NORTH CAROLINA UTILITIES COMMISSION

In the Matter of:	}	
Biennial Determination of Avoided Cost Rates for Electric Utility Purchases from Qualifying Facilities - 2018	}	**Docket No. E-100, Sub 158**
	}	

Responsive Testimony of
Devi Glick

On Behalf of
Southern Alliance for Clean Energy

On the Topics of
Battery Storage and PURPA Avoided Cost Rates

July 3, 2019

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I. INTRODUCTION AND QUALIFICATIONS

Q. Please state your name and business address for the record.

A. My name is Devi Glick. I work at Synapse Energy Economics, Inc., located at 485 Massachusetts Avenue in Cambridge, Massachusetts.

Q. Please describe Synapse Energy Economics.

A. Synapse Energy Economics is a research and consulting firm specializing in electricity and natural gas industry regulation, planning, and analysis. Our work covers a range of issues, including integrated resource planning; economic and technical assessments of energy resources; electricity market modeling and assessment; energy efficiency policies and programs; renewable resource technologies and policies; and climate change strategies. Synapse works for a wide range of clients, including attorneys general, offices of consumer advocates, public utility commissions, environmental advocates, the U.S. Environmental Protection Agency, the U.S. Department of Energy, the U.S. Department of Justice, the Federal Trade Commission, and the National Association of Regulatory Utility Commissioners. Synapse has over 30 professional staff with extensive experience in the electricity industry.

Q. Please summarize your professional and educational experience.

A. I have a master's degree in public policy and a master's degree in environmental science from the University of Michigan; a bachelor's degree in environmental studies from Middlebury College; and more than six years of professional experience as a consultant, researcher, and analyst.

At Synapse, and previously at Rocky Mountain Institute, I have focused on a wide range of energy and electricity issues, including: utility resource planning, distributed energy resource valuation, energy efficiency program impact analysis, and rate design effectiveness. For this work, I develop in-house models and perform analysis using industry-standard models.

On topics related to the costs and benefits of distributed generation, I have submitted written testimony and appeared in person before the Public Service Commission of South Carolina in a number of dockets relating to the avoided costs associated with solar photovoltaics ("PV"). Additionally, I have co-authored two studies reviewing valuation methodologies for solar PV. These studies continue to be frequently cited in public utility proceedings for their recommendations around distributed energy resource pricing and rate design.

My CV is attached as Glick Exhibit A.

Q. On whose behalf are you testifying in this proceeding?

A. I am testifying on behalf of Southern Alliance for Clean Energy ("SACE").

Q. Have you testified previously before the North Carolina Utilities Commission?

A. No.

Q. What is the purpose of your responsive testimony in this proceeding?

A. On June 14, 2019, the Commission issued an *Order Requiring Supplemental Testimony and Allowing Responsive Testimony*. The order requested that parties address the avoided cost rate schedule and contract terms and conditions that an existing Qualifying Facility ("QF") proposing to add battery storage to its electric generating facility would receive under North Carolina's implementation of the Public Utility Regulatory Policies Act of 1978 ("PURPA"). The primary purpose of my testimony is to respond to Duke Energy Carolinas' ("DEC") and Duke Energy Progress' ("DEP"; together "Duke Energy" or "the Companies") joint supplemental testimony. Dominion has not proposed any changes to rates or terms of existing QFs seeking to add battery storage, therefore I will not specifically respond to Dominion's supplemental testimony.[1]

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[1] Dominion's position on the avoided cost rate schedule and contract terms and conditions is very similar to the position expressed by Duke Energy.

II. BACKGROUND AND SUMMARY

Q. Please summarize your reaction to Duke Energy's proposed "material modification" language and the Companies' position on the avoided cost rate that should apply.

A. Duke Energy's proposed language on "material modification" to existing QFs grants Duke Energy "sole discretion" to deny the addition of energy storage if the QF seeks to retain its pre-existing standard offer Power Purchase Agreement ("PPA").[2] By doing so, this proposal actively discourages the addition of battery storage, a capacity resource that would add significant value to the system. This outcome is undesirable for ratepayers and grants the utility unnecessary and unwarranted control over a QF.

Duke Energy has stated that the production profiles of solar QFs do not coincide with system demand peaks.[3] Battery storage firms up solar PV capacity and allows the output from solar QFs to shift to align with these system peaks. Duke Energy claims that the ability of battery storage to shift the profile of production under a QF's existing avoided cost rate increases payments to the QF and therefore increases costs to ratepayers, due in part to the shift in peak time periods over the years. However, if the peak time periods in the QF's existing contract do not align with Duke Energy's current system peaks, the Companies should propose new peak time periods for QFs that add battery storage. Specifically, the Companies' proposal should: (1) pay QFs their existing rates and (2) shift the premium pricing time periods to align with current system peak.

By shifting production to align with current system peaks, the utility avoids greater cost and receives greater value from the QF. The utility can lower operational costs by not running its most expensive peaking resources and by

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[2] Duke Energy Carolinas, LLC, and Duke Energy Progress, LLC's Joint Initial Statement and Exhibits at p. 35, Docket E-100 Sub 158 (hereinafter "Duke Energy Initial Statement").

[3] Duke Energy states that Solar QFs lack coincidence with customers highest demand periods. Duke Energy Initial Statement at p. 24.

gaining the ancillary services provided by battery storage.[4] Additionally, the utility can lower system costs by deferring or eliminating the need to build new peaking capacity resources, and even transmission or distribution infrastructure. Therefore, the Companies' claim that allowing existing QFs to add storage while maintaining their PPA would disadvantage ratepayers and violate PURPA is unsupported.

Q. Please provide additional context for battery storage compensation as a QF under PURPA.

A. In *Luz Development and Financial Corp.*, the Federal Energy Regulatory Commission ("FERC") clarified that battery storage is eligible for QF status if its primary energy source is "one of those contemplated by the statue…e.g., biomass, waste, renewable resources, geothermal resources, or any combination thereof."[5] Solar PV is a renewable resource, therefore battery storage added to an existing solar QF is QF eligible under PURPA.

Q. Can the utility restrict operation of a solar QF that adds battery storage under PURPA?

A. So long as the QF discharges power onto the grid (1) consistent with PURPA and the QF's interconnection agreement, and (2) at a level that does not surpass its current AC generating capacity, the QF should be permitted to operate with storage under its existing contract. By adding a DC-coupled battery storage system to the existing QF, the QF does not increase its AC capacity, and the battery should be considered part of the QF. Therefore, the utility has no reasonable basis to regulate the operation of individual components on the operator side of the meter.

The QF should also be entitled to reasonably modify operations within the terms of its existing contract. To understand why, consider an example from a

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[4] The utility does not have direct control over the battery under typical QF system design, however rate designs can incent operators to provide ancillary services rather than just energy to the grid.

[5] 51 FERC ¶ 61,078, at 61,172 (1990).

different QF resource: a waste-steam plant. If a manufacturing plant changed its factory hours to produce waste steam at a higher-valued generating time, Duke Energy would have no basis to require the factory to shift operating hours back to the original timeframe. A solar QF seeking to add battery storage and shift its generation profile should be treated no differently.

III. MATERIAL MODIFICATIONS LANGUAGE IN THE PPA TERMS AND CONDITIONS

Q. Please summarize the material modifications language Duke Energy has proposed adding to the standard offer PPA contracts as it relates to the integration of battery storage to an existing QF.

A. Duke Energy proposed new language to its Schedule PP Terms and Conditions which allows the Companies to "either terminate the Agreement or suspend purchases of electricity from the Seller" based on "any material modification to the Facility without the Duke's consent or otherwise delivering energy in excess of the estimated annual energy production of the facility."[6]

Additionally, Duke Energy provided that "any material modification to the Facility, including without limitation, a change in the AC or DC output capacity of the Facility or the addition of energy storage capability shall require the prior written consent of the Company, which may be withheld in the Company's sole discretion, and shall not be effective until memorialized in an amendment executed by the Company and the Seller."[7]

Finally, Duke Energy provided an Energy Storage Protocol in the Companies' Reply Comments to provide clarity on how battery storage integrated with QFs is allowed to interact with the grid.[8]

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[6] Duke Energy Initial Statement, DEC Exhibit 4 at p. 2; Duke Energy Initial Statement, DEP Exhibit 4 at p. 2.

[7] Duke Energy Initial Statement, DEC Exhibit 4 at 5; Duke Energy Initial Statement, DEP Exhibit 4 at p. 4.

[8] Duke Energy Carolinas, LLC and Duke Energy Progress, LLC. Reply Comments at p. 150, Docket No. E-100, Sub 158. (hereinafter "Duke Energy Reply Comments").

Q What is the Companies' position regarding the avoided cost rate that an existing QF adding battery storage should receive?

A. Witness Snider states that an existing QF that adds battery storage should be required to enter a new or modified PPA at the Companies' current avoided-cost rate.[9] The Companies' current avoided cost rates are lower than previous avoided cost rates for existing QFs.[10]

Q. How does Duke Energy seek to justify the Companies' position that an existing QF adding battery storage should be subject to a lower, new avoided cost rate?

A. The Companies claim that it will be "inequitable and inconsistent with PURPA" to allow QFs with existing contracts to: (1) increase their generators' size; (2) increase their capability to produce energy in more hours of the day; or (3) shift their energy production to make additional or modified sales at rates that are much higher than the Companies' current avoided cost rates.[11]

Duke Energy goes on to state that allowing QFs to integrate battery storage (or other technology) that alters a QF's energy output or shifts its power production under existing avoided cost rates would result in increased payments to QFs that exceed current avoided cost rates.[12] According to Duke Energy, this in turn would burden customers with the incremental charges.

Q. How do you respond to Duke Energy's concerns?

A. The Companies' claims are unfounded and unsupported by Witness Snider's testimony. There is no change to the avoided cost *rates* that apply to a QF with battery storage capability. Only the total payments would increase, in line with increased value provided by the battery storage addition. The addition of DC-

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[9] Duke Energy Carolinas, LLC and Duke Energy Progress, LLC, Docket No. E-100, Sub 158, Supplemental Testimony of Glen A. Snider at p. 5 ("hereinafter "Supplemental Testimony of Glen Snider").

[10] *Id.* at p. 7-8.

[11] *Id.* at p. 7.

[12] Supplemental Testimony of Glen Snider at p. 8.

coupled battery storage does not increase the AC capacity of a QF. Additionally, shifting production to different hours in the day can actually benefit the system by enabling QF production to align with the hours of highest system need. Finally, QFs are receiving higher avoided cost payments for the energy provided during premium pricing windows because they are offering higher value to the system and lowering system costs during those hours. If the existing premium pricing periods do not fully align QF generation with peak system demand, the utility should propose updated pricing periods for QFs that add battery storage that award the highest payments during current peak hours.

I will explore each of these three main points regarding (1) generation quantity; (2) generation profile; and (3) and system impacts, including generation payments, in detail in the sections that follow.

IV. GENERATION QUANTITY AND PROFILE

Q. Please explain how battery storage paired with a solar QF will alter a QF's energy output.

A. If a QF is sized at or below contract capacity specified in the PPA,[13] the addition of battery storage will generally decrease the total quantity of electricity dispatched to the grid. The round-trip efficiency of a battery, or the fraction of energy put into the battery that can be retrieved, is typically around 80–90 percent for a lithium-ion battery.[14] This means that 10-20 percent of energy is lost in the process of charging and discharging the battery (additionally, the battery storage system might have additional parasitic load for cooling). This lost electricity is no longer available to sell to the grid. Thus, for a QF sized at or below contract capacity, the addition of battery storage will generally decrease the QF's overall

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[13] *See* Duke Energy Joint Initial Statement, DEC Exhibit 1 at p. 1; Duke Energy Joint Initial Statement, DEP Exhibit 1 at p. 2.

[14] The range varies depending on the battery's chemistry and the QF's operation.

electricity output, though it does enable the shift in electricity to better align with peak demand.[15]

Q. Please explain how battery storage paired with a solar QF will shift the profile of power production.

A solar QF *without* battery storage will send electricity to the grid whenever the sun is shining. A QF *with* battery storage can easily shift output and will likely discharge some or all of the electricity generated to the grid during the hours when it receives premium pricing, set at times of peak demand. If there are multiple pricing tiers, the operator will act to co-optimize across multiple time periods to maximize its profit. As long as the pricing tiers are properly aligned with peak demand, the QFs should be driven to discharge during peak hours when electricity is most needed and otherwise most expensive for the utility to generate.

Q. Does system peak sometimes falls outside of the premium pricing window in the QF's contract?

A. QFs on contracts that are more than a few years old may have premium pricing windows that do not completely align with current system peaks. This shift in the peak is in part because the QFs are providing capacity during the periods that would be peaks were it not for the deployment of solar PV, much of which has occurred because PURPA has provided a pathway for QF development.

Q. Can more granular pricing and rate design help the system maximize the value provided by battery storage?

Yes, as mentioned above, updated time periods, or other more granular price signals or incentives, can further align QF premium pricing windows with current system peaks. Duke Energy treats the rate options for existing QFs as binary:

[15] QFs that currently clip electricity and are not able to dispatch all electricity to the grid under current rates will be able to use the battery storage to store the clipped electricity for sale to the utility at a later time, and thus may be able to maintain existing generation output levels rather than decreasing total output.

either stay on the previous contract rates without storage or enter into new PPAs on the current avoided cost rate if seeking to add storage.[16]

In reality, the Companies have the opportunity to offer QFs modified contracts that (1) pay QFs their existing rates; (2) shift the premium pricing time periods to align with current system peak.

QFs should be amenable to considering such a change in contract provided they know the pricing periods in advance and can size their batteries to maximize revenue from their QF systems during the new pricing windows. Failure by the utility to explore different terms with existing QFs that could harness storage options to lower overall system costs ultimately disadvantages ratepayers.

V. SYSTEM IMPACTS AND GENERATION PAYMENTS

Q. How does Duke Energy support its argument that adding battery storage to solar QFs on their existing rates will increase system costs?

A. Duke Energy's argument regarding increased system costs from adding battery storage to existing QFs can be broken down into two parts: (1) current system peaks may not align with system peaks from existing QF contracts; (2) the avoided cost rate for existing QFs is higher than the Companies' current avoided cost rates, therefore existing QFs will be overcompensated. On the first issue of system peak, I have clearly outlined above how new premium pricing periods can align existing QF generation with current system peaks.

On the second issue regarding the avoided cost rates for existing QFs, Duke Energy has not demonstrated that an existing QF rate exceeds the incremental cost to the electric system of the utility providing the capacity and energy that would be needed but for the QF with integrated battery storage. Specifically, the Companies have not demonstrated that the current avoided cost

[16] Supplemental Testimony of Glen Snider at p. 8.

rate captures all values (including ancillary services, transmission and distribution capacity, and even energy and generation capacity) provided by a solar QF with battery storage.[17]

Q. How will the addition of battery storage to an existing solar QF impact the utility?

A. Battery storage impacts operational and planning decisions for the utility. First, the peaking capacity provided by battery storage will decrease operational costs by reducing the need to run the most expensive resources during peak times. Second, battery storage can provide ancillary services that the utility needs to operate the grid. These values are not currently included in Duke Energy's avoided cost rates. Finally, battery storage has the potential to obviate, reduce, or defer the need for the utility to invest in large, expensive, capital generation projects that are driven by the need to meet peak demand (particularly rate winter peaking events), or even certain distribution and transmission investments (which once again are not fully captured in current avoided cost rates).

Currently, the Companies compensate solar QFs a small amount of their capacity contribution based on the argument that: (1) the utility systems are currently dual or winter peaking and; (2) solar generation does not align with winter peaks, which begin in the morning before the sun rises. However, a QF with battery storage can contribute capacity during winter mornings, and therefore the capacity contribution value should be significantly higher for solar QFs with storage for planning purposes.

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[17] Given the short timeframe for response comments we were not able to quantify the net benefits from adding battery storage to solar QFs. However, the impacts are quantifiable though production cost and capacity expansion modeling, as well as a close examination of how well the current avoided cost rates capture the values provided by a QF with battery storage, including ancillary services, avoided transmission and distribution capacity, and other environmental benefits.

Q. How will the integration of battery storage with existing QFs impact ratepayers?

A. As mentioned above, battery storage paired with a solar QF can increase the value provided by the QFs. When the utility operates an expensive peaking resource or invests capital in a new peaking resource (or even new transmission and distribution equipment), the costs and any associated future risks are typically passed on to the ratepayers. However, when battery storage is added to existing QFs, the ratepayers gains peaking capacity for at most the incremental cost of the peak versus off-peak avoided cost rate.[18]

Q. Will there be any negative impacts on grid reliability from the integration of battery storage with existing QFs?

A. Battery storage paired with a solar QF will increase grid reliability by (1) allowing a solar QF to store electricity when need is lower and dispatch to the grid when need is higher; and (2) allowing the operator to limit and control the QF's ramp rates in accordance with an Energy Storage Protocol when operating the battery.

Duke Energy performs its System Impact Studies assuming a QF is operating at maximum Physical Export Capability during the entire study period (i.e., daylight hours of 9:00 am–5:00 pm). These studies determine whether the addition of a QF will impact the grid under the most extreme output conditions. As long as the QF is dispatching power during this same time block studied in the System Impact Study (and in accordance with ramping requirements), the QF is safely operating according to the utility's own system impact studies.[19]

In almost every case, a QF producing power during system peak reduces system cost. However, if the system peak load is outside of the study window, the QF may not be permitted to operate due to the limits of its System Impact Study.

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[18] The additional services and values provided by battery storage reduces the incremental cost. Additionally, the contract length for a QF is significantly less than the 25–30 year typical amortization period for a new peaking plant.

[19] Reliability and system impact concerns were the subject of NC Docket E-100, Sub 101, Revision to Interconnection Standards.

It is in the best interest of the ratepayers for the utility to expedite a study of system impacts with an expanded study window when a QF requests to add battery storage to its contract so that QFs can provide power during times of the system's highest need.

Finally, the Companies have proposed an Energy Storage Protocol which outlines measures that affect reliability and system performance. These measures include ramp rates, discharge profile, installation location in relation to the inverter, and curtailment requirements, which control certain aspects of battery operation. This protocol, if my concerns described below are addressed, provides an opportunity for QFs to provide a higher net value to the grid by avoiding fast ramps that could otherwise cause grid integration challenges.

Q. What specifically are your concerns with Duke Energy's Proposed Energy Storage Protocol?

A. I have two main concerns with the protocol. First, the protocol should constrain the operation of the QF, not its sub-components. In Items 4, 5, and 6 of the protocol,[20] it should be immaterial to the Companies where the power is coming from. Additionally, Duke Energy's metering currently cannot tell which part of the facility is supplying power so it unclear how this could be enforced.

Second, the requirement in Item 7 to maintain output level at the highest possible output level is inappropriate.[21,22] The QF compensation and operation structure should be fair to any QF that an operator wants to propose, whether that is a 1-hour battery to control ramping and avoid a solar integration charge, a 4-hour battery to discharge during premium period, or any other design. With Item 7 in place, the Protocol effectively favors particular system designs, rather than

[20] Duke Energy Reply Comments, Exhibit 6 at p. 1.

[21] Duke Energy Reply Comments, Exhibit 6 at p. 1.

[22] PURPA does not grant the utility control over when a QF produces electricity, how much to produce, or what the production profile should look like (except in certain emergency situations).

simply ensuring that the QF is fairly compensated for its output, regardless of its design.

This requirement also will sub-optimally limit system discharge at low levels. During a winter morning when winter peak system demand begins before sunrise, for example, the battery can begin to discharge at the beginning of a morning premium peak period. However, before the sun comes up system discharge will likely be limited by the highest sustained level of battery discharge. Depending on battery size, the protocol as it stands today could require the QF to curtail its solar generation as the sun rises in order to keep system output flat during the premium peak. This is the case regardless of whether the system will benefit from an increased level of generation from the QF as the sun comes up and can generate more electricity.

VI. SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

Q. Please summarize your primary conclusions regarding Duke Energy's proposed language on material modifications.

A. My conclusions are as follows:

1. Duke Energy's proposal actively discourages the addition of battery storage, a capacity resource that would add significant value to the system and to ratepayers by firming up solar PV variability and allowing the shifting of output from solar QFs to further align with system peak. This shifting can address the criticism of solar PV, expressed by Duke Energy, that the typical solar generation profile is not coincident with certain peak demand periods.[23]

2. The Companies' claim that allowing QFs to integrate battery storage will increase costs to customers is inaccurate and ignores the significant potential increased

[23] Duke Energy Initial Statement at p. 24.

value to the system provided by storage that can both firm capacity and align QF power output with system-wide capacity needs.

3. The proposed Energy Storage Protocol is imprecisely targeted at QF system sub-components, and it imposes a constant output requirement that could unnecessarily limit generation output during high demand, premium periods.

Q. Please summarize your recommendations for the Commission.

A. I recommend that the Commission do the following:

1. Reject Duke Energy's current proposed material modification language in the terms and conditions.
2. Require that Duke Energy honor existing contracts with QFs that integrate battery storage, for all capacity in their contract.
3. Require that Duke Energy develop a modified rate design proposal for existing QFs that seek to integrate battery storage, to be approved by the Commission, that will: (1) pay QFs their existing rates; (2) shift the premium pricing time periods to align with current system peaks.
4. Require that Duke Energy allow QFs that integrate battery storage to shift the profile of generation and discharge at the discretion of the operator, so long as the QFs dispatch in accordance with the final Commission-approved Energy Storage Protocol and during a time period that the Companies have evaluated with a System Impact Study.
5. Require that Duke Energy amend the Energy Storage Protocol to (1) only regulate output of the QF, not operation of the subcomponents; and (2) remove the requirement of constant output during the premium peak hours.
6. Require that Duke Energy expedite System Impact Studies for existing QFs that want to integrate battery storage to understand the grid impacts from the integration of a solar QF in all hours when the utility thinks there could be a system peak (not just during the hours that fall within current study window).

7. Require that Dominion Energy follow all the above outlined recommendations if any QFs in Dominion Energy's territory seek to integrate battery storage into an existing QF.

Q. Does this conclude your testimony?

A. Yes