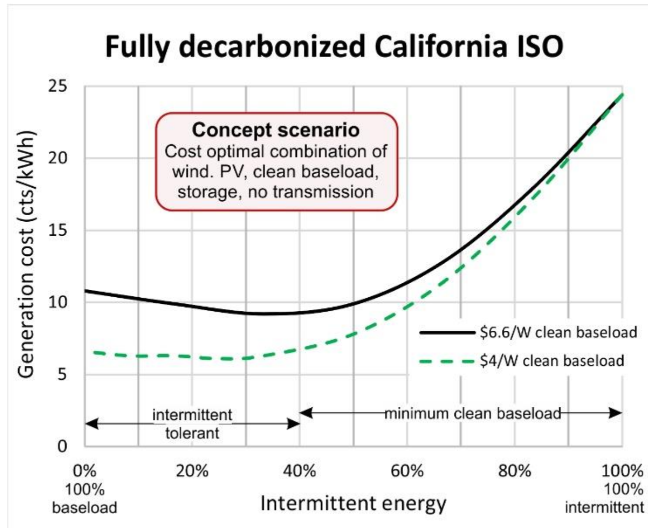
March 3, 20221
Alex Pavlak comments

Quantify options for 100% fully decarbonized electric power

The professional method is to FIRST quantify all options for 100% fully decarbonized electric power independent of policy. AFTER the physical & economic constraints are clarified, THEN a rational policy roadmap can be constructed. Introducing policy goals first is guesswork. 100% RPS & 100% CARES are not the same as fully decarbonized. Under both policies, imports/exports are allowed; costs are dependent on arbitrary assumptions about the policies of other PJM States; they assume the existence of PJM, and ignore novel system opportunities such as small, high-availability distributed generation. 100% RPS/CARES may interfere with full decarbonization. I recommend that a classical architectural assessment should be conducted in parallel with 100% RPS/CARES.

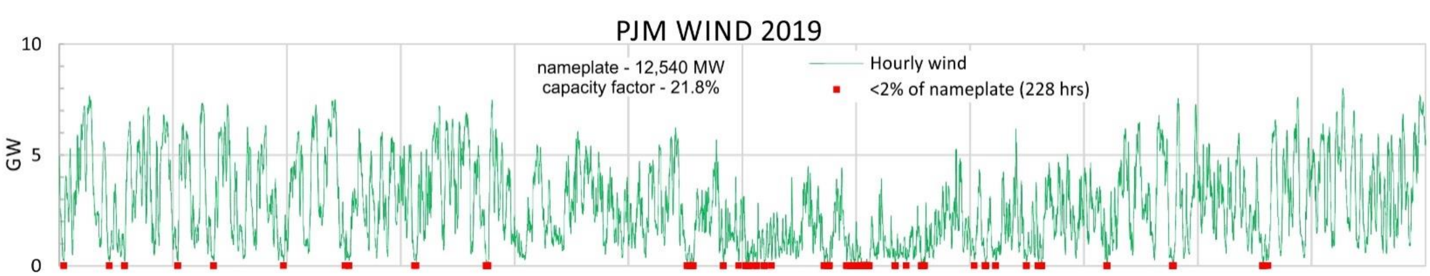


Classical architecture would quantify cost-optimal combinations of wind, PV, storage, and clean baseload for fully decarbonized electric power without transmission constraints. A simple copper plate transmission assumption (no cost, no loss) allows the exploration of hundreds of technology & performance/cost combinations with modest effort. An example of the result for CAISO is presented in the adjacent figure; it is noteworthy that the low-cost mix is PV+baseload, no wind. CAISO onshore wind always added cost. The result identifies parameter combinations worthy of deep-dive transmission studies. DNR should request the legislature add the following parallel task to the CEJA2019 100% Study.

7-714 (F) (2) (IV) A parallel architectural task that is not constrained by current legislation and existing infrastructure. The goal is to quantify cost-optimal combinations of wind, PV, storage, and clean baseload for fully decarbonized electric power for Maryland.

Validating model variability

"*VCE starts by recreating 2020 with existing generation and transmission as it was then…*," The chart below presents an hourly time series of total wind production on the PJM system for the year 2019. Note that total wind power on the whole PJM system dropped below 2% of nameplate (red dots) for 228 hours during 2019.



Dr. Alex Pavlak; Future of Energy Initiative; www.pavlak.net; www.FutureOfEnergyInitiative.org
315 Dunham Ct., Severna Park, MD 21146; (410) 647-7334; (443) 603-3279(c); alex@pavlak.net

Hours-below-threshold is an important validation metric because it is the result of PJM scale weather patterns. No PJM wind means no PJM wind power no matter how many wind turbines are on the system. Based on scaling evidence, managing system wide low-wind-low-sun conditions begins to dominate total system costs when intermittent generation exceeds 20%. VCE has said that modeled profiles are smoother than actual generation. If model smoothing eliminates these 228 low wind hours, it would unrealistically overestimate wind reliability. Validating WIS:dom-P for hours-below-threshold for the base year, provides confidence that the model can fairly represent OSW.

BRIEFING QUESTIONS & COMMENTS

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.
2. Does the model reasonably represent hours-below-threshold data for the base year?
3. What are wind and solar capacity factors for the base year?
4. For new construction, how does VCE quantify real world conditions: forced outages, planned maintenance, imperfect installations, shadowing, ageing equipment, and local curtailment?
5. Dowling has shown that the more weather years, the more storage required. How many weather years will be included in the modeling?
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.
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.
8. Illinois – The professional engineering approach is to quantify options for 100% decarbonization then work backwards. Illinois adds unnecessary confusion.
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.
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.
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.

Dr. Alex Pavlak; Future of Energy Initiative; www.pavlak.net; www.FutureOfEnergyInitiative.org
315 Dunham Ct., Severna Park, MD 21146; (410) 647-7334; (443) 603-3279(c); alex@pavlak.net