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March 1, 2019

Judith Whitney, Clerk
Vermont Public Utility Commission
112 State Street
Montpelier, VT 05602

Re: Case No. 18-2660-INV Investigation into promoting the ownership and use of electric vehicles in the State of Vermont

Dear Ms. Whitney,

Plug In America appreciates the opportunity to contribute to Vermont's investigation of the issues surrounding the ownership and use of electric vehicles (EVs). Please accept for filing the Comments of Plug In America on "Rate Design and Grid Management" for the Commission's upcoming workshop of March 15, 2019.

EV Rate Design

As the PEV market grows, it is critical that utilities and regulators understand the tremendous impact electricity rate design will have on PEV adoption. Well-designed rates offer drivers incentives to charge at times that are optimal for the grid, reducing costs to the drivers and reducing electricity system costs for everybody. On the other hand, some rate designs are excessively punitive to PEV drivers. Plug In America recognizes the need for PEVs to pay their fair share according to the costs they impose on the electricity grid, and notes the potential for smart rate design to accurately reflect these costs while giving drivers the opportunity to save money and benefit all ratepayers.

Some utilities have offered EV-only time of use rates. Typically, these require a second utility meter, with its attendant costs (installation and an additional monthly customer charge). It is rare that the savings from time-of-use rates for the EV can make up the additional costs. As a result, EV-only time-of-use rates have low uptake.

More commonly, utilities will inform EV owners of the potential for whole-house time-of-use rates. Since PEVs often have considerable leeway in when they are charged (especially for at-home charging), TOU plans can offer considerable cost savings to PEV drivers while also reducing the costs they impose on the grid. For example, Georgia Power's "Super Off-Peak" rate is $0.01/kWh and extends from 11 pm to 7 am every day of the year. Experience shows that EV owners also typically shift some non-EV load to off-peak (low-cost) periods when they enroll in such a rate plan.

A "whole-house" TOU rate means that the customer's entire account is switched onto this plan. This may cause concerns that the customer will be unable to shift the load enough and will be economically impacted by using electricity during the peak period. For example, if somebody is home during the day, he/she may use more air conditioning during peak periods than a home with no one home mid-day. Where PEV drivers have the option to try TOU rates, Plug In America strongly supports the use of 'shadow billing' or 'bill protection'. These measures allow the customer to see their total bill under a flat rate plan and under a time-of-use plan. It may be employed before deciding to switch to the time-of-use plan and enables the customer to the decision with better information. The customer is able to pay a lower bill for a period of time while he/she learns how to adjust the electricity usage. California Senate Bill 1090 (of 2013-2014) allows utilities to implement time-of-using pricing as the default for residential customers, subject to the customer receiving one year of interval data and associated information prior to switching and one year of bill protection after switching.

A third option is to develop time-of-use incentives. Because incentives are not subject to the same regulatory requirements as billing, utilities have been able to offer time-of-use incentives without the installation of a second meter. Instead, the incentives may rely on the timing of charging as noted by the embedded meter in the charging station or in the vehicle. For example, Con Ed has been piloting such incentives using a device that connects to the vehicle's telematics port. Plug In America supports these innovative approaches to encourage EV-only TOU pricing without requiring a separate utility meter.

Real-time pricing employs finer gradations than time-of-use pricing, and more dynamic changes. In true real-time pricing, the consumer sees energy prices as the spot market does. An approximation of this was proposed in SDG&E's dynamic pricing pilot. In that program, customers received hourly electricity prices for the next day. Unlike standard TOU plans, this could account for day-to-day variation in renewable energy generation and grid demand, offering lower prices at times when there might be surplus energy available.

Time-varying rates will help inexpensive but relatively inflexible forms of generation. As more wind and solar comes on the grid, they stand to benefit from these rates. The long-term effect of a well-designed policy will be to align demand with abundant clean energy supply. For example, time-varying rates that are low at mid-day due to plentiful solar power will shift demand to that time of day, countering the "value erosion" that can occur with additions of new solar capacity. Workplace charging of PEVs represent an excellent load to take advantage of such rates.

Plug In America highly encourages utilities and regulators to adopt best practice policies for PEV charging rates and rate design as follows:

- We support offering the option of time-of-use pricing, to encourage PEV charging when it is best for the grid and least expensive for the driver;
- We oppose forcing PEV drivers onto TOU rates;
- We support the option of PEV-only TOU, using submetering or time-of-use incentives, as some PEV drivers may not be comfortable with whole-house TOU;
- We support innovative means to reduce the metering cost for PEV-only TOU;
- Where whole-house TOU is used, we support 'shadow billing' and 'hold harmless' provisions to enable PEV drivers to become familiar with the tariff and the means to shift their loads;
- We support shifting DCFC systems onto energy (kWh) based rate tariffs and reducing demand charges;
- For DCFC and industrial or commercial accounts with PEV chargers, we support emphasizing time-varying rates over kW-based demand charges as a means of system cost recovery.

Demand Charges and DCFC

DC fast charging (DCFC) represents a small but essential component of PEV charging infrastructure. It enables PEVs to do road trips beyond their battery range. Even with many vehicles now having 200-300 miles of range, there will still be some trips that require recharging along the way. In addition, those PEV drivers that do not have a garage or a dedicated parking space, such as those who live in multi-unit dwellings or apartment buildings, may rely on DCFC to charge.

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Demand charges are present in most industrial and large commercial rates. They are based on the maximum instantaneous power draw (kW) by a customer. The timing of an individual load's peak may or may not line up with the overall system peak. Demand charges are particularly difficult for DCFC systems, which can have high peak power but low utilization in public charging. Numerous states have implemented rate relief for DCFC, shifting them on to tariffs with a higher cost per kWh but no demand charges, for a period of several years. Pilot programs in Hawaii and Connecticut have removed demand charges for DCFC five years. Pacific Power in Oregon removed them and installed a ten-year ramp to phase demand charges back in. Southern California Edison and the New York Power Authority have also implemented or proposed temporary phaseouts of demand charges. Plug In America strongly supports moving DCFC off of demand charge tariffs while utilization is low.

Switching DCFC systems to non-demand-metered tariffs will maintain these systems' viability while the PEV market grows. The current utilization rates of DCFC make demand charges excessively disadvantageous. Even when the market grows and utilization increases, returning to demand charges as the primary tool of recouping system costs may not be appropriate. Rather, Plug In America considers that time-varying rates will be a better means of addressing system impacts than solely kW-based demand charges. A combination of these rate design elements may be appropriate in some cases. An individual load's peak demand may not align with the system peak; non-coincident peak demand does not impose as many costs on the grid.

Pacific Gas & Electric has proposed a subscription plan for public DC fast chargers that would result in lower demand charges. Because this is a time-of-use plan, it would be more suitable for fleets than for DCFC along travel corridors, where drivers have less discretion in their time of charging. PG&E estimates station owners might pay approximately $0.23/kWh under this plan once all costs are considered. Of course, the capital cost of the station would be in addition to this.

New York recently approved a utility plan to support DCFC development, giving owners of new DCFC a per-plug incentive that declines over time from 2019 through 2025. This would have a similar effect to reducing and then gradually increasing demand charges. There would be higher incentives for stations that can supply 75 kW or more, to encourage deployment of faster DCFC. We support this concept in general, although have concerns about the restriction of the incentive to new stations; many existing ones are not profitable at current levels of utilization. Maintaining these stations' viability is as important as expanding the infrastructure.

Plug In America highly encourages utilities and regulators to adopt best practice policies for DCFC as follows:

- We support shifting DCFC systems onto energy (kWh) based rate tariffs and removing demand charges;
- For DCFC and industrial or commercial accounts with PEV chargers, we support time-varying rates over kW-based demand charges as a means of system cost recovery;
- We support innovative plans such as with California's PG&E and in New York to alleviate the burden of demand charges on third-party DCFC;
- We support prudent investments by utilities in DCFC, particularly in areas where the stations are needed for travel corridors but the economics are not favorable for third-party investment;
- Where possible, we encourage DCFC owners to take the long view when setting prices, as low prices now will lead to increasing utilization and ultimately greater revenue.

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Vehicle-Grid Integration

If all light-duty vehicles were to be electric, U.S. energy consumption would increase by about 25%. This estimate is based on 3 trillion light-duty vehicle-miles traveled per year, 3 miles per kWh, and current electricity consumption of about 4 trillion kWh per year. As a rule of thumb, the percentage of EV penetration in the light-duty fleet can be divided by 4 to give the increase in electricity consumption. If 20% of light-duty vehicles were EVs, they would increase overall electricity consumption by about 5%. Medium- and heavy-duty vehicles will represent additional load.

We are not aware of any constraints imposed on the electricity system by EVs' near- and medium-term *energy* demand (kWh). We do realize that EVs' *power* demand (kW) could have local and grid-scale impacts. Therefore, Plug In America supports using rate design to incentivize off-peak charging. There is already sufficient intelligence in the vehicles to schedule charging, and smart meters at most homes in Vermont. Therefore, it would be possible to use price signals to encourage off-peak charging.

Plug In America recommends that Vermont adopt a Vehicle Grid Integration Strategy, to prudently plan for expanded PEV adoption and to permit (but not require) vehicles to use smart charging to benefit the grid;

Managed Charging and Storage

Improvements in battery technology have led to greater interest in using batteries to support the electricity system. This has become particularly important with the increasing deployment of wind and solar power. These forms of renewable energy have increased so much that, at times, they produce more electricity than some local grids need, even driving wholesale prices negative. Batteries can absorb the surplus renewable electricity, then return it to the grid during times of peak demand.

Another option is to move the demand to times when there is an over generation of renewable energy. Utilities can encourage energy consumption at predictable times of renewable energy surplus with time-of-use (TOU) rates, or during more unpredictable real-time events with programs like real-time pricing (as SDG&E proposed) or PG&E's Excess Supply Pilot.

Flexible loads such as PEVs, electric water heaters, commercial ice chiller air conditioners and agricultural water pumps all have some leeway as to when they take power from the grid. Given the right price signals, these flexible loads can shift demand away from peak periods to times of surplus renewable electricity. In California, this might be late morning and early afternoon hours when solar power is creating a 'duck curve.' In the Great Plains, this might be hours at night when wind is blowing but demand is low. Flexible loads can also reduce demand or provide other 'grid services' such as frequency regulation, voltage support and other products that provide financial benefits. None of these flexible loads (with the exception of PEVs configured for vehicle-to-grid) send electricity back to the grid. While this limits their functionality compared to dedicated storage (which effectively shifts supply and demand), it also limits installation and interconnection costs.

In addition to demand shifting (which may be readily accomplished through time-of-use rates), more advanced forms of vehicle-grid integration can perform frequency regulation, demand response, and other grid services. These have been demonstrated in many pilots and could help with short-term fluctuations on the grid due to variable renewable energy. The technical performance of EVs in such pilots is generally outstanding, as "smart loads" can react to grid conditions very quickly and accurately.

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However, these pilots do not yet show a path to monetizing the value of this demand flexibility. In addition to the need for more sophisticated communication systems, there are transaction costs, resource certification fees, integration with ISO systems, staff time, and other "soft costs". In aggregate, these costs exceed the economic value of grid services provided. Additionally, the grid services markets are small and quickly saturated.

It is possible that more advanced grid services could provide value to EVs in the long term – longer than the lifetime of EVSE installed now. For the systems to be installed in the next few years, we encourage Vermont to focus on and incentivize accessibility, visibility, reliability, and cost. Managed charging should focus on demand shifting through time-of-use pricing. However, should market participants wish to attempt more advanced VGI interactions, we encourage Vermont to help them reduce the "soft costs" of doing so. We do support allowing the inclusion of EVSE in utility demand response programs in the hopes of gaining experience and reducing these costs, as long as driver needs take priority.

Plug In America offers the following recommendations:

- For the systems to be installed in the next few years, we encourage Vermont to focus on and incentivize accessibility, visibility, reliability, and cost;
- Managed charging should focus on demand shifting through time-of-use pricing;
- Should market participants wish to attempt more advanced VGI interactions, we encourage Vermont to help them reduce the "soft costs" of doing so;
- Utilities should be permitted to include PEVs within demand response programs; and,
- Driver needs must take priority over the fairly modest revenue that can be garnered from participation in grid services markets.

Relationship Between Dedicated Storage and EV Charging

Several states have adopted or proposed energy storage targets or mandates, including California, Oregon, Massachusetts, New York, Arizona, and Nevada. Should Vermont choose to follow suit, Plug In America recommends that flexible loads be eligible for such programs, including PEVs enrolled in "smart charging" programs. Even if the rebate or incentive levels are not identical to those of dedicated stationary batteries, flexible loads should be eligible for incentives, and should count as partial credit towards state goals.

If PEVs cannot compete with dedicated grid batteries in the grid services markets due to mandates, then another opportunity arises: incorporating those mandated stationary batteries into high-speed charging systems.

A DC fast charger draws a substantial amount of electricity – typically at least 50 kW, though sometimes up to 150 kW and even up to 350 kW. These high powered charging stations are likely to be utilized for electric trucks, or ride-sharing services that will want vehicles to charge quickly to maximize availability, whether the vehicles are driven by humans or are autonomous. This high power draw leads to considerable installation costs and high demand charges. Batteries provide a way to mitigate both of these costs. The battery can be charged by drawing power at a lower power rate over a long period of time, while providing high power output for short periods of time when needed.

This approach does require good advance knowledge of the likely utilization rate of the DCFC; storage is best for low-to-moderate -utilization systems. As a system increases in utilization rate, the battery will not be able to reduce demand charges as much, but can continue to provide other grid benefits.

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Batteries integrated into DCFC can qualify for rebates under storage mandates, provide grid services, and also limit the cost of DCFC grid connection and operation. Such projects have been installed by Tesla, Greenlots, ChargePoint, and others.

Plug In America encourages utilities and regulators to adopt best practice policies that recognize the role PEVs have to play as flexible loads under storage mandates and targets. These include:

- Consider 'Smart Charging' of PEVs and other flexible loads when developing energy storage goals, targets, and mandates (if any);
- Credit flexible loads appropriately given their capability of achieving the goals of the energy storage targets (such as better alignment of supply and demand);
- Allow flexible loads to compete against stationary energy storage systems in providing grid services;
- Consider incentivizing incorporation of storage into publicly-supported EVSE where doing so would reduce installation costs, demand charges, or other expenses; and,
- Allow such storage to generate multiple revenue streams.

Submetering

Given a normally distributed error, it does not seem that falling outside the strict accuracy requirements of utility-grade meters is problematic. Only if there were a directional bias would the error be unfair to either the driver or the utility. Even so, it is our understanding that the meters in the vehicles and the EVSE are highly accurate. They may not meet all of the other (non-accuracy) requirements that Vermont imposes on utility meters, such as display requirements. We support developing a pilot to test submetering approaches for EV-only time-of-use rates.

Thank you for the opportunity to provide these comments. Please do not hesitate to contact me with any questions.

Best regards,

Peter O'Connor

Pete O'Connor
Policy Specialist
Plug In America