Mid-Atlantic Solar & Storage Industries Association
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March 1, 2019

Ms. Aida Camacho-Welch, Secretary
and
Energy Storage Analysis team
New Jersey Board of Public Utilities
44 South Clinton Avenue
P.O. Box 350
Trenton, New Jersey 08625

Re: New Jersey Energy Storage Analysis

Via email to Energy.Storage@bpu.nj.gov and Rule.Comments@bpu.nj.gov

Dear Ms. Camacho-Welch and Energy Storage Analysis team:

On behalf of the Mid-Atlantic Solar & Storage Industries Association (MSSIA), formerly known as the Mid-Atlantic Solar Energy Industries Association (MSEIA), please accept these comments related to the above-referenced matter.

MSSIA is a trade organization that (as MSEIA) has represented solar energy companies in New Jersey, Pennsylvania, and Delaware since 1997. During that 21-year-plus period, the organization has spearheaded efforts in the Mid-Atlantic region to make solar energy a major contributor to the region's energy future.

During these years, MSSIA has adopted and followed three fundamental policy principles, which in short can be stated as: (1) Grow solar energy in our states as quickly as practicable; (2) do so at the lowest possible cost to ratepayers, while delivering the greatest possible benefit as a public good; and (3) preserve diversity in the market, including opportunity for Jersey companies to grow sustainably and create local jobs (see MSSIA's fundamental policy principles at https://mseia.net/fundamental-principles/).

Comments regarding issues listed in the Request for Comments

MSSIA offers the following comments regarding the issues identified in staff's request for comments. In general, MSSIA notes that large-scale deployment of energy storage will be a pre-requisite to achieving the renewable energy requirements of the Clean Energy Act and Executive Order 28. Comprehensive study, including quantification of a number of inter-related factors, as discussed below, is essential if a cost-optimized plan is to be created for compliance.

1. How might the implementation of renewable electric energy storage systems benefit ratepayers by providing emergency back-up power for essential services, offsetting peak

loads, providing frequency regulation and stabilizing the electric distribution system;

Offsetting peak loads – customer side
FR and DR – wholesale, grid side
Can generate revenue, reducing or eliminating the need for incentives to drive the deployment of storage in order to comply with the requirements of the act
Emergency backup power for critical facilities is a capability that energy storage facilities are uniquely suited to provide. Batteries are more reliable than engine-generators. They can come on line and respond to load much more quickly too, and can provide and maintain very high power quality. When used in conjunction with solar power, they offer backup power without dependence on external sources of fuel that can be affected by extreme weather events (when the emergency power is needed most). When batteries are used in combination with both solar power and engine generators in microgrid mode, very high reliability can be achieved as each of the sources exploits its own strengths while covering the weaknesses of the others.

2. How might the implementation of renewable electric energy storage systems promote the use of electric vehicles in New Jersey, and what might be the potential impact on renewable energy production in New Jersey;

The implementation of renewable electric storage systems will promote the use of electric vehicles by mitigating the need, and the cost, of service upgrades at facilities that need substantially more power in order to add electric vehicle charging stations. Multiple charging stations, or charging stations for heavy duty vehicles, can bring about the need for large amounts of additional power during peak EV charge times. Further, in order to make electric vehicles a practical choice for most New Jersey citizens, charging stations will trend toward fast chargers that draw very high levels of power. Behind-the-meter stationary energy storage assets, in addition to providing many other valuable services discussed elsewhere in this response, can be discharged to reduce a facility's peak EV charging demand, thus reducing or possibly eliminating the need for expensive service upgrades.

Even more importantly, the "rolling" battery capacity that will be embodied in New Jersey's future electric vehicle cohort can be used with bi-directional charging to help provide the necessary storage to enable large amounts of intermittent renewable energy on the grid, and to assist in maintaining reliable electric service. This vehicle-to-grid, or V2G capability is expected to be a massive asset, eventually dwarfing stationary energy storage capability (see the answer to Question 9, below). Taking advantage of this vital and cost-saving asset base will require planning, especially for an emphasis on bi-directional charging infrastructure with the attendant communication and software capabilities. It will also require cooperation from electric vehicle manufacturers.

3. What types of energy storage technologies are currently being implemented in New Jersey and elsewhere;

Grid-connected energy storage systems currently deployed in New Jersey, to our knowledge, include:
1. Grid-scale, commercial-scale, and residential-scale battery systems;
2. Electric vehicle batteries with vehicle-to-grid capability
3. Pumped hydro storage (Mount Hope Hydro)
4. Ice storage systems
5. Hydrogen energy storage in conjunction with electrolysis and fuel cells

Elsewhere, other notable energy storage systems include:
1. Compressed air storage
2. Flywheels
3. Ocean pumped hydro
4. Molten salt storage
5. Hot water and chilled water storage

4. What might be the benefits and costs to ratepayers, local governments, and electric public utilities associated with the development and implementation of additional energy storage technologies;

The benefits to ratepayers, local governments, and utilities are discussed elsewhere in this response.

5. What might be the optimal amount of energy storage to be added in New Jersey over the next five years in order to provide the maximum benefit to ratepayers;

MSSIA believes that thorough study is required in order to have a reliable assessment of the need for storage over the next five years. However, MSSIA generally agrees with the amounts required in the Clean Energy Act. Linear interpolation between the 600 MW by 2021 requirement and the 2,000 MW by 2030 requirement leads to an amount of energy storage in five years (2024) of about 1,170 MW. Assuming that the average discharge time duration of the energy storage is 2.5 hours (a guess), that would translate to about 2,900 MWH in terms of the energy rating of the storage (see below under Question 11 for more explanation of power rating vs. energy rating).

6. What might be the optimum points of entry into the electric distribution system for distributed energy resources (DER);

Generally all points of entry to the distribution system for DERs are useful. They can reduce peak loads on the circuits and substations to which they are connected and help control voltage. Energy storage in particular can provide those services, and also help counteract any effects of intermittency from renewable DERs.

In particular, points on the distribution system that are experiencing congestion or voltage excursions are especially optimal places for connecting DERs. Points on the distribution system that have high solar energy penetration are especially optimal places to connect energy storage. "End-of-the-line" battery assets can be aggregated to be particularly useful during peak demand periods, in addition to performing many grid-stabilizing services during normal times.

As mentioned before, critical facilities are valuable places to connect all types of DERs, singly or in combination as microgrids, that are capable of providing emergency backup power.

Any locations that have, or are likely to have, especially large total amounts of solar power connected, or that have single large-scale solar farms connected, should be prioritized for energy storage.

Finally, once large amounts of offshore wind power come online, it will be important to locate as much energy storage as possible close to the point of interconnection of that wind power as it reaches land. However, note that the offshore wind connection point or points may not be on the distribution system.

7. What might be the calculated cost to New Jersey's ratepayers of adding the optimal amount of energy storage;

As stated in the answer to Question 4, MSSIA does not believe it can calculate the cost to ratepayers of adding the optimal amount of storage at this time. As stated elsewhere in our answers, careful and comprehensive study that includes many factors, including storage, is needed in order to identify the optimal amount of storage. Further, the cost to ratepayers will be influenced not only by the decline in the cost of the storage technology, but also by the proportion of that cost that can be offset by market revenue, and by the value of parallel additional services, such as emergency backup power, that can be provided by the storage.

8. What might be the need for integration of DER into the electric distribution system;

Most DERs will need to be integrated into the electric distribution system. Barriers to this integration is already becoming very problematic, especially in Atlantic City Electric territory, where most of the potential points of connection are either not allowed or highly restricted, and many highly restrictive and expensive policies are applied even when connection is allowed. Many if not most of these problems could be solved by:

1. Modernizing the New Jersey interconnection standards, which are seriously out of date, and not meant for high penetration of renewables. Up-to-date standards must include high penetration of local circuits, and enabling substations to backfeed renewable power, as is routine in other states.
2. Allowing smart inverter capabilities to facilitate interconnection approvals (especially volt-VAR control).
3. Allowing energy storage to provide services to facilitate interconnection approvals.

9. How might DER be incorporated into the electric distribution system in the most efficient and cost-effective manner.

In the context of the ESA, the incorporation of DERs with non-controllable and intermittent fuel sources are the most challenging, and in need of the most careful planning and study. Therefore, MSSIA's answer to this question will focus on those DER's with non-controllable and intermittent fuel sources (primarily wind and solar).

Identifying the most efficient and cost-effective manner to incorporate these types of DERs into the grid is not a simple matter. The fundamental challenge in integrating such DER's into the grid while maintaining reliability is matching generation to load on a moment-by-moment basis. Recent research has emphasized a variety of different methods of accomplishing grid reliability rather than placing the lion's share of the task on storage deployment. Those methods include:

1. Generation mixing

Different DERs have different temporal generation profiles, so they can be combined in careful quantities to improve the matching of generation to load. Solar and wind, in particular, can be combined in this way to improve the match. Sustainable biomass, a controllable fuel source, can help to an extent, limited by the amount available.

2. Geographic mixing
As renewable resources like solar and wind are mixed over larger and larger geographic regions, the differences in climate will cancel out intermittencies, producing a smoother generation curve, and one that can be matched to load better. Ultimately, long-distance transmission across time zones will play an important role.

3. Smart inverter functions
The inverters used in solar power systems have built-in functions that can perform grid stabilization services. Voltage ride through, frequency ride-through, ramp rate control, and volt-VAR control are all built in. Volt-VAR control, in particular, is a powerful tool for maintaining steady voltage in distribution circuits. The capabilities are available at no cost since they are standard features, although there may be a small loss of energy in using some features. The scale of the capability is massive, with gigawatts of inverter capacity available, distributed throughout the state.

4. Generation shaping
Curtailment of solar and wind is a measure that can prevent oversupply of those DERs when they are at high penetration levels. Research such as the Minnesota Solar Pathways study suggests that curtailment can be more cost effective than storage in many circumstances.

5. Load shaping
Shaping generation to match load is not the only way to accomplish the match; the reverse can also be effective. There is physical load shaping (i.e., demand side management) in which loads are curtailed or increased when needed, either locally in direct response to changes in the grid or, more often, remotely controlled. There is also economic load shaping (i.e. real-time pricing) in which people are induced to make economic decisions to curtail or increase their power usage when needed.

6. Energy storage
No matter how much the previous five methods are employed, it is evident that in a high-penetration renewable future - like New Jersey's 50% by 2030 and 100% by 2050 goals - very large amounts of storage will be required. The cost of battery storage is falling rapidly, but the cost of storage at the scale needed will still be high.

One way to mitigate the cost is to have the storage provide additional value by performing other functions in parallel with grid stabilization, such as emergency backup power functions for critical facilities.

Another potential way of mitigating the cost of storage is to utilize electric vehicle batteries. MSSIA's analysis indicates that if one-third of the vehicles in the state are electric vehicles, the total storage in their batteries will reach about 180,000 megawatt-hours (MWH). This swamps the stationary battery capacity required in the Clean Energy Act. There are many challenges to be addressed in utilizing that EV storage capacity to help accommodate renewable energy on the grid, but even a small fraction of the total capacity would be of great importance in ensuring a reliable grid at high renewable penetration levels. MSSIA believes that it would be a great error to spend large sums of money on electric vehicle charging infrastructure without incorporating the bi-directional capability required for vehicle-to-grid (V2G) operation.

The aggregation of very small energy storage (e.g., residential) systems into virtual power plants may play a role in

MSSIA also believes that efficient and cost-effective deployment of storage may be aided by having utility companies act as aggregators of energy storage assets in order to utilize - and monetize - the capabilities of those assets in both the distribution system and the transmission system, as others have suggested.

10. In the context of the ESA, what might be the definition of Energy Storage?

In the context of the ESA, MSEIA believes that the definition of energy storage could be:

"An energy storage system is a system capable of storing energy from the electric grid and delivering the stored energy back to the grid at a later time to serve a policy objective."

Alternatively, in order to include technologies, such as ice storage, that can deliver equally valuable storage services to the grid by *avoiding* energy usage whenever desired, the definition could be:

"An energy storage system is a system capable of storing energy from the electric grid and delivering the stored energy back to the grid at a later time, or avoid the usage of power from the grid at a later time, to serve a policy objective."

11. What discharge time duration could be applied to the State goals of 600 MW of energy storage by 2021 and 2,000 MW of energy storage by 2030? Four hours? Ten hours? Other?

The requirement in the Clean Energy Act is expressed as 600 megawatts by 2021 and 2,000 megawatts by 2030. The storage requirement is expressed in megawatts, a power rating. Every grid-connected energy storage system has a <u>power rating (e.g., megawatts [MW]),</u> as well as an <u>energy rating (e.g., megawatt-hours [MWH]).</u> Most storage systems consist of an energy storage sub-system and a power conversion sub-system, which is usually an inverter. The power rating is the rating of the inverter, while the energy rating is the amount of energy that can be stored and delivered by the storage sub-system. Since the Act expressed the requirement as a power rating (megawatts), MSSIA believes that the total power rating of storage built in the state should be the measure of compliance. That being the case, the time duration of the battery storage system will not be relevant to compliance with the act.

Further, different time durations will be appropriate for different applications (e.g., solar and storage systems for resiliency, microgrids, systems designed primarily for frequency regulation, etc.) It would be very inefficient to specify a particular time duration for compliance or for any incentive; systems requiring less time duration than specified would be burdened with unnecessary cost, while those requiring more than specified would be disadvantaged in receiving incentives.

MSSIA believes that the average discharge time duration during the early years between now and 2030 might be between two and three hours. After that, as renewable penetration reaches higher levels and the cost of storage drops, time shifting of generation for several hours is likely to become more of a priority. That is expected to cause a trend toward more hours of discharge time duration.

12. What storage systems should be counted towards the achievement of the State's goal?

Existing systems? Those systems placed into operation after the May 23, 2018 enactment date of the statute?

MSSIA believes that storage systems placed into operation after the date of enactment of the Clean Energy Act should count toward the achievement of the storage requirement of that act.

13. How might Federal Energy Regulatory Commission's (FERC) Order 841[2] and the associated PJM compliance filing[3] affect the foregoing?

The primary effect of PJM's implementation of FERC Order 841 is expected to be to enable behind-the-meter storage systems to fully, and hopefully relatively easily, participate in PJM's wholesale markets, notably ancillary service markets. This will enable storage systems tied to solar power systems to participate in those markets, and thereby derive revenue to offset the costs of storage and resiliency.

The cost of deploying storage systems will be reduced due to the co-location and sharing of interconnection costs, and the streamlined process for interconnecting. Storage developers may also be able to take the federal investment tax credit for the storage when integrated with solar power. All of these cost and revenue benefits will enable deployment of storage to accelerate with less, if any, state incentives.

We thank you for considering these comments, and look forward to exploring these matters further.

Best regards,

Lyle Rawlings, President