BEFORE THE NORTH CAROLINA UTILITIES COMMISSION
DOCKET NO. E-2, SUB 1219

In the Matter of:	**)**
Application of Duke Energy Progress,	**)**
LLC for Adjustment of Rates and	**)**
Charges Applicable to Electric Service	**)**
in North Carolina	**)**

DIRECT TESTIMONY OF JUSTIN R. BARNES ON BEHALF OF NORTH CAROLINA SUSTAINABLE ENERGY ASSOCIATION

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Apr 13 2020

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I. INTRODUCTION

Q. PLEASE STATE YOUR NAME, BUSINESS ADDRESS, AND CURRENT POSITION.

A. My names is Justin R. Barnes. My business address is 1155 Kildaire Farm Rd., Suite 202, Cary, North Carolina, 27511. My current position is Director of Research with EQ Research LLC.

Q. ON WHOSE BEHALF ARE YOU SUBMITTING TESTIMONY?

A. I am submitting testimony on behalf of the North Carolina Sustainable Energy Association ("NCSEA").

Q. HAVE YOU PREVIOUSLY SUBMITTED TESTIMONY BEFORE THE NORTH CAROLINA UTILITIES COMMISSION ("THE COMMISSION")?

A. Yes. I submitted testimony on behalf of NCSEA in Docket No. E-7, Sub 1146 on the Duke Energy Carolinas, LLC's ("DEC") 2017 general rate case application, in Docket No. E-2, Sub 1142 on the Duke Energy Progress, LLC's ("DEP" or "the Company") 2017 general rate case application, and in Docket No. E-7, Sub 1214 on the DEC 2019 general rate case application.

Q. PLEASE DESCRIBE YOUR EDUCATIONAL AND OCCUPATIONAL BACKGROUND.

A. I obtained a Bachelor of Science in Geography from the University of Oklahoma in Norman in 2003 and a Master of Science in Environmental Policy from Michigan Technological University in 2006. I was employed at the North Carolina Solar

Center at N.C. State University for more than five years as a Policy Analyst and Senior Policy Analyst.[1] During that time I worked on the *Database of State Incentives for Renewables and Efficiency ("DSIRE")* project, and several other projects related to state renewable energy and energy efficiency policy. I joined EQ Research in 2013 as a Senior Analyst and became the Director of Research in 2015. In my current position, I coordinate and contribute to EQ Research's various research projects for clients, assist in the oversight of EQ Research's electric industry regulatory and general rate case tracking services, and perform customized research and analysis to fulfill client requests.

Q. PLEASE SUMMARIZE YOUR RELEVANT EXPERIENCE AS RELATES TO THIS PROCEEDING.

A. My professional career has been spent researching and analyzing numerous aspects of federal and state energy policy, spanning more than a decade. Throughout that time, I have reviewed and evaluated trends in regulatory policy, including trends in rate design and utility regulation. For example, as part of my current duties overseeing EQ Research's general rate case tracking and regulatory tracking services, I have reviewed dozens of utility rate design proposals and the associated regulatory determinations.

I have submitted testimony before utility regulatory commissions in Colorado, Hawaii, Georgia, New Hampshire, New York, Oklahoma, South Carolina, Texas, Utah, and Virginia as well as to the City Council of New Orleans,

[1] The North Carolina Solar Center is now known as the North Carolina Clean Energy Technology Center.

on various issues related to clean energy policy, rate design, and cost of service.[2] These individual regulatory proceedings have involved a mix of general rate cases and other types of contested cases. My *curriculum vitae* is attached as **Exhibit JRB-1**. It contains a full list of proceedings where I have submitted testimony and related information such as docket numbers and the subject matter addressed.

Q. PLEASE DESCRIBE THE PURPOSE OF YOUR TESTIMONY AND HOW IT IS ORGANIZED.

A. The purpose of my testimony is to propose that the Commission direct DEP to establish electric vehicle ("EV") specific rates for both home charging and commercial charging applications. I use the term "EV-specific rates" throughout my testimony to refer to rate options that apply to separately metered EV charging loads to the exclusion of any other loads on the premises. In Section II of my testimony, I discuss in general why EV rates hold benefits for DEP's ratepayers as a whole and general principles for their design. In Section III, I describe the shortcomings in current residential rate options for EV charging and make my residential EV rate proposal. In Section IV, I discuss and make recommendations for non-residential EV rate options. Section V contains my concluding remarks.

Q. WHAT ARE YOUR RECOMMENDATIONS TO THE COMMISSION?

A. First, I recommend that the Commission direct DEP to, within 60 days of a final order, file separate, targeted EV-specific tariffs for both residential and non-

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[2] The City Council of New Orleans regulates the rates and operations of Entergy New Orleans in a manner equivalent to state utility regulatory commissions.

residential dedicated EV charging. These tariffs should reflect core characteristics that are consistent with effective EV rates that I discuss in my testimony. The Commission should allow a comment period on these tariffs but generally seek to expedite their approval and deployment as soon as possible.

Second, I recommend that the Commission establish an investigatory docket to receive further information and permit further discussion of EV-specific rates, lessons learned, and potential refinements. DEP should be directed to file quarterly reports updating the Commission and parties on deployment status, tariff enrollment, ratepayer savings, system cost savings, and any other information that the Commission deems relevant to support evaluation of the tariffs and their future evolution. If the Commission adopts the recommendation for a comprehensive rate design study made by Public Staff Witness Floyd in DEC's pending rate case, the investigatory docket could become part of this larger review.

Finally, I recommend that any rates established pursuant to a Commission decision remain available, at a minimum, until any successors or replacements are adopted pursuant to the system of Commission review that I recommend. As reflected in my recommendations for non-residential EV-specific rate characteristics, the duration should also reflect the certainty needed for ratepayers that make large investments in higher powered charging equipment such as Direct Current Fast Chargers ("DCFCs").

Q. WHAT IS YOUR RECOMMENDATION FOR THE ESTABLISHMENT OF A RESIDENTIAL EV-SPECIFIC RATE?

A. I recommend that existing Schedule R-TOU be made available for submetered home EV charging with a modest submetering charge in place of the tariffed Basic Facilities Charge ("BFC"). The amount of the submetering charge should consider the incremental costs of the additional metering as well as the impact that the charge would have on cost savings for the EV owner in order to ensure that the additional cost of taking submetered service does not create a barrier to enrollment.

With the exception of not being available for submetered use, Schedule R-TOU already contains several characteristics that are supportive of home EV charging, as follows:

1. Three pricing periods and short duration on-peak periods;
2. A price differential between the off-peak rate and the otherwise applicable flat rate that should be sufficient to produce meaningful bill savings for EV charging, taking into account a modest incremental metering charge and a typical amount of home EV charging; and
3. An off-peak pricing period with a duration of at least eight hours that allows ample time for low voltage charging to produce a battery charge sufficient for a reasonable length trip or commute.

Q. WHAT IS YOUR RECOMMENDATION FOR THE ESTABLISHMENT OF A NON-RESIDENTIAL EV-SPECIFIC RATE?

A. I recommend that a rate or rates for submetered and standalone EV charging be established for non-residential ratepayers under a design that features time variation and mitigates the outsized effects that demand charges have on charging costs. More specifically, the rate or rates should:

1. Address the issues presented by demand rates for non-residential EV charging installations by doing one or both of the following: (a) modifying Schedule SGS-TOUE to permit submetering for EV loads and eliminating or relaxing the maximum demand-based availability limitations currently contained in Schedule SGS-TOUE for EV load, or (b) applying a demand charge limit to Schedules SGS-TOU and LGS-TOU that caps demand charges at an implied maximum volumetric rate, or alternatively, a percentage of the ratepayer's monthly bill;
2. Use the otherwise applicable BFC for standalone charging stations and a submetering charge in place of the BFC for charging units located behind an existing meter; and
3. Remain available to participants for ten years from the date of their enrollment in order to provide a reasonable level of investment certainty to prospective equipment owners.

My testimony also discusses two other options for mitigating the punitive effects that demand rates can have on high voltage EV charging equipment owners:

(a) allowing multiple meters serving EV load to be aggregated for the purpose of determining demand charges, and (b) basing demand charges on the sum of daily maximum demand rather than monthly maximum demand. Due to the relatively more novel nature and additional complexity of these options I do not recommend that they be adopted at this time. However, the Commission should consider both as longer-term options as it pursues future refinements.

Q. PLEASE EXPLAIN THE PRACTICE OF SUBMETERING AS REFERRED TO IN YOUR RECOMMENDATIONS.

A. The measurement of EV load as separate from other load located on the same premises can be accomplished with an additional dedicated electricity meter or with a submeter installed between the existing meter and the EV charger. Submetering can be less costly than the installation of a separate revenue grade meter and associated equipment (e.g., a new meter socket, conduit, etc.). The relatively lower costs mitigate the potential for incremental metering costs to become a barrier to enrollment in the rate.

II. RATIONALE AND JUSTIFICATION FOR EV-SPECIFIC RATES

Q. PLEASE EXPLAIN THE DIFFERENCE BETWEEN AN "EV RATE" AND AN "EV-SPECIFIC RATE" AS YOU USE THE TERMS IN YOUR TESTIMONY.

A. EV-specific rates are a sub-genre of EV rates. As I use the term, an EV rate refers to any rate that is applicable only to ratepayers with an EV charging load. An EV-specific rate refers to a rate that is applied exclusively to EV charging load as opposed to any other electric load that exists on a premises. An EV-specific rate requires the EV load to be separately measured. Both types of rates may have a place in supporting transportation electrification, but EV-specific rates have the potential to be more targeted so as to take advantage of the unique usage patterns and flexibility that characterize EV loads relative to whole home or building loads.

Q. PLEASE ELABORATE ON THE MERITS OF EV-SPECIFIC RATES RELATIVE TO EV RATES AND THE IDEA OF "TARGETING" WITHIN EV-SPECIFIC RATES.

A. The merits of EV-specific rates and targeting are best illustrated by examples. For instance, a declining block whole home rate that is available only for ratepayers with an EV qualifies as an EV rate and could potentially reduce costs for EV owners and support EV adoption. However, it would not take advantage of ratepayers' ability to manage their charging behavior in a manner that reflects the time-varying costs of electric service.

Furthermore, within the definition I use for an EV-specific rate is a further sub-genre of rates that are *specifically designed* to take *full* advantage of the unique attributes of EV load (i.e., targeted EV-specific rates). For instance, a generally available time-varying rate that can be used for submetered EV load is an EV-specific rate. However, such a rate may display characteristics such as simplified peak and off-peak windows and/or minimal rate spreads that reflect the challenges of managing whole home or whole building use. This fails to take advantage of relatively greater flexibility and controllability of home EV charging relative to other loads. Alternatively, a non-residential rate adapted for EV submetering may still reflect a pass-through of more generally deployed rate designs such as demand-based charges in a way that creates barriers for EV charging.

Q. WHY WOULD THE DEPLOYMENT OF EV RATES BE BENEFICIAL TO THE STATE OF NORTH CAROLINA AND DEP RATEPAYERS?

A. There are several reasons. First, well-designed EV rates encourage EV owners to charge their vehicles during off-peak times. Off-peak charging helps mitigate the potential that growing EV load could exacerbate peak demands and create additional costs, and in doing so can improve system load factor. Second, EV-specific rates could potentially be used to help mitigate "duck curve" issues that can arise due to the combination of low loads and high solar generation during some parts of the year. This can play a role in avoiding renewables curtailment and more generally concentrating load at times of low marginal greenhouse gas emissions.

Well-designed EV rates also produce cost savings for EV owners relative to what they might otherwise pay under a standard rate. Cost savings are directly beneficial to EV owners and could also be seen as a generally fairer outcome under circumstances where a large portion of EV charging is expected to occur during off-peak hours anyway due to EV owners' work and personal schedules. Finally, potential cost savings are an important consideration for ratepayers considering purchasing an EV or installing charging equipment. The development of greater charging accessibility is a critical element in transportation electrification. In turn, EV rates are an important element in increasing the availability of cost-effective charging options in homes, and perhaps even more importantly, in public settings.

Ultimately, strategic use of rate structure can be a more scalable support mechanism for EV deployment than "programmatic" solutions, which tend to be inherently limited in size. Programmatic solutions certainly still have a place in transportation electrification, such as targeting specific sectors or barriers. Rate structure, on the other hand, is a critical tool for transforming the broader market.

Q. HOW DOES NORTH CAROLINA POLICY ADDRESS TRANSPORTATION ELECTRIFICATION?

A. North Carolina has not established any statutory mandates or guidance on transportation electrification. However, the North Carolina Clean Energy Plan stemming from Executive Order 80 (2018) ("EO 80") recommends that utilities be required to develop innovative rate design pilots for EVs to encourage off-peak charging and test the effectiveness of different rate structures at shifting energy usage.[3] EO 80 itself sets a goal of achieving 80,000 registered zero-emission vehicles in the state by 2025.[4]

Q. IS IT NECESSARY FOR THE COMPANY TO CONDUCT FURTHER STUDY OF CHARGING BEHAVIOR BEFORE DEPLOYING EV-SPECIFIC RATES?

A. No. The charging behavior of EV owners under a generally applicable pricing regime would not be representative of their charging behavior under a well-designed EV rate. If one makes the reasonable assumption that EV charging will in the future take place principally, or even entirely, under time-varying rate designs, an analysis of EV charging under traditional rates that are not designed for EV charging is not predictive of the long-term impacts of EV charging.

Q. WOULD IT MAKE SENSE TO DELAY ADOPTING EV RATES IN ORDER TO STUDY EV CHARGING BEHAVIOR UNDER TRADITIONAL RATES?

No, delaying analysis of charging behavior under rates designed specifically for EV charging while studying charging behavior under traditional rates would only delay the results of a comparative analysis. There is no reason why both sets of evaluations could not be undertaken concurrently if the goal is to reach conclusions on the effects that rate design has on EV charging behavior.

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[3] North Carolina Clean Energy Plan. October 2019. p. 137. Available at: https://files.nc.gov/governor/documents/files/NC_Clean_Energy_Plan_OCT_2019_.pdf

[4] N.C. Exec. Order No. 80 (October 29, 2018), https://files.nc.gov/governor/documents/files/EO80-%20NC%27s%20Commitment%20to%20Address%20Climate%20Change%20%26%20Transition%20to%20a%20Clean%20Energy%20Economy.pdf.

Q. IN DOCKET NO. E-7, SUB 1214, DEC'S GENERAL RATE CASE, PUBLIC STAFF WITNESS FLOYD RECOMMENDED THAT THE COMMISSION ORDER A COMPREHENSIVE RATE DESIGN STUDY TO ADDRESS MANY RATE MODERNIZATION ISSUES, INCLUDING EV RATES. DO YOU AGREE WITH THIS RECOMMENDATION IN THE CONTEXT OF EV RATE DEPLOYMENT IN DEP'S SERVICE TERRITORY?

A. I agree with Witness Floyd that a comprehensive rate design study would be worthwhile, and also that it would be a "lengthy undertaking" that "takes a significant amount of time to develop, as well as to implement."[5] While it is not clear to me what sort of timeline Witness Floyd envisions for the deployment of new rate options, I do not think that conducting a lengthy, all-encompassing study is necessary or advisable prior to making EV-specific rates available in some form. To the extent that Witness Floyd's recommendation would result in such a delay, I respectfully disagree with that aspect.

Q. PLEASE ELABORATE ON WHY AN EXTENDED STUDY PERIOD IS NOT NECESSARY OR ADVISABLE AS A PRECURSOR TO EV RATE DEPLOYMENT.

A. My concern is that such a study and associated stakeholder processes could easily extend several years. By that point, North Carolina is likely to be well behind the curve with respect to EV rate and infrastructure deployment, to the detriment of the

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[5] *Testimony of Jack L. Floyd on Behalf of the Public Staff – North Carolina Utilities Commission*, p. 24, ll. 9-18, Docket No. E-7, Sub 1214 (February 18, 2020).

potential near-term benefits to ratepayers and achieving the EO 80 goal of 80,000 zero-emission vehicles by 2025.

In addition, while an extended study process is appropriate for considering an overarching re-design of DEP's and DEC's respective rates, it is not necessary for the deployment of EV-specific rates because the shortcomings of current rate options are very basic and do not raise the same issues as a broader re-design of rates. For home charging, the basic problem is that customers do not have access to a time-varying rate option that does not require them to take whole home time-varying service. For non-residential charging, the basic problem is the outsized impacts that demand charges have on the cost of EV charging, in particular DCFC. Both issues can be mitigated in the near term through relatively simple changes. I discuss these issues and my recommended near-term solutions in more detail in subsequent sections of my testimony.

Finally, a broader re-design of rates that is undertaken to establish durable solutions would benefit from the information gleaned from the deployment of EV-specific rates in the near term. As I observed previously, at present we lack data on EV charging behavior under EV-specific rates in DEP's (and DEC's) service territories. While considerable insight can be gleaned from evaluating the results of studies performed in other jurisdictions, more recent and more targeted data certainly would not hurt for the purpose of refining EV rate options.

Q. HOW SHOULD THE COMMISSION VIEW REVENUE AND COST IMPACTS AND THE POSSIBILITY FOR CROSS-SUBSIDIES TO OCCUR?

A. The averaging nature of rates ensures that intra-class subsidies will exist within any rate. Under averaged rates, no ratepayer pays their exact cost of service, even if that amount could be determined with precision. The same is true for inter-class cost of service relationships. Furthermore, when designing rates that target a specific type of new load and seek to direct ratepayer behavior, it is unavoidable that mismatches will occur between costs and revenue and the distribution of both among ratepayers as a whole.

While such issues bear attention, the magnitude of EV load at present and in the near future is small relative to other loads. As a consequence, the scale of any mismatches that do exist is bound to be small as well. In any case, it is not possible to know how costs and revenue align without the information gleaned from deployment and evaluation of EV rates. Class averages that might be applied to make a whole-site load rate theoretically revenue neutral cannot be applied to new EV load. In addition, as I previously observed, charging behavior under traditional rates is not an accurate predictor of charging behavior under an EV rate. Ultimately, revenue and cost distribution uncertainties are unavoidable, and they should not function as a pretext for delaying the deployment of EV-specific rates. Allowing them to do so amounts to creating a Catch-22 where assembling the information on which to base future decisions is prevented by a failure to establish means by which the information can be gathered.

Q. GIVEN THESE UNCERTAINTIES, HOW SHOULD THE COMMISSION ATTEMPT TO ENSURE THAT EV-SPECIFIC RATES ARE LIKELY TO BENEFIT RATEPAYERS AS A WHOLE?

A. The design of EV-specific rates should have a solid foundation in time-varying marginal costs in recognition of the fact that new EV load, if well-managed, need not contribute to additional costs driven by peak demands. It is my understanding that DEP does not study the marginal costs of transmission and distribution. However, the pricing periods in existing rates, and in Schedule PP,[6] reflect the time-varying nature of energy and capacity costs and can serve as a guide for defining higher cost and lower cost time periods. For instance, transmission costs are driven by the same system-wide peak demands as generation capacity costs, even if a marginal transmission cost is not studied itself. As long as the pricing periods for an EV-specific rate are generally aligned with established pricing periods, they should be aligned with the additional costs of EV charging at different times. From the standpoint of new load, as long as the rate a ratepayer pays is at or above the marginal cost, other ratepayers are indifferent or accrue benefits.

[6] Schedule PP contains time-varying rates for the purchase of energy and capacity from small power production facilities. Those pricing periods have been updated more recently than the pricing periods used for existing time-varying retail rates.

III. RESIDENTIAL EV RATE OPTION

Q. WHY ARE EV-SPECIFIC RATES IMPORTANT FOR RESIDENTIAL RATEPAYERS?

A. Viable home charging options are important for residential EV owners because the vast majority of residential EV charging occurs at home. A 2015 study by the Idaho National Laboratory examined the charging habits of Americans, and found that a typical driver charges their EV at home 84-87% of the time.[7] While it is plausible, and even likely, that the availability of public or workplace charging options could diminish the amount of home charging, it is difficult to envision any near-term scenario where home charging does not comprise a large portion of residential EV charging. Home charging is simply highly convenient and likely to remain so.

Q. DOES DEP CURRENTLY OFFER AN EV-SPECIFIC CHARGING RATE FOR RESIDENTIAL RATEPAYERS?

A. No.

Q. IS DEP PROPOSING AN EV-SPECIFIC CHARGING RATE FOR RESIDENTIAL RATEPAYERS IN THIS RATE CASE?

A. No.

[7] Idaho National Laboratory, "Plugged In: How Americans Charge Their Electric Vehicles," 2015. Available at: https://avt.inl.gov/sites/default/files/pdf/arra/PluggedInSummaryReport.pdf.

Q. IS DEP PROPOSING AN EV-SPECIFIC CHARGING RATE FOR RESIDENTIAL RATEPAYERS IN ANY OTHER FORUM?

A. No. DEP's transportation electrification proposal includes proposed tariffs for each EV pilot program, but it does not propose new residential rate designs for EV charging as a component of these tariffs. For example, the Residential EV Charging Program tariff would provide certain incentives for residential Level 2 EV charging, but usage would still be "billed under the applicable residential schedule." These tariffs would also be limited to the size and duration of the EV pilot programs.[8]

Q. WHAT RATE OPTIONS ARE CURRENTLY AVAILABLE FOR A PROSPECTIVE RESIDENTIAL EV OWNER?

A. DEP's residential ratepayers can choose from several rate schedules. The generally-available rate options and their basic rate designs are as follows:

- Schedule RES – Includes a monthly BFC and flat seasonal energy charges with a slightly lower rate during winter months.
- Schedule R-TOU – Includes a monthly BFC and seasonal time-varying energy charges under a three-period design (on-peak, shoulder, and off-peak), with fairly sizable rate spreads between rates for each pricing period.

[8] *Duke Energy Carolinas, LLC and Duke Energy Progress, LLC's Application for Approval of Proposed Electric Transportation Pilot*, Docket Nos. E-2, Sub 1197 and E-7, Sub 1195 (March 29, 2019).

- Schedule R-TOUD – Includes a monthly BFC, seasonal on-peak demand rates, and time-varying energy charges with a modest rate spread between peak and off-peak rates under a two-pricing period design (on-peak and off-peak).

Q. WHAT FACTORS ARE IMPORTANT FOR DESIGNING EV-SPECIFIC RATES THAT ENCOURAGE RESIDENTIAL ENROLLMENT?

A. Both the price differential between peak and off-peak rates, as well as the duration of off-peak period windows are important for encouraging residential EV owner enrollment. The price differential refers to the difference between the applicable rate for off-peak usage compared to the applicable rate for on-peak usage, and can also be expressed as a ratio. The price differential or ratio needs to be sufficiently large to result in meaningful changes in ratepayer charging behavior. The larger the price differential, the more the ratepayer is incentivized to conduct EV charging during off-peak periods and avoid charging during on-peak periods.

A 2018 presentation from the Brattle Group summarizing residential EV rate options from U.S. utilities indicates the median summer season price ratio is greater than 3:1 and the median winter season price ratio is well above 2:1, with larger average price ratios for three-period TOU rates compared to two-period TOU rates. When comparing the peak rate to the lowest available off-peak rate, the median price differential for the summer season is $0.17/kWh for two-period TOU rates and $0.28/kWh for three-period TOU rates. Price differentials are lower during the winter season, averaging $0.09/kWh and $0.12/kWh for two-period and three-or-more-period TOU rates.[9] A more recent report from the Smart Electric Power Alliance ("SEPA") shows a median differential ratio of 3.6:1 and a median price differential of $0.20/kWh.[10]

The duration of the peak and off-peak windows is also important because EV owners must have an off-peak charging window that is long enough achieve a sufficient charge for commutes or normal daily driving. A common rate design for residential EV-specific rates is to incorporate an off-peak window that allows EV charging to occur overnight, allowing residential EV owners to charge their vehicle in advance of a morning commute. Nearly all residential EV rates use an off-peak charging window of at least six hours. The median off-peak window for residential EV-specific rates is 8 hours for both the summer and winter seasons, although some rates have off-peak periods for up to 16 hours.[11]

The charging duration necessary for an individual EV owner depends on the ratepayer's driving needs, charging equipment, and access to charging outside of the home. Table 1 shows the broad characteristics of different types of EV charging equipment.

[9] Ahmad Faruqui, Ryan Hledik, and John Higham. "The State of Electric Vehicle Home Charging Rates." October 15, 2018. Attached as **Exhibit JRB-2**.
[10] SEPA. "Residential Electric Vehicle Rates that Work." November 2019. Attached as **Exhibit JRB-3**.
[11] **Exhibit JRB-2**. The rates used to develop these statistics appear to include a significant percentage of rates that apply to the entire residence. The survey includes 31 unique rate offerings, 18 of which are whole home rates, 8 of which are exclusively for EV charging, and 5 of which can be used either on a whole home or EV-specific basis.

Table 1: Types of EV Chargers[12]

Type	Voltage (V)	Capacity (kW)	Minutes to Supply 80 Miles of Range
Level 1	120 V	1.4 - 1.9	630 - 860
Level 2	240 V	3.4 - 20	60 - 350
Level 3 (DCFC)	480 V	50 - 400	3 - 24

The added charging speed associated with Level 2 charging comes at a cost in terms of the price of the charging equipment, and any possible electric upgrades necessary to accommodate the additional load. The price differential is critical for producing ratepayer savings that can help offset incremental EV costs and the costs of higher capacity charging equipment.

Q. WHAT ARE THE MERITS OF A RATE DESIGN WITH THREE PRICING PERIODS RELATIVE TO ONE WITH ONLY TWO PRICING PERIODS?

A. Greater granularity of pricing periods provides a more accurate reflection of the time-varying nature of the cost of electric service. In particular, a three-period rate design typically enables shorter duration peak periods that correspond to hours of particularly high demand. The relative flexibility and controllability of EV loads lends itself to a more complex rate design than what might be attractive to customers if applied to whole home or whole building loads.

In the context of EV charging, shorter duration peak periods help avoid circumstances where a small amount of non-off-peak charging produces an

[12] Garrett Fitzgerald and Chris Nelder. "From Gas to Grid: Building Charging Infrastructure to Power Electric Vehicle Demand." Rocky Mountain Institute, 2017. p. 33. Available at: https://rmi.org/wp-content/uploads/2017/10/RMI-From-Gas-To-Grid.pdf. Attached as **Exhibit JRB-4**.

incremental cost increase that offsets the cost savings of a much larger amount of off-peak charging. This phenomenon is highly pronounced for rates with a demand component, but can also be present under fully volumetric rates if the difference between an otherwise applicable flat rate and the on-peak rate is significantly larger than the difference between the flat rate and the off-peak rate. A shorter duration peak period makes it easier to avoid peak charges even if an EV owner occasionally needs to charge a vehicle during non-off-peak hours (*e.g.,* during the daytime). A mid-peak or shoulder rate applicable to periods of intermediate demand can send a moderated price signal that avoids significantly rewarding or penalizing charging that takes place during medium demand periods.[13]

Q. IS IT IDEAL FOR RATEPAYERS WITH EVS TO CHARGE THEIR VEHICLES ONLY DURING OFF-PEAK PERIODS?

A. Of course it is, but that may not be practical for all EV owners at all times. EV charging loads can be highly flexible, but that does not make them infinitely flexible. From time to time, an EV owner may need to charge their vehicle during peak periods. For instance, a 2018 report by Synapse Energy Economics ("Synapse") notes that EV-specific rates offered by California investor-owned utilities ("IOUs") have been highly successful at encouraging off-peak charging, but not 100% successful. Synapse's analysis showed that 93% of charging on occurred during off-peak hours for Pacific Gas and Electric's EV-specific rate

[13] Depending on the underlying cost structure and pricing period design, the "middle" pricing period could have a small premium or a small discount relative to a flat rate. The shoulder rates in DEP Schedule R-TOU have a small premium relative to the flat rate under Schedule RES.

while 88% percent of charging is off-peak on Southern California Edison's EV-specific rate.[14]

EV rates should encourage EV owners to charge during off-peak times, but the risk-reward relationship must be balanced and consistent. A rate that is not forgiving of occasional departures from the ideal makes perfect the enemy of the very good. Rates with demand components such as Schedule R-TOUD do not provide this balance.

Q. ARE THESE EXISTING RATE OPTIONS WELL-SUITED FOR RESIDENTIAL EV HOME CHARGING?

A. No. Schedule RES features flat energy charges and as a consequence fail to take advantage of the potential for managed charging. Schedule R-TOU has one major shortcoming: the lack of a submetering option. This is problematic in two ways. First, managing usage behavior for a whole home is far more complex than doing so for a single, and theoretically highly flexible, EV load. Second, the BFC for Schedule R-TOU is $16.85/month, which is $2.85/month higher than the BFC for Schedule RES. The higher BFC diminishes the potential for a customer to realize cost savings relative to what they would pay under Schedule RES.

Schedule R-TOUD has the same shortcoming as Schedule R-TOU (*i.e.,* lack of a submetering option and a higher BFC than Schedule RES), but also has two additional features that could make it unattractive for ratepayers with EVs. First,

[14] Whited, M., Allison, A., and Wilson, R. ("Whited et al.") June 25, 2018. Driving transportation electrification forward in New York: Considerations for effective transportation electrification rate design. p. 2. Cambridge, MA: Synapse Energy Economics. Attached as **Exhibit JRB-5**.

the demand component in Schedule R-TOUD contributes an added level of complexity for a ratepayer that is accustomed to volumetric rates and likely has little or no understanding of demand rates generally, their own demand patterns, and how demand rate service could affect their electric bill. Second, the two-period design contains extended on-peak periods, totaling 11 hours per day from April – September (10 AM – 9 PM) and 12 hours per day from October – March (6 AM – 1 PM and 4 PM – 9 PM.[15]

Q. ARE THERE ANY OTHER RATE DESIGN ELEMENTS ASSOCIATED WITH ESTABLISHING AN EFFECTIVE EV-SPECIFIC RATE FOR HOME CHARGING?

A. Yes. It is reasonable for EV ratepayers to pay for the cost of additional metering required to measure EV charging usage, but any incremental fixed charge associated with the submetered load should be limited to the incremental metering cost. This would be equivalent to how monthly fixed charges were assessed under DEC's now closed rate schedule for submetered controlled water heating (former Schedule WC).

The Commission should be aware that the costs of separate meter and even submetering (to a lesser extent) have been cited as a barrier to some EV-specific home charging rates.[16] However, it is not clear whether submetering costs would present a barrier in North Carolina. At the time of its closure former DEC Schedule

[15] These on-peak periods are limited to non-holiday weekdays.
[16] *See* **Exhibit JRB-3** and **Exhibit JRB-5** for an additional discussion of metering cost issues and submetering options.

WC had modest submetering charge of $1.71/month, an amount that could easily be offset and exceeded by ratepayer savings even with a relatively moderate price differential between a flat rate and the off-peak rate.

Costs for additional EV load metering among Virginia utilities are slightly higher. Dominion Virginia's Schedule EV contains an additional monthly fixed charge of $2.73/month.[17] Appalachian Power's Schedule PEV uses a different approach, translating the incremental monthly submetering cost to a volumetric rate based on an assumed amount of monthly off-peak charging and adding that amount to the off-peak rate. The submetering cost used in this calculation is $2.37/month.[18]

Q. HOW DO YOU RECOMMEND THAT AN EV RATE BE ESTABLISHED FOR DEP'S RESIDENTIAL CUSTOMERS?

A. I recommend that existing Schedule R-TOU be opened for submetered EV charging, with modest submetering charge. My recommendation is based on the fact that Schedule R-TOU already contains several of the attributes that are important for an effective home charging rate. It has a three-period design with a 5-hour peak period from April – September and a 3-hour peak period from October – March, and long duration off-peak periods that measure 15 hours from April – September and 10 hours from October – March. At the rates proposed by DEP in

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[17] Virginia Electric and Power Company, Schedule EV, *available at* https://www.dominionenergy.com/library/domcom/media/home-and-small-business/rates-and-regulation/residential-rates/virginia/schedule-ev.pdf?la=en&modified=20190401150009.

[18] Virginia State Corporation Commission. Docket No. PUR-2019-00067. *Petition of Appalachian Power Company for approval to implement a voluntary schedule for owners of Personal Electric Vehicles*. Exhibit 2. April 23, 2019, *available at* http://www.scc.virginia.gov/docketsearch/DOCS/4g2w01!.PDF

this proceeding, the off-peak rate from July – October is $0.04262/kWh lower than the flat rate under Schedule RES while from November – June off-peak rate is $0.0366/kWh lower. The off-peak rates, at $0.0837/kWh are considerably higher than the off-peak marginal costs for energy and capacity found in Schedule PP, which are generally approximately $0.03/kWh or less.

Collectively these features would allow an EV owner to accrue meaningful savings for off-peak charging as long as the submetering charge is reasonable, while also producing benefits for other ratepayers because the off-peak retail rate is well above off-peak marginal costs. Table 2 shows estimated savings under proposed rates with sensitivities total monthly charging, the amount of non-off-peak charging,[19] and the amount of a hypothetical submetering charge.

Table 2: Estimated Customer Savings Under Submetered R-TOU

Monthly Charging (kWh) & Off-Peak %	Annual Gross Savings ($)	Annual Net Savings ($2.00/month metering charge)	Annual Net Savings ($3.00/month metering charge)
200 (100% off-peak)	$92.66	$68.66	$56.66
200 (90% off-peak)	$61.48	$37.48	$25.48
300 (100% off-peak)	$138.98	$114.98	$102.98
300 (90% off-peak)	$92.22	$68.22	$56.22

[19] The "on-peak" charging rate for the purpose of this estimate is the average of the proposed on-peak and shoulder rates, which would represent 5% on-peak period charging and 5% shoulder period charging.

IV. NON-RESIDENTIAL EV RATE OPTIONS

Q. HOW DO CONSIDERATIONS FOR NON-RESIDENTIAL EV CHARGING RATE OPTIONS DIFFER FROM THOSE FOR RESIDENTIAL CHARGING?

A. The main difference between non-EV rates for residential charging and non-residential non-EV rates is the use of demand charges in non-residential tariffs. Demand charges under standard utility rate schedules for non-residential ratepayers have been repeatedly shown to be the largest barrier to non-residential EV charging, especially DCFC charging.[20] Demand charges assessed for EV charging can easily overwhelm any potential revenue a public EV charging station would generate, or create extraordinarily high costs for charging in non-public applications (e.g., fleet charging or workplace charging). For example, a study by the Rocky Mountain Institute found that demand charges can be responsible for more than 90% of a DCFC ratepayer's electric bill under existing typical utilization rates.[21] While the overall bill impact will be smaller for ratepayers with Level 2 chargers, which have a considerably smaller demand than DCFCs, demand charges can still have a significant impact on these ratepayers' electricity bills under low utilization rates.

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[20] *See, e.g.,* David Farnsworth, Jessica Shipley, Joni Sliger, and Jim Lazar. "Beneficial Electrification of Transportation." Regulatory Assistance Project, January 2019; Dane McFarlane, Matt Prorok, Brendan Jordan, and Tam Kemabonta. "Analytical White Paper: Overcoming Barriers to Expanding Fast Charging Infrastructure in the Midcontinent Region." Great Plains Institute, July 2019; Garrett Fitzgerald and Chris Nelder. "EVgo Fleet and Tariff Analysis." Rocky Mountain Institute, 2017, attached as **Exhibit JRB-6**; Garrett Fitzgerald and Chris Nelder. "DCFC Rate Design Study for the Colorado Energy Office." 2019. Rocky Mountain Institute.

[21] **Exhibit JRB-6**.

EV charging stations today tend to have relatively low utilization rates due to the modest adoption of EVs to date, but since EV charging stations have a fixed demand that is based on the type of charger installed, an EV charging station with a low utilization rate still pays the same demand charge as a highly utilized charging station. This creates a "chicken or the egg" problem for EV deployment: widespread DCFC deployment is needed to encourage adoption of EVs, but DCFC infrastructure cannot be affordably deployed until conditions are present that would lead to higher utilization rates of DCFC equipment (i.e., greater EV adoption).

Q. WHY IS IT IMPORTANT TO FOSTER THE GROWTH OF VIABLE NON-RESIDENTIAL CHARGING OPTIONS?

A. It is commonly accepted that a lack of public EV charging infrastructure presents a considerable barrier to the growth of personal EVs, as fast charging enables long distance travel. Separately, public charging options are important for EV owners that live in multi-family dwellings or rely on street parking. Higher capacity charging stations also support fleet electrification for vehicles that have intensive charging needs (e.g., buses). All of these applications are important in the context of broader transportation electrification, hence the need to create near-term bridging mechanisms that address the barrier that demand rates pose for high capacity charging.

Q. DOES DEP CURRENTLY OFFER AN EV-SPECIFIC RATE FOR NON-RESIDENTIAL RATEPAYERS?

A. No.

Q. WHAT RATE SCHEDULES ARE AVAILABLE TO DEP'S NON-RESIDENTIAL RATEPAYERS FOR EV CHARGING?

A. Since DEP does not currently offer any EV-specific rates, generally applicable non-residential rates would apply to all usage for EV charging at a Level 2 or DCFC stations, whether the station is for public charging or restricted use. Non-residential ratepayers can generally choose between a standard rate and a voluntary time-varying rate. The options mapped to customer size are shown below.

Table 3: Current Non-Residential Rate Options

Demand (kW)	Rate Option	Energy Charges	Demand Charges
> 50	SGS	3-tier declining block	None
	SGS-TOUE	3-period TOU, large rate spread	None
	SGS-TOU	2-period TOU, small rate spread	Seasonal on-peak & off-peak excess
50 - 1,000	MGS	Flat	All hour
	SGS-TOU	2-period TOU, small rate spread	Seasonal on-peak & off-peak excess
< 1,000	LGS	Flat	3-tier declining block, all hour
	LGS-TOU	2-period TOU, small rate spread	3-tier seasonal on-peak & off-peak excess, with on-peak declining block

One of the time-varying rates, Schedule SGS-TOUE, is designed in much the same way as Schedule R-TOU rate. Schedule SGS-TOUE would likely not be an option for any ratepayer that installs a DCFC station or for a standalone DCFC station because it is only available to ratepayers with maximum demands of 50 kW or less and a contract demand of 30 kW or less. As shown previously in Table 1 DCFC stations often exceed this demand threshold.[22]

Q. ARE THESE RATE OPTIONS WELL-SUITED TO NON-RESIDENTIAL EV CHARGING?

A. No. Schedule MGS and Schedule LGS do not contain any time variation and Schedule LGS charges higher rates to ratepayers with low load factors. Two of the available time-varying rate options shown in Table 3, SGS-TOU and LGS-TOU, provide the principal time-varying price signal through the on-peak demand component. For both of these rates the on-peak demand charges is determined by monthly maximum demand, which in both cases applies to monthly maximum demand from 10 AM – 10 PM period during April – September (12 hours) and 6 AM – 1 PM and 4 PM – 9 PM during October – March (12 hours). As a consequence, a single instance of on-peak charging during a month would incur a demand charge that drives a ratepayer's bill. The on-peak demand windows would be virtually impossible to avoid entirely.

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[22] DCFC stations typically have a charging capacity of 50 kW per charging port and often have multiple ports.

Schedule SGS-TOUE could be attractive for non-residential EV charging but it is not available for submetered use. Furthermore, as noted above it would likely not be available for higher capacity charging units due to the maximum demand limit. Even the addition of a Level 2 charging unit could easily push a non-residential ratepayer beyond that demand threshold and cause the rate to become unavailable for even whole building use.

Q. CAN YOU PROVIDE AN EXAMPLE OF HOW DEMAND CHARGES CAN AFFECT THE COST OF EV CHARGING?

A. Yes. Table 4 illustrates the impacts of demand charges based on the proposed rates in DEP Schedules TOU-SGS and MGS on a hypothetical DCFC station with two charging ports that each have a 50 kW demand. It assumes that the units are in use by multiple vehicles at the same time at least once per month, resulting in a 100 kW maximum demand. For the Schedule SGS-TOU example, it is assumed that at least one 100 kW monthly demand is registered during an on-peak period each month.[23]

[23] The calculation uses the average of the summer and winter on-peak demand charge from Schedule SGS-TOU. Off-peak excess demand is assumed to be zero because off-peak demand is never higher than the 100 kW rating for the station itself.

Table 4: Demand Charge Impacts on DCFC Charging Costs

	SGS-TOU	MGS
BFC ($/month)	$35.50	$28.50
Demand Charge ($/kW)	$10.66	$6.72
On-Peak Energy	$0.07100	$0.08068
Off-Peak Energy	$0.05754	$0.08068
Energy/Session (kWh)	50	50
Demand (kW)	100	100
15 Total Sessions/Month, Composed of 14 Off-Peak Sessions and 1 On-Peak Session		
Annual Bill	$13,738	$9,132
Cost/Session	$76.32	$50.73
Cost/kWh	$1.53	$1.01
60 Total Sessions/Month, Composed of 59 Off-Peak Sessions and 1 On-Peak Session		
Annual Bill	$15,292	$11,310
Cost/Session	$21.24	$15.71
Cost/kWh	$0.42	$0.31

Two important details are shown in Table 4. First, even with a relatively high utilization rate of 60 sessions per month (two per day), the cost of charging is still fairly high on a $/kWh basis under both rates. Second, a charging unit owner would be better off under Schedule MGS, which is not time-differentiated, because it has a lower demand charge.

Q. IS DEP PROPOSING AN EV-SPECIFIC CHARGING RATE FOR NON-RESIDENTIAL RATEPAYERS IN THIS RATE CASE?

A. No.

Q. IS DEP PROPOSING AN EV-SPECIFIC CHARGING RATE FOR NON-RESIDENTIAL RATEPAYERS IN ANY OTHER FORUM?

A. Not really. The tariffs associated with the Company's transportation electrification proposal generally refer to existing non-residential rates for the purposes of billing, although DEP does propose a few modest modifications under several pilot programs. The non-residential rate options allow for separately metered EV charging, but not submetering, and either fail to provide time-varying price signals or fail to consider the detrimental effects that the existing rate designs would have on charging costs. For instance, the proposed fleet charging program uses the existing SGS-TOU rate. It requires the customer to pay a full BFC and rates under a design for which the principal price signal is an on-peak demand charge assessed during a long-duration peak window.

For multi-family dwelling and public Level 2 charging services, ratepayers would be charged a Level 2 Charging Fee comprised of the utility's first block energy rate of Schedule SGS, plus $0.02/kWh (*i.e.,* no time differentiation). For DCFC charging, DEP's proposed Fast Charging Fee, to be updated quarterly, only applies to its proposed network of utility-owned and operated DCFCs, and would not be available for usage by third-party-owned DCFCs. The pilot programs are also limited in size and duration, and do not reflect permanent offerings that would result in a sustained incentive for off-peak charging.[24]

[24] *Duke Energy Carolinas, LLC and Duke Energy Progress, LLC's Application for Approval of Proposed Electric Transportation Pilot*, Docket Nos. E-2, Sub 1197 and E-7, Sub 1195 (March 29, 2019).

Q. WHAT RATE OPTIONS ARE AVAILABLE FOR ADDRESSING THE EFFECTS OF DEMAND CHARGES ON OWNERS OF HIGH CAPACITY EV CHARGING STATIONS?

A. There are several options as follows:

1. Substitution of time-varying volumetric charges for demand charge components.
2. Establishing limits or caps on demand charges.
3. Allowing aggregation of multiple meters for the purpose of calculating demand charges.
4. Modifying the calculation of demand charges from being based on monthly maximum demand to the daily maximum demand.

Q. HOW COULD THE SUBSTITUTION OF TIME-VARYING ENERGY CHARGES FOR DEMAND CHARGES BE ACCOMPLISHED IN AN EV-SPECIFIC NON-RESIDENTIAL RATE?

A. The simplest way would be to open Schedule SGS-TOUE to submetered EV charging and eliminate or relax the existing 50 kW monthly demand and 30 kW contract demand limits for submetered EV loads. Like Schedule R-TOU, Schedule SGS-TOUE already features attributes that are supportive of EV charging, making it a reasonable place to start for design of a non-residential EV-specific rate.

As a submetered EV rate option, Schedule SGS-TOUE would feature a submetering charge if the EV load is located behind an existing whole building meter, or the otherwise applicable BFC under either Schedule SGS-TOUE or

Schedule SGS-TOU for standalone charging installations. The Schedule SGS-TOU BFC would apply for larger capacity installations that would otherwise only qualify for Schedule SGS-TOU. An increase in the demand limit for submetered EV load could correspond to the 1,000 kW threshold used in Schedule SGS-TOU.

Q. ARE THERE EXAMPLES OF NON-RESIDENTIAL EV-SPECIFIC RATES THAT FEATURE A SIMILAR USE OF VOLUMETRIC RATHER THAN DEMAND CHARGES?

A. Yes. There are several examples of this general design feature, with variations based on the state and utility. In some, but not all cases, the substitution is subject to a specific term and/or phase-out system. This kind of feature provides predictability for charging station owners, helps mitigates cross-subsidization concerns, and reflects an expectation that the impacts of demand charges will be reduced by higher utilization rates in the future. Below are several examples illustrating this model. The examples below should not be viewed as an exhaustive list.

- California (SCE): Southern California Edison ("SCE") offers rates under Schedules TOU-EV-7 through TOU-EV-9 for separately metered EV charging stations with different load sizes (e.g., TOU-EV-8 applies to loads from 20 kW – 500 kW). The rates offer a demand charge free rate for five years (from March 1, 2019 through March 1, 2024), followed by the phase-in of a modest demand charge over the following five years for the TOU-EV-8 and TOU-EV-9 rate schedules. Customers on Schedule TOU-EV-7 (demand of less than 20 kW) retain an energy-only option. Time-varying volumetric energy charges are increased to recover costs that would otherwise be recovered in the demand charge.[25]

- Connecticut (Eversource): Eversource Energy's Electrical Vehicle Rate Rider allows separately metered public charging stations to pay energy charges in place of any otherwise applicable demand rate that would apply under the standard general service rate schedules. The energy charge is determined by the average rate for that rate component. This rider does not have a sunset or phase-out clause.[26]

- Nevada (Nevada Power Company & Sierra Pacific Power Company): Both utilities offer Schedule EVCCR-TOU to customers under the larger commercial rate schedules that install separately metered DCFC stations. The rates offer at ten-year discount schedule under which demand rates are reduced by 100% in the first year (starting April 1, 2019) and the discount declines by 10% each year thereafter to zero after the tenth year (starting April 1, 2029). Customers pay a substitute transition energy charge in place of the demand charges.[27] [28]

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[25] *See e.g.,* SCE Schedule TOU-EV-8. Available at: https://library.sce.com/content/dam/sce-doclib/public/regulatory/tariff/electric/schedules/general-service-&-industrial-rates/ELECTRIC_SCHEDULES_TOU-EV-8.pdf.

[26] Eversource Connecticut. Electric Vehicle Rate Rider. Available at: https://www.eversource.com/content/docs/default-source/rates-tariffs/ct-electric/ev-rate-rider.pdf?sfvrsn=e44ca62_0.

[27] Nevada Power Company. Schedule EVCCR-TOU. Available at: https://www.nvenergy.com/publish/content/dam/nvenergy/brochures_arch/about-nvenergy/rates-regulatory/electric-schedules-south/EVCCR-TOU_South.pdf

[28] Sierra Pacific Power Company. Schedule EVCCR-TOU. Available at: https://www.nvenergy.com/publish/content/dam/nvenergy/brochures_arch/about-nvenergy/rates-regulatory/electric-schedules-north/EVCCR-TOU_Electric_North.pdf.

- Pennsylvania (PECO): PECO Energy Company's Electric Vehicle DCFC Pilot Rider (Schedule EV-FC) applies a five-year discount to billed distribution demand for customers with publicly available or workplace DCFC charging stations. The demand discount is set at 50% of the maximum nameplate capacity of connected DCFCs.[29]

Q. PLEASE DESCRIBE WHAT YOU MEAN BY A DEMAND CHARGE LIMIT OR CAP OPTION.

A. A demand charge cap limits the portion of a ratepayer's monthly bill that is associated with billed demand charges to either a specified percentage of the ratepayer's bill or an implied volumetric rate. Such a rate could be applied more generally as a way to reduce the adverse impacts of demand charges on ratepayers with low load factors. However, in the present context, it more specifically addresses circumstances where EV charging load contributes to demand charges being a very high percentage of a ratepayer's bill due to a low utilization rate and low load factor. A demand charge cap could be deployed as a special condition for ratepayers with under Schedules SGS-TOU or LGS-TOU for ratepayers with EV load (i.e., not separately metered), or it could be reflected in a tariff for dedicated EV charging.

[29] PECO Electric Tariff. Schedule EV-FC at tariff p. 84. Available at: https://www.peco.com/SiteCollectionDocuments/CurrentTariffElec.pdf.

Q. CAN YOU PROVIDE ANY EXAMPLES OF THE DEPLOYMENT OF A DEMAND CHARGE LIMIT OPTION?

A. Yes. In 2019, Minnesota Power received approval to deploy a rate for commercial EV charging that caps demand charges at 30% of a ratepayer's bill. The Order that approved the rate also directed Minnesota Power to establish a three-period time-varying rate design for the commercial EV charging tariff.[30] Minnesota Power's proposal was based in part on an evaluation of six of its customers with on-site EV charging equipment and the effective energy rate those customers paid due to the demand charge. The results of this analysis are shown below in Table 5 followed by the rate that these customers would have paid under the capped demand charge in Table 6. The percentage-based cap produced approximately the same effective energy rate for five of the six customers and only a slightly higher rate for the one remaining customer. The applicable demand rate for this comparison is $6.50/kW of on-peak demand.[31]

[30] Minnesota Public Utilities Commission Docket No. E015/M-19-337. *In the Matter of Minnesota Power's Docket No. Petition for Approval of its Electric Vehicle Commercial Charging Rate Pilot.* "Order Approving Pilot with Modifications and Setting Reporting Requirements." December 12, 2019.

[31] Minnesota Public Utilities Commission Docket No. E015/M-19-337. *In the Matter of Minnesota Power's Docket No. Petition for Approval of its Electric Vehicle Commercial Charging Rate Pilot.* "Petition for Approval of Electric Vehicle Commercial Charging Rate." p. 13. May 16, 2019.

Table 5: Bills Under Generally Applicable Commercial Rate

Customer	Demand Charge (% of Bill)	Rate Paid ($/kWh)	Percentile Rank (Bill/KWh) Among GSD Customers
1	56%	$0.19	94.80%
2	75%	$0.34	98.80%
3	73%	$0.31	98.70%
4	78%	$0.38	99.10%
5	78%	$0.39	99.10%
6	88%	$0.78	99.70%

Table 6: Bills Under Proposed Commercial EV Rate

Customer	Demand Charge (% of Bill)	Rate Paid ($/kWh)	Percentile Rank (Bill/KWh) Among GSD Customers
1	30%	$0.12	65.50%
2	30%	$0.12	67.00%
3	30%	$0.12	67.70%
4	30%	$0.12	69.70%
5	30%	$0.12	69.80%
6	30%	$0.14	82.70%

I have attached Minnesota Power's application as **Exhibit JRB-7**. Attached **Exhibit JRB-8** contains Minnesota Power's compliance tariff addressing the modifications made by the Minnesota Public Utilities Commission in approving the tariff, most notably shortening the on-peak period from 14 hours to 5 hours.

Incidentally, Duke Energy Kentucky's rates contain a similar limiter. In Duke's Kentucky territory, the generally applicable rate for non-residential service at distribution voltage caps maximum monthly charges, excluding the monthly fixed charge, at a rate of roughly 23.7 cents/kWh. This rate is not specific to EV ratepayers and is available to non-residential ratepayers with demands up to 500 kW.[32]

Q. HOW COULD A DEMAND CHARGE CAP BE SET FOR AN EV-SPECIFIC NON-RESIDENTIAL RATE?

A. One method would be to set the cap as a volumetric rate equivalent or, approximately so, to the rate that a residential ratepayer would pay on flat rate service (*i.e.,* Schedule RES). Since a residential ratepayer has a choice between charging at home or charging at a commercial location, setting the cap in this manner ensures that owners of EV chargers are not effectively paying more than a residential ratepayer would pay to charge an EV at home.

Q. HOW COULD A DEMAND CHARGE LIMIT FOR EV LOAD BE ESTABLISHED IN THE FORM OF A TARIFF?

A. A demand charge limit for dedicated EV charging could be established by modifying Schedules SGS-TOU and LGS-TOU to apply the limit to EV-only loads. For standalone installations, the otherwise applicable BFC would apply. Submetered EV loads behind another meter would incur an incremental submetering charge. I note that this approach would fail to address the long on-peak windows found in Schedules SGS-TOU and LGS-TOU, but it would help mitigate the outsized role that the demand charge plays in determining charging costs.

[32] Duke Energy Kentucky. Rate DS: Service at Secondary Distribution Voltage. Available at: https://www.duke-energy.com/_/media/pdfs/for-your-home/rates/electric-ky/sheet-no-40-rate-ds-ky-e.pdf?la=en.

Q. PLEASE EXPLAIN THE CONCEPT OF A METER AGGREGATION OPTION FOR THE PURPOSE OF CALCULATING DEMAND CHARGES.

A. Currently, the bills of ratepayers with multiple meters are calculated individually for each meter. For example, a business that has multiple locations within a utility's service territory will pay a separately calculated electricity bill for each location. A policy that allows the aggregation of multiple meters for purposes of calculating demand charges for EV charging would permit these ratepayers to aggregate their demand across all participating locations for the sole purpose of calculating the demand charge. In the context of EV charging, this policy recognizes that a ratepayer with multiple EV charging stations installed across multiple locations could experience diversity with respect to when the charging stations are used. When EV charging station utilization rates are relatively low, and individual metered loads have relatively low load factors, this policy can help reduce the total demand charges paid by a ratepayer with multiple accounts.

It is important to note that this is different from the concept of aggregated billing. Under aggregated billing, a ratepayer's individual charges are combined onto a single bill. In contrast, aggregating meters to calculate demand charges only affects the billing determinant used to calculate demand charges.

Q. ARE THERE EXAMPLES OF UTILITIES PROPOSING TO ALLOW THE AGGREGATION OF MULTIPLE METERS TO ENCOURAGE THE DEPLOYMENT OF EV CHARGING?

A. Yes. As part of its June 2019 rate case filing, Puget Sound Energy ("PSE") in Washington state proposed establishing a five-year Conjunctive Demand Pilot that would allow its Large General Service ratepayers that have accounts in multiple locations to aggregate the demands in the different locations for the purpose of calculating transmission and generation demand charges.[33] Under PSE's proposal, the utility would use the highest hourly interval of demand across a participating ratepayer's multiple accounts during a billing period to calculate billed demand for purposes of recovering power and transmission costs. Distribution costs would still be billed using demands at the ratepayer's individual locations.

In its supporting testimony, PSE noted that "from the perspective of power and transmission cost causation, customers served by PSE through multiple locations look no different to PSE (i.e., have no materially different cost of service) than a single customer with similar load characteristics," yet they could pay more in demand charges than a single customer.[34] PSE expressly justified its proposal as a way to mitigate high demand charges that pose a barrier to EV deployment.[35]

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[33] Washington Utilities and Transportation Commission, Docket No. UE-190529.

[34] *Prefiled Direct Testimony of Jon A. Piliaris*, Washington Utilities and Transportation Commission, Docket No. UE-190529 (June 20, 2019).

[35] PSE cited several other examples of utilities that have proposed or implemented such a system in Michigan (Consumers Energy and Detroit Edison) and Minnesota (Northern States Power Company, or Xcel Energy). However, I have not verified the accuracy of these other examples.

PSE's proposed tariffs for implementing the program are attached as **Exhibit JRB-9**.

Q. PLEASE EXPLAIN THE CONCEPT OF A DAILY DEMAND CHARGE.

A. A daily demand charge occupies something of a middle ground between traditional demand charges based on monthly maximum demand and fully volumetric rates. A daily demand charge uses the highest recorded demand each day to calculate charges, either during all hours or during a time-varying demand pricing period. In doing so it reflects an averaged contribution to costs and does not penalize ratepayers for a small number of anomalously high demands. The averaging effect is less than that embodied within a volumetric charge because it derives from peak daily demands whereas a volumetric rate charges a ratepayer based on fully averaged demand across all intervals in a given time period.

Q. HOW COULD A DAILY DEMAND CHARGE DESIGN SUPPORT TRANSPORTATION ELECTRIFICATION?

A. Substituting volumetric charges for demand charges provides the greatest benefit to ratepayers with low load factors. At present, many non-residential EV charging loads have this characteristic. A daily demand charge design could be beneficial to EV charging stations with higher utilization rates and higher load factors because at a certain load factor threshold a ratepayer prefers demand charges to energy charges. Such could be the case for fleet charging, where reasonably predictable charging needs can be managed to consistently cycle vehicles in and out in a way that optimizes the use of charging equipment.

Q. WHAT ARE YOUR RECOMMENDATIONS TO THE COMMISSION ON THE ESTABLISHMENT OF A NON-RESIDENTIAL EV-SPECIFIC RATE?

A. I recommend that the Commission direct DEP to deploy a non-residential EV-charging rate under options (1) or (2). Option 1 would accomplish the substitution of energy charges for demand charges by using the fully volumetric time-varying rate design found in Schedule SGS-TOUE. Schedule SGS-TOUE should be modified to allow submetering of EV load, and to eliminate or relax the maximum 30 kW contract demand and 50 kW maximum demand limits for EV load in order to permit high capacity charging. The 1,000 kW demand limit found in SGS-TOU could be applied to separately metered or submetered EV load. Submetered load behind an existing meter would be subject to a submetering charge limited to the cost of the additional metering, while standalone installations would be subject to the otherwise applicable BFC under Schedule SGS-TOUE or SGS-TOU.

Option 2 establishes a demand charge limit for separately metered or submetered EV charging load within Schedules SGS-TOU and LGS-TOU, and uses the same submetering charge and BFC system as Option 1. I recommend that the demand charge limit be designed to produce a maximum implied volumetric rate that is approximately the same as a residential ratepayer would pay to charge an EV under a standard flat rate option such as Schedule RES. Alternatively, a cap based on a percentage of a ratepayer's bill attributable to demand charges could be used to similar effect.

I do not recommend Option (3), demand aggregation, or Option (4), a daily demand charge design, for immediate deployment because both involve greater complexities and consideration of additional issues. However, both of these options should have a place in continued discussions of EV-supportive rates and innovative rate designs more generally. Such a discussion could take place as part of the larger rate design study recommended by Public Staff Witness Floyd in DEC's pending rate case if the Commission adopts that recommendation.

V. CONCLUSION

Q. PLEASE SUMMARIZE YOUR RECOMMENDATIONS TO THE COMMISSION?

A. I recommend that the Commission direct DEP to file separate, targeted EV-specific tariffs for both residential and non-residential dedicated EV charging, reflecting the core characteristics discussed in my testimony. I believe this should occur within 60 days of the order in this rate case.

I also recommend that the Commission establish an investigatory docket to receive further information and permit further discussion of EV-specific rates, lessons learned, and potential refinements, including quarterly reports from DEP updating the Commission and parties on deployment status, tariff enrollment, ratepayer savings, system cost savings, and any other information that the Commission deems relevant to support evaluation of the tariffs and their future evolution. If the Commission orders the comprehensive rate design study recommended by Public Staff Witness Floyd in DEC's pending rate case, this investigatory docket could become part of or be used to support that effort.

Finally, I recommend that any rates established pursuant to a Commission decision remain available, at a minimum, until any successors or replacements are adopted pursuant to the system of Commission review that I recommend above.

Q. WHAT IS YOUR RECOMMENDATION FOR THE ESTABLISHMENT OF A RESIDENTIAL EV-SPECIFIC RATE?

A. I recommend that existing Schedule R-TOU be made available for submetered home EV charging with the modest submetering charge described above in place of the tariffed BFC. With the exception of not being available for submetered use, Schedule R-TOU already contains several characteristics that are supportive of home EV charging, as follows:

1. Three pricing periods and short duration on-peak periods;
2. A price differential between the off-peak rate and the otherwise applicable flat rate that should be sufficient to produce meaningful bill savings for EV charging, taking into account a modest incremental metering charge and a typical amount of home EV charging; and
3. An off-peak pricing period with a duration of at least eight hours that allows ample time for low voltage charging to produce a battery charge sufficient for a reasonable length trip or commute.

Q. WHAT IS YOUR RECOMMENDATION FOR THE ESTABLISHMENT OF A NON-RESIDENTIAL EV-SPECIFIC RATE?

A. I recommend that a rate or rates for submetered and standalone EV charging be established for non-residential ratepayers under a design that features time variation and mitigates the outsized effects that demand charges have on charging costs. More specifically, the rate or rates should:

1. Address the issues presented by demand rates for non-residential EV charging installations by doing one or both of the following: (a) modifying Schedule SGS-TOUE to permit submetering for EV loads and eliminating or relaxing the maximum demand-based availability limitations currently contained in Schedule SGS-TOUE for EV load, or (b) applying a demand charge limit to Schedules SGS-TOU and LGS-TOU that caps demand charges at an implied maximum volumetric rate, or alternatively, a percentage of the ratepayer's monthly bill;
2. Use the otherwise applicable BFC for standalone charging stations and a submetering charge in place of the BFC for charging units located behind an existing meter; and
3. Remain available to participants for ten years from the date of their enrollment in order to provide a reasonable level of investment certainty to prospective equipment owners.

I also recommend that the Commission consider the demand aggregation and daily demand charge options discussed in my testimony as it pursues future refinements.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.