TESTIMONY OF THE NATURAL RESOURCES DEFENSE COUNCIL

Mark C. Szybist, Senior Attorney

on House Bill 11

Before the House Consumer Affairs Committee

Harrisburg, Pennsylvania

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Chairman Roae, Chairman Matzie, members of the Committee: thank you for inviting me to comment on House Bill 11.

My name is Mark Szybist and I am a senior attorney for the Natural Resources Defense Council (NRDC), a member-based non-profit environmental organization with more than 110,000 members and activists in Pennsylvania. NRDC works in the U.S. and internationally to protect the air, water, and land that support human health and long-term economic growth. My job is to advocate for Pennsylvania laws and policies that reduce emissions of greenhouse gases and other air pollutants and create an equitable, sustainable, and prosperous clean energy economy.

The following testimony:

1. Outlines the best practices that NRDC uses to evaluate state legislation that subsidizes nuclear power plants, including HB 11;
2. Explains how HB 11 falls short of those best practices;
3. Discusses the state of renewable energy in the U.S. and in the Commonwealth, and Pennsylvania's Alternative Energy Portfolio Standards Act of 2004 (AEPS);
4. Reviews Pennsylvania's 1996 Electricity Generation Customer Choice and Competition Act and explain how competitive energy markets in Pennsylvania favor fossil fuel generation, to the detriment of both renewable energy and nuclear power; and
5. Outlines how Pennsylvania could develop a market-based policy that limit emissions of carbon dioxide from the power sector, creating a more level playing field for renewables and nuclear, and generating revenue.

NRDC'S POSITION ON NUCLEAR POWER AND NUCLEAR SUBSIDIES

NRDC's position on state subsidies for nuclear power is described in our issue brief, *Transitioning Away from Uneconomical Nuclear Power Plants*, a copy of which is attached to this testimony.[1]

In short, we believe that state policymakers grappling with the future of nuclear power should have the goal of an orderly and deliberate transition away from nuclear to a safer, more economical low-carbon power sector that has significantly higher levels of both renewable energy and energy efficiency. Further, we believe that in managing this transition, policymakers

[1] The issue brief is also available at https://www.nrdc.org/sites/default/files/transition-away-uneconomical-nuclear-plants-ib.pdf.

should work both to ensure that electricity is affordable for consumers and to support the communities and workers whose livelihoods currently depend on nuclear plants by spurring new economic development in those communities. We believe the policymakers should provide the same support to communities and workers affected by the closure of coal-fired power plants.

In accordance with this position, NRDC's issue brief identifies several "best practices" that we look for in state proposals to compensate nuclear plants for the low-carbon power they generate. These practices include:

1. A requirement that plants show severe financial distress as a precondition to receive subsides;
2. The narrow tailoring of support mechanisms (i.e., so that they account for current market conditions), accompanied by a finite time horizon to prevent the establishment of an entrenched subsidy;
3. A binding and declining cap on carbon emissions;
4. Policies to significantly scale up energy efficiency and renewable energy;
5. Conditioning support for uneconomical nuclear power plants on a commitment to better manage the toxic waste they house onsite; and
6. Mechanisms to aid the workers and communities that will be affected when a plant closes.

Our position is based mainly on three considerations.

First, it is critical that we – Pennsylvania, the United States, and rest of the world – reduce our greenhouse gas emissions dramatically to avoid the worst impacts of climate change. Based on the latest U.S. National Climate Assessment[2] and a recent report by the Intergovernmental Panel on Climate Change,[3] to avoid the worst impacts of climate change we must limit warming to 1.5 degrees above pre-industrial levels. That requires us to achieve net-zero carbon emissions by 2050.[4] We are not on track to do that. While emissions fell in the United States from 2013 to

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[2] U.S. Global Change Research Program, *Fourth National Climate Assessment*, available at https://nca2018.globalchange.gov/chapter/front-matter-about/.

[3] Intergovernmental Panel on Climate Change, *Global Warming of 1.5 °C*, available at https://www.ipcc.ch/sr15/.

[4] Pennsylvania's Climate Change Act, Act 70 of 2008, directs the Department of Environmental Protection to prepare a triennial assessment concerning the impacts of climate change in the Commonwealth. The law also requires the DEP to prepare an action plan to address those impacts. A draft of the latest report, which combines the impacts assessment and action plan, was published in November. The final report is due to be released this spring and will include both "mitigation" strategies to reduce greenhouse gas emissions and slow global warming and "adaptation" strategies that Pennsylvania can use to cope with the impacts that are impossible to avoid.

2017, emissions actually rose in 2018 by 1.4 percent in the power sector and 2.8 percent on an economy-wide basis.

Second, although nuclear power has beneficial low-carbon attributes, it also has significant safety, global security, environmental, and economic risks. Until these risks are properly mitigated and the complete nuclear fuel cycle is sufficiently regulated, nuclear power should not be a leading strategy to diversify America's energy portfolio and reduce carbon pollution.

Third, the most economically and environmentally sustainable way for United States to make dramatic cuts in greenhouse gas emissions is to dramatically increase our use of energy efficiency and renewable energy while minimizing our use of both fossil fuels and nuclear power. NRDC's 2017 report, *America's Clean Energy Frontier: The Pathway to a Safer Climate Future*, [5] sets forth a strategy for doing so that includes dramatic improvements in energy efficiency across all sectors, a 13-fold increase in wind and solar energy, and the electrification of our vehicles, industrial processes, homes, and offices. If the U.S. follows this path, which we can do economically and with existing technologies, we can achieve an 80 percent reduction in greenhouse gas emissions by 2050, with a decline of nuclear power from 20 percent of our generation mix today to less than 3 percent.

NRDC'S OPPOSITION TO HOUSE BILL 11

NRDC opposes HB 11 because the bill is at odds with NRDC's best practices in almost every respect.

HB 11 would amend Pennsylvania's Alternative Energy Portfolio Standards Act (AEPS) to require electric distribution companies, or EDCs, to buy 50 percent of the electricity they distribute from generation sources included in a new Tier III.

Currently, the AEPS has two tiers. Tier I includes renewables, along with biomass, landfill gas, coalbed methane, fuel cells, and biologically derived methane. Tier II includes waste coal, municipal garbage, and other non-renewables. EDCs comply with the AEPS by purchasing alternative energy credits, with each credit representing one megawatt-hour (MWh) of electricity generated by a qualified source. Since 2004, EDCs have been required to incrementally increase

[5] *See America's Clean Energy Frontier: The Pathway to a Safer Climate Future*, available at https://www.nrdc.org/sites/default/files/americas-clean-energy-frontier-report.pdf.

their purchases of Tier I and Tier II credits in accordance with inclining statutory goals. In 2021, these goals will plateau at 8 percent for Tier I and 10 percent for Tier II.

The price of Tier I and Tier II credits is determined by markets where credits and credit futures are traded, and the costs of credits purchased by EDCs and EGS are passed on to consumers as a cost of electricity generation. Credits represent a revenue stream for prospective alternative projects that can, depending on the price, help them attract debt and equity financing. The Public Utility Commission has estimated that the costs of AEPS compliance in 2021 will be approximately $0.007 (seven-tenths of one cent) of every dollar spent by EDC customers.[6]

Nominally, Tier III sources include both nuclear power and renewable sources that meet certain criteria. Among other things, Tier III sources must prevent or avoid carbon dioxide and criteria pollutants (e.g., ground-level ozone and particulate matter) emissions in Pennsylvania; they must not have received any kind of subsidy from another state on account of their environmental attributes; and they cannot be owned by a vertically-integrated utility (such as Virginia and North Carolina have) that builds its own power plants.

However, if HB 11 were enacted, it is likely that almost all Tier III credits would be earned by nuclear power because eligibility is only the first step to receiving Tier III credits. The next step would be for the PUC to rank each eligible source for participation in the Tier III program based on "how well the alternative generation source satisfies the criteria specified under this act." After the eligible source is ranked, the PUC would select sources based on their ranking until the estimated generation from these sources totaled 50 percent of the electricity that EDCs distribute.

Under this rubric, Pennsylvania's five nuclear plants would almost certainly be picked first because they generate the greatest amounts of low-carbon electricity and so avoid the greatest amount of emissions. Because nuclear plants currently generate around half of the electricity distributed by EDCs,[7] this would leave little to no room for renewables, even though the formula for determining nuclear plants' estimated generation would yield "discounted" numbers lower than those plants' actual generation.[8] That said, even if a significant number of Tier III credits ended up being available to renewables, Tier III would be unlikely to drive new renewables

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[6] This translates to approximately $103.7 million per year (out of total expenditures of more than $14 billion). *See PUC, 2017 Annual Report, Alternative Energy Portfolio Standards Act of 2004*, at 12-13, available at http://www.puc.pa.gov/Electric/pdf/AEPS/AEPS_Ann_Rpt_2017.pdf.

[7] *See* Public Utility Commission, Electric Power Outlook (2017-2022) at 20, available at http://www.puc.pa.gov/General/publications_reports/pdf/EPO_2018.pdf

[8] *See* section 8.1(b)(2)

because the credit price would be too low, and investors would heavily or completely discount these credits because of their speculative nature.

In addition to doing very little to incentivize renewables, HB 11 fails to accord with NRDC's other best practices. There are no provisions to address the needs of workers and communities when plants eventually close. Credit eligibility is not conditioned on the implementation of best practices concerning waste storage and decommissioning. While the bill *contemplates* a price on carbon, HB 11 would not itself establish carbon limits. Nor would it increase energy efficiency goals. Arguably, the AEPS is not the appropriate legislative vehicle for limiting and pricing carbon or raising efficiency goals. However, there is no reason why an AEPS bill could not be packaged with other bills that address these policy priorities.

HB 11 also requires no showing of severe financial distress. Tier III credits could be claimed by nuclear plants irrespective of their profitability, resulting in high program costs: between $421 and $548 million per year. Moreover, the impact on customers' bills would be immediate: there would be no ramp-up to the 50 percent Tier III target in HB 11, as there has been for Tier I and Tier II. Under the Federal Power Act, Pennsylvania may not establish subsidies for nuclear plants (or for any other resource) that are priced to make up the difference between the amount of money that plants are earning on wholesale power markets and the amount of money they need to be profitable.[9] Subsidies must be on account of environmental attributes and must be priced to value those attributes. However, states may establish threshold conditions for the receipt of subsidies, such as requiring companies to open their books to demonstrate financial need. States can also authorize regulators to adjust credit amounts downward to reflect market conditions, which of course can change. Indeed, New Jersey did both when it enacted its "zero emissions credit" in 2018.[10]

The absence of a means test in HB 11 is unacceptable, both as a matter of basic fairness and because many Pennsylvanians currently struggle to pay their electricity bills in both urban and rural areas. Last December, the U.S. Census Bureau released its latest American Community Survey and Poverty Estimates report, which covered 2013 through 2017. It found, among other things, that while U.S. GDP has risen an average of 2.2 percent annually since 2012, the official poverty rate in Pennsylvania has remained at 13.1 percent. The real poverty rate is much higher,

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[9] *See* Miles Farmer, "Why the Supreme Court's Decision in Hughes is Good for Clean Energy," available at https://www.nrdc.org/experts/miles-farmer/why-supreme-courts-decision-hughes-good-clean-energy

[10] *See* New Jersey Board of Public Utilities, "Frequently Asked Questions about the Zero Emissions Certificate ("ZEC") Law," available at https://www.state.nj.us/bpu/pdf/publicnotice/ZEC%20Application%20QA.pdf

because according to Census Bureau guidelines, a family of four is not considered to be in "poverty" if its income exceeds $25,100. Although the Commonwealth has "experienced a steady uptick in new jobs," in recent years, "the pay that comes with them hasn't been enough to push more workers out of poverty or stop them from seeking government aid to eat."[11]

To protect Pennsylvanians from the impacts of climate change and ensure sustainable economic growth, Pennsylvania needs to make significant investments in clean energy. But those investments must be equitable and they must return long-term value. The proposed nuclear investments in HB 11 would do neither.

RENEWABLE ENERGY IN PENNSYLVANIA AND THE AEPS

In recent years, renewable energy has grown rapidly in the United States due to falling costs, technological improvements, and targeted incentives like state Renewable Portfolio Standards. Although Pennsylvania has seen significant growth in renewables, it lags behind leading U.S. states largely because the AEPS – an *alternative* energy standard, rather than a *renewable* energy standard – has been a relatively weak driver of renewables. Consequently, while Pennsylvania has created an impressive number of jobs in renewable energy, it has largely failed to take advantage of the economic development and job creation that renewables can bring.

Over the last decade, prices for solar and onshore wind in the U.S. have fallen by 88 and 64 percent, respectively. In some parts of the U.S., solar and wind are already the cheapest type of new generation to build, and they are projected to become increasingly cheaper. A recent analysis found that by 2025, building new renewables will be less expensive than running 86 percent of *existing* coal plants in the United States.[12]

These changing economics have translated into a massive increase in renewable generation. In 2008, less than 1.5 percent of the electricity generated in the United States came from wind and solar power. Since then, wind and solar generation have increased by 550 percent, to almost 9 percent. Overall, renewables (wind, solar, and hydropower) now account for around 16 percent of electricity generation in the U.S. In 2018, eighteen states generated 10 percent or more of their electricity from the sun and wind, and eleven states generated at least 20 percent.[13]

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[11] *See* https://www.mcall.com/news/pennsylvania/mc-nws-pennsylvania-census-poverty-pay-20181205-story.html
[12] *See* https://energyinnovation.org/wp-content/uploads/2019/03/Coal-Cost-Crossover_Energy-Innovation_VCE_FINAL.pdf
[13] Amanda Levin, "U.S. Power in 2018: The Good, the Bad, and the Gassy," available at https://www.nrdc.org/experts/amanda-levin/us-power-2018-good-better-and-gassy

Top 10 Wind & Solar States in 2018 (as % of generation)					
Wind & Solar Total		Wind		Solar	
Kansas	36.5%	Kansas	36.4%	California	19.0%
Iowa	33.9%	Iowa	33.7%	Nevada	12.7%
Oklahoma	31.8%	Oklahoma	31.7%	Hawaii	11.2%
Vermont	26.8%	North Dakota	25.8%	Vermont	11.0%
North Dakota	25.8%	South Dakota	24.4%	Massachusetts	10.7%
California	25.5%	Maine	21.0%	Arizona	6.5%
South Dakota	24.4%	New Mexico	18.7%	Utah	6.4%
New Mexico	23.5%	Minnesota	17.9%	North Carolina	5.4%
Maine	21.6%	Colorado	17.3%	New Mexico	4.7%
Colorado	20.3%	Texas	15.9%	New Jersey	4.2%

This is the good news. The bad news is that we are not ramping up renewables fast enough to achieve the carbon reductions necessary to avoid the worst impacts of climate change. This is especially true in Pennsylvania. Currently, renewables account for less than five percent of electricity generated in the state,[14] and most of new generation being built is natural gas-fired power. Since 2011, approximately 40 new gas power projects representing more than 17,000 megawatts (MW) of generation capacity have sought air quality permits from the Pennsylvania Department of Environmental Protection.[15]

The explosion of gas-fired power is due in part to historically low (for now) natural gas prices, which investors see as an opportunity to push coal and nuclear power offline in Pennsylvania's competitive power markets,, then enjoy handsome returns on their investment as gas prices rise.

[14]*See* Public Utility Commission, *2017 Annual Report: Alternative Energy Portfolio Standards Act of 2004*, available at http://www.puc.pa.gov/Electric/pdf/AEPS/AEPS_Ann_Rpt_2017.pdf
[15]*See* Department of Environmental Protection, "Natural Gas Power Project List as of 4/2/2019"

But this growth of gas generation is also a function of the fact that Pennsylvania's AEPS has been so weak over the last fifteen years.
As noted above, the AEPS currently has only an eight percent goal for "Tier I" resources, which include both renewable sources (solar, wind, hydropower, and geothermal) and non-renewable sources (coal-mine methane, biomass, and wood manufacturing waste products). Within this eight percent, there is a "carve-out" of one-half of one percent (0.5 percent) for solar photovoltaic (PV) electricity.

Pennsylvania has the potential to cost-effectively generate much greater amounts of renewable energy than this. According to the DEP's 2018 Energy Assessment, Pennsylvania has the potential to economically increase grid scale solar 3,687 percent and distributed generation solar 255 percent from 2015 – 2050.[16] In its recently completed "Finding Pennsylvania's Solar Future" project, the DEP explored a narrower question: whether Pennsylvania has sufficient technical and economic solar potential to meet 10 percent of in-state electricity demand with in-state solar generation by 2030. The report found that Pennsylvania does have such potential and recommended fifteen strategies for achieving it, including increasing the solar target in the AEPS to between four and eight percent by 2030.[17] Wind capacity is currently only 1,369 MW in Pennsylvania, but the state has the technical potential for 108,946 MW.[18]

The independent analysis completed for DEP in the "Finding Pennsylvania Solar Future" project also revealed that increasing solar to 10 percent by 2030 would create "60,000 to 100,000+ jobs, depending on the ratio of smaller systems to larger systems [smaller distributed generation requires more labor and results in more jobs than grid scale]. From installers to system designers, these solar jobs have median wages of $20–$38 per hour, and will be available in rural, urban, and suburban areas," and "could result in a net benefit of over $1.6 billion annually from 2018 to 2030."

By scaling up renewable energy through a strengthened AEPS, Pennsylvania could create tens of thousands of new good-paying jobs. Since 2015, Environmental Entrepreneurs (E2) and the Keystone Energy Efficiency Alliance (KEEA) have released annual reports enumerating the

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[16] *See* Department of Environmental Protection, *Energy Assessment Report for the Commonwealth of Pennsylvania* (April 16, 2018). *See also Pennsylvania's Solar Future Plan: Strategies to Increase Electricity Generation from In-State Solar* (November, 2018), available at https://www.dep.pa.gov/Business/Energy/OfficeofPollutionPrevention/SolarFuture/Pages/Pennsylvania's-Solar-Future-Plan.aspx
[17] ***See*** *Pennsylvania's Solar Future Plan: Strategies to Increase Electricity Generation from In-State Solar, id.*
[18] *See* https://www.awea.org/Awea/media/Resources/StateFactSheets/Pennsylvania.pdf

Commonwealth's jobs in energy efficiency, renewable energy, battery storage, and clean vehicles. The 2018 *Clean Jobs Pennsylvania* report counted more than 8,500 renewable energy jobs.[19] But because Pennsylvania's renewable energy goals lag behind those of neighboring states, the state's job-creation rates also lag. For example, New Jersey and New York, which have both set goals to obtain 50 percent of their electricity from renewable sources, have 1,321 and 918 clean energy jobs per million residents, respectively. Pennsylvania has only 681 jobs per million residents.

At a House Committee hearing on April 8, one witness suggested to the Committee that because of the declines in renewable energy costs noted above, policies like the AEPS are no longer needed to drive growth in renewables. This is not true, at least in Pennsylvania.

Historically, the federal government and state governments have intervened liberally in energy markets "to develop public goods, such as national security and defense, to promote positive externalities, such as economic development within the United States and an expansion of power abroad, and to overcome market barriers, such as the high cost and financial risks of transporting remote natural resources to markets."[20] Although the oil and gas, coal, and nuclear industries would like us to believe that they have simply pulled themselves up by their bootstraps in free markets, they have benefited enormously from government assistance – far, far more than renewables have – and they continue to do so today.[21]

Given the urgent need to reduce greenhouse gas emissions, it is critical that states support energy resources that both create jobs and economic development *and* reduce these emissions – especially when wholesale energy markets inhibit those resources, as the markets run by the PJM Interconnection do. (These markets are described in the following section). While there is an argument for providing narrowly tailored, time-limited support to struggling nuclear plants in Pennsylvania so that they can be replaced by renewable energy, efficiency, or other low-carbon

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[19] *See* https://www.e2.org/wp-content/uploads/2018/06/Clean-Jobs-Pennsylvania-2018.pdf

[20] Tracey M. Roberts, "Picking Winners and Losers: A Structural Examination of Tax Subsidies to the Energy Industry," Columbia Journal of Environmental Law, Vol. 41:1 (2016), available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2657336

[21] *See, e.g.*, Gilbert E. Metcalf, "Ending Fossil Fuel Subsidies: Removing Tax Preferences for Domestic Oil and Gas Production," Kleinman Center for Energy Policy (April 27, 2017), available at https://kleinmanenergy.upenn.edu/policy-digests/ending-fossil-fuel-tax-subsidies. *See also* David Roberts, "Friendly policies keep US oil and coal afloat far more than we thought," available at https://www.vox.com/energy-and-environment/2017/10/6/16428458/us-energy-coal-oil-subsidies, and Doug Koplow, *Nuclear Power: Still Not Viable Without Subsidies*, Union of Concerned Scientists (2011), available at https://www.ucsusa.org/sites/default/files/legacy/assets/documents/nuclear_power/nuclear_subsidies_report.pdf

resources instead of natural gas-fired power plants without carbon capture technology, to ensure long-term emission reductions the Commonwealth must make stronger support for renewables the foundation of changes to the AEPS.

Pennsylvania's Competition Act and the Problem with PJM's Competitive Power Markets

The Electricity Generation Customer Choice and Competition Act of 1996 ("Competition Act," or "Act") may be Pennsylvania's most important energy law, and understanding it is critical to understanding why nuclear power is increasingly struggling in the Commonwealth. The Act also helps explain why so many new natural gas power plants are being built in Pennsylvania at a time when we should be decarbonizing our power sector.

The Competition Act "restructured" Pennsylvania's electric power industry by separating the generation and distribution of electricity into separate businesses. It was part of a wave of regulatory reform that sought to introduce competition in various utility functions after the end of the Cold War, following what was seen as the successful economic deregulation of many other industries, from airlines to telecommunications.[22]

Before the Act, Pennsylvania's electric utilities were "vertically integrated," meaning that they both (1) built and operated power plants and (2) distributed electricity to homes, businesses, and factories. Utilities had a monopoly on both functions (subject to oversight by the state Public Utility Commission, or PUC), and when a utility wanted to build a power plant, it had to get approval from the PUC. The point of PUC review was to ensure that construction of the plant was "prudent," since the cost of building the plant would be reflected in the price of the utility's electricity, and customers had no choice but to buy that electricity.

The Competition Act was based on the premise that while electricity *distribution*—essentially, building and operating poles, wires, and substations—is a "natural monopoly" that can be performed most efficiently by one company under PUC supervision, a competitive market could be established for electricity *generation*, and that this would lead to increased efficiency (i.e., lower prices for consumers). Accordingly, the Act made three major changes to Pennsylvania's electricity system.

[22] Borenstein and Bushnell, "The U.S. Electricity Industry After 20 Years of Restructuring," National Bureau of Economic Research (April, 2015), available at https://www.nber.org/papers/w21113.pdf

First, the Act forced utilities out of the generation business, requiring them to spin off their power plants and become "electricity distribution companies," or EDCs. Today, the job of Pennsylvania's EDCs is to maintain distribution infrastructure, design rates, manage bills, and run assistance programs for Pennsylvania's many payment-troubled customers, as well as programs to help customers use energy more efficiently. These functions are supervised by the PUC.

Second, the Competition Act created a "retail" electricity market where customers can choose to buy electricity generation from any qualified "electric generation supplier" (EGS), and EGS (including both companies that own power plants and marketers that buy power and re-sell it to customers) are allowed to market different generation "products" to customers. When customers don't shop, "default suppliers" (usually EDCs) buy electricity for them under rules established in the Competition Act.

Third, the Competition Act effectively outsourced planning for Pennsylvania's electricity generation sector to the markets designed and run by Montgomery County-based PJM Interconnection, LLC. PJM is authorized under The Federal Power Act to act as a "regional transmission organization" for the Mid-Atlantic United States, which essentially means that it manages the electricity system and ensures the system's reliability. PJM does this in part by creating and designing "wholesale" electricity markets where electricity is sold as a commodity. These markets determine what power plants are generating electricity at any given time, as well as the price of that electricity.

The restructuring of Pennsylvania's power sector is sometimes described as "deregulation," but that is a misnomer. Before the Competition Act was enacted, Pennsylvania's power sector was regulated by the PUC under laws passed by the General Assembly. Now the power sector is regulated by market rules adopted by PJM and approved by the Federal Energy Regulatory Commission (FERC). PJM, a limited liability company, designs the rules for its markets based on input from its members, most of which are companies that participate in the markets. (The members of an LLC are roughly equivalent to shareholders of a corporation). The Commonwealth of Pennsylvania is not a member of PJM, and the General Assembly has no voice in the design of PJM's markets. Pennsylvania's only formal engagement at PUC is through the Organization of PJM States (OPSI), which itself is not a member of PJM, only a "stakeholder."

The struggles of nuclear power to remain economical in Pennsylvania are largely due to a profound design flaw in PJM's markets: they do not account for the climate impacts of carbon pollution from power plants that burn coal and gas. (While coal produces more carbon pollution than gas, gas-fired power plants emitted 24.20 million tons of carbon dioxide in Pennsylvania in 2015, and several new gas plants have been built since then). If the markets did price carbon pollution—something that PJM has begun to explore but has never acted on—companies emitting it by burning coal and gas would have to pay for it. That would make non-emitting power sources, including both renewables and nuclear, more competitive.

Carbon Limits and Pricing: A Market-Based Approach to Help Fix Pennsylvania's Power Sector

At the Committee's hearing on April 8, one witness suggested that it was time for a "conversation" about carbon pollution. In fact, though, a conversation has been happening for years – and it has increasingly pointed in the direction of using market mechanisms to cap and price carbon emissions from the power sector and create a more level playing field between generation sources that emit carbon pollution and those that do not. In part, the current struggles of the state's nuclear plants can be attributed to Pennsylvania's not having adopted such a mechanism to date. We respectfully suggest that the General Assembly consider immediate action to do so now.

Over the last 125 years, Pennsylvania has developed or embraced a number of innovative policies to solve environmental problems. For example, in 1901, after clear-cutting of the state's vast hardwood and Hemlock forests led to a succession of floods and fires (which in turn resulted in human casualties and property damage),[23] the General Assembly responded by creating the Department of Forestry (now the Department of Conservation and Natural Resources), to bring the land back to productive use and protect watersheds. Today, according to a recent Penn State study for the Center for Rural Pennsylvania, the total estimated annual expenditures associated

[23] "For this industrial progress [brought by the lumber trade], the commonwealth paid an exorbitant and ruinous price. In their wake, the loggers left vast acreages of devastation. All cutover land, strewn with waste tree limbs, bark, and unwanted logs, was dry and inflammable. Fires swept over the mountains, destroying timber, creating soil erosion, silting streams, and causing incredible destruction to what we today recognize as the ecosystem. So ravaging were these forces of cutting and burning that millions of acres of once productive and beautiful sylvan landscape became acres of desolation. Joseph Trimble Rothrock called this area 'the Pennsylvania Desert.'" Henry Clepper, "Forest Conservation in Pennsylvania: the Pioneer Period, from Rothrock to Pinchot," available at https://journals.psu.edu/phj/article/viewFile/24211/23980

with state forest visitation are nearly $400 million (a figure that does not include expenditures associated with state park visits).[24]

More recently, during the 1980s Pennsylvania had the worst acid rain in the U.S.[25] because of sulfur dioxide pollution from coal-fired power plants – a problem both for the health of the state's rebuilt forests and the trout population of its streams. President George H.W. Bush proposed the nation's first major market-based environmental law, a cap-and-trade program, and Pennsylvania embraced this program. It was a huge success, cutting emissions faster and cheaper than expected. [26]

The acid rain program is just one example of how, when legally binding, declining limits are placed on pollution and environmental costs are priced into markets, the markets work to reduce emissions. In short, send a strong and clear signal to a sector that it should move in a direction and the market responds through innovation to get there. Do nothing, and the unsustainable status quo will persist.

This is a lesson that Pennsylvania can apply to carbon pollution from its power sector and, in the process, both help the economics of its nuclear plants and create a revenue stream that the General Assembly can use to help Pennsylvanians.

One approach that Pennsylvania could take would be to join – or simply link to – the Regional Greenhouse Gas Initiative, or RGGI (pronounced "Reggie"), a market-based, cap-and-invest program to cut carbon pollution from power plants that launched in 2009. RGGI's members currently include Delaware, Maryland, New York, and the six New England states. New Jersey is in the process of joining RGGI, and Virginia is preparing to link to RGGI's trading markets (both states are far along in their regulatory processes, and will be part of RGGI by next year, January 1, 2020).

The "cap" part of RGGI is a regional limit on carbon emissions from the power plants of participating states. The cap is determined by negotiation among the RGGI states, then lowered by 3 percent annually. The "invest" part starts with the fact that power plants under RGGI must

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[24] Ran, Hafer, et al. "An Economic Evaluation of the State Forest System" (December, 2018), available at http://www.rural.palegislature.us/documents/reports/State-Forest-Economic-Eval-2018-print.pdf
[25] New York Times, "Rain in Pennsylvania Found Most Acidic" (January 3, 1989), available at https://www.nytimes.com/1989/01/03/science/rain-in-pennsylvania-found-most-acidic.html
[26] Joe Goffman, "What Environmental Protection Owes to George H.W. Bush," available at https://eelp.law.harvard.edu/2018/12/what-environmental-protection-owes-george-h-w-bush/

purchase one "allowance" for every ton of carbon that they emit. RGGI creates allowances in a number equal to the number of tons in the regional cap, then auctions the allowances to power plants (and other parties who wish to buy them). The auction proceeds are then returned to states to be invested in various beneficial purposes, including energy efficiency, renewable energy projects, and bill rebates for consumers.

RGGI gives the power sector flexibility to achieve the required emissions reductions efficiently. After allowances have been auctioned, they can be traded among power plants and third parties on secondary markets. This maximizes the economic efficiency of RGGI by incentivizing emission reductions where they are most cost-effective. The result? Delivering pollution reductions at a lower cost to consumers while jumpstarting investment in the transition to a clean energy economy.

RGGI also makes generating resources that do not emit carbon pollution – including both nuclear power and renewables like wind and solar – more competitive in power markets by increasing the price of resources that do emit carbon more expensive. And it raises revenue for states. Since 2009, RGGI states have received more than $3 billion from the auction of allowances. They have invested these monies in their local economies in the form of (among other things) energy efficiency programs and measures, renewable energy projects, bill assistance for consumers, and education and job training programs.[27] According to the most recent evaluation of RGGI's economic impacts, from 2015 to 2017 the RGGI program led to $1.4 billion (in net present value) of net positive economic activity in the nine-state region.[28] And that is on top of nearly $3 billion in net economic benefits from RGGI's first six years.[29] This bears emphasis: these states have slashed power plant pollution *while growing their economies, maintaining a reliable electric sector, and capturing an increasing market share of the burgeoning clean energy economy.*

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[27] Analysis Group, *The Economic Impacts of the Regional Greenhouse Gas Initiative on Nine Northeast and Mid-Atlantic States: Review of the Use of RGGI Auction Proceeds from the Third Three-Year Compliance Period (2015-2017)*, (April 17, 2018), available at https://www.analysisgroup.com/globalassets/uploadedfiles/content/insights/publishing/analysis_group_rggi_report_april_2018.pdf

[28] *Id.*

[29] Analysis Group (2015), *The Economic Impacts of the Regional Greenhouse Gas Initiative on Nine Northeast and Mid-Atlantic States: Review of the Use of RGGI Auction Proceeds from the Second Three-Year Compliance Period (2012-2014)*, https://www.analysisgroup.com/globalassets/uploadedfiles/content/insights/publishing/analysis_group_rggi_report_july_2015.pdf; Analysis Group (2011), *The Economic Impacts of the Regional Greenhouse Gas Initiative on Ten Northeast and Mid-Atlantic States: Review of the Use of RGGI Auction Proceeds from the First Three-Year Compliance Period*, https://www.analysisgroup.com/globalassets/uploadedfiles/content/insights/publishing/economic_impact_rggi_report.pdf

RGGI, then, is a very different value proposition from HB 11. As with HB 11, Pennsylvania's joining RGGI would have the effect of raising electricity rates (though probably less). But unlike HB 11, RGGI would return a significant amount of money to the Commonwealth to be used for beneficial purposes, including not only clean energy investments but also potentially aiding in worker and community transitions where plants retire. By investing RGGI revenues in efficiency programs that enable consumers to use less energy, Pennsylvania could also save consumers money on their overall electricity bills.[30] Moreover, because around 30 percent of the electricity generated in Pennsylvania is exported to – and paid for by – other states, RGGI auctions would effectively *import* money from those states to Pennsylvania.

RGGI is not the only market-based system that Pennsylvania could use to make the operation of PJM's competitive power markets fairer in the Commonwealth. But it is ready-made program with a proven track record. And this is a propitious time to join RGGI, because PJM recently announced plans to study carbon pricing in an effort to better reflect states' policy priorities in its markets.[31] This is critical, because if Pennsylvania were to adopt carbon pollution limits and price that pollution, PJM has already begun exploring mechanisms by which they could adjust wholesale electricity prices at the border and thereby mitigate market distortions that might otherwise result. With Pennsylvania pricing carbon—and teaming with New Jersey, Delaware, Maryland, and Virginia—a compelling case could be readily made to PJM to go beyond the exploratory stage and actually begin analyzing different options that could be implemented.

Chairman Roae, Chairman Matzie, thank you again for the opportunity to testify on HB 11 and the important energy policy issues facing Pennsylvania today. I would be happy to answer any questions you may have.

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[30] For example, according to data from the current RGGI states, investments made under RGGI through 2016 have already saved consumers more than $900 million on their energy bills, and energy efficiency and other clean energy measures that have already been installed under RGGI will ultimately save consumers more than $9 billion on their energy bills. *See RGGI, Inc. (2018), Investment of RGGI Proceeds in 2016,* www.rggi.org/sites/default/files/Uploads/Proceeds /RGGI_Proceeds_Report_2016.pdf; RGGI, Inc. (2017), Investment of RGGI Proceeds in 2015, www.rggi.org /sites/default/files/Uploads/Proceeds/RGGI_Proceeds_Report_2015.pdf; *RGGI, Inc. (2016), Investment of RGGI Proceeds Through 2014,* www.rggi.org/sites/default/files/Uploads/Proceeds/RGGI_Proceeds_Report_2014.pdf.

[31] *See* PJM Interconnection Issue Charge, "Carbon Pricing in the PJM Energy Market" (March 21, 2019), available at https://pjm.com/-/media/committees-groups/committees/mrc/20190321/20190321-item-08-carbon-pricing-issue-charge.ashx

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ISSUE BRIEF

TRANSITIONING AWAY FROM UNECONOMICAL NUCLEAR POWER PLANTS

PROTECTING CONSUMERS, COMMUNITIES, WORKERS, AND THE ENVIRONMENT

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Some states are considering financial support for struggling nuclear plants as policymakers worry that abrupt closure of these power plants will lead to increased carbon emissions and the loss of jobs and tax revenues. If state leaders decide to provide subsidies, it is imperative that they also enact policies to accelerate a truly clean energy future based on efficiency and renewables. So, states providing aid must also:

- **Cap carbon pollution and scale investment in energy efficiency and renewable energy**
- **Assure best practices for waste management and plant closures**
- **Retrain or compensate workers and support new economic development plans for affected communities**
- **Limit the length and the amount of the aid**
- **Mandate that companies show their books to prove the plants are in severe financial distress**

Most nuclear power plants in the U.S. were built before 1990 and are scheduled to reach the end of their operating licenses by 2050. But across the country nuclear plants are facing abrupt closure on economic grounds, especially in competitive wholesale electricity markets that do not put a price on carbon pollution. Many states are concerned about the climate impacts if nuclear power is replaced by fossil fuel generation and about the loss of jobs and the local tax base that nuclear plants provide. Some states have already developed plans for an orderly transition away from nuclear power. Others are weighing options, including direct financial support to nuclear facilities to delay closure. This issue brief outlines key considerations for states seeking to transition away from nuclear power in a manner that is consistent with the urgent need to decarbonize the U.S. economy.

Experience in five states grappling with the potential closure of nuclear plants—California, New York, Illinois, Connecticut, and New Jersey—makes clear that any financial support should be predicated on a showing of financial distress, narrowly tailored, and phase out at a firm date in the future. When providing aid, policymakers must also enact a cap on carbon, drive investment in energy efficiency and renewable energy, assure best practices for management of the radioactive waste and support the workers and local communities.

THE ROLE OF NUCLEAR POWER IN ADDRESSING CLIMATE CHANGE

Although nuclear power has beneficial low-carbon attributes, it also has significant safety, global security, environmental, and economic risks. Until these risks are properly mitigated and the complete nuclear fuel cycle is sufficiently regulated—from the mining and milling of uranium, through mitigating the risk of severe nuclear accident during reactor operations, to the final disposal of radioactive wastes—nuclear power should not be a leading strategy to diversify America's energy portfolio and reduce

For more information, please contact:
Dale Bryk, dbryk@nrdc.org
Jackson Morris, jmorris@nrdc.org

www.nrdc.org/policy
www.facebook.com/nrdc.org
www.twitter.com/nrdc

carbon pollution. NRDC's 2017 report, *America's Clean Energy Frontier: The Pathway to a Safer Climate Future*, sets forth an economically and environmentally sustainable strategy for cutting carbon emissions 80 percent by 2050. The strategy includes dramatic improvements in energy-efficiency across all sectors, a 13-fold increase in wind and solar energy, and the electrification of our vehicles, industrial processes, homes, and offices. If the U.S. follows this path, which we can do economically and with existing technologies, we can achieve an 80 percent reduction in greenhouse gas emissions by 2050, with a decline of nuclear power from 20 percent of our generation mix today to less than 3 percent.

BEST PRACTICES FOR NUCLEAR TRANSITIONS

As America's nuclear plants age, reach the end of licenses or license extensions, or become increasingly uneconomical in today's wholesale electricity markets, an increasing number of reactors are likely to be retired. A well-planned, systematic transition is critical to: ensure that clean, renewable and more cost-effective alternatives replace the plants; that carbon emissions do not increase; and avoid detrimental impacts to workers and to host communities that rely on nuclear facilities for their tax base. Short-term, narrowly tailored financial support for existing nuclear facilities that demonstrate severe financial distress may make sense in some cases, provided it is tied to robust efforts to ensure an orderly transition.

California, New York, Illinois, New Jersey and Connecticut have taken steps to avoid the abrupt closure of nuclear plants with varying degrees of success. The states developed these policies for a variety of reasons, including avoiding backsliding on efforts to meet state greenhouse gas reduction goals, protecting jobs, and preserving an important source of tax revenue for local communities. Their experience reveals the following best practices for transitioning away from nuclear power:

Showing of severe financial distress. Financial support for a nuclear facility can be considered if the owner can demonstrate that it will close the plant absent such support: reduced profitability is not sufficient. In New York and Illinois, plant owners filed notice of closure and opened their books to state regulators.

Narrowly tailored support. The financial support needed to extend operation of a plant should depend on wholesale electricity market prices, as well as any carbon price, and should be adjusted accordingly to avoid a windfall to shareholders at the expense of consumers. New York has a mechanism to adjust the value of nuclear subsidies biannually to reflect wholesale market and carbon price fluctuations; Illinois adjusts its nuclear subsidy to reflect wholesale market changes, ties the value of the subsidy to the Environmental Protection Agency's Social Cost of Carbon, and caps the overall cost of the subsidies.[1]

Time limits. The purpose of subsidizing existing nuclear plants is to create the time needed to plan for an orderly transition to clean energy, while taking into account the workers and surrounding community: there is no public policy justification for indefinite support. In New York the transition period extends to 2030; in Illinois the payments are structured as 10-year contracts.

Figure I: The Trend and Changing Source Mix of Electricity from 2015 to 2050, in the NRDC Pathways Core Scenario

Electricity is shown in terawatt-hours (TWh). 1 TWh is enough to meet the annual electricity needs of 96,000 households (2014 data). 1 exajoule (EJ) = 277.8 TWh

Cap on carbon emissions. The legal basis for financial support for nuclear power is the state's interest in the emission benefit, which is not otherwise recognized in wholesale or retail electricity markets. States should demonstrate the seriousness of this interest by coupling any financial assistance program for nuclear power with a cap on carbon emissions, similar to the one that Northeast and Mid-Atlantic states have adopted with the Regional Greenhouse Gas Initiative (RGGI).

Scaling energy efficiency and renewable energy. From an environmental perspective, any justification for subsidizing existing nuclear plants is to provide the time needed to scale up clean energy, e.g. energy efficiency and renewable energy. If zero-emission nuclear facilities abruptly retire, the near- to medium-term outcome can be increased generation and emissions from nearby coal, oil, and natural gas plants.

Maintaining the integrity of efficiency and renewable policies. States should not allow funds intended to drive investment in energy efficiency or renewables to be siphoned for nuclear subsidies, and nuclear generation should not "count" toward a state's renewable energy targets. This would undermine the goal of scaling up those very resources. In California, the retirement and replacement legislation calls for additional investment in efficiency, wind, solar and other zero-carbon replacement resources. New York's utility commission adopted a "zero-emission credit" mechanism to support existing nuclear plants in conjunction with a legally binding program to scale up renewable resources to meet 50 percent of the state's electricity demand by 2030 (nearly doubling its current renewable energy supply); nuclear generation will not count toward that target. Illinois's legislation provided more than twice the value of its nuclear support to kickstarting efficiency and renewables.[2]

Waste management, decommissioning, and plant autopsies. While the federal government has jurisdiction over the safety of nuclear plants, states have a strong interest in reducing the cost and land use impacts of nuclear plant operation and waste management. States should condition any financial support for nuclear power upon an enforceable agreement by the plant owners to transfer the current inventory of spent nuclear fuel in pools to dry cask storage; to continue transfer of any newly generated spent nuclear fuel in the pools to dry cask storage within a specified period of time from its removal from the reactor core; to initiate immediate, near-term decommissioning of any eligible nuclear plant; and to conduct an autopsy of the reactor core and environmental radiation surveys within a specified period of time following plant closure.

Worker transition. Nuclear plants typically employ several hundred to more than 1,000 people. Some employees can transition to the work of decommissioning when a plant closes, a process best begun immediately after nuclear plant closure employing workers with knowledge and experience of the plant being decommissioned. Plant owners can also transfer workers to other facilities within their companies, as Entergy is considering doing for up to 180 employees at its Palisades nuclear plant.[4] The California proposal includes provisions for worker retention, retraining and compensation; the New York and Illinois policies do not, although the Illinois legislation does provide $30 million for broader job-training programs, and New York has an existing clean energy, job-training program.[5]

Community transition. Many communities with nuclear power plants rely on them for a substantial portion of their tax base. A scheduled transition provides time to develop plans to attract new businesses to the area to replace lost tax revenue. States can also provide direct support for a glide path to new economic development, as Entergy is doing in southwest Michigan,[6] and as Massachusetts did for the towns of Somerset and Holyoke in connection with

ZERO EMISSION CREDITS AND WHOLESALE POWER MARKETS

Nuclear plants do not provide any unique resilience, reliability or fuel diversity benefits.[3] On the contrary, inflexible nuclear power plants are increasingly out of step with a dynamic modern power grid that requires flexibility to efficiently balance fast-changing supply and demand. The sole beneficial attribute of nuclear power is the generation of low-carbon electricity. The purpose of ZECs is to assign a monetary value to this attribute that wholesale power markets fail to provide, just as the purpose of Renewable Energy Credits (RECs) is to monetize the value of carbon-free electricity from renewables. In recent years, low natural gas prices and a stunning growth in wind and solar generation have driven down the cost of wholesale electricity generation. In response, coal and gas plant operators are trying to raise prices by securing changes to electricity markets, especially those run by PJM in the Mid-Atlantic region. This campaign has targeted state RECs and ZECs as price-distorting subsidies, while conveniently ignoring the market failures—externalized environmental costs—that have prompted states to adopt these measures, as well as many subsidies that benefit fossil fuels (such as those embedded in the tax code). Luckily, a series of court decisions have upheld the right of states to provide this support. PJM has proposed changes to its "capacity market" that would undermine the ability of states to use RECs and ZECs to promote lower-carbon electricity. All states, and especially those that within PJM, must actively engage with wholesale market operators to protect their rights and prevent such operators from infringing on their ability to set public policy.

the closure of local coal plants.[7] The California proposal includes provisions for community compensation; the New York and Illinois policies do not, although New York has a statute to provide temporary transitional tax base relief to communities that face the retirement of power plants. When nuclear facilities retire, those communities may apply for such relief.[8]

STATE APPROACHES TO NUCLEAR TRANSITIONS

California

In June 2016, Pacific Gas & Electric, along with labor and environmental organizations, announced the Diablo Canyon Joint Proposal,[9] a historic commitment to the orderly phase-out of California's last nuclear power plant by 2025 and replacement of its electric generating capacity with lower-cost, emissions-free options including energy efficiency, and wind and solar power. In September 2018, California Gov. Jerry Brown signed into law SB 1090, which mandated full implementation of all remaining provisions in the Joint Proposal. The plant is now scheduled to close by August 2025. Had the two reactors been relicensed, they could have operated an additional 29 to 49 years.

Due to its enormous size and lack of flexibility in operation, Diablo Canyon increasingly is an obstacle to adding clean generation and displacing natural gas, which also adds to greenhouse gas emissions. Removing Diablo Canyon will open space for new, less costly renewable resources, and increased generation from renewables already on the system. In addition, Diablo Canyon is located near earthquake fault lines: by shortening the life of the plant, the proposal substantially reduces the risk of catastrophic earthquake damage to an operating nuclear facility.

The retirement plan for Diablo Canyon does not include any financial subsidy for the facility. Rather, it directs an orderly and just transition, including support for workers and host communities, leading to closure of the plant in order to avoid more costly upgrades that would be required with relicensing. PG&E has estimated that costs to refurbish and operate the plant would more than double to more than 10 cents per kilowatt-hour (kWh) after 2025, and that a portfolio of energy efficiency, renewable energy, and other zero-carbon measures would cost substantially less. NRDC has estimated the savings at more than $1 billion, which exceeds the cost of the community and worker compensation that were also integral to the Joint Proposal.

New York

In August 2016, the New York Public Service Commission adopted the Clean Energy Standard (CES), which includes a zero-emission credit (ZEC)—the first carbon emissions credit created exclusively for nuclear power.[10] This was done to avoid the premature closure of three upstate facilities: James A. FitzPatrick Nuclear Power Plant, Ginna Nuclear Power Plant, and Nine Mile Point Nuclear Generating Station. These plants had already been relicensed; the current licenses expire in 2034, 2029 and 2029, respectively, providing sufficient time to develop a cost-effective plan to replace them with energy efficiency and renewable energy.

However, the New York Public Service Commission determined that the plants were at risk of abruptly retiring because they were uneconomical under current market conditions. Agency staff reviewed financial data and tax filings for the plants, which made clear that they had been in financial distress over a number of years.[11] For the near- and medium-term, closures would have led to increased generation from polluting sources like oil and natural gas because it takes time to scale up and integrate sufficient renewable resources and energy efficiency into the electric grid.

New York is in the process of implementing its CES, which requires utilities and other electricity providers to deliver 50 percent of their electricity from renewable energy sources by 2030. The ZEC program, which requires electricity providers to purchase credits from the upstate nuclear power plants until 2030, is structured as a component of the CES, but is entirely separate and distinct from the renewables program. The Public Service Commission will undertake a public biennial review of the ZEC program to make any necessary adjustments. Not a single megawatt hour of electricity generated from nuclear facilities will count toward the renewables target.

A NOTE ON INDIAN POINT

The troubled and aging Indian Point Energy Center, a 2,000 MW two-unit facility on the Hudson River, is not included in New York's ZEC program. The state has negotiated an agreement to shut down the facility, based in part on its proximity to New York City—making emergency evacuation all but impossible—and the decades-long series of safety and operational problems that have plagued the plant.

Under the agreement, Indian Point's remaining Unit 2 reactor will close in 2020 and Unit 3 in 2021. The agreement does not specify a plan for replacement power, but Gov. Andrew Cuomo has made a commitment that the closure will not cause an appreciable increase in carbon emissions.[12] If New York implements a sufficiently strong energy efficiency portfolio on par with its ambitious requirement to scale up renewable energy to 50 percent by 2030, and follows through on the state's efforts to bolster the transmission grid, the governor can deliver on this commitment.[13]

In addition, New York is part of the nine-state Regional Greenhouse Gas Initiative, which caps carbon emissions in the power sector. The recently strengthened program requires regional emissions to decline by 3 percent annually from 2021 to 2030, on the basis of modeling that assumes the retirement of Indian Point in accordance with the agreement.

Illinois

In December 2016, the Illinois General Assembly passed the Future Energy Jobs Act.[14] The legislation includes direct financial support for the Clinton Nuclear Generating Station and Quad Cities Nuclear Generating Station in the form of zero-emission credits, but that support is narrowly tailored. It was issued in the form of a 10-year contract, and was contingent on a showing by Exelon, the plants' owner, that the facilities were no longer economically viable. Exelon had previously filed notice with the Illinois Public Utility Commission of its intent to shutter the facilities. Analysis also showed that absent this legislative package, increased generation from coal and natural gas facilities would have been required to meet the electricity demand served by the nuclear plants.

Illinois's decision to provide financial support for these nuclear plants was made in the context of a state clean energy policy badly in need of reform. The state had been a clean energy leader, having built the second-largest number of wind turbines in the nation by 2012. But in the intervening years prior to passage of the Future Energy Jobs Act, wind development in the state had ground to a halt due to structural issues with its the Renewable Portfolio Standard that prevented the procurement of renewables through long-term contracts. Similarly, the state's Energy Efficiency Portfolio Standard had been failing to achieve its original policy goals by a wide margin, in large part due to a cost cap that limited utilities' spending even if additional investments would have been cost-effective.

The 2016 legislation remedied these flaws in the state's clean energy policies, and with implementation now underway Illinois is set to be a leader in energy efficiency programming, in utility-scale renewable energy development, and—thanks to the Illinois Solar For All and Community Solar programs—in providing local communities and low-income populations equal access to the benefits of clean energy.[15]

Connecticut

In October, 2017, Connecticut enacted SB1501, "An Act Concerning Zero Carbon Solicitation and Procurement,"[16] directing agencies to solicit power agreements from Dominion Energy Inc.'s Millstone plant, the state's sole nuclear facility, as well as Class I renewable resources and hydropower. The law permits, but does not require, such agreements.

Pursuant to SB1501, the Public Utilities Regulatory Authority is currently considering whether Millstone is at risk of closure before its operating license expires. If it is found "at risk," the Connecticut Department of Energy and Environmental Protection (DEEP) would allow Millstone to be compensated for its environmental and reliability attributes in the solicitation for zero-carbon generating resources, which would allow it to command higher prices than the wholesale market. The solicitation is limited to up to 12 million megawatt-hours of energy annually, in the aggregate; any proposal selected would result in purchase agreements with the state's utilities. Dominion contends that without the higher zero-carbon market prices it would prematurely retire the two reactors at the plant.

As of the time of this writing, DEEP has determined that Millstone may be "at risk" of closing after June 2023 without additional financial support, while the Public Utilities Regulatory Authority is still evaluating the economic viability of the plant.

New Jersey

In June 2018, New Jersey adopted a Zero Emission Credit program to prop up the struggling Salem and Hope Creek nuclear generating facilities.[17] The plant owners must open their books to the state Board of Public Utilities, which will issue ZECs upon a finding of financial distress. The legislation balances concerns about consumer impacts by setting a fixed ZEC value of approximately $10/Mwh, substantially below the values set in New York and Illinois.

NUCLEAR POWER BASICS

Nuclear power represents 19.7 percent of all U.S. electricity production (and 11% of production worldwide), and the U.S. nuclear plant fleet comprises 99 reactors at 61 facilities across 30 states.[18] Most of the plants were designed and constructed in the 1960s and 1970s and almost all reach the end of their 60-year operating licenses in the 2030s and 2040s. A portion of these reactors are at risk of closing well before their license end dates because they are no longer economical and cannot compete in the marketplace, often because of the low price of natural gas and renewable energy and in some cases due to the need to replace expensive major components.

Nuclear power's beneficial low-carbon attributes are important to consider in a warming world but we must take seriously the significant safety, global security, environmental, and economic risks that this technology imposes on society. This reality demands stringent regulation of the complete nuclear fuel cycle, beginning with the mining and milling of uranium and ending with the final disposal of radioactive wastes. The 2011 Fukushima nuclear disaster in Japan, the worst since Chernobyl, illustrates some of these risks. Until these risks are properly mitigated, expanding nuclear power should not be a leading strategy for diversifying America's energy portfolio and reducing carbon pollution. More practical, economical, and environmentally sustainable approaches to reducing U.S. and global carbon emissions are available, including the widest possible implementation of energy efficiency throughout the economy, and the adoption of policies to accelerate the commercialization of clean, flexible, renewable energy technologies.

However, it does not include the sunset provisions adopted by those states. The New Jersey law also directs plant owners to develop plans "to retain, retrain, or compensate personnel whose employment would be eliminated as a direct result of the cessation of the selected nuclear power plant's operations" and to pursue "alternative economic development" for those communities.

New Jersey is the first state to consider the expedited transfer of nuclear waste to dry cask storage in the context of a ZEC program, directing plant owners to study and report on the optimal use of such storage "considering environmental impacts, worker safety, and cost impacts."

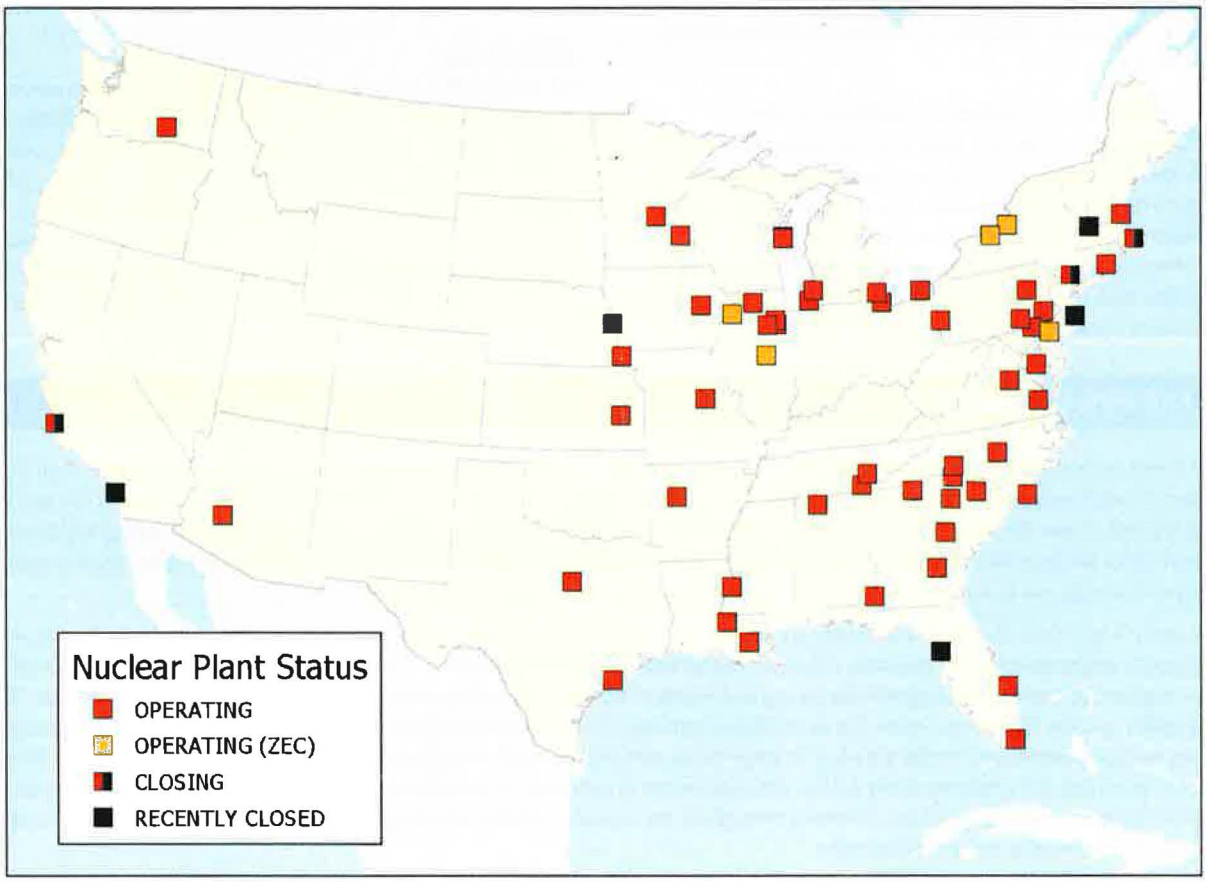
Simultaneously, New Jersey adopted a Clean Energy Law that directs utilities to deliver annual energy efficiency savings of at least 2 percent (0.75 percent for natural gas); increases the Renewable Portfolio Standard to 50 percent by 2030; overhauls the state's costly and volatile solar incentive program and expands it to include community and utility-scale solar; requires investment in 2000 MW of energy storage; and codifies Gov. Phil Murphy's commitment to invest in 3500 MW of offshore wind.[19]

NEW NUCLEAR PLANTS

Despite perennial talk of a "nuclear renaissance" by industry advocates, the nuclear sector has been plagued by poor economics and renewed concern about nuclear safety following the Fukishima disaster. There are currently only two nuclear reactors under construction in the U.S., both at the troubled Vogtle project in Georgia. The costs of that project keep increasing, and are now estimated to top $25 billion, in part because of delays in construction tied to the bankruptcy of nuclear supplier Westinghouse. Southern Co., the plant's primary owner, scrambled to avoid having its partners withdraw from the project in late October and had to accept greater responsibility for any future cost overruns. A similar project under construction in South Carolina, V.C. Summer, was scrapped by that state last year as costs skyrocketed. No other applications are pending to build a new reactor.

The future of nuclear energy in the United States is uncertain. Entrepreneurial projects promoting alternate reactor designs such as small modular, molten salt, liquid metal, high-temperature gas-cooled and pebble bed

Figure: Recent and announced nuclear plant closures, and nuclear plants receiving ZEC subsidies



reactors currently lack data from a design prototype by which to rigorously evaluate their safety, reliability, and economics. The recent fate of the nuclear start-up company Transatomic Power is a cautionary tale: this alternate reactor design, once heralded as an important tool to mitigate climate change, was instead exposed as based on engineering miscalculations, and the company folded.[20]
To the extent that new nuclear reactor design projects go forward with public money, NRDC has five prescriptions for such federal programs: give priority to solving the nuclear waste problem; learn from mistakes in recent nuclear construction; consistently apply a nuclear weapons proliferation test to advanced nuclear designs; consider the full impacts of the nuclear fuel cycle associated with advanced nuclear reactors, including severe accidents; and get clarity on the economic competitiveness for advanced nuclear designs early on.[21]

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