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HB 708 Comprehensive Climate Solutions

Position: Support

Clean Air Task Force (CATF) supports HB 708, which requires net-zero statewide greenhouse gas (GHG) emissions by 2045.

California, Hawaii, Louisiana, Massachusetts, Michigan, Nevada, New York, Virginia, and Washington have all made legally binding net-zero or carbon neutrality targets for no later than mid-century. In addition, a diverse group of states across the United States (U.S.), representing 27% of U.S. electricity consumption, have adopted clean energy standards for the electric sector with commitments to be fully decarbonized by no later than mid-century. In 2021 alone, Illinois, North Carolina, and Oregon, representing 7% of U.S. electricity consumption, enacted clean energy legislation.

The issues of required infrastructure growth, grid reliability and stability, cost, and job impacts are typically discussed when considering the transition to a zero-carbon economy. CATF used results from the widely respected Net-Zero America Project (NZAP) to analyze these issues and demonstrate that the 2045 net-zero GHG requirement of HB 708 is achievable.

Infrastructure Growth

Three scenarios from the NZAP study are particularly relevant for framing the potential implications of a Maryland transition to net-zero GHG emissions by 2045.

1) Reference Case: Business as usual to 2050 with no additional GHG emissions restrictions.
2) Unconstrained Technology Mix (E+): The electric grid is not constrained to only wind and solar as possible energy sources. In addition, the following assumptions are included in the E+ scenario:
    a. 100% of new sales of all vehicles are electric by 2050,
    b. Air source heat pumps grow to dominate new sales for space heating,
    c. Residential final energy demand falls by 45% between 2020 and 2050, and
    d. Residential final energy intensity declines by 6% per year.
3) Constrained Renewables (E+/RE-): In addition to the E+ assumptions, new solar and wind energy is limited based on the historical maximum single-year record for the U.S. The E+/RE- scenario is intended to illustrate a future in which technical and physical challenges might be a constraint on the buildout of new infrastructure.

CATF is discussing and comparing these scenarios because they mirror the high electrification intent of HB 708. The purpose of the discussion and the figures included below are to illustrate that the growth in infrastructure needed to achieve net-zero GHG emissions across the Maryland economy by 2045 is technically and economically feasible, and that there are multiple possible pathways to achieve net-zero GHG emissions. The scenarios are not intended to be prescriptive or predictive of future development, but instead bound the infrastructure growth from historical variable renewable annual capacity additions to greatly accelerated solar and wind capacity additions. Each of the scenarios accounts for the additional transmission needed to connect power projects to the existing transmission system (i.e., spur lines) and to enable interstate trade.

It should be noted that the NZAP study was originally conducted at a regional scale across the U.S. and was then downscaled to the state level as a first order estimate of Maryland's transition to a net-zero GHG economy.

It should also be noted in the following figures that "natural gas" refers to synthetic fuels that are zero-carbon fuels (e.g., hydrogen or ammonia that are used to power vehicles).

The following figure illustrates the increase in installed capacity based on the scenarios detailed above. Each scenario models a stable and reliable grid with different degrees of needed capacity growth depending on the strategy pursued to achieve net-zero GHG emissions.

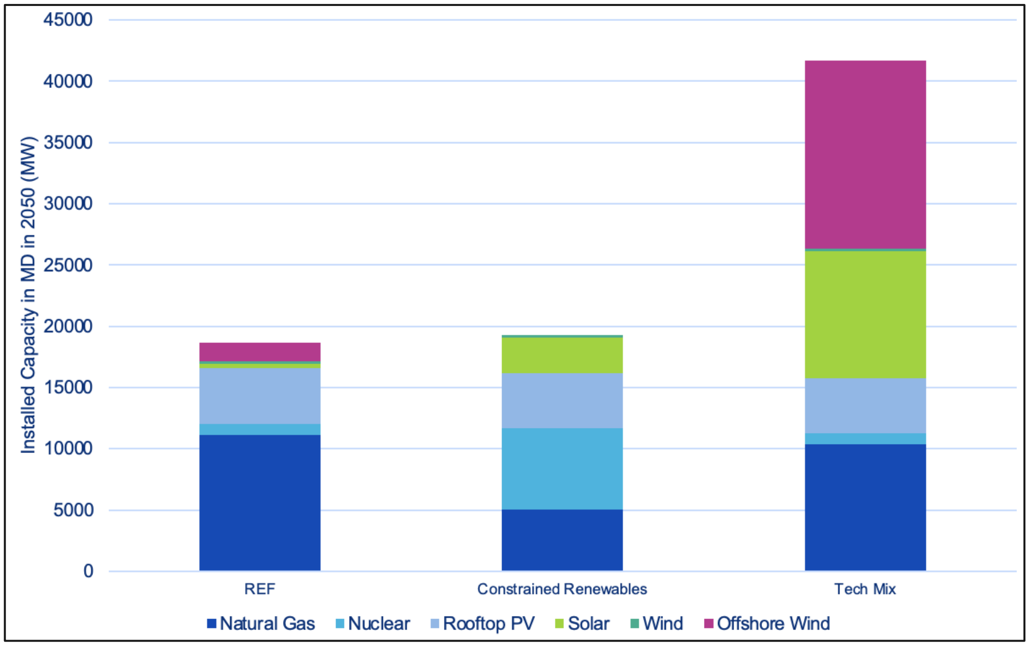

Figure 1. NZAP analysis for the installed capacity based on the scenarios detailed above to achieve net-zero GHG emissions economy-wide in Maryland. The constrained renewables and tech mix scenarios are compared to the business as usual "REF". Note that "PV" stands for photovoltaic.

The next two figures focus on the additional transmission that is required for each scenario detailed above, relative to the current baseline. The unconstrained technology mix scenario requires substantially more additional transmission than the other scenario because spur lines need to be built to connect the dispersed variable renewable resources to the transmission network.

Figure 2. Additional high voltage transmission required for each of the scenarios, relative to the business as usual "REF" case. The base transmission is roughly estimated at 1,316 GW-km.[1]

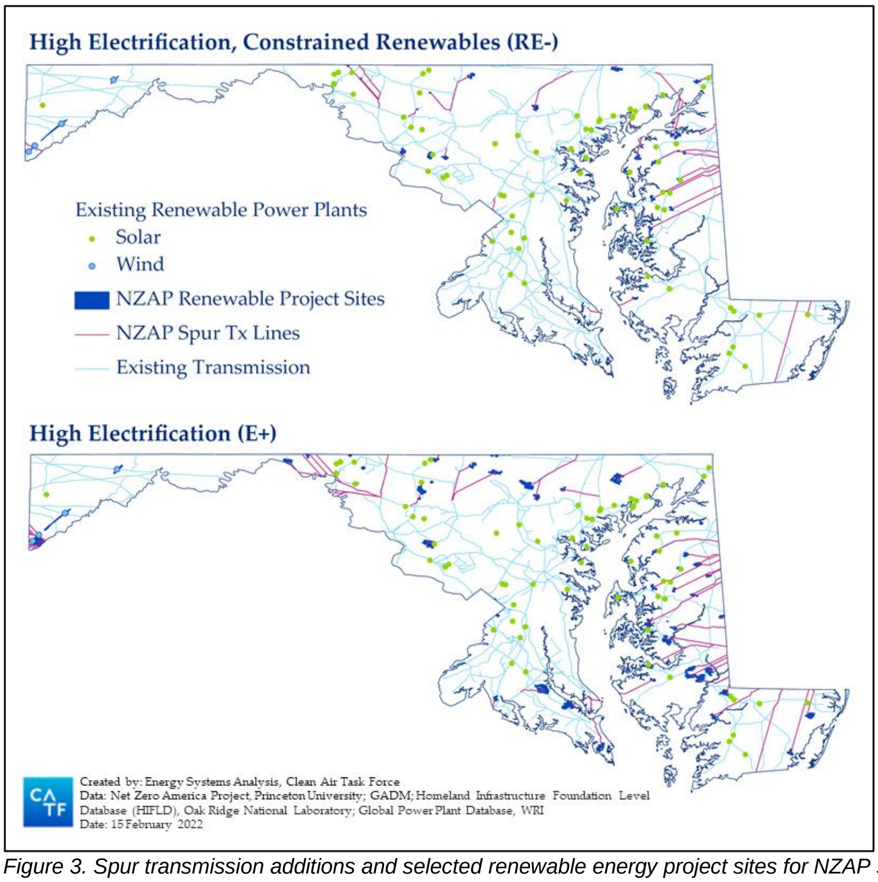

Figure 3. Spur transmission additions and selected renewable energy project sites for NZAP scenarios E+ and E+/RE- mapped alongside existing wind and solar power plants in Maryland.

[1] https://hifld-geoplatform.opendata.arcgis.com/datasets/geoplatform::electric-power-transmission-lines-1/about
http://www.ece.ualberta.ca/~apic/papers/Vstability_and_Dynamics/LineCapabilityCurve.pdf

Reliability and Stability

The reliability of the electric grid is not strictly a function of an emissions target (e.g., net-zero GHG emissions by 2045). Instead, grid reliability is a function of the design of the electric grid. As the share of variable, weather-dependent energy resources like wind and solar increases in the state-level energy mix, reliability and stability can be managed by maintaining firm, dispatchable capacity like nuclear or natural gas with carbon capture and storage (CCS). These firm resources can supply zero-carbon electricity at times of low variable generation to maintain a balanced and reliable grid.

HB 708 sets Maryland up for success by enabling a stable decarbonized grid by both allowing for multiple types of firm capacity (e.g., nuclear, geothermal, and natural gas with CCS) and promoting the growth of variable renewable energy (e.g., wind and solar).

Provided this allowance for multiple types of firm capacity along with the growth of variable renewable energy (VRE), it is possible for Maryland to meet the net-zero GHG requirement of HB 708 in a way that allows for a reliable and stable electric grid in the time required.

Cost

Studies have also consistently demonstrated that the net-zero energy transition at the economy-wide scale can be economically feasible.[2,3] There are two categories of costs we discuss in this section:

1) Total cost of investment required to transition the energy system to net-zero, and
2) The cost of electricity to the consumer that will result from such a transition.

Both of these costs vary depending on the make-up of the energy mix. While the studies do not specifically project costs for Maryland, the trends and relative changes at the national level are relevant for demonstrating feasibility at the state level.

CATF notes that in implementing a net-zero target, most recent studies demonstrate that employing an "all-of-the-above" strategy that relies on a suite of clean energy technologies have lower impacts on electricity costs to the rate payer.[4] In other words, the more technological diversity (i.e., firm dispatchable resources) that comprise the energy system, the lower the costs.[5] The primary reason for this is that including firm resources like nuclear and CCS reduce the need to overbuild renewable capacity for times of low solar and/or wind generation.

The following figure from a 2021 NREL study shows how total cost to the economy of a net-zero transition vary depending on the price of renewable energy technologies as

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[2] Sepulveda et. al, "The Role of Firm Low-Carbon Electricity Resources in Deep Decarbonization of Power Generation," *Joule* 2 (October 17, 2018): 1-18

[3] Clack, Christopher, "Modeling Renewable Energy, Clean Technologies and Electrification for Deep Decarbonization Future," Bipartisan Policy Center (May 31, 2019)

[4] https://www.vibrantcleanenergy.com/wp-content/uploads/2021/10/US-Econ-Decarb_CCSA.pdf See also: Net Zero America Project Report (https://netzeroamerica.princeton.edu/img/Princeton_NZA_Interim_Report_15_Dec_2020_FINAL.pdf) and Decarb America "Pathways to Net-Zero Emissions (https://decarbamerica.org/report/pathways-to-net-zero-emissions/)

[5] Evolved Energy Research, "Federal Policy for Low-Carbon, High-Renewables Electricity" (2020). https://www.evolved.energy/post/federal-policy-for-electricity-decarbonization

well as the percentage of variable renewable resources in the electricity mix. While this study was done at the national level, the trends are representative for Maryland.[6]

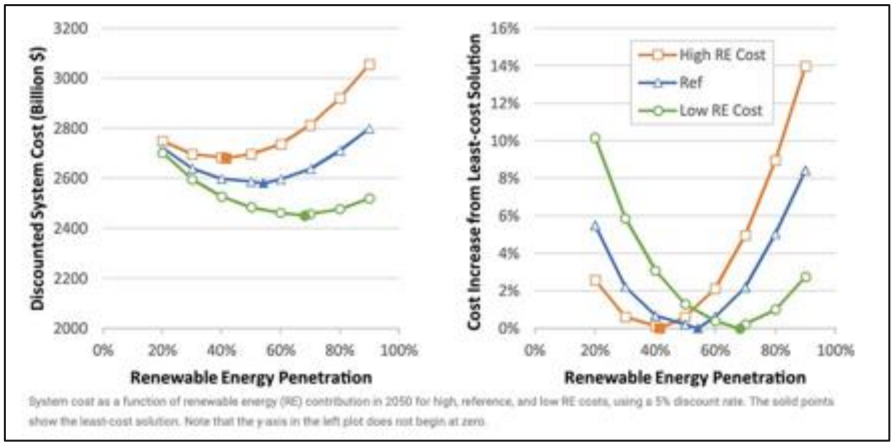

Figure 4. Percentage of renewable energy penetration relative to system cost.[7]

Similarly, the average annual levelized costs of electricity in 2050 associated with a U.S.-wide net-zero GHG transition has been modeled to be reasonable relevant to today's costs.[8] As shown in the figure below from a study by Evolved Energy Research (EER), the electricity levelized costs vary by the degree of diversity in the generation mix. While this study cannot directly project Maryland's wholesale electricity prices, the key takeaway is that the consumer is not likely to see dramatic shifts in electricity prices as a result of the net-zero transition. For example, the "all options" scenario in the study resulted in a levelized cost of electricity of about $35/MWh ($2016), which is about $41/MWh in today's dollars. In comparison, PJM load-weighted average electricity costs have ranged between $20/MWh to $55/MWh over the past ten years.[9] Therefore, average wholesale electricity prices are projected to remain reasonably consistent with today's prices in a decarbonized grid. Electricity rates, or cost to consumer, will depend on additional factors such as fees, taxes, etc.

[6] Cole, Wesley, Nathaniel Gates, and Trieu Mai. "Exploring the cost implications of increased renewable energy for the US power system." The Electricity Journal 34, no. 5 (2021): 106957.

[7] Cole, Wesley, Nathaniel Gates, and Trieu Mai. "Exploring the cost implications of increased renewable energy for the US power system." The Electricity Journal 34, no. 5 (2021): 106957.

[8] Cole, Wesley, Nathaniel Gates, and Trieu Mai. "Exploring the cost implications of increased renewable energy for the US power system." The Electricity Journal 34, no. 5 (2021): 106957.

[9] https://www.spglobal.com/commodity-insights/en/market-insights/latest-news/electric-power/031121-2020-pjm-power-prices-lowest-in-history-due-to-lower-fuel-prices-capacity-reform-needed#:~:text=New%20York%20%E2%80%94%20PJM%20Interconnection%20real,market%20monitor%20said%20March%2011

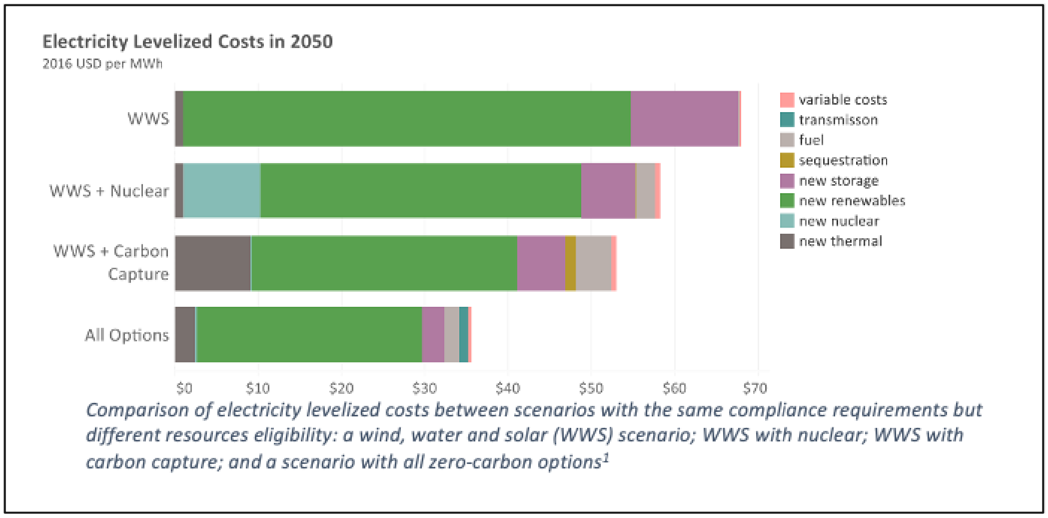

Figure 5. Evolved Energy Research (EER) study showing how system costs vary as a function of both percentage of VRE in the energy mix as well as the range of renewable energy prices (figure sourced from EER). [10]

Jobs

NZAP also applies a model to assess the labor impacts of decarbonization scenarios and estimates the associated employment, wages, education, experience, and training requirements for each scenario assessed. The NZAP model focuses on jobs related to operation and maintenance of generation infrastructure, construction, exploration and development, professional, scientific and technical services, marketing, manufacturing, etc. for the following sectors:

- VRE: wind and solar
- Fossil: Coal, oil, and natural gas
- Grid: transmission and distribution
- Nuclear
- Biofuels and CO_2: biomass, transport, storage

While jobs across fossil fuel industries diminish over time, more jobs are created to support grid and renewable energy growth. As is shown in the figure below, NZAP estimated the number of jobs by energy resource sector. Note that these are ‘full time equivalent job years’, which means one job year can represent two individuals that both have part time jobs for one year or one individual with a full-time job for one year. They also represent the jobs in the year indicated rather than across the five-year span between time steps. These estimates are not meant to be predictions but rather indications of likely impacts from an energy transition within Maryland.

Implementing new policies to support decarbonization efforts in Maryland could increase grid and renewable energy jobs nearly 3-fold relative to the reference case in 2045. In the E+/RE- scenario, more than 23,000 and 50,000 new jobs are created in 2040 and 2045 respectively, primarily in transmission and distribution to build out the

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[10] Evolved Energy Research, “Federal Policy for Low-Carbon, High-Renewables Electricity” (2020). https://www.evolved.energy/post/federal-policy-for-electricity-decarbonization

electric grid to support the expansion of renewable electricity needed to support a reliable electric grid.

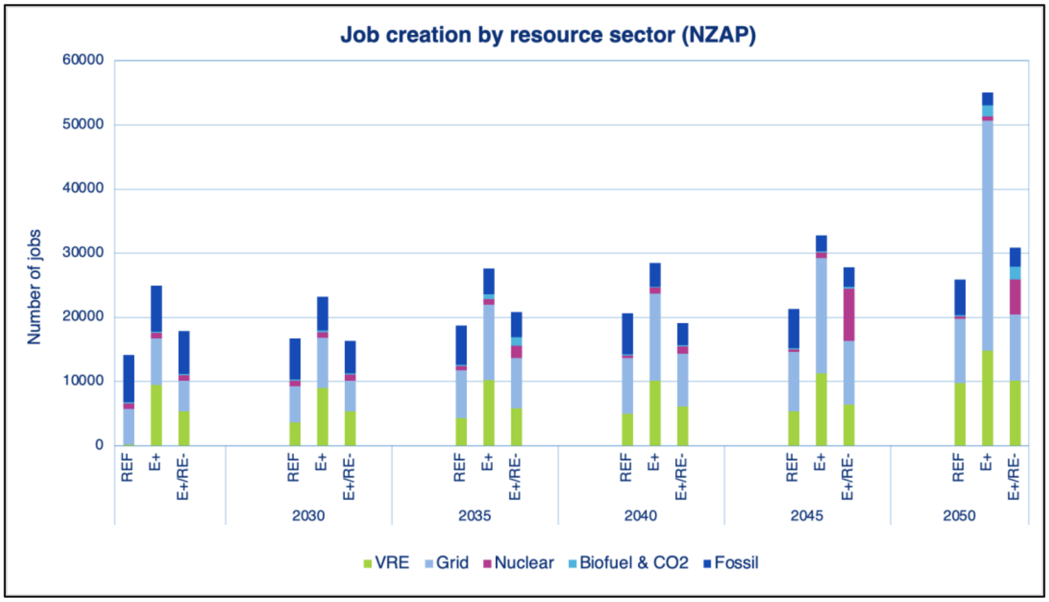

Figure 6. Job creation by resource sector from 2025 through 2050. The reference case (REF) assumes no new policies, no GHG constraints, and consistently low oil and gas prices.

Conclusion

The 2045 net-zero GHG emission requirement of HB 708 can be achieved while simultaneously maintaining Maryland's grid reliability and stability. The required infrastructure growth and cost of the transition are a factor of the clean firm power sources (i.e., nuclear, geothermal, and CCS) that are included within the transition and studies have shown that the transition is achievable at a moderate cost. Furthermore, although jobs across the fossil fuel industry will diminish over time, these will likely be compensated for by growth in grid and renewable energy jobs, resulting in a net increase in jobs.

We urge the Committee to issue a favorable report on HB 708.

Please reach out to Andrew Place (email aplace@catf.us, cell: 412.522.3654) or Angela Seligman (email: aseligman@catf.us, cell: 314.922.5293) with any questions.

CATF is a global nonprofit organization working to safeguard against the worst impacts of climate change by catalyzing the rapid development and deployment of low-carbon energy and other climate-protecting technologies. With 25 years of internationally recognized expertise on climate policy and a fierce commitment to exploring all potential solutions, CATF is a pragmatic, non-ideological advocacy group with the bold ideas needed to address climate change. CATF has offices in Boston, Washington D.C., and Brussels, with staff working virtually around the world.