NEPR

Received:

Oct 23, 2019

11:35 PM

GOVERNMENT OF PUERTO RICO
PUBLIC SERVICE REGULATORY BOARD
PUERTO RICO ENERGY BUREAU

IN RE: REVIEW OF THE PUERTO RICO ELECTRIC POWER AUTHORITY INTEGRATED RESOURCE PLAN	CASE NO. CEPR-AP-2018-0001 **SUBJECT**: PRE-FILED TESTIMONY

MOTION SUBMITTING EXPERT WITNESS PRE-FILED TESTIMONY

TO THE HONORABLE PUERTO RICO ENERGY BUREAU:

COMES NOW Sunrun, represented by appearing counsel and respectfully alleges and prays:

1. Sunrun submits testimony of one expert witness:

   A. Mr. Christopher J. Rauscher, J.D., Director of Policy & Storage Market Strategy at Sunrun.

Note that attestation of witness' prefiled testimony has been carried out as per Regulation 9021, Section 3.06 and notarized as per norms of the State of Maine, where witness is domiciled. We are, notwithstanding, able to execute additional formalities if this Honorable Bureau so requires.

WHEREFORE It is respectfully requested from this Honorable Energy Bureau receive and accept the testimony submitted.

CERTIFICATE OF SERVICE

We hereby certify that a copy of the filling was sent via e-mail to the Energy Bureau Clerk to secretaria@energia.pr.gov and wcordero@energia.pr.gov, and to counsel at legal@energia.pr.gov; and sugarte@energia.pr.gov.

Additionally, the instant filing was sent via e-mail to pending or actual intervenors:

Arctas, Caribe GE, League of Cooperatives and AMANESER 2025, OIPC, EcoEléctrica, Empire Gas, Environmental Defense Fund, Local Environmental Organizations, National, "Non Profits", Progression, SESA-PR, Renew, Shell, Wartsila, Windmar Group and amici ACONER, AES-PR, RMI, CUD, MIDA, PRMA and ICSE at the following e-mail addresses: agrait@agraitlawpr.com; sierra@arctas.com; tonytorres2366@gmail.com; cfl@mcvpr.com; gnr@mcvpr.com; info@liga.coop; amaneser2020@gmail.com; hrivera@oipc.pr.gov; jrivera@cnslpr.com; carlos.reyes@ecoelectrica.com; ccf@tcmrslaw.com; manuelgabrielfernandez@gmail.com; acarbo@edf.org; pedrosaade5@gmail.com; rmurthv@earthjustice.org; rstgo2@gmail.com; larroyo@earthjustice.org; jluebkemann@earthjustice.org; acasellas@amgprlaw.com; loliver@amgprlaw.com; epo@amgprlaw.com; robert.berezin@weil.com; marcia.goldstein@weil.com; jonathan.polkes@weil.com; gregory.silbert@weil.com; maortiz@lvprlaw.com, rnegron@dnlawpr.com; castrodieppalaw@gmail.com, voxpopulix@gmail.com, paul.demound@shell.com, escott@ferraiuoli.com; mgrpcorp@gmail.com, aconer.pr@gmail.com; axel.colon@aes.com; rtorbert@rmi.org; kbolanos@diazvaz.law; & n-vazquez@aeepr.com.

In San Juan, Puerto Rico, this 23rd day of October 2019.

Respectfully submitted,
[*signed/ Javier Rúa-Jovet*]

Javier Rúa-Jovet
Director of Public Policy,
SUNRUN

RUA12602
Centro de Seguros Bldg.
701 Ponce de Leon Ave.
Suite 406
San Juan, PR 00907
(787) 396-6511
javier.ruajovet@sunrun.com

NEPR

Received:

Oct 23, 2019

11:38 PM

SUNRUN IRP DIRECT EXPERT TESTIMONY

MR. CHRISTOPHER RAUSCHER

SUNRUN IRP DIRECT EXPERT TESTIMONY BY MR. CHRISTOPHER RAUSCHER

A. Witness Identification:

1. Q: Please state your name, title, employer, and business address.
2. A: Christopher J. Rauscher, J.D. I am the Director of Policy & Storage Market Strategy at Sunrun, Inc., which is located at 225 Bush Street, #1400, San Francisco, California.
3. Q: On behalf of which intervenor are you testifying before the Puerto Rico Energy Bureau in this IRP proceeding?
4. A: I am testifying on behalf of Sunrun, Inc.
5. Q: Briefly describe Sunrun nationally and its presence in Puerto Rico.
6. A: Sunrun is the leading residential solar, storage, and distributed energy/grid services company in the United States, with over 1,760 MW deployed and more than 255,000 customers in 22 states, the District of Columbia and the Commonwealth of Puerto Rico. Sunrun began deploying to Puerto Rico philanthropically post Hurricane-Maria in mid-October 2017, in partnership with local firefighters, Empowered by Light (non-profit), and leading local construction firm Aireko to bring solar and battery storage to fire stations on the island. Sunrun completed three fire stations installs. Previously, the stations had been powered by unpredictable diesel generators operating on only a few hours of energy a day. Unfortunately, the island keeps getting hit by blackouts. Our donated installations have been providing continuous power to the fire stations during

these blackouts. In June 2018, Sunrun formally entered the Puerto Rico market, in partnership with a local installation company. Since then Sunrun has been installing our residential solar plus storage systems, growing dozens of local jobs, and helping to rebuild the grid, one home at a time, through our local partners. Sunrun has also been and plans to continue being deeply engaged in the Puerto Rico processes that have advanced and continue advancing the policies that enable the transition to a decentralized and democratized electricity system, like Act 17-2019 and related implementation actions.

B. Subject Matter Addressed in Testimony:

7. Q: What is the subject matter of your testimony?
8. A: I will focus on aggregated solar plus storage technologies that should be specifically considered in this IRP process and by PREPA as part of a robust approach to distributed energy and demand side management to reach Puerto Rico's energy policy objectives. I intend to articulate the rationale for utilizing distributed solar and storage in Puerto Rico as part of the IRP's generation and grid planning process, to inform rational, forward looking programs and procurements. I intend to also suggest potential elements and structures that should be considered to realize the potential for this technology. Networked distributed solar and storage will play a critical role in rebuilding Puerto Rico's energy system while contributing to site-level resiliency and reducing costs.

C. Educational Background and Qualifications:

9. Q: What is your educational background?

10. A: I obtained a Bachelor of Classics from Dalhousie University in Halifax, Canada and a Juris Doctor from University of Maine School of Law.

11. Q: What is your relevant professional experience?

12. A: I joined Sunrun in 2015, with an initial focus on federal energy policy. I now focus on the intersection of energy policy and DER aggregation business development. I primarily work in the Northeast and Caribbean, but have experience nationally. I lead Sunrun's ISO-NE and NEPOOL engagement and help guide interactions with FERC. I frequently testify at state legislative hearings and intervene in regulatory dockets throughout the Northeast. My work centers around the role that aggregated distributed solar and storage can play in our electricity system by providing services that more traditional resources do. This includes driving Virtual Power Plant procurement opportunities, retail-level tariff development, wholesale market participation, and disaster recovery.

Prior to Sunrun, I was an energy policy advisor to US Senator Angus King. I counseled the Senator on the Energy and Natural Resources Committee in the US Senate. I advised Senator King on all subjects related to his committee responsibilities and to the energy system both nationally and in the New England region. I also conducted research and drafted bills for the Senator, including the Free Market Energy Act which set federal parameters around state-level distributed generation proceedings.

D. Specific Testimony and Basis for Conclusions and Recommendations:

13. Q: Dr. Nelson Bacalao from Siemens has expressed for the record the notion that aggregated distributed solar & storage or so-called virtual power plants are an embedded

or silent premise of the IRP. What exactly are the services that can be provided by aggregated distributed solar plus storage and Virtual Power Plants (VPPs)?

14. A: Rooftop solar and energy storage provide renewable energy to PREPA's grid and can be designed for future integration into a Distributed Energy Resource Management System (DERMS) to be adopted by PREPA. Because adoption of distributed solar and energy storage is expected to grow in Puerto Rico, this will represent a large resource, reaching hundreds of megawatts of capacity in coming years. Because it is a uniquely valuable resource the IRP should not remain "silent" on it. Instead its capabilities should be articulated, target scale agreed, and routes to procurement identified.

As Puerto Rico's grid continues its transformative recovery from Hurricane María, a fleet of distributed assets can be monitored and managed as a dispatchable resource at multiple levels of aggregation, which will support mini-/micro-grid architecture. This is sometimes described as a "Virtual Power Plant". In terms of capabilities, distributed resources can be managed to provide fundamentally the same services that can be provided by individual larger energy storage installations sited on the grid. This includes:

- System-level peak capacity and ramping services
- Fast-responding dispatches filling the need for spinning reserves
- Automated inverter-based response to frequency deviations

Distributed resources have unique additional capabilities and value that may not be accessible to larger scale energy storage depending on its siting on the grid, including:

- Peak capacity in localized areas reducing the need for transmission capacity in standard or contingency operations, for example in a "mini-grid architecture"
- Peak capacity on the distribution grid (coincident or non-coincident with system peak), reducing strain or investment on distribution in standard or contingency operations
- Distribution services including voltage management
- Neighborhood and site-level resiliency

As I will describe in greater detail, by leveraging the capabilities of third parties that deploy and aggregate distributed solar and storage assets, they can provide immediate value even before a full DERMS software is adopted by PREPA. This means that procurement of this resource can begin alongside all other resources in the IRP.

15. Q. What is the relative cost-effectiveness of distributed solar and storage for use in Virtual Power Plants as compared to so called "utility scale" or large-scale installations?

16. A. The cost of a VPP takes account of both added value energy storage provides at the distribution grid as well as the lower effective net cost for battery capacity realized after customers procure energy storage for resilience. If storage paired with solar and eligible for the ITC is compared with standalone storage, this cost effectiveness grows further.

We have used the information included in the PREPA IRP to compare centralized solar costs with prospective distributed solar costs in Puerto Rico. Sunrun believes this analysis illustrates that with a few conservative assumptions, the IRP analysis suggests that distributed solar can be equally or even more cost effective than centralized solar on a *delivered energy* basis. A key driver of this is avoided line losses, which the IRP estimates are as high as 17%. Additional factors are requisite infrastructure costs associated with centralized solar that are not required for distributed solar, such as land costs, interconnection costs (which are embedded in the distributed solar cost) and transmission and distribution costs. Let me explain a bit more.

First, the added value of T&D peak capacity and distribution level services must be taken into account as value that distributed storage can provide. This can be valued in terms of specific avoided infrastructure costs or in relation to the marginal cost for T&D capacity on the PREPA system. Given the generalized need for T&D investment and hardening across the PREPA system, it would be appropriate to assign a value to all Virtual Power Plant resources on the distribution grid set to the marginal T&D capacity cost.

Second, customers have "voted with their feet" - and with their wallets - to show there is strong demand to adopt batteries for resilience. When batteries are used solely in case of backup power, the entire cost of the battery has been paid for by the customer. However, customers can gain substantially all backup value of battery capacity if they (a) retain a portion of battery charge at all times and (b) have paired solar to recharge batteries during extended outages. Customers gain the full value of a battery during outages even while "sharing" use of a significant portion for energy management during all other times.

For example, a customer with a 16 kWh battery who reserves 8 kWh in battery capacity can charge with solar and discharge (or "cycle") 8 kWh per day for use in a Virtual Power

Plant or in another form of load shifting for grid value. If 8 kWh from the battery is discharged over two hours during 4-6pm as a Demand Response type resource to reduce peak load, the customer retains 8 kWh in the battery. If a short outage occurs, the customer will have backup power for this period. In an extended outage, the 8 kWh may eventually run out overnight if the homeowner does not monitor their demand, but beginning immediately the following morning, the paired solar system powers the home and recharges the battery. In Sunrun's experience, customers are highly likely to participate in programs to "share" or utilize battery capacity if they are compensated appropriately because this reduces their realized costs substantially. This type of grid service program is, in fact, the default for most of Sunrun's battery markets. This creates attractive net costs for battery capacity for use by the utility, illustrated below.

Illustrative Net Value Comparison - Grid-Scale vs. Customer-Sited Battery

	Grid-Scale Battery (Standalone)	**Customer-Sited Battery (PV Tied)**
Battery Capex	$300 / kWh	$800 / kWh
26% ITC Benefit	-$0 / kWh	-$208 / kWh
Customer Payment for Resiliency Value	-$0 / kWh	-$300 / kWh
Net Cost to Utility for Battery Capacity	**$300 / kWh**	**$292 / kWh**
Avoided Marginal T&D Cost (4-hour duration, 10 year battery lifetime)	-$0 / kWh	-$92 / kWh
Net Cost to Utility for Battery Capacity after Added T&D Value	**$300 / kWh**	**$200 / kWh**

17. Q. Can you explain line losses a bit more?

18. A. Yes. Solar and storage sited at customer load eliminates technical losses that occur between centralized generation and consumption. The IRP suggests that PREPA's losses from gross generation to net sales are 17%. This means that the peak capacity delivered by a battery sited with load is 17% more efficient than peak capacity delivered from centralized generation. In other words, 1.00 kWh of output from a centralized source will serve ~0.83 kWh of peak load. 1.00 kWh of output from a battery sited with customer load will deliver 1.00 kWh of peak capacity. It will also eliminate the need for the transmission and distribution capacity to deliver that energy.

19. Q. Why is it necessary for the IRP to make explicit the Virtual Power Plant resource type that is currently "embedded" in the IRP?

20. A. Distributed solar and energy storage serving as Virtual Power Plants create a new resource type that requires procurement. It also modifies resources assumed to be in the IRP. For example, a large percentage of future distributed solar installations in Puerto Rico will be paired with batteries behind-the-meter. If these batteries are used for load shifting of any kind (whether in response to a Demand Response program or a full fledged Virtual Power Plant approach) this will modify the assumed production from such solar in dramatic ways. To properly value this solar requires considering the resulting load shape and dispatchability. If this approach is taken, it may be seen that when VPP potential is added to EE potential, the overall potential and value from demand side resources is much greater than has previously been assumed and the best

possible portfolio approach may shift.

Second, to serve as planning resources VPP resources must be procured. In order for VPP's to offset investment in infrastructure or capacity that may be less cost effective procurement must be done *before* these other resources are procured. Otherwise these sunk costs cannot be avoided. Further detail is shared below on procurement approaches including how this can relate to T&D infrastructure costs. If VPP approaches are assumed purely as a reaction that will be overlaid on whatever distributed solar and batteries happen to be "autonomously" procured by customers, the potential for integrating distributed resources into the grid will be largely lost. Instead there will be duplicative infrastructure that increases costs for all Puerto Ricans and forestalls progress to clean energy policy goals. This "Autonomous Procurement" must be harnessed.

Finally, the IRP cannot serve its key function of determining which resources are most cost effective if it is not investigating the actual *costs* as well as *values* that VPPs can deliver. This is not accomplished by saying that a certain amount of distributed solar is likely to appear. I describe in detail below how (a) distributed solar can have lower costs than centralized solar on a *delivered cost basis* (b) distributed storage capacity can have a lower cost than centralized storage capacity on a *net value basis* after resiliency value is taken into account and (c) targeting procurement of specific megawatts of distributed capacity to mini-grid regions can result in reduced infrastructure costs.

21. Q: Do you see TOU as a path for a solar plus storage VPP?

22. No. TOU rates can be a behavioral tool for demand-side management, but unless they are

mandatory for all residential customers they will not drive solar plus storage deployment. This is because TOU rates are very complex and it is difficult to explain the value proposition they represent and then also explain the sophisticated technology that customers can adopt to manage the rate. Further, without historic load profiles for customers it is very difficult to present any TOU-based value proposition at all. If a full VPP cannot be procured in the short-term, a Bring-Your-Own-Device demand response program is a much better pathway for driving value from customer-sited batteries than TOU. Most states in the Northeast have, in fact, taken this approach.

23. Q: Why are these aggregated solar plus storage or so called Virtual Power Plants a path forward for Puerto Rico and for PREPA?

24. A: Utilities like PREPA have two general choices for renewable energy: a centralized, utility-scale solar array paired with utility scale energy storage, or a distributed network of solar and energy storage, installed directly on the homes and apartment buildings of residents and other like structures and facilities. Distributed, behind-the-meter installations can be networked to be centrally managed as one coordinated resource. This resource can collectively perform the same capabilities as a central power plant and in some cases perform even more valuable services to balance the local grid, thus reducing costs for transmission and distribution assets by reducing the peak loading on these assets or reducing the need for redundancy in the event of failures of individual lines. A fleet of distributed solar and energy storage resources can then be intelligently integrated into a DERMS to be adopted by PREPA or its concessionaire, and then managed by PREPA or its concessionaire for the overall benefit of the grid. Leading markets where distributed

energy storage is being utilized for grid value include California, New York, and Massachusetts. Puerto Rico can use this solution to put into practice the same smart solar and energy storage approaches being used in these leading states. Additionally, Hawai'i is a proving ground for island applications of customer-sited solar paired with energy storage, and Puerto Rico can be the first to apply these technologies at the largest scale to benefit all its residents.

25. Q. Why is aggregated solar plus storage an appropriate resource for PREPA's system?

26. A. Aggregated solar plus storage Virtual Power Plants are an ideal technology for PREPA because this approach dovetails with enormous solar and battery technical potential and customer demand for resiliency and the hundreds of millions of dollars that PREPA customers will independently invest in these technologies. Because it can be interconnected behind the meter, rooftop solar and energy storage can be designed to provide emergency backup power to the facilities on which it is installed on an unlimited duration basis by recharging batteries via solar.

If these resources are not utilized in Virtual Power Plants, duplicate infrastructure will be built at a cost to all ratepayers. If these resources are partially used for grid services, customers can earn value from this and leverage that towards increased investments in resiliency for both private and public benefit.

In addition, coordinated deployment of customer-sited VPPs can be a tool for PREPA to hedge against the significant risk of grid or load defection.

27. Q: Is this VPP or aggregated solar plus storage approach consistent with the draft IRP?

28. A: Yes. It is fully in line with PREPA's draft Integrated Resource Plan, which emphasizes development of over 750 - 1,200 MW of solar in 2019-2022 and 500 - 1,100 MW of storage over the same time period. VPP approaches are modular and can be adapted to integrate with any of the potential paths considered in PREPA's IRP. Specifically, this approach is a full expression of the path articulated in the IRP for "distributed, flexible generation, emphasizing resiliency and closer proximity of generation sources to the customer." Even as behind-the-meter, customer-sited solar delivers backup power to individual buildings that centralized solar cannot deliver, the proposed approach eliminates many of the costs associated with solar that are assumed in PREPA's IRP, namely most interconnection costs and land costs. Furthermore, local generation in urban areas can reduce the need for cross-island transmission capacity and spinning reserves to account for both generation and transmission contingencies. For these reasons, the proposed RFP may produce results that beat expectations for rooftop solar and behind-the-meter storage costs and value relative to current planning assumptions.

29. Q: Would you explain in detail some actual Virtual Power Plant projects?

30. A: 1. ISO-NE Capacity: Last winter, Sunrun won a 20 MW bid in the ISO-NE wholesale capacity market, where we competed on price with traditional generating resources. The capacity market secures obligations 3-years forward to ensure there is enough generating capacity to serve need in the region. Sunrun's winning bid represents about 5,000 solar and storage homes spread across four states in New England. Importantly, as with all of our projects, we will be ensuring our customers retain enough battery charge for backup power, even as we meet our market obligation. So, a locally resilient solution providing a

competitive wholesale market need.

2. Hawaii Electric: This 1,000 home, 4.3 MW Virtual Power Plant was awarded to Sunrun and its partner OATI via RFP. We will provide HECO with peak load reduction over 4-hour periods as well as autonomous fast frequency response for the grid.

3. East Bay Community Energy multifamily: EBCE is a community choice aggregator in the Bay Area in Northern California serving approximately 600,000 customers. A CCA is a public entity that functions similarly to a retail energy provider in deregulated markets, procuring and selling power with a mandate to increase clean energy mix. Sunrun has partnered with EBCE as part of a portfolio of local resources to retire a peaker plant located in Oakland, CA. To do this, Sunrun will develop solar and storage on affordable multifamily housing and use the batteries on each site to provide peak capacity. This will be done by aggregating the batteries as a Proxy Demand Resource for participation in the CAISO. By meeting market participation requirements a PDR serves as "Resource Adequacy" as required of load-serving entities in California.

31. Q: Could such a Virtual Power Plant be deployed in Puerto Rico?

32. A: Yes.

33. Q. What is the scale that distributed solar and batteries could reach in Puerto Rico in order to form Virtual Power Plants, for example from the residential segment specifically?

34. A. We estimate that the techno-economic scale potential for distributed solar and energy storage in Puerto Rico from the residential sector alone, meaning the scale at which solar

and battery installation could be carried out at economics comparable to those under which customers are already adopting solar and batteries, is approximately 6.6 GW solar and 12.4 GWh energy storage. This includes >1 GWh of potential in eight of the ten prospective "mini-grid" regions that Sunrun has examined. This effectively means that there is no practical upper bound that PREPA will experience in coming years if it seeks to develop aggregated solar and energy storage Virtual Power Plants. By procuring aggregated solar and energy storage Virtual Power Plants, PREPA will simultaneously be providing a value stream that supports residential customers adopting batteries for resiliency. The following table estimates the total residential BTM solar and energy storage potential for each minigrid.

Minigrid	**Total Number of residential properties**	**Solar viable residential properties**	**Behind-the-Meter Solar Potential (MW)**	**Avg. Solar kW per Home**	**Behind-the-Meter Battery Storage Potential (MWH)**
Veja Baja	254,479	142,958	1,104	7.8	2,148
Jayuya	205,545	129,138	1,057	8.2	1,937
Yabucoa	166,825	96,294	781	8.1	1,444
Mayagüez	155,525	83,109	674	8.1	1,246
Barceloneta	115,318	79,592	672	8.4	1,194
Humacoa	146,411	79,421	644	8.1	1,915
San Juan	242,678	77,569	601	7.8	1,164
Costa Sur	126,764	74,109	601	8.1	1,112
Sabana Llana	136,348	57,964	451	7.8	869
Aguas Buenas	10,794	5,590	45	8.1	830
Vieques & Culebra	6,613	2,555	21	8.1	38
Total	**1,567,300**	**828,299**	**6,658**	**8.0**	**12,424**

35. Q. What metering and communications technology must PREPA invest in to realize the potential of distributed solar and storage?

36. A. A key facet of aggregated solar and energy storage Virtual Power Plants is that their value can be maximized by full integration with a utility's grid management, but that significant value can be delivered and measured even with no capex investment by PREPA. Distributed solar and energy storage can be aggregated and managed using independent communications networks.

For example, each solar and battery installation used in a Virtual Power Plant would be installed with connectivity such as via cellular chip or customer wi-fi network (or both) as solar and battery installations currently include. This allows an aggregator to communicate with each device including receiving operating data on frequent intervals. This eliminates the need for a PREPA smart meter as a prerequisite for using batteries as a demand side resource. It is only necessary for PREPA to interact with the aggregator to send signals and receive telemetry following a response - this could be as simple as a dispatch signal from PREPA via an email, requiring no DERMS.

In the event of an outage that makes cellular communication impossible, solar and batteries would presumably also be in outage mode and delivering backup power to each individual site. In other words, a VPP would not be sought for grid services when the grid is down, so cellular service interruption is not an impediment to a VPP. For more intermittent cellular communication interruption, batteries would operate according to the last received communication. In aggregate, VPP resources would be highly responsive based on cloud-based communication to each device.

In Puerto Rico, maximum value might be delivered from a Virtual Power Plant aggregation if it can be called as a replacement for spinning reserves on <10 minutes notice. This may require integration with PREPA's control centers for automated dispatch. PREPA's grid managers would send a signal to the software platforms of a VPP aggregator requesting this response, and the aggregator's platform would issue commands to each device for a response.

However, at any time an aggregator that manages distributed storage could set batteries to charge or discharge according to a variety of price signals or schedules set by PREPA or communicated via analog means. For example, charge and discharge schedules could be set to provide system or local peak shaving. This could be updated on a day ahead basis or communicated via phone or email if emergency changes are needed. This means that PREPA can begin taking advantage of distributed battery potential in the near future.

37. Q. How can PREPA encourage customers to "share" battery capacity as part of Virtual Power plants so that battery capacity can be accessed at the lowest cost?

A. As noted above, a key feature of the cost effectiveness of a Virtual Power Plant is shared utilization for grid value while delivering resiliency value to customers with the residual capacity and during extended outages. In order to minimize complexity for PREPA while creating a customer-centric approach, aggregators can engage customers with a variety of constructs to choose from.

This means that PREPA does not need to make any changes to billing infrastructure, rate structures, or customer communications in order to realize VPP potential, because aggregators manage these elements on PREPA's behalf. This can be done in partnership with the utility to ensure alignment with overall customer engagement goals and approved approaches.

For example, an aggregator can earn a management fee for each kilowatt of battery capacity it makes available to PREPA for dispatch. They can then share a portion of this value with an end customer who adopts a battery and makes it available for dispatch by that aggregator. Aggregators could have varied approaches. Some customers might want to receive value of participation in a 10-year VPP program in the form of an upfront discount or "rebate". Other customers may want to receive a monthly or annual payment for ten years. An aggregator would manage this. PREPA simply needs to make available a reliable value stream for the capacity that an aggregator makes available to customers. Aggregators would manage all aspects of communication with customers and devices.

38. Q. What best practices could PREPA adopt in order to procure Virtual Power Plant capacity at the most efficient costs?

39. A. Successfully procuring BTM solar and battery storage resources for minigrids and normal grid operation will take different forms than standard procurement for utility-owned assets. However, creative engagement with clean energy innovators will enable PREPA to deliver a customer-centric approach to building out the resources needed for mini-grids. Working with developers and aggregators of distributed solar and energy storage will reduce deployment costs so that they approach the installation costs illustrated above in comparison with centralized resources. Approaches for procuring innovative clean energy resources can include the following:

a. Define the utility need, not the specific solution. By clearly articulating the need in terms of the operating and delivery requirements for a solution, respondents can identify approaches that PREPA may not have imagined. This could include technology, financing or business model elements.

b. Share data to enable smart solutions. The best solutions will be informed by a clear picture of grid needs. For example, data on load patterns and mapping of the distribution grid will enable respondents to propose solutions that are designed to fit the unique characteristics of individual mini-grids. Specifically, characteristics of contingency operations would enable design of creative solutions specific to that need.

c. Enable respondents to propose creative modes of collaboration with PREPA to deliver on the need. The best technology option may include new business models. For example rather than resources being owned by the utility, the utility could play a role to help third parties deploy resources to target locations. Creative structuring of a contract with PREPA could enable respondents to leverage private financing and reduce upfront cost burdens for the utility.

d. Value modularity and flexibility. Small-scale energy resources can be deployed over time in relation to evolving needs and improving technologies. PREPA could create master structures in which increments of resources can be deployed over time, facilitating efficient partnerships with successful clean energy developers.

e. Value proposed approaches holistically. New approaches may create multiple values for the grid, for example delivering support in a minigrid contingency operations scenario but also delivering capacity or ancillary services on an ongoing basis. Evaluation of solutions should enable respondents to highlight the full scope of benefits their solution can provide, inclusive of infrastructure cost savings, environmental benefits, and social and economic impact of the project and for customers.

40. Q. Can VPPs support the mini-grid architecture considered for PREPA's grid?

41. A. Yes. The above procurement and programmatic approaches could be utilized to support regional or local needs, for example as follows:

a. PREPA identifies the need for local generation and battery capacity in a geographic area such as a mini-grid region and the avoided infrastructure and generation / storage cost that can be delivered via distributed Virtual Power Plant.

b. PREPA partners with one or more developers / aggregators in this region to maximize deployment of resources in line with these goals and to aggregate and make available to PREPA this capacity.

c. PREPA works with public agencies and municipalities to identify sites for solar and energy storage to be developed and incorporated in the Virtual Power Plant.

d. The developer / aggregator also works independently and with PREPA's support to engage customers (residential, C&I) to deploy solar and energy storage.

e. Customers gain resiliency at reduced cost for sharing utilization of their batteries and/or earn an ongoing value stream for the same.

f. PREPA coordinates with developer / aggregator to utilize the Virtual Power Plant for grid services and capacity during normal and contingency operations. PREPA sends dispatches, receives data on asset performance and pays for performance delivered.

42. Q: How could such a Puerto Rico VPP be deployed for the greatest public benefit?

43. A: One possible path would be for PREPA and/or public entities to develop solar and energy storage on public sites across Puerto Rico resulting in a new 100% clean energy resource that lowers costs for all customers and provides emergency backup power to each site, with a focus on sites that deliver emergency services and that are needed in the event of grid outages. Between school, municipal and public housing resources there are hundreds of megawatts of solar and energy storage potential that can be realized via partnership with public property owners. Once installed, solar and storage assets would provide valuable services for the grid, just as with a central power plant, and can enable PREPA to more quickly reduce usage of expensive existing generators to maintain grid reliability. Public agencies with critical facilities and extensive building stock could partner with PREPA and private developers to make rooftops available as development sites for rooftop solar and energy storage. Puerto Rico can help people who need it most by directly utilizing rooftops at public housing and critical facilities for first responders (eg. fire, police, medical, and other essential services) to provide emergency backup power for vulnerable communities.

Further, when emergency backup power is not required, the sites can be leveraged to provide flexible PREPA grid services as required and contribute to a system of more distributed, flexible generation, emphasizing resiliency and closer proximity of generation sources to the customer. All assets and services could be delivered in a complete turnkey package to ensure cost-effective delivery without adding complexity for PREPA or site owners. As an inherently modular technology, development of solar and energy storage can be undertaken immediately and quickly completed, impacting dozens of communities.

A complementary fast path could also involve installing solar plus storage that is VPP capable in new private residential developments and other private premises. For example, mew urbanizations could be conceptualized since their inception as projects to provide its residents with resiliency when needed, while also providing PREPA with energy and grid services.

44. Q: PREPA's DRAFT IRP is by its own terms founded upon "five five key pillars", in brief, these are: a customer-centric, financially viable, reliable and resilient, model of sustainability, and an economic growth engine. PREPA has expressed that the IRP focuses on "addressing the impacts of an aging generation fleet, achieving a reduction of cost of supply by incorporating renewables at the new market prices, achieving compliance with the Renewable Portfolio Standard, and shifting from centralized generation to more decentralized generation resources distributed across the island. What in your opinion and experience would be the optimal path to achieve these ends?

45. A: As we learned during the blackout after Hurricane Maria, customer-sited solar with battery storage was and is a highly reliable solution. Fuel supply shortages and mechanical breakdowns resulted in many critical facilities ending up with no electricity

when the facilities were needed the most, some of which had double or triple redundancy with traditional gas/diesel backup generators. Distributed solar and storage is in our view the most reliable and resilient energy option available today. It is also the most customer centric, as the solar and storage equipment is located on the customer's premises, and the customer typically has a wide range of options to choose her configuration, sizing, location and financing for these systems. Solar plus storage is also a model of sustainability and sustainable economic development via emissions-free local solar and storage, declining costs at costs below other technology options, and the construction of solar plus storage provides more local jobs per megawatt constructed than any other form of energy generation. For these reasons, the optimal path to the most successful outcome, as measured by any one of the five pillars and as all of them taken as a whole, is to focus on the development of solar and storage solutions that are located at or as close as possible to a customer's property. This path could be referred to as a "bottom-up" approach, with the primary focus being utility support for the most rapid development possible of customer-sited solar and storage systems. And aggregated solar plus storage/VPPs, as discussed, optimizes and magnifies all these benefits.

46. Q: PREPA has expressed that the Draft IRP considers the development of distributed energy resources, distributed renewable generation, battery storage, demand response and energy efficiency. Do you agree that the consideration is sufficient and/or correctly framed?

47. A: The IRP's consideration given to distributed energy resources, distributed renewable generation, battery storage, demand response and energy efficiency is insufficient.

Clearly stating the central role of DERs and of aggregated solar plus storage in the final IRP is imperative. Distributed solar plus storage is the only no regrets energy option from all relevant perspectives: environmental, land use, socioeconomic, customer-resiliency, no fuel procurement, price stability, cost reductions for utility and prosumers and other benefits.

E. Conclusions and Recommendations:

48. Q: What are your conclusions and your recommendations pertinent to this IRP process?

49. A: My testimony has shown that today's technology allows for aggregation and coordination of multiple solar and battery systems, enabling communities to share energy and provide services to the grid, creating savings for all, while ensuring resilient backup power. I have established the rationale for clearly including aggregated, networked distributed solar and storage for Puerto Rico's grid and this IRP process. I also discussed elements and structures for the processes that can be utilized to procure and realize the potential for this technology in Puerto Rico.

Aggregated solar plus storage is a large scale resource being deployed now, building a smarter grid today from the bottom-up, benefiting customers with invaluable resiliency and utilities with grid and energy services that improve their operations and make them more cost-effective. There are efficient ways to achieve high penetration of solar plus storage by taking full advantage of Puerto Rico's ample flat roof resource in governmental as well as private sites. The environmental, land-use, economic and societal benefits are self-evident and have been discussed. This IRP process must overtly and specifically include aggregated solar plus storage as an important part of Puerto Rico's energy generation resources mix, so that it correctly informs procurement decisions that strictly align with binding pro-renewables public policy and the public interest in general.

52. Q: Does this complete your Direct Testimony?

53. A: Yes.

ATTESTATION

Affiant, Mr. Christopher Rauscher, being first duly sworn, states the following: the prepared Pre-Filed Direct Testimony and the information, documents and workpapers attached thereto constitute the direct testimony of Affiant in the above-styled case. Affiant states that he would give the answers set forth in the Pre-Filed Direct Testimony if asked the questions propounded therein at the time of the filing. Affiant further states that, to the best of his knowledge, his statements made are true and correct. ____________

Affidavit No. N/A

Acknowledged and subscribed before me by Christopher J. Rauscher in his capacity as Director of Policy & Storage Market Strategy at Sunrun, who is personally known to me or whom I have identified by means of his driver's license number 6224266 in Cumberland, ME, this 23rd day of October 2019.

Public Notary Taige Zhou exp 06/12/2024

TAIGE ZHOU
Notary Public-Maine
My Commission Expires
June 12, 2024