**Initial Findings**

**Energy Storage Technology Study (HB 773)**

## Introduction

1. Energy storage adoption is universally expected to have profound impacts on the electric power industry.

2. Energy storage can provide services traditionally provided by a generator, a transmission asset, or a distribution asset, making it difficult to characterize energy storage from a regulatory standpoint.

3. Storage systems can range in size from small on-site units to utility-scale systems that interconnect to the bulk power grid. Depending on the technology used—e.g., pumped hydro, thermal storage, batteries, flywheels—and project size, energy storage systems can discharge at their full capacity for a maximum of 15 minutes to days.

4. Some storage projects can be developed in months rather than years, and can be sized precisely to meet demand. Additional capacity can be added as needed.

5. Historically, pumped hydro has provided the most energy storage capacity in the United States, with 38 facilities located in areas where the geography is suitable. There is no pumped hydro in Maryland, nor any significant prospect for it.

## Costs

6. Cost declines are opening market applications for a variety of non-hydro resources—such as flywheels, solid rechargeable batteries, flow batteries, and water- or salt-based thermal storage—collectively known as "advanced energy storage technologies."

7. In particular, battery storage is generating interest due to its modularity and fast-response times, which allow for multiple applications, and to its especially dramatic price declines (which are being driven by the electric vehicle market). According to IHS, an analytical consulting firm, lithium-ion battery prices declined by 50 percent between 2012 and 2015, and are expected to decrease by another 50 percent by 2019.

8. Thermal storage technologies (when used for thermal applications) are more efficient than electrical storage technologies. Though rarely in the spotlight, technologies such as grid-connected water heaters, ice storage, and chilled water storage, have low capital costs, long durations, and, in some cases, fast response times that make them well-suited for a wide range of services.

9. Along with projected cost declines and technology improvements, increasing renewable energy generation and the electrification of transportation will be drivers for energy storage.

10. Pairing storage with renewable energy generation has some cost advantages relative to stand-alone systems. Currently, energy storage paired with solar generation qualifies for the federal investment tax credit for renewable generation, as long as at least 75 percent of the energy used to charge the energy storage system comes from a renewable energy system.[1] Also, the cost of some system control equipment can be shared between the renewable energy and energy storage systems, as can siting and interconnection expenses.

**Benefits**

11. Energy storage offers several benefits, the value of which depends on the perspective taken—that of the State considering financial and social benefits; that of the electric distribution utility considering the cost of alternative approaches to addressing system needs; that of the project developer considering potential revenue streams; or that of the customer considering retail energy costs and electricity reliability concerns.

12. In Baltimore Gas and Electric's service territory, the 10 percent of the hours during which demand was at its highest accounted for 25 percent of annual electricity costs in 2016 and 2017. Instead of relying on natural gas peaking plants during times of high electricity demand, energy storage can release energy stored during off-peak periods when electricity prices are lower.[2]

13. Energy storage can provide backup power when outages occur due to severe weather or other causes. Storage systems tied into microgrids can help support critical facilities in communities, such as large hospitals, or defense facilities. Maryland also has state and federal government entities and high-technology businesses that need high levels of reliability and could be potential hosts for, or sponsors of, energy storage projects.

14. More "flexible generation" resources with fast response times and the ability to ramp down to low operating levels will help to maintain reliable grid operations as more variable generation such as wind and solar become more prevalent. Energy storage is one such option for these grid-stabilizing services.

15. Energy storage can help electric distribution utilities manage reverse power flows at distribution substations with high levels of solar generation. It can also shave localized peak demand on specific, small areas of the distribution grid. Achieving these services, and those described in the prior finding, requires some level of visibility, direction or control by an electric distribution company.

16. Especially when paired with PV, energy storage systems in homes or businesses can help customers minimize their electricity bills and provide back-up power when needed.

[1] Also, the amount of the ITC for an energy storage system is limited to the percentage of the charging energy provided by renewable energy. For example, if 90 percent of the energy used to charge the energy storage system is sourced from a solar energy system, then the energy storage system is eligible for only 90 percent of the ITC.

[2] Based on PJM electricity prices and usage data. For each hour in 2016, PPRP multiplied BGE's Day Ahead Hourly LMP by real-time load to calculate an hourly cost of electricity. PPRP summed hourly costs for the 10 percent of hours with the highest costs and divided this by the sum of all hourly costs for the year. PPRP repeated this process for 2017 and averaged the results.

Maryland's electric distribution utilities could also potentially leverage their investments in advanced metering infrastructure (AMI) with behind-the-meter storage to support the grid.

17. Together, the services described above can: reduce peak demand; allow for the deferral of investments in new generation capacity; increase the grid's flexibility, reliability, and resiliency; reduce greenhouse gas emissions and associated compliance costs; possibly defer transmission and distribution investments; and create new jobs for Marylanders involved in storage-related industries.[3]

**Obstacles**

18. Many of the benefits described above result in system-wide cost savings but have no market value. From a developer's perspective, storage projects may not be justified economically unless more of these benefits are monetized by policymakers, regulators, and/or PJM.

19. Receiving compensation from multiple value streams is key to energy storage economics. Regulatory and operational hurdles exist towards providing multiple services using a single system, including services at both the wholesale and retail level.

20. Maryland's retail electricity rates tend to mask the real-time cost of energy and/or fold demand-related expenses into volumetric (i.e., per-kWh) charges. This gives customers little incentive to minimize their usage at times of peak demand, eliminating one of the key potential benefits to customer-sited storage.

21. It is unclear whether electric utilities can own and operate energy storage projects in Maryland because of provisions in Maryland's electric restructuring law prohibiting electric utilities from owning generation assets. It is anticipated that the Maryland Public Service Commission or the General Assembly will address this issue.[4]

22. There is little information available to the Maryland PSC or the public on how the State's electric distribution utilities are evaluating energy storage projects.

23. Because advanced energy storage devices are relatively new, real-world performance data is limited.

24. The interconnection process for behind-the-meter energy storage is not fully defined. For example, questions remain about how to treat energy storage systems that are not designed to export power to the grid or are programmed not to exceed certain export levels.

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[3] Although storage is often associated with renewable energy as a "clean" resource, energy storage is only as clean as its original power source. Storage devices are also subject to losses—meaning power displaced or used during the charge and recharge process—that range from 2 to 60 percent, depending on the technology. Therefore, storage has the potential to increase GHG emissions if it draws primarily on fossil fuel generation, rather than renewable energy.

[4] The PSC has convened an Energy Storage Working Group, which has developed a memo on utility ownership of storage. This will serve as the basis for the corresponding sections of the Energy Storage Study.

25. Third parties, such as commercial, industrial and government customers, would benefit from standard language that can be incorporated into contracts to ensure that energy storage assets can serve the grid when needed.

**Policies**

26. In over 20 states, regulatory and legislative bodies are considering strategies to spur growth in energy storage. These state initiatives range from investigating energy storage, clarifying how energy storage fits into existing rules, planning for energy storage as part of grid modernization initiatives, providing market incentives for energy storage, or supporting in-state storage R&D and manufacturing.

27. A combination of factors influences the suitability of approaches used elsewhere. Like many other states interested in energy storage, Maryland has statutory requirements to increase the use of renewable energy generation and to decrease greenhouse gas emissions.

28. Maryland also has an energy R&D center at its flagship university that attracts major federal funding for advanced batteries (used in biomedical, aerospace, and defense applications) and has spun off two companies.

29. Unlike states where utilities remain vertically integrated, Maryland no longer oversees planning for investments in generation or transmission. Also, Maryland no longer requires electric distribution utilities to submit integrated resource plans, with detailed explanations of their long-term distribution system needs and investment strategies.

30. In 2017, Maryland became the first state to enact state income tax credits for energy storage systems, which are in effect through 2022. The tax credit is for up to $5,000 for residential applications and is limited to the lesser of $75,000 or 30 percent of the installed system costs for commercial customers. A statewide annual tax credit cap of $750,000 is also imposed. Concern has been expressed that this tax credit is not large enough to serve as a significant catalyst for energy storage deployment in the State.

31. Four states (California, Massachusetts, New York, and Oregon) have adopted procurement mandates/targets for energy storage. Based on conversations with stakeholders, there is support from energy storage companies for procurement targets or mandates, although electric distribution utility and utility trade association representatives have expressed concerns that mandates can be arbitrary and inefficient.

32. In the context of creating an energy storage procurement target or mandate, important policy considerations to address include bulk power and distribution system needs, technology neutrality, and project diversity, in terms of size, ownership, and grid location.

33. There is widespread interest in pilot projects to demonstrate energy storage value/benefits, controlling a cohort of small-scale distributed systems, testing different ownership models, or exploring different technologies. Stakeholders have stressed the importance of creating a framework for broader deployment after results of the pilot projects are made available.

34. Important policy considerations to address in the context of electric distribution utility ownership include permissible locations and uses for storage assets—in particular, whether utilities may earn revenues as an energy or ancillary services provider, as well as using storage as a distribution asset. There are also hybrid ownership models to consider.

35. A storage target could complement Maryland's Renewable Portfolio Standard (RPS) goals. Their structures might be different since the RPS is a MWh-based target, and the charging and discharging of energy storage devices may result in little, no, or negative net energy. Should Maryland wish to boost energy storage through the State's RPS, modifications that Massachusetts and Vermont have made to their respective RPS policies offer possible models to consider.

36. Besides procurement targets or mandates and pilot projects, support has also been expressed for rate changes (e.g., more TOU, higher demand charges, location-based charges); incentive programs to address first costs; rebates; building code credits; coordination with EmPOWER Maryland; and state financial and technical support for potential in-state energy storage manufacturing.

37. With regard to electric distribution utilities, support has been expressed for allowing a return on storage investments and/or contracts for storage services provided by third parties; reforming the interconnection process; requiring the consideration of storage during system planning; and shifting from return on investments to performance-based incentives.

38. The cost of promoting energy storage is a source of concern for consumers. Many storage projects are cost-effective, meaning that they either result in straightforward savings or minimize bill increases that would otherwise occur over time. However, energy storage mandates and pilot programs are intended to "kick-start" the adoption of promising new technologies whose costs, in some cases, are anticipated to fall dramatically as markets for their services grow. This may raise near-term costs for citizens and ratepayers, to achieve a mix of long-term environmental, social and financial benefits.

**PJM**

39. It is possible energy storage could participate in PJM's regional transmission planning processes, although that has not occurred yet. PJM representatives have indicated that this is being considered.

40. About 300 MW of battery installations participate in PJM's frequency regulation market, but that market is relatively small—PJM buys about 700 MW per hour. PJM representatives have indicated that the market is saturated, and prices are coming down.

41. In some portions of the country, energy storage can serve as a capacity resource, meaning that it is compensated for committing to serve loads during the few times each year when the grid is most taxed—usually due to severe weather. Current rules make it difficult for energy storage to participate in PJM's capacity market due to requirements that a resource be available for any emergency, regardless of its duration.