Power Plant Research Advisory Committee
Energy Storage Work Group Meeting
October 26, 2017 10:00 AM – 3:00 PM

Participating organizations: AF Mensah; Alexendar & Cleaver; Baltimore Gas & Electric (BGE); Geosyntec; Kent Conservation & Preservation Alliance (KCPA); MD Clean Energy; MD Energy Agency (MEA); MD Power Plant Research Program (PPRP); MD Public Service Commission (PSC); NextEra Energy Resources; Pepco; Pepco Holdings; Trane; and University of Maryland Energy Innovation Institute (EII).

This document summarizes the Q&A-based conversations that accompanied formal presentations, which are available on PPRP's website. Statements are paraphrased and, in some cases, moved to the Barriers discussion (see page 4) and grouped with other comments on a given topic.

Storage Use Cases Q&A Topics

Presenters:
Kiran Kumaraswamy, AES, front-of-the-meter applications
Betty Watson, Tesla, behind-the-meter applications
Marc Randell, Trane, thermal applications

Job Creation
Kiran (AES): Projects not going to lead to a lot of jobs—1 or 2 people at facility. Run remotely.

Pre- and Post-Installation Impacts
Kiran (AES): Pre-installation will follow standard protocols for construction. Looks like any commercial building site. Post-installation, expect 10-20 years of life, batteries degrade over time. 100 MW contract for 20 years—over time, augment system with additional battery modules to ensure 100 MW. Sustainability—send batteries back to suppliers to recycle.

Customer Bill Impacts
Betty (Tesla): On-bill credits to participants in Green Mountain Power's (GMP's) aggregated residential battery pilot program do not completely offset the cost of participating. Customer charges include the cost of cellular communications device.

Depression of System Prices
Betty (Tesla): The impact of storage on system prices is not reflected in GMP's payments to participants. Instead, GMP passes savings from not having to buy as much capacity from ISO New England's capacity market on to customers.

Electric Vehicles as Grid Resources
Betty (Tesla): Not much interest from Tesla's car customers. They want to know when battery will be charged and have freedom to use car when they want to.

Outage Performance Data
Betty (Tesla): Such data from the GMP pilot exists but not organized into useful info.

Rapid Deployment
Betty (Tesla): Notes recent Southern California Edison RFP to supplement natural gas generation that relied on natural gas from Aliso Canyon. AES and Telsa both received contracts. Took just 3 months. One thing that's useful about batteries is their modularity—they can be added in small increments to precisely meet demand.

Communication and Monitoring Equipment
Betty (Tesla): Battery function in GMP pilot program determined by inverter settings. Have not switched to internet, still using cellular services. GMP will use GridLogic for its new battery program. Utility controls in real-time. Cost of GridLogic is not included in customer fees.

Ownership Options
Betty (Tesla): Similar programs to GMP being proposed without utility ownership, i.e., San Diego Gas & Electric (SDG&E) program. The key is to aggregate batteries under utility control. SDG&E would have offered battery to customers for free. For GMP program, customer signs 10-year lease. Customer can take battery and end contract; transfer battery to a new place within GMP's service territory; or transfer the lease to the new owner.

Warranty
Betty (Tesla): Telsa offers 10-year warranty, expects one cycle per day. GMP services battery. Not sure if there is an additional service fee. Larger customers can re-up contract or Telsa can take battery back to factory for disposal.

Content of Liquid Used in Thermal Cooling Devices
Marc (Trane): We use water and glycol (~20%). Used in traditional A/C to keep systems from freezing in winter.

Feasibility of Using Heat to Store Energy
Marc (Trane): One can do thermal storage with just water; but need large site.

Steve (PHI): MN has rate for storing heat at night, Pacific NW for water heaters.

Heat Pump Efficiency
Marc (Trane): Depends on location. Heat pumps efficient in the South because it doesn't get as cold, not as efficient in the North. Efficient for heating hot water.

Which Use Cases are a "Good Fit" for Maryland
Betty (Tesla): For commercial and industrial customers, demand charges of $2-4/kW are tough to beat using demand management.

Kiran (AES): T&D segment, lot of work we can do there to increase efficiency of system.

Marc (Trane): Time-of-day rates could help incentivize peak demand shifting. You're paying the same amount at night and during the day, if you're paying average rates.

Utility Activities in Maryland

Presenters

John Maruc, BGE
Steve Steffel, PHI

Since John spoke without PPT slides, we have summarized his remarks and Steve's as well.

John M (BGE): Opportunities coming closer and closer. 93 solar installations in 2016. Over 26,000 distributed generation units in total, slowing down a little bit. Mostly rooftop solar (kW), 1-2 MW for commercial and community solar. Did study on energy storage two years ago—saw several areas of key interest for storage: voltage stabilization, reliability, less on resiliency (i.e., days and weeks timeframe), and peak load management. Doing peak load management project at substation that has a narrow spikey peak that will violate the operating limit on transformer. Working in conjunction with Exelon. Available tools include customer load management. Modularity of storage a key. Didn't see drivers or applications in 2015 at the time. Want storage as part of a utility's tool box to maintain reliability. Energy storage an option for deploying in voltage banks and capacitors.

Steve (PHI): I manage DER integration team. 55,000 solar installations for all of PHI. 80 MW system is the largest. Looking at energy storage in conjunction with a transmission project. Put storage along feeder to do peak shaving. Also have substation transformers. In evaluation mode, not as far along as BGE, not ready to order equipment.

Pilot project with Tesla (2.18 MW PV) and Battery (1 MW AF Mensah) at Chesapeake College. On feeder with a lot of solar capacity. Asked Telsa to put in advanced inverter for solar system. MEA funded battery project. Battery will participate in PJM ancillary services market. Solar system will meet load. Doing test of integration for optimizing distribution system. We can prioritize loss reductions, reduce operations on line equipment, control voltage, etc. Battery system will isolate load during outage; equivalent to micro-grid.

Another area: mitigation of reverse power on substation transformers. Reverse power can cause line faults on high side and trip the transformer. Can put in battery at substation at transformer. Absorb energy during low load and high solar output.

Some demonstrations are underway using vehicles-to-grid (V2G) for frequency regulation and load shifting. Working with a government agency that has EVs onsite to participate in PJM market. 200 kW, perhaps will be increased up to 1 MW.

Batteries can be beneficial to customers and the grid. Sometimes both benefit, sometimes mutually exclusive. Without proper control, operation can be detrimental to one or the other. Timing important with discharge and charge.

DER Integration

Steve (PHI): Working on DERM (distributed energy management system) to interact with distribution grid management system.

Grid Interconnection

Drew Adams (AF Mensah): Chesapeake College battery is both BTM and front of the meter. Has a front of the meter interconnection for participation in PJM. Also has direct connection to college for islanding.

Barriers to Storage Q&A Topics

Panelists:

Kiran Kumaraswamy, AES
Betty Watson, Tesla
John Quinn, BGE
Andrew Johnston, PSC

Getting Started

John Q (BGE): We expect a major transformation in next 10 years but it's all about taking the first step. The Energy Storage Study will help us figure out how to get storage off square one.

Utility Ownership

John Q (BGE): Utilities are integral to storage development and should not be excluded. Allow utilities to get involved and access market revenue streams.

Kiran (AES): Ownership is the main barrier. Industry has responsibility for making storage part of the "tool kit" for utilities for T&D planning. Need to provide certainty that it is an acceptable solution.

Andrew (PSC): Whether utilities can own storage is a threshold question; answer will help answer other issues. Statute unclear. Is storage generation? Not in a classic sense but competes in PJM market with other generation. Murky. In the PC 44 Storage WG's memo to the Commission, most people agree utilities can own storage if used for distribution functions. Needs clarity in statute, PSC regulation, or a PSC order. Also, how to ensure level playing field for third parties, and to ensure storage is cost effective. Do up-front proceedings for cost recovery need to be done? Does PSC need to weigh on issues with third parties?

Eric (EII): Storage is converting one energy source to another. It's not generation. This should not be an issue.

Non-Wires Alternatives

Betty (Tesla): In Maine, before transmission assets are considered, owner has to study non-wire alternatives and pursue those if they are more cost effective. Avoided $15 million transmission upgrades using $3-6 million of non-wire actions.

Pilot Programs

Kiran (AES): Pilot programs need to be tangible, defined, and with clear next steps. Pilots should be structured around demonstrating value/benefits, use cases and ownership models. But it should be developed with a view of creating a framework for broader deployment after results come in. There are enough storage projects built across the country that can serve as models for how technology works and how they enable utilities to realize benefits. (We can bring folks to Warrior Run to show that). The intention is not to figure out "whether it works". It is to do it with the idea of creating a broader framework for "at-scale" deployments after the first few projects.

Experience

Betty (Tesla): Regulatory certainty is important but so is experience. California storage procurements are a good example—state procurement target inspired early experience.

Data

Andrew (PSC): PC 44 Customer Choice Working Group looking at how to share data from AMI and smart meters. That will help energy storage.

Storage Technologies

Kiran (AES): There are many forms of storage (thermal, battery, molten salt, moving trains). Batteries technologies attractive because of speed of response and can follow signal very closely.

Shawn (DNR): Don't forget pumped storage technologies. Need to find someone in this group to represent pumped hydro storage. [Note: Anne Linder of Exelon is a member.]

Interconnection

Betty (Tesla): Interconnection process can be uncertain, complicated. Can take months and months for BTM. Is a battery a generator? How will it operate?

Andrew (PSC): The PC 44 Interconnection WG is proposing: a definition of storage for interconnection purposes; allowing utilities to monitor and control systems under 2 MW with customer consent; and considering how to define the actual capacity of combined solar/storage project (e.g., 20 MW solar system paired with 10 MW battery system).

John M (BGE): We all agree on interconnection and the need for reform.

Resiliency / Reliability Benefits

Kiran (AES): Resiliency is a huge issue. But it's a catch-all term like "smart grid." No one knows what it is. How do you quantify benefits with resiliency? How do you make it more tangible?

Eric Wachsman (University of Maryland Energy Innovation Institute): DOE has a NOPR to reward generators that keep 90 days-worth of fuel on-site. Yet with storage and solar, a site could be online indefinitely.

Betty (Tesla): We have lots of resiliency at the bulk power level. Ninety-day fuel supply may not be as valuable to end-use customers as staying on-line if grid goes down.

Kiran (AES): Each customer has a different appetite for resiliency.

Betty (Tesla): Outages in large events, such as hurricanes, don't affect outage statistics. Need to factor in those large events for reliability.

RPS

Andrew (PSC): Hard to translate energy storage into RPS, since 1 REC = 1 MWh. Production incentives would help energy storage.

Access to PJM Markets

John M (BGE): Need to look at PJM requirements to participate in market in order to access other revenue streams. BGE wants to work through these issues, as well, with developers and others.

Costs/Financing

Andrew (PSC): Financing and costs could be addressed through on-bill financing or procurements.

T&D Utilization

Kiran (AES): There is no industry measure like "capacity factor" for the T&D system. We should be increasing the efficiency of existing T&D assets (just as Uber is increasing utilization of cars-for-hire or airlines are minimizing time on tarmac). PJM transmission congestion—storage can play a role in reducing or alleviating transmission congestion.

Betty (Tesla): The way PJM addresses congestion, with Annual Revenue Rights (ARRs) and Fixed Transmission Rights, is inefficient. Perhaps, instead, we should ask what it would be worth to have 1 kW more of transmission and pay that resource.

Incentives

Marc (Trane): Include utility incentives for thermal storage in Empower MD peak reduction, like NY, NJ, CA.

Drew (AF Mensah): Incentives, pilot programs, benefit quantification. Incentives imprecise; better to have right market signals and market will take care of itself.

Rate Signals – End-Use Customers

Marc (Trane): Time-of-day rates help incentivize peak demand shifting. if you're paying average rates, you're paying the same amount at night and during the day. C&I customers in Maryland tend to think of electricity in terms of per kWh costs.

Betty (Tesla): For C&I customers, demand charges of $2-4/kW are tough to beat. Residential customers in restructured markets have zero ability to financially benefit from improving system conditions under current structures.

Betty (Tesla): TOU isn't an easy solution. Should it be keyed to coincident peak or distribution feeder peak? When is demand most important? If customers opt in, how do you treat customers that don't opt in? Need to make it simple for customers, clear end, not a lot of risk.

Andrew (PSC): Proposal for TOU before PSC. Distribution rate pilot, second is supplier-based pilot. EV working group is working to pair storage at charging stations at commercial buildings. Demand charges low for residential.

Betty (Tesla): How does adding a battery affect participation in net metering? Any energy from solar should count, regardless of what it goes through.

Andrew (PSC): Value of solar study underway at PSC; one part is to assess value of solar+storage. Out in spring 2018. Daymark Energy doing the study.

<u>Rate Signals – ISOs and Utilities</u>

Betty (Tesla): "Rate design" references customers, but "rate signals" applies to all segments. Do utilities get ROE bump? Is there a utility benefit for optimizing the distribution system? PJM has no signal to optimize their system.

Kiran (AES): There must be incentive for utilities to think of innovative solutions. For example, FERC gives added basis points for innovative solutions. How can we construct that at retail level to incent utilities to think of storage?

Bill (OPC): Peak shaving value decreasing in PJM in recent years, less valuable to have battery shave peak. Going in wrong direction. Separate from T&D questions.

Betty (Tesla): GMP example works because there is only one entity involved. Ownership affects who can take advantage of benefits. How do we ensure incentives stay intact?

<u>Location</u>

David C (MEA): Ensure if there are incentives that there is value to the grid, not just promoting storage that is placed anywhere.

<u>Rate Impacts</u>

Janet (KCPA): From consumers point of view, concern about cost shifting. If you raise rates during daytime, will customers have to buy a battery? Worried about electricity prices going higher.

John Q (BGE): If we can make the system run more efficiently, it will drive costs down. Decoupling helps.

Andrew (PSC): Costs always on PSC's and others' minds. Part of statutory duty of PSC and driving force behind PC44.

Eric (EII): How do we quantify benefits of storage? Is decreasing carbon a benefit? Is increasing jobs a benefit? Is reducing power imports a benefit? Like to see some verbiage to that effect.