Responses to comments from Alex Pavlak provided March 3, 2022:

1. *Existing legislation is guesswork. PPRP is tasked to recommend changes. The best way to identify changes is to start with a blank slate, and quantify options, no preconceptions. If OSW is a high-cost solution, that should be identified early.*

The Maryland Clean Energy Jobs Act of 2019 specifies what areas the 100% study is supposed to address, and PPRP intends to comply with those requirements. Other statutes in Maryland will affect the 100% study, such as the Maryland RPS, net metering, and offshore wind requirements.

2. *Does the model reasonably represent hours-below-threshold data for the base year?*

VCE's WIS:dom model simulates the electricity system on a hour-by-hour basis, both current and into the future (2040, for this project). Therefore, WIS:dom will capture low-wind hours as well as high-wind hours. Before running the first three cases, VCE will initialize its model and review results to ensure that grid operations in Maryland, and in PJM as a whole, are as close to actual operation in 2020 as possible.

3. *What are wind and solar capacity factors for the base year?*

The VCE model calculates wind and solar capacity factors for multiple years using data from the National Oceanic Atmospheric Administration's High-Resolution Rapid Refresh model at a 3 kilometer, 5-minute resolution. This allows the VCE model to weigh the temporal and spatial variability that comes with wind and solar energy generation. For reference, the average capacity factor for land-based wind power in PJM and in Maryland are 30% and 34%, respectively, while the average capacity factor in PJM for utility-scale, community solar and residential solar are 24%, 18%, and 18%, respectively, and 25%, 19% and 19% for Maryland, also respectively. To be clear, these average capacity factors are not used as a flat capacity factor in VCE's model.

4. *For new construction, how does VCE quantify real world conditions: forced outages, planned maintenance, imperfect installations, shadowing, ageing equipment, and local curtailment?*

Forced outages and planned maintenance are built into VCE's model. VCE's model will also curtail generation, including wind and solar, as needed to maintain reliability. More information is available in VCE's report on its dataset: https://vibrantcleanenergy.com/wp-content/uploads/2020/08/VCE-Weather-Dataset-Overview_August2020.pdf. VCE currently does not include performance degradation from ageing of equipment. However, VCE thinks that this will only have a minor impact and should not significantly change model results.

5. *Dowling has shown that the more weather years, the more storage required. How many weather years will be included in the modeling*?

VCE will run the current modeling on 4 weather years—the weather year 2020, and three others representing low, medium and high resource scenarios.

6. *Transmission – Upgrading existing transmission is certainly more realistic than new transmission, but it is not so simple. Reconductoring will have voltage sag and stability issues. You can't push power very high above the surge impedance loading without having voltage and stability problems. More parallel lines or going to a higher voltage doesn't integrate well with existing lines. We should be looking at scenarios that REDUCE transmission through high availability distributed generation.*

We agree that upgrading existing transmission is not simple. For that reason, VCE has emphasized rebuilding rather than reconductoring. Regarding distributed generation, a sensitivity scenario emphasizing high levels of distributed generation for both the 100% renewable and 100% clean scenarios could be run, if the working group desires. PPRP intends to collect additional feedback from the working group prior to initiating additional scenarios.

7. *GGRA – There is a logical flaw here. The imperative should be to eventually achieve 100% decarbonization. Goals of 50% by 2030, or net zero by 2050, or the cheapest next step will almost certainly deploy technology that will interfere with or be stranded by optimal cost 100% decarbonization.*

As noted during the meeting, we will not be considering the GGRA for the three initial cases. We will most likely have a sensitivity scenario on climate change, and the GGRA or a net zero requirement by 2050 are certainly options for the working group to consider.

8. *Illinois – The professional engineering approach is to quantify options for 100% decarbonization then work backwards. Illinois adds unnecessary confusion*

We are not performing a 100% decarbonization study. We are conducting a study as required by the Maryland General Assembly, i.e. 100% renewable energy and 100% clean energy by 2040. Because Illinois is one of the primary sources of renewable energy credits for the Maryland RPS, we felt it was important to reflect the provisions of the Illinois Clean Energy Jobs Act of 2021 as accurately as possible.

9. *Geothermal heat pump (GHP) - The technology here is still emerging. It makes sense to use GHPs sized to also handle A/C load. But managing peak load with sufficient reserves requires whole system design.*

We agree with your comment on geothermal heat pumps. In terms of managing peak load, VCE's model will take into account changes to the load profile as a result of addition of GHPs along with maintaining required planning reserve margins and load following reserves.

10. *SMR costs - The proposed numbers (CAPEX of $3,500/kW) are reasonable. As ETI notes, Southeast Asia, with mature nuclear industries is building nuclear at $2-4/W with China under $2. The West, confronted with first-of-a-kind costs is currently building at $8-12/W. We do not know enough to put a learning curve on $3.5/W.*

We agree.

11. *Discount rate - The 2021-ATB-Data_Masteer_new defines WACC (Weighted Average Cost of Capital (real) as "The average expected rate that is paid to finance assets. (Default in ReEDS is 6.2% real); WACC is a function of DF, RROE, IR, i, and TR." 6.2% is consistent with the assumed interest rate of 5.4% as well as typical EIA assumptions. HOWEVER, under Offshore Wind tab, WACC (real) – moderate is set at 2.6%. I can only assume that NREL is assuming weird temporary subsidy or guarantees which just hides real cost, transferring risk to someone else. This is a big difference that has nothing to do with inflation. For the 100% Study, my recommendation is to use the 6.2% number.*

After considering the comments made at the working group meeting, we will use a weighted average cost of capital of 6%, which is roughly in the middle between the 5.87% VCE recommended and the 6.2% in the NREL ReEDS model.