

## SB0265, Dr. Alex Pavlak, SUPPORT WITH AMMENDMENT

*The professional development of an unprecedented system consists of three sequential steps:*

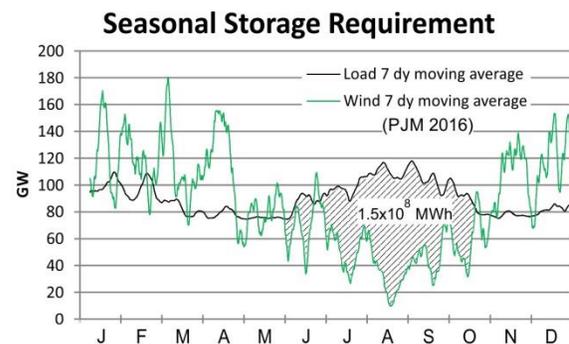
**1 Set the goal → 2 Quantify the options → 3 Choose one**

Memorandum #1 notes that Maryland's RPS goal and the GGRA goals are inconsistent. In May 2019 Governor Hogan announced the goal of 100% clean electricity by 2040. Excellent! A clear and stable performance goal provides an invaluable constraint on system development.

Quantifying options is an engineering task. In building construction, this amounts to architectural sketches showing sizes, costs and the marketable features of different skyscraper configurations. In bridge building (e.g. the Wilson bridge), engineers estimate the cost of meeting requirements with a high bridge, low bridge, drawbridge, and tunnel. For the Apollo Moon Project, engineers estimated mass associated with three options: 1- A big rocket launched from the surface of the earth to land on the moon then return; 2 – building a rocket in earth orbit, landing on the moon, then return; 3 – a lunar-orbit-rendezvous: earth surface to lunar orbit, drop an astronaut to the lunar surface, pick him up, and return to earth. What is impressive about Apollo is that the program had the discipline to spend one year up front to clarify concepts before choosing. They made the correct choice and the rest is history.

For clean energy, concept definition starts with a blank sheet of paper and imagines what the world will look like without fossil fuel. Core carbon-free grid technologies are wind, solar, nuclear and storage. How do these concepts fit together in reliable affordable systems? Intermittency is a serious challenge to reliable system design because all the electricity generation from all generators of a particular technology type falls to zero at the same time. This happens every night for solar PV. Wind on the PJM system drops below 2% of nameplate capacity for a dozen hours per year, often during peak load.

Storage has been touted as a solution. For solar PV overnight storage flattens diurnal cycles, but it does not solve for the problem of sequential cloudy days. For wind, the adjacent figure shows that the storage requirement is seasonal and huge. Seasonal storage is theoretically possible but economically impractical. While intuition says that the wind is always blowing somewhere, a [2014 paper](#) combined wind production data from PJM and MISO and found that wind production from the combined system still falls to almost zero.



Since peak loads determine installed capacity, it is important that models correctly portray the peaks and valleys; not just average production. Published models suppress volatility by assuming wind-load independence, and by spatial and temporal averaging. Only recently has enough good wind production data accumulated to rigorously validate models with real data from 5+ years.

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### **SB-0265 amendments:**

- 1) State Maryland's goal: 100% clean electric power.
- 2) Fund the development of a plan : a [Concept Design Study](#)

