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November 12, 2015

Secretary John Quigley
Department of Environmental Protection, Policy Office
Rachel Carson State Office Building
P. O. Box 2063
Harrisburg, PA 17105-2063
Submitted via eComment

Re: Comments of Exelon Corporation on Development of the Commonwealth's Compliance Plan for the United States Environmental Protection Agency's Final Rule for Carbon Pollution Emissions Guidelines for Existing Stationary Sources; Electric Generating Units (Clean Power Plan)

Dear Secretary Quigley:

On behalf of Exelon Corporation, attached please find our comments in response to the Department's Solicitation of Comments. We appreciate the tremendous effort you and your staff have devoted to evaluating this important rulemaking and, in particular, the extensive public outreach that has been conducted, notably the 14 listening sessions across the Commonwealth this autumn.

Exelon strongly supports Pennsylvania's adoption of a mass-based plan that includes both existing and new units as well as submission of a plan as soon as practicable, preferably by the 2016 deadline. Our comments offer more detail and address many of the other questions posed in the Department's Solicitation.

Please do not hesitate to contact me if you would like additional information or clarifications related to our comments. We look forward to working with the Department to ensure implementation of a plan that meets Pennsylvania's Clean Power Plan obligations while promoting a reliable, affordable, diverse, and increasingly clean generation supply for the benefit of the Commonwealth's families and businesses.

Respectfully Submitted,

/s/ Kathleen Barrón

COMMENTS OF EXELON CORPORATION ON PENNSYLVANIA'S IMPLEMENTATION OF THE CLEAN POWER PLAN

I. INTRODUCTION AND SUMMARY OF COMMENTS

Exelon Corporation is pleased to submit these comments on Pennsylvania's implementation of the U.S. Environmental Protection Agency's ("EPA's") Clean Power Plan ("CPP"). Exelon strongly supports Pennsylvania's adoption of a mass-based plan that includes both existing and new units as well as submission of a plan as soon as practicable, preferably by the 2016 deadline. Pennsylvania has long been a leader in energy production, clean energy, and energy and environmental policy. Pennsylvania's thoughtful and balanced leadership has left the Commonwealth well-positioned to lead once again by meeting or exceeding the reasonable emission reduction standards that EPA has set forth in its Clean Power Plan. Pennsylvania's action to implement the CPP in a timely manner will ensure that the Commonwealth remains a leader in the production of reliable, clean energy, securing a strong and environmentally-sound economic future for the Commonwealth and all of its citizens.

As a leading provider of clean energy in Pennsylvania and across the country, Exelon supports the goal of continuing to reduce carbon dioxide ("CO_2") emissions from the power sector. Assuming states use a mass-based compliance strategy covering existing and new units, the targets in the CPP are more than achievable using technologies and practices that companies like Exelon have successfully deployed for decades to reduce emissions while providing affordable and reliable electricity. Exelon sees a straightforward path to compliance with the CPP by continuing to deploy these proven and cost-effective measures.

For reasons explained in detail below, Pennsylvania's adoption of a mass-based plan that includes existing and new units can be readily implemented under existing Pennsylvania law, would be straightforward to administer in the context of existing electricity markets, would create consistent and efficient market incentives, and would build on the success of existing emissions trading programs for greenhouse gases and other pollutants, some of which Pennsylvania has utilized for decades.

Exelon also strongly encourages Pennsylvania to submit a state plan as soon as practicable, preferably by the 2016 deadline. Like the emission reduction targets, this deadline is achievable. Pennsylvania regulators and power companies are already familiar with the mass-based program we recommend. The earlier Pennsylvania submits a state plan, the sooner the industry will have regulatory clarity and certainty, and the sooner we can focus our attention on sensible, cost-effective opportunities to address CO_2 emissions from the power sector.

A. Exelon Corporation

Exelon is one of the largest competitive U.S. power generators, with more than 32,000 megawatts ("MW") of owned capacity comprising one of the nation's cleanest and lowest-cost power generation fleets. The company's Constellation business unit provides energy products and services to more than 2.5 million residential, public sector and business customers, including more than two-thirds of the Fortune 100. Exelon's utilities deliver electricity and natural gas to

more than 7.8 million customers in southeastern Pennsylvania ("PECO"), central Maryland ("BGE"), and northern Illinois ("ComEd").

As one of the nation's leading clean energy generators with a significant presence in Pennsylvania, including business unit headquarters in Philadelphia and Kennett Square, Exelon is uniquely situated to provide recommendations on how the Clean Power Plan should be implemented in Pennsylvania.

With approximately 6,000 Pennsylvania employees, Exelon is one of the Commonwealth's largest employers. Exelon owns and operates three of Pennsylvania's five nuclear power stations, Peach Bottom Atomic Power Station in York County, Limerick Generation Station in Montgomery County, and Three Mile Island in Dauphin County. Exelon is generating additional employment at an uprate construction project at Peach Bottom, which will increase the amount of carbon-free electricity generated at that plant using the same amount of nuclear fuel. Exelon also owns and operates hydropower, landfill gas, natural gas, and oil generation capacity in Pennsylvania. In addition, Philadelphia-based PECO is an electric and natural gas utility serving 1.6 million electric and more than 506,000 natural gas customers in southeastern Pennsylvania and employing about 2,400 people in the region.

Exelon's substantial investments in a lower-carbon portfolio have made it one of the least carbon-intensive generators in the United States. Notably, Exelon owns and/or operates 24 of the nation's 99 nuclear reactors in five states and is the nation's largest owner and operator of nuclear generation. Exelon's nuclear plants provide more than one-quarter of the U.S.'s nuclear generation, avoiding approximately 150 million metric tons of CO_2-equivalent ("CO_2e") annually.[1]

Our experience shows that deployment of low-carbon energy resources benefits consumers, protects system reliability, and makes good business sense. Over several decades, Exelon has successfully provided its customers with reliable, affordable electricity while maintaining a low-carbon generating profile. As but one example, the Peach Bottom uprate, when complete, will add 276 MW of always-on, zero-carbon generation. The uprate alone will displace nearly two million short tons of CO_2 annually.[2]

B. Importance of Nuclear Generation to Pennsylvania's Cost-Effective Compliance

Preserving the existing nuclear fleet is an essential precondition to reducing CO_2 emissions while maintaining Pennsylvania's status as a least-cost exporter of electricity. Pennsylvania's five nuclear plants generate 34 percent of Pennsylvania's electricity and 93 percent of Pennsylvania's zero-carbon electricity. A recent report by the Brattle Group

[1] NUCLEAR ENERGY INSTITUTE ("NEI"), Fact Sheet, NUCLEAR ENERGY: AMERICA'S LOW-CARBON ELECTRICITY LEADER (May 2014), *available at* http://www.nei.org/CorporateSite/media/filefolder/Backgrounders/Fact-Sheets/Nuclear-Energy-Americas-Low-Carbon-Electricity-Leader-May-2014.pdf?ext=.pdf.

[2] This calculation is based on PJM's 2014 average marginal emissions rate at 1,677 lb/MWh. PJM, 2014 MARGINAL CARBON EMISSIONS REPORT 2 (2015), *available at* https://www.pjm.com/~/media/committees-groups/committees/mic/20150311/20150311-informational-marginal-carbon-emissions-report.ashx.

concluded that Pennsylvania's five nuclear plants annually prevented over 51 million tons of CO_2 emissions as well as nearly 70,000 tons of sulfur dioxide emissions, 53,000 tons of nitrogen oxide emissions, 5,000 tons of $PM_{2.5}$ emissions and 6,000 tons of PM_{10} emissions.[3] However, the continued financial viability of the existing nuclear fleet is currently in question, as described more fully in Appendix B. The loss of any of these plants would have a significant effect on CPP compliance and increase costs to consumers. The 51 million tons of CO_2 displaced annually is five times Pennsylvania's initial compliance obligation. Even without the impact on CPP compliance obligations, the loss of a nuclear unit would be extraordinarily costly to consumers as this reliable baseload power would need to be replaced with new generation.

While a national issue, as explained in Appendix B, these factors have challenged the financial viability of Pennsylvania's Three Mile Island Unit 1 facility, as highlighted in the plant's recent failure to clear the PJM capacity auction for the 2018/19 delivery year. Three Mile Island is a world-class nuclear plant that has broken several world records for continuous, safe operation.

In addition to being Central Pennsylvania's largest source of clean air energy, Three Mile Island is also one of this region's most important economic engines, employing more than 700 highly skilled workers, and the plant contributes millions of dollars to the local economy through its payroll, maintenance work, and taxes. The absence of market mechanisms to value the emissions-free nature of nuclear generation can be addressed with the proper implementation of the Clean Power Plan, helping to enable nuclear plants like Three Mile Island to continue providing emissions-free energy for many years to come.

C. Recommendations

In order to achieve the reductions necessary to meet EPA's goals under the Clean Power Plan and to support the continued existence of Pennsylvania's nuclear power fleet, Pennsylvania should adopt a regulatory program with the following elements:

- Pennsylvania should implement a mass-based trading program that includes new and existing power plants.
- Pennsylvania should prevent unfair advantage to units in neighboring states by allowing trading only with sources in states that similarly cover new sources, so as to reduce environmental and market distortions.
- Pennsylvania should submit a final plan as soon as practicable, preferably by the deadline of September 6, 2016.

A mass-based plan with these characteristics, including most importantly the inclusion of new units, will be the best way to promote the most cost-effective emissions reductions and support continued investment in zero-emissions resources.

[3] MARK BERKMAN & DEAN MURPHY, THE BRATTLE GROUP (prepared for NUCLEAR MATTERS), PENNSYLVANIA NUCLEAR POWER PLANTS' CONTRIBUTION TO THE STATE ECONOMY 11 (Sept. 2015), *available at* http://www.nuclearmatters.com/resources/reports-studies/document/Nuclear-Matters-Report_Pennsylvania-Value-of-Nuclear.pdf.

The following comments will expand upon these points. Appendix A notes where these comments address the specific questions that the Department posed in the Solicitation.

II. PENNSYLVANIA SHOULD ADOPT A MASS-BASED PROGRAM COVERING NEW AND EXISTING SOURCES

In developing its program for complying with the Clean Power Plan, Pennsylvania faces a choice between two basic approaches: mass-based or rate-based compliance. States electing a mass-based approach must decide whether the mass-based approach should cover all new and existing sources or if it should essentially exempt new sources, while adding provisions to mitigate this flaw through the allocation methodology. For Pennsylvania, the choice is clear. It should adopt the only regulatory system that has a proven track record of achieving real emissions reductions at the least cost with no market distortions – a mass-based system applying to all new and existing power plants.

This option is the only one that meets the following goals with regard to CPP implementation:

- *Achieve the CO_2 Reductions Required by the Clean Power Plan in a Verifiable Way*. A state's plan must achieve the emissions goals. State plans must include compliance mechanisms that accurately measure and track actual emissions so that units may easily demonstrate that they have fulfilled their obligations under the Clean Power Plan; mass-based plans leverage existing emissions monitoring mechanisms at minimal additional expense. Transparency is also key to ensuring cost-effectiveness and cost minimization for consumers – that is, ensuring that Pennsylvanians get what they pay for.

- *Minimize Compliance Cost to Control Ratepayer Impacts.* State plans should seek to achieve the emissions reductions required by the Clean Power Plan for the lowest cost possible. Minimizing the total compliance cost through implementation of a mass-based plan that includes new units and trading with other states that have adopted the same approach will minimize the costs ultimately passed on to ratepayers.

- *Preserve Reliability of the Electric Grid.* A state plan should avoid measures that threaten to impair the reliability of the electric system. Rather, states should adopt compliance measures that align with the principles of that system, most notably a single, clear price signal for incorporation into least-cost dispatch of generation resources. A mass-based plan ensures that emitting plants will be available to run when the system needs them.

- *Be Technology Neutral.* A mass-based system covering new and existing plants will allow the electric industry to respond in the most reliable, cost-effective manner without favoring any one technology, and leave a path open for technologies that have not yet been invented.

- *Simplify Compliance and Reduce Administrative Burdens of Demonstrating Compliance.* Simpler compliance programs are less costly and less burdensome to implement. In particular, a mass-based system covering new and existing plants will eliminate the need for complicated "anti-leakage" measures that would otherwise be required if the plan covers only existing plants. Simplicity in design also yields greater predictability for electric generators, promoting the efficient use of capital and long-term planning.

A. Mass-Based Programs Are Vastly Superior

Mass-based programs are superior for a number of reasons.

First, a mass-based program covering all new and existing units is the only type of program that ensures real emissions reductions. Given how the formula for rate-based (lb/MWh) compliance is calculated, an existing nuclear plant (or existing wind or solar or hydropower) could be replaced in part by a much lower-capacity new renewable resource, backed up by new natural gas not subject to requirements for emissions reduction. In such a case, the state would achieve compliance even though emissions would actually increase (because the new renewable generation is the only portion of that scenario included in compliance calculation). This would have extraordinarily perverse environmental and reliability effects and is not a logical path for Pennsylvania.

Second, mass-based programs promote reliability through their ease of use and single, clear price signal. Because a mass-based program, unlike a rate-based program, is technology-neutral, Pennsylvania electricity generators can rely on a broad range of cost-effective emissions reductions and generation technologies. Further, these programs are readily compatible with least-cost dispatch, particularly as compared to rate-based programs or command-and-control requirements (*e.g.*, annual run-time limits). Under mass-based compliance, the cost of CO_2 becomes just another variable operating cost, with no more complexity than accounting for fuel or labor. In fact, a number of mass-based emission programs are currently incorporated into PJM units' bids. Other approaches, however, introduce potentially unworkable – or at least costly – uncertainties and distortionary subsidies and could undermine reliability.

Third, a mass-based program with new units will best utilize and preserve Pennsylvania's current diverse mix of generation resources.[4] Notably, a mass-based program that includes new units represents the best means to preserve Pennsylvania's existing nuclear fleet as well as the Commonwealth's hydroelectric fleet. By contrast, the rate-based approach would favor new deployment of certain currently-known technologies and would likely manifest this favor through subsidies that would undermine existing nuclear, hydroelectric, and renewables, thereby impairing reliability and fuel diversity while potentially increasing emissions.

[4] Section 3 of the Pennsylvania Greenhouse Gas Regulation Implementation Act ("Act 175") requires the Department to consider the "necessity and value to having a diverse generation fleet to ensure electric reliability," to prioritize "a least cost compliance approach" and to consider a number of other factors such as maintaining a diverse generation mix in developing a plan to implement the Clean Power Plan. 2014 Pa. Laws 2873, No. 175, § 3.

Fourth, mass-based programs promote cost certainty by providing a clear price signal to all sources as well as developers of new generation and energy efficiency. At their core, mass-based programs are a simple way to translate an environmental goal (*e.g.*, level of emissions, usually expressed in tons) into a price signal that will provide a clear incentive to invest in clean resources up to the point necessary to achieve the identified objective, and no more. This happens because emitting generators factor the cost of an allowance into their variable costs just like any other cost of operation, while clean resources obviously do not. As noted above, the electricity sector currently integrates emissions allowance trading programs into wholesale electricity and capacity markets.[5] A key feature of all these successful programs is the inclusion of new units and the resultant compatibility with security-constrained least-cost dispatch – the cost of mass-based price signals is simple and clear when new units are included. Allowances are auctioned and/or sold in a transparent market, with a single price point. As a result, mass-based programs may generate revenue – through the sales of allowances – for the state that can be directed to electric customers to offset higher prices in a known way. By contrast, rate-based programs require a multitude of often-opaque costs, some borne by taxpayers or utility customers separate from energy costs. These revenues are not returned to customers or even necessarily used in-state. Whether allowances are allocated or auctioned, there are futures markets and trading markets for all programs that provide necessary transparency to the markets and allow informed bids.[6] These markets also provide opportunities for rigorous independent oversight.

Fifth, Pennsylvania will incur lower costs and administrative burdens in establishing, enforcing, and implementing a mass-based compliance plan that includes all units. Pennsylvania units are already required to monitor and report CO_2 emissions by mass. By contrast, a rate-based program would require entirely new administrative processes to evaluate, approve, track, certify, and enforce the creation of emission rate credits ("ERCs").

Sixth, mass-based programs promote lower-total cost compliance than rate-based plans. Mass-based programs offer flexibility for sources to achieve compliance in the least costly manner, as opposed to a rate-based program or a command and control program, both of which would favor certain technologies, regardless of relative cost or emissions performance. Mass-based programs provide clear signals to all clean energy, including energy efficiency and renewables. Renewable Portfolio Standards ("RPS") and Energy Efficiency Resource Standards ("EERS") can and often do operate in parallel with mass-based compliance – RPS and EERS promote specific technologies, while mass-based programs ensure emissions reductions goals are met. However, by directly targeting the ultimate aim – emissions reductions – mass-based programs ensure that customers are not overpaying to achieve environmental compliance. The cheapest resource – after considering the cost of pollution – will operate.

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[5] For example, the Acid Rain Program has utilized a nationwide mass-based compliance program for new and existing power plants since 1990. In the eastern U.S., new and existing electric generating units ("EGUs") – including those in Pennsylvania – have participated in mass-based programs for NOx and SO_2 since 1999. Also in neighboring states, the Regional Greenhouse Gas Initiative ("RGGI") has operated since 2009 as a mass-based CO_2 program that includes new units.

[6] *See, e.g.*, *Regional Greenhouse Gas Initiative (RGGI) CO_2 Allowance Futures Quotes*, CME GROUP, http://www.cmegroup.com/trading/energy/emissions/regional-greenhouse-gas-initiative-rggi-futures.html (last visited Nov. 11, 2015).

Seventh, mass-based programs are technology-neutral and value all zero-carbon technologies. The generation sector must operate below an emissions cap while providing sufficient electricity, with no additional considerations or costs. The least-cost generation, inclusive of CO_2 costs, will run. This gets closer to a "true cost" least-cost dispatch.

Eighth, assuming Pennsylvania submits its own plan, allowances are created by Pennsylvania; they can therefore be auctioned or allocated for the benefit of Pennsylvania residents and businesses. They could also be allocated to reduce leakage, if needed. Although as noted, Pennsylvania should include new units under the cap, mooting the requirement to address leakage separately (the requirement to address leakage only applies to states that include only existing units under the cap).

Finally, a mass-based plan that includes new units would facilitate trading with other states, further promoting cost-effective compliance. It is reasonable to assume at least Pennsylvania's neighboring RGGI states will include new units within their cap. Thus, Pennsylvania could be sure of having at least nine states with whom to trade allowances and seek least-cost solutions.

B. The Program Should Include New Units

It is vital that Pennsylvania's mass-based program apply to all new and existing sources, an approach EPA has offered as trading-ready, requiring no multi-state agreement and no complex anti-leakage mechanisms. If the plan does not include new units, the environmental benefits of the program will be minimal as new natural gas combined cycle ("NGCC") units will be allowed to replace existing coal, reducing emissions, but also replacing existing NGCC and existing zero-carbon resources, including nuclear, hydro, and renewables. The replacement of non-coal generation with new NGCC plants would maintain or increase emissions rather than reduce them. In addition, an artificial dichotomy in compliance obligations between units constructed before and after January 8, 2014, would create inefficient market dynamics. In effect, new generation would be encouraged and increased use of Pennsylvania's existing resources would be discouraged. The final rule requires states to account for this leakage from existing gas to new gas and to mitigate this incentive, and the potential methods for accomplishing this outside of including new units are complex, unwieldy, likely ineffective, and potentially counter-productive. By contrast, creation of a mass-based program including new units is automatically approvable and best promotes the goals of the CPP while minimizing market distortions. As discussed in detail below, regulating new units is within Pennsylvania's purview to adopt under current authorities and does not go beyond the federal requirements. In fact, a mass-based plan must have leakage prevention mechanisms and inclusion of new units is the only mechanism that does so without distorting energy markets.

Ironically, measures currently under discussion to limit this element of leakage – from existing NGCC to new NGCC – could sustain or even exacerbate the economic conditions that are challenging existing zero-emitting nuclear plants. Currently, NGCCs have higher variable costs than coal units, nuclear units, or renewables. Electricity prices, therefore, tend to reflect the marginal costs faced by NGCCs, whose bids in competitive markets often set the price paid to all generators. One of the proposed leakage prevention approaches for mass-based states that do not include new units would subsidize the operation of existing NGCC to encourage the switching of

dispatch from coal plants to existing NGCC plants and mitigate the incentives to switch to new NGCC instead. The proposed subsidy to existing plants would have the effect of temporarily lowering the wholesale price of electricity for all generators – further undercutting the economic viability of existing nuclear and other existing clean generation (as well as coal).[7] The proposed measures would also provide a similar operational subsidy to new wind and new solar, creating the same perverse incentive to run below those units' marginal cost (including when prices are negative), putting further pressure on nuclear plants, also to no CO_2 benefit.[8] Although some argue that incentives for price suppression are a positive for customers, it actually results in higher customer costs as the premature retirement of nuclear and other existing clean generation must be replaced by higher-cost generation, such as new NGCCs. Requiring all new and existing fossil EGUs to obtain and surrender allowances equal to their CO_2 emissions will alleviate these perverse results.

Moreover, the establishment of a cap covering both new and existing facilities will likely be necessary to provide Pennsylvania electricity generators with the widest market from which to seek or sell allowances. EPA has rightly concluded and previous experiences demonstrate that a broader trading market will result in consumer protections and more cost-effective emissions reductions (broad regional markets being the core element of the regional electrical grid). Thus, it would be most prudent for Pennsylvania to adopt a program that will protect its plants' ability to trade most broadly.

In contrast to the many benefits of a mass-based program that includes new units, there are very few sound arguments favoring either a rate-based system or a system that does not incorporate new units, particularly in Pennsylvania. In fact, numerous misconceptions underlie the primary argument in favor of rate-based compliance: that such a system is necessary to accommodate economic growth. This argument is founded on the fundamentally incorrect assumptions that economic growth and load growth go hand-in-hand, and that load growth inevitably requires growth in fossil fuel emissions. These twin assumptions are both untrue, as has been demonstrated nationally in recent years as well as studied in depth to evaluate the RGGI experience. In the RGGI region, since the start of the program, emissions (from all units; new and existing) have declined 40 percent while GDP increased eight percent (adjusted for

[7] Further, preserving nuclear and other clean generation through a fuel-neutral mass-based plan that includes new units promotes retention of coal generation, particularly newer and more efficient power plants. Absent significant emissions-free generation, compliance becomes markedly more expensive, challenging otherwise-viable coal plants. *See* PJM INTERCONNECTION, PJM REGIONAL TRANSMISSION EXPANSION PLAN PROCESS – RELIABILITY SCENARIO STUDIES RELATED TO THE PROPOSED CLEAN POWER PLAN (July 31, 2015), *available at* http://www.pjm.com/~/media/documents/reports/20150731-pjm-reliability-scenario-studies-related-to-the-proposed-cpp.ashx; PJM INTERCONNECTION, PJM INTERCONNECTION ECONOMIC ANALYSIS OF THE EPA CLEAN POWER PLAN PROPOSAL 60 (Mar. 2, 2015), *available at* http://www.pjm.com/~/media/documents/reports/20150302-pjm-interconnection-economic-analysis-of-the-epa-clean-power-plan-proposal.ashx; PJM INTERCONNECTION, PJM ECONOMIC ANALYSIS OF EPA'S PROPOSED CLEAN POWER PLAN: STATE-LEVEL DETAIL 80-81, 85 (Mar. 2, 2015), *available at* http://www.pjm.com/~/media/documents/reports/20150302-state-level-detail-pjm-economic-analysis-of-epas-proposed-clean-power-plan.ashx.

[8] *See infra* Appendix B (discussion of the impact of negative prices).

inflation).[9] In fact, economic growth and emissions growth, particularly emissions from electricity generation, are no longer directly related.[10]

C. Pennsylvania Should Not Trade With States That Do Not Include New Units

Pennsylvania should also ensure that its emission reduction program is not undermined by states that do not include new units in their compliance plans. If Pennsylvania generators achieve compliance by purchasing allowances from states that do not cover new units, then those out-of-state allowances may not represent actual carbon reductions. If another state in PJM does not require new NGCC plants to purchase allowances, those plants would not be required to include a price on CO_2 emissions and likely would be moved up in the dispatch order, displacing existing NGCC plants in Pennsylvania and other states that have imposed a price on CO_2 from new units. EPA requires that leakage from existing-only states be mitigated. Pennsylvania should permit trading only with other mass-based states that include new units, not only as an incentive for potential trading partners to include new units, but also as a backstop leakage provision.[11] This would not impair Pennsylvania's ability to trade with states that include new units without a formal multi-state agreement such as RGGI – in other words, such a condition would allow Pennsylvania to remain trading-ready, but limit trading to states with equivalent programs.

D. Mass-Based Programs Including New Units Can Readily Be Implemented Under Existing Pennsylvania Law

Article I, §27 of the Pennsylvania Constitution and the Pennsylvania Air Pollution Control Act ("PaAPCA"), the statute under which Pennsylvania implements the federal Clean Air Act, provide sufficiently broad authority to allow the adoption of a mass-based program covering new and existing sources and providing for interstate emissions trading.[12] These authorities also authorize any method for allocation of allowances, including an auction.

The PaAPCA broadly authorizes DEP to "[i]mplement the provisions of the Clean Air Act in the Commonwealth."[13] Thus, regulating new units is within Pennsylvania's purview to adopt under current authorities because it is the simplest approvable option for a required element of the final rule. The PaAPCA also authorizes the DEP to cooperate with the agencies

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[9] RGGI, INVESTMENT OF RGGI PROCEEDS THROUGH 2013 5 (Apr. 2015), *available at* http://www.rggi.org/docs/ProceedsReport/Investment-RGGI-Proceeds-Through-2013.pdf.

[10] INTERNATIONAL ENERGY AGENCY ("IEA"), STATISTICS, KEY TRENDS IN CO2 EMISSIONS – EXCERPT FROM: CO2 EMISSIONS FROM FUEL COMBUSTION viii (2015), *available at* http://www.iea.org/publications/freepublications/publication/CO2EmissionsTrends.pdf (attributing reduction in global CO_2 emissions during the economic growth of 2014 to switching of fuel to clean energy sources and increased energy efficiency); Chris Mooney, *Why the Global Economy Is Growing, But CO_2 Emissions Aren't*, WASHINGTON POST, Mar. 13, 2015, https://www.washingtonpost.com/news/energy-environment/wp/2015/03/13/for-the-first-time-in-40-years-the-world-economy-grew-but-co2-levels-didnt/ (explaining decoupling of CO_2 emissions from economic growth based on the IEA data).

[11] KATHRYN ZYLA, LISSA LYNCH, & GABE PACYNIAK, GEORGETOWN CLIMATE CENTER, WORKING PAPER: SUPPORTING STATE PLAN COMPATIBILITY AND INTERSTATE COMPLIANCE WITH THE CLEAN POWER PLAN 5 (July 2015), *available at* http://www.georgetownclimate.org/sites/www.georgetownclimate.org/files/GCC_InterstateCompatibility_July2015_0.pdf.

[12] PA. CONST. art. I, § 27; 35 PA. STAT. ANN. § 4001 *et seq.* (West, 2015).

[13] 35 PA. STAT. ANN. § 4004(1) (West, 2015).

of other states and interstate organizations with respect to the control, abatement, and reduction of air pollution.[14] It directs DEP to develop a comprehensive plan "for the control and abatement of existing air pollution and air contamination and for the abatement, control and prevention of any new air pollution and air contamination" and to submit the plan to the Environmental Quality Board ("EQB") "for its consideration and approval."[15] Likewise, the Act broadly authorizes the EQB to "[a]dopt rules and regulations, for the prevention, control, reduction and abatement of air pollution" and to "[a]dopt rules and regulations to implement the provisions of the Clean Air Act," providing further that the rules and regulations "shall be consistent with the requirements of the Clean Air Act."[16] Thus, the PaAPCA authorizes the EQB to adopt regulations that implement the CPP, including a mass-based plan that includes new units.

Further, the federal Clean Air Act specifically authorizes mechanisms including the award or allocation of tradable allowances either to parties for a fee, free of charge or by way of auction as pollution control techniques. Thus, the Clean Air Act requires that each state implementation plan, on which this plan process is modeled,

> include enforceable emission limitations and other control measures, means, or techniques (including economic incentives such as fees, marketable permits, and auctions of emission rights).[17]

The express authorization to adopt rules "to implement the Clean Air Act . . . consistent with the requirements of the Clean Air Act," necessarily includes use of "economic incentives such as fees, marketable permits, and auctions of emissions rights" to implement emissions reduction requirements.

Pennsylvania has relied on the authority provided by the PaAPCA and the Article I, § 27 to adopt rules implementing cap-and-trade programs in response to federal requirements. These include the regulations implementing interstate mass-based NO_x trading within the ozone transport region (NOx Budget Program or "NBP") and regulations implementing NO_x and SO_2 trading under the Clean Air Interstate Rule ("CAIR").[18] In doing so, Pennsylvania adopted its own allowance allocation mechanisms, including allocations to non-emitting entities, to implement CAIR.[19]

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[14] *Id.* § 4004(24).

[15] *Id.* § 4004(18).

[16] *Id.* § 4005(a)(1), (8).

[17] 42 U.S.C. § 7410(a)(2)(A).

[18] Pennsylvania's emissions trading regulations appear at title 25, chapter 145 of the Pennsylvania Code. Those regulations are a part of Pennsylvania's approved state implementation plan ("SIP"). *See* 40 C.F.R. § 50.2020(c) (2015) (designating Chapter 145 as a part of Pennsylvania's approved program). Pennsylvania has not yet adopted regulations implementing the Cross-State Air Pollution Rule ("CSAPR"), so it remains subject to the federal implementation plan. *See* 40 C.F.R. §§ 52.2039- 52.2041 (2015). Pennsylvania submitted a notice to EPA indicating that it intended to modify the allowance allocation provisions in CSAPR, but has not yet modified those provisions. https://www.portal.state.pa.us/portal/server.pt/document/1477348/7-csapr_presentation_aqtac_2-12-2015_final_pdf.

[19] 25 PA. CODE §145.212.

III. ALLOWANCE ALLOCATION

As discussed above, inclusion of new units avoids a multitude of costly implementation concerns and should be Pennsylvania's choice. Under this option, Pennsylvania has complete control over allowance distribution and is able to auction or allocate allowances in order to ensure that the value created by the program benefits consumers. This could be accomplished through an auction with revenue directed to consumer benefit or through allocation to electric distribution companies ("EDCs") for consumer benefit.[20] Both options would enable the Commonwealth to mitigate price impacts and ensure maximum market efficiency and liquidity.[21] Neither of these alternatives requires the complex and potentially market-distorting updating allocations proposed for states that do not include new units.

However, more complex allocation mechanisms are necessary in the event that new units are not included to address the final rule's leakage requirements as well as the perverse impacts these incentives have on existing clean generation. Thus, if new units are not included, Pennsylvania would lose control of a significant portion of the allocation process. Furthermore, the proposed allocation formula is an updating allocation to existing NGCC and new renewable generators, which would exacerbate the situation for existing zero-emission generators in Pennsylvania like Three Mile Island. Pennsylvania should allocate allowances in a way that supports all clean generation in Pennsylvania. This could include proportionately allocating allowances to all generators of electricity in Pennsylvania or setting aside a specified portion of allowances for clean generation to mitigate the implicit and explicit subsidies to NGCC discussed above. Both of these options are suggested in EPA's proposed model rule as potential ways to demonstrate that a state has adequately prevented emission leakage. Allocating to a broad spectrum of system participants, rather than just compliance entities, would also promote market liquidity in the absence of an auction.

This allocation method would serve Pennsylvania in several ways. Because zero-emissions electric generating units would not be required to surrender allowances, this would provide an additional revenue stream that could prevent their retirement. This approach would encourage the development of new zero-emissions electricity in order to secure future years' allocations to the extent that retired units' allocations are redistributed to newer clean resources, as proposed by EPA. This approach would encourage switching dispatch from coal to lower- and zero-emitting units as EPA intended.

IV. PENNSYLVANIA SHOULD SUBMIT A PLAN BY SEPTEMBER 6, 2016

Exelon strongly supports Pennsylvania's efforts to submit a Clean Power Plan compliance plan by the deadline of September 6, 2016, without seeking an extension. Delay will prolong uncertainty that will hamstring long-term planning efforts and stifle investment in the

[20] EPA used the term "load-serving entity" ("LSE") to propose this option in the model rules. Federal Plan Requirements for Greenhouse Gas Emissions From Electric Utility Generating Units Constructed on or Before January 8, 2014; Model Trading Rules; Amendments to Framework Regulations, 80 Fed. Reg. 64,965, 65,016-18, 65,027 (proposed Oct. 23, 2015).

[21] Given that EDCs have no need for allowances, all allowances would reach the market just like in an auction.

Commonwealth. There is simply no good reason to delay submission if DEP can develop a quality plan on time.

First, timely submittal would provide the electricity industry sufficient regulatory certainty to carry out its business, including making decisions on new resources and investing in existing resources. As the Department is aware, electricity generation and transmission projects require many years of advance planning and entail large capital investments with a life of several decades. Regulatory certainty is vital for this type of long-term planning. Delay will only prolong uncertainty and deter investments necessary to cost-effectively secure reliable electricity for all Pennsylvanians in the future.

Delay will also introduce unnecessary uncertainty into the PJM capacity procurement process. To accommodate the advance planning needed for reliability, PJM holds its annual capacity auctions three years in advance. Thus, a delay until September 2018 would not resolve this regulatory uncertainty until the May 2019 auction for capacity for the 2022/2023 delivery year. Meanwhile, in May 2018, generators would have to submit bids for 2021/2022 – the beginning of the compliance period – when they will face a compliance obligation of unknown scope and scale. Delay will not promote least-cost or most-efficient outcomes. Delaying the submission of Pennsylvania's plan until after 2016 will deprive Exelon and other electricity generators of information vital to structuring their bids and ensuring that sufficient capacity is secured at least cost. This regulatory certainty consideration is also critical to those considering investments in new NGCC. Decisions to invest in such units must consider the operational cost those units will incur, which will be unknown unless and until Pennsylvania submits a compliance plan that includes new units.[22]

Second, the principal reason cited by those urging delay does not stand up to scrutiny. Some proponents of delay argue that litigation of the Clean Power Plan may result in its reversal, and Pennsylvania should therefore wait for the results of those appeals. However, the challenges will likely not be resolved until after September 6, 2018, given recent precedents regarding the length of litigation. For example, in the case of EPA's most recent high-profile air litigation (involving CSAPR and Mercury and Air Toxics Standards ["MATS"]), litigation was not resolved until more than three years after the rules' promulgation. Thus, Pennsylvania will know no more about the fate of the Clean Power Plan on September 6, 2018, than it does today. Further, EPA's obligation to address greenhouse gas emissions from power plants will remain and a comprehensive mass-based program will remain the best option.

Finally, delay will hamper the ability of new renewable energy projects and new energy efficiency projects in low-income areas to participate in the Clean Energy Incentive Program ("CEIP"). In order to qualify for benefits under CEIP, projects must commence construction after submission of a state's final implementation plan. If Pennsylvania submits its final plan in 2016, developers can begin working on qualifying projects immediately. Given that CEIP only provides credit for generation or demand reduction in 2020 and 2021, the more lead time

[22] These comments do not delve into the future regulatory landscape for NGCC, but it is prudent to expect they will face a compliance obligation of some sort in the near future, possibly before the CPP even takes effect. Thus, inclusion of these units in the plan now mitigates the future risk of the unknown – and possibly more onerous – regulatory burden.

developers have, the more projects will be online in the 2020-21 period. If Pennsylvania submits its final plan in September 2018, there will be less than 16 months before projects could begin to earn CEIP credits. This narrow window is too small to allow robust participation in this federal subsidy program.

V. APPENDIX A – QUESTIONS FROM SOLICITATION OF COMMENTS

PA DEP Question	Location of Response
Compliance Targets/Timeline	
Should the state plan use rate-based (expressed in pounds of carbon dioxide emissions per megawatt-hour) or mass-based (total tons of carbon dioxide) targets?	Section III
How should allowances be allocated under a mass-based approach?	Section III
Should new natural gas plants be included within a mass-based target?	Section II, II.B
What methods should be used to measure compliance?	Section II
Participation in Trading	
Should Pennsylvania adopt a trade-ready program without a formal multi-state agreement?	Section II.B
Should Pennsylvania, join a formal multi-state trading collaborative?	Section II.B, II.C
Should Pennsylvania manage carbon emissions without trading at all?	Section I.C, II.C
Energy Efficiency & Renewables	
How can the state best use renewable energy in meeting its compliance obligations?	Section II.A
How can the state best use energy efficiency in meeting its compliance obligations?	Section II.A
Should the state participate in the Clean Energy Incentive Program?	Section IV
Should the state set aside allowances or credits to participate in the Clean Energy Incentive Program?	Section IV
Least-Cost Compliance and Reliability Issues	
What compliance pathway represents the least-cost option for Pennsylvania?	Section II.A
How can Pennsylvania meet its objective of prioritizing indigenous resources?	Section II.A
How can Pennsylvania maintain a diverse fuel mix?	Section II.A

How can Pennsylvania protect the commonwealth's position as a net energy exporter?	Section I.B
How can Pennsylvania ensure electric reliability?	Section II.A

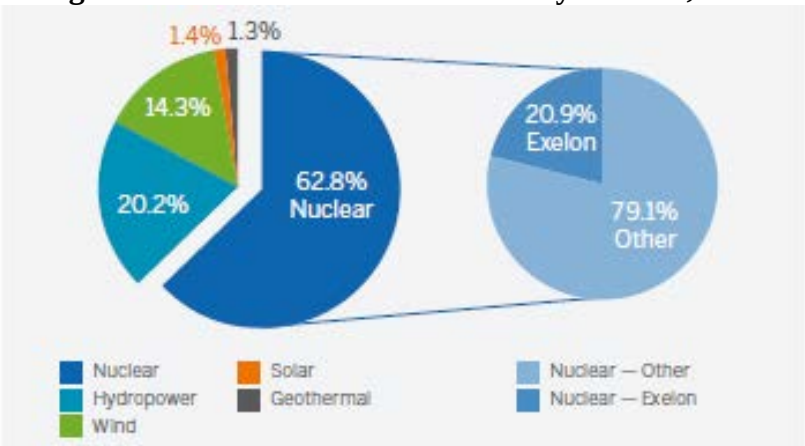
VI. APPENDIX B – NUCLEAR ECONOMICS

Retaining the existing nuclear fleet, as well as all other existing zero-emissions sources, is vital to maintaining electricity reliability and moderating price impacts while reducing CO_2 emissions.

A. Nuclear Facilities Are the Largest and Most Reliable Source of Carbon-Free Electricity

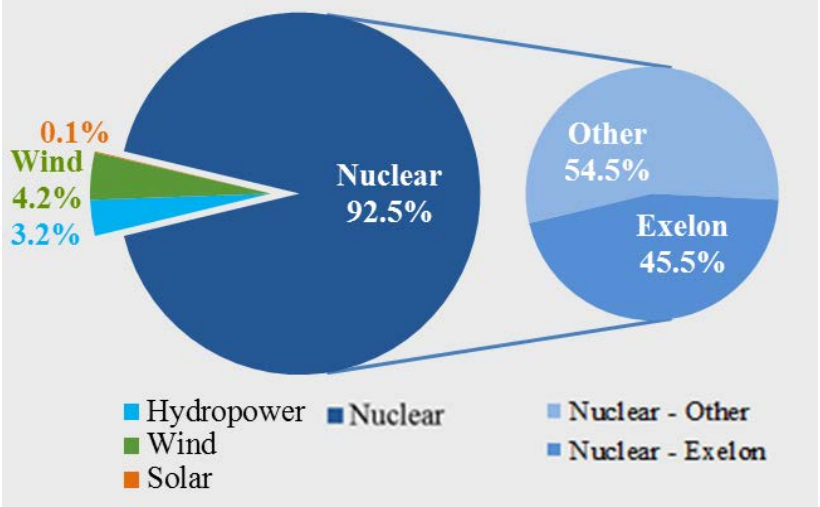
Electricity generation accounts for nearly 40 percent of U.S. CO_2 emissions. However, existing nuclear power plants, which produce 19 percent of the nation's electricity, emit no CO_2 and are among the cleanest sources of electricity available. In 2014, nuclear power plants provided 63 percent of the carbon-free electricity in the United States (*see* Figure 1) as well as 92.5 percent of the carbon-free electricity in Pennsylvania (*see* Figure 2).

Figure 1. U.S. Carbon-Free Electricity Sources, 2014



Source: U.S. Energy Information Administration ("EIA"), Electric Power Monthly

Figure 2. Pennsylvania Carbon-Free Electricity Sources, 2014



Source: EIA Electric Power Monthly, SNL

Nuclear facilities are critical to the reliability of the electric grid because they operate continuously and largely independent of weather conditions. One example is presented by the deep freeze brought on by the polar vortex in January 2014, which resulted in more than 35,000 MW of outages (nearly 20 percent of PJM capacity).[23] In the eastern part of the U.S. and Texas, natural gas plants accounted for 55 percent of these outages. Even coal plants reported outages. Nuclear units accounted for only three percent of forced outages – despite making up 12 percent of total capacity – and were least affected by the weather conditions, operating at 90 percent capacity through the polar vortex event.[24] In contrast to natural gas plants, which receive their fuel supply through a gas pipeline system that may be constrained under certain circumstances, nuclear facilities have their fuel on-site and it cannot freeze or be otherwise affected by weather.[25] Further, even in non-extreme conditions, nuclear facilities continue to generate electricity at all times of day and in all weather conditions. The ability to rely on nuclear power in all circumstances will become increasingly important as the nation's electricity system becomes less reliant on coal and more reliant on technologies that are weather-dependent, such as gas and renewables.

B. Nuclear Facilities Are at Risk of Premature Retirement, Endangering Both Reliability and Emissions

Despite generating large amounts of clean energy and playing a vital role in grid reliability, nuclear facilities across the country are at risk for premature retirement, as evidenced by the three plants announced for closure just this year. Approximately half of the Nation's existing nuclear units are merchant generators in states such as Pennsylvania with competitive electricity markets, in which wholesale prices are set by generators' bids and which can only incorporate identified costs (e.g., there must be a required carbon price in order to value carbon-free electricity). As with any resource, unless wholesale electricity prices (and capacity prices in RTOs that have capacity markets) fairly compensate the nuclear plants to cover their costs, they will retire. Thus, is it is imperative that markets include the full costs of generation, including the value of avoiding CO_2 pollution. The clearest way to do that is through a mass-based program that includes new as well as existing units.

The economic pressure on nuclear units has been exacerbated by operating subsidies for other generation technologies, notably wind, which has placed further downward pressure on wholesale electricity prices. Operating subsidies allow wind generators to remain profitable even when they pay to put their electricity onto the grid; these units can therefore bid a negative price into the electricity markets yet still make money. On breezy nights, the market-clearing price of electricity has become negative in locations where there is insufficient transmission to relieve the local area of excess electricity production.[26] States such as California are beginning

[23] PJM INTERCONNECTION, COLD WEATHER PEAKS AND GENERATOR OUTAGES (Jan. 2014), *available at* https://www.pjm.com/~/media/documents/reports/20140109-january-2014-cold-weather-peaks-and-generator-outages.ashx.

[24] NORTH AMERICAN ELECTRIC RELIABILITY CORP., POLAR VORTEX REVIEW 13, 32 (Sept. 2014), *available at* http://www.nerc.com/pa/rrm/January%202014%20Polar%20Vortex%20Review/Polar_Vortex_Review_29_Sept_2014_Final.pdf

[25] Natural gas availability can also constrain the operation of coal plants, which often require natural gas as a startup fuel.

[26] FRANK HUNTOWSKI, AARON PATTERSON & MICHAEL SCHNITZER, THE NORTHBRIDGE GROUP, NEGATIVE ELECTRICITY PRICES AND THE PRODUCTION TAX CREDIT: WHY WIND PRODUCERS CAN PAY US TO TAKE THEIR POWER – AND WHY THAT IS A BAD THING (Sept. 10, 2012), *available at*

to see this phenomenon midday as a result of solar production as well.[27] Nuclear plants in those areas cannot stop running during such times and have absorbed substantial losses as a result. This quickly jeopardizes these plants' financial viability. Thus, in the long-term, operating subsidies for wind power displace nuclear generation, to no CO_2 benefit.

Analysts estimate that 11 percent of the nation's nuclear facilities are at risk of premature closure from these poor market conditions. Among the at-risk units identified by the analysts is Exelon's Three Mile Island plant in Pennsylvania, which as noted above, did not clear the recent PJM capacity auction.[28] The twelve plants that these analysts identified as "at risk," which included the Ginna and Pilgrim plants, have an aggregate capacity of 10,583 MW and displace 90 million tons of CO_2 annually – more than a quarter of the reduction anticipated from the entire CPP.[29]

If all of the twelve plants identified by the analysts retire and they are replaced by new NGCC plants like the two recently permitted in Pennsylvania (and those NGCC plants are unconstrained by a CO_2 cap), CO_2 emissions would rise by 37.3 million tons per year. Because EPA assumes that nuclear plants will continue to operate, this will wipe out nine percent of the 413 million tons of reductions that EPA is predicting for the Clean Power Plan nationally in 2030.[30] If Three Mile Island is replaced by new NGCC plants, CO_2 emissions in Pennsylvania will increase by approximately three million tons per year, erasing a large percentage of the emissions reductions required under the Clean Power Plan.[31]

Further, states that adopt a rate-based approach or otherwise fail to address emissions from new NGCC have the potential to actually increase the financial pressure on existing nuclear plants. Currently, NGCCs generally have higher variable costs than coal units, nuclear units, or renewables. Electricity prices, therefore, tend to reflect the marginal costs faced by NGCCs, whose bids in competitive markets set the price paid to all generators. Both of EPA's rate-based approaches and the proposed leakage prevention approach for mass-based states that do not include new units will likely involve some operating subsidy to existing NGCC plants to encourage the switching of dispatch from coal to NGCC plants. The potential subsidy to existing plants could have the effect of artificially lowering the wholesale market price of electricity for all generators – further undercutting the economic viability of existing nuclear and renewables in

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http://www.nbgroup.com/publications/Negative_Electricity_Prices_and_the_Production_Tax_Credit.pdf; *Wind Power Causes Negative Electricity Prices*, SEARCHFORENERGY (Apr. 29, 2015), https://www.searchforenergy.com/blog/wind-power-causes-negative-electricity-prices/; Clifford Krauss & Diane Cardwell, *A Texas Utility Offers a Nighttime Special: Free Electricity*, N.Y. TIMES, Nov. 9, 2015, A1, *available at* http://www.nytimes.com/2015/11/09/business/energy-environment/a-texas-utility-offers-a-nighttime-special-free-electricity.html?_r=0.

[27] Naureen S. Malik, *Spot Power Turns Negative in California on Solar, Wind Output*, BLOOMBERGBUSINESS, Mar. 12, 2014, 5:18 PM EDT, http://www.bloomberg.com/news/articles/2014-03-12/spot-power-turns-negative-in-california-on-solar-wind-output.

[28] Andrew Engblom & Hira Fawad, *As Pilgrim Falls, 11% of Nuclear Generation at Risk of Early Closure*, SNL, Oct. 16, 2015, 10:33 AM ET, https://www.snl.com/InteractiveX/Article.aspx?cdid=A-34103057-13109.

[29] *Id.*

[30] EPA, EPA-452/R-15-003, Regulatory Impact Analysis for the Clean Power Plan Final Rule ("RIA") (Aug. 2015) at ES-7.

[31] The September 2, 2015 permit for Moxie Freedom, LLC permits allows 3.7 million tons of CO_2 emissions per year for an NGCC plant with a rated capacity of 1,050 MW. Pennsylvania Plan Approval Permit # 40-00129A (Sept. 2, 2015).

the near term. New NGCC plants will have no need to purchase allowances and will therefore also be able to bid lower prices into the market. In the long run, however, the premature retirement of nuclear plants will result in both increased electricity prices and emissions, as nuclear plants are replaced with higher-cost and higher-emissions NGCC generation.

C. Preventing the Early Retirement of Existing Nuclear Generation Is Essential

Because a loss of nuclear generation would necessarily increase CO_2 emissions from power generation, maintaining the existing nuclear fleet is an essential element of any plan to reduce CO_2 emissions from the power generation sector. Commissioners of the Federal Energy Regulatory Commission ("FERC"), state public service and environmental commissioners, scientists, and others have all called upon environmental and energy policymakers to develop solutions to preserve nuclear energy's unique role among the nation's clean energy resources. Former FERC Commissioner John Norris observed that "[w]e need to maintain our nuclear fleet, as it is a valuable base load and carbon free resource."[32]

In November 2013, four of the world's most respected climate and energy scientists – Dr. Ken Caldeira of Carnegie Mellon, Dr. Kerry Emanuel of MIT, Dr. James Hansen of Columbia University, and Dr. Tom Wigley of the National Center of Atmospheric Research – acknowledged the critical importance of nuclear energy to addressing climate change. The scientists released a letter calling on world leaders to support nuclear energy, concluding that "in the real world there is no credible path to climate stabilization that does not include a substantial role for nuclear power."[33] These scientists reiterated this call in advance of the upcoming United Nations Conference on Climate Change ("UNFCCC") 21st Conference of the Parties ("COP21") negotiations in Paris later this year.[34] The Center for Climate and Energy Solutions released a study identifying the challenges facing nuclear units and noting that retirements of nuclear units will have serious climate change implications.[35] Similarly, the National Association of Regulatory Utility Commissioners ("NARUC") passed a resolution recognizing that "[n]uclear energy has played a substantial role in the achievement of existing [greenhouse gas] State or regional emissions reduction goals to date, and continued operation of nuclear power plants is vital to States' ability to economically meet new federal regulation, and provides an essential tool to manage risks associated with potential [greenhouse gas] emissions reduction requirements."[36] NARUC urged EPA to adopt rules encouraging states to "preserve, life-extend,

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[32] Former FERC Commissioner John R. Norris Statement, *Preserving our Country's Nuclear Fleet*, FERC (May 15, 2014), http://www.ferc.gov/media/statements-speeches/norris/2014/05-15-14-norris.asp.

[33] Andrew C. Revkin, 'To Those Influencing Environmental Policy But Opposed to Nuclear Power', N.Y. TIMES DOT EARTH BLOG (Nov. 3, 2013 8:20 AM), http://dotearth.blogs.nytimes.com/2013/11/03/to-those-influencing-environmental-policy-but-opposed-to-nuclear-power/.

[34] Amanda Reilly, *James Hansen, Other Scientists Push Reactors' Role In Climate Talks*, GREENWIRE, Nov. 12, 2015 2:24 PM, http://www.eenews.net/greenwire/2015/11/12/stories/1060027891.

[35] DOUG VINE & TIMOTHY JULIANI, CENTER FOR CLIMATE AND ENERGY SOLUTIONS (C2ES), CLIMATE SOLUTIONS: THE ROLE OF NUCLEAR POWER 8-9 (Apr. 2014), *available at* http://www.c2es.org/docUploads/nuclear-energy-brief-04-14-final.pdf.

[36] NARUC, Resolution Recognizing the Importance of Nuclear Power in Meeting Greenhouse Gas Goals (adopted Nov. 19, 2014), *available at* http://naruc.org/Resolutions/Resolution%20Recognizing%20the%20Importance%20of%20Nuclear%20Power%20in%20Meeting%20Greenhouse%20Gas%20Goals.pdf.

and expand existing nuclear generation."[37] Many comments at the recent Listening Sessions echoed these concerns.

The premature retirement of a nuclear facility leaves an enormous hole: each nuclear facility generates so much electricity so consistently that, with current technology, it cannot feasibly be replaced entirely by zero-emissions generation – zero-carbon options such as wind and solar have much lower capacity factors. Thus, when nuclear plants retire, CO_2 emissions increase. This has been borne out time and again when nuclear plants are retired – for example, the closure of the San Onofre Nuclear Generating Station ("SONGS") in early 2012 resulted in the loss of more zero-emissions electricity than the combined production of all wind, solar, and biomass in all of California.[38] The following year, emissions increased by 35 percent.[39] Similarly, when the Kewaunee nuclear plant in Wisconsin closed in 2013, the fossil fuel generation that took its place emitted an additional 3.6 million metric tons of CO_2.[40] As noted above, if the Three Mile Island plant retires and is replaced by electricity produced by NGCCs, emissions will increase by three million tons annually, one-third of Pennsylvania EGUs' initial compliance obligation.[41] Thus, the loss of just a single nuclear plant can have a devastating impact on a state's ability to reduce CO_2 emissions.

In addition, nuclear supports grid reliability in a way that intermittent zero-carbon technology does not.[42] According to EIA data, in 2014, nuclear facilities had a capacity factor of approximately 90 percent nationwide. By comparison, wind facilities had a capacity factor of approximately 30 percent and utility-scale photovoltaic solar generation had a capacity factor of 33 percent.[43] Thus, wind and solar power do not replicate nuclear power's ability to generate electricity 24 hours per day, independent of weather conditions.

D. Establishing a Cap on All Emissions Will Drive the Development of New Zero Emissions Electricity to Replace Plants that Must Retire

Establishing a program that prevents emissions increases and puts a price on all CO_2 emissions is not only essential to preserving the existing nuclear fleet, it is also essential to drive the development and implementation of new zero-carbon technologies. The electricity industry can meet the challenge, in coming decades, of replacing nuclear units that have reached the end

[37] *Id*.

[38] *California Electrical Energy Generation*, CALIFORNIA ENERGY COMMISSION ENERGY ALMANAC, http://energyalmanac.ca.gov/electricity/electricity_generation.html (last updated Sept. 10, 2015).

[39] *California Electrical Energy Generation*, CALIFORNIA ENERGY COMMISSION ENERGY ALMANAC, http://energyalmanac.ca.gov/electricity/electricity_generation.html (last updated Sept. 10, 2015).

[40] This calculation is based on Kewaunee's 4,519.9 GWh of output in 2012, replaced with MISO generation with an emissions factor of 1,756 pounds of CO_2 emitted per MWh.

[41] *See supra* note 31.

[42] *See* EIA, ELECTRIC POWER MONTHLY – WITH DATA FOR JULY 2015 Table 6.7.B (Sept. 2015) (reporting capacity factors for utility scale generators not primarily using fossil fuels), *available at* http://www.eia.gov/electricity/monthly/current_year/september2015.pdf. Exelon's fleet averaged a 94.2 percent capacity factor in 2014.

[43] *Id*.

of their useful lives with other zero-emitting generation while continuing to replace fossil-fired generation and meeting increased demand as other sectors electrify.

Technologies that either already exist, or that are currently under development and are likely to be commercialized in the coming decades, include:

- *New nuclear facilities*. Nuclear units are a demonstrated, proven technology for generating zero-carbon electricity. Certainly, it is technically feasible to replace units that have reached the end of their remaining useful life with new units. Five nuclear EGUs at three plants presently are under construction: Vogtle in Georgia, Watts Bar in Tennessee, and V.C. Summer in South Carolina (Watts Bar 2, in fact, received its operating license last month). All four units in South Carolina and Tennessee are AP1000s from Westinghouse, headquartered in Cranberry Township, Pennsylvania.

- *Innovations that will extend the life of existing nuclear facilities.* The nuclear industry continually develops and implements such innovations, and the Nuclear Regulatory Commission ("NRC") will soon receive applications to extend licenses for a fourth twenty-year term.[44] Just this week, NRC announced the beginning of the process to consider the first application for a license to 80 years.[45]

- *Next-generation nuclear technology.* The nuclear industry is currently developing modular small and medium size nuclear reactors that could significantly reduce construction times and costs.[46] Although current economic conditions make the development of such reactors in competitive electricity markets challenging, these innovations could be applied within regulated markets, and when the technology is proven, applied more broadly if there are market incentives for CO_2 emissions reductions. The International Atomic Energy Agency has also identified developments in fast reactors and gas-cooled reactors.[47] This could also be an opportunity for Pennsylvania-based advanced nuclear generation design, engineering, and manufacturing companies, such as Westinghouse and GE.

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[44] *See, e.g., U.S. Nuclear Energy Industry Innovations That Focus on Aging Management or Long-Term Plant Reliability*, NEI, http://www.nei.org/Knowledge-Center/Industry-Innovation/U-S-Nuclear-Energy-Industry-Innovations-That-Focus (last visited Nov. 11, 2015); Matthew L. Wald, *Power Plants Seek to Extend Life of Nuclear Reactors for Decades*, N.Y. TIMES, Oct. 20, 2014, B3, *available at* http://www.nytimes.com/2014/10/20/business/power-plants-seek-to-extend-life-of-nuclear-reactors.html.

[45] Albert Wong, *Preparing for Subsequent License Renewal*, NRC (Nov. 6, 2015), http://public-blog.nrc-gateway.gov/2015/11/06/preparing-for-subsequent-license-renewal/.

[46] *See Small and Medium Sized Reactors (SMRs) Development, Assessment and Deployment*, INT'L ATOMIC ENERGY AGENCY ("IAEA") (Mar. 31, 2015), http://www.iaea.org/NuclearPower/SMR/index.html; IAEA, ADVANCES IN SMALL MODULAR REACTOR TECHNOLOGY DEVELOPMENTS – A SUPPLEMENT TO: IAEA ADVANCED REACTORS INFORMATION SYSTEM (ARIS) (Sept. 2014), *available at* http://www.iaea.org/NuclearPower/Downloadable/SMR/files/IAEA_SMR_Booklet_2014.pdf.

[47] *Support for Innovative Fast Reactor Technology Development and Deployment*, IAEA (last updated Oct. 29, 2015), *available at* http://www.iaea.org/NuclearPower/FR/index.html.

- *Carbon capture and reuse from existing coal-fired plants.* EPA has already found that carbon capture and storage or sequestration ("CCS") is technically feasible (though not yet cost-effective) for many existing coal-fired plants, and a variety of such systems are under development.[48] Some involve the capture and purification of CO_2 emissions to compress the CO_2 to a super-critical liquid that can then be reused in industrial processes or injected into geologic formations for long term, permanent sequestration and removal from the atmosphere. In 2009, Pennsylvania examined establishing a network of geologic sequestration sites in the Commonwealth and found it feasible.[49] However, in the absence of market incentives for CO_2 emissions reduction from existing fossil fuel-fired plants, the efforts to develop a sequestration site network were abandoned. Other processes under development include capture by genetically enhanced algae to produce new fuels, thus recycling CO_2 rather than releasing new from long-term carbon sinks.[50]

- *CCS from NGCC.* CO_2 capture from NGCCs for reuse or sequestration will be feasible within the next decade, so that retiring nuclear plants could be replaced by new NGCCs that produce electricity without emissions. On October 15, 2014, Exelon Generation announced that it had joined a joint venture that would validate that technology at a site in Texas, using supercritical CO_2 as a working fluid to drive a combustion turbine and ultimately to produce pipeline-quality CO_2 that can be sequestered or used in industrial processes. The developer is working toward commissioning the plant in the coming years.[51]

- *Improved solar generation.* Photovoltaic solar is becoming dramatically less costly. There have also been new developments in utility-scale thermal projects that can deliver solar-generated electricity with increasing reliability. For example, the 280 MW Solana plant in Arizona, which came online in October 2013, uses molten sodium to store heat generated during the day to produce steam during late afternoon peak hours or when the sun is no longer shining to achieve a

[48] Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. 64,661, 64,756 (Oct. 23, 2015) (to be codified at 40 C.F.R. pt. 60) (noting that "construction of one CCS retrofit application with [enhanced oil recovery] has already been completed at a unit at the Boundary Dam plant in Canada, and construction of another CCS retrofit application with [enhanced oil recovery] is underway at the W.A. Parish plant in Texas).

[49] *See* PA. DEP'T CONSERVATION NATURAL RES. ("PA DCNR"), SUMMARY OF ASSESSMENTS ON CARBON CAPTURE AND STORAGE 2-3 (Apr. 9, 2010); THOMAS A. GRAY ET AL. (prepared for PA DCNR), ASSESSMENT OF RISK, LEGAL ISSUES, AND INSURANCE FOR GEOLOGIC CARBON SEQUESTRATION IN PENNSYLVANIA 6-1 (Nov. 2009) (report submitted to Pennsylvania General Assembly pursuant to Act 129 of 2008); CLINTON CLIMATE INITIATIVE (prepared for PA DCNR), VIABILITY OF A LARGE-SCALE CARBON CAPTURE & SEQUESTRATION NETWORK IN PENNSYLVANIA 6 (Nov. 2009); PA DCNR, GEOLOGIC SEQUESTRATION OPPORTUNITIES IN PENNSYLVANIA xiv (Aug. 14, 2009).

[50] Alicia P. Gregory *et al.*, *Algae CO_2 Capture Part 1: How It Works*, UNIVERSITY OF KENTUCKY (Oct. 3, 2013), http://reveal.uky.edu/algae_part1_howitworks.

[51] Press Release, *Exelon, CB&I and 8 Rivers Proceed with Clean Energy Demonstration Plant*, EXELON CORP. (Oct. 15, 2014), http://www.exeloncorp.com/Newsroom/pr_20141015_power_cleanenergydemoplant.aspx.

40 percent capacity factor.[52] The price for Solana's power falls within the range EPA has determined is cost-effective. Moreover, new technologies such as solar shingles and solar films are allowing increasing use of distributed solar generation in or at the building sites where the electricity is consumed.

- *Improved storage technologies.* Battery, fuel cell, and other storage technologies are improving rapidly.[53] Although these technologies do not generate electricity, they will allow greater and more efficient use of intermittent technologies such as wind and solar. Fuel cell technologies will also permit more efficient production of electricity from natural gas during periods of time that renewable generation is unavailable.

- *Smart Grids and improved techniques for distributed generation.* These innovations in electricity distribution allow demand to be matched more closely with supply of electricity, allowing intermittent renewable resources to be integrated efficiently, electric vehicles to provide grid balancing services, demand response to reduce electricity consumption at peak times in the most efficient manner, and transmission losses to be reduced through distributed generation.[54]

These emerging technologies will not attain commercial viability without a strong and consistent price on all sector CO_2 emissions. Historically, environmental regulation has been a strong driver of innovation in the power sector and the CPP need not be an exception.[55]

[52] Kate Shaw Yoshida, *Who Needs Sunlight? In Arizona, Solar Power Never Sleeps*, ARS TECHNICA (Feb. 18, 2014, 9:00 AM EST), http://arstechnica.com/science/2014/02/making-solar-power-even-after-the-sun-goes-down/; ABENGOA, Fact Sheet, SOLANA, *available at* http://www.abengoasolar.com/export/sites/abengoasolar/resources/pdf/Solana_factsheet_09092013.pdf.

[53] *See, e.g.*, Yoshida, *supra* note 52.

[54] *See* LITOS STRATEGIC COMMUNICATION (prepared for DEP'T OF ENERGY), SMART GRID: AN INTRODUCTION, *available at* http://energy.gov/sites/prod/files/oeprod/DocumentsandMedia/DOE_SG_Book_Single_Pages%281%29.pdf; Matthew L. Wald, *In Two-Way Charging, Electric Cars Begin to Earn Money From the Grid*, N.Y. TIMES, Apr. 26, 2013, B3, *available at* http://www.nytimes.com/2013/04/26/business/energy-environment/electric-vehicles-begin-to-earn-money-from-the-grid.html.

[55] *See* NORTHEAST STATES FOR COORDINATED AIR USE MANAGEMENT ("NESCAUM"), ENVIRONMENTAL REGULATION AND TECHNOLOGY INNOVATION: CONTROLLING MERCURY EMISSIONS FROM COAL-FIRED BOILERS VII-1 (Sept. 2000), *available at* http://www.nescaum.org/documents/rpt000906mercury_innovative-technology.pdf/download.