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Topic: Energy Storage

Introduction

Chairman Murkowski, Ranking Member Manchin, and members of the Committee – thank you for inviting me to testify on pumped hydro and the other energy storage attributes of hydropower. My name is Mitch Davidson. I am the U.S. CEO for Brookfield Renewable.

Brookfield Renewable Partners L.P. ("Brookfield Renewable") owns and operates one of the world's largest renewable power portfolios, containing 900 renewable power facilities in North America, South America, Europe, India and China with a combined installed capacity of 17,500 megawatts. We operate these resources with an abiding global commitment to safety, environmental responsibility and community engagement.

Our U.S. portfolio includes 137 hydro facilities[1], 26 wind farms, 490 solar installations, a thermal facility, and a battery project, all totaling 6,500 megawatts of installed capacity. This portfolio includes the 600 megawatt pumped hydro facility called Bear Swamp, located in the Commonwealth of Massachusetts.

[1] The hydro facilities are 51 run of river, 85 reservoir hydro, and 1 pumped hydro facility.

Role of Hydropower

Hydropower facilities provide carbon-free power, local tax revenues, recreational opportunities[2], and both direct and indirect jobs. Brookfield Renewable's hydroelectric projects are often located in less developed rural areas and frequently represent the largest taxpayer in their local communities, providing critical funds for local schools, fire departments and other public services.

Hydropower is the original renewable energy resource. It is a proven, long-life and reliable energy resource, providing critical, clean, baseload and peaking power and delivering a variety of important reliability benefits to the electricity grid, all with zero emissions. Reservoir and pumped hydro are the only renewable energy resources capable of delivering dispatchable, firm energy across peaking periods.

I believe we can all agree that the key benefit offered by energy storage is the ability to save energy during periods of low demand and then deliver that same energy back to the grid during periods of peak demand. Pumped hydropower can shift energy supply across hours, temporarily storing energy from the grid when there is an abundance of supply and injecting it back into the grid later when it is needed. Reservoir hydropower has a similar ability to shift energy production by days, weeks, months and even seasons, storing large quantities of clean renewable energy for electric production during peak demand periods. Both act as important energy storage management tools for the grid, which enhances grid reliability and greatly improves grid resiliency.

Reservoir Hydro

Hydroelectric generation resources associated with reservoirs can store the water collected (you should think of this as fuel) during the spring snow melt or rainy seasons and turn that fuel into energy during the summer and winter months when it is needed the most. For instance, on a single river in Maine, we control 3 large reservoirs and 7 generation stations which provide the fuel security equivalent of 30 days of stored energy. Unlike most renewable generating facilities,

[2] Hydropower facilities with and without reservoirs often provide recreation areas for swimming, fishing, bird watching and boating.

these units provide the flexibility to follow dispatch orders by increasing or decreasing their output in a manner necessary to best serve the fluctuations of electricity demand and they do so without the loss of renewable resources. This ramping capability also allows these hydroelectric resources to provide valuable ancillary services such as operating reserves, frequency regulation, VAR support, black start capability, and fast ramping.

Pumped Hydro

Many pumped hydro facilities in the U.S. were originally developed near large coal and nuclear plants. This occurred for three reasons: 1) to allow these large coal and nuclear units to achieve efficiencies by maintaining higher production levels during off-peak periods; 2) to store excess production from these facilities during off-peak periods for redelivery during peak periods of demand; and 3) to mitigate against the loss of these plants that are typically the largest contingency on the grid. Similarly, today, pumped hydro facilities are performing the same function, except instead of just helping to maintain large baseload generation units at efficient production levels during off-peak hours, pumped hydro is also capturing power deliveries from intermittent resources during periods of excess supply that would normally be curtailed during those hours and redistributing that energy to peak periods.

As has been raised before this Committee in the past, pumped hydro is one of the most efficient ways to store energy. With the right market signals, pumped hydro facilities can be designed to provide hours of firm, dispatchable energy across peaking periods. In addition to the long duration of storage, pumped hydro can also provide the other valuable ancillary services that I mentioned earlier.[3]

Pumped hydro facilities are massive infrastructure projects that require significant capital investments, add jobs in the rural areas where they are located, and when maintained properly, can last over 100 years. The generating and pumping machinery is designed and built to perform efficiently for 30-50 years and when that machinery is replaced or upgraded, that system will perform as if it were a new asset for decades longer.

[3] Operating reserves, frequency regulation, VAR support, black start capability, and fast ramping.

Bear Swamp

The Bear Swamp facility began generating electricity 45 years ago in 1974. It is a 600 MW pumped hydro generating facility in western Massachusetts, jointly owned by Brookfield Renewable and Emera Energy. This facility uses energy from the grid during off-peak periods to pump approximately 4,600 acre feet of water uphill into its reservoir, and then uses that stored water during peak periods to generate energy and capacity during peak electric demand. The facility can reach maximum output from a standstill in 3 minutes and is capable of taking 600 MW of excess generation off the grid to generating 600 MW's for the grid in 30 minutes. That 1,200 MW swing as well as the ability to maintain its 600 MW rate of generation continuously for up to 6 hours are the reasons why the ISO-NE operations staff and CEO believes this facility is critical to the management of the electric system.

Bear Swamp is currently undergoing an upgrade and a relicensing. Following the upgrade, it will be capable of producing 660 MW at 6% greater efficiency by 2021 and will be able to reduce the time it takes to pump to full capacity by an entire hour, a significant improvement. Following the completion of the upgrades, Bear Swamp will have essentially two new generation units, thereby prolonging the useful life of the station by over 50 years.

Pumped Hydro and (not versus) Battery Storage

Most people today associate the term "energy storage" with batteries. I do not consider reservoir or pumped storage and battery storage to be an either/or choice. Each provide different but significant benefits. Battery storage can respond within a fraction of a second to system demands and is also able to provide some frequency regulation and voltage support. Also, the cost of battery storage has been declining rapidly which is a very positive trend as we look to integrate more storage into the electric system.

However, battery storage is not the tool for every job and there are important roles on the grid for reservoir and pumped hydro. We should be mindful of the role that hydropower will play in meeting the demands of the grid of the future. Some of our generation facilities have been relicensed multiple times, are over 100 years old and continue to generate efficient, safe and reliable energy. There is every reason to expect these assets to continue to provide those benefits well into the future.

Resiliency

Grid resiliency – all the rage in energy discussions of the last few years - does not just mean coal and nuclear. It also means hydropower with its capability to provide baseload generation, to balance intermittent solar and wind generation, to offer fuel security and long-term energy storage, and to enhance grid reliability through its fast ramping and black start capabilities.

Hydropower should be considered critical energy infrastructure. As a generation technology, it is not only the largest generator of renewable energy in the country[4], but as nature's battery it provides resiliency, fuel security, and the crucial ability to balance the increasing penetration of variable renewables.

Hydropower delivers these attributes even during severe weather conditions that can pose a challenge for many generation resources. For example, during the severe cold weather that occurred from December 2017 to January 2018, our hydroelectric generation resources in New England continued to generate at their planned output and some resources operated at levels of 10-50% above their typical hourly output.

FERC Licensing

A FERC license on a hydro facility, issued under the Federal Power Act, can last between 30 and 50 years. This licensing process can easily exceed 5 years, and occasionally takes as long as 8-10 years to complete. The process requires a comprehensive review of all affected resources and includes input from FERC, multiple other federal and state agencies, and other stakeholders, which may include nearby residents, recreational and environmental interests, Native American tribes and other members of the local community. This effort and the resulting conditions, environmental mitigation and capital improvement requirements imposed through the new licenses routinely costs many millions of dollars and often results in operational limits which sacrifice the benefits afforded by these facilities. We are very familiar with the process as our company is the largest private holder of FERC hydro licenses in the country.

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[4] EIA data; Energy Information Administration, FAQ "What is U.S. electricity generation by energy source?", March 2019, https://www.eia.gov/tools/faqs/faq.php?id=427&t=3

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Energy Policy and Existing Resources

While hydro power facilities may appear to operate nearly self-sufficiently, they are a capital-intensive resource, requiring significant periodic reinvestment to ensure reliable, efficient and safe operation. Unfortunately, many state renewable portfolio standards favor new renewable generation capacity to the disadvantage of existing renewable generation, putting existing hydropower facilities at an economic disadvantage. As policymakers consider ways to further reduce emissions from the electricity grid, it is critical that existing hydropower be treated on par with other renewable resources.

Closing

In closing, I would like to reiterate that conventional hydropower and pumped hydro have been and continue to be critical components of this country's energy infrastructure. And, more specifically, hydropower facilities are critical components of a resilient electricity grid. With the right regulatory policies and economic signals, hydropower will continue to enable the large-scale deployment of variable renewable energy resources.

I appreciate your time and look forward to your questions.