HB 363 & 1349 Dr. Harry Winsor SUPPORT WITH AMENDMENT February 28, 2020

Recommendations & Possible Amendments (A1 to A6)

What's Right in HB 363 & 1349 – Setting the overall goal. Working with both Maryland Energy Administration and Department of the Environment is a good start. Defining nuclear as "clean" and drafting an initial action frame also makes sense. There's much more to do—more departments must be brought into the team, and they must operate in concordance and tempo with the overall goal, and the sub-goals determined to be most effective in reducing MD's Greenhouse Gas emissions.

Amendment Intent – This page attempts to scope major opportunities, constraints and tradeoffs and recommends amendment items for House Bill 363 & 1349 for integrating clean technologies into a reliable non-fossil-fuel electrical grid to achieve Maryland's stated CARES goal of a clean grid by 2040. **First Amendment (A1):** The highly technical points should be studied openly in the PJM Concept Definition Study (and other supportive studies, if necessary) to validate and disseminate the technical choices envisioned in the CARES legislation, and their predicted progress to meeting the CARES criteria. Absent such studies, significant costs and delays are likely to be incurred. To be a leader, Maryland must take "first mover" actions. Getting the technical parts of the transition to clean energy studied is the essential first step. Only then can a reasonable cost be assigned to a technical choice or implementation. Further possible first mover actions are identified below, but it is impossible at present to determine the timing or order in which they should be introduced.

Overall Problem – Climate Change overall solution—(The next World War's Manhattan Project) See CO2 Annual Plots:. https://www.co2levels.org/. http://www.esrl.noaa.gov/gmd/ccgg/trends/history.html. Needs more than "CO2 break-even" due to steadily increasing warming releasing ever more buried CO2. Electricity is only a main part of the solution.

A2: End fossil fuel & extraction tax breaks – This can be done incrementally over a reasonable time by removing all subsidies and/or adding/increasing a tax, then partially repaying them from the increased tax revenue so that it can be tailored to phase out at the desired (TBD) tempo. It becomes much easier to cost out transformation options when there is no implicit or hidden subsidy. This is also a way to announce that MD is serious without immediately affecting fossil fuel stakeholders' cash flow until the transition requires it. Amendment suggestion: ***A3: Social cost of CO2 Analysis study*** – In order to choose the transition tempo, the cost of each proposed action and the cost of not acting must be known. Honest appraisals, with transparency to all & enough to secure votes for major program funding, are essential, especially as Social Cost functions (including training opportunities) must be justified separately for each of the possible technical choices for each MD chosen transition step.

The Electrical Grid's long-term role in the overall solution – Ultimately, electricity must make fuel for vehicles and remote and special uses, and for raw materials for industry. This may be an opportunity for intermittent power, but grid stability must be maintained. This main effort will require orchestrating billing and technology using good social planning.

Impacts on Business – ***A4: Streamline business and environmental approval*** – Improve License certification and regulation of Heating, Air conditioning Insulation, ventilation, etc. Specify MD State and business priorities/needs to highlight the latest and future opportunities.

A5: Establish engineering and transition training programs that support a realistic transition path – Geology (Is offshore disposal of CO2 really safe and permanent?), Reactor Technology (What is the best reactor technology, and how rapidly will better choices appear?), Interruptible power engineering (How can all surplus electrical energy be fully utilized to reduce emissions in any sector?), etc.

The Electrical Grid's initial part of the overall solution– Goal: Clean Electrical Power from sources that do not further poison the Atmosphere & Environment and that permit all fossil energy to be diverted to processes using only clean energy – At least Zero emission from the Grid. ***A6: Information dissemination program*** to discuss cost and benefit options for MD steps freely, possibly to designate specific city, county, and state "microgrid boundaries within PJM" that allow flexibility for determining local rates and reliability targets and suitable generation connection terms for each microgrid.

Dr. Harry Winsor; Future of Energy Initiative; www.FutureOfEnergyInitiative.org; hvwinsor@comcast.net
17 South Beechwood Ave., Catonsville, MD 21228; (410) 788-8884; (443) 851-3951(c)

Updated Nuclear Fission Opportunities for CARES

Intent – To briefly describe major opportunities for integrating nuclear technology into a non-fossil-fuel electrical grid. In detail, these opportunities are highly technical and should be the subject of a PJM Concept Definition Study to validate and disseminate the technical future envisioned in the CARES legislation. Absent such a Study, significant costs and delays are likely to be incurred.

History – Existing nuclear power plants (Generation II technology) are large scale versions of reactors originally designed for ships and submarines. In the 1950s Adm. Rickover adapted a military reactor for first commercial use at Shippingport PA. President Eisenhower declassified the technology, and the utilities replicated designs to leverage the military investment. Some consequences of simply increasing the size of naval designs are that large cores are more susceptible to melt-down and pressurized-water cooling requires large structures to contain steam in the event of an accident. They should be selectively replaced or retired as reactors better designed for commercial service become available.

Improvement Efforts – Gen III reactors, available since CY-2000, are an evolutionary improvement of Gen II designs: better fuel technology, thermal efficiency, passive safety systems and standardization. Gen IV reactors, currently under development, are the first generation designed and optimized for civilian requirements. They include such technologies as sodium cooled fast neutron reactors, high temperature gas reactors and thorium fuel cycles. Small modular reactors are factory built, either Gen III or Gen IV technology. Several concepts are touted to be “walk-away safe”. While the designs of these new reactor types are facilitated by computer technology, they still must be thoroughly validated in use tests and practical use before committing to expensive build programs. Will MD & NRC be able to respond promptly?

Long-Term Sustainability – Gen II technology burns the fissile isotope U235 (0.7% of mined uranium). This is not sustainable: Proven uranium reserves can power 100% of civilization’s electricity needs for only a few decades if only 0.7% is used. Burning spent fuel in future “fast neutron” (breeder) reactors could burn the remaining 99.3%, extending proven reserves to thousands of years. It may also, with the right fuel cycle technology, greatly reduce the radioactive lifetime of the spent fuel. On civilization’s time scales this is sustainable. Furthermore, there is enough uranium in sea water to power the planet indefinitely, as it is slowly released from granite by erosion. How rapidly can we develop the technology?

Safety – Public concern, often called “fear of radiation and nuclear reactors” is at least partly irrational. While there have been some worker deaths, no civilian deaths from radiation exposure at Three Mile Island, Chernobyl, or Fukushima have been conclusively documented. Emotional trauma from evacuation has been a problem. Large number projections of long-term distributed deaths and cancer are based on the Linear No Threshold (LNT) assumption for biological damage. Improving research indicates that LNT may be too pessimistic at low radiation doses. Improved technology is less accident prone than old designs and the nuclear industry has an excellent safety record compared to other energy sources. Public perceptions can be expected to change with time, achievement of safe performance records and credible new information. This may require changes in NRC policies and/or factory-built and tested reactors.

Spent fuel processing – Spent fuel from US Gen II reactors consists of 96% uranium, 3% fission products (elements with ~½ the molecular weight of uranium), and 1% actinides (new elements created by absorbing a neutron). Most fission products have a relatively short half-life, so letting the spent fuel cool to stable isotopes in a cask on the reactor site for 30 years is a sound initial step to reduce radiation caused difficulties in further reprocessing steps. The uranium and actinides can then be more safely and economically reprocessed to supply fuel to fast neutron reactors. Proper selection and implementation of new technology reactor and fuel systems may lower the danger from radioactive waste, perhaps

Dr. Harry Winsor; Future of Energy Initiative; www.FutureOfEnergyInitiative.org; hvwinsor@comcast.net
17 South Beechwood Ave., Catonsville, MD 21228; (410) 788-8884; (443) 851-3951(c)

by a factor of 500 to 1,000. Also, there is a bill in Congress to allow reactor waste burial at New Mexico's Waste Isolation Pilot Plant, and opposition to other storage sites may decrease with documented safety records. ***How long will it take?***

Desired nuclear power system design features for grid use – Nuclear generators that are safe enough to locate and run in urban centers make possible up to a 3-fold increase in usable output energy: Using heat as well as electricity. This would be extremely valuable for space-heating in colder climates, and for weaning many industries from fossil fuels. "City-safe" nuclear generation may also reuse many fossil fuel generator sites that may otherwise be closed, preserving their transmission and distribution connections. (Most powerlines are "one-way", and the cost to upgrade to "two-way", as most renewables "plans" imply, can be very high.) Increased operating flexibility nuclear reactors able to run at small fractional loads, and to direct excess power into heating, may also increase their reliability to resist sudden failure modes.

Grid features for fair and economical use of dispatchable and variable (nuclear and renewable) generators – (Memo #26, in process) The discussion of FERC's MOPAR Order E-1, highlights the sorts of difficulties that can occur when state policies and rate plans do not properly comply with the US Constitution's inter-state commerce laws. Separating the technical grid design from policy and rate plans should clarify the problems. Otherwise, interactions between in-state and out-of-state generation may significantly complicate integration, especially if an intermittent power market must simultaneously serve a state, but conflicts with an interstate grid. Already differing subsidies are beginning to drive essential services off many grids. ***Can the loss of perfectly good interim power generators to such competition be capably planned?***

Best existing nuclear-hydro renewable-system transition – Ontario Canada has successfully transitioned to 96% carbon free. Nuclear and hydro are the low carbon work horses (see Table). Significantly, the 6% of total consumption that was generated by wind is after 2/3 of the wind was curtailed or exported at discount prices. Sweden does very well with a nuclear + hydro grid, and France has been successful with an ~80% nuclear grid. Defining PJM Options to economically yield as clean a system for Maryland will require a PJM Concept Definition Study.

Nuclear	63%
Hydro	26%
Gas	4%
Renewables	7%
Ontario electricity mix 2017	

EMP, storm, damage resistance and ability to recover – Maryland's location near the National Capitol means that its power system must cooperate with significant Federal priorities and goals, such as robustness in the face of damage from storms, sabotage, hacking and acts of war. Since Federal efforts to define these priorities are still underway, MD's plans need to consider the possibly changing Federal constraints. This may include re-architecting the MD grid in such a way as to reduce cyber attack and facilitate rapid recovery from blackout conditions. Nuclear generators will likely be superior to wind and solar generators due to shorter transmission lines, reduced attack area and better shielding against damage that can be designed in. ***Is Maryland able to respond rapidly to such Federal needs?***

****

Nuclear fission has enormous development potential. Technical progress will depend on the magnitude of investment. Political commitment requires planning and investment to soundly answer numerous technical, safety, social and interstate cooperation questions, and to educate the public to changing realities.

Does Maryland have a workable plan for incorporating nuclear generation promptly and safely?

Future Topics:

Ocean Thermal References   Separate Rate plan from technical   Grid Architecture Concerns

CCS Reference?

Dr. Harry Winsor; Future of Energy Initiative; www.FutureOfEnergyInitiative.org; hvwinsor@comcast.net
17 South Beechwood Ave., Catonsville, MD 21228; (410) 788-8884; (443) 851-3951(c)