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Form Energy Comments on the Draft 2019 New Jersey Energy Master Plan

Introduction

Form Energy appreciates the opportunity to comment on the Draft 2019 New Jersey Energy Master Plan (EMP), and we support New Jersey's goals to achieve 2,000 megawatts of energy storage by 2030, 100% clean energy by 2050, and 80% economy-wide reductions in greenhouse gas emissions from 2006 levels by 2050. We also appreciate New Jersey's leadership in PJM to pro-actively study pathways to achieve 100% clean energy for New Jersey and the rest of the Interconnect.

Our comments focus on three main themes and include several recommendations for New Jersey to consider as it finalizes the EMP and transitions to implementation actions:

1) Policies to achieve New Jersey's energy storage target;
2) Modeling of pathways to achieve 100% clean energy; and
3) The role of bulk energy storage in achieving 100% clean electricity by 2050

Background on Form Energy

Form Energy is developing and commercializing a new class of energy storage systems to enable intermittent wind and solar resources to be fully firmed year-round. Form's ultimate goal is to make 100% renewable electricity grids reliable and cost-effective and to completely replace needs for conventional thermal generation. At the core of Form's offering is a new kind of battery that is an order of magnitude cheaper than lithium ion batteries in $/kWh and optimized for long duration grid applications (>24hrs of continuous energy on a single charge). Form is reimagining batteries as bi-directional power plants that can be located in any market and scaled to match energy infrastructure globally.

Form Energy's long-duration energy storage system is uniquely suited to addressing three emerging grid needs in New Jersey: bulk energy storage to firm and maximize the value of large-scale in-state renewable energy resources; non-wires solutions to manage grid congestion and address transmission constraints; and zero-carbon solutions to improve grid resilience in vulnerable communities, even during multi-day weather events.

Policies to Achieve New Jersey's Energy Storage Target

<u>NJBPU Should Develop an Expedited Energy Storage Demonstration Program</u>

Form Energy supports the most actionable recommendation in the New Jersey Energy Storage Analysis: that New Jersey should "establish pilot programs and pursue a balanced portfolio to ensure that New Jersey gains experience with the bulk power system, distribution level, and customer-side applications, and multiple technologies."[1]

We recommend that the New Jersey Board of Public Utilities (NJBPU) begin work in 2019 to develop an expedited energy storage demonstration program that will result in either public funding or electric distribution companies (EDCs) contracting for initial demonstration projects by no later than 2022. An expedited program along this timeline will support New Jersey in developing a clearer understanding of the cost, benefits and performance of different storage technologies to inform the development of larger-scale programs to achieve New Jersey's goal of 2,000 megawatts of storage by 2030.[2]

A storage demonstration program should have several goals:

1. *Demonstrate new and emerging energy storage technologies*

The Energy Storage Analysis highlighted that a number of storage technologies have yet to be demonstrated at a meaningful scale in New Jersey and that new technologies are likely to become commercial in the coming years. Technologies with different attributes are likely to be better suited to some applications than others; thus, it is important to demonstrate a range of different technologies that may be at different stages of commercialization and provide different grid benefits.

2. *Demonstrate a range of storage applications, including:*

    - *Distribution deferral*: avoiding the need for traditional distribution system investments to accommodate distributed energy resources and new load.
    - *Transmission deferral*: managing congestion and avoiding needs for traditional wires investments to accommodate new generation and/or loads.
    - *Firmed renewables*: improving the capacity contribution (and reliability) of utility-scale renewable energy resources, as well as managing curtailment and contingencies caused by multi-day weather events.
    - *Resilience*: deploying energy storage to improve the resilience of either critical grid assets or communities vulnerable to single points of failure that could result in extended power outages.

3. *Support the commercialization of energy storage technologies*

[1] New Jersey Energy Storage Analysis (ESA) Final Report at vi.
[2] New Jersey Clean Energy Act of 2018: P.L.2018, c.17; N.J.S.A. 48:3-87.8 (1)(d)

New Jersey should view energy storage technology and application demonstrations as the first low-cost, no-regrets step in what should be a comprehensive suite of policies to support the commercialization of energy storage.

NJBPU Should Support Both Utility Owned and Third-Party Owned Energy Storage Systems for Different Applications

As NJBPU works to develop programs to achieve New Jersey's energy storage goal, it should be open to supporting both utility-owned storage and third-party owned storage where reasonable in different circumstances. Two types of storage applications — distribution deferral and transmission deferral — are particularly well suited for utility ownership as a way to maximize value for electric customers. In such applications, utilities usually have the benefit of insight into distribution and transmission system operational needs, and they are well positioned to flexibly operate storage systems to respond to distribution and transmission grid needs that may be difficult to capture in contracts, identify through wholesale market signals, or finance solely through wholesale market revenues. Conversely, third-party ownership is well suited for applications in which energy storage is physically or virtually paired with utility-scale renewables to firm renewable assets and reduce financial risk in wholesale markets. As NJBPU develops storage programs, it should examine ways to leverage the strengths of both utilities and third-parties to develop high-value storage applications for New Jersey customers.

Modeling of Pathways to Achieve 100% Clean Electricity

Electric Grid Capacity Expansion Modeling Should be Capable of Studying the Effects of Multi-Day Weather Events

As New Jersey works to identify the least-cost pathways to achieve New Jersey's 2050 goals of 100% clean energy and 80% emissions reductions, it should ensure that its modeling tools and approaches are capable of identifying needs that are likely to emerge with high penetrations of renewables. We recommend that New Jersey work in the future to ensure that its capacity expansion modeling tools have a few key features: 1) they should be able to model a full year of load and renewable generation at hourly resolution; 2) they should conduct optimizations over a full year; and 3) they should be able to model the effect that typical and atypical weather years have on load and renewable generation.

Most least-cost planning exercises rely on capacity expansion modeling tools, and many such tools have limitations that include the following: 1) they model a limited number of representative days of load and renewable generation, rather than a full year at hourly resolution; 2) they conduct resource optimization over a single-day horizon rather than a full year at hourly resolution; and 3) they are incapable of stochastically modeling renewable energy generation profiles. Our experience is that these shortcomings must be overcome in order to understand how to achieve grid reliability at least cost with high penetrations of renewables.

In grids with low penetrations of renewables, these modeling deficiencies pose limited problems.

However, as renewable penetrations increase, and as grid planners aim for fully-decarbonized grids, these deficiencies can cause major blind spots that mask technology solutions capable of minimizing overall renewable resource needs, transmission needs, and system costs.

For example, a capacity expansion modeling tool that only uses representative days of renewable energy generation will fail to capture the effects that multi-day weather events have on renewable energy output. Several studies have identified multi-day lulls in renewable energy output as a driver of significant reliability risk and cost as renewable penetrations increase.[3] Grids with high percentages of renewables must be able to manage these risks and costs, but they cannot do so if the impacts of multi-day weather events are not modeled.

Additionally, capacity expansion modeling tools that only have a single-day optimization horizon will never be able to identify and value needs for >24-hr long-duration energy storage, which can support both least-cost grid reliability and also maintain reserves to support grid resiliency (i.e. backup power) during multi-day weather events. Modeling efforts must be able to track the benefit of maintaining stored energy in reserve from day to day and season to season.

Although New Jersey is part of the expansive PJM territory and can rely for the near-future on other resources in the region to balance its in-state renewable energy investments, New Jersey can bolster its leadership role in the Interconnect by demonstrating best-practice capacity expansion modeling for other states in the region.

Transparent Development of Modeling Inputs, Assumptions and Scenarios Will Improve Results

The Energy Master Plan states that the Integrated Energy Plan will determine the best approach to reach New Jersey's 100% clean energy and 80x50 greenhouse gas reduction goals.[4] Unfortunately, we have not been able to find any public information about the Integrated Energy Plan modeling efforts or opportunities to contribute to this effort. In the future, we encourage New Jersey to work closely with stakeholders in a public forum to develop inputs, assumptions and scenarios for these types of ambitious and complicated modeling efforts. Increased transparency into this process will not only help New Jersey improve its modeling results but will also help stakeholders understand and plan to address the most pressing challenges New Jersey will face as it works to decarbonize its energy supply. We expect that New Jersey will need to update its Integrated Energy Plan modeling on a cyclical basis, and we look forward to sharing our perspectives in the future.

The Role of Bulk Energy Storage in Achieving 100% Clean Electricity by 2050

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[3] *See* for example: 1) CEC, Deep Decarbonization in a High Renewables Future available at https://www.ethree.com/wpcontent/uploads/2018/06/Deep_Decarbonization_in_a_High_Renewables_Future_CEC-500-2018-012-1.pdf; 2) Eurelectric, Decarbonization Pathways, available at https://cdn.eurelectric.org/media/3558/decarbonisation-pathways-all-slideslinks-29112018-h-4484BB0C.pdf; and 3) E3, Resource Adequacy in the Pacific Northwest, available at https://www.ethree.com/wp-content/uploads/2019/03/E3_Resource_Adequacy_in_the_Pacific-Northwest_March_2019.pdf.

[4] EMP at 98-99.

Bulk Energy Storage Should be a Central Part of New Jersey's Efforts to Achieve 100% Clean Energy by 2050

The EMP and the Energy Storage Analysis both seem to discount the essential role that bulk energy storage will play in achieving 100% clean electricity by 2050. Without significant investments in bulk energy storage to balance its planned investments in new offshore wind energy and other renewables, whether in New Jersey or in other PJM states, New Jersey will continue to rely directly on fossil-fueled resources to meet its energy needs when renewables aren't available, even if New Jersey electricity suppliers have sufficient renewable energy certificates to match total energy sales on average.

Although New Jersey has less direct control over the resource mix in PJM, it can take important steps to encourage the transition to a grid in which renewables and energy storage eliminate all needs for fossil-fueled generation. New Jersey's goal of achieving 2,000 megawatts of energy storage by 2030 is a powerful step in that direction. By placing an equal emphasis on customer-sited and bulk energy storage, the Energy Master Plan can ensure that new renewable resources continue to contribute meaningfully to peak capacity needs, even as renewable penetrations grow to significant levels. A number of studies have shown that renewables contribute less to peak load requirements as penetrations increase[5] and that it will be difficult to eliminate the last 10-20% of fossil-fueled generation capacity from the grid without new forms of longer-duration, lower-cost energy storage.[6]

Long-duration bulk energy storage in particular has the potential to shape renewable energy so that it is firmed and dispatchable over a full year, without relying on existing fossil-fueled resources to provide balancing functions. Long-duration energy storge can also fulfill critical grid resiliency needs during emergencies by providing multiple days of energy storage at a cost per kilowatt-hour that is far less than what lithium-ion storage can provide. We hope that the Energy Master Plan will highlight bulk energy storage as an essential component of its strategy to achieve 100% clean energy by 2050 and to support both grid reliability and community resilience in the event of multi-day weather events.

New Jersey Can Support Environmental Justice Communities by Deploying Long-Duration Energy Storage to Reduce Dependence on Natural Gas Peakers

[5] *See most recently*: Long Run Resource Adequacy under Deep Decarbonization Pathways for California at 36-37, available at https://www.ethree.com/wp-content/uploads/2019/06/E3_Long_Run_Resource_Adequacy_CA_Deep-Decarbonization_Final.pdf. Although this study focuses on California, the underlying dynamic of the declining capacity value of renewables pertains to all high-renewables grids.

[6] *See* Storage Requirements and Costs of Shaping Renewable Energy Toward Grid Decarbonization, available at https://www.cell.com/joule/fulltext/S2542-4351(19)30300-9?_returnURL=https%3A%2F%2Flinkinghub.elsevier.com%2Fretrieve%2Fpii%2FS2542435119303009%3Fshowall%3Dtrue

Environmental justice communities tend to be disproportionately exposed to pollution from fossil-fueled power plants. We encourage New Jersey to examine the location and function of its natural-gas power plants and to prioritize the deployment of bulk energy storage in locations where it can replace the reliability functions that these power plants fulfill. New York recently conducted a study to evaluate the potential of energy storage to repower or replace peaking units.[7] We encourage New Jersey to conduct a similar study so it can develop programs and incentives to direct storage investments in locations that have the greatest positive impact on vulnerable communities.

Conclusion

Form Energy applauds New Jersey's ambitious goals and the expansive scope of the Draft 2019 Energy Master Plan. We look forward to continuing to work with New Jersey and other stakeholders to achieve these goals, and we appreciate this opportunity to provide public comments.

Sincerely,

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[7] *See* The Potential for Energy Storage to Report or Replace Peaking Units in New York State, available at https://www.ethree.com/wp-content/uploads/2019/08/E3_The_Potential_for_Energy_Storage_to_Repower_or_Replace_Peaking_Units_in_New_York_State_July_2019.pdf