Review of

***2017 INVENTORY OF RENEWABLE ENERGY GENERATORS ELIGIBLE FOR THE MARYLAND RENEWABLE ENERGY PORTFOLIO STANDARD – Preliminary Draft,* Prepared by Exeter Associates and BCS Inc.**

Prepared or the

Mid-Atlantic Renewable Energy Coalition

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1. Introduction

The Maryland Department of Natural Resources, Power Plant Research Program (PPRP) contracted with Exeter Associates, Inc. (Exeter) and BCS, Inc. (BCS) to review the current and future inventory of generators eligible to support Maryland's proposed changes to its Renewable Portfolio Standard (RPS) and explore Maryland's ability to meet its future RPS goals. In response, Exeter and BCS published their *2017 INVENTORY OF RENEWABLE ENERGY GENERATORS ELIGIBLE FOR THE MARYLAND RENEWABLE ENERGY PORTFOLIO STANDARD – Preliminary Draft* in March 2018 (the Exeter Report).

In June 2018, Mid-Atlantic Renewable Energy Coalition (MAREC) engaged Gabel Associates (Gabel) to review and comment on this Exeter Report, including its analysis, assumptions, and conclusions. In conjunction with its review of the Exeter Report, Gabel also reviewed MDV-SEIA's presentation entitled *PJM Tier I Inventory & Forecasting - Updates to Eligible Supply, Capacity Factors, and Addition Assumptions in response to PPRP RPS Study Group report by Exeter Associates, June 8, 2018* (MDV-SEIA Presentation).

Gabel is a specialized energy, environmental and utility consulting firm actively providing analysis on wholesale, retail, and renewable energy markets across North America, focusing primarily on the PJM region. Gabel has performed comprehensive supply/demand analysis of PJM Class I, multiple states' Class II, and solar RPS markets. Further, Gabel provides ongoing market advice and intelligence on SREC, Class I, and Class II renewable energy certificates (RECs) for municipal, commercial, and utility clients.

2. Summary of Overall Findings

While the Exeter Report presents a substantial amount of data, the analysis contains several fundamental flaws that overstate PJM-wide RPS demand and significantly underestimate long-term RPS supply growth. This results in a number of analytic summary tables that show a misleading amount of Class I/Tier I (hereafter Tier I) REC shortfall and leads to an incorrect conclusion that Maryland will be unable to satisfy its RPS goals with PJM-sourced RECs.

Specifically, the Exeter Report states that **"…added pressure may be placed on Maryland to procure RECs for RPS compliance from outside-of-PJM resources since there are insufficient PJM non-carve-out Tier 1 (or equivalent) resources expected to be developed to allow reliance on only PJM resources." ES-4/5**

However, this conclusion is hedged in the Exeter Report as it acknowledges that: **"Market dynamics, therefore, can be expected to resolve much, if not all, of the potential shortfalls in non-carve-out Tier 1 renewable resource availability over time." ES-5**

Gabel's view, supported by current market activity and market data, is that there are currently enough PJM-sourced, Tier I eligible generators to supply Maryland's proposed RPS goals.

Gradually increasing Tier I REC prices should attract enough PJM-based generation to continue supporting Maryland's future RPS targets. As PJM states' RPS targets climb, the increased demand for Class I RECs attracts additional renewable generation. This successful market dynamic is demonstrated in increasing number of PJM interconnection requests for wind and solar projects.

The large size of the broader PJM Class I market buffers all participants form minor changes in any single state's RPS changes. All else being equal, the RPS compliance flexibility in other PJM states (Illinois, Indiana, and Virginia in particular) is such that Maryland's RPS proposed change requiring PJM-sourced RECs to meet RPS compliance should not have a material impact on its future compliance costs or otherwise hinder its ability to meet future compliance targets.

It should be noted, however, that the PJM Tier I market has been in a state of oversupply for several years which has kept downward pressure on Tier I REC prices. Looking forward, this surplus is expected to decline over the next several years which should put upward pressure on REC prices. This is reflected in current Tier I REC market prices climbing from about $6.50/MWh for 2017 RECs to $8.00 for 2020 RECs. RPS increases recently adopted by New Jersey and proposed by Maryland can be expected to put additional upward pressure on these prices.

3. Specific Comments on the Exeter Report Content and Analysis

In the following comments, Gabel notes specific areas in the Exeter Report where assumptions, analysis, and conclusions are inconsistent with current market data, historical market dynamics, and long-term forecasts. For ease of reference, we have provided the page reference for each section and provided our comments thereafter.

A. The Exeter Report Overstates PJM-sourced Tier I REC Demand

Report Reference:

Page ES-3 - The Exeter Report discusses that Indiana, Virginia and Illinois will "…meet their RPS requirements with PJM resources."

Gabel Comments:

By including demand from MISO/PJM border states and states with voluntary RPS programs, the Exeter Report overstates PJM-sourced Class I RECS for Indiana, Virginia and Illinois.

Indiana has voluntary RPS goals and can satisfy RPS compliance with MISO-sourced or PJM-sourced RECs. Virginia also has voluntary RPS goals and a known surplus of available in-state RECs. Illinois can satisfy RPS compliance with MISO-sourced, PJM-sourced RECs, or by paying a very low Alternative Compliance Payment (ACP) – which acts as a cap on REC prices.

Regarding Indiana, it has established voluntary RPS goals through the Comprehensive Hoosier Option to Incentive Cleaner Energy Program or 'CHOICE' program. There is no penalty for utilities that do not join the program. Utilities that do join the program cannot increase rates higher than would occur without the CHOICE RPS compliance but receive a separate state incentive to participate. Because these market dynamics do not have a material impact to the PJM REC market, the demand for RECs to support Indiana's RPS goals should not be included in the Exeter Report's analysis. By including them in the Exeter Report, it overstates the demand for PJM-sourced Tier I RECs.

Likewise, Virginia has voluntary RPS goals. The PJM Generation Attribute Tracking System (GATS) shows that 4.5 million in-state generated RECs from Virginia are still available from 2017, indicating significant surplus. As a result, the Virginia demand should not be included in the Exeter Report's analysis as it overstates the demand for PJM-sourced Tier I RECs.

Finally, Illinois crosses over two regional transmission organization (RTO) footprints, as it is partially in PJM and partially in MISO. Between a choice of PJM or MISO based generation, RECs purchased for state-level RPS compliance would come from the most economical source, which is currently MISO. Further, the low ACP ($1.24 - $1.89/MWh) exceeds the cost of PJM RECs. The Exeter Report correctly acknowledges that "…a retail energy supplier needing to satisfy an RPS obligation would only be willing to pay a price slightly below the ACP" (Page I-12). Based on the Exeter Report's own statement, the demand for RECs to support Illinois' RPS goals should not be included in the Exeter Report's analysis as it overstates the demand for PJM-sourced Tier I RECs.

B. The Exeter Report Understates the Total PJM-sourced Tier I Generation Capacity

Report Reference:

Page II-3, Table II-2 shows 13.93 GW of Maryland Certified Tier I generation.

Gabel Comments:

Maryland has a specific set of fuel and generation technology requirements for Class I eligibility. While most PJM states have largely similar, overlapping eligibility requirements, there are additional fuel/technology combinations that are certified as Class I in other states. By including only those generators that are eligible in Maryland, the Exeter Report understates the total available PJM Tier I capacity and leads to a lower Tier I supply forecast.

C. The Exeter Report Mixes the Use of State-level Retail Load and PJM-level Total Generation Supply in its RPS Supply Demand Analysis

Report Reference:

Page III-2 – "This study assumes that for states with only partial PJM service, the RPS requirement is directly proportional to the amount of service supplied."

Gabel Comments:

RPS goals are based on retail sales within the state and have no association with where the energy is generated. It is not clear why the Exeter Report is using generation data rather than load data in this part of the analysis. Using generation data rather than retail load data results in an "apples and oranges" mix of input data and could have unexpected impacts on the supply/demand analysis. In this case however (states that are only partially in PJM), the Exeter Report should simply exclude these states' demand from the PJM-sourced REC analysis.

D. The Exeter Report's Analysis Assumes that MISO/PJM Border States and Voluntary RPS Programs will Source their RECs from PJM-based Sources

Report Reference:

Page III-6, Table III-3 – The table shows Tier I demand for Illinois (13,597 GWh for 2017), Indiana (984 GWh for 2017), Virginia (7,870 GWh for 2017)

Gabel Comments:

As discussed above, voluntary RPS and PJM/MISO boarder states should be excluded (or at least substantially restricted) from the demand side of the PJM-sourced supply/demand analysis. None of these demands should be included in a PJM-based mandatory RPS supply/demand analysis as discussed below:

- Illinois has a very low ACP ($1.24 - $1.89/MWh) and has the option to supply all of RPS compliance from low-priced MISO-based REC supply. Historical data shows that Illinois uses few of its in-state, PJM-interconnected resources to satisfy its RPS requirements.

- PJM GATS shows that Illinois retired 855,126 Tier I RECs for EY 2017 compliance (ending in May 2017) out of 9.4 million generated in-state. Although greater than the 0 that "market forces" would predict, it is far lower than the 13.6 million REC demand used in the Exeter Report.

- Indiana and Virginia are voluntary programs, not subject to the same economic market drivers as mandatory RPS programs. PJM GATS provides summary data for voluntary REC

market retirements, showing 1.21 million and 1.67 million retired for 2016 and 2017 respectively, indicating a very low demand.

E. The Exeter Report's Analysis has Lower than Expected Capacity Factors for Several Renewable Resources

Report Reference:

Page IV-1, Table IV-1 – The table shows capacity factors for a variety of renewable energy technologies.

Gabel Comments:

Several of the values are lower than historical data supports, particularly with respect to wind and utility-scale solar.

The Exeter Report assumes that on-shore wind has a capacity factor of 26% whereas MDV-SEIA states that historical data support a 29% capacity factor for existing capacity. For future wind development, it is reasonable to assume the 29% capacity factor will continue, if not increase. One could argue that the best wind-energy sites have already been developed and future capacity will have a lower capacity factor. However, wind technology is continuing to improve which supports a higher capacity factor for future projects. Based on these conflicting factors, it is recommended that a capacity factor of 29% be utilized. The Exeter Report's assumption of 26% leads to a lower Tier I long-term supply forecast.

The Exeter Report assumes a 16% capacity factor for solar PV installations. While this is a reasonable assumption for residential and small commercial installations, utility scale solar projects typically have a higher capacity factor of 20-25%. As a point of reference, MDV-SEIA notes that DOM's 2018 IRP includes a 26% capacity factor for utility-scale solar in Virginia. By assuming 16% for all solar generation, the Exeter Report understates the total solar PV generation.

F. The Exeter Report Assumes that Solar PV Will Not Contribute to Tier I REC Supply

Report Reference:

Throughout the Exeter Report analysis, it is assumed that solar will not contribute to PJM-sourced Class I REC supply.

Gabel Comments:

In addition to a low capacity factor assumption, the Exeter Report assumes that 0 GWh of solar will contribute to PJM-sourced RECs available for Tier I compliance. It is reasonable to assume that most of PJM-sourced solar PV will be retired for compliance with solar RPS requirements as solar RECs are typically higher priced than Tier I RECs. However, historical PJM GATS data shows that PJM-sourced solar RECs have been retired for past Tier I compliance and are available for future Tier I compliance. Also, for states that limit the solar-specific SREC for solar projects (e.g. New Jersey 10-15 years), the solar capacity converts to Class I eligible capacity. In the case if New Jersey, this amounts to several GW of future capacity by 2030. As a result, the Exeter Report understates the Tier I long-term supply forecast.

G. The Exeter Report Shows Historical Data of Maryland Becoming Less Reliant on Out-of-PJM RECs Over Time

Report Reference:

Page IV-6, Table IV-4 – The Exeter Report graph shows Maryland relying on 800,000 outside-of-PJM RECs used for RPS compliance in 2012, increasing to more than 1,000,000 in 2014, then declining to about 700,000 in 2015.

Gabel Comments:

This shows that Maryland's reliance on out-of-PJM RECs has declined from about 20% in 2012 to about 8% in 2015. Clearly this is much lower than the 55% PJM-sourced REC shortfall implied in the Exeter Report. The historical trend of Maryland's Class I REC sources does not support the Exeter Report's conclusion that Maryland may be unable to satisfy its Tier I RPS goals with PJM-sourced RECs.

H. The Exeter Report Shows a Substantial Shortfall of PJM Tier 1 RECs, Contrary to PJM GATS Data

Report Reference:

Page ES-3 states that "…PJM would experience a nearly 31,000 gigawatt-hour (GWh) deficit (i.e., 55 percent) in 2017 non-carve-out Tier 1 generation."

Gabel Comments:

As stated in other comments above, PJM data does not support the implication that 55% out-of-PJM RECs are used for PJM states' RPS compliance. Further, this statement does not reconcile with PJM GATS data which reports that 17,627 of Tier I RECs as still "Available" from PJM sourced, in-state generation for 2017. These available RECs indicate a continuing surplus of PJM-sourced Tier I RECs.

I. The Exeter Report Understates the Available Tier 1 Generation Capacity

Report Reference:

Page IV-2 - "The 2017 Inventory Database contains 8,806 MW of nameplate, non-carve-out Tier 1 capacity from 282 individual plants, excluding solar resources."

Gabel Comments:

This 8,806 MW capacity estimate is lower than the 13,390 MW capacity value reported on Page II-3 for Maryland-certified Tier I generators. The lower capacity level used in the Exeter Report results in an unreasonably low Tier I supply forecast.

J. The Exeter Report reports that 7,263.5 MW of Additional Wind Capacity is Estimated to be In Service for 2018

Report Reference:

Page V-3, Table V-1 of the Exeter Report shows 12,660.6 MW of wind in the PJM interconnection queue and an estimated In Service for 2018 of 7,263.5 MW.

Gabel Comments:

Although the Exeter Report shows this wind capacity addition from the PJM interconnection queue data, it uses much lower capacity assumptions in its supply forecast. This leads to an understated Tier I long-term supply forecast.

K. The Exeter Report Assumes a Very Low Growth Rate for Installed Wind Capacity

Report Reference:

Page V-3, Table V-2 – The table shows a 3% in service for PJM Queue wind projects, indicating that only 3% of current PJM queue projects will be built. E.g. if 10,000 MW of wind projecst are currently seeking PJM interconnection, the Exeter Report assumes that only 300 MW will be completed. This leads to an assumption of 1% annual capacity growth for PJM wind resources used in the long-term Tier I supply forecast.

Gabel Comments:

The Exeter Report uses PJM data from 2012 to 2014 in its analysis of how many PJM wind projects get completed, concluding that only 3% of wind projects will be built. This is a period when the PJM Tier I market was experiencing an increasing surplus of Tier I RECs and REC prices were correspondingly very low – in the $3.00/MWh range through 2012-2013. These low REC prices led to an inability for projects to secure financing. As a result, many of the wind projects that were started in the 2012-2014 timeframe were delayed or canceled. Using the limited 2012-2014 timeframe is not representational of historic wind development and results in understating long-term wind capacity expansion.

With the current trend of gradually increasing Tier 1 REC prices accompanying a projected decline of surplus capacity, the wind market is showing renewed interest as shown by Table V-1 (page V-2) with 3.5 GW of wind capacity entering the queue in 2016 and 5.1 GW entering in 2017. The analysis does not recognize this rapid increase in the development of PJM wind projects. This contributes to an underestimated forecast for future Tier I REC generation.

L. The Exeter Report Shows a High Shortfall of Tier I RECS for 2018

Report Reference:

Page VIII-3, Table VIII-3 – The table shows a 2018 Tier I shortfall of 37,358 GWh.

Gabel Comments:

As stated earlier on our comments, this implied 37,358 GWh shortfall does not reconcile with 2017 Tier I supply/demand dynamics or the reported PJM GATS data. Currently, PJM GATS shows a 17,627 GWh of surplus PJM-sourced 2017 Tier I RECs.

4. Review of the MDV-SEIA Presentation

MDV-SEIA conducted its own analysis regarding the Exeter Report and provided a Presentation that identifies the same or similar issues discussed above; namely that some of the Exeter Exeter Report's primary assumptions are inconsistent with market data and lead to conclusions that there is a current and forecasted shortfall of available Tier I PJM-sourced RECs. In general, Gabel agrees with the MDV-SEIA assumptions and conclusions.

Specifically, the MDV-SEIA Presentation shows that:

- Tier 1 REC pricing does not support the conclusion of PJM undersupply;
- The Tier 1 undersupply assessment is not shared by other third-party analysts (i.e., MDV-SEIA and Karbone analysis);
- The Exeter Report's assumption for 0 GWh of solar contributing to Tier I REC availability results in a supply forecast that is too low;
- The Exeter Report's assumption for 1% growth of wind capacity, or about 78 MW per year, is inconsistent with both the historical average of ~800 MW per year and the recent increase in wind project interconnection requests (8.6 GW for 2015-2016). This results in a supply forecast that is too low; and,
- The Exeter Report is inconsistent with its assumptions for Tier I eligible generation which contributes to an understated supply forecast.

5. Conclusion

Regarding Maryland's proposed changes to its Tier I RPS generator eligibility, the Exeter Report's conclusion that **"…there are insufficient PJM non-carve-out Tier 1 (or equivalent) resources expected to be developed to allow reliance on only PJM resources"** is based on inaccurate assumptions that lead to a demand forecast that is too high and a supply forecast that is too low. This results in a supply/demand imbalance (effectively a 55% shortfall in 2017) that is not supported by historical market dynamics, PJM GATS data, or Tier I REC prices.

The surplus of PJM Tier I RECs is expected (by many market participants) to decline in the next several years. This supply/demand balancing is driven by increasing RPS targets in the PJM states and demonstrated by the increase of PJM interconnection requests for wind and solar resources. In short, the market dynamics are working efficiently, with increasing RPS targets attracting new renewable generation capacity. There is nothing in the market data that suggests Maryland will have difficulty meeting its increased RPS compliance with PJM-sourced generation.