Secretary of Natural Resources for the Commonwealth of Virginia
Molly Joseph Ward
P.O. Box 1475
Richmond, VA 23218

Re: AEE Institute's Comments on Executive Directive 11 to Reduce and Cap Carbon Dioxide from Fossil Fuel Fired Electric Power Generating Facilities

Dear Secretary Ward,

Advanced Energy Economy Institute (AEE Institute) appreciates the opportunity to comment on Governor McAuliffe's Executive Directive 11 (ED-11). AEE Institute supports the Governor's movement on advanced energy through ED-11. This effort offers an opportunity to drive innovation in the energy sector by attracting advanced energy technologies to the Commonwealth, supporting new jobs in the state, attracting businesses to Virginia through sustainable and low-cost energy, and – at the end of the day – saving consumers money.

AEE Institute has actively followed and participated in carbon regulatory efforts in Virginia over the last two years with the Administration. These efforts include participating as a member of the Department of Air Quality's Clean Power Plan stakeholder group from December 2015 to March 2016, presenting to the Executive Order 57 (EO-57) Working Group in October 2016, and submitting public comments in May 2017 to the EO-57 Working Group.[1] Our organization is deeply invested in the future of Virginia's energy markets and any policies that may allow for increased growth of the advanced energy market, and we strongly support the Administration's Virginia Energy Plan to allow for the expansion of in-state energy market.

We look forward to assisting the Department of Environmental Quality (DEQ) and the Regulatory Advisory Panel (RAP) as they develop a proposed regulation for the State Air Pollution Control Board's consideration to abate, control, or limit carbon dioxide emissions from electric power facilities that:

a. Includes provisions to ensure that Virginia's regulation is "trading-ready" to allow for the use of market-based mechanisms and the trading of carbon dioxide allowances through a multi-state trading program; and
b. Establishes abatement mechanisms providing for a corresponding level of stringency to limits on carbon dioxide emissions imposed in other states with such limits.

[1] AEE Institute is a 501(c)(3) charitable organization whose mission is to raise awareness of the public benefits and opportunities of advanced energy. AEE Institute provides critical data to drive the policy discussion on key issues through commissioned research and reports, data aggregation, and analytic tools. AEE Institute also provides a forum where leaders can address energy challenges and opportunities facing the United States. AEE Institute is affiliated with Advanced Energy Economy (AEE), a 501(c)(6) business association, whose purpose is to advance and promote the common business interests of its members and the advanced energy industry as a whole. Visit https://www.aeeinstitute.org/home for more information.

In preparation for the drafting of the regulation, AEE Institute respectfully submits the following materials as assistance in the development of the proposed rule. AEE Institute has shared this information with DEQ, the Administration, and other Virginia stakeholders before, but believe the materials can help guide the development of a rule, and demonstrates how reducing carbon emissions modernizes the electric grid and provides significant economic benefits to Virginia.

AEE Institute's analysis demonstrates that Virginia can achieve the intended carbon regulation in a cost-effective manner, while bringing numerous benefits to the economy. We respectively submit the following materials, which have accompanied our previous engagement in the Commonwealth:

1. *Assessing Virginia's Energy Future; Employment Impacts of Clean Power Plan Compliance Scenarios*: This report demonstrates that a carbon reduction plan can provide substantial net employment benefits for Virginia. Specifically, the report's scenarios forecast a carbon reduction plan could result in between **54,231 and 122,912 cumulative additional job years** from compliance with carbon regulation policy. While the analysis used carbon reduction targets from the Clean Power Plan, it demonstrates the clear employment benefits for Virginia by reducing carbon emissions.

2. *Modeling a Low-Cost Approach to Clean Power Plan Compliance for Virginia: Insights from the State Tool for Electricity Emissions Reduction*: This report shows that implementing carbon reduction policy – specifically the Clean Power Plan – could have minimal impact on electricity costs in Virginia, and even provide savings for ratepayers, compared with projected energy costs in 2030. AEE Institute's modeling tool applied Virginia-specific data to develop these findings. The Virginia version of the State Tool for Electricity Emissions Reduction (STEER) is an open-access integrated resource planning tool, developed for analyzing least-cost strategies to implement the Clean Power Plan. It automatically calculates the least-cost plan given policy options, load, and price forecasts.

3. *A Performance-Based Approach to Allowance Allocation for Clean Power Plan Compliance*: This white paper explains a performance-based approach of how to allocate carbon emission allowances is the optimal approach for states implementing a mass-based carbon reduction policy. The report describes that allocation to affected units on the basis of historical generation is the least effective of the many options available. The historical generation approach to allocation will limit compliance options, hamper competition, and introduce market uncertainty, which is likely to drive compliance costs higher for electricity customers relative to other allocation systems. This paper describes one alternative – performance-based allocation – which would award allowances on a technology-neutral basis according to the emission reductions achieved in the prior year. **By allowing all eligible emission reduction measures to participate on the basis of cost and value, a performance-based approach would create an open and competitive marketplace, lowering compliance costs for affected units and ratepayers alike.**

4. *Advanced Energy Technologies for Greenhouse Gas Reduction*: Advanced Energy Economy offers this compendium of 40 different advanced energy technologies that can be used to create a modern electric power system that is secure, clean, and affordable. From zero- and low-emissions forms of electricity generation to sophisticated grid management tools and demand reduction,

investment in advanced energy solutions can modernize the electric power system, provide economic benefits, and reduce carbon emissions at the same time.

5. *Integrating Renewable Energy into the Electricity Grid: Case Studies Showing How Technologies and Operations are Maintaining Reliability*: This report examines the technologies and operational techniques that grid operators are using in the United States to successfully integrate the levels of renewable energy contemplated under the Clean Power Plan into reliable electric systems today. The report provides two in-depth case studies, covering the Electric Reliability Council of Texas (ERCOT) and Xcel Energy Colorado.

6. *Electricity Markets, Reliability, and the Evolving U.S. Power System*: A recent report by Analysis Group finds that market forces have caused the resource mix of the nation's grid to change over the last decade. The forces – primarily low-cost natural gas and flat demand for electricity – have caused some traditional power resources, such as coal and nuclear plants, to retire. As this transition has occurred, the more flexible and diverse resource mix has not threatened the reliability of the grid.

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How Advanced Energy Can Help Virginia

By implementing a carbon reduction policy with a flexible design that allows for a variety of technologies and services for that best suit the state, Virginia could be presented with an opportunity to modernize its electric grid for the benefit of consumers and the economy to accelerate a transition to a higher performing grid that is reliable, resilient, and affordable.

To achieve those improvements in the Commonwealth's electricity system, Virginia must continue to invest in 21st century electricity generation and grid technologies. Luckily, these same technologies will also lower the state's carbon emissions. As mentioned, forty such technologies are detailed in an AEE report, *Advanced Energy Technologies for Greenhouse Gas Reduction*.[2] These technologies include, among others, energy efficiency, demand response, solar, wind, hydropower, smart grid technologies, electric vehicles and infrastructure, and energy storage.

Renewable energy and energy efficiency are competitive resources in today's marketplace that will not only be cost-effective mechanisms for carbon reduction but should also be expected to grow strictly on the basis of cost. Based on data from Lazard, a financial advisory and asset management firm, the levelized cost of electricity (LCOE) for utility-scale wind and solar power has declined by 66 percent and 85 percent, respectively, from 2009 to 2016, such that these technologies are increasingly competitive.[3] These prices are continuing to decline rapidly. In June of 2015, Austin Energy in Texas announced it was procuring PV projects at a record of $0.04/kWh, only to be outdone the next month by NV Energy, which agreed to a PPA at $0.0387/kWh in July 2015.[4,5] Utility renewable energy purchases that were once driven primarily by state policies (e.g., renewable portfolio standards) are now

[2] Report available at: http://info.aee.net/epa-advanced-energy-tech-report
[3] https://www.lazard.com/media/438038/levelized-cost-of-energy-v100.pdf
[4] http://www.greentechmedia.com/articles/read/cheapest-solar-ever-austin-energy-gets-1.2-gigawatts-of-solar-bids-for-less
[5] http://www.utilitydive.com/news/nv-energy-buys-utility-scale-solar-at-record-low-price-under-4-centskwh/401989/

increasingly made based on economics.

Generation from zero- and low-carbon-emitting technologies such as natural gas combined cycle, dispatchable hydroelectric power, biomass, and waste-to-energy can be used to meet baseload generation. These resources can integrate with variable renewable energy and also complement each other both technologically and economically, allowing the electricity system to provide reliable, low-carbon energy.

High voltage direct current (HVDC) transmission can facilitate the integration of renewable energy technologies and reduce transmission line losses 30-50 percent compared to traditional alternating current (AC) systems.[6]

Demand response also provides grid benefits, including firm capacity reserves, system-wide peak shaving when demand is high, and ancillary services to facilitate the integration of renewable resources in a low-carbon manner. A November 2014 Navigant report found that DR can directly reduce CO_2 emissions by more than 1 percent through peak load reductions and provision of ancillary services, and that it can indirectly reduce CO_2 emissions by more than 1 percent through accelerating changes in the fuel mix and increasing renewable penetration.[7] Demand response can also strengthen reliability, as evidenced during the 2014 polar vortex when demand response was credited with helping to maintain reliability of the system.[8] In addition, , demand response also provides cost-effective alternatives to meeting peak demand, both locally and at the wholesale level, and can improve reliability while reducing peak power costs. According to the PJM Internal Market Monitor, demand response and energy efficiency saved PJM customers $11.8 B in capacity costs between June 2013-June 2014.[9] Neighboring states, including Maryland, Pennsylvania, and New York, are reducing energy costs for their customers through the deployment of utility peak-shaving demand response programs. In New York, where the Ratepayer Impact Measure (RIM) test is used, the utility demand response programs have achieved results as high as 1.89.[10] These programs also boost the local economy, as the majority of program payments are given to local businesses and organizations (e.g. school districts) that participate.

Distributed resources can also provide grid benefits such as reduced congestion and increased reliability and flexibility. These resources include distributed generation such as residential and commercial solar and wind, combined heat and power (CHP), industrial waste energy recovery, and fuel cells. Similarly, energy efficiency reduces congestion and peak demand, and reduces the impacts of changes in the firm capacity associated with retiring EGUs. Advanced grid technologies such as advanced metering infrastructure (AMI), distribution automation, microgrids, high temperature superconducting (HTS) transmission, and smart grid management technologies can help integrate and manage the growing diversity of renewable, low-emitting and traditional fossil generation. For example, Dominion Energy was able to reduce total energy use by 2.8% through voltage optimization. As noted by Dominion, their

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[6] Siemens, High Voltage Direct Current Fact Sheet (Jul. 2012), http://www.siemens.com/press/pool/de/events/2012/energy/2012-07-wismar/factsheet-hvdc-e.pdf

[7] Navigant Consulting. "Carbon Dioxide Reductions from Demand Response." November 25, 2014

[8] https://www.pjm.com/~/media/documents/other-fed-state/20140707-dccircuit-11-1486.ashx

[9] Monitoring Analytics, the Internal Market Monitor for PJM. "Analysis of the 2013/2014 PJM Base Residual Auction Revised and Updated." September 20, 2010. Page 52

[10] Orange & Rockland Utilities, Inc. Annual Report on Program Performance and Cost Effectiveness of Dynamic Load Management Programs. Case Number 14-E-0423. December 1, 2016

program delivers energy and demand savings, adapts to real-time system changes, and reduces the impact on the environment, all while benefiting all consumer classes.[11]

Energy storage also helps integrate renewables and reduces the need for peaking power plants – leading to fewer emissions – and thermal units to provide ancillary services such as frequency regulation and spinning reserves, allowing these traditional units to operate at more efficient heat rate blocks leading to fewer emissions.[12] For example, AES Storage – headquartered in Arlington, VA – developed a 32MW lithium ion battery in West Virginia to pair with a 98 MW wind project. This battery system helped to provide additional reliability to the grid as well as important grid services such as frequency regulation.[13]

Additionally, plug-in electric vehicles (PEVs) can be an important component to aid in greenhouse gas reduction and grid support as market penetration continues. PEVs are beneficial in both reducing emissions and providing grid energy storage. PEVs reduce transportation-related greenhouse gas emissions, even when considering power plant emissions associated with vehicle charging. This benefit varies depending on the power generation mix, but even in regions with relatively high electricity-related emissions there is a net benefit. With full, bi-directional integration with the grid, PEVs can also be used for energy storage, providing grid support functions such as peak shaving, load shape smoothing, renewables integration, and power quality services. As the size of the PEV fleet grows, the ability to aggregate and manage vehicles in a coordinated fashion has the potential to create a large source of energy storage. Virginia could consider adoption of additional electric vehicle charging infrastructure, as well, to reduce range anxiety for consumers and encourage support for PEVs.

Importantly, these advanced energy technologies can ensure that deployment of these technologies will have no significant adverse impacts on grid reliability and cost. The Brattle Group published a report on reliability – *Integrating Renewable Energy into the Electricity Grid: Case Studies Showing How Technologies and Operations are Maintaining Reliability* – analyzing how variable renewable generation is being managed by grid operators today.[14] The Brattle Group found that "ongoing technological progress and ongoing learning about how to manage the operations of the electric system will likely allow the integration not only of the levels of variable renewable capacity now in places like Texas and Colorado but even significantly larger amounts in the future."

In a recent report, AEE Institute described the grid benefits of the transforming energy sector. As the energy revolution sweeps the United States, greater fuel diversity has provided us with more options to meet our energy needs while maintaining, if not improving, reliability. This paper – *Changing the Power Grid for the Better* – argues that incorporating more renewable energy, fast-ramping natural gas generation, a range of demand management techniques, and new resources like energy storage – rather than a return to a singular reliance on baseload resources – is the foundation of electric power system reliability. The paper sheds light on what is driving our changing resource mix and how it is improving

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[11] https://www.michigan.gov/documents/energy/Powell_418130_7.pdf
[12] California Energy Commission, *Integrated Energy Policy Report* (2011), available at: http://www.energy.ca.gov/2011publications/CEC-100-2011-001/CEC-100-2011-001-CMF.pdf
[13] http://www.wvcommerce.org/App_Media/assets/doc/energy/WWG/2012/AES-LM-Overview2012.pdf
[14] http://info.aee.net/integrating-renewable-energy-into-the-electricity-grid

reliability and lowering costs for businesses and consumers.[15]

Advanced energy technologies and services will help Virginia balance cost, energy system performance, environmental, and public health considerations. These technologies are also well established in the United States and global marketplaces, as illustrated in *Advanced Energy Now 2017,* a market report produced by Navigant Research.[16] The assessment found that the 2014 market for advanced energy technologies was $1.4 trillion globally and $200 billion in the United States. The wide-spanning industry generates twice as much revenue on an annual basis as the airline industry globally, and equal to domestic pharmaceutical manufacturing domestically.

Allowance Allocation

One of the most important decisions facing the Air Pollution Board in promulgating ED-11 is deciding how allowances are allocated.

DEQ has discretion to distribute allowances in its state plan however it sees fit. The state can distribute allowances in a few ways: The state may simply allocate allowances either a) to Emitting Generating Units (EGUs); b) eligible resources; or c) both entities. AEE Institute believes the Commonwealth should consider allocating allowances to all emission reduction measures, not just EGUs. This method will ensure that the allowance allocation remains technology neutral and encourages competition among emission reduction measures, allowing for both existing future technologies to serve as compliance mechanisms.

Although an auction method for distributing allowances as currently employed by other carbon allowance systems including the Regional Greenhouse Gas Initiative (RGGI) is not permissible under state law, a variation of allowance allocation that distributes to the load-serving entity or an updating output-based allocation could serve as a good alternative. More information can be found in the paper *A Performance-Based Approach to Allowance Allocation for Clean Power Plan Compliance*, referenced above.

Conclusion

AEE Institute appreciates the opportunity to comment in this proceeding, and looks forward to continuing work with the Department of Environmental Quality and all Virginia stakeholders.

Sincerely,

Dylan Reed
Advanced Energy Economy
dreed@aee.net

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[15] AEE Institute, *Changing the Power Grid for the Better,* May 2017, http://info.aee.net/hubfs/Baseload_Paper_FINAL_053017.pdf
[16] http://info.aee.net/aen-2017-market-report