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Gubernatorial Decarbonization Commission Proposal

To provide Maryland's with better informed, more rational advice.

Decarbonization is critically dependent on 100% clean electric power. Re-inventing the electric power system is a difficult political and engineering challenge complicated by incomplete information and inadequate bureaucracies. States are forced into a leadership role because some States are committing billions; political unity is greater at the State level than at the national level; and resources, electrical loads and solutions are regional.

The proposed attempts to introduce centralized coordination and classical engineering discipline into Maryland's policymaking process. Builders normally begin with a vision of the final result. Artists, sculptors, architects, and engineers, those who build things for a living, start with a functional design, architectural concepts and rational options. This is how NASA builds Mars Rovers, how MD &VA built the Wilson bridge, how the Pentagon builds complex systems. The rational development sequence is:

1 Set the goal > 2 Quantify 100% options > 3 Form a rational vision > 4 Plan/policy/market design

Decentralized liberal democracies often lack the discipline to follow this sequence with the result that policymakers are confronted with poorly informed politically competing visions. This proposal attempts to fill that void.

1.0 THE COMMISSION CONFIGURATION

The number of clean electric power system studies is growing, few of them have been critically reviewed. Some of these studies are excellent, some not so much, and the casual reader cannot judge the difference. The primary management process is (virtual) public hearings with invited expert testimony subjected to critical query, along with high quality direct studies. It is important to provide a current understanding of nuances, what is important vs unimportant, certain vs uncertain; and what needs additional investigation.

Commissioners are chosen for mature judgement, political bipartisan balance, system development expertise and to maintain a healthy tension between long-term strategic goals and short-term political goals. Twelve core commissioners are proposed balancing politicians with technocrats, staffing by the Maryland Energy Administration.

2.0 MISSION

To provide advice to the State of Maryland. The scope is decarbonization with immediate priority on electric power. The Commission has a budget and is staffed to conduct studies and hearings. Priority tasks are: 1) what if anything to do about OSW-2, 2) executive oversight and tasking of the Maryland 100% Study (3.2.8), and 3) how to procure new nuclear.

The following tasks provides options for consideration by the Commission.

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3.0 STRATGEGIC TASKS

3.1. **Certify the strategic goal** – Climate change demands that ultimately the power grids be fully decarbonized, no fossil fuel. The professional low-risk approach is to start with the ultimate goal then work backwards to figure out how to get there from here. Concepts like carbon sequestration are a potential interim solution. EVERYTHING depends on a sound goal.

3.2. **Conceptually quantify fully decarbonized systems –** Highest priority is to clarify basic directions, to quantify optional electric power system architectures independent of legacy infrastructure existing market design and current policy.

- ***3.2.1.*** MODEL ASSESSMENT – There are several model methodologies available, some useful some not so much. What is state-of-the-art today?
- ***3.2.2.*** GENERATION BALANCE – Using copper plate assumption (no cost, no loss) what is the optimal balance of clean generators (e.g. wind, PV, nuclear and storage) that can satisfy prospective loads.
- ***3.2.3.*** TRANSMISSION ARCHITECTURE VIEW - Transmission has two functional requirements: distribution, transmission from generator to load; and generator interconnection for backup and system reliability. A perfect generator needs no interconnection, it is all distribution. Modeling should range from a national grid and minimal grid. Define the value of DC interconnections,
- ***3.2.4.*** INDEPENDENT MARYLAND – Model a closed boundary around the State, what does the power system look like.
- ***3.2.5.*** PJM – Closed boundary around PJM, Is there any reason why Maryland's optimal solution will change.
- ***3.2.6.*** NATIONAL GRID - Intermittent wind and solar have low-capacity factors. Is there any evidence that a national grid connecting intermittent generation with a big enough grid is a practical solution?
- ***3.2.7.*** AUTONOMOUS DISTRIBUTION SYSTEMS – Could high availability generation + storage embedded in distribution systems eliminate the need for long distance transmission.
- ***3.2.8.*** **DNR 100% RPS STUDY TASKING – CEJA2019 tasked the DNR PPRP program to characterize the impact of 100% RPS. This has been extended to 100% CARES. The 100% study needs executive attention, redirection based on results. Maryland needs to see cost optimal system fully decarbonized configurations, technology agnostic, independent of legacy systems, existing market structure, and current policy.**
- ***3.2.9.*** DATA NEEDS – What does Maryland need from the federal government, PJM, other states in the way of information and prototype demonstrations.

3.3. **Market design -** How will retail and wholesale markets evolve? Given a physical system design, what market design minimizes total system cost. The existing marketplace has been optimized for lowest generation cost. Intermittent generation is not fungible with dependable generation and breaks the paradigm. Future markets, designed for lowest clean, reliable system cost are likely to be split between dependable and interruptible power. As costs shift from variable fuel cost dominated to fixed capital cost dominated, the alignment of price with value, and market design, will change.

3.4. **Pace& Risk –**. The quickest path to 100% is to avoid big mistakes. One risk is proceeding too fast or too slow. Another risk is a premature commitment to the wrong concept. This could lead to an expensive, dirty, unreliable systems where citizens balk at high electricity prices and Maryland becomes stuck, unable to fix mistakes in a timely manner. Quantifying options minimizes risk. There are technical risks including EMP, stability, terror, and solar flares.

3.5. **How will electrification affect grid design?** – What are the optional roadmaps for decarbonization? Once reliable zero GHG electric power is achieved, what are the structural directions for total decarbonization? Waste heat? EVs? H_2 via electrolysis? What do the many different roadmap studies have to say about big contributors to overall decarbonization?

3.6. **Governance evolution -** Maryland is constrained by the existing governance structure (ISOs, RTOs, FERC, NERC, PSCs, PUCs…) which evolved during a period of fossil fuel and technology stasis. Decarbonization, intermittent generators, ultra-reliable SMRs…, all change the physics and economic basis for this structure. In planning its future, Maryland should anticipate likely changes.

4.0 TACTICAL TASKS

4.1. **Metrics & targets** – In most cases, clean energy will be more costly than fossil fuel. Establishing a system of common metrics such as \$/lb CO_2, would establish a common basis for valuing investments.

4.2. **EMPOWER –** The EMPOWER program is accumulating debt. How does Maryland pay it?

4.3. **OSW-2- What, if anything, can or should be done about it?**

4.4. **New nuclear** – Develop a plan for incorporating and verifying the promise of modern generation concepts.

4.5. **Rationalize Maryland's relationships**

- **4.5.1.** **Maryland's relationship with PJM** – Maryland and PJM currently have different and incompatible goals. Can Maryland overcome this difference and achieve its goals? Should Maryland strive for capacity independence from PJM? What can be said about the long-term impact of MOPR & FRR? Should Maryland become its own ISO/RTO like New York State?
- **4.5.2.** **Partnerships with other states –** Certain tasks like modeling PJM, multiple unit nuclear procurements, would benefit from collaboration with neighboring State. Do recent blackouts experienced by Texas, California, and Australia signal minor growing pains or warnings of structural flaws.
- **4.5.3.** **Federal support -** What does Maryland want to see in the way of federal programs?

5.0 EDUCATION TASKS

One purpose is to rationalize and strengthen a political consensus in Maryland through education, public testimony by the world's experts subject to commissioner inquiry. Understanding the following issues is important for making sound judgments. This topic may require original studies. Partnering with other coastal States would raise awareness and promote political unity.

5.1. **How serious is the threat of sea level rise?** What is the impact on Maryland if the Greenland Ice Cap and/or the Antarctic ice sheet melts? Over what time frames can this be expected? What does history have to say?

5.2. **What can be learned from Case Studies? -** Lessons, both political and technical, from the 8 largest clean grids (France, Quebec, Ontario, Sweden, Norway, British Columbia, Paraguay, and Switzerland). How can they get to zero GHG? What can be learned from grids with high renewable penetration – California, Germany, Ireland, Denmark, ERCOT?

5.3. **What can be learned from a critical review of the latest system studies? –** Several system studies are emerging that need critical review. As a minimum they include MISO's RIIA, Net Zero America, NREL's LA-100 and National Transmission planning. A common thread is that low-cost systems need reliable baseload, the question is how much baseload is required for system reliability?

5.4. **What is the strategic (long term) value of nuclear in Maryland?** The challenges are 1) preserve existing power plants, 2) reform the market to appropriately reward clean baseload and 3) reconstruct the US nuclear power industry.

5.5. **What is the strategic value of Wind in MD?** Does land-based wind have a long term future within the geographic boundaries of Maryland? How does the system value wind energy and its capacity? What do we know about the cost and performance of offshore wind (OSW)? How sound is the engineering basis for these numbers?

5.6. **What is the strategic value of PV in MD**? How does the system value of PV energy and capacity depend on penetration levels and other grid assets? What is optimal? What are lessons from high PV penetration grids. [California], [Hawaii]. What are levelized costs for Maryland? What are system constraints and penetration limits?

5.7. **What is the strategic value of CO_2 sequestration in Maryland?** – Maryland has a geology that may be attractive for the geological sequestration of CO_2. What are Storage methods, costs, and opportunities? How do we know that CO_2 sequestration is permanent and will not leak to contaminate Maryland's potable aquifers or return to the atmosphere?

5.8. **What is the strategic value of electric power storage?** Overview what is known about system requirements for storage and identify technologies. What policies should Maryland adopt?

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