TESTIMONY OF THE NATURAL RESOURCES DEFENSE COUNCIL

Daniel J. Sawmiller, Ohio Energy Policy Director

on Substitute House Bill 6

Before the Senate Energy and Public Utilities Committee

Columbus, Ohio

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Chairman Wilson, Vice-Chair McColley, Ranking Member Williams and Members of the Senate Energy and Public Utilities Committee, thank you for inviting me to comment on Substitute House Bill 6.

My name is Dan Sawmiller and I am the Ohio energy policy director for the Natural Resources Defense Council (NRDC), a member-based non-profit environmental organization with more than 52,000 members and activists in Ohio. 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 Ohio laws and policies that reduce emissions of greenhouse gases and other air pollutants while creating 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 Sub. HB 6;
2. Explains how Sub. HB 6 falls short of those best practices;
3. Discusses the state of renewable energy in the U.S. and in the state of Ohio, and Ohio's Alternative Energy Portfolio Standards enacted in 2008 (AEPS);
4. Details the importance of Ohio's energy efficiency programs and the Energy Efficiency Resource Standard;

1. NRDC's Position On Nuclear Power And Nuclear Subsidies

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 that includes efforts to scale up energy efficiency and renewable energy.

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]

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

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 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 policymakers should also support the 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 – Ohio, the United States, and the 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. This requires us to achieve net-zero carbon emissions by

[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 ºC*, available at https://www.ipcc.ch/sr15/.

2050. We are not on track to do that. While emissions fell in the United States between 2013 and 2017, emissions actually rose in 2018 by 1.9 percent in the power sector and 3.4 percent on an economy-wide basis. This spike was caused by two primary things (1) extreme weather: a relatively cold winter in 2018 led to a spike in the use of oil and gas for heating in areas like New England and (2) economic growth: the U.S. economy grew at a strong pace and as a result, electricity demand from factories, mills, planes and trucks soared with natural gas generation meeting the increased demand which lead to an increase in carbon emissions.[4]

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 the United States to make dramatic cuts in greenhouse gas emissions is to considerably 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.

2. NRDC's Opposition to Sub. House Bill 6

NRDC opposes Substitute HB 6 because the bill is at odds with NRDC's best practices in almost every respect.

Sub. HB 6 would effectively repeal Ohio's current Alternative Energy Portfolio Standard (AEPS) which requires electric distribution utilities (EDUs) and certified retail electricity suppliers (CRES), to buy 12.5 percent of the electricity they provide from renewable energy resources.

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[4] https://www.vox.com/2019/1/8/18174082/us-carbon-emissions-2018

[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.

Currently, the AEPS includes a 12.5% goal by 2027 to be achieved by qualifying renewable energy resources, along with biomass, landfill gas, coalbed methane, fuel cells, and biologically derived methane.[6] Solar energy has a 0.5% carve-out from this resource mix. EDUs and CRES providers comply with the AEPS by purchasing renewable energy credits (RECs), with each credit representing one megawatt-hour (MWh) of electricity generated by a qualified source. Since 2008, EDUs have been required to incrementally increase their purchases of RECs in accordance with inclining statutory goals. In 2027, these goals will plateau at 12.5 percent under current law.

The price of RECs is determined by markets where credits and credit futures are traded, and the costs of credits purchased by EDUs and CRES providers are passed on to consumers as a cost of electricity generation. RECs represent a revenue stream for prospective renewable energy projects that can, depending on the price, help them attract debt and equity financing. The Public Utilities Commission of Ohio (PUCO) recently reported that for the 2nd quarter of this year (2019), **AEPS compliance has cost residential customers an average of $0.52/month** across the state.[7]

In contrast, the so-called "Ohio Clean Air Program" (OCAP) envisioned by Sub. HB 6 would provide a payment of $9.00 for each MWh of electricity produced by the state's nuclear plants, which would provide non-incremental benefits to the state while scrapping both the RPS and EERS. The Ohio Air Quality Development Authority (OAQDA) would also qualify certain eligible solar projects who have already received a siting permit, setting an arbitrary deadline of June 1, 2019 for projects to qualify. OAQDA would select sources to receive credits until the fund is depleted. There are no clear goals established for emissions reductions (carbon or otherwise) and the amount of credits received, if any, is not market-based, and are subject to

[6] Ohio's AEPS previously totaled 25% by 2025 and included both a renewable energy commitment of 12.5% and an alternative energy commitment of 12.5%. 50 percent of compliance was also previously required to come from resources located inside the state. The 12.5% alternative standard has been repealed along with the in-state requirement, the annual benchmarks were "frozen" for two years, and an effective moratorium on wind development passed in 2014. All of these ongoing attacks on clean energy in Ohio have severely limited Ohio's progress in attracting renewable energy development.

[7] Note, this captures average compliance costs for the Ohio EDUs only, not the CRES suppliers. https://www.puco.ohio.gov/industry-information/industry-topics/ohioe28099s-renewable-and-advanced-energy-portfolio-standard/renewable-portfolio-standard-rate-impacts-2nd-quarter-2019/

significant change over time at the sole discretion of OAQDA. This lack of structure can be expected to make any potential credits unreliable and likely unfinanceable.

Even if a significant number of clean air credits ended up being available to renewables (though the bill is unclear on this), the OCAP would be unlikely to drive new renewable developments in the state as investors would heavily or completely discount these credits because of the speculative nature of them.

In addition to doing very little to incentivize renewables, Sub. HB 6 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. And while the bill seems to contemplate the benefits of reducing carbon pollution, Sub. HB 6 would not itself establish carbon limits. Nor would it increase energy efficiency goals, but instead would effectively repeal Ohio's overwhelmingly successful energy efficiency programs which, according to reports filed by Ohio's EDUs with the PUCO have saved customers more than $5.1B to date. A package of financial support for the state's nuclear facilities that does not also provide a policy pathway for future emissions reductions and economic development through wind and solar projects and energy efficiency misses the mark.

Sub. HB 6 also does not require a showing of severe financial distress. Clean air credits could be claimed by nuclear plants irrespective of their profitability. The absence of a means test in Sub. HB 6 is unacceptable, both as a matter of basic fairness and because many Ohioans currently struggle to pay their electricity bills in both urban and rural areas, making energy efficiency services critical for these families. This February, the Ohio Development Services Agency released its latest Ohio Poverty Report which shows that 1,583,000 people in Ohio were considered "poor" with 41 of Ohio's 88 counties above the national average. Nearly 25 percent of these families rely on some type of state assistance. 17.2 percent of the people in Appalachian Ohio were considered "poor" compared to the rest of the state averaging 14.4 percent over 5 years.[8] Indeed, parts of Ohio's Appalachian Region stand to economically benefit most from large-scale solar developments and this exciting opportunity can coexist with other policy goals.

To protect Ohioans from the worst impacts of climate change, provide low-cost and pollution-free power, and ensure sustainable economic growth, Ohio needs to make significant investments

[8] https://www.development.ohio.gov/files/research/p7005.pdf

in clean energy. But those investments must be equitable, and they must return long-term value. The proposed nuclear investments in Sub. HB 6 would do neither.

3. Renewable Energy in Ohio 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 Ohio has seen growth in renewable energy, it lags behind leading U.S. states. Consequently, while Ohio has created an impressive number of jobs in renewable energy thanks largely to its rich manufacturing community, it has largely failed to take advantage of the economic development and job creation that renewables are bringing to Ohio's neighboring states and other parts of the nation.

While a number of factors are driving renewables growth in the Midwest, policy action is one of the most critical. Consumer demand and other market forces have caused a precipitous drop in wind and solar costs in recent years. But renewable energy is picking up the most steam in states that are taking definitive policy action to ensure that wind and solar (and not natural gas-fired power) are available to fill the gap left behind from the waning era of coal-intensive power generation. Unfortunately, though, Ohio is not one of those states. The state has been fallow ground for renewable energy development in the last few years, lagging behind its neighbors.

Amidst lots of exciting progress in our region, Ohio's numbers unfortunately paint a decidedly different picture—one of relative stagnation on wind and solar development. Ironically, Ohio has led the region in carbon emissions reductions from its power sector over the last decade but is placing dead-last in the region for renewables in its overall generation profile (barely cracking 2 percent for wind generation). Ohio's emissions reductions reflect the steep decline of coal-fired power in the state. Unfortunately, natural gas-fired power plants—not renewables—are rapidly filling the gap left behind by coal. While natural gas is less carbon-intensive than coal, if left uncontrolled it is still a huge source of greenhouse gas emissions (from extraction, all the way through power production).

Ohio, its economy and its people, simply cannot afford to trade one all-in energy source (for the last century, coal) for another (natural gas).

We can produce clean renewable energy right here in Ohio.

It is clear that Ohioans are demanding more clean energy produced here at home. While the concerns around global warming are - by definition - "global", the impacts on Ohio's economy of the lack of renewable development are local. Further, the impacts of fossil fuel generation are felt locally, and moving our in-state electricity production toward clean, renewable sources is not only what Ohio's electricity customers want and what is best for Ohio's economy, but is imperative to reduce the health impacts caused by burning fossil fuels.

Over the last decade, prices for solar and onshore wind in the U.S. have fallen by 88 and 64 percent, respectively. In many 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. And in some parts of the U.S., building a new wind or solar project is cheaper than running an existing coal plant. In fact, 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.[9]

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.[10]

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[9] *See* https://energyinnovation.org/wp-content/uploads/2019/03/Coal-Cost-Crossover_Energy-Innovation_VCE_FINAL.pdf

[10] 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%

In 2014, the PUCO studied Ohio's AEPS for its impact on carbon emissions and wholesale electricity prices.[11] This report concludes that **"Ohioans are already benefitting from renewable resource additions through downward pressure on wholesale market prices and reduced emissions."** As the PUCO notes, the reduction in wholesale market prices can be considered a partial offset to the costs incurred by utilities to comply with the alternative energy

[11] http://www.ohiomfg.com/wp-content/uploads/2013-08-16_lb_energy_renewable_resource_and_wholesal_price_suppression.pdf

standards (currently averaging $0.52/month). The modeling done in this report also showed that the AEPS is successfully reducing carbon dioxide emissions.

As noted above, the AEPS currently has only a modest 12.5 percent goal. Within this 12.5 percent, there is a "carve-out" of one-half of one percent (0.5 percent) for solar photovoltaic (PV) electricity. RECs purchased to satisfy this demand can come from any state contiguous to Ohio.

Ohio has the potential to cost-effectively generate much greater amounts of renewable energy than this. In reviewing the siting cases before the Ohio Power Siting Board, Ohio has more than ten large-scale solar projects either approved for siting or have an application pending. These projects represent more than $3B in capital investments, thousands of jobs in areas of our state where new economic opportunities are needed most and millions of dollars each year in local economic benefits.

By scaling up renewable energy through a strengthened AEPS, Ohio could create thousands of new good-paying jobs. Since 2015, Environmental Entrepreneurs (E2) has released annual reports enumerating Ohio's jobs in energy efficiency, renewable energy, battery storage, and clean vehicles. The 2018 *Clean Jobs Ohio* report counted more than 14,000 renewable energy jobs.[12] It is important to note when reviewing this jobs number that - **of the more than 1,400MW of pending large-scale solar projects announced in the state - zero are operational.** Eliminating the state's AEPS as Sub. HB 6 would do, would put each of them at risk along with the significant job growth and local economic benefit they represent.

The bad news.

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 Ohio. Currently, renewables account for *less than three percent* of electricity generated in the state[13] and most of the new generation being built is natural gas-fired power.

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 Ohio's

[12] https://www.cleanjobsohio.org/

[13] https://www.puco.ohio.gov/be-informed/consumer-topics/how-does-ohio-generate-electricity/

competitive power markets, then enjoy handsome returns on their investment as gas prices rise, placing Ohio's electricity consumers at risk. But this growth in gas generation is also a function of the fact that Ohio's AEPS is too low (and has been under constant attack) and the lack of long-term contracting opportunities for low cost, fixed-price renewable energy purchase agreements.[14]

A brief case study.

Currently pending a decision from the PUCO is a set of solar projects to be developed in Highland County. Totaling 400MWs, this would be the largest clean energy development in state history with the potential to create 4,000 construction job years and 150 new, sustainable manufacturing jobs in the solar supply chain. Seeing these projects move forward would save electricity customers more than $218M and result in economic development (Ohio workers' earnings would grow by more than $250M) that would ensure the region has access to competitively priced solar energy and remains at the forefront of America's energy industry.

These projects have been in consideration for development for years now. Thousands of supportive comments have been filed with the PUCO by Ohio's electricity customers, public hearings have been packed by hundreds of people with nearly 60 people testifying, all in support.

Still, the outcome of these projects remains uncertain. Removing the state's AEPS could certainly be a fatal blow for these projects, and others like them in Ohio.

Ohio's AEPS is needed now, more than ever.

Some believe that because of the declines in renewable energy costs noted above and the current renewable energy industry employment statistics, policies like the AEPS are no longer needed to drive growth in renewables. This is not true, at least in Ohio.

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

[14] Reply Brief of NRDC, OEC and Sierra Club in PUCO Case Number 18-501-EL-FOR. https://dis.puc.state.oh.us/TiffToPDf/A1001001A19C27B71031J04290.pdf

abroad, and to overcome market barriers, such as the high cost and financial risks of transporting remote natural resources to markets."[15] 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.[16]

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. While there is an argument for providing narrowly tailored, time-limited support to struggling nuclear plants in Ohio so they can be replaced by renewable energy, efficiency, or other low-carbon resources instead of gas-fired power plants, **Ohio must make stronger support for renewables the foundation of Sub. HB 6.**

4. Energy Efficiency and the Energy Efficiency Resource Standard (EERS)

Energy efficiency is one of the most powerful weapons for combatting global climate change, boosting the economy, and ensuring that the air is safe to breath. Energy efficiency is America's largest energy resource, contributing more to the nation's energy needs over the last 40 years than oil, coal, natural gas, or nuclear power. It accounts for more than 2.2 million U.S. jobs – more than 81,000 of which are in Ohio – at least 10 times more than oil and gas drilling or coal mining.

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[15] 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

[16] *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," found 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

But what is energy efficiency?

It is the art of getting the same or better performance using less energy – all while cutting utility bills for residential, business and industrial customers.

In 2017, every dollar spent on energy efficiency programs created $2.65 in benefits for Ohio's homes and businesses.[17] Total bill savings to date top $5.1B. Furthermore, Ohio's efficiency programs reduced more than 1.1 million tons of carbon pollution in 2017 alone. Ohioans benefit from cleaner air resulting from efficiency programs as well; preventing more than 44,000 asthma attacks, 2,400 asthma-related emergency room visits, 4,400 heart attacks and over 2,800 premature deaths attributable to coal plant pollution.[18]

An often-used phrase when discussing energy efficiency is that "the low-hanging fruit is gone." This argument, which has been echoed for decades, is demonstrably false and equally dangerous. In 2017, Ohio ranked at number 16 in terms of the level of savings generated from energy efficiency investments. It trailed other Midwest states, including Illinois, Minnesota and Michigan.[19] Not only have Ohio's utilities' own potential studies identified a clear pathway to meet the current state goals, recent analysis by the American Council for an Energy Efficient Economy (ACEEE) shows additional savings opportunities, including emerging technologies and strategies to encourage additional customer participation.[20] Providing assurance of this is the fact that in order to implement energy efficiency programs in Ohio, they must first prove to save more money than they cost.

In addition to the energy, capacity and transmission and distribution savings that energy efficiency delivers, it is also the cheapest new resource (table below). This means that if Ohio were to fill the MWhs gap created by the repeal of the EERS, all available options for new resources would be more expensive.

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[17] MEEA, Energy Efficiency: A Good Investment for Ohio

[18] NRDC, Cleaner Air and Better Health - Benefits of Ohio's Renewable and Efficiency Standards (2015).

[19] ACEEE, The 2018 State Energy Efficiency Scorecard, https://aceee.org/sites/default/files/publications/researchreports/u1808.pdf

[20] https://aceee.org/blog/2019/04/aceee-debunks-myths-behind-ohio-bill

Levelized Cost of Electricity (LCOE) for A New Plant of a Fuel Type[21]

	LCOE ($/MWh)[22]
Nuclear	$150
Coal	$102
Gas	$58
Wind	$42[23]
Solar	$31
Energy Efficiency	$15

Eliminating the state's efficiency programs as Sub. HB 6 proposes would certainly increase the electric bills of all Ohioans. Maintaining Ohio's efficiency standard is critical to ensure reasonable electricity bills, reducing emissions and creating jobs in the state.

Chairman Wilson, Vice-Chair McColley, Ranking Member Williams and Members of the Senate Energy and Public Utilities Committee, thank you again for the opportunity to testify on Substitute HB 6 and the important energy policy issues facing Ohio today. I would be happy to answer any questions you may have.

[21] LCOEs for supply-side resources are based on Lazard 2018. The LCOE for energy efficiency is calculated using Ohio utilities' reported spending on efficiency programs in 2017 as well as their projected savings.

[22] LCOEs reflect the all-in costs of building and operating a new plant, including fuel and operation and maintenance costs, as well as capital costs and financing. LCOEs provide a common footing enabling the cost comparison of multiple technologies.

[23] Does not include the federal Production Tax Credit for wind

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ISSUE BRIEF

TRANSITIONING AWAY FROM UNECONOMICAL NUCLEAR POWER PLANTS

PROTECTING CONSUMERS, COMMUNITIES, WORKERS, AND THE ENVIRONMENT

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
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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:

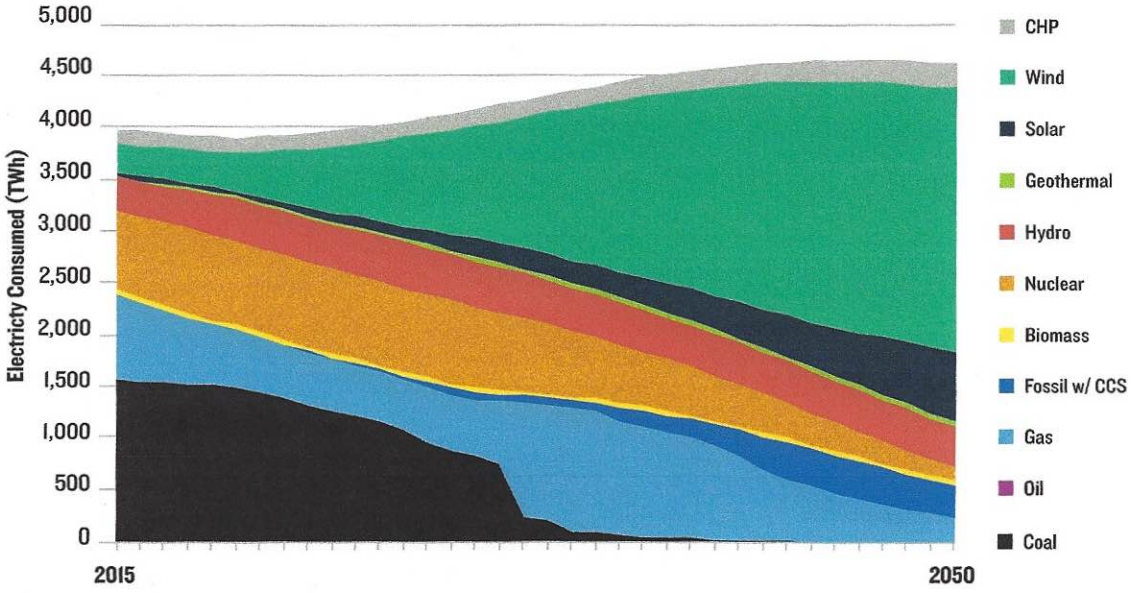
Showing of severe financial distress. Financial support for a nuclear facility can be considered if the owner can demonstrate that it will close the plant absent such support: reduced profitability is not sufficient. In New York and Illinois, plant owners filed notice of closure and opened their books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

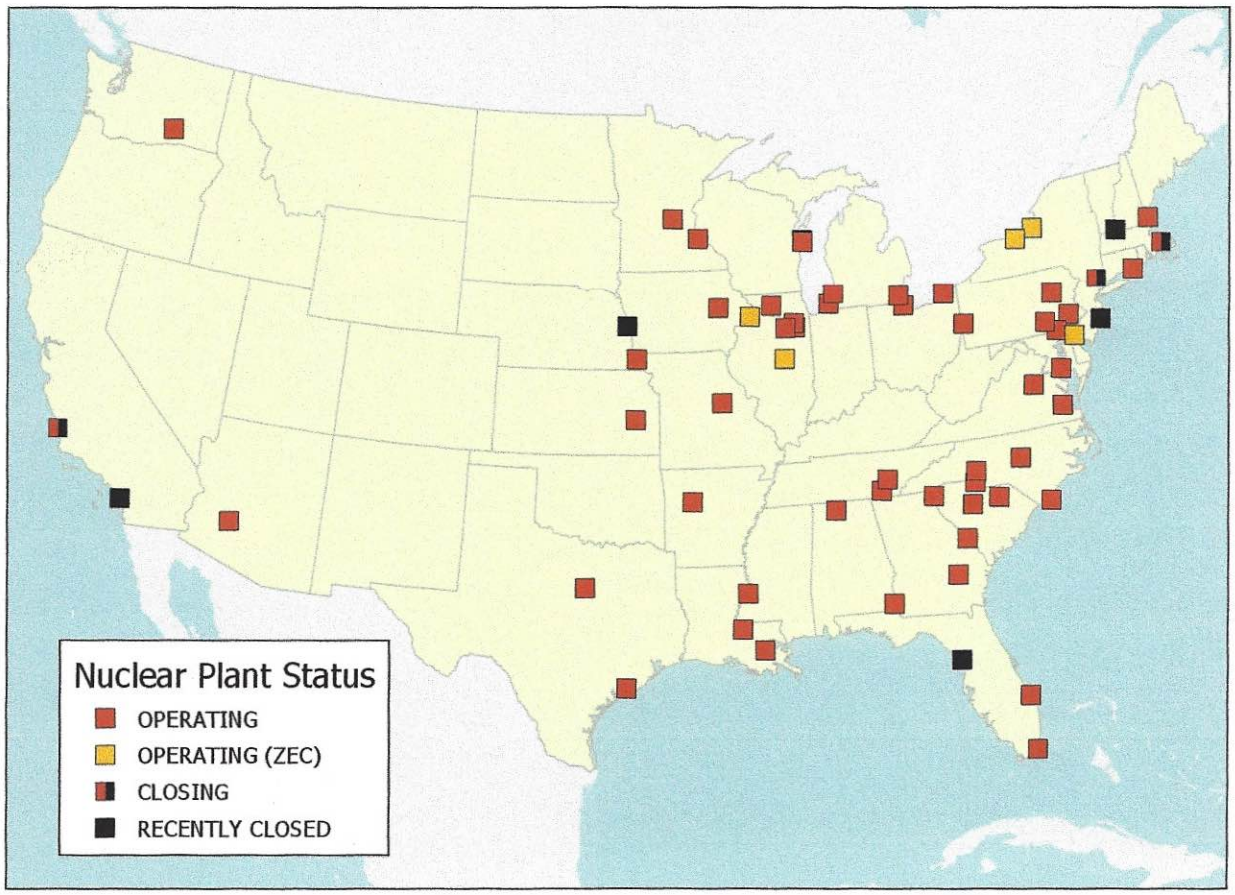
Simultaneously, New Jersey adopted a Clean Energy Law that directs utilities to deliver annual energy efficiency savings of at least 2 percent (0.75 percent for natural gas); increases the Renewable Portfolio Standard to 50 percent by 2030; overhauls the state's costly and volatile solar incentive program 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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