

June 15, 2018

Attention: Susan Gray
Maryland Department of Natural Resources
Power Plant Assessment Division

Re: March 2018 Preliminary Draft Report
2017 Inventory of Renewable Energy Generators Eligible for the Maryland RPS

In response to the Power Plant Assessment Division of Maryland's Department Natural Resources Request for Comments on the above referenced Draft Report, Brookfield Renewable ("Brookfield") is pleased to submit the following comments and recommendations.

Brookfield has a strong presence in PJM, including almost 875MW of carbon-free hydropower resources in Maryland, Pennsylvania and West Virginia, 377MW of hydropower in North Carolina and Tennessee that also supplies the PJM market, and 120MW of solar development projects in Virginia. In Maryland, Brookfield's 20MW Deep Creek hydropower facility provides renewable, carbon-free power, local tax revenues, recreational opportunities, and both direct and indirect jobs in Garrett County. Brookfield is also the controlling shareholder of Terraform Power, which owns and operates 285MW of distributed solar and wind resources in PJM, including 19MW of distributed solar in Maryland.

Brookfield's comments and recommendations focus on:

- Improvements to the assumptions in the Draft Report to better reflect the supply of eligible resources available to meet RPS obligations in PJM and anticipated future RPS obligations among PJM states.
- Options to help address anticipated deficiencies in non-carve-out Tier 1 resources by expanding eligibility for existing hydropower, while maintaining sufficient incentives for the build out of new renewables. Transitioning Tier 2 hydropower resources to Tier 1 would reduce the supply gap by about 8 percent annually on average from 2018 to 2030 and

produce ratepayer savings of over \$400 million over the same period if Maryland’s RPS is expanded to 50 percent.

- The flexibility, reliability and resiliency benefits of hydropower resources to Maryland and the region.

Comparison of Projected Availability of Renewable Energy and RPS Requirements

The analysis presented by Exeter Associates (“Exeter”) indicates that there are insufficient non-carve-out Tier 1 resources in PJM to satisfy all RPS policies within PJM states. Specifically, Exeter finds that PJM states will collectively experience a deficiency of more than 37TWh of renewable energy in 2018 relative to their RPS requirements. This deficiency increases to almost 74TWh by 2030.

Table VII-1. Non-carve-out Tier 1 RPS Requirements in PJM Compared to Projected PJM Renewable Energy Generation (2018-2030) (GWh)¹

Year	Generation Requirement	Projected Generation	Difference
2018	64,072	26,538	(37,535)
2019	73,019	27,341	(45,678)
2020	79,325	28,144	(51,181)
2021	83,998	29,861	(54,137)
2022	92,820	30,664	(62,155)
2023	95,559	31,923	(63,636)
2024	99,215	32,726	(66,489)
2025	106,964	33,529	(73,434)
2026	109,098	34,333	(74,765)
2027	109,592	35,136	(74,456)
2028	110,214	35,939	(74,275)
2029	110,641	36,742	(73,899)
2030	111,183	37,546	(73,637)

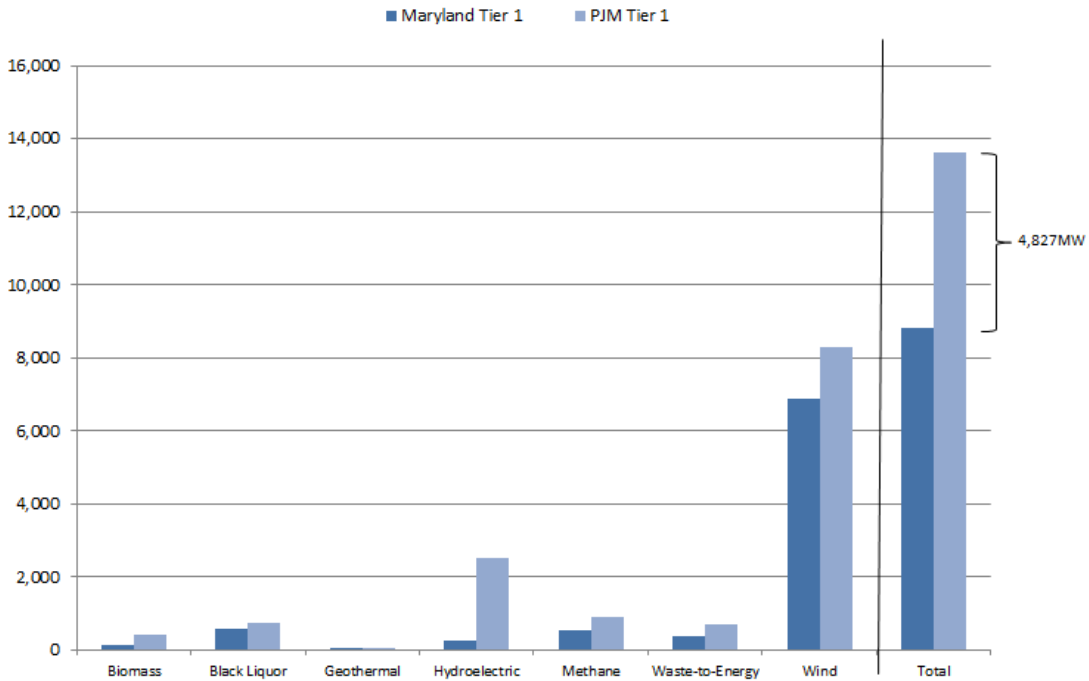
However, the aforementioned finding is highly dependent on the assumptions made by Exeter. Brookfield recommends that several of these assumptions be revisited to better reflect the supply of eligible resources available to meet RPS obligations in PJM. Specifically, there are two considerations in Exeter’s approach to accounting for available resources that Brookfield recommends revisiting:

¹ 2017 Inventory of Renewable Energy Generators Eligible for the Maryland Renewable Energy Portfolio Standard, Preliminary Draft, March 12, 2018, Table VII-1.

1. The supply of available resources includes only those resources that are certified as Tier 1 eligible in Maryland in PJM-GATS, thereby underestimating the actual PJM supply.

This assumption is problematic as it causes a significant quantity of Tier 1 resources to be excluded from the supply analysis. Resources that are eligible under Maryland’s program requirements may instead choose to register in other PJM states where their RECs are sold. In addition, differences in resource eligibility criteria may cause some resources to be considered Tier 1 eligible in some PJM states despite being excluded from Maryland’s Tier 1 program. Nevertheless, these resources are available to contribute to the RPS programs of other PJM states and should be included in the analysis to have an accurate account of the available supply. Brookfield’s analysis suggests that changing this one assumption alone could result in almost 5,000MW of additional existing Tier 1 supply.

**Chart 1
Existing Non-Solar Certified Tier 1 Generation Capacity (MW)²**



² Maryland Tier 1 generation capacity is taken from Table II-2 in the Draft Report. PJM Tier 1 generation capacity is taken from PJM GATS and includes only those resources located inside PJM.

2. The supply of available resources is limited to solar, wind, hydropower, methane, biomass, waste-to-energy, black liquor and geothermal.

This assumption is problematic as it excludes resource types that are Tier 1 eligible under other PJM states' RPS programs (e.g., coal mine gas). While these resources do not contribute to Maryland's Tier 1 program, they do contribute to PJM Tier 1 supply and should be considered as part of the total available supply. In fact, in 2017, over 2.6TWh from resources that are not recognized in Maryland's RPS were retired for Tier 1 compliance in other states.

In addition to the above supply side assumptions, Brookfield recommends that Exeter revisit the following assumption to better reflect anticipated future RPS obligations among PJM states:

1. New Jersey's recently approved expansion of its RPS.

After the publishing of this preliminary draft, New Jersey's Governor signed S2314³, requiring that by January 1, 2020, 21 percent of energy sold in the State by each electric power supplier and each basic generation service provider be from Class I renewable energy sources. The bill also requires the Board of Public Utilities to initiate a proceeding to establish renewable energy portfolio standards of 35 percent by energy year 2025 and 50 percent by energy year 2030. This change alone will result in almost 22TWh of additional renewables demand in PJM in 2030.

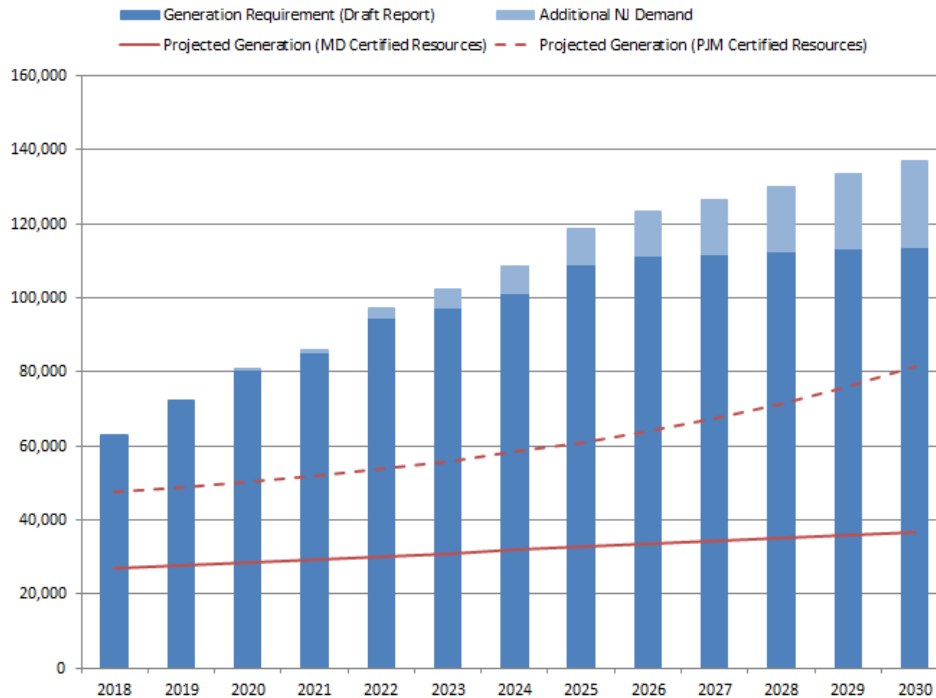
Brookfield's analysis suggests that revising the aforementioned assumptions would have a significant impact on Exeter's analysis:

³ New Jersey Senate Bill 2314 of the 218th Legislature, Available at: <http://www.njleg.state.nj.us/bills/BillView.asp?BillNumber=S2314>.

**Brookfield’s Amendment of
Table VII-1. Non-carve-out Tier 1 RPS Requirements in
PJM Compared to Projected PJM Renewable
Energy Generation (2018-2030) (GWh)**

Year	Generation Requirement	Projected Generation	Difference
2018	63,078	47,461	(15,617)
2019	72,179	48,806	(23,373)
2020	80,373	50,299	(30,074)
2021	85,932	51,963	(33,969)
2022	97,109	53,826	(43,283)
2023	102,234	55,920	(46,314)
2024	108,343	58,285	(50,059)
2025	118,605	60,966	(57,640)
2026	123,279	64,016	(59,263)
2027	126,365	67,500	(58,865)
2028	129,831	71,492	(58,340)
2029	133,343	76,080	(57,263)
2030	137,146	81,369	(55,777)

**Chart 2
Brookfield’s Analysis compared to
Exeter’s Analysis of Non-carve-out Tier 1 Supply and RPS Obligation
(2018-2030) (GWh)**

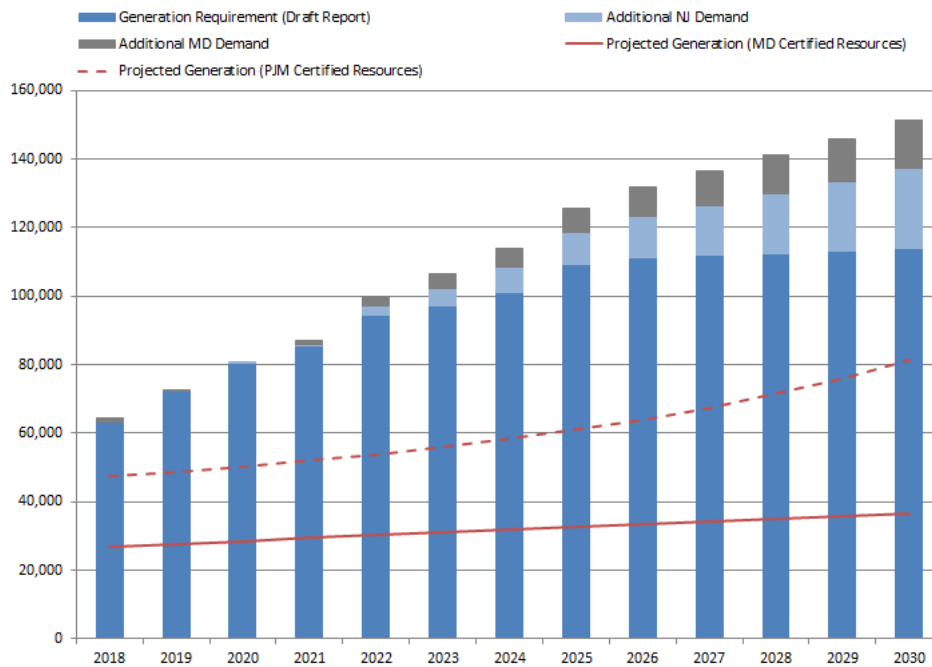


Brookfield’s analysis of PJM certified resources, represented by the dashed red line in Chart 2 above, reveals a larger existing supply (an additional 20TWh in 2018) as compared to Exeter’s analysis, represented by the solid red line. This significantly reduces the annual growth rate of renewable energy generation required for all PJM states to meet their RPS obligations in 2020 to approximately 20 percent, rather than 46 percent in Exeter’s Draft Report. Nonetheless, Maryland and other PJM states still cannot collectively meet their non-carve-out Tier 1 requirements.

Future Policy Developments

In the Draft Report, Exeter models an RPS target of 50 percent by 2030 to measure potential impacts of an expansion of Maryland’s RPS requirements, should the State Legislature approve such an increase⁴. Adding the 50 percent by 2030 target to Brookfield’s preceding non-carve-out Tier1 supply analysis results in an additional 14TWh of renewable demand in PJM in 2030.

Chart 3
Brookfield’s Adjusted Baseline as compared to
2018-2019 Legislative Initiatives
2030 Obligation (GWh)



⁴ 2017 Inventory of Renewable Energy Generators Eligible for the Maryland Renewable Energy Portfolio Standard, Preliminary Draft, March 12, 2018, Table VIII-1.

Exeter's analysis further assumes that the other 13 market participants in PJM maintain their existing RPS requirements, when in fact RPS expansions are likely. Just this past month, policy developments occurred that could further increase the gap between the region's renewable generation requirement and available supply:

- On May 23rd 2018, New Jersey Governor Phil Murphy signed Executive Order 28, directing the development of an Energy Master Plan for the state to achieve 100 percent clean energy by 2050⁵.
- On May 1st 2018, council members in Washington DC introduced legislation to increase their Renewable Portfolio Standard to 100 percent by 2050⁶.

An increase in the Maryland RPS requirement from 25 percent in 2020 to 50 percent by 2030, coupled with RPS expansions in other PJM states, poses further challenges to meeting state RPS goals.

Options to Address Non-Carve-Out Tier 1 Resource Deficiency

Exeter acknowledges that addressing undersupply concerns through resource development in PJM will be challenging. Under Exeter's modeling, in order for wind and solar resources to meet non-carve-out Tier 1 supply in 2030, an additional 40GW of these resources would need to be added, requiring an almost three-fold increase in the resources that exist today. This scale of new development in land constrained mid-atlantic states will be met with siting, permitting, and building challenges.

As an alternative, Exeter emphasizes that Maryland and other PJM states will need to look outside the region to meet RPS requirements. While the increased delivery of renewable energy into PJM is important, it is also subject to certain limitations. For example, PJM's Renewable Integration Study

⁵ New Jersey Executive Order 28, Governor Phil Murphy. Available at: <https://nj.gov/infobank/eo/056murphy/pdf/EO-28.pdf>.

⁶ One Hundred Percent Renewable Portfolio Standard Expansion Amendment Act of 2018. Available at: <http://lms.dccouncil.us/Download/40279/B22-0812-Introduction.pdf>.

found that existing RPS compliance requirements represent a minimum transmission congestion cost of \$4 billion, which presents a real barrier to meeting PJM RPS obligations⁷.

Given these limitations, Maryland and PJM states should also consider expanding Tier 1 eligibility to include additional non-emitting renewable resources to both access the full range of available resources and reduce compliance costs to ratepayers.

Expanding Tier 1 Eligibility to Existing Hydropower Resources within PJM

Brookfield recommends that Exeter assess the value of extending eligibility to existing hydropower resources that are not eligible under Maryland's current Tier 1 program due to the 30MW cap on hydropower facilities.

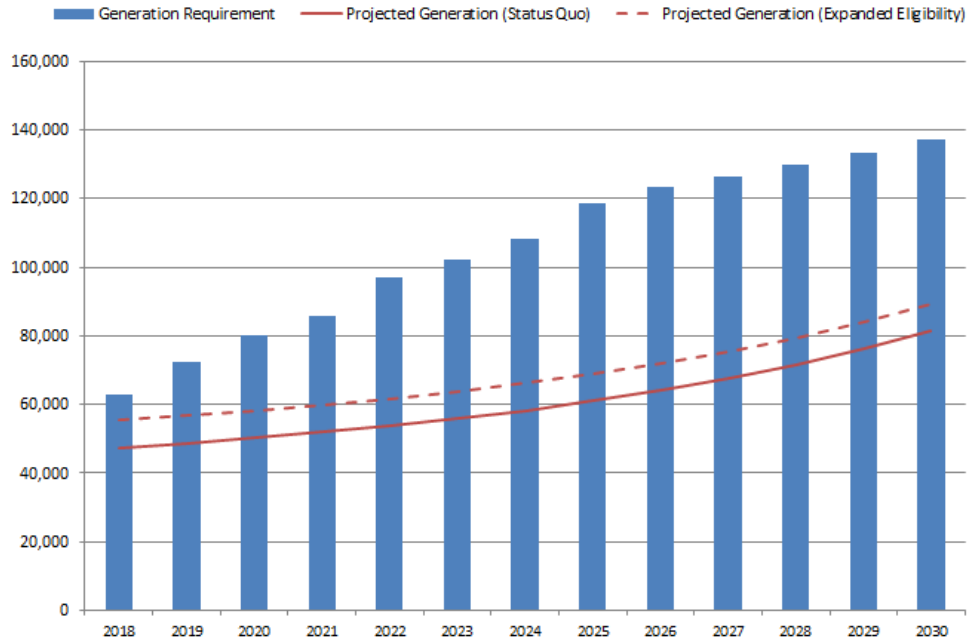
Hydropower has a long history of contributing to Maryland's RPS program. In fact, hydropower has been the largest contributor in each of the ten years of the RPS from 2006 to 2015⁸. However, with the expiration of the Tier 2 program for large-scale hydropower in 2018, Maryland will lose an important contributor to its renewable energy supply.

Currently over 2,000MW of hydropower is certified as Tier 2 in Maryland. Transitioning these resources to Tier 1 would help address anticipated deficiencies in non-carve-out Tier 1 resources in PJM, while maintaining incentives for the build out of new renewables. Brookfield's modeling suggests that expanding Tier 1 eligibility to include 2,000MW of additional hydropower would reduce the supply gap by about 8 percent annually on average from 2018 to 2030.

⁷ PJM Renewable Study Integration Reports. Available at: <http://www.pjm.com/committees-and-groups/subcommittees/irs/pris.aspx>.

⁸ Public Service Commission of Maryland, Renewable Energy Portfolio Standard Report, January 10, 2017, pg. 16.

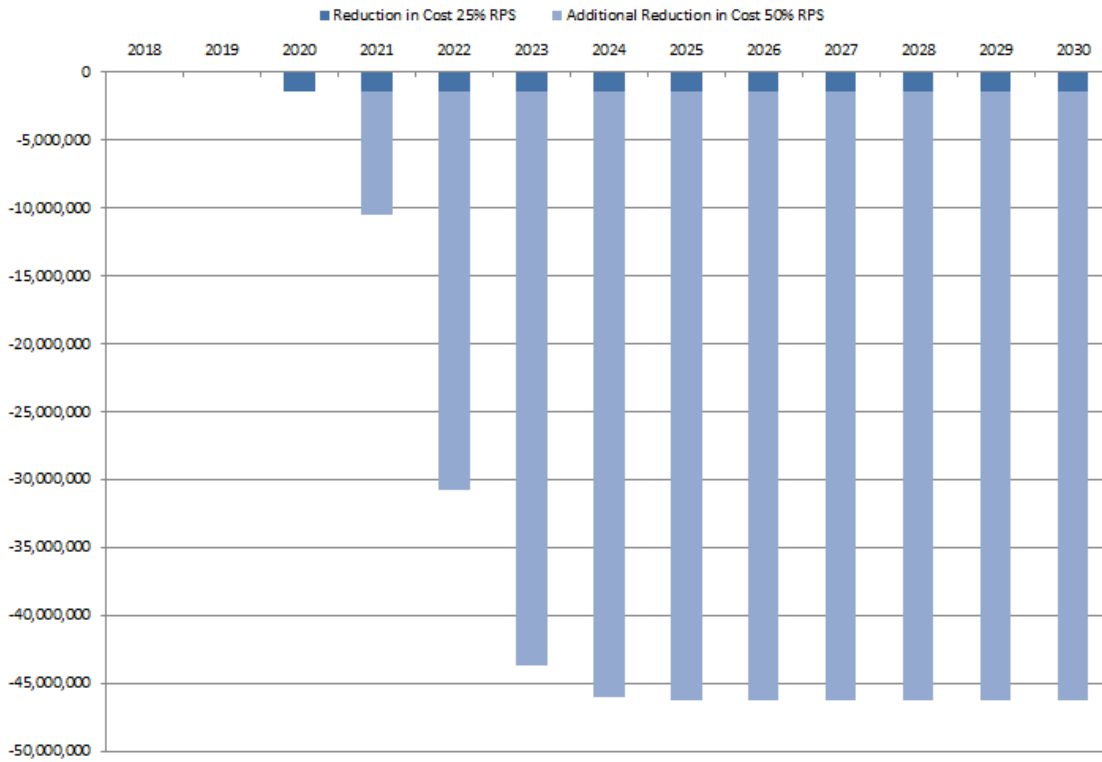
Chart 4
Expanded Tier 1 Eligibility for Hydropower⁹



This one change alone could produce almost \$16 million in ratepayer savings by 2030, with savings potentially increasing to over \$400 million over the same period if Maryland’s RPS is expanded to 50 percent.

⁹ Incorporates Brookfield adjusted baseline and 50% New Jersey RPS as discussed in the preceding section.

Chart 5
Annual Ratepayer Savings from
Expanded Tier 1 Eligibility for Hydropower (\$)



In addition to renewable, carbon-free energy, hydropower delivers essential grid reliability and resiliency attributes

Hydropower is a reliable, renewable, carbon-free source of energy. Compared to other generation technologies, it is unparalleled in terms of flexibility and its ability to provide reliability and resiliency attributes to the grid, including inertia, reserves, capacity, frequency response, voltage control, ramping, and blackstart capability. A study by PJM found that hydropower’s reliability attributes exceed those of all other resources, including traditional fossil fuel fired generation:

Chart 6
PJM Generator Reliability Attribute Matrix¹⁰

Resource Type	Essential Reliability Services (Frequency, Voltage, Ramp Capability)					Fuel Assurance		Flexibility			Other		
	Frequency Response (Inertia & Primary)	Voltage Control	Ramp			Not Fuel Limited (> 72 hours at Eco. Max Output)	On-site Fuel Inventory	Cycle	Short Min. Run Time (< 2 hrs.) / Multiple Starts Per Day	Startup / Notification Time < 30 Minutes	Black Start Capable	No Environmental Restrictions (That Would Limit Run Hours)	Equivalent Availability Factor
			Regulation	Contingency Reserve	Load Following								
Hydro	●	●	●	●	●	○	○	●	●	●	●	○	●
Natural Gas - Combustion Turbine	●	●	○	●	○	●	○	●	●	●	●	○	○
Oil - Steam	●	●	●	●	●	●	○	○	○	○	○	○	○
Coal - Steam	●	●	●	●	●	●	○	○	○	○	○	○	○
Natural Gas - Steam	●	●	●	●	●	●	○	○	○	○	○	○	○
Oil/ Diesel - Combustion Turbine	●	●	○	●	○	○	○	●	●	●	●	○	○
Nuclear	○	●	○	○	○	●	○	○	○	○	○	○	○
Battery/ Storage	○	○	○	○	○	○	○	○	○	○	○	○	○
Demand Response	○	○	○	○	○	○	○	○	○	○	○	○	○
Solar	○	○	○	○	○	○	○	○	○	○	○	○	○
Wind	○	○	○	○	○	○	○	○	○	○	○	○	○

This finding was reinforced in a recent report by the Brattle Group, which identified hydropower as a cost-effective solution for addressing growing flexibility needs¹¹.

As a highly flexible source of baseload renewable energy and critical ancillary services, hydropower can be a substitute for traditional baseload resources that have retired in recent years due to age or other market pressures. It is also a natural complement to intermittent generation resources and can balance these resources to create a 100 percent non-emitting, renewable, reliable energy product.

¹⁰ PJM’s Evolving Resource Mix and System Reliability, PJM Interconnection, March 30, 2017. Available at: <http://www.pjm.com/~media/library/reports-notice/special-reports/20170330-pjms-evolving-resource-mix-and-systemreliability.ashx>.

¹¹ Maximizing the Market Value of Flexible Hydro Generation, the Brattle Group, March 29, 2018. Available at: http://files.brattle.com/files/13659_maximizing_flexible_hydro_market_value_3-29-18_final.pdf.

Conclusion

The legislative intent of HB1414 is to conduct a comprehensive review of the history, implementation, overall costs and benefits, and effectiveness of the RPS. In particular, this includes considering “the availability of all clean energy sources at reasonable and affordable rates, including in-state and out-of-state renewable energy options¹².”

Expanding Tier 1 eligibility to include PJM hydropower will provide Maryland with the necessary optionality to access the broadest range of renewable resources available, helping the state achieve its renewable energy goals at the least cost to ratepayers.

We thank you for the opportunity to provide comments on the Draft Report and would be pleased to provide any additional information.

¹² House Bill 1414, Renewable Energy Portfolio Standard – Study. Available at: <http://mgaleg.maryland.gov/2017RS/bills/hb/hb1414E.pdf>.