC;
- Pilot economic development tariffs or pilots that grant a demand-charge holiday with an eventual, predictable return of demand charges;

- Provide annual credits for DCFC that are designed to mimic and offset the anticipated uneconomic portion of demand charges.²⁰ Incentives should be interim to kick-start the market and should not be technology specific.

Regardless of what rate designs are implemented to remove or mitigate the barrier currently presented by demand charges, it will be necessary that they provide demand-charge relief to station owners, cover a utility's costs, and do not provide cross-subsidies.

(b) Time-of-use rates

The present low cost of electricity relative to gasoline is a benefit, rather than a barrier, to EV charging. According to Green Mountain Power, at current gasoline and residential electric rates, most Vermonters adopting an EV will experience a 50% fuel cost reduction starting on their first day of ownership.²¹ However, as evidenced by the relatively low number of EVs currently registered in Vermont, this benefit has not been enough to overcome the other barriers to widespread EV adoption. One way that the value proposition of electricity as a transportation fuel can be meaningfully increased is through utility time-of-use ("TOU") rates or incentives.

A TOU rate typically encourages a utility customer to use electricity when it is best for the electric grid by giving the customer a price incentive. This is accomplished by a utility changing its retail rates in response to changes in its per-unit cost of providing electricity as that cost changes during the course of a day. For example, the per-unit cost to provide electricity is greater when there is high demand for electricity, such as on an overcast winter day, because of the increased generation needs. When the demand for electricity is less – such as the middle of the night – the cost to provide electricity is lower because generation needs are less. TOU rates can be used to reflect these cost differences and make them available to customers. When customers shift their electricity consumption to times that are best for the electric grid in reaction to the price signals resulting from TOU rates, they will save money.

Most EV charging occurs at home and overnight, which is typically a low-demand period. Because EV charging behaviors align with periods of low electricity demand, there are significant opportunities for utilities that have not already done so to develop TOU rates that will be beneficial to EV owners and customers at large. Off-peak EV charging represents incremental utility load that can increase utility revenues and system load factor

²⁰ *Proceeding on Motion of the Commission Regarding Electric Vehicle Supply Equipment and Infrastructure*, Case No. 18-E-0138, New York State Department of Public Service, Order of February 7, 2019.

²¹ PUC Case No. 18-2660-INV, Green Mountain Power May 13 comments at 3.

without a commensurate increase in utility costs.²² This benefits all utility customers by spreading a utility's fixed system costs over a greater number of kWh sold and places downward pressure on electricity rates for all ratepayers, including those who do not own or operate EVs.

The question, then, is not whether utilities should offer TOU rates that would benefit EV owners and all ratepayers, but how those TOU rates can best be designed, whether they should be specific to EV charging (as opposed to whole-home TOU rates), whether utilities should be required to make TOU rates available, and whether EV owners should be required to take service under TOU rates.

Participants in this investigation cited studies assessing customer acceptance of and behavioral responses to TOU rates. These participants suggested that TOU rates are most effective when there are multiple TOU periods – such as peak, off-peak, and super off-peak – and where the differential in price between peak and super off-peak is meaningful. Participants suggested that residential EV charging is very responsive to TOU rates, as is fleet vehicle and workplace charging. On the other hand, public charging stations may not be as responsive to demand-management programs such as TOU pricing because public EV charging occurs when the need arises. In contrast to home charging, public charging needs are inelastic: Many drivers using public charging stations are probably in need of a quick charge to get back on the road.

Whole-house TOU rates can offer EV drivers considerable cost savings while also reducing the costs imposed on the grid. To ease customer concerns over potential adverse financial consequences from whole-house TOU rates, some jurisdictions offer programs that illustrate the benefits of TOU rates without financial risk. For example, a utility can provide a customer with information about what its past utility bills would have been under a TOU rate. A utility can also use “shadow billing” to illustrate what a customer's current bill would be under a traditional rate plan and under the TOU rate plan. And a utility can offer “bill protection” or “hold harmless” provisions for a period of time – whereby a customer would pay no more than they would have under a traditional rate plan – to enable EV drivers to become familiar with the tariff and shift their home electrical use without adverse financial consequences.

²² Load factor is the ratio of the average load to the peak load over a given time period. In an ideal system, a utility's load would be evenly distributed over the day and the grid equipment would not need to be oversized to accommodate peaks. Charging EVs during traditionally lower load periods, such as overnight, moves the system load factor toward that ideal even distribution.

Whole-house TOU rates may not be for everyone. An alternative to whole-house TOU would be to offer TOU rates specific to EV charging. EV-only TOU rates typically require a second utility meter with attendant costs, which commonly include meter installation and an additional monthly customer charge. Some participants in this investigation suggest that it is rare for the savings from TOU rates for the EV to make up for the additional costs. When that is the case, EV-only TOU rates have low uptake. Absent a very compelling off-peak energy rate, the costs of a second meter can make TOU rates impractical, uneconomical, or both for many customers. Therefore, if EV-only TOU rates are to be part of the solution to beneficial EV adoption, it will be necessary to find innovative ways to reduce the metering cost for EV-only TOU rates, or to design rates in a way to make them economic for customers.

To get around the requirement for a second utility meter for EV-only TOU programs, some participants suggest the use of sub-meters or the meters embedded in EV chargers (or the EVs themselves) to track the time of day and the amount of energy used when an EV is charged. Because these meters may not be as accurate as utility-grade meters, and therefore may not be relied upon for billing purposes, participants suggest using the EV charging data to calculate TOU incentives. Rather than differentiate the per-kWh rate for electricity based on time of day, a customer may receive an incentive, such as a bill credit, for charging that takes place at specified times, as measured and recorded by the alternative metering device. The customer's total energy usage for billing purposes will be measured by the utility meter that serves the house. Some utilities have found the minor inaccuracies in the submeter used to measure EV charging to be acceptable for the purpose of calculating a bill credit.²³

Recommendation

It is promising that today's equipment can automate customer responsiveness to TOU rates and incentives. An EV driver does not need to wander out to the garage to plug in her EV late at night. Instead, existing technology within the EV, EV charging station, or smart meter can be used to schedule off-peak charging to take place automatically.

The Commission finds that TOU rates, including EV-only TOU rates and incentives, hold great promise for increasing the value proposition of EV ownership. In addition, as incremental EV charging load is added to the electric grid at least-cost times, all ratepayers will benefit. That said, we do not recommend requiring EV drivers to use TOU rates given the early stages of EV adoption. Instead, the public should be educated about the benefits

²³ See discussion below in Section III.C.

of TOU rates, and those rates should be optimally designed for the convenience of customers while covering the utility's cost to serve.

(c) Incentives

Vermont utilities are already offering incentives for EVs and EV charging equipment as part of their Tier III programs.²⁴ Examples of these Tier III offerings include incentives for the purchase or lease of new EVs, incentives for the purchase or lease of new plug-in hybrid EVs, free or discounted Level Two residential EV chargers, incentives for electric buses and electric bicycles, and incentives for workplace EV charging stations. In addition to offerings funded through ratepayer dollars, several Vermont utilities are funding public charging stations using grant dollars from the Vermont Low Income Trust for Electricity ("VLITE"), and several utilities seek to fund public charging stations using Volkswagen Mitigation Trust Fund dollars.

Because Tier III projects are required by law to be cost effective and to cost the utility less than the applicable alternative compliance payment, there is a limit to how large an individual utility incentive can be. Therefore, while utility incentives offered for EVs and EV charging equipment through Tier III programs play an important role in overcoming barriers to greater adoption of EVs and deployment of EV charging equipment, these incentives alone will not be enough, especially early in the market's transformation, to achieve Vermont's Comprehensive Energy Plan and GHG emissions reduction goals.

Recommendation

We commend those Vermont utilities that have sought additional non-ratepayer funds to increase the deployment of EV charging stations in their service territories. We recommend that Vermont utilities, State agencies, and legislators continue to identify and appropriate additional, meaningful, non-ratepayer funds that may be used as incentives to enable increased EV adoption and EV charging equipment deployment.

(d) Utility EV plans

Utilities play an important role in facilitating the transformation of the EV market. Therefore, we intend to invite utilities to submit transportation electrification proposals, including pilots or tariffs, to the Commission as a means of speeding EV adoption. We hope that such utility plans will increase awareness of EV benefits, provide accurate information and dispel myths about EVs, and facilitate TOU and managed charging. These

²⁴ Tier III refers to the energy transformation category of Vermont's Renewable Energy Standard. See 30 V.S.A. § 8005(a)(3).

proposals may include purchase incentives, TOU rates for home charging, and public education addressing the environmental, cost, and public health benefits of EV adoption.

Based on current EV adoption levels, Vermont drivers will need to purchase electric vehicles at a compound annual growth rate of 54% to achieve the goal of 10% renewable energy in the transportation sector set by the Comprehensive Energy Plan.²⁵ Through transportation electrification plans, each utility could indicate the part it will play in ensuring that those goals are met. Such plans could address how a utility will promote EV ownership and charging within its service territory based on the needs of its customers. Collectively, the utility plans will form a roadmap indicating how Vermont, in partnership with other market actors including vehicle manufacturers and EV charging equipment companies, will reach its energy and environmental goals as they relate to transportation.

Examples of utility actions that may be incorporated into transportation electrification plans include the following:

- Investment in EV charging stations in areas that are not effectively served by third parties, such as rural areas, where utility investment will enable further EV adoption;
- Forecasts addressing where and when EVs will materialize on their systems;
- Load management efforts, such as TOU rates or managed charging programs; and
- Educating customers about EVs and charging. Utilities should educate customers, for example, about the difference between an at-home Level Two charger and simple “drip” charging at 120 volts, about how electric rates are set, how TOU rates may work for customers and the grid, and how electric fuel compares to gasoline or diesel at the pump. Utilities may also educate customers about how EV programs help the environment and help advance Vermont’s energy policies and goals. EV technology and the EV market are new, complicated, and potentially intimidating. Robust education and outreach by utilities is necessary and appropriate.

2. Strategies for managing the impact of EVs on and services provided by EVs to the electric transmission and distribution system.

EV charging is a new load on the electric system, but the energy demand (kWh) associated with this load is not expected to create system constraints due to otherwise declining loads in Vermont. However, EVs’ power demand (kW) may still have local and grid-scale

²⁵ PUC Case No. 18-2660-INV, Department of Public Service comments dated 4/8/19 at 2.

impacts. This section of the report examines strategies to address the potential impacts and manage the services provided by EV charging to the electric grid.²⁶

Given the flat and declining load in Vermont, a significant increase in EV usage is not likely to have a negative impact on transmission and distribution system reliability.²⁷ According to the Vermont Electric Power Company's ("VELCO")²⁸ 2018 Long Range Transmission Plan, there will be approximately 125,000 EVs in Vermont by 2037.²⁹ Projected additions to both summer and winter peak resulting from new EV load are just under 70 MW. This forecast assumes no load management measures to help identify any system concerns associated with the new load that might require such measures.³⁰ However, the Vermont Department of Public Service has concluded that there is already sufficient capacity on the New England and Vermont bulk transmission systems to handle the additional EV charging load over the forecast horizon.³¹

However, while the bulk transmission system is expected to be able to handle the increased demand for electricity that will result from growth in the use of EVs in Vermont, Vermont's distribution utilities may face challenges on parts of their systems as loads increase to capacity levels and possibly beyond as a result of increased EV charging.³² Potential distribution system impacts include sagging voltage or service transformer overload. Each distribution network is unique, and Vermont's distribution utilities will need to understand the pace and varying location of load growth associated with EV charging in order to plan to accommodate that growth.

²⁶ The Commission will further address the topic of electric vehicle charging tariff design in a report that is due to be filed on December 15, 2019, with the Senate Committees on Transportation and on Natural Resources and Energy and the House Committees on Transportation and on Energy and Technology pursuant to Section 35 of House Bill 529 (pending enactment by the Governor).

²⁷ PUC Case No. 18-2660-INV, Green Mountain Power comments dated 5/13/19 at 3.

²⁸ VELCO manages the bulk electric transmission system that serves Vermont's distribution utilities. The assets that comprise that transmission system are owned by Vermont Transco LLC.

²⁹ See <https://www.velco.com/assets/documents/2018%20LRTP%20Final%20asfiled.pdf> at 17. The EV forecast incorporated into VELCO's plan was performed by the Vermont Energy Investment Corporation ("VEIC").

³⁰ *Id.* The Vermont Department of Public Service expects that the peak MW associated with EVs could be significantly reduced through load-management measures such as time-of-use rates and customers giving the utility control over their charging during peak events in exchange for a lower rate. PUC Case No. 18-2660-INV, Department comments dated 3/1/19 at 3.

³¹ *Id.*

³² See, e.g. PUC Case No. 18-2660-INV, Department comments dated March 1, 2019 at 3; Vermont Electric Cooperative, Inc. ("VEC") comments dated March 1, 2019, at 2-3.

EV-specific programs can be used both to inform distribution utilities where EV load growth is occurring on their systems and to provide the distribution utilities opportunities to manage those loads. For example, offering advantageous pricing mechanisms that encourage charging during off-peak hours and during times when Vermont's solar generation is producing at a high rate allows a utility to take better advantage of existing system capacity, but also informs the utility where EV load growth is occurring as customers sign up.

However, if a utility does not offer an EV-specific program it is unlikely to know which of its customers own EVs. In that event, the utility could consider offering customers a nominal rebate for "registering" their EV with the utility so that the utility may have increased knowledge of where new home-based EV charging will take place. While notification-only programs would provide the utility with information about where EV loads are appearing, they would forgo the opportunity to manage the potential grid impacts of increased EV charging. Therefore, utilities that do not offer EV-specific programs should consider doing so. As discussed elsewhere in this report, a significant percentage of EV charging takes place at home, can be flexible, and can be influenced by TOU pricing. Such flexible loads can respond to price signals by shifting demand and thereby provide benefits to generation owners and the grid.

In addition to TOU pricing, which relies on customer behavior to shift demand to avoid grid impacts, utilities can use managed charging to shift EV charging demands based on electric grid conditions via communication with a utility or grid operator. Managed charging typically requires an EV driver to cede some level of control over his or her charging to a third party, which could be a utility or a third-party aggregator. Managed charging enables increased adoption of EVs without new grid infrastructure investments and promotes grid reliability by allowing a central operator to curtail EV charging at times that benefit the utility and customers, such as at times of peak demand. In exchange for allowing a third party to have some level of control over charging and the benefits that accrue, EV owners may receive an incentive for their equipment and may charge their EVs at a lower electric rate or receive a bill credit.

Recommendation

The ability to shift and shape EV charging load can facilitate grid modernization and decarbonization efforts. For example, charging EVs at times of robust renewable energy generation may support the integration of greater amounts of renewable energy resources by absorbing surplus renewable energy.

Regardless of the strategies employed to manage the impact of EVs on the grid, it is essential that the needs of EV drivers be accounted for in relation to the revenue streams that may result from vehicle participation in the grid-services market. Participation by EV drivers must be voluntary, and the terms of participation must be transparent and easy to understand.

3. Electric system benefits and costs of EV charging, electric utility planning for EV charging, and rate design for EV charging.

The proliferation of EVs can provide benefits to all ratepayers, not just EV owners. Increased electricity sales due to EVs can exert a downward pressure on unit energy costs for all customers because utilities are able to spread fixed costs across a larger number of kWhs delivered. The benefits to all utility customers can also be increased and risks to grid infrastructure decreased by incorporating smart charging or managed charging and associated programs to encourage beneficial charging behaviors.

However, at larger scales of EV adoption, unmanaged or unplanned-for EV charging also has the potential to cause significant utility costs. When EV charging is not properly managed, increased costs could include additional Forward Capacity Market and Regional Network Service charges. Clusters of EV charging could necessitate grid infrastructure upgrades and increase costs. To enable Vermont to achieve its energy policy and GHG goals in a cost-effective manner, EV load must not be added in a way that requires excessive new investments in distribution infrastructure and high-cost peak generation.

The potential benefits of EV charging may be achieved, and the potential increased costs may be avoided, by utility strategies including well-formed rate designs and managed charging. Load management (including rate design that contains price signals) can be effective to avoid increases to a utility's load at peak times, increases in costs, and increases in grid infrastructure investment.

Recommendation

To benefit EV drivers, other ratepayers, and utilities, effective rate designs are likely to have several of the following characteristics. Rate design structures should reflect the capabilities of the host utility and the level of EV deployment in its territory. EV rate designs should be simple and well-formed, so that consumers can understand the rates and manage their charging behaviors. Rates for both residential and workplace charging should offer steep discounts for off-peak or managed charging. The benefits of simple, well-formed rates should outweigh the costs. Attractive residential EV end-use rates will likely attract a high percentage of EV owners. Examples of recent Vermont EV rate designs that reflect these

characteristics include Burlington Electric Department's bill credit for off-peak charging and Green Mountain Power's unlimited off-peak EV charging rate.

Rate design can have a significant impact on EV adoption. Well-designed rates can offer drivers incentives to charge at times that are optimal for the grid, reducing costs to the drivers and reducing electricity system costs for all customers. Time-varying rates can also be used to better align demand, such as workplace charging that typically occurs during the day, with times of abundant renewable energy generation, such as at mid-day when there is often plentiful solar power. EV drivers must also pay their fair share of the costs that they impose on the grid. Smart rate design should accurately reflect these costs while giving EV drivers the opportunity to save money and benefit all ratepayers.

In addition to rate design, managed EV charging can also be used to avoid increasing utility costs by avoiding times of peak energy costs that result in increases in Forward Capacity Market and Regional Network Service charges. Managed EV charging can also provide distribution utilities the ability to avoid potential local distribution constraints due to the addition of EV load.³³

4. The appropriate role of electric distribution utilities with respect to the deployment and operation of EV charging stations.

Utilities are uniquely situated to ensure that EV charging stations are deployed in underserved areas and that new load from EVs is incorporated in a safe, reliable, and efficient manner. Utilities may deploy and operate utility-owned EV charging stations and may encourage and facilitate non-utility-owned EV charging stations.

In most contexts today, the business case for investing in, owning, and operating public charging infrastructure is not attractive for private investment alone to appropriately scale the market. Therefore, utility ownership and operation of EV charging stations may be appropriate in places or in situations not served by the private market (for example, to serve rural or low-to-moderate-income neighborhoods or communities that may not otherwise attract private investment). Utility investment could be through the regulated entity or through an unregulated affiliate.

Several states have introduced public-interest tests for utility investments in EV charging stations. For example, the Massachusetts Department of Public Utilities articulated a test for approval of EV-related investments that considers whether utility proposals: (1) were in the public interest, (2) met a need regarding the advancement of EVs in Massachusetts, and

³³ PUC Case No. 18-2660-INV, Department comments dated 5/13/19 at 4.

(3) did not hinder the development of the competitive EV charging market.³⁴ Like other public charging stations, a utility-owned station should not require a particular EV make or membership in an EV charging network, should be open to all customers (need not be customers of the utility), and should accept multiple forms of payment.

Where there is potential for private-market investment in EV charging stations, the role of the utility will be to offer tariffs for non-utility-owned EV charging stations and to support engineering review and construction. Utilities may support make-ready deployments for EV charging stations, for example by offering rebates for EV charging station installations that meet the utility's criteria (*e.g.*, charging stations that provide open networks and managed charging capabilities). New EV charging stations typically go through utility "new service" request processes. Utilities conduct system studies during the new service request process to identify whether infrastructure upgrades will be required for the station to take service. Because utilities have existing planning and load-forecasting processes, it may not be necessary to create new processes to evaluate deployment of EV charging stations and the impact on the distribution grid.

Recommendation

Under traditional regulatory principles, costs to the system are assigned to the customers that cause the costs. Therefore, EV charging station operators are typically required to pay for any upgrade costs to provide electrical service to the station. Some participants have advocated for waiver or reduction of these interconnection and make-ready costs. As with utility Tier III incentives for EV charging equipment and instances of utility ownership of EV charging stations, there may be instances where the public interest in advancing public EV charging infrastructure warrants a deviation from traditional cost-causation principles. We recommend considering proposed deviations on a case-by-case basis.

B. EV Charging Stations Owned or Operated By Persons Other Than Electric Distribution Utilities.

1. How and on what terms, including quantity, pricing, and time of day, such charging stations will obtain electric energy to provide to EVs.

During the 2019 legislative session, the Legislature passed H.529, a transportation bill that in part addressed several issues related to EVs. Section 35 of H.529 directs the Commission to file a supplement to this report by December 15, 2019, that examines the design for EV charging tariffs for Vermont electric utilities with more than 17,000 customers. The

³⁴ PUC Case No. 18-2660-INV, Sierra Club November 5 comments at 11, citing Massachusetts Department of Public Utilities, DPU 13-182-A.

Commission is in the initial stages of an investigation to gather the information necessary to respond to this legislative directive.

There is currently nothing in Vermont law requiring or prohibiting Vermont's electric distribution utilities from filing tariffs that propose rates, terms, and conditions for service to public EV charging stations. If such a tariff were filed, the Commission would review it to ensure that the rates were just and reasonable, as it would with any other proposed rate-regulated service offering.

However, as of the writing of this report, no Vermont electric distribution utility has a tariff with rates, terms, and conditions that are specific to providing service to non-utility-owned public EV charging stations. Rather, such stations would obtain service under an electric utility's existing tariffs. Because applicable tariffs would vary by utility, the actual rates, terms, and conditions available to an individual charging station would depend on the utility service territory in which the station is located.

Electric service to a non-utility-owned public charging station would typically fall under the relevant distribution utility's applicable commercial or industrial tariff. The rates applicable to such service would likely depend on the amount of usage or demand by the customer. Lower usage and demand levels may be subject to a monthly customer charge and a volumetric, or usage, charge, calculated on a per-kilowatt-hour (kWh) consumed basis. For customers with higher volume or higher demand, a monthly demand charge may also be applicable.³⁵ Demand charges are a means for electric distribution utilities to recover part of the fixed costs of providing service.³⁶ A utility must maintain the capacity to serve customers who use large amounts of electricity over the course of a billing period (*e.g.*, a month), or who use very large amounts over short time frames during a billing period. When a customer exceeds a certain level of usage or demand, a demand charge becomes applicable. The demand charge is based on a "snapshot" of the highest amount of power demanded over a small period of time (for example, 15 minutes) during a billing period and is measured in kW rather than kWh.³⁷

The configuration of a non-utility-owned charging station's electric service connection could affect whether a rate specific to a public charging station is accessible. The simplest configuration that allows for a public charging station rate is a stand-alone charging station

³⁵ Demand charges were discussed above in Section III.A.1.

³⁶ See *Demand Charges, Analysis and Recommendations, Pursuant to Act 194, Section 9*, Vermont Department of Public Service (January 31, 2019) (DPS Demand Charge Report) for a complete explanation of the purpose and use of demand charges in Vermont.

³⁷ A demand meter is used to take this "snapshot."

with its own service connection and a dedicated, utility-owned meter measuring the amount of electricity delivered to that station. Under this configuration it would be a simple matter to apply a charging-station-specific rate to the service provided to that station.

However, public charging station configurations may not always have a dedicated utility meter. For example, a store owner may install a charging station in a store parking lot to allow customers to charge while shopping. Under this configuration, it is possible that the charging station would simply be another source of power consumption connected to the distribution grid, using the same meter that is measuring the overall usage at the store. In other words, the utility would have no way of identifying how much power consumed during a billing period was actually used by the charging station as opposed to lights, refrigerators, or any other power use by the store. This type of configuration complicates the ability of a utility to offer a charging-station rate in the absence of a separate meter that could isolate the usage of the charging station from the usage at the rest of the premises.

While many charging stations themselves have their own separate internal meter to measure the amount of power dispensed from the station to a vehicle that is being charged, there was some level of disagreement among participants in this investigation regarding the degree of accuracy of those meters for utility billing and cost-recovery purposes. A discussion of charging station metering accuracy can be found in Section III.C. of this report. Absent resolution of the accuracy of a charging station's internal meter and a means to transmit that meter's information to the utility for billing purposes, the service configuration described above would likely require the installation of a second stand-alone utility meter to measure a charging station's consumption as a pre-condition to the availability of a charging-station-specific rate.

As noted above, depending on the level of usage or demand at a charging station, demand charges may be applicable under the tariff of the utility serving a charging station. Demand charges are often cited by EV charging equipment providers as a potentially significant barrier to the economic viability of public charging stations, especially with respect to DC fast-charging stations. This is because DCFC stations draw large amounts of power when in use, resulting in isolated periods when demand may be high enough to trigger demand charges even though overall usage of the station during the course of a billing period remains low.³⁸ As a result, the kWh usage component of a DCFC station's bill would remain low to reflect the low amount of total usage over the billing period, but the short-term spike in demand could result in a high demand charge for that month's bill. Absent

³⁸ The ratio between the average load and the peak load is known as a load factor. DCFC stations are anticipated to at least initially have low load factors.

the revenue from a higher rate of use throughout the billing period, it may be economically challenging for a DCFC charging station to operate in the face of high demand charges until such time as more EVs are on Vermont's roads and utilizing those stations.

The Commission studied demand charges as part of its investigation. Suggestions for addressing the issue included implementation of a temporary demand-charge "holiday," adjusting the per-kWh usage rate to include the fixed expenses normally recovered through demand charges, developing more targeted demand-related charges to influence consumer behavior, and actions available to a charging station operator to reduce or avoid demand charges altogether.

A demand-charge holiday would suspend demand charges to DCFC stations for a period while EV ownership, and thus charging at those stations, increased to a point where the charging stations would be economically viable. At that time demand charges would again apply, either immediately or phased back in over time.

Adjusting the kWh charges for services provided to DCFC stations would increase the per-kWh fee paid by these stations but would alleviate the impact of a high monthly demand charge in the face of only a small amount of sales over the course of a billing period. If done properly, such an approach could allow the utility to recover some portion of its fixed costs through the kWh charge while billing the station operator in a manner more reflective of actual charging station usage.

More targeted demand charges could be applied only at times of high demand on the utility's overall system, encouraging station operators to reduce usage at times when high system demand results in higher costs to the serving utility from the regional grid operator.³⁹

Last, the investigation considered options available to charging station operators to reduce or avoid demand charges. For example, a charging station operator could implement battery storage to offset some of the power demand from its utility when an EV actually utilizes the charging station.

Recommendation

The Commission supports utility efforts to develop tariffs specific to providing electric service to public EV-charging stations, including DCFC stations. The Commission

³⁹ See DPS Demand Charge Report for a detailed explanation of targeted demand charges and reducing utility costs related to system peaks.

encourages Vermont's electric distribution utilities to consult with the Department of Public Service to explore ways to develop such tariffs that would encourage the deployment of charging stations while still providing appropriate cost recovery to the utility so that other customer classes are not subsidizing charging station customers.

With respect to demand charges, the Commission, at this time, is not convinced that a simple demand-charge holiday is an appropriate solution to the challenge presented to the deployment of DCFC stations by the existence of demand charges. Those charges are intended to recover in part the fixed and embedded costs of utility service to customers. Simply eliminating those charges for DCFC stations, even temporarily, creates the potential for upward pressure on rates elsewhere in a utility's cost of service, possibly resulting in non-EV-driving utility customers subsidizing the deployment of DCFC stations for use by EV owners and users that may or may not be customers of that utility.

Instead, the Commission believes it would be appropriate for utilities to propose new approaches for addressing the barriers presented by demand charges to DCFC stations. As noted above, DCFC stations are anticipated, at least initially, to have low load factors. For example, utilities could develop rates for serving these stations that are more focused on usage charges during this initial period and that increasingly rely on demand charges as a station's load factor rises over time. The goal would be to strike a balance whereby the deployment of DCFC stations is economically viable while at the same time the serving utility recovers its costs of providing the service.

The Commission also anticipates that charging station operators will explore additional paths to reduce the costs of providing service, particularly as technologies evolve. For a simple example, a DCFC station operator could install on-site photovoltaic generation and use it to charge a battery. The battery could then be called upon when a vehicle uses the charging station. In this way, the DCFC station operator can reduce its demand when a vehicle is charging, thereby lowering demand charges from the utility.⁴⁰

2. What safety standards should apply to the charging of EVs.

The safety standards applicable to the charging of EVs at public charging stations are found in Article 625 of the National Electrical Code. The National Electrical Code was adopted for use in Vermont by the Vermont Department of Public Safety, Division of Fire Safety.⁴¹ Article 625 of the National Electrical Code sets forth the standards that are applicable to the

⁴⁰ This example does not address net-metering EV charging stations, which will be addressed in the Commission's H.529 report, due to be filed with the Vermont Legislature on December 15, 2019.

⁴¹ See Vermont Electrical Safety Rules (2017) at 3, 8.

installation of EV charging stations. Code enforcement is performed by the Commissioner of Public Safety through the Division of Fire Safety.⁴²

3. The recommended scope of the jurisdiction of the Commission, the Department of Public Service, and other State agencies over such stations.

On January 23, 2019, the Commission sent a recommendation to the House and Senate Committees on Transportation, the House Committee on Energy and Technology, the Senate Committee on Finance, and the Senate Committee on Natural Resources and Energy regarding the appropriate scope of jurisdiction of the Commission and the Department of Public Service over EV charging stations. The recommendation included proposed statutory language that would amend 30 V.S.A. § 203 to make clear that the jurisdiction conferred on the Commission and Department by that section does not include utility-style regulation of EV charging stations that are operated by non-utility entities or by unregulated affiliates of utilities.

In advance of filing the January 23 recommendation, the Commission solicited comments and conducted workshops on this question. Comments on the scope of jurisdiction were solicited from investigation participants on October 4 and 24, 2018, and workshops addressing the jurisdiction question were conducted on October 1 and November 30, 2018.⁴³

Apparent from the comments received was the need for the Commission to address jurisdictional issues regarding EV charging stations as the first step of the investigation. Thus, the Commission submitted its jurisdictional recommendation on January 23, 2019, in time for the Legislature to take any action it deemed necessary during the 2019 legislative session.

Most commenters favored no jurisdiction or jurisdiction with a limited exercise of regulatory authority. The comments varied on whether the jurisdiction granted to the Commission and Department by 30 V.S.A § 203 applies to EV charging stations and the steps that the Commission should take to clarify the scope of any jurisdiction created under Section 203. However, almost all commenters agreed that clarifying the extent of jurisdiction over EV charging stations was a necessary precursor to the growth of EV charging infrastructure investment in Vermont. The Commission agreed that jurisdictional issues needed to be addressed early in its investigation to provide certainty and stability to potential charging infrastructure investors, whether they be regulated Vermont utilities or non-utility investors (including unregulated affiliates of Vermont's electric utilities).

⁴² See 26 V.S.A. Chapter 15.

⁴³ The October 1 workshop addressed jurisdiction along with several other topic areas, while the November 30 workshop was dedicated to the question of Commission and Department jurisdiction.

After consideration of all the comments received in writing and those made at the workshops, the Commission determined that the best way to promote the deployment of public EV charging stations, and thus the use of EVs, is to largely exclude charging stations from Commission and Department jurisdiction. The exception would be where a regulated utility seeks to invest in and deploy public EV charging infrastructure and include the costs of that infrastructure in its rates. In such an event, the Commission and Department would retain full jurisdiction over that charging infrastructure investment just as if it were any other infrastructure deployed by a utility.⁴⁴

This jurisdictional approach is consistent with the approach taken in approximately 23 other states and the District of Columbia, at least with respect to third-party, non-utility operators of charging stations. Some states have implemented the decision not to regulate EV charging stations as utilities through a utility commission order interpreting its statutory grant of jurisdiction to exclude charging stations, while others have done so through legislation expressly exempting charging stations from utility commission jurisdiction.

In Vermont, the Commission has encountered differing views on whether the jurisdiction conferred on the Commission and Department by 30 V.S.A. § 203 extends to EV charging stations. Given the good-faith arguments advanced on both sides of the question and given Vermont's greenhouse gas reduction goals, the Commission recommended that the Legislature clarify the extent of jurisdiction over EV charging stations through statute rather than through a Commission order interpreting the extent of that jurisdiction. A legislative change clarifying the extent of Commission and Department jurisdiction would remove any uncertainty and provide greater stability than a Commission order because an order would be subject to legal challenge and possibly subsequent amendment depending on the opinions of future commissioners.

The Commission believes that allowing EV charging stations to deploy and operate free from utility-style regulation will encourage more rapid deployment of such infrastructure than would occur in a fully regulated environment. One of the most-cited barriers to the adoption of EVs by Vermont drivers is what is known as "range anxiety." While EV manufacturers are increasing the number of miles that can be traveled on a single charge in newer vehicle models, range anxiety still persists in the mind of the traveling public. Additionally, early EVs with more limited ranges will be part of Vermont's vehicle fleet for some time to come, in particular as used EVs are resold to Vermonters who are not yet prepared to purchase a new vehicle. More widespread deployment of public charging

⁴⁴ The appropriate role of utilities in the deployment of EV charging stations is discussed in more detail in Section III.A. of this report.

stations will help alleviate these concerns and increase the comfort level of Vermonters in choosing an EV when they are in the market for a vehicle.

Recommendation

The Legislature largely adopted the Commission’s January 23, 2019, recommendations when it passed H.529. Section 39 of H.529 clarifies that neither the Commission nor the Department has jurisdiction over persons that are otherwise not regulated by the Commission and Department just because they are “engaged in the siting, construction, ownership, operation, or control of a facility that sells or supplies electricity to the public exclusively for charging a plug-in electric vehicle.” The section further clarifies that such entities may sell electricity at charging stations by the kWh without being considered regulated utilities.⁴⁵

Nothing in H.529 prohibits Vermont’s electric distribution utilities from operating public charging stations on an unregulated basis through the formation of an unregulated affiliate company. Additionally, H.529 allows Vermont’s electric distribution utilities to seek to include the costs of deploying and operating EV charging stations in rates subject to Commission review and approval under traditional ratemaking principles.

Given the actions of the Legislature, the Commission has no further recommendations on this topic at this time.

4. Whether such stations will be free to set the rates or prices at which they provide electric energy to EVs, and any other issues relevant to the appropriate oversight of the rates and prices charged by such stations, including the transparency to the consumer of those rates and prices.

The passage of H.529 means that charging station owners will be allowed to set the rates and prices they will charge to members of the public seeking to charge their EVs.

The primary purpose for regulating the rates charged by utilities is to ensure that rates remain just and reasonable when a monopoly service provider is selling a service with inelastic demand characteristics. In other words, where there is only a single provider of a service for which there is a high demand without any reasonable substitute, the opportunities for excessive pricing are abundant. When a company begins to lose its monopoly status and more options for addressing consumer needs become available, the

⁴⁵ While the section allows charging stations to sell electricity by the kWh, it does not require them to do so. For example, a station operator may charge its customers in any manner it chooses, such as by the hour, per session, or not at all.

need to regulate rates begins to diminish. For example, Vermont's incumbent local exchange phone companies were once subject to full regulatory rate review. However, once competition began to develop in the form of competitive local exchange carriers, carriers offering all-distance dialing, and cell phone offerings, there was less need to fully regulate the rates for all services offered by the incumbent carriers. As a result, the Legislature passed 30 V.S.A. § 226b, which allows for incentive-based regulation of basic exchange carriers. Additionally, the Commission may suspend rate regulation for competitive telecommunications services (30 V.S.A. § 227a) and may suspend or reduce numerous regulatory requirements for non-dominant telecommunications carriers (30 V.S.A. § 227c and PUC Rule 7.500).

The Commission expects that the market for public EV charging will develop competitively without the concerns associated with monopoly public service providers. Therefore, the Commission does not see a need to regulate the rates charged at public charging stations as if such stations were operating as monopoly public service utilities.

For several reasons, the Commission believes that allowing non-utility and unregulated utility affiliates to set their own rates and charges at public charging stations will lead to an increased rate of deployment of EV charging infrastructure, a wider variety of innovative charging practices, and a competitive environment that will deter operators of charging stations from charging excessive prices to EV users.⁴⁶

First, there was near unanimity among investigation participants that not regulating prices at public EV charging stations would lead to an increased rate of deployment of this infrastructure in Vermont.

Second, not regulating the rates and charges at these stations would allow the operators to offer a variety of charging scenarios that would be difficult or perhaps even impossible to implement in a market where the stations were regulated like public utilities. The typical charges to most end-users of electric service are billed on a kWh basis to reflect the amount of energy consumed by the customer. However, while many charging station owners will follow this practice, others might not. For example, some charging services may be provided without cost as an amenity to a customer of a business, such as an inn or restaurant. Stores might opt to provide discounted charging in preferred parking spots for

⁴⁶In the event a regulated utility owns and operates a public charging station, the service would be subject to a tariff that would be reviewed and approved by the Commission. In that instance, the Commission would ensure that the prices charged would properly recover the costs of deploying and operating the station. This would ensure that the utility was not subsidizing its charging station costs with revenues from other regulated services, allowing the utility to charge artificially low rates at its charging station and thereby skew the competitive market.

shorter periods of time as a means to draw customers to their business. Still others might charge by the kWh for a specified time period, with a time-based fee to be added for additional time spent in the charger's parking space to discourage EV drivers from occupying parking spots for longer than is needed to charge their vehicles. Given the wide variety of charging station operators and scenarios under which they will operate, regulating the rates charged by public charging stations would unnecessarily restrict innovation in the variety of charging scenarios that might otherwise be deployed to the benefit of EV users in Vermont.

Third, the Commission believes that the EV charging market will develop in an evolving yet competitive environment that will deter station operators from charging excessive prices. The foremost factor to consider in this regard is that most EV drivers do 80% or more of their charging at home.⁴⁷ The rate that an EV user pays to charge a vehicle at home would likely be regulated by the Commission because the charging equipment draws power from the consumer's home electric account. The Commission has already seen the development of time-of-use rates by Green Mountain Power Corporation and the City of Burlington Electric Department to encourage at-home charging during off-peak overnight hours, when an EV user is likely at home and the EV would simply be parked.

The Commission is aware that the availability of home charging is not a complete source of competitive pressure for public charging stations. However, the fact that so much charging does occur at home means that public stations will have to set their rates at competitive prices to obtain the remaining share of the charging market. Currently, there are approximately 215 publicly available EV charging stations in Vermont that offer charging under a variety of different scenarios and rates, and the Commission is not aware of any complaints regarding prices or rates charged at these stations.⁴⁸ This number of charging stations places Vermont near the top of the country on a per-capita basis.⁴⁹ Therefore, if the proper environment is established, the Commission believes that Vermont is well-positioned to develop a healthy competitive market for public EV charging as both EV use and EV infrastructure deployment rise in the state.

Additional competition will continue to be provided by fossil-fuel vehicles, which will remain a part of Vermont's transportation fleet for the foreseeable future. While the purchase price of an EV is typically higher than the purchase price of an equivalent fossil-

⁴⁷ <https://www.energy.gov/eere/electricvehicles/charging-home>

⁴⁸ <https://www.driveelectricvt.com/charging-stations/public-charging-map>

⁴⁹ See, e.g. <https://www.myev.com/research/comparisons/most-ev-friendly-states>; <https://www.forbes.com/sites/jimgorzalany/2018/10/16/heres-which-states-are-best-for-owning-an-electric-car/#6f350b894a06>.

fuel vehicle, studies show that the total cost of ownership over the life of an EV can be significantly less than that of a fossil-fuel vehicle. The difference is due to both lower maintenance and “fuel” costs.⁵⁰ Operators of public EV charging stations will benefit from increased EV usage and therefore have an incentive to emphasize the lower operation and maintenance costs of an EV by keeping prices for EV charging reasonable.

However, operators of public charging stations must be required to accurately and transparently display the costs for charging an EV at their stations so that consumers know what they will be charged before they begin a charging session. Costs associated with a charging session must be displayed clearly at the charging station itself and should also be accessible to consumers on-line so they can plan their trips in advance by locating charging stations that best serve their needs. All public charging stations should also be required to prominently display a toll-free telephone number that is staffed at all times the station is in operation for consumers to call to report problems with a charging session. The number should be staffed by individuals who are trained to assist consumers with problems that might typically arise during a charging session, including both technical and billing issues.

It is also imperative to the development of a competitive EV charging market that public charging stations be “interoperable,” accessible to any member of the public, and allow for payment via credit card. Interoperability refers to public charging stations that operate using non-proprietary, open standards such as the Open Charge Point Protocol, or OCPP, a leading and freely available universal communications protocol. Using open standards enables component vendors and charging network operators to mix and match interoperable charging station hardware and software. Networks that rely on proprietary standards are limited in their ability to select hardware and/or software, potentially resulting in stranded costs as EV charging technology evolves. This is particularly important if ratepayer dollars are being used to support the deployment of public EV charging infrastructure.

Open access to public EV charging stations should also be required. Network operators should not be allowed to require membership or subscription fees to access a publicly located EV charging station. There also must be more than one method of paying for a charging session at a public station, and the ability to pay by credit card should be a mandatory option at all public stations.

The Legislature has in part addressed the issues described above through the passage of H.529. Section 30 of H.529 requires that public EV charging stations disclose all charges at

⁵⁰ See, e.g. <https://www.forbes.com/sites/constancedouris/2017/10/24/the-bottom-line-on-electric-cars-theyre-cheaper-to-own/#20deebbb10b6>.

the point of sale and provide for multiple payment options without a subscription or membership requirement. Below, the Commission makes recommendations for the Legislature to take additional action in the next session to further strengthen both consumer protections and the ability of the EV charging station market to thrive in Vermont.

Last, with respect to consumer complaints regarding transactions between the operator and a user of an EV charging station, the Commission notes that the Consumer Protection Unit of the Attorney General's Office investigates and prosecutes violations of Vermont's consumer protection laws, which prohibit businesses from engaging in unfair or deceptive acts or practices. In addition, consumer complaints regarding transactions between an EV driver and an electric utility that owns a public charging station may be addressed by the Department of Public Service and the Commission pursuant to Commission Rule 2.300. The Commission believes that the economic and competitive pressures discussed above, backstopped by the consumer protections provided by the Attorney General, will provide sufficient assurance to allow the owners and operators of public EV charging stations to set their own prices and terms for charging at their stations.

Recommendation

Consistent with its recommendation on jurisdiction, the Commission supports the Legislature's decision to allow operators of public EV charging stations to set the rates for charging at their stations without Commission oversight. However, as discussed above, those operators must accurately and transparently disclose their rates to customers of public charging stations. H.529 clearly intends for that to be the case. The Commission recommends that the Agency of Agriculture, Food, and Markets utilize its weights-and-measures authority to develop regulations to ensure proper disclosure of prices to consumers in advance of a charging session, the provision of a receipt at the conclusion of a charging session, and the display of a toll-free telephone number for customers to call to resolve any problems with their charging session.

The Commission also recommends that the Legislature consider adopting legislation that requires all public EV charging stations to operate based on open standards, such as the Open Charge Point Protocol.

Last, in addition to the provisions of H.529, the Commission recommends that the Legislature consider adopting legislation to ensure full and open access to public EV charging stations that contains the following requirements:

1. That the multiple payment options at public charging stations required by H.529 expressly include the option to pay by credit card.

2. That the owner or operator of a public EV charging station disclose the location and characteristics of each of its public charging stations, including, but not limited to, the address, voltage, and timing restrictions, to the federal database operated by the United States Department of Energy Alternative Fuels Data Center.

3. That parking in a space equipped with a public EV charging station be restricted to plug-in hybrid electric vehicles or battery electric vehicles (prohibiting internal combustion engine vehicles from parking in such a space).

5. **The recommended billing and complaint procedures for such charging stations.**

The Commission believes that the billing and complaint procedures for sales to end users at public EV charging stations should be similar to other retail transactions of a similar character. The goal should be to have transactions that are familiar to end users so that they do not have to incorporate another learned behavior. The easiest point of comparison is a gas station.

The billing procedure for a public charging station should resemble that of a gas station. In the most basic transaction, a consumer should be able to insert a credit card to activate and charge at a public station, with the credit card being billed at the completion of the session with the option to receive a paper receipt. However, the Commission does not recommend excluding other types of transactions in addition to the credit card transactions just described. Operators of public charging stations should be allowed to develop other types of transactions, such as subscription models, and should be able to offer the option of receiving receipts electronically. In summary, public charging station operators should be required to allow for the type of simple credit-card transaction that we are familiar with when fueling our internal combustion engine vehicles, but should not be prohibited from developing other innovative services for the delivery and billing of charging services.

The initial resource for lodging a complaint would be the charging station operator via the recommended toll-free telephone number to be displayed on the charging station. If a customer is unable to resolve his or her complaint by calling the toll-free number, the consumer could file a complaint with the Consumer Protection Unit of the Attorney General's Office, which investigates and prosecutes violations of Vermont's consumer protection laws. For more information on the complaint process, see:

<https://ago.vermont.gov/cap/consumer-complaint/>.

C. Overarching issues.

1. Options to address how EV users pay toward the cost of maintaining the State's transportation infrastructure, including consideration of methods to assess the impact of EVs on that infrastructure and how to calculate a charge based on that impact, the potential assessment of a charge to EVs as a rate per kilowatt hour delivered to an EV; varying such a charge by size and type of EV; and phasing in such a charge.

The comments and discussions presented during the Commission's investigation generally addressed three approaches to obtaining EV-user contributions to funding the state's transportation infrastructure. Consistent with previous legislative reports prepared by Vermont State agencies, these approaches included a registration fee, a vehicle-miles traveled, or "VMT" fee, and a per-kWh fee on electricity used for EV charging.⁵¹ The VMT fee and the per-kWh fee both found support with participants. No participant supported an increased registration fee.

No consensus on the best approach to collecting EV contributions to transportation infrastructure emerged during the Commission's investigation. However, consistent with previous reports prepared by Vermont agencies, the participants agreed that no fees (or minimal fees⁵²) should be imposed at this time. According to these reports and comments received in this investigation, the most significant impact on state transportation funds is the increasing efficiency of internal combustion engine vehicles and lack of inflation adjustments to the gas tax.⁵³

The 2012 Report

⁵¹ See Sec. 15. 2016 Plug-In Hybrid and Electric Vehicle Registration Fees Legislative Report, Agency of Transportation, 12/2016 (addressing registration fees) (available at <http://legislature.vermont.gov/assets/Legislative-Reports/2016-Legislative-EV-Study-FINAL-formatted.pdf>) ("2016 Report"); Section 28 Report: A Study on Replacing Motor Fuel Tax Revenues Not Collected from Plug-In Electric Vehicles, Department of Public Service, 12/15/2013 ("2013 Report"); and Act 153: Section 39 Report: Alternative Fuel Vehicle User Fee Options, Agency of Transportation, 11/5/2012 ("2012 Report") (both available at https://publicservice.vermont.gov/energy_efficiency/transportation_goal1).

⁵² The Department, Agency of Transportation, and Agency of Natural Resources (the "Vermont Agencies") support the implementation of a "relatively small per-kWh fee" to develop the system for collection by the distribution utilities while the number of EV owners is low. PUC Case No. 18-2660-INV, Joint Responses of Agency of Transportation, Agency of Natural Resources, and Department of Public Service dated 1/9/19 at 2-3.

⁵³ PUC Case No. 18-2660-INV, Joint Responses of Agency of Transportation, Agency of Natural Resources, and Department of Public Service dated 1/9/19 at 2-3; Vermont Agency of Transportation Sec. 15. 2016 Plug-In Hybrid and Electric Vehicle Registration Fees Legislative Report dated 12/2016 at 7-8; California Road Charge Pilot Program 2017 Final Report at 1 (available at http://www.dot.ca.gov/road_charge/resources/final-report/docs/final.pdf).

In 2012, the Vermont Energy Investment Corporation prepared a report for the Agency of Transportation that reviewed transportation infrastructure user fee options for alternative fuel vehicles in Vermont.⁵⁴ In addition to reviewing fee options, the 2012 Report provided an overview of EVs, projections of EV penetration, and activities in other states and countries. There were 120 EVs registered in Vermont as of the date of the 2012 Report.⁵⁵

The 2012 Report evaluated three fee options: an annual registration fee; volumetric taxes on electricity (per-kWh fee); and VMT fees. The criteria used to evaluate the fee options were:

- Does the option provide the State a stable revenue stream?
- Is the option practical to implement and administer, and easy for users to understand and accept?
- Is the option consistent with State energy and economic goals?

The 2012 Report did not make specific recommendations regarding the fee options. Instead, the 2012 Report presented the results of its evaluation under the above criteria and recommended appropriate fee levels for each option.

Regarding the annual registration fee, the 2012 Report concluded that the option provided administrative simplicity and low expense, but was less equitable because the fee is not tied to the impact of vehicles on Vermont's roads.⁵⁶

Regarding the per-kWh fee option, the 2012 Report explained that some mechanism, such as submetering, may be needed for differentiating energy used for transportation from energy used for other purposes, but the fee would parallel the current fuel tax system. The 2012 Report also noted that one benefit of the per-kWh fee approach was the possibility of rate designs that could be used to generate funds for transportation efficiency programs, similar to the way that efficiency charges are used to reduce electricity demands.⁵⁷

Regarding the VMT fee option, the 2012 Report noted that a VMT fee would be a long-term solution that involved significant policy changes. The 2012 Report also explained that a VMT fee was "perhaps the most equitable option" due to its correlation to actual usage as well as providing the "greatest opportunity for optimized demand management."⁵⁸ The 2012 Report recognized that there were potential privacy concerns with the VMT fee option

⁵⁴ The 2012 Report focused primarily on EVs, but also included a discussion of compressed natural gas vehicles. Our discussion above focuses on the EV portion of the report.

⁵⁵ 2012 Report at 8.

⁵⁶ 2012 Report at 14.

⁵⁷ 2012 Report at 16.

⁵⁸ 2012 Report at 18.

but explained that odometer readings were already being collected as part of annual vehicle inspections. Other potential drawbacks of the VMT fee option identified in the 2012 Report include the inability to recover usage fees from vehicles registered out of state and the lack of incentive for using fuel-efficient vehicles. With respect to the latter, the 2012 Report notes that a separate registration fee could be used to adjust for fuel efficiencies.

The 2012 Report also noted the importance of the timing of policy implementation, explaining that the policies “must provide adequate revenue while not discouraging early adoption of alternative vehicle technologies”⁵⁹ In addition to several suggestions on timing, the 2012 Report also discusses blended-fee approaches that could be used to transition EV users to new fee arrangements.

2013 Report

In 2013, the Department of Public Service and the Department of Taxes prepared another report that addressed ways to replace motor fuel tax revenues lost from hybrid and EV owners. Similar to the 2012 Report, the 2013 Report reviewed per-kWh fees, VMT fees, and registration fees. The 2013 Report explained that an underlying assumption of its recommendations was that other alternative funding structures would be developed nationally or state-by-state in the coming decade. As a result, the 2013 Report explained that the bases of its recommendations “highly valued flexibility and the avoidance of stranded costs in collecting revenue from electric vehicles during [the] transition period.”⁶⁰ According to a publication by Drive Electric Vermont cited in the 2013 Report, there were 432 EVs registered in Vermont as of October 2013.⁶¹

Regarding per-kWh fees, the 2013 Report concluded that it would take significant time for utilities to implement a system capable of collecting and processing the necessary information and integrating the information into the utility billing systems. The 2013 Report also noted that per-kWh fees would also be subject to the same increased efficiency issue that has affected the fuel tax. Finally, the 2013 Report warned that “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.”⁶²

The 2013 Report also concluded that a VMT-based fee would be a complicated alternative, citing reports prepared by the Agency of Transportation in 2012.⁶³ After reviewing the

⁵⁹ 2012 Report at 19.

⁶⁰ 2013 Report at 1.

⁶¹ <https://www.driveselectricvt.com/blog/demand-growing-for-electric-cars-in-vermont>.

⁶² 2013 Report at 4-5.

⁶³ 2013 Report at 5.

advantages and disadvantages, the 2013 Report recommended against pursuing a VMT fee for EVs unless the State was also considering moving all vehicles to a VMT fee.⁶⁴

The 2013 Report ultimately concluded that “the registration fee funding mechanism is the most reasonable and efficient to implement at this time, and could be implemented relatively quickly,” but cautioned that it was not a long-term solution.⁶⁵ The 2013 Report also noted that Vermont’s “only current policy incentive for the purchase of electric vehicles is the absence of payments into the Transportation Fund,” and recommended an incentive program to offset any new costs if increased registration fees were adopted for hybrids and EVs.⁶⁶

2016 Report

In 2016, the Agency of Transportation prepared another report specifically addressing the topic of registration fees for EVs. The 2016 Report concluded that EV user fees should not be added in the immediate future because introducing fees was “at cross purposes with the state’s efforts to incentivize EV purchase and use” and that “EVs are an exceedingly small part of today’s transportation revenue problem.”⁶⁷ The 2016 Report instead recommended a more comprehensive transportation revenue solution to address increasing vehicle efficiencies and changing driving behaviors. Absent a comprehensive solution, the 2016 Report recommended waiting until registered EVs represent 15% of annual automobile sales in Vermont (approximately 18,835 new EVs registered in a calendar year).⁶⁸ The 2016 Report states that as of October of 2016, Vermont had a total of 1,395 registered electric vehicles.

Current Investigation

According to information provided by Drive Electric Vermont during the Commission’s investigation, there were 2,985 EVs registered in Vermont as of January of 2019.⁶⁹ This number corresponds to roughly 0.5% of Vermont’s total registered vehicles, and reflects an annual sales rate well below the 15% threshold for introducing EV fees recommended by the Agency of Transportation in the 2016 Report. As a result of the low levels of EV

⁶⁴ 2013 Report at 6.

⁶⁵ 2013 Report at 7.

⁶⁶ 2013 Report at 8.

⁶⁷ 2016 Report at 26.

⁶⁸ 2016 Report at 27.

⁶⁹ PUC Case No. 18-2660-INV, VEIC comments dated 4/8/19 at 7-8.

penetration at this time, the corresponding loss of fuel tax revenue to the Transportation Fund due to EV adoption is also low, currently estimated at approximately \$200,000.⁷⁰

The fee options discussed in the current investigation mirrored those discussed in the past reports. EV-specific registration fees were mentioned, but no participant recommended their adoption. Several participants endorsed the implementation of a VMT-fee approach at some point in the future because of the alignment between VMT fees and actual use of state transportation infrastructure.⁷¹ The VMT-fee approach could also be combined with consideration of vehicle weight to provide a fee assessment more accurately reflecting a vehicle's impact on roads.⁷² Several other states are currently studying various implementations of road-usage fees.⁷³ Oregon's OReGO program, for example, is a limited program exploring several options for VMT implementation, some of which include on-board devices.⁷⁴ Washington has also recently completed its road-usage-charge pilot project and plans to complete a final report, including findings, in early 2020.⁷⁵

The Vermont Agencies, including the Agency of Transportation, recommended a per-kWh fee to be collected by Vermont's distribution utilities.⁷⁶ According to the Vermont Agencies, a per-kWh fee has several advantages. It would be comparable to the current gasoline tax scheme and easy for consumers to understand. It would also capture revenue from out-of-state EVs traveling in Vermont and using charging stations. The Vermont Agencies also conclude that per-kWh fees would not create an additional up-front cost barrier to EV ownership. Finally, the Vermont Agencies conclude that per-kWh fees could be combined with rate design to encourage adoption of EV-specific rates and the infrastructure necessary to ensure collection of the per kWh fee, and to ensure that the fee does not create a disincentive for EV ownership. The Vermont Agencies recommended implementing the infrastructure needed to collect a per-kWh fee now while EV adoption rates are low.⁷⁷ Along with the infrastructure, the Vermont Agencies recommend a small per-kWh fee that

⁷⁰ PUC Case No. 18-2660-INV, Joint Responses of Agency of Transportation, Agency of Natural Resources, and Department of Public Service dated 1/9/19 at 2-3. The Vermont Agencies do not specify whether these losses are annual or cumulative.

⁷¹ PUC Case No. 18-2660-INV, Conservation Law Foundation comments dated 1/9/19 at 1; Greenlots comments dated 1/9/19 at 2.

⁷² See, e.g., PUC Case No. 18-2660-INV, Plug In America comments dated 1/9/19 at 3.

⁷³ http://www.dot.ca.gov/road_charge/resources/finalreport/docs/summary.pdf;
<https://www.oregon.gov/ODOT/Programs/Pages/OReGO.aspx>; <https://waroadusagecharge.org>.

⁷⁴ <https://www.myorego.org/about/>.

⁷⁵ <https://waroadusagecharge.org/participant-experience/>.

⁷⁶ PUC Case No. 18-2660-INV, Joint Responses of Agency of Transportation, Agency of Natural Resources, and Department of Public Service dated 1/9/19 at 1.

⁷⁷ PUC Case No. 18-2660-INV, Joint Responses of Agency of Transportation, Agency of Natural Resources, and Department of Public Service dated 1/9/19 at 2-3.

would be phased in over time as adoption increases, rising to the full fee amount at 15% EV penetration.⁷⁸

The per-kWh fee recommended by the Vermont Agencies met with substantial opposition from other participants in the proceeding, particularly from the participating distribution utilities that would become responsible for implementing, collecting, and remitting the per-kWh fee recommended by the Vermont Agencies. Among the reasons for opposing the per-kWh fee were the following:

- The prematurity of fees given the early stage of EV adoption.
- The customer infrastructure required to ensure accuracy and to minimize avoidance of the tax. Accurate calculation of EV charging would require additional equipment in customer homes, whether a separate submeter or accurate charging system.
- Utility infrastructure required to update billing systems. If Vermont distribution utilities are required to collect a tax, they will need to update their billing systems to handle the data received from customer submeters or third-party chargers. The distribution utilities estimate that the upfront costs of implementing the necessary system could exceed the revenues collected pursuant to the tax.
- The potential for stranded costs resulting from prematurely committing to a particular fee approach on both utilities (billing infrastructure) and EV owners (submeters).
- Difficulty of utility enforcement for non-payment.

Recommendation

The Commission supports waiting to implement any EV-specific transportation infrastructure fees until EV penetration moves beyond early-adoption levels as discussed in prior reports. This recommendation differs from the recommendation of the Vermont Agencies which, as discussed above, recommend requiring distribution utilities to implement a per-kWh fee now. The Agencies' recommendation was based, in part, on their desire to establish a mechanism to collect EV-specific transportation infrastructure fees even if the implementation is delayed or phased in over time.

The Commission recommends waiting for the following reasons.

⁷⁸ PUC Case No. 18-2660-INV, Final Recommendations of the Department of Public Service filed 5/13/19 at 7.

First, any new fees will act as a disincentive to EV adoption at this early stage. However, one benefit of a per-kWh fee advanced by the Vermont Agencies is that it does not present an up-front cost to potential EV purchasers nor would it represent a disincentive when combined with effective rate design. While the fee itself does not impose an upfront cost, there is a cost to getting potential EV owners to participate in a system in which a per-kWh fee can generate revenue. As the distribution utilities and past reports have explained, implementing a per-kWh charge on EV owners will require additional equipment in customer homes, whether that equipment is a submeter or charging device capable of relaying charging information back to the utility. Both options require EV-owners to incur the expense of installing the equipment in their homes to charge their EVs. The Vermont Agencies have noted that such equipment is offered by some of the utilities through Tier III programs, and that the utilities could also recoup such costs as part of an EV-specific rate design. However, rather than incur the expense of installing new equipment, new EV owners could avoid the expense by simply charging their EVs from an existing outlet or by installing their own charger without notifying the utility. This approach would also result in the loss of the per-kWh fee and any beneficial EV-specific rates. The Vermont Agencies have stated that it may be possible to overcome this challenge through EV-specific rate designs that encourage new EV owners to contact their utility and sign up for the rate.

Second, replacing lost revenues due to EVs is not needed at this point. As the Vermont Agencies explain, the current losses to the Transportation Fund due to EVs are approximately \$200,000. Most of the revenue losses affecting the Transportation Fund are due to the increased efficiency of internal-combustion engine vehicles.⁷⁹ The Agency of Transportation has also explained that the lost fuel tax revenues due to EV purchases are actually offset by the increased purchase-and-use taxes paid into the Transportation Funds due to the higher sale price of EVs. According to the Agency of Transportation, this increased tax offsets approximately five years of lost fuel-tax revenues per car.⁸⁰ This dynamic is unlikely to continue if the upfront cost of an EV continues to decline.

⁷⁹ PUC Case No. 18-2660-INV, Joint Responses of Agency of Transportation, Agency of Natural Resources, and Department of Public Service dated 1/9/19 at 2-3. Similar to the recommendations of the Agency of Transportation in the 2016 Report, the Regulatory Assistance Project has recommended that states develop comprehensive transportation funding reform rather than just focusing on revenues lost due to EVs. See D. Farnsworth & J. Lazar, *Revisiting the Gas Tax* (Feb. 2019), available at https://www.raponline.org/wp-content/uploads/2019/02/rap_farnsworth_lazar_revisiting_gas_tax_2019_february.pdf.

⁸⁰ 2016 Report at 25 (“The added purchase and use tax from these vehicles more than makes up for lost fuel taxes, with total transportation funding estimated to increase by \$1.5 million compared to the 2016 baseline.”). See also 2013 Report at 2-3 (“[F]or 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.”).

Third, choosing a fee approach now creates an unnecessary risk of stranded costs. This report is the fourth report to the Legislature that the Commission is aware of addressing fees on EVs. The fee options for obtaining transportation funding from EVs have not changed significantly in the seven years since the 2012 Report, and neither has the loss of revenues resulting from EV adoption. Here in Vermont, the number of registered EVs has increased from 120 in 2012 to 2,895 in 2019, which represents 0.5% of vehicles registered in Vermont. This remains well below the 15% penetration level identified in prior reports as an appropriate point at which to implement fees on EVs. Vermont can and should continue to investigate fee options as other states are doing, but absent some compelling reason, it should not commit to a per-kWh fee approach now.

The Commission's recommendation should not be interpreted as opposing the idea of a per-kWh fee. Instead, the Commission opposes requiring distribution utilities to implement the necessary infrastructure for a per-kWh fee at this time. The data collection and billing system upgrades necessary for distribution utilities to calculate EV-specific energy usage and per-kWh fees would be expensive. The distribution utilities would recover these costs through traditional cost-of-service principles whether or not the investment ultimately proves to be a prudent one.⁸¹ Although the Vermont Agencies state that these costs could be recovered from the per-kWh fees themselves, the current low EV penetration levels and the reduced initial rates proposed by the Vermont Agencies do not support that conclusion.⁸² As a result, the utilities' costs would be recovered from all ratepayers rather than just those that own EVs.

Any per-kWh billing system implemented by the utilities would be based on limited information about what the future transportation landscape will look like. No other state has adopted a per-kWh scheme for residential charging.⁸³ As discussed above, most are looking at different approaches to EV transportation fees, such as the VMT or blended solutions. If a fee solution other than the per-kWh fee emerges as the consensus favorite nationally or regionally, Vermont's distribution utilities would still recover the costs associated with implementing a per-kWh fee infrastructure from Vermont ratepayers.

⁸¹ PUC Case No. 18-2660-INV, Green Mountain Power Final Recommendations dated 5/13/19 at 7; Comments of Burlington Electric Department and Vermont Public Power Supply Authority dated 1/9/19 at 3.

⁸² PUC Case No. 18-2660-INV, Comments of Vermont Electric Cooperative dated 2/15/19 at 2-4; Comments of Burlington Electric Department and Vermont Public Power Supply Authority dated 1/9/19 at 2.

⁸³ PUC Case No. 18-2660-INV, Joint Responses of Agency of Transportation, Agency of Natural Resources, and Department of Public Service dated 2/14/19 at 2. A report prepared by the Iowa Department of Transportation proposes a per-kWh fee for non-residential charging beginning in 2020. 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%20RUTF%20Impact%20Report%20123118.pdf> at 3. This fee is in addition to a supplemental registration fee for passenger electric vehicles.

Improvements in the rapidly developing area of EV charging technology could also make the distribution utilities' investments in billing infrastructure unnecessary or obsolete.

Several Vermont utilities are experimenting with EV-specific rates that require capturing EV-specific energy usage. Those utilities are currently gathering the EV data manually, first capturing the data from approved charging equipment and then manually entering the data into their billing systems.⁸⁴ However, these manual experiments are not long-term solutions and are not scalable to widespread implementation without automation. Also, any lessons learned from the experimentation of these two distribution utilities—one of which is the largest distribution utility in the state—will not necessarily transfer to Vermont's smaller municipal utilities in a cost-effective manner.⁸⁵

Absent a pressing need to implement a transportation fee on EVs immediately, utilities should be permitted to continue their experimentation and should not be required to incur the costs of updating their billing systems to accommodate a per-kWh fee system at this time. Pursuant to the requirements of H.529, which was passed by the Legislature last session, the Commission will continue to investigate the viability and costs of requiring Vermont distribution utilities to collect per-kWh fees for EV charging on behalf of the Transportation Fund.

2. The accuracy of electric metering and submetering technology for charging EVs.

Two of the EV charging equipment providers that participated in the Commission's investigation addressed the accuracy of the meters within EV charging equipment. ChargePoint explained that it "meets or exceeds the requirements set forth in the electricity-as-motor-fuel sections of NIST Handbooks 44 In utility terms, our charging stations meet the accuracy requirements of ANSI C12.1-2008 (1% class) as applied to embedded EVSE metering."⁸⁶ Greenlots similarly explained that Level Two internal metering can already meet revenue-grade accuracy requirements.⁸⁷ Consistent with the comments provided by EV charging equipment providers, Green Mountain Power referred to a

⁸⁴ PUC Case No. 18-2660-INV, Green Mountain Power comments dated 2/15/19 at 2; Comments of Burlington Electric Department and Vermont Public Power Supply Authority dated 2/15/19 at 9-10.

⁸⁵ PUC Case No. 18-2660-INV, Tr. (3/15/19) at 68 (Lyle).

⁸⁶ PUC Case No. 18-2660-INV, ChargePoint Final Recommendations dated 5/13/19 at 15. "NIST Handbooks 44" refers to Section 3.40 of the National Institute of Standards and Technology's Handbook 44, which provides a draft of standards for electric vehicle fueling systems. The standards are available at: <https://www.nist.gov/pml/weights-and-measures/publications/nist-handbooks/other-nist-handbooks/other-nist-handbooks-0>. "EVSE" stands for "electric vehicle supply equipment," which refers to EV charging equipment.

⁸⁷ PUC Case No. 18-2660-INV, Greenlots comments dated 3/1/19 at 6.

comparison study performed by ChargePoint that showed a 0.76% difference in accuracy when comparing a Level Two charger to a utility meter and represented that the accuracy was sufficient for the purposes of its pilot program implementing EV-specific rates.⁸⁸

Some loss of metering accuracy may be due to the use of electricity by the EV charging equipment itself (e.g., illuminating the interface screen) or, in the case of DC fast chargers, losses associated with the conversion of energy from AC to DC.⁸⁹ An analysis performed by Burlington Electric Department found differences of 2-8% for Level Two chargers and 8-15% for DC fast chargers between the electricity measured by the utility-owned revenue-grade meters and the electricity measured by the EV charging equipment.⁹⁰ These discrepancies should not result in any loss of revenue to the utility as long as every charging station is behind a utility- grade meter. These discrepancies could, however, affect the accuracy of a customer's EV-specific electricity usage calculations when applying EV-specific rates or a per-kWh EV fee.

3. Strategies to encourage EV usage at a pace necessary to achieve the goals of the State's Comprehensive Energy Plan and its greenhouse gas reduction goals, without shifting costs to electric ratepayers who do not own or operate EVs.

The primary barrier to EV adoption identified by consumers is price.⁹¹ That barrier must be addressed if we are to increase the pace of EV adoption. Possible strategies for reducing up-front purchase costs for EVs, as well as strategies for reducing other barriers to EV adoption such as the availability of charging infrastructure, are discussed in more detail in Section IV. ("Moving Forward").

4. Other issues relevant to ensuring a fair, cost-effective, and accessible EV charging infrastructure that will be sufficient to meet increased deployment of EVs.

All issues have been incorporated into our discussions and analyses of the substantive topics enumerated in Section 25 of Act 158.

⁸⁸ PUC Case No. 18-2660-INV, Green Mountain Power Final Comments dated 5/13/19 at 7.

⁸⁹ Level One and Level Two chargers supply AC power to the EV, which converts that power to DC for charging the battery. DC fast chargers perform the AC-to-DC conversion themselves and supply DC power directly to the EV.

⁹⁰ PUC Case No. 18-2660-INV, Comments of Burlington Electric Department and Vermont Public Power Supply Authority dated 3/1/19 at 8-9.

⁹¹ PUC Case No. 18-2660-INV, Drive Electric Vermont comments at 3; Department of Public Service Final Comments dated 5/13/19 at 7.

IV. Moving Forward

Vermont's Comprehensive Energy Plan ("CEP") aims to increase the share of renewable energy in Vermont's transportation sector to 10% by 2025 and 80% by 2050. The CEP also seeks to reduce GHG emissions from the transportation sector by 30% by 2025.⁹²

As of January 2019, there were 2,985 EVs registered in the state.⁹³ Estimates for how many EVs must be registered in Vermont to meet the goals set forth in the CEP range from 50,000 to 60,000 vehicles by 2025.⁹⁴ Over the last several years, EV registrations in Vermont have been slowly but steadily increasing annually, beginning with 283 registrations in 2014 and ending with 647 registrations in 2018. However, 2017 stands out among these years with a total of 806 registrations.⁹⁵ This spike in registrations is at least in part the result of a partnership between Vermont's distribution utilities and Nissan to offer \$10,000 "fleet-tail" discounts on the Nissan LEAF in 2017. During this period, Nissan EV registrations increased by nearly eight times compared to prior years.⁹⁶ As of August of 2018, Vermont ranked fourth in the nation in EV sales on a per-capita basis per 10,000 people.⁹⁷

While this may be characterized as a good start, Vermont's EV registrations must increase significantly on an annual basis if the State is to achieve the goals set forth in the CEP. The balance of this section is intended to provide potential pathways toward achieving those goals and includes discussions of potential incentives and their effects, the need and opportunity for EV charging station deployment, opportunities associated with mass transit electrification, and the need for additional education and outreach on the benefits of EV ownership and use.

A. Incentives.

Almost all the participants in the Commission's investigation stated that purchase incentives were particularly effective in influencing individuals who are shopping for a new vehicle to decide on purchasing an EV instead of a fossil-fueled vehicle. It goes without saying that the larger the incentive, the more likely it is to result in the desired decision.

⁹² PUC Case No. 18-2660-INV, Department of Public Service comments dated 4/8/19 at 1.

⁹³ PUC Case No. 18-2660-INV, Drive Electric Vermont workshop 4 presentation, April 23, 2019 at slide 4.

⁹⁴ PUC Case No. 18-2660-INV, Drive Electric Vermont workshop 4 presentation, April 23, 2019 at slide 4; PUC Case No. 18-2660-INV, Department of Public Service comments dated 4/8/19 at 2.

⁹⁵ PUC Case No. 18-2660-INV, Drive Electric Vermont workshop 4 presentation, April 23, 2019 at slide 13.

⁹⁶ PUC Case No. 18-2660-INV, Drive Electric Vermont comments dated 4/8/19 at 4. This figure is indicative of the positive effect that financial incentives can have in influencing the purchase of a new EV. Incentives are discussed below in greater detail.

⁹⁷ PUC Case No. 18-2660-INV, Drive Electric Vermont workshop 4 presentation, April 23, 2019 at slide 7.

However, beyond that, the information gathered during this investigation does not demonstrate a specific incentive level that is necessary to achieve effective results.

For example, information presented by Drive Electric Vermont showed that EV purchases increase with increasing incentives. A survey found that in Massachusetts, California, and Connecticut, some level of incentive was required to cause the purchase of an EV 46%, 49%, and 68% of the time, respectively.⁹⁸ Drive Electric Vermont's 2016 consumer awareness survey found that the likelihood of EV purchase increased from a baseline range of approximately 20-25% without incentives up to 41% with incentives of \$2,500 or higher.⁹⁹ As a further demonstration, the \$10,000 2017 Nissan LEAF incentive program referenced above resulted in an approximate eight-fold increase in Vermont sales compared to prior years. Subsequently, Nissan continued to offer a \$5,000 LEAF discount in 2018 and 2019, but the resulting sales have been markedly lower than what was experienced at the \$10,000 incentive level.¹⁰⁰

Purchase incentives can come in a variety of forms. The most common are point-of-sale incentives, rebates, and tax credits. (Additionally, in Vermont most, if not all, electric distribution utilities offer EV purchase incentives under Tier III of the RES program.) If the dollar amount of the incentive is the same in each of the three categories, EV purchasers prefer a point-of-sale incentive because it is realized immediately, whereas there is delay between the time of purchase and receipt of a rebate or tax credit. However, surveys have shown that the larger the incentive, the more willing a purchaser is to wait to receive it.¹⁰¹

The State has little or no control over point-of-sale manufacturer or dealer discounts. However, Vermont's distribution utilities should be encouraged to work with local dealerships as well as EV manufacturers to couple any of their RES Tier III incentives with manufacturer and dealer discounts, thereby leveraging these individual incentives into a single, larger incentive to purchase an EV. Vermont's utilities should also proactively engage with Vermont dealerships that sell EVs so that their salespeople are aware of existing utility incentives and can communicate them to prospective purchasers while they are shopping. Similarly, utility employees who engage with customers as part of their job should be knowledgeable about sales incentives available at Vermont EV dealerships so that the information can be conveyed at the same time as information about any utility incentives.

⁹⁸ PUC Case No. 18-2660-INV, Drive Electric Vermont workshop 4 presentation, April 23, 2019 at slide 14.

⁹⁹ PUC Case No. 18-2660-INV, Drive Electric Vermont workshop 4 presentation, April 23, 2019 at slide 15.

¹⁰⁰ PUC Case No. 18-2660-INV, Drive Electric Vermont comments dated 4/8/19 at 4.

¹⁰¹ PUC Case No. 18-2660-INV, Drive Electric Vermont workshop 4 presentation, April 23, 2019 at slide 16.

There is currently a federal tax credit of up to \$7,500 for the purchase of a new EV.¹⁰² However, that amount decreases once a manufacturer sells 200,000 vehicles and is phased out entirely over the course of the following year. Tesla's federal incentive was cut in half in January of 2019 and General Motors' credit was reduced by half on April 1, 2019. While there has been some activity in Congress to strengthen these incentives, it is far from certain that any such efforts will be successful.¹⁰³ Given the uncertainty surrounding the federal tax credit, it is becoming increasingly important for the State of Vermont to take a larger role in providing incentives for EV purchases if the State is to meet its emissions-reduction goals, at least until EVs reach cost-parity with internal combustion engine vehicles.

As part of H.529, Vermont instituted an electric vehicle incentive program that will provide EV purchase and lease incentive payments that will vary by income to encourage a greater rate of EV adoption in the state. The program will provide incentives to Vermont households with low and moderate income at or below 160% of the state's prior five-year average Median Household Income level and will apply to manufactured EVs with a Base Manufacturer's Suggested Retail Price of \$40,000 or less. The program will apply to both purchases and leases of new EVs, with an emphasis on creating and matching incentives for exclusively electric-powered vehicles that do not contain an onboard combustion engine. The program will be administered by the Vermont Agency of Transportation. The Agency is authorized to spend up to \$2,000,000 in support of the electric vehicle incentive program and a companion high-fuel-efficiency vehicle incentive and emissions repair program. Of that \$2,000,000, at least \$1,100,000 must be made available for EV incentives.

The State should also consider the possibility of a temporary tax waiver on the purchase of new EVs. At this time, a 6% sales-and-use tax is applied to the purchase of automobiles in Vermont. Eliminating or reducing the sales tax on EV purchases would provide an additional financial incentive to potential buyers, yet would not cause significant financial consequences to the State's budget given the current low level of EV sales on an annual basis. The tax waiver could be limited based on the income of the purchaser and/or the cost of the vehicle, phasing out as income levels and vehicle prices increase. Additionally, as sales levels increase on an annual basis, the sales-tax waiver could be phased out over time.

Another option to consider with respect to the sales tax as a source of incentives is to waive 5% of the tax but allow the remaining 1% to be retained by the dealer. This type of

¹⁰² The actual credit amount is based on a vehicle's battery capacity. The credit is also indirectly available for leased vehicles. Because the dealership is the owner of a leased vehicle, it claims the tax credit. However, a dealership will often factor the tax credit, or some portion thereof, into the lease price for the vehicle.

¹⁰³ See, e.g. Driving America Forward Act, <https://www.congress.gov/bill/116th-congress/senate-bill/1094/text> (extending tax credit of up to \$7,000 for up to 600,000 vehicles sold).

“midstream” incentive can be very useful in encouraging dealerships to actively market and sell EVs.¹⁰⁴ To date, auto manufacturers in the United States have expended relatively little effort in marketing their EV models.¹⁰⁵ Anecdotally, the Commission was informed during its investigation that some auto dealerships in Vermont are not actively promoting EV sales. Participants in the workshop opined that the lack of enthusiasm for the sale of EVs is founded on a lack of training for salespeople, a lack of inventory on dealership lots, and the potential for lost post-sale dealer income due to the decreased level of maintenance required for EVs.

If the State decides to pursue either of the tax-holiday approaches discussed above, it should require that dealerships meet qualifying requirements, such as sales force training, active EV marketing efforts, and commitments to maintaining an inventory of EV models, before being allowed to participate in the program.

Many other states currently offer various incentives for the purchase, lease, or use of an EV. These incentives range from special rates for the charging of EVs offered by electric utilities to tax credits or waivers, point-of-sale incentives, and certain parking or driving privileges. Examples of such incentives on a state-by-state basis can be found here:

<https://www.clippercreek.com/ev-incentives/>

and here:

<https://www.energy.gov/eere/electricvehicles/electric-vehicles-tax-credits-and-other-incentives>.

The State should consider whether any of these additional incentives are appropriate for adoption in Vermont.

B. EV Charging Station Deployment.

While the vast majority of EV charging will occur at home, the need for publicly available EV charging stations remains high. Charging stations will be needed along major transportation corridors to support long-distance travel, in city centers to accommodate charging by visitors, in public parking structures for charging during work or shopping, and at workplaces to allow for charging during work, including for employees who are unable to charge at home. Suitable locations for EV charging equipment subject to State influence may include park and rides, State employee parking lots, and rest areas.

¹⁰⁴ PUC Case No. 18-2660-INV, Drive Electric Vermont comments dated 4/8/19 at 2-3.

¹⁰⁵ PUC Case No. 18-2660-INV, Drive Electric Vermont workshop 4 presentation, April 23, 2019 at slide 20.

The State should reduce or eliminate hurdles to the siting and construction of public charging stations that may currently exist at either the state or local levels, such as zoning ordinances that may prove to be overly restrictive to the siting of charging stations in some communities. For example, the State could task municipalities with a review of their zoning ordinances to ensure that no undue barriers exist to the placement of EV charging stations in their communities and to identify locations where EV charging station installation is preferred.

The State should also consider establishing building code standards for new construction or significant renovations that would require certain structures to be “EV ready” when they are completed. For example, new or renovated parking structures and multi-unit dwellings with off-street parking could be required to include pre-installed charging infrastructure such as conduits and wiring to allow for installation of charging stations without the need for expensive retrofitting, and parking structures could be required to set aside a number of parking spaces to be dedicated to EV charging. For example, California requires EV charging infrastructure at new multi-family dwellings and non-residential developments, and newly constructed buildings in Los Angeles must provide for EV charging. New York City requires that newly constructed and upgraded parking garages and lots include hardware for EV charging equipment in at least 20% of the parking spaces.¹⁰⁶

While the Commission believes that the steps taken by the Legislature with respect to the Commission’s jurisdiction over public EV charging stations will do much to encourage the deployment of EV charging stations in Vermont, taking additional steps like those described above should further aid in the deployment of public charging stations throughout Vermont.

C. Opportunities Associated With Mass Transit Electrification.

Significant GHG emission reductions can be realized through electrification of Vermont’s mass transit system, in particular replacing diesel-fueled buses with electric buses. Replacing these large GHG-emitting vehicles with non-emitting electric buses will significantly reduce emissions in Vermont’s more densely populated and emission-challenged areas. An added benefit of switching to electric buses is the reduction in overall ambient urban noise levels that results from replacing noisy diesel vehicles with far quieter electric buses.

¹⁰⁶ Source <https://afdc.energy.gov/bulletins/technology-bulletin-2015-08.html>.

Much like challenges associated with the upfront costs of purchasing an electric passenger vehicle, the upfront costs of electric buses present a challenge when it comes time to replace aging mass transit vehicles. A new diesel bus costs approximately \$500,000, while an electric bus can cost approximately \$750,000. However, the lifetime operating cost of an electric bus can be up to 20% less than the cost of operating a diesel bus. This means that over the life of the vehicle, the total costs of ownership are roughly equal. Unfortunately, the upfront cost difference can often compel a mass-transit operator to opt for the diesel bus over an electric bus when replacing aging vehicles.¹⁰⁷

With the passage of H.529, the Legislature has allocated \$1,884,000 for two large all-electric transit buses for the Burlington area and \$480,000 for two all-electric small shuttle buses for the Montpelier area.¹⁰⁸ The State should encourage these mass transit operators to look into a new program announced by electric bus manufacturer Proterra. Proterra recently announced a \$200,000,000 credit facility to support battery leasing for its electric buses. A customer purchases a bus but leases the battery over a 12-year period, with the result that the upfront cost of the electric bus is roughly equivalent to that of a diesel bus. Proterra owns and services the batteries, and a performance warranty guarantees the buses will retain their energy capacity throughout the 12-year life of the bus. Rather than pay the costs of diesel fuel to run the bus, the operator makes payments to Proterra to lease the battery. The goal of the approach is for the costs of ownership and operation of the electric bus to be equivalent to the costs of a diesel bus but without the upfront premium associated with the cost of the battery that powers the bus.¹⁰⁹ Pursuing potential opportunities such as this will allow mass transit operators to leverage their funding and could eliminate cost barriers to pursuing the benefits of mass transit electrification as vehicles approach the end of their useful life and are in need of replacement.

D. Education and Outreach.

The State should engage with entities to develop and institute wide-ranging education and outreach programs to educate its citizens about the benefits of owning or driving an EV.

Currently, Vermont's electric utilities are promoting EV use and ownership through incentives and messaging to their customers, and Drive Electric Vermont engages in a variety of efforts to promote the understanding of the advantages of driving an EV. However, more needs to be done.

¹⁰⁷ <https://www.greentechmedia.com/articles/read/proterra-rolls-out-bus-battery-leasing-program-with-mitsui#gs.gzxg2x>.

¹⁰⁸ See H.529 at section 2(4).

¹⁰⁹ <https://www.forbes.com/sites/sebastianblanco/2019/04/18/proterra-ready-for-electric-bus-battery-leasing-with-200-million-credit-facility/#2526eca82314>.

Studies show that the total cost of ownership of an EV is less than the total cost of ownership of a comparable fossil-fueled vehicle. The cost savings realized by EV drivers typically stem from savings on “fuel” – the per-mile cost of electricity is significantly less than the per-mile cost of gasoline – and the lower maintenance costs of EVs. However, this does not appear to be common knowledge among the car-buying public. Additionally, there needs to be better education about incentives for the purchase and lease of an EV. Without widespread knowledge of the availability of these incentives, potential purchasers may be deterred by the sticker price of an EV, not knowing what the actual costs would be after taking advantage of available incentives. Last, the public should be made aware of the societal benefits of driving EVs in the form of reduced air emissions.

Drive Electric Vermont is a well-positioned entity to engage in increased educational outreach to Vermont’s citizens. Its mission is to promote the use of EVs in Vermont, and it has significant experience in doing so. The State should consider establishing funding for Drive Electric Vermont specifically for the purpose of conducting additional education and outreach throughout the state. Such efforts are of significant importance given the relative lack of EV advertising efforts by the automotive industry to date.¹¹⁰ If car buyers in Vermont are to consider EVs to be a viable alternative to fossil-fueled vehicles, it is imperative that they understand the benefits that can be realized by choosing to go electric.

In developing outreach and educational efforts, the State should also consider targeting some of those efforts to younger Vermonters. Younger people tend to be more accepting of technological change and, even if not yet in the market for their own new vehicle, could be a source of influence in the decision-making process of household adults who are seeking to purchase a new vehicle. Additionally, as more used EVs appear in Vermont’s automotive market, younger Vermonters should be well informed about the advantages of EVs as they seek to purchase their own vehicles, creating a future generation of EV purchasers and users.

E. State Opportunities.

The State should also increase its efforts in setting an example for the citizens of Vermont by focusing on purchasing and leasing EVs as it replaces or expands its fleet of motor vehicles. Given Vermont’s stated policy goals of GHG reductions, the State itself should play a leading role in transportation electrification, giving its citizens confidence that electric vehicles are both reliable and economical alternatives to fossil-fueled vehicles.

¹¹⁰ PUC Case No. 18-2660-INV, Drive Electric Vermont workshop 4 presentation, April 23, 2019 at slide 20 (detailing the almost total lack of EV advertising by Ford in 2017).

F. Fleet and Commercial Vehicles.

This report has focused primarily on the personal transportation sector. However, future opportunities will present themselves as technology continues to expand. The Commission expects that as EV technology matures, a market will develop for fleets of commercial vehicles and perhaps even school buses. Vermont should be prepared to take advantage of these opportunities as they arise and be ready to accommodate both the challenges and opportunities that will flow from the electricity demand that will be associated with this future growth.

V. Conclusion

Vermont has set ambitious goals for reducing GHG emissions in the state. While great strides have been made in reducing the state's carbon footprint in the electric energy sector, much remains to be done in the transportation sector.

Vermont is a rural state featuring long commutes for many of its residents, at times in difficult and demanding conditions. If the State is to meet its GHG reduction goals, more Vermonters will need to choose EVs as their main mode of transport. While Vermonters have shown an interest in EVs, much remains to be done in promoting and enabling their use so that they become a common means of transport—to become the rule rather than the exception.

The most often cited barriers to widespread EV adoption are the limited range an EV can travel on a single charge, limited availability of charging opportunities, and the acquisition cost of EVs compared to internal combustion engine vehicles. Additional perceived negatives are a lack of vehicle choice and misconceptions about vehicle performance. There is much the State can do to address the primary barriers to widespread EV adoption. Range anxiety can be addressed through increased deployment of public EV charging stations. The up-front costs of purchasing an EV can be mitigated through incentive programs, better education, and coordination among Vermont's electric utilities and EV dealerships to help dispel perceived negatives and yield a better-informed population regarding the benefits of traveling by EV.

It is the intent of this report to identify specific barriers to more widespread adoption of EVs and deployment of EV charging stations, and to propose possibilities for removing or mitigating those barriers so that Vermont can more readily meet its ambitious GHG reduction goals. Legislation passed in the 2019 legislative session, in the form of H.529, is a significant step in the right direction. This Commission encourages the Legislature to consider the various recommendations made throughout this report for action in the 2020

legislative session. Bold legislation, including identifying and appropriating meaningful funds to enable additional EV adoption and EV charging station deployment, will continue to establish Vermont as an EV-supportive environment, and will facilitate progress towards Vermont's GHG emissions reduction responsibilities.

APPENDIX A | HISTORY OF PUC CASE NO. 18-2660-INV

The Commission initiated Case Number 18-2660-INV on July 9, 2018, in response to Section 25 of Act 158 (H.917) of the 2017-2018 Vermont legislative session. The investigation was conducted as a series of workshops and several rounds of written requests for information, each addressing one or more specific topic areas.

Workshops were conducted as follows:

DATE	TOPICS ADDRESSED
October 1, 2018	Current and evolving state of technology for EVs and electric vehicle supply equipment, barriers to the deployment of EVs and supply equipment and strategies for the removal of those barriers, and the appropriate scope of jurisdiction, if any, over EV charging stations.
November 30, 2018	The appropriate scope of jurisdiction of the Commission and Department of Public Service over EV charging stations.
March 15, 2019	Planned or currently available EV-specific rate offerings for both home charging and service to public charging stations, demand charges and DC fast-charging stations, incorporation of growing EV charging load into the electric grid and issues associated with serving that new load, the potential benefits of managed EV charging to the electric grid, including using EV batteries for purposes such as peak shaving and regulation and the likelihood of realizing such benefits based on EV usage in Vermont and existing and expected technological capabilities, and the accuracy of electric metering and submetering technology for charging EVs.
April 23, 2019	Strategies to encourage EV usage at a pace necessary to achieve the goals of the State's Comprehensive Energy Plan and its greenhouse gas reduction goals, without shifting costs to electric ratepayers who do not own or operate EVs, including incentives, educational initiatives, and efforts from other jurisdictions, and safety standards that should apply to the charging of EVs.

Written comments were solicited as follows:

DATE	TOPICS ADDRESSED
July 9, 2018	Recommendations on scope, schedule, and structure for conducting the investigation.
October 4, 2018	How to proceed with the investigation given what was learned at the October 1, 2018, workshop, next steps for the investigation, including proposals for future workshops, and the appropriate scope of jurisdiction over EV charging stations and whether legislative changes are necessary to effectuate participants' recommendations.
October 24, 2018	The appropriate scope of jurisdiction of the Commission and Department of Public Service over EV charging stations.
December 20, 2018	Mechanisms for contributions to the transportation fund by EV users.
February 4, 2019	Information on implementing EV-user contributions to the transportation fund based on kWh purchased during charging.
February 4, 2019	Information related to planned or currently available EV-specific rate offerings for both home charging and service to public charging stations, demand charges and DC fast-charging stations, incorporation of growing EV charging load into the electric grid and issues associated with serving that new load, the potential benefits of managed EV charging to the electric grid, including using EV batteries for purposes such as peak shaving and regulation and the likelihood of realizing such benefits based on EV usage in Vermont and existing and expected technological capabilities, and the accuracy of electric metering and submetering technology for charging EVs.
March 22, 2019	Recommendations to encourage EV usage at a pace necessary to achieve the goals of the State's

DATE	TOPICS ADDRESSED
	Comprehensive Energy Plan and its greenhouse gas reduction goals, without shifting costs to electric ratepayers who do not own or operate EVs, including incentives, educational initiatives, and efforts from other jurisdictions, and safety standards that should apply to the charging of EVs.
May 13, 2019	Final recommendations from investigation participants, including any ideas or recommendations that would assist the State in meeting its transportation electrification goals that were not otherwise raised by questions posed by the Commission during the course of the investigation.

The workshops were conducted as presentations and discussions addressing specific issues. Materials were often filed with the Commission in advance of the workshops to allow the Commission and participants to develop questions in advance of a workshop. The written requests for information were used to elicit specific information and recommendations, to help prepare for workshops, or to obtain information to supplement the information provided during workshops.

In addition to the workshops and information requests, Commission staff met with representatives from the Department, the Vermont Agency of Natural Resources, and the Vermont Agency of Transportation on January 22, 2019, to discuss issues related to EV users' contributions toward the cost of maintaining Vermont's transportation infrastructure.

Commissioners and Commission staff also attended all-day conferences in Boston, Massachusetts on September 13, 2018, and March 28, 2019. The conference was a day-long discussion of issues related to EV usage and EV charging station deployment and featured presentations and interactive discussions by and among representatives from utility commissions throughout New England, as well as representatives from interested segments of the private sector.

The Commission also engaged in a significant amount of self-directed research based on the information it obtained throughout the investigation.

The Commission reviewed all of the information collected throughout this proceeding and consulted with relevant staff in developing this report and the recommendations it contains

APPENDIX B | LIST OF PARTICIPANTS IN PUC CASE No. 18-2660-INV

Vermont Department of Public Service
Vermont Department of Transportation
Vermont Agency of Natural Resources
Vermont Agency of Agriculture, Food, and Markets
Vermont Department of Buildings and General Services
VEPP Inc.
Green Mountain Power Corporation
Swanton Village, Inc. Electric Department
Village of Johnson Water & Light Department
Vermont Electric Cooperative, Inc.
Town of Stowe Electric Department
City of Burlington Electric Department
Village of Enosburg Falls Water & Light Department
Town of Northfield Electric Department
Village of Enosburg Falls Water & Light Department
Town of Hardwick Electric Department
Village of Lyndonville Electric Department
Village of Jacksonville Electric Company
Village of Orleans Electric Department
Village of Morrisville Water & Light Department
Washington Electric Cooperative, Inc.
Barton Village, Inc. Electric Department
Village of Hyde Park Electric Department
Vermont Public Power Supply Authority
Green Mountain Transit
Regulatory Assistance Project
Union of Concerned Scientists
Sierra Club
Conservation Law Foundation
Advanced Energy Economy
National Consumer Law Center
Greenlots
Siemens
FLO Services USA, Inc.
General Motors
Chargepoint, Inc.

Electrify America
Plug In America
Freedom Nissan of South Burlington
Renault-Nissan-Mitsubishi
Nissan USA
Tesla Energy
Renewable Energy Vermont
Auto Alliance
Chittenden County Regional Planning Commission
ISO New England, Inc.
Vermont Fuel Dealers Association
Alliance for Transportation Electrification
Vermont Natural Resources Council
Drive Electric Vermont
Vermont Energy Investment Corporation
Vermont Public Interest Research Group