

# MEMORANDUM

To: Vermont Agency of Transportation  
From: CDM Smith  
Date: September 27, 2021  
Subject: Per Kilowatt Hour Fees System Definition

## 1. Purpose and introduction

This memorandum presents the challenges, opportunities, and options for the per kilowatt hour fee (per-kWh fee) portion of Vermont's Road Usage Charge concept. This memorandum provides background, analysis and recommendations on key policy and design choices and the feasibility of the per-kWh fee for Vermont. The analysis of alternatives documents challenges and opportunities for utilities, including:

- definition of business processes for fee collection and revenue flows to the state,
- identification and evaluation of options to protect Vermont EV owners from the impact of the fee,
- determination of capital and annual operational costs to the utilities,
- definition of reporting requirements, and
- identification of privacy concerns and protection measures.

This memo includes recommendations from the consultant, CDM Smith, for consideration and discussion by the Vermont Agency of Transportation and the Road Usage Charge Advisory Committee and does not necessarily reflect the Agency's position or approved policies.

## 2. The context

### Synopsis

For practical reasons, the Vermont PUC recommended the legislature not apply a per-kilowatt hour (per-kWh) fee to electric vehicle owners, but raised the possibility of apply in the fee to non-resident EV drivers at public charging stations.

States have theorized about imposing a tax or fee on electric vehicle use to pay for transportation systems for over a decade. Vehicles, when traveling via electric power, do not use gasoline or diesel, allowing their owners to avoid paying the gas tax, a fundamental portion of the Vermont’s transportation revenues. As the number of electric vehicles grows, finding an alternative transportation funding mechanism will become increasingly necessary.

Plug-in electric vehicles (PEVs) receive energy from the electric grid for recharging batteries used to power vehicle motors. EVs come in two types:

- (1) *All-electric vehicles* (AEVs) (often referenced as Battery Electric Vehicles (BEVs)), powered exclusively by energy stored in a battery;
- (2) *Plug-in hybrid vehicles* (PHEV), powered by energy stored in a battery and alternating with a gasoline or diesel engine to achieve an extended range.

The Vermont Public Utilities Commission (PUC) prepared a report to the state legislature at the end of 2019 on the feasibility of levying a per-kWh fee on all electric vehicle charging in Vermont.<sup>1</sup> The PUC revealed impracticalities of applying a per-kWh fee to electric vehicles registered in Vermont. However conceived, applying a per- kWh fee to *at-home charging*—the place where most EV charging occurs—remains expensive and ineffectual because of the technical challenges of segregating EV charging from all other residential electric uses.

Owing to these practical obstacles and the impossibility of equitable enforcement, the Public Utilities Commission recommended the state not impose statewide per-kWh fees on electric vehicle charging by Vermonters. Rather, the Public Utilities Commission raised the *possibility* of “having a per-kWh fee apply to charging performed at publicly available charging stations, where out-of-state drivers are most likely to recharge their cars.”<sup>2</sup> National EV charging network operators own and operate many of the public charging stations in Vermont. Sometimes the public charging offered is free.

---

<sup>1</sup> Vermont Public Utility Commission, *Report to the Vermont State Legislature: Supplemental Electric Vehicle Report Submitted Pursuant to Section 35 of Act 59 of the 2019-2020 Vermont Legislative Session*, December 13, 2019. Available from: [https://puc.vermont.gov/sites/psbnew/files/doc\\_library/EV-Supplemental-Report.pdf](https://puc.vermont.gov/sites/psbnew/files/doc_library/EV-Supplemental-Report.pdf).

<sup>2</sup> Ibid.

Evaluation of the feasibility of imposing a per-kWh fee at public charging stations must consider Vermont’s ability to meet its greenhouse gas emission goals, including the essential component of increasing purchase and usage of electric vehicles in the state. Accordingly, implementation of a per-kWh fee must not hamper the deployment of EV charging infrastructure in the state. Presumably, imposing a fee on EV owners that is no more costly than the gas tax for those driving an internal combustion engine vehicle, and not much difference in ease of compliance, would meet this test.

### 3. The Vermont per-kilowatt hour fee concept

Synopsis

The Vermont concept is to impose a per-kWh fee on the amount of electricity transferred into electric vehicles at public charging stations.

As part of a broader program to collect a set of road usage charges to replace the gas tax, the state of Vermont would collect a *per-kWh fee*—a per-unit assessment on the amount of electricity transferred into an electric vehicle—at all public charging stations in the state, or a specially selected grouping of stations, as an additional charge on top of a base electricity rate. Previous studies estimated a fee rate of \$0.034/kWh to be revenue neutral with what the average vehicle currently pays in gas taxes. The design of the per-kWh fee should enable capture of road usage charges on nonresident EV travel in Vermont.

### 4. Background

Synopsis

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

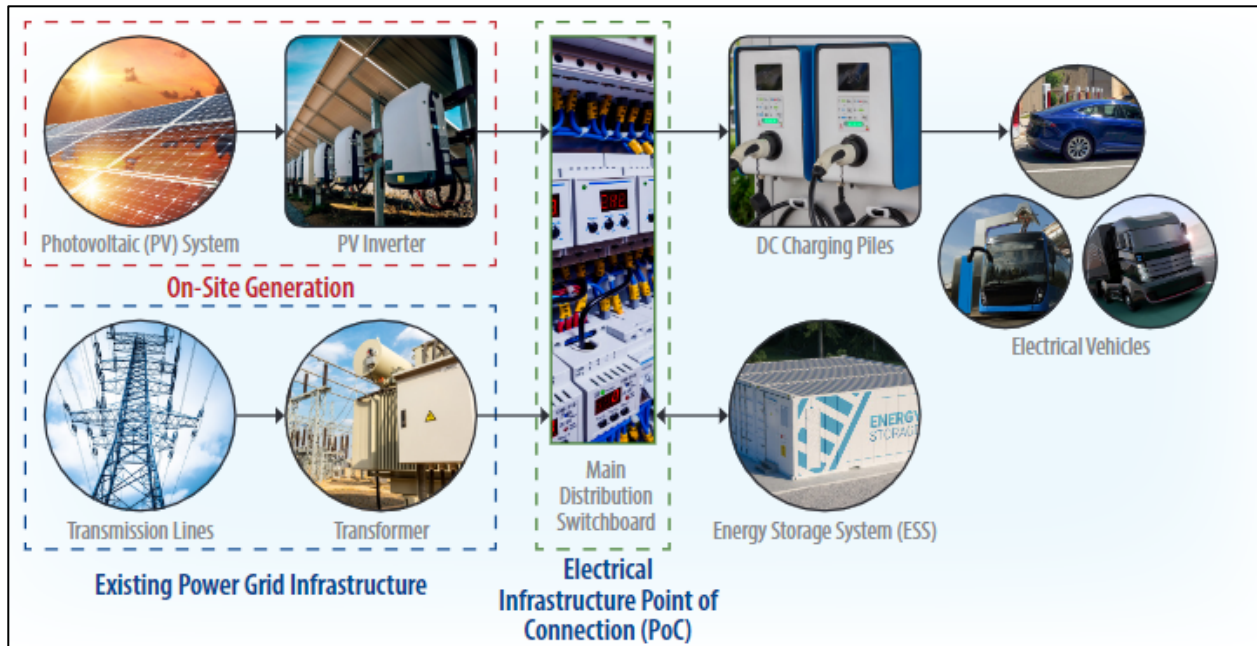
Electric vehicle public charging stations generally employ a mix of level 2 and 3 charging equipment. These stations also price electricity transfers under different business models. Some price electricity transfers based on kWh while others on time of use of the charging equipment. Beneficial charging stations offer electricity charging for free.

Several RUC concepts have emerged to impose a fee on the use of electricity as an alternative policy option to an annual flat fee or a mileage-based user fee. Determining the feasibility of a per kilowatt-hour fee for Vermont requires understanding how public charging stations price electricity and the business models for delivering power to electric vehicles.

### *How public charging infrastructure delivers electricity to electric vehicles*

Public electric vehicle charging infrastructure includes the following major components:

- **Power Sources.** EV charging stations receive electricity from the existing power grid and utility network or via on-site power generation from solar panels or wind turbines, when the utility power source is not available.
- **Electrical Infrastructure Point of Interconnection.** The interconnection is the point where the power source electrically connects to the charging station and the utility has an electricity meter for billing the charging station owner/operator.
- **Energy Storage System.** Typically used with on-site generation option—when the power grid is not available, or it is unstable or when the system experiences frequent power outages—to store energy produced by solar panels or wind turbine during the day and use later when drivers are charging their vehicles. Addition of the on-site generation (solar, wind) and energy storage system along with optimizing the times when charging electrical vehicles represent one of the mitigation strategies to reduce the cost of charging stations.
- **Electric Vehicles Charging Station Parking Stalls (also known as piles).** Stalls are the locations where the electric vehicle drivers recharge their vehicles and pay using different technologies such as an RFID card, credit card, and contactless payment using smartphone apps. The charging stations must have accurate sensing and control of power output and two-way communication capability.



There are three levels of electrical vehicle chargers. Each level delivers varying amounts of voltage, with higher voltage recharging batteries faster. Assuming an average conversion of about three miles of vehicle travel per kWh of charge, following are the approximate charging speeds for each level:

- **Alternative-Current (AC) Level 1** (120 volt. In other words, charging via typical electric outlet in a residence). Charging speed of 2 to 5 miles per hour.
- **Alternative-Current (AC) Level 2** (208 volt to 240 volt). Charging speed of 18 to 28 miles per hour.
- **Direct-Current (DC) Level 3** (480 volt to 900 volt, DC Fast Charging and Supercharging (Tesla). Charging speed of 3 to 20 miles per minute (180 to 1,200 miles per hour).

The higher the level of charging, the faster the charging process, as the system delivers more power to the vehicle at a faster pace. As of 2020, over 15 percent of public electric vehicle charging ports in the United States were DC fast chargers. The others are Level 2. Extremely cold weather can affect charging times. The rate of charging in cold temperatures can be roughly three times slower than in warmer temperatures.<sup>3</sup>

*How the electric utilities price electricity for public charging stations in Vermont*

<sup>3</sup> <https://eepower.com/news/quantifying-the-negative-impact-of-charging-evs-in-cold-temperatures/#>.

The 17 electric distribution companies presently operating throughout Vermont vary in size and sophistication. They include one investor-owned utility, 14 municipal electrical departments and two staff-owned and member-owned rural electrical cooperatives that serve anywhere from a few hundred consumers to just under 300,000. Each utility brings unique pricing methodologies and customer service attributes.

Electric utilities meter electricity consumed by commercial EV charging stations (via AC Level 2 and DC Level 3 fast charging) using commercial and industrial electricity rates, which, in most cases, incorporate a demand charge plus a volumetric charge.

Commercial tariffs typically offer lower volumetric charges than residential tariffs. However, they also require demand charges set at the highest level of demand over any 15-minute period over the course of one month. Demand charges reflect the projected cost to the utility of providing the generation and distribution infrastructure required to meet peak demand on both a system level and a local distributional level. Since demand charges depend only on maximum demand of a customer such as an EV charging station operator, the charge rises proportionally for additional chargers at a given site.

All electric utilities apply demand charges widely in Vermont to higher-usage customers, such as EV charging stations. In turn, EV charging stations may pass these costs on to motorists charging their EVs using a variety of pricing models, as depicted in Table 1, and allowed by state law.

Table 1. Vermont Most Used Public Charging Networks

Public Charging Network	Charging Speed Level	Charging Time (up to 80% of battery capacity)	Pricing/Cost of Charge		Payment Options Basis
			Electricity used	Per-Minute	
			[\$/kWh]	[\$/min]	
Blink	AC Level 2 (240V)	65 miles per hour	Blink Member: \$ 0.2-0.49 per-kWh  Blink Guest: \$0.59 per-kWh	Not applicable	Easy payment* via RFID, Apple Pay, Google Wallet, and all major credit cards
	DC Fast Charging (Level 3)	10-30 minutes	Not applicable	\$0.35 per minute	Authentication Method- RFID: MI-FARE ISO/IEC14443A/B, ISO/IEC15693, ISO/IEC18000-3, FeliCa, NFC.  Optional Contact-less or 3-in-1 (region dependent)

Public Charging Network	Charging Speed Level	Charging Time (up to 80% of battery capacity)	Pricing/Cost of Charge		Payment Options Basis
			Electricity used	Per-Minute	
			[\$/kWh]	[\$/min]	
<b>Tesla</b>	DC Fast Charging (Level 3)	15 miles per minute	<p>\$0.28 per-kWh (most common for Tesla network)</p> <p>Idle fees apply to any full charged car occupying a supercharger</p> <p>Fee of \$0.50 per minute if the station is at least 50% full, and a fee of \$1.00 per minute when the station is 100% full</p>	<p>When billing per minute, there are two tiers to account for changes in charging speeds, called tier 1 and tier 2</p> <p>Tier 1 applies while cars are charging at or below 60 kW and tier 2 applies while cars are charging above 60 kW. Tier 1 is half the cost of tier 2</p>	Tesla app for iPhone and Android to control and remotely monitor Tesla's products
<b>Charge Point</b>	AC Level 2	25 miles per hour	Not applicable	\$0.52 per hour	RFID card, mobile app, calling customer support and contactless debit and credit cards
	DC Fast Charging (Level 3)	30-60 min	The pricing across the network is very inconsistent; \$2 per charging session + \$0.35-0.53 per-kWh	Not applicable	
	DC Fast Charging (Level 3)	10 min		Not applicable	
<b>EVGo</b>	AC Level 2	20 miles per hour	Not applicable	Pay as you go (\$1.5 per hour)	Credit and debit cards
	DC Fast Charging (Level 3)	75 miles per 30 minutes	Not applicable	<p>Pay as you go (\$0.35 per minute, 60 minute time limit);</p> <p>Membership: \$0.31 per minute but save 10% off per minute with charging commitment of \$7.99 per month (60 minute session time limit)</p>	
<b>Electrify America</b>	AC Level 2	25 miles per hour		Pay as you go (\$0.03 per minute with idle fee of \$0.40 per minute)	Credit and debit cards
	DC Fast Charging (Level 3)	30-50 miles per 30 minutes (25 kW charger); 80-180 miles per 30 minutes (150 kW)	Not applicable	<p>Pay as you go and Pass Member (\$0.43 per-kWh);</p> <p>Pass+ Member:</p> <p>1-90kW: \$0.31 per-kWh plus \$4 monthly fee</p> <p>1-350kW: \$0.24 per-kWh plus \$4 monthly fee;</p> <p>Idle fee: \$0.40 per minute</p>	<p>Guests: swipe or tap credit card to pay;</p> <p>Members: contactless payment using cell phone</p>

## *How public charging stations price electricity for electric vehicles*

The market for the electric vehicle charging infrastructure follows two primary business models:

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

In the *owner-operator business model*, the site host owns and operates the charging station infrastructure. The owner-operator has complete control over the kWh price to charge electric vehicles and is also responsible for working with their electric utility company, obtaining permits, coordinating station maintenance, and covering any operating costs associated with the charging infrastructure.<sup>4</sup>

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

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

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

Electric vehicle owners experience three approaches for calculating the price of charging:

- **Nominal Fee to Cover Costs.** Fees set high enough to recoup operational and/or installation charging station costs, as a price per kilowatt-hour of electricity delivered, per unit of time, or per charging station session.
- **Profit Center:** The site operator designs the fee for charging to turn a profit from the sale of charging services, typically setting the price per kilowatt-hour inclusive of the elements mentioned in the “nominal fee” approach plus profit.

---

<sup>4</sup> Charles Satterfield and Nick Nigro, Atlas Public Policy, Washington DC, *Public EV Charging Business Models for Retail Site Hosts: A Financial Analysis of Common EV Charging Business Models for Retail Site Hosts*, April 2020. Available from: <https://atlaspolity.com/wp-content/uploads/2020/04/Public-EV-Charging-Business-Models-for-Retail-Site-Hosts.pdf>.



- **No fee:** The site operator offers charging for free to customers as an amenity, deriving value from alternative sources such as increased sales or corporate branding.

Public charging stations offering pricing may operate on a pay-as-you-go basis or by monthly subscription. The charging station network providers typically offer a combination of the first two, including a lower rate for the users that choose the subscription method to incentivize frequent use of the charging station. See Table 1 for details on the variety of charging models used currently in Vermont.

## 5. State enactments of per-kilowatt hour fees

### Synopsis

The states of Iowa and Oklahoma recently adopted per-kWh hour taxes upon transfers of electricity to electric vehicles but neither has implemented these laws. Iowa set the tax rate at \$0.026 per-kWh while Oklahoma set the rate at \$0.030 per-kWh. Neither state distinguishes resident from nonresident drivers.

The Oklahoma law exempts legacy charging stations in operation prior to November 1, 2021 if these stations never had a metering system in place capable of measuring the transfer of electricity to the vehicle or never charged a fee for use of the charging session.

In 2001, the Ohio General Assembly enacted a per-kilowatt hour tax that electric distribution companies, and a few large commercial end-users, must pay. Ohio's per-kWh tax is broadly applied across nearly all electric uses rather than application to a particular type of electricity usage.<sup>5</sup> To date, no other state has enacted a broad per-kilowatt hour tax. However, two states have enacted laws imposing per-kWh taxes specifically on electric vehicle charging.

Iowa and Oklahoma have enacted legislation imposing per-kWh taxes on electricity charging for electric vehicles, but neither state has implemented such a tax to date. Enacted in 2019, the Iowa law imposes per-kWh taxes on all non-residential electric vehicle charging beginning July 1, 2023. The Oklahoma Legislature passed legislation in 2021 imposing per-kWh taxes on all public electric vehicle charging beginning January 1, 2024. The information released about how these two states will actually implement these laws is limited or nil at this point, perhaps because Iowa has more than 21 months left before launch and Oklahoma has more than 27 months left.

---

<sup>5</sup> Ohio Department of Taxation, *Kilowatt-Hour Tax*, available at <https://tax.ohio.gov/wps/portal/gov/tax/business/ohio-business-taxes/excise/electric-distribution-kwh>.

### *Iowa's per-kWh tax*

Iowa's enacted legislation (HF 767) primarily focuses on extracting revenues from electric vehicle owners by imposing special annual registration fees on battery electric motor vehicles (BEV) and plug-in hybrid electric motor vehicles (PHEV) in addition to the standard annual registration fee.

Iowa's law also authorizes collection of a \$0.026 per-kWh fuel excise tax for electric vehicle charging at non-residential locations. The law requires collection of this new fee at the point-of-sale and paid by licensed electric fuel dealers and users (also known as dispensers) "in a manner prescribed by the department [of revenue]," although law allows the testing of EV charging stations for accuracy. Every six months, the dealers and dispensers of electricity at charging stations shall file a tax return with the state and pay the tax. The law requires computation of the tax by multiplying the tax rate by the number of kilowatt-hours delivered or placed into the electric vehicle. For purposes of enabling auditing, the law requires maintenance of records of all transactions, including pertinent records and papers, for a period of three years.

This policy intends for collection of Iowa's per-kWh excise tax in a manner similar to the state's excise gas tax.<sup>6</sup> This law does not prohibit dispensers from passing the cost of the per-kWh tax on to end customers (EV owners charging their vehicles), nor does it prescribe how to pass along such costs. To recover the cost of the tax and its preparation, EV charging station owners operating under a "nominal fee" or "profit center" model would need to increase the rates they charge to their customers. It is unclear how the tax would affect charging stations operating under the "free" model. This law also does not differentiate electricity charging of resident EVs from nonresident EVs. Thus, both resident and nonresident drivers would pay the cost of the per-kWh tax should the station operator pass it on in some form of increased prices. However, given the variety of pricing models including subscriptions, time-based charging fees, and kWh-based charging fees, it is nearly impossible for the costs to be passed on to customers on a per-kWh basis in a precise or consistent manner.

### *Oklahoma's per-kWh tax*

The Oklahoma enacted legislation imposes a tax of \$0.03 per-kWh on the electric current used to charge the battery of an all-electric vehicle (AEV) or plug-in hybrid electric vehicle (PHEV) at public charging stations beginning January 1, 2024. Unlike the Iowa law, the Oklahoma law requires the charging station owner to provide conspicuous notice of the tax on an invoice to electric vehicle owners charging at the station, collect the tax and remit the tax to the state tax commission monthly. This law does not differentiate treatment of resident EV owners from nonresident EV owners as both must pay the per-kWh tax at point-of-sale.

---

<sup>6</sup> 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>.

The Oklahoma law requires public charging stations to use a metering system capable of imposing the cost for the charging service using a unit per kilowatt hour or a comparable measurement such as time elapsed while charging. The law exempts legacy charging stations in operation prior to November 1, 2021 from tax collection if these stations never had a metering system in place capable of measuring the transfer of electricity to the vehicle or never charged a fee for use of the charging session. Charging stations which begin operations after November 1, 2021 must use a metering system capable of imposing the tax. The law imposes an administrative penalty for failure to comply.

## 6. Summary of challenges and opportunities

### Synopsis

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

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

In theory, a state can levy a per-kWh fee on electric vehicle charging. Technology exists to accurately measure per-kilowatt hours as the basis for the fee and the measurement is reportable.

It is, nevertheless, impractical to capture every charging event because of the ubiquitous accessibility of inexpensive Level 1 charging outlets at homes and businesses without the capability of accurately measuring and reporting kilowatt-hours. Public charging stations use Level 3 charging technologies that often do have the capability for Level 2 and Level 3 charging, but many do not.

EV charging stations operators incur two categories of main costs that they may pass along to their customers: (1) the cost of equipment to recharge the vehicle (fixed costs) and (2) the power consumed (energy costs). The fixed costs associated with charging equipment have three main components: make-ready charging infrastructure, utility infrastructure upgrade, and the

cost of charging equipment. Adding a new metering equipment on top of this emerging industry presents an additional cost component.

The Vermont PUC's December 2019 report to the legislature recommended against a per-kWh fee on electric vehicles of resident owners. The primary argument related to the enormous difficulty of assessing fees on home-based charging. Indeed, there are other ways to capture the participation of resident EV drivers, such as the mileage-based user fee (MBUF) and an annual flat fee, the other two components of Vermont's Road Usage Charge Concept.

The Vermont per-kWh fee concept focuses on *public charging stations*, resolving many of the Public Utility Commission's concerns. Nevertheless, the following challenges remain:

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

Solving these challenges may create an opportunity to assure the contribution of nonresident EV drivers to the Vermont transportation system who otherwise would have no way to contribute for their use of the system.

## 7. The business processes for paying the per-kWh fee

### Synopsis

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

- EV owner at the point of electricity transfer;
- Charging station owner;
- Electric utility;
- Free charging stations.

Each option affects the complexity and expense of imposing the per-kWh fee and how to unburden Vermont's electric vehicle owners from paying the fee.

Possible exemptions from the fee may include beneficial charging stations at churches, libraries and workstations and legacy charging stations without the necessary equipment.

### Decisions

1. Who pays the per-kWh fee?
  - a. Electric vehicle owner at point-of-sale?
  - b. Public charging station owner/operator?
  - c. Electric utility?
2. Do free charging stations pay the fee?

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

### Per-kWh Fee Functions

The following basic functions comprise the business process for a per-kWh fee collection system at public charging stations:

1. **Identify subject vehicle and its owner/lessee**—the owner/lessee of an EV presents themselves as a payer when accessing electricity at a public charging station.
2. **Generate kWh data for subject vehicle at public charging station**—the public charging station equipment accurately measures the data for kWh transferred at a public charging station event. This is a function carried out by the owner/operator of the public charging station.

3. **Access per-kWh data**—this means receiving the kWh consumption data from the electricity transferred to EVs vehicles and storing it in an accounting system. This is a function of the entity obliged to pay the per-kWh fee.
4. **Apply per-kWh rates**—processing the kWh data to determine the amount of taxes owed. This is a function of the entity obliged to pay the per-kWh fee.
5. **Provide invoice to EV owner/lessee (if end user payment model is adopted)**—provide vehicle owner a notice of the tax owed. If the EV owner pays the per-kWh fee at retail, this is a function of the owner/operator of the public charging station.
6. **Collect payment**—support various payment options, including credit cards and, in mandatory systems, cash. If the EV owner pays the per-kWh fee at retail, this is a function carried out by the owner/operator of the public charging station.
7. **Issue acknowledgement of payment**—provide receipts for payment. If the EV owner pays the per-kWh fee at retail, this is a function of the owner/operator of the public charging station.
8. **Enforce payment**—provide means of fraud detection and consequences to ensure most everyone pays. Fraud detection is a shared role of the owner/operator of the public charging station and the state, but serious consequences (for serious fraud) is a role of the state.
9. **Remit revenue to appropriate fund**—this is a shared role of the entity obliged to pay the per-kWh fee and the state. The entity obliged to pay the per-kWh fee typically remits all funds to a single account, and the state treasury then routes those funds further as required by law.

### Who pays the per-kWh fee and how does the money flow?

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

1. The *EV owner* pays fee at point-of sale (POS) and the charging station owner/operator has the obligation to collect the fee and remit it to the authorized agency;
2. The *charging station owner/operator* pays the fee based on all electric vehicle electricity sales at the station and remits the fee to the authorized agency;
3. The *electric utility* pays the fee based on all electric vehicle charging station electricity usage for which the utility transfers power and remits the fee to the authorized agency.

Under option 1, *free charging station operators* would be required to implement point-of-sale systems to collect the fee from customers and remit the fee to the authorized agency. Under option 2, *free charging stations operators* would be required to calculate and pay the fee based on electricity transfers to EVs, and remits the fee to the authorized agency.

Commingled with this issue is how to ensure the cost of the per-kWh fee does not rest with Vermont EV owners who already pay per mile or by flat fee. See section 8 for a discussion of this issue.

- **EV owner pays fee at point-of-sale.** If the EV owners pays the per-kWh fee paid at point-of-sale, a number of issues arise. As Table 1 depicts, many public charging stations

do not bill EV owners by kWh in every instance because they have business reasons to bill otherwise; instead they may bill by time of use (TOU) which cannot be converted into kilowatts because electric vehicles receive electricity at different speeds, depending on the technology of the vehicle and charging station, the age of the battery and how full the battery is when charging. Requiring a public charging station to implement a per-kWh fee at the POS may require billing system upgrades and installation of dedicated meters at each charging stall (technically known as a *pile*) because research shows discrepancies between the electricity measured by the utility-owned revenue-grade meters and the electricity measured by EV charging equipment.<sup>7</sup> The PUC says, “These discrepancies could ... affect the accuracy of a customer’s EV-specific electricity usage calculations when applying ... a per-kWh fee.”<sup>8</sup>

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

- **Charging station owner pays fee.** The Vermont PUC recommended in its 2019 report to the legislature that since the per-kWh fee would be a volumetric levy with the kWh as the unit of volume, the state could collect the fee in a manner similar to collection of the gas tax. “The gas tax model would be appropriate because it obligates the operator of the [EV charging] station to collect and remit that tax. This would require either a dedicated utility meter or an accurate submeter to measure the electricity consumed by EV charging at the station.”<sup>9</sup> In other words, the state would charge the fee on the charging station owner who would then make the likely decision of building the fee amount into the electricity rate at the point-of-sale.

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

An alternative is for the EV owner to present an official card or other identification, such as a Vermont Driver’s License, exempting them, by law, from payment of the per-kWh fee embedded in the electricity price and receive a discount on the price. The station owner could accumulate data of the number of discounts granted to receive a credit against the per-kWh fee the station owes to the authorized agency once a month, and the station operator could receive a rebate of such an amount from the state.

---

<sup>7</sup> Vermont Public Utilities Commission, *Report to the State Legislature*, June 27, 2019. Available from: [https://puc.vermont.gov/sites/psbnew/files/doc\\_library/EV-Supplemental-Report.pdf](https://puc.vermont.gov/sites/psbnew/files/doc_library/EV-Supplemental-Report.pdf)

<sup>8</sup> Ibid.

<sup>9</sup> Vermont Public Utilities Commission, *Report to the Vermont State Legislature: Supplemental Electric Vehicle Report per Section 35 of Act 59 (H.529) of the 2019-2020 Vermont Legislative Session*, December 13, 2019. p 18. Available from: [https://puc.vermont.gov/sites/psbnew/files/doc\\_library/EV-Supplemental-Report.pdf](https://puc.vermont.gov/sites/psbnew/files/doc_library/EV-Supplemental-Report.pdf).

- **Electric utility pays fee.** The simplest approach would apply the per-kWh fee at the utility level based on the amount of electricity consumed at the public charging station. As the per-kWh fee should not apply to electricity uses other than EV charging, the utility or stations would have to add dedicated metering capabilities to the stations or perhaps deduct an approved standard offset for charging station operations unrelated to directly charging vehicles and adjust the fee rate accordingly. This approach would not generate the necessary detailed receipts as evidence for a resident EV owner credit for per-kWh fees paid against an MBUF or flat fee RUC. The alternative of the EV driver presenting an official tax exemption card for a discount does not seem viable either as the utility is not involved in the electricity charging transaction.
- **Free charging stations pay the fee.** If the commercial public charging stations collect or pay per-kWh fee, the question arises whether the *free* public charging stations should also collect or pay the fee. Presumably, the charging stations offering free power for EVs would not pay the per-kWh fee because there is no *sale* for the transfer of electricity into the EV. Legislation could mandate that free charging stations collect the per-kWh fee anyway, requiring operators to acquire all the necessary point-of-sale transaction equipment and software, as well as accurate metering infrastructure to enable the fee collection. This seems unlikely given the benevolent motivations of the *for-free* charging station sponsors in the context of Vermont's climate change goals.

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

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

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



### *Which agency collects the per-kWh fee and provides enforcement?*

Regardless of how collection of the per-kWh fee occurs, the arrangement will be similar to collection of the gas tax in that collection occurs *upstream* from the end consumer in a volume-based retail transaction. On a monthly basis, the owner/operators of public charging stations (or utilities) would remit the fees collected to the State. In this case, the Vermont PUC expects the Department of Motor Vehicles would receive the fee revenues.<sup>10</sup> Enforcement of the per-kWh fee would happen in a manner similar to the gas tax. The PUC has opined that enforcement authority for the per-kWh fee should rest with the Department of Motor Vehicles and the Attorney General.<sup>11</sup>

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

## 8. Policy and system design issues

### Synopsis

Vermont EV owners can avoid the burden of paying the per-kWh fee by the possibilities:

1. Presentation of an official exemption identification card;
2. Input of a discount card at the point-of-sale;
3. Presentation of receipts of per-kWh fee paid to receive a credit against a flat fee or mileage-based user fee.

### Decisions

1. How will Vermont residents owning electric vehicles not bear responsibility for paying the per-kWh fee?
  - a. Input of discount code?
  - b. Present official exemption identification?
  - c. Present receipts for payment of per-kWh fees to obtain credit toward mileage-based user fee or annual flat fee.
2. Should a privacy law protect personal information used for per-kWh fee.

<sup>10</sup> Vermont Public Utilities Commission, *Report to the Vermont State Legislature: Supplemental Electric Vehicle Report per Section 35 of Act 59 (H.529) of the 2019-2020 Vermont Legislative Session*, December 13, 2019, p 18. Available from: [https://puc.vermont.gov/sites/psbnew/files/doc\\_library/EV-Supplemental-Report.pdf](https://puc.vermont.gov/sites/psbnew/files/doc_library/EV-Supplemental-Report.pdf).

<sup>11</sup> *Ibid*, p 19.

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

There are three possibilities for targeting the per-kWh fee only on nonresident EV drivers:

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

This different treatment of non-resident EV drivers from resident EV drivers should not run afoul of the US Constitution's Commerce Clause because the resident EV drivers will pay either the MBUF or annual flat fee instead of the per-kWh fee while the nonresident EV drivers will pay only the per-kWh fee. As long as the fee rates are similar in impact, payment of different fees by nonresident drivers and resident drivers does not violate the Commerce Clause.<sup>12</sup>

*What are the reporting requirements for the per-kWh fee?*

Data reporting requirements vary depending upon the selected approach to collecting per-kWh fee payments and identifying resident EVs for an exemption. To facilitate auditing, entities required to remit per-kWh fee payments should have the obligation to report and retain data on the commercial transactions that are the basis of the payments. These entities should report total kWh consumption, estimated or measured consumption by resident and nonresident EV drivers and the total fees collected and remitted. Some form of vehicle identification and person identification may be required.

*How would the system protect the per-kWh data reported?*

In the event this data consists of transactions whereby personal information concerning the identity of an EV owner can be discerned, certain data privacy protections should be enacted into law to protect customers.

- Prohibition of the transfer of personal information to a third party unless the data is aggregated and anonymized;
- Direction to delete personal information after a designated period of time during which an audit may occur;

---

<sup>12</sup> *RUC and The Commerce Clause and other provisions of the United States Constitution (unpublished)*, a report prepared for the Washington Road Usage Charge Steering Committee, March 14, 2019.

- Establishment of rights to access to personal information held, rectification of errors and erasure of personal information held beyond designated periods of time.
- Remedies for violation of the privacy provisions.

## 9. Which laws should apply to entities collecting the per-kilowatt fee in Vermont

### Synopsis

If charging station owners collect the per-kWh fee from EV drivers, consumer protection laws should apply.

If the public charging station has the obligation to collect a per-kWh fee from the EV owner at the point-of-sale, the owner/operator of the station should be subject to consumer protection laws. The PUC 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 PUC also opines that 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.”

## 10. Capital and annual operating costs for collection of per-kilowatt hour fee

### Synopsis

Many public charging stations will have to incur the costs to upgrade software and hardware systems to capture revenue-grade measurement of kilowatt hours.

The imposition of per-kWh fees at public charging stations will have costs to the station owner, whether private operator or utility company. Charging station systems must have the capability to capture, or be modified to capture, the per-kWh data, process it, obtain payment, and remit funds to the state. There will be initial capital costs for billing-system upgrades and installation

of accurate metering equipment to implement the per-kWh fee as well as the on-going, operational expenses, both on the part of the charging station owner/operator and the state. The authorized agency will have tax return and payment processing, audit and compliance enforcement expenses.

For many current charging stations, ensuring these capabilities may only mean software upgrades, yet the cost of upgrades can prove significant, especially for charging stations currently providing subscription-based charging or free charging. The cost of software upgrades is typically included in the monthly per port fee of a networked charging station using the vendor's platform. The cost for this service can be roughly \$100-\$300 per port per month.<sup>13</sup>

Public charging stations may also need expensive hardware upgrades to accommodate payment or accommodate the input of vehicle residency cards to ensure the vehicles of residents are not charged the per-kWh fee. Public charging stations that currently do not have sub-metering will require, in many cases, installation of one or more revenue grade meters to accurately measure the quantity of kWh delivered to EVs. The meter can be installed at the power panel that feeds the chargers or outside at the charger in a weatherproof clear box. This option will need current transformers (CTs) to meter power/energy consumption. A single sub-meter with CTs and a weatherproof enclosure can cost roughly \$700. Installation costs will be dictated on where the unit is installed. The total cost will also depend on the number of sub-meters installed. Software for this system can be free depending on the vendor selected.

To alleviate some of the costs of upgrading the units to be able to charge based on kWh, new charging stations with advertising capabilities could be purchased to replace older, end of life units. The current price range of a dual port Level 2 networked EV charger is between \$2,400 and \$8,100. The cost to add advertisement onto a unit can be as little as \$200 to add a wrap with a company logo to a unit but could cost as much as \$1,100 to use the LCD screen to advertise. The owners of the charging stations can charge between \$200-\$500 a month for this advertisement which would offset some of the costs.

Public charging station operators may need to obtain letters of credit or surety bonds to ensure proper remittance of the revenue collected on behalf of the state.

---

<sup>13</sup> <https://www.chargedfuture.com/cost-to-install-ev-charging-stations/>.

## 11. Recommended legislative provisions for a per-kilowatt hour fee

### Synopsis

A law enacting a per-kWh fee should contain numerous provisions imposing the obligation to pay, setting the tax rate, setting exemptions and granting administrative authority to a specific government agency.

A law enacting a per-kWh fee for non-resident EV owners to pay while driving in Vermont should have the following provisions:

- Identify the Department of Taxation as the authorized agency responsible for receiving revenues generated by the per-kWh fee and enforcing collection of the per-kWh fee.
- Authorize the selected agency to use the current statutory enforcement tools for collection of the gas tax to collect the per-kWh fee from persons or entities evading their obligation or late on payment.
- Impose the per-kWh fee obligation on public charging station owner/operators using the gas tax model.
- Set a rate for the per-kWh fee.
- Require public charging stations to have accurate metering equipment for imposing a per-kWh fee on electric vehicle recharging.
- Establish statutory exemptions from the per-kWh fee for public charging stations sponsored by churches, libraries or workplaces serving essentially only Vermont residents and exempt legacy charging stations currently without the necessary equipment from application of the per-kWh fee but establish a date certain for compliance by all new charging stations and those adding charging capacity.
- Allow public charging stations to recover the cost of installation of accurate metering equipment as part of the EV charging fee structure by embedding the per-kWh fee into the price of electricity.
- If found feasible and equitable, authorize public charging stations to use a TOU conversion for EV drivers to pay the per-kWh fee, and specify the conversion.
- Affirm application of the state's consumer protection laws to public charging station transactions involving payment of the per-kWh fee.
- Establish provisions for protection of privacy for personal information obtained during the process of collecting the per-kWh fee.
- In the event the per-kWh fee payment data consists of personal information concerning the identity or behavior of an EV owner, certain data privacy protections should be enacted into law to protect data concerning the EV driver's charging location and amount of electricity consumption. The law should prohibit transfer of the personal information to a third party unless the data is aggregated and anonymized. The law

should direct deletion of the personal information after a designated period of time during which an audit may occur.

## 12. Recommendations

### Synopsis

Given the unknowns and complexities of implementing a per-kWh fee, it is recommended that Vermont undertake a pilot test using the model for collecting the gas tax. Under the gas tax model, the public charging station owner pays the fee and builds the cost of the fee into the retail rate for electricity.

### Decisions

Does the advisory committee support these recommendations?

What are the modifications to these recommendations that obtain support?

Are there other decisions that obtain support?

Given that there are presently too many unknowns about the feasibility and equitability of implementing a per-kWh charge on non-resident vehicle charging in Vermont, we recommend the state thoroughly examine the gas tax model approach to per-kWh fee collection before enactment. If feasible and equitable, the gas tax approach to per-kWh fee collection could have the following advantages:

1. Cost-effectiveness with minimal or no impact on the profitability of public charging stations;
2. Authorization of public charging stations to use time-of-use (TOU) for EV drivers to pay the per-kWh fee, resulting in minimal disruption of the business models of many public charging providers;
3. Development of a methodology by which resident EV drivers would not bear responsibility for payment of the per-kWh fee.

To test the feasibility and equitability of the gas tax approach to collection of the per-kWh fee, the state should undertake a pilot program. Elements of the pilot program may include:

- Analyzing the cost and impact of requiring all public charging stations in Vermont, including free stations, to add or upgrade billing-systems and to use technologies that can accurately determine the kWh transferred to EVs during charging events;
- Researching how many public charging stations in Vermont currently do not have the metering capability to accurately measure the transfer of electricity into an electric vehicle.

- Testing the accuracy of EV chargers, smart meters and submeters compared to a dedicated utility meter in determining the kilowatt hours transferred to EVs during charging events.
- Examining compatibility issues between EV chargers and the tax collecting entity's billing system.
- Examining the possibilities for cost recovery of software and hardware upgrades added to public charging stations for the purpose of collecting a per-kWh fee;
- Testing the feasibility and equitability of TOU fees to accurately calculate the kWh transferred to EVs during charging events to enable payment of the per-kWh fee in this manner;
- Testing the feasibility and equitability of requiring EV owners to use receipts from recharging at public charging stations to prove an estimation of the per-kWh fee amount to obtain a credit against their MBUF or annual flat fee amount.
- Testing a process for EV owners to obtain a credit of an estimate of the per-kWh fee for use against their MBUF or annual flat fee amount;
- Alternatively, testing the feasibility and equitability of EV owners presenting an official card or other identification at EV charging stations to trigger an exemption from the per-kWh fee that results in a discount on the price of electricity;
- Determining the relative impact of not requiring free public charging stations to collection or pay the per-kWh fee.
- Determining the relative impact of only applying the per-kWh fee at public charging locations with Level 3 charging equipment capable of accurate metering of electricity transfers and inexpensive billing-system adjustments.
- Researching the issues of liability and consequences for nonpayment.
- Proposing alternatives for assessing the per-kWh fee when public charging stations offer EV charging on a basis other than per-kWh.
- Submittal of a report to the legislature on the feasibility and equitability of implementation of the gas tax model approach for per-kWh fee collection.

Should the legislature consider authorizing legislation for the undertaking of a per-kWh fee pilot program, it would be helpful if the following provisions received worthy attention:

- Identify the agency (or agencies) responsible for undertaking the per-kWh fee pilot program.
- Test collection of the per-kWh fee from public charging station owner/operators using the gas tax model.
- Set a rate for the per-kWh fee.
- Test collection of the per-kWh fee from at least two public charging stations to test the relative accuracy of measuring electricity transfers to EVs via dedicated utility meters and various forms of submeters, smart-meters and electric charging equipment. At least one of the public charging stations should have accurate submetering equipment and at least one other public charging station shall have only electric charging equipment with no submetering equipment.

- The public charging stations participating in the per-kWh fee pilot program shall have their capital costs and operational costs of participation covered by the pilot program budget.
- Test and research the feasibility and equitability of using TOU in the per-kWh fee pilot program.
- Examine questions of per-kWh fee liability and consequences for non-payment.
- The agency undertaking the per-kWh fee pilot program should adopt a privacy policy for protection of personal information used or acquired during the operations of the pilot program.

## 12. Conclusion

The current set of networks providing EV public charging in Vermont do not have consistent business models nor technologies that allow easy application of a per-kWh fee to nonresident drivers. Imposing collection of a per-kWh fee on public charging stations may disrupt business operations and create added capital and operational costs that may impede the profitability of commercial public charging stations but also impact the financial viability of free public charging stations.

Although this memorandum details a number of fairly difficult issues for resolution to enable the feasibility of collection of the per-kWh fee from nonresident EV drivers at public charging stations, the concept is worthy of testing. We therefore recommend that the Road Usage Charge Advisory Committee request the state legislature to direct the Vermont Agency of Transportation to undertake a limited-duration pilot demonstration of the concept of collecting a per-kWh fee from non-resident EV drivers at public charging stations.