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State Options to Keep Nuclear in the Energy Mix

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Acronyms

Btu: British thermal unit

BWR: Boiling water reactor

CAISO: California Independent System Operator

COL: Combined operating license, a license issued by the NRC which authorizes the construction and operation of a new nuclear plant

CWIP: Construction Work in Progress

EPA: U.S. Environmental Protection Agency

ERCOT: Electric Reliability Council of Texas

FERC: U.S. Federal Energy Regulatory Commission

GW: Gigawatt

IOU: Investor-owned utility

ISO: Independent system operator

ISO-NE: New England Independent System Operator

MISO: Midcontinent Independent System Operator

MW: Megawatt

MWh: Megawatt-hour, equivalent to delivering one megawatt of electricity continuously for one hour

NRC: U.S. Nuclear Regulatory Commission

NYDPS: New York Department of Public Service

NYISO: New York Independent System Operator

NYSERDA: New York State Energy Research and Development Authority

PJM: PJM Interconnection

PPA: Power purchase agreement

PTC: Production Tax Credit, a federal subsidy for wind energy

PUCO: Public Utilities Commission of Ohio

PWR: Pressurized water reactor

RECs: Renewable Energy Credits

RPS: Renewable Portfolio Standard

RTO: Regional transmission organization

SMR: Small modular reactor, an advanced reactor design for smaller nuclear plants

SPP: Southwest Power Pool

TVA: Tennessee Valley Authority

ZECs: Zero Emissions Credits, a financial compensation program enacted in Illinois and New York which pays nuclear plants for the amount of zero-carbon electricity they produce

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Executive Summary

Since 2013, six nuclear reactors in the United States have permanently closed, another 12 reactors have been scheduled to shut down, and operators at several more plants have warned of other possible reactor closures in the coming years. While nuclear power provides almost 20 percent of the nation's electricity generation, some nuclear plants in restructured electricity markets are finding it difficult to adapt to changes brought about in recent years by competing energy sources and relatively low electricity demand growth. This combination of factors has challenged nuclear's place in the nation's energy mix, drawing the attention of utilities, regulators, federal officials and state policymakers.

Although legislators are exploring policies that support nuclear generation for a number of reasons, primary factors include the high reliability of nuclear power, its carbon-free emissions profile and nuclear's economic contribution to states. Nuclear plants are a reliable generation source, operating at a 92 percent capacity factor in 2015[1]—higher than any other generation source. Commercial nuclear reactors also account for approximately 60 percent of the nation's carbon-free electricity,[2] while providing jobs and tax revenue for the local communities and states in which they operate.

In late 2016, two states established new policies aimed at retaining existing nuclear power plants. Illinois and New York will begin implementation of similar policy mechanisms that aim to compensate struggling nuclear plants for their carbon-free attributes. It is likely that these Zero Emissions Credits, as they are known, will keep four at-risk power plants operating into the following decade.

Although this report focuses on existing nuclear plants and the role state legislatures may play in efforts to retain the current nuclear fleet, some states are also exploring ways to support advanced technologies such as small modular reactors. Bills have been introduced in several states that provide tax incentives, urge continued federal investment or evaluate the economic benefits of advanced nuclear technologies as a way to continue the use of nuclear power in the United States. States are also introducing measures to leverage science, technology, engineering and math research that encourages continued investment in nuclear jobs and education. In addition, 21 states have introduced legislation since 2015 pertaining to the transportation, storage and disposal of spent nuclear fuel. While NCSL recognizes that the management of the nation's spent nuclear fuel is an important issue, this report focuses on power generation and does not examine current state action or policy options for waste management.

This report explores the reasons nuclear plants are at risk of closing and how state policymakers, federal officials and the industry are responding. It is meant to serve as a resource for state policymakers who are interested in ways to maintain a state's nuclear generation.

Many of the policy options discussed in this report have already been proposed in various states. While only a few of these bills have been enacted, policymakers in a number of states are increasingly discussing this issue as more plants come under pressure. Policies range from offering tax incentives or imposing a carbon tax, to the creation of statewide mandates that require utilities to purchase a specified amount of nuclear power, similar to renewable portfolio standards. The intent of this report is to continue the dialogue on the role of state policymakers, utility regulators, federal officials and the nuclear industry in providing affordable, reliable and clean energy across the United States.

Status of U.S. Nuclear Reactors

Since 2013, the following nuclear power plants have ceased power production and begun decommissioning:

- **Crystal River 3:** Due to a failed steam generator replacement, this unit in Florida shut down in February 2013.
- **Kewaunee:** Due to market conditions, this unit in Wisconsin shut down in May 2013.
- **San Onofre 2 and 3:** Due to a failed steam generator replacement, these two units in California shut down in June 2013.
- **Vermont Yankee:** Due to market conditions, this unit in Vermont shut down in December 2014.
- **Fort Calhoun:** Due to market conditions, this unit in Nebraska shut down in October 2016.

The following nuclear plants have announced plans to close by 2019:

- **Oyster Creek:** To avoid the large capital costs associated with building a cooling tower, the plant's owner entered into an agreement in 2010 that will see this unit in New Jersey shut down by Dec. 31, 2019.
- **Pilgrim:** Due to market conditions, in October 2015, the owner of this unit in Massachusetts announced that it will be shut down by June 2019.
- **FitzPatrick:** Due to market conditions, in November 2015, the owner of this unit in New York announced that it will be shut down by February 2017. However, the plant will likely continue operations with a policy change in New York and its pending sale to another company.
- **Ginna:** Due to market conditions, the owner of this unit in New York has said it would shut down the plant at the end of a reliability contract with the state. This plant will likely continue operations due to a policy change.
- **Clinton:** Due to market conditions, in June 2016, the owner of this unit in Illinois announced that it would be shut down by June 2017. This plant will likely continue operations due to a policy change.
- **Quad Cities 1 and 2:** Due to market conditions, in June 2016 the owner of these two units in Illinois announced that they will be shut down by June 2018. This plant will likely continue operations due to a policy change.
- **Palisades:** Due to market conditions, in December 2016, the owner of this unit in Michigan announced that it will be shut down by October 2018.

The following nuclear plants have announced plans to shut down four reactors by 2025:

- **Indian Point 2 and 3:** Due to market conditions, safety concerns and ongoing disputes with the state, in January 2017, the owner of these two units in New York announced they will be shut down by 2021.
- **Diablo Canyon 1 and 2:** Due to market conditions and safety concerns, in June 2016, the owner of these two units in California announced they will be shut down by 2025.

Overview of Nuclear Energy in the United States

Nuclear power is facing an array of near- and long-term challenges as it looks to participate in a rapidly evolving energy sector. The nuclear power industry has found it difficult to compete with low-cost natural gas power plants in restructured electricity markets, while policies aimed at reducing carbon emissions in the electric power sector have largely failed to include nuclear power.

While there are a few exceptions, it is important to note that nuclear power plants in vertically integrated states have not faced the same level of economic challenges as those in restructured states, where power plants compete on a daily basis to sell electricity in an open, wholesale market.

The issue has played out over the past several years. However, a spate of recent nuclear plant closures—along with rising concerns that more could follow—have caught the attention of policymakers. The United States has 99 operating nuclear reactors in 30 states, which provide close to 20 percent of domestic electricity generation, and approximately 60 percent of carbon-free generation. Since 2013, six nuclear reactors have permanently closed in California, Florida, Nebraska, Vermont and Wisconsin. Operators have announced that eight additional reactors in Illinois, Massachusetts, Michigan, Nebraska, New York and New Jersey could close by 2019, while four reactors at plants in California and New York will shut down by 2025.

While these numbers are likely to change due to recent policy changes aimed at retaining some of the struggling plants, the underlying challenges remain. Almost as soon as the Illinois General Assembly passed legislation that will likely keep two of the state's money-losing nuclear plants in operation, another company announced plans to close a nuclear plant in Michigan.

So far, policy changes in Illinois and New York may help retain four plants that would otherwise close—the Clinton Nuclear Generating Station and Quad Cities Nuclear Generating Station in Illinois, and the R.E. Ginna Nuclear Power Plant and James A. FitzPatrick Nuclear Power Plant in New York.

However, a number of nuclear plants still are at risk of closing prematurely due to their inability to compete in wholesale electricity markets. The Nuclear Energy Institute has warned that another 15 to 20 reactors are facing similar problems.

While four new reactors are under construction and one began commercial operation in October 2016, these projects have faced economic and regulatory challenges that have hindered their progress. These challenges are of considerable concern to developers of new nuclear power.

Some policymakers and energy officials are supporting policies intended to help nuclear power compete as a low-carbon baseload electricity source in order to maintain its role in the energy mix.

Federal and State Oversight

The Federal Role

The nuclear power industry is regulated by the U.S. Nuclear Regulatory Commission (NRC), which has authority to establish rules and regulations, along with providing licensing requirements, oversight and incident response for commercial nuclear reactors. The NRC is responsible for licensing, certification and decommissioning of nuclear facilities. Most new reactors receive an initial 40-year operating license, with the option of applying for a 20-year license extension. Currently, 65 Pressurized Water Reactors (PWRs) and 34 Boiling Water Reactors (BWRs) are licensed to operate by the NRC.

Eighty-two of the nation's reactors currently are operating on 20-year license extensions.[3] Kewaunee, Vermont Yankee and Fort Calhoun had recently received license extensions when operators decided to shut down the units—an indication of how quickly the operating environment changed. In addition, 10 reactors are in the process of applying for license extensions, although it is expected that applications for the two reactors at Diablo Canyon will be withdrawn. The 20-year license extensions for 52 of these reactors will expire before 2040. To date, two nuclear plants—the Surry Power Station in Virginia and the Peach Bottom Nuclear Generating Station in Pennsylvania—have notified the NRC that they plan to file for a second 20-year license extension,[4] which could allow them to operate for up to 80 years. If the NRC grants Surry and Peach Bottom a second extension, it may encourage the owners of other reactors to also apply for such an extension.

As part of the NRC's mission, the agency ensures the safe operation of the nation's nuclear plants. Recent NRC reports placed all but three of the nation's operating reactors in the top two performance categories, with 85 reactors in the top category.[5] However, the NRC also reassesses safety based on new information and releases operational and safety mandates to nuclear plants in response. As a result of the 2011 accident at the Fukushima Daiichi power plant in Japan, the NRC has required a number of safety enhancements,[6] most of which were completed by the end of 2016.

In addition, the NRC has issued four combined licenses (COLs)[7] that authorize the construction and operation of new nuclear power plants. Four of these licensees—for two reactors at the Alvin W. Vogtle Electric Generating Plant in Georgia, and two reactors at the Virgil C. Summer Nuclear Generating Station in South Carolina—have begun construction. Another five COLs are under review for sites in Florida, Pennsylvania, South Carolina and Virginia. For various reasons, nine applicants have either suspended or withdrawn their applications.

The first new nuclear reactor to come online in the United States in nearly two decades is at the Watts Bar Nuclear Generating Station in Tennessee. Watts Bar Unit 2 was 80 percent complete when construction stopped in 1988. After a decades-long hiatus, the owner and operator, the Tennessee Valley Authority (TVA), decided to complete the project. The NRC issued an operating license for Unit 2 in October 2015, and the unit began commercial operation on Oct. 19, 2016. TVA reported the $4.7 billion project came in on budget. The same cannot be said for the ongoing projects in Georgia and South Carolina, each of which has seen a series of delays and cost overruns.

The NRC has a memorandum of agreement[8] with the Federal Energy Regulatory Commission (FERC), which regulates the interstate transmission of electricity and wholesale interstate electricity markets in which nuclear plants compete. FERC's primary function in relation to nuclear power plants is to regulate wholesale markets. It does this by authorizing a regional entity to act as the grid operator and to sell electricity at market-based rates in restructured states. The grid operator is generally an independent system operator (ISO) or a regional transmission organization (RTO). These ISOs and RTOs use bid-based markets to determine the most economic means of dispatching electricity. Two-thirds of the nation's electricity load is served in ISO and RTO regions.[9] In areas of the country that are not served by an ISO or RTO—for example, the Southeast and much of the West—traditional, vertically integrated markets are overseen by state public utility commissions.

State and Local Regulation

While most of the federal regulatory framework is designed to ensure the safety of nuclear technologies and the safe operation of nuclear plants, states also play an important role in the regulation of nuclear facilities. State decision makers, including legislatures, governors' offices and other state executive agencies, can enact policies that support or hinder the development of nuclear power. Vertically integrated states can establish requirements for a diverse energy portfolio through integrated resource plans, which are used to prepare for future energy demands through a combination of supply-side and demand-side resources. Some states—including restructured states—have implemented renewable portfolio standards (RPS) that require a certain percentage of a state's electricity to be derived from renewable resources. Arizona, Illinois and New York have considered similar mandates for nuclear generation.

In addition, states and localities can exert authority over the siting and taxation of nuclear plants. State agencies can conduct independent environmental impact reviews and influence the siting of these facilities. State and county governments also have control over issues of taxation. For example, Calvert County, Maryland, authorized a property tax credit in 2006 that was intended to encourage Constellation Generation Group, the owner of Calvert Cliffs Nuclear Power Plant, to expand and build a new reactor at the facility.[10] Similarly, in New York, a section of the Real Property Tax Law allows local governments to opt into a program that exempts nuclear generation facilities from real property taxes for a period of time, allowing the plant and local government to agree upon a payment in lieu of taxes in exchange.[11]

What's Causing Nuclear Plant Closures?

Nuclear power faces considerable economic challenges in the current market. The near-term is of particular concern for the industry and those who support nuclear generation. A variety of factors—such as pressures from competing energy sources and relatively low growth in electricity demand—are challenging the future of U.S. nuclear power. As a result, plants that are otherwise viable have been forced to close prematurely.

Three nuclear plants—Fort Calhoun in Nebraska, Vermont Yankee in Vermont and Kewaunee in Wisconsin—have closed due to economic factors. Another seven reactors at six power plants—the Clinton and Quad Cities plants in Illinois, the Pilgrim plant in Massachusetts, the Palisades plant in Michigan, and the Ginna and FitzPatrick plants in upstate New York—are scheduled to follow by 2019. Due to policy changes in Illinois and New York, it is likely that plants in those states will remain in operation.

Generally, the small, single-unit facilities that produce less than 1,000 megawatts (MW) in restructured states are the most vulnerable. Kewaunee had a capacity of around 550 MW, while Vermont Yankee had a capacity of just over 600 MW. Fort Calhoun was the nation's smallest reactor, with a capacity of 476 MW. According to industry reports, the average total generating cost at single-unit plants was $44.52 per megawatt-hour, while at multi-unit plants the cost was $32.90.[12] Several larger facilities, such as the two-unit Byron and Quad Cities plants in Illinois, also have struggled in recent years, according to their owner, Exelon Corp.

Industry representatives and policymakers have questioned the value of allowing the near-term market environment to affect the closure of nuclear assets that may offer long-term benefits, and have called for policies that value the positive attributes of nuclear power, given that it is carbon-free baseload generation that maintains a large and highly paid workforce with little price volatility.

Low-Cost Natural Gas

Although the price of natural gas has come down considerably since 2008, it has historically been a volatile commodity, with prices spiking to over $13 per million British thermal units (Btu) in October 2005 before dropping to just under $5 per million Btu within a year. In more recent years, it has generally fluctuated between $2 and $5 per million Btu due to weak demand and robust production.[13]

On average, natural gas spot prices—the price at which it was bought and sold for immediate delivery across the country—fell over 30 percent across the nation in 2015, according to FERC. Given that natural gas-fired generation sets marginal prices in a number of markets, electricity spot prices also fell by around 30 percent in that same year. [14]

More than two-thirds of the retail electricity price for fossil fuel-based technologies is linked to the cost of fuel.[15] Therefore, these price fluctuations will affect electricity prices considerably as natural gas overtakes coal as the largest source of electricity generation in the United States. Natural gas has become the fuel of choice for many utilities due to its low price and the fact that natural gas power plants are cheaper and easier to site than coal or nuclear plants. In addition, natural gas plants meet current U.S. Environmental Protection Agency (EPA) air regulations and can be built in as little as 20 months. In 2013, half of power plant capacity additions were natural gas.[16]

By comparison, nuclear plants require high capital investments that are not included in wholesale prices. They also take longer to build—in some cases, a decade or more. In fact, the application for a 20-year license extension from the NRC often takes 30 months to complete.[17]

The cost of fuel accounts for around 25 percent of total generating costs for most nuclear power plants, compared to more than 80 percent for most natural gas plants.[18] A reliability benefit of nuclear plants is that they store fuel on-site, so they are not subject to fuel delivery issues that limit some other technologies.

Low Growth in Electricity Demand

Electricity demand in the United States has been relatively flat since 2007. While this can be partially attributed to the effects of the Great Recession, the low growth in electricity demand has continued through a period of significant economic growth. In fact, net electricity generation has decreased in three of the past five years, and remains lower than in pre-recession years.[19]

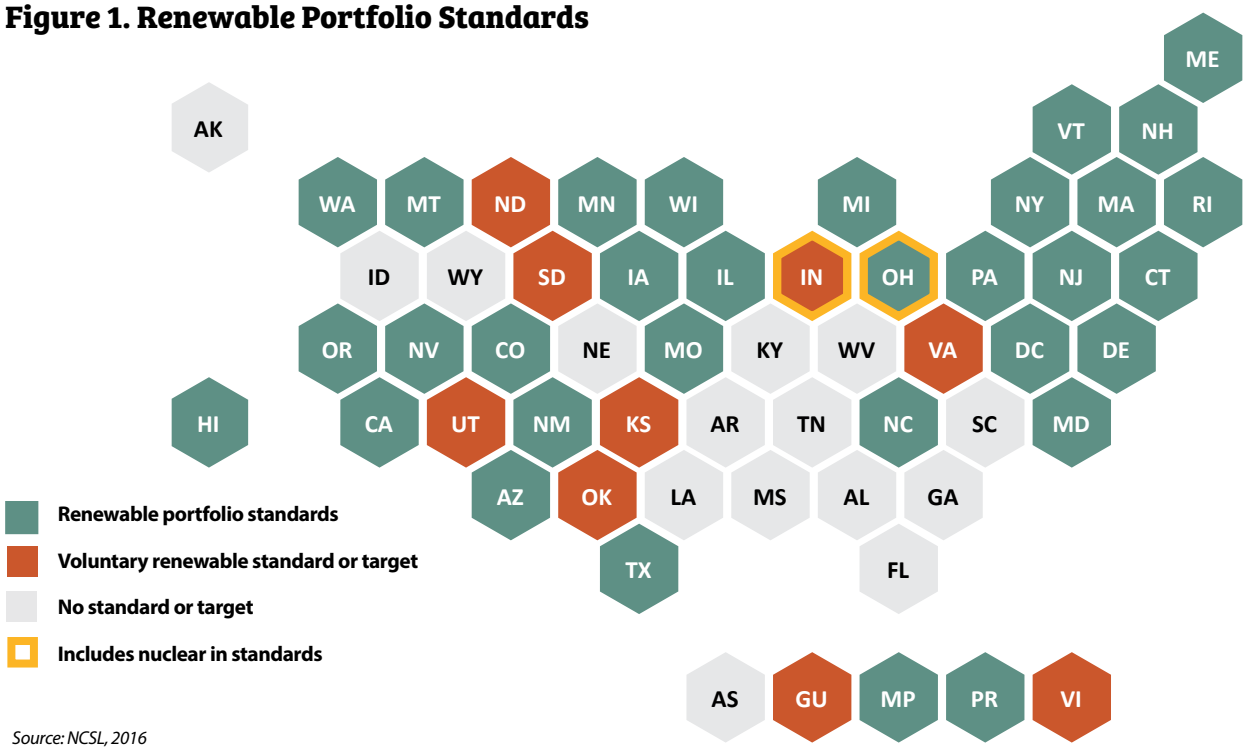
The slowdown can be attributed to several factors, including reduced population growth, energy efficiency improvements of electric appliances, and the continued adoption of state energy efficiency measures. In addition, the growth of distributed generation has reduced the demand for delivered electricity to residential and commercial buildings, which accounted for around 70 percent of electricity demand in 2013, according to the U.S. Energy Information Administration's 2015 Annual Energy Outlook.[20]

This slower growth has benefited smaller scale generation projects. In the 1950s, electricity use grew nearly 10 percent annually, requiring significant capacity additions that benefited large power plants. The past decade has seen an annual growth rate of around 0.5 percent. The slower growth has meant that low-capacity distributed resources can largely cover the demand.

Federal and State Renewable Energy Incentives

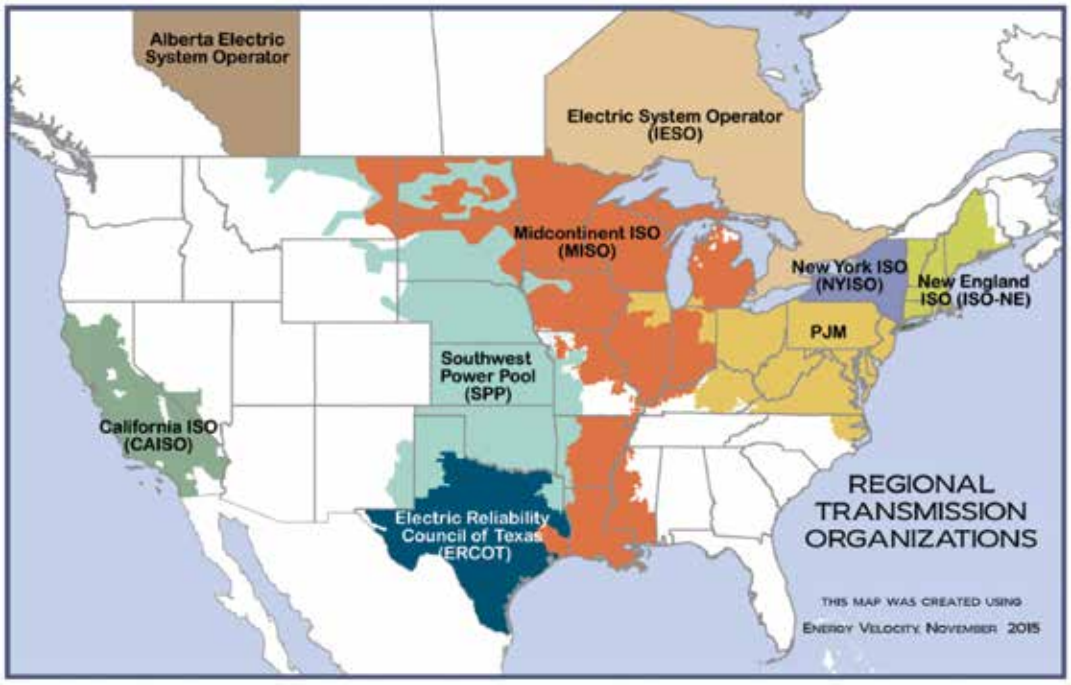
Federal tax credits and state renewable portfolio standards (RPS) have driven much of the growth in renewable generation in recent years. The cost of generating electricity from these renewable resources has dropped considerably in recent years, to the point that they have reached grid parity in several regions. Wind capacity grew by 12 percent in 2015, and is forecast to grow by around 10 percent over the next two years. Meanwhile, utility-scale solar photovoltaic capacity is forecast to increase by over 13 gigawatts (GW) during the same period.[21] While these policies have achieved their goal of deploying renewable resources, there is ongoing debate about whether, and to what degree, these types of policies and subsidies are affecting nuclear power's competitiveness. For example, the federal Production Tax Credit (PTC) is believed to have contributed to lowering wholesale power prices in some markets—most notably in the Midwest and Texas. The PTC's structure has led to periods of negative pricing, when power generators have to pay for the grid to take their electricity. This theoretically could place a strain on nuclear plants because they cannot simply shut off at times of low demand.

Figure 1. Renewable Portfolio Standards



Source: NCSL, 2016

Figure 2. RTOs and ISOs in the United States



Source: Federal Energy Regulatory Commission

At the state level, 29 states and the District of Columbia have mandatory renewable portfolio standards that outline carbon-free or low-carbon mandates, while another eight states have voluntary standards (Figure 1). These policies require that a certain percentage of a utility's retail electricity sales come from renewable resources by a certain date. Two states include nuclear power in the eligible technology mix.[22] Along with new technologies like solar and wind, Indiana's voluntary target allows for 30 percent of its target to be met by nuclear, clean coal and natural gas. Ohio's mandatory RPS was established in 2008. In 2014, the legislature froze the standard for three years, and a recent bill to extend the freeze was vetoed by Governor John Kasich. Unless it is overridden, Ohio's RPS will snap back into place in 2017. It currently is divided into two categories: renewable energy resources and advanced energy resources. Nuclear power is included in the advanced energy resources category, along with cogeneration and clean coal.

It is worth noting that most of these standards were established to support development of new renewable energy projects in each state, with carbon reduction treated as an assumed byproduct of the policies. However, as nuclear has come under pressure, some states are considering measures that include nuclear in their RPS or nuclear-specific low-carbon portfolio standards. In 2015, a bill to add nuclear to the state RPS failed in the Arizona Senate, and in Illinois, the General Assembly considered legislation to create a low-carbon standard, which would have benefited all forms of low-carbon generation, including nuclear. However, the legislature adjourned before addressing the measure.

Market Structures

The restructuring of electric utility markets in certain states has dramatically shifted the manner in which nuclear plants operate. Traditionally, electric utilities in the United States operated as regulated monopolies, with the state public utilities commission exerting oversight and regulatory authority over investor-owned utilities' rates and other issues. Except in a few states, publicly owned and cooperatively owned electric utilities are regulated by locally appointed or elected governing boards. In vertically integrated states with traditional markets—those in which utilities are responsible for system operations and management, along with providing power to retail customers—utilities own and operate power plants and then sell electricity to end-users.

In strictly restructured states, utilities had to divest ownership in generation and transmission and focus on distribution and billing. There are many types of restructuring, however, and some states have allowed

Traditional vs. Restructured Markets

Traditional electricity markets were built around self-supply and bilateral contracting. In these markets, which still operate largely in the Southeast and Western United States, a vertically integrated utility delivers electricity to its customers at a rate approved by a state utilities commission. It supplies electricity through the operation of its own power plants, and through contracts with third-party power plants for the purchase of electricity.

In wholesale electricity markets, electricity generators offer to sell power and ancillary services on a competitive, open market. Utilities can then purchase power and ancillary services to meet their demand.

In most states that have restructured their electricity markets, the majority of generated electricity is sold through competitive wholesale markets.

A number of states, especially those served by MISO and SPP, have hybrid markets, with both traditional and wholesale elements. In these states, utilities can self-supply, engage in bilateral contracting, and purchase electricity on the wholesale market.

utilities to own generation. In restructured states, investor-owned merchant power plants operate in the wholesale power market, which is run by grid operators—ISOs and RTOs—to ensure reliability (Figure 2). While billing rates for utilities in traditional states are generally calculated as a total of all costs to a utility plus a small profit, rates in wholesale power markets are not required to cover utility expenses. These markets are operated differently, offering day-ahead and real-time pricing, which allows utilities to know the price of electricity at any given time and to make cost-conscious purchasing decisions based on that information. Some regions also have capacity markets that operate with a longer outlook, allowing merchant power producers to compete in capacity auctions designed to ensure resources will remain available if needed at any given time through a certain date. PJM's capacity market, for instance, aims to ensure the grid operator secures adequate resources for three years into the future.[23] A three-year outlook, however, generally fails to support investments in costly assets with potential lifetimes of over 40 years.

Beginning in the 1990s, restructuring spread to a number of states before it was halted by the California electricity crisis of 1999-2000. The Northeast and Mid-Atlantic have the largest collection of restructured states. During the same time period, a number of regions formed centrally organized wholesale electricity markets, spurred by FERC Order No. 888[24] and the Energy Policy Act of 1992, which required transmission access to be guaranteed. The New England ISO (ISO-NE) includes the six states in New England, while New York's grid is operated by New York ISO (NYISO). PJM serves some or all of the seven states in the Mid-Atlantic and the District of Columbia. Aside from Vermont, these three markets are operated in restructured states. Several other states—including California, Texas and, to a lesser extent, Oregon—have also pursued some form of restructuring. Texas' market administrator is the Electric Reliability Council of Texas (ERCOT), while California's is California ISO (CAISO). In 2015, California legislators passed Senate Bill 350, which could lead to expansion of CAISO into a larger, regional organization that would be responsible for market and grid operations across a number of Western states.

Two other regional wholesale power markets, the Midcontinent Independent System Operator (MISO) and the Southwest Power Pool (SPP), operate predominantly in states that have not pursued retail competition. MISO operates in all or part of 16 states in the Midwest and South, along with Manitoba, Canada. SPP oversees the wholesale power market in all of Kansas and Oklahoma and portions of 12 other states. These hybrid markets include traditional ratemaking that is regulated by state utility commissions along with wholesale energy markets similar to those found in restructured states. This structure allows for both utility-owned and merchant-operated power plants that can contract to sell power directly to a utility through power purchase agreements and bilateral contracts, or that can sell on the wholesale market.

Power Purchase Agreements

Power purchase agreements (PPAs) between electricity generators and electricity buyers can offer several benefits to both parties, such as predictability for markets and investors. Power producers benefit from the certainty of contracts and revenue, while offering utilities a means of hedging against price spikes. These contracts also reduce the risk to developers and lenders that finance the construction of new power generation resources.

Every operating nuclear power plant in the United States was built when joint ownership, bilateral contracts or long-term PPAs were a common means of procuring electricity. In traditional markets, utilities relied on self-supply and PPAs to ensure they had the electricity they required. These arrangements guaranteed income and operational certainty to nuclear plants, reducing risk for plant owners.

A traditional PPA is negotiated between an electricity generator and an electricity buyer—a power plant and a distribution utility—on a voluntary basis. These contracts can vary in many respects, but they generally commit a utility to purchasing a set amount of electricity from a power plant, with certain restric-

tions on price over a particular time frame.

Several nuclear plants in vertically integrated states operate under traditional PPAs, including the Point Beach facility in Wisconsin. In 2006, the operator of the Point Beach nuclear plant signed a PPA with Wisconsin Electric Power Co., which runs into the 2030s. The state's Kewaunee plant was unable to negotiate a similar agreement with utilities and has since shut down. In addition, the Iowa Utilities Board authorized the Duane Arnold Energy Center to extend a PPA in 2013 with Interstate Power and Light Co. In approving the agreement, the Iowa Utilities Board agreed that the PPA was in the long-term best interest of customers, noting that the nuclear plant offers safe and reliable electricity and contributes to maintaining a diverse energy supply in the state.

Utilities in vertically integrated states are generally able to enter into a PPA upon approval by the state public utilities commission. However, as evidenced recently in Maryland and Ohio—where a U.S. Supreme Court decision has reinforced FERC's oversight authority and called into question a number of state-approved PPAs—these contracts tend to be harder to come by in restructured states.

There are a few notable attempts at entering into a PPA in restructured states, which demonstrate the difficulties, along with examples of how some states are attempting to circumvent these restrictions.

OHIO'S DAVIS-BESSE

The most high-profile recent development in this area has been in Ohio, which is a restructured state within PJM's service territory. The Public Utilities Commission of Ohio (PUCO) approved an eight-year PPA between a distribution utility, FirstEnergy Corp., and the Davis-Besse Nuclear Power Station—a single-unit, 889 MW capacity power plant.[25] The PUCO approved the agreement unanimously in early 2016, along with another similar agreement that offered PPAs to seven struggling coal plants in the state.

The plans called for ratepayers to subsidize Davis-Besse and these older coal plants, which are struggling to maintain profitability against gas-fired competition. Under the agreements, FirstEnergy's distribution companies would have bought electricity directly from Davis-Besse at cost and then sold that capacity, energy and ancillary services back into the PJM wholesale markets. Where auction prices were below the PPA price, ratepayers would have needed to make up the difference. Where auction prices were higher than the PPA price, ratepayers would have received a credit on their bills. The PUCO justified its decision by saying the plan ultimately would have saved ratepayers millions of dollars over the life of the contract and offered market stability.

The decision to approve these PPAs was highly controversial, with consumer advocacy groups and competing utilities arguing that ratepayers should not be forced to prop up uncompetitive plants. At the same time, the PPAs were viewed as an infringement on FERC's jurisdiction over wholesale markets. A similar agreement in Maryland was at the heart of a case before the U.S. Supreme Court, *Hughes v. Talen Energy Marketing, LLC*. In April, the Supreme Court ruled unanimously against the agreement in Maryland, noting that wholesale markets are the domain of FERC alone. The decision immediately called into question the validity of the PPAs approved in Ohio.

Soon after the Supreme Court's decision, FERC moved to block the agreements in Ohio, saying the PPAs would have to undergo an affiliate abuse test, which requires companies to prove that other buyers would be willing to pay similar prices. FERC limits utilities with captive customers from buying wholesale electricity from affiliate generators without first undergoing such a review to ensure that prices are fair to customers.

FERC's decision could have a ripple effect—especially in restructured states—in terms of whether PPAs could serve as a viable mechanism for supporting nuclear assets. Already, supporters of the PPAs and the utilities involved have said they plan to push for legislation in the Ohio General Assembly that would re-regulate parts of the electricity market in the state. It is unclear whether there is enough political momentum to support such a move, but in the meantime, FirstEnergy moved to withdraw its proposal to avoid the FERC review.

FirstEnergy filed a modified plan with PUCO that would avoid FERC oversight by removing the PPA. However, the plan sought many of the same benefits, including the customer surcharges to compensate Davis-Besse. In the new proposal, the surcharges would have been based on estimated power production

costs—not the PJM wholesale market. In October, the commission rejected FirstEnergy's proposal in favor of a $131 million annual distribution modernization rider that would last between three and five years in order to provide the utility with credit support. The rider would not offer the financial support FirstEnergy was seeking, and the utility has said it will appeal the decision.

CONNECTICUT'S MILLSTONE

The Connecticut General Assembly offers another approach, which could ultimately prove effective and replicable so long as there is support within a state legislature. Connecticut is restructured and within ISO-NE, so the state and its power plants face some of the same issues seen in Ohio. The state's electricity consumption is split nearly 50-50 between nuclear and natural gas.[26] The state is home to the Millstone Power Station—a two-unit, 2,037 MW capacity nuclear plant in Waterford, Connecticut—that is the largest power plant in New England. Millstone also supplies nearly all of the state's carbon-free electricity.

In March 2016, the General Assembly's joint Energy and Technology Committee opened discussion on the threats to nuclear power in the state with a special public hearing on whether the legislature should take action to make Millstone more profitable.

From that forum, the Energy and Technology Committee developed Senate Bill 344, which would have allowed Millstone to bypass the competitive wholesale markets and enter into PPAs for up to 50 percent of its capacity. The bill also would have granted similar concessions to other energy sources—such as Class I renewables and large-scale hydropower—although all such proposals would have to be approved by the state commissioner of Energy and Environmental Protection, with oversight from the state Attorney General and Office of Consumer Counsel. Proposals would be evaluated based on the best interests of ratepayers, the reliability of the system and the forecasted price of energy. If approved, the commissioner could direct electric distribution companies to enter into agreements for energy, capacity or any environmental attributes for a period of not more than 10 years.

In essence, the bill would have allowed the state to direct its utilities to enter into PPAs with Millstone—something they currently cannot do.

Senate Bill 344 passed the Senate but was tabled in the House. The legislature adjourned on May 4, 2016, although there is some discussion that they will consider a similar measure in the 2017 legislative session.

Capacity Markets and Reliability Contracts

Capacity markets are a relatively new development within RTOs and ISOs. Their purpose is to ensure that a system will have a required amount of capacity at a given point in the future. These markets provide revenue to power plants in exchange for assurances that the power plants will be ready when called upon to supply power. MISO, ISO-NE, PJM and NYISO operate capacity markets, although each of these functions differently and operates based on different sets of load projections. NYISO's market operates six months into the future; its primary intent is to cover capacity that is not fulfilled through self-supply or bilateral contracts. MISO's capacity market is voluntary and projects one year into the future, allowing its various load-serving entities to project their own demand needs and fulfill those needs with their own generation resources.

ISO-NE and PJM operate mandatory capacity markets that project three years into the future. In these regions, all capacity must be attained through these markets, notwithstanding self-supply or ownership considerations of load-serving entities. In parts of Illinois and Michigan, MISO is considering adoption of this type of capacity market due to concerns about capacity shortfalls.

ISO-NE and PJM hold annual capacity auctions in which power plants submit bids hoping that they will clear the market, which would require them to stay online and available through a certain date—although interim auctions and other processes enable bidders to effectively change their obligations. These auctions have proven to be hard on nuclear plants in recent years as natural gas capacity increases and drives down clearing prices.

The clearing prices for PJM's capacity auction for the 2019-2020 planning year were announced in May 2016; three nuclear plants failed to clear the auction. Exelon announced that its Quad Cities plant in Illinois and its Three Mile Island plant in Pennsylvania failed to clear, while a portion of Byron's capacity also failed to clear. The clearing prices surprised many observers because they came in around 40 percent lower than the previous auction throughout much of the region. PJM said the lower clearing price was largely the result of efficiency and low natural gas prices, with over 5,000 MW of new gas-fired power bid into this auction.

The Pilgrim plant in Massachusetts is currently operating under a capacity contract with ISO-NE that obliges the plant to stay online through May 2019. For this reason, the plant's owner, Entergy Corp., has announced that the plant will undergo refueling one more time to meet its obligations.

New York has worked hard to find another means of achieving a similar end for the Ginna plant. The plant is now operating under a reliability support services agreement that was negotiated between the power plant, the local utility, state regulatory staff, consumer advocates and large consumers. FERC approved the settlement in early 2016. The agreement provides a lifeline to the plant by offering revenue in exchange for grid support services to Rochester Gas and Electric. However, this is only a two-year contract that will expire in 2017, at which point the facility would have faced the same problems and likely shut down. With adoption of a new policy in New York, the plant is expected to remain in operation.

Considerations as the Nuclear Fleet Ages

In general, the nuclear fleet is aging. While one new reactor recently came online and another four will come online during the next few years, the majority of the nation's nuclear assets have already begun operating on a 20-year license extension. Fifty-two of these license extensions—representing over half the current fleet—will expire by 2040.

However, two facilities—the Surry plant in Virginia, and the Peach Bottom plant in Pennsylvania—intend to apply for a second 20-year license extension. In order to ensure that these facilities can continue to operate safely, the NRC requires that they clear significant regulatory hurdles. The relicensing process often can take up to 30 months—longer than it generally takes to license and build a natural gas plant. It is expected that a number of other nuclear facilities will follow suit, which could see nuclear plants operate into the second half of the century.

With these license extensions come public concerns about safety. Recent NRC reports placed all but three of the nation's operating reactors in the top two performance categories, with 85 reactors in the top category. The reactor oversight program focuses almost exclusively on safety issues, with three main focus areas: reactor safety, radiation safety and safeguards. Based on the NRC framework and performance indicators, the NRC places reactors in one of five performance categories that correspond directly with the level of oversight exerted by the NRC, placing reactors in the lower categories under much greater scrutiny than those in the highest.

According to the U.S. Energy Information Administration, the nuclear power industry also is operating aging plants very efficiently. Prior to 2000, nuclear plants were generally operating at a capacity factor of below 80 percent—producing electricity less than 80 percent of the time. Since that time, the nuclear industry's capacity factor has risen steadily. In 2015, the U.S. nuclear fleet operated at a capacity factor of 92.2 percent[27]—a significant record and milestone. Natural gas and coal, meanwhile, operated at capacity factors of around 55 percent in 2015.[28]

Nuclear facilities operate under high scrutiny, and the level of scrutiny increases substantially in the wake of high-profile nuclear incidents, such as the recent accident at the Fukushima Daiichi power plant in Japan. In response to this incident, the NRC mandated safety and operational changes to the nation's nuclear reactors.

In particular, the work done to prepare for license extensions and post-Fukushima upgrades has come at some cost to the industry. Capital expenditures have risen by 103 percent in real terms since 2002, with some of this also a result of power uprates, which increase a power plant's generating capacity. In fact, 92 of the nation's operating reactors have been approved for uprates that have added over 7,000 MW of capacity.[29] There is some expectation that, since most license renewals and post-Fukushima upgrades have been completed, the recent increase in capital spending should normalize to a more moderate level.

In some cases, these large-scale investments in capital improvements have proven insurmountable as plants find it difficult to recoup capital costs in restructured markets. This has led some operators to shut down rather than make the necessary investments. For example, the Oyster Creek facility in New Jersey has elected to shut down 10 years early in an agreement with the state, instead of investing in adding expensive cooling towers.

The nuclear industry is also leading efforts to increase efficiency and lower the cost of operations. A multi-year initiative, "Delivering the Nuclear Promise," focuses on analyzing cost drivers and redesigning plant processes to increase efficiency, which can reduce costs and increase revenue. The goal is to reduce the cost of generating electricity at nuclear power plants by 30 percent by 2018.[30]

Photo courtesy of the Nuclear Energy Institute

Case Studies Examining Recent State Activity

Several states have taken a variety of actions to address current concerns about the future of nuclear power in the United States. In an effort to highlight recent state action on nuclear issues, NCSL has chosen to examine the work in three states. Illinois and New York were chosen due to their prominence in the national debate over premature nuclear plant closures in restructured markets, while Wisconsin offers an example of how these issues are spilling into states that are vertically integrated.

Illinois

Illinois, a restructured state, is the country's top producer of nuclear energy, with 11 nuclear reactors at six plants. These 11 reactors, operated by Exelon Corp., generate almost 50 percent of the state's electricity. In recent years, Exelon has publicly said that three of its nuclear plants—Byron, Quad Cities and Clinton—are unprofitable and are at risk of closure without assistance from the state. In fact, Exelon announced in June 2016 that it planned to retire the three reactors at its Clinton and Quad Cities plants unless the state enacted policy changes. The announcement came after the Illinois legislature failed to pass a measure that would have established a Zero Emission Standard to provide make-whole payments to the plants. Ultimately, the General Assembly passed a comprehensive energy reform bill in its November 2016 veto session that established a Zero Emissions Credits (ZECs) program for the Clinton and Quad Cities plants. It appears that this move will keep the reactors in operation for at least another decade. However, the path to the November 2016 vote could be of interest to other states.

In May 2014, the state legislature adopted a resolution that urged FERC, along with the two regional transmission organizations that cover Illinois—PJM and MISO—to consider policies and rules that would protect the state's nuclear plants. The resolution called for a study to examine the environmental, reliability, capacity and economic effects that prematurely closing these plants would have on the state and to explore market-based solutions to ensure that the plants would not close.

In response to the request, four Illinois state agencies released a report in early 2015[31] addressing issues pertaining to the premature closures of the state's nuclear power plants. The report not only detailed the potential costs to the state if the plants close, but also suggested that investments in other clean energy sources could mitigate some of the impacts. The report also recommended several programs the state could undertake to support carbon-free energy sources such as nuclear power. The recommendations included implementing a carbon tax or cap and trade program as well as considering a low-carbon portfolio standard, similar in structure to the state's renewable portfolio standard.

In response, the Illinois General Assembly introduced two bills in 2015—known as the Illinois Low Carbon Portfolio Standard—designed to reduce carbon emissions, increase renewable energy, and maintain a stable and secure electricity supply. The bills would have helped Exelon's most at-risk reactors by requiring utilities to buy 70 percent of their power from low-carbon sources of generation, including nuclear. The legislation also included a price cap so that the average electricity customer would have paid no more than about 2 percent in additional electricity costs above 2009 rates. In addition, customers would have been given a direct credit if wholesale prices exceeded a specified level. However, the bill failed to reach the floor of either chamber before the legislature adjourned.

Exelon had deferred any decisions in 2015 regarding closure of its Illinois plants. In April 2016, Exelon announced that its Clinton nuclear plant cleared the 2016-2017 capacity auction within MISO, which commits the plant to operate through May 2017. Meanwhile, Quad Cities and Byron nuclear plants cleared the transition capacity auction within PJM for the 2017-2018 planning year. Only a month later, the results of PJM's capacity auction for the 2019-2020 planning year came back with prices 40 percent lower than the previous auction—a fact attributed largely to significant bids from new natural gas

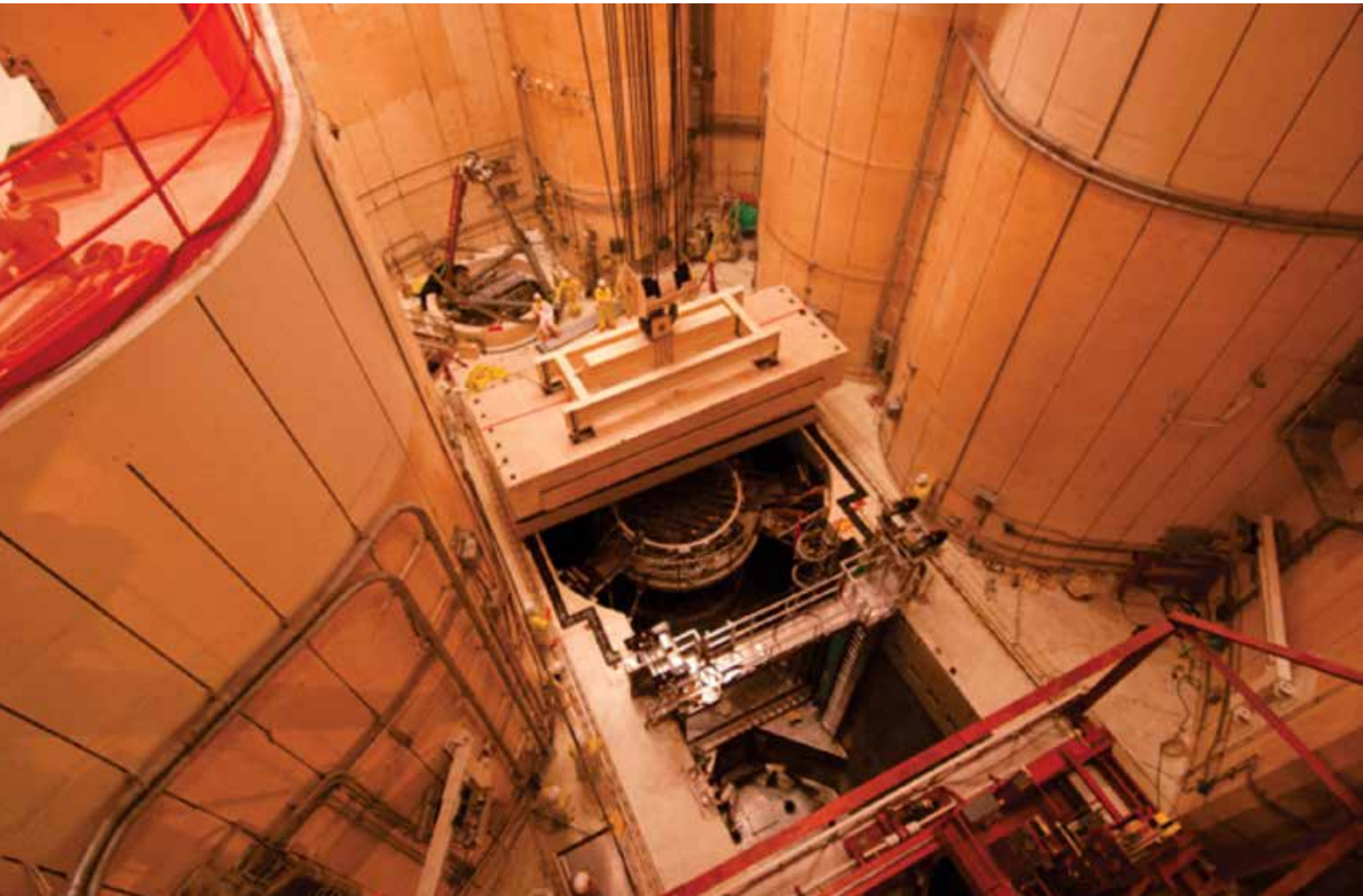


Photo courtesy of the Nuclear Energy Institute

capacity. Quad Cities failed to clear the auction, while only a portion of Byron's capacity cleared.

At the same time, the state legislature considered a new measure that combined the primary components from previous bills, along with a zero emission standard to support nuclear generation in the state. Senate Bill 1585—the Next Generation Energy Plan—was backed by a number of stakeholders, including Exelon. The bill would have offered ZECs to struggling nuclear plants, recommending that nuclear plants prove their need for financial support prior to receiving the subsidy. Based on this information, the state would have established the level of help each plant would need.

While this legislation brought many stakeholders to the table, it faced opposition and suffered from a budget stalemate between the Republican governor and the Democrat-controlled General Assembly. Lawmakers adjourned without a full vote on the bill. On May 6, 2016, Exelon announced plans to shut down the Clinton nuclear plant in 2017, and the Quad Cities nuclear plant the following year. The company cited the need for legislative reforms and market design changes in MISO so the plants could remain economically viable. The Byron plant is obligated to operate through May 2019.

The November 2016 veto session offered one other opportunity to pass legislation. The fast-moving session saw a new bill surface—Senate Bill 2814—which was an all-encompassing energy reform package that included changes to the state RPS, along with financial support for struggling power plants. The Future Energy Jobs Bill initially included financial supports not only for the Clinton and Quad Cities plants, but also for struggling coal plants in the southern part of the state. Due to opposition from environmentalists, subsidies for coal plants were removed, while a variety of other changes were made to the 500-page bill—over 30 in total—in order to garner support from various stakeholders. One final change included ratepayer protections, which capped rate increases for businesses and residential customers. In the end, the bill passed by only three votes in the House. Governor Bruce Rauner signed the bill into law on Dec. 7, 2016.

The Future Energy Jobs Bill will offer around $235 million per year in ratepayer subsidies to the Clinton and Quad Cities plants by establishing a Zero Emission Standard that is designed to increase the state's reliance on nuclear by purchasing Zero Emissions Credits from nuclear plants—a mechanism by which nuclear plants are compensated on a megawatt-hour basis for producing carbon-free electricity. ZECs are calculated, in part, based on the social cost of carbon, but will be reduced if the price of electricity rises in order to benefit ratepayers. The contract for purchasing ZECs runs 10 years.

New York

Nuclear power accounts for roughly 30 percent of New York's electricity generation. Only natural gas—at nearly 40 percent—provides more electricity. There are six operating nuclear reactors at four nuclear power facilities in the state. The Ginna and FitzPatrick facilities are single-reactor power plants, while Indian Point and Nine Mile Point each operate two reactors. All the reactors, aside from Indian Point, are located in upstate New York; Nine Mile Point and FitzPatrick sit less than a half-mile apart. Indian Point is located on the Hudson River, around 30 miles north of New York City. Entergy Corp. owns the FitzPatrick and Indian Point facilities, while the Ginna and Nine Mile Point facilities are owned by Constellation Energy, a subsidiary of Exelon Corp.

The electric power sector is restructured in New York. The grid is managed by the NYISO, while the New York Public Service Commission oversees market regulation. The state currently is pursuing its "Reforming Energy Vision" initiative that aims to transform the state's electric sector into a modern, clean and efficient system, with significant attention devoted to increasing the penetration of distributed renewable resources.

All the upstate nuclear plants—especially the single-unit FitzPatrick and the Ginna plants—have struggled in the current market. The state was able to retain the Ginna plant for the time being through a special power contract, the Ginna Reliability Support Services Agreement,[32] which was approved by FERC in 2016. The agreement offers the plant guaranteed revenue in exchange for grid support services to Rochester Gas and Electric Corp. However, this two-year contract will expire in 2017, at which point the facility would likely have faced being shut down.

In late 2015, Entergy announced plans to close FitzPatrick by January 2017. Similar to its work with Ginna, the state tried to retain the FitzPatrick plant or, if that was unsuccessful, to find a buyer that was willing to keep the plant operating.

Governor Andrew Cuomo's administration issued a white paper in early 2016 that proposed including nuclear power in the state renewable portfolio standard, along with making nuclear facilities eligible for Zero Emission Credits.

On Aug. 1, 2016, the New York Public Service Commission approved a proposal that included ZECs for upstate nuclear plants, but dropped the RPS-style mandate. The policy[33] will go into effect in 2017, and will compensate upstate nuclear plants for every megawatt-hour (MWh) of carbon-free electricity generated. The subsidy is projected to cost around $7.6 billion over a 12-year period. In the first two years, upstate nuclear plants will receive ZECs compensation at a rate of $17.48 per MWh, based on the social cost of carbon and the avoided carbon emissions the plants represent. The rate will be adjusted every two years based on several factors, including the social cost of carbon and market conditions. If electricity prices continue to fall, ZECs compensation could rise to $29.15 per MWh in 10 years, according to the proposal. However, if the forecast price of electricity and capacity rises above $39 per MWh, ZECs compensation would drop correspondingly. The Public Service Commission expects the average residential customer to pay an additional $2 per month on electricity bills.

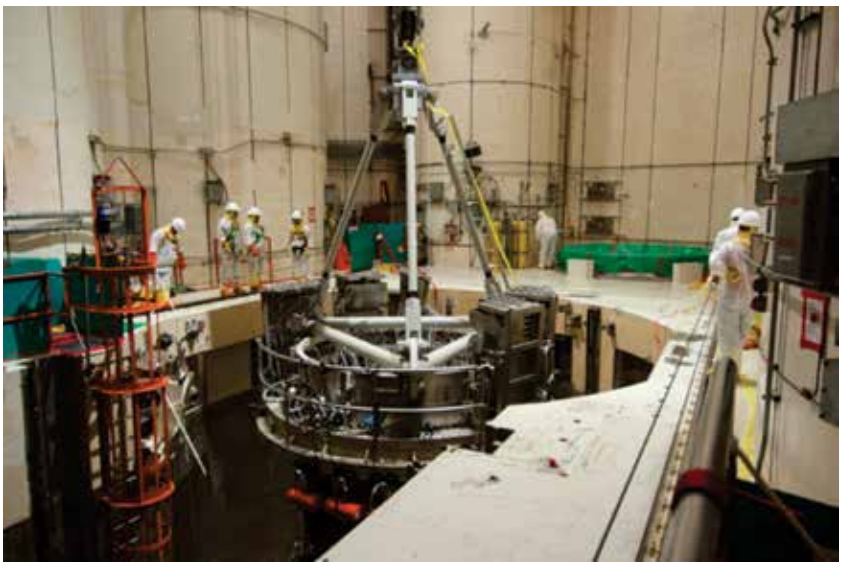


Photo courtesy of the Nuclear Energy Institute

Notably, Indian Point will not benefit from the proposal, given that the plant is not operating at a loss and therefore is not in need of additional compensation.

Public Service Commission staff said the state will experience "significant economic and environmental benefits" as a result of the ZECs plan. By retaining the state's nuclear fleet, New York would avoid replacing the lost baseload capacity with plants that would result in emissions of around 31 million metric tons of carbon dioxide during the next two years.

The initial response to the ZECs proposal has been mixed. The nuclear industry is generally supportive, while anti-nuclear groups have attacked the plan as a bailout. A number of groups already have filed suit in opposition to the policy.

Entergy said the proposal came too late for the company to change its position on FitzPatrick, and noted the exclusion of Indian Point. However, Exelon praised the policy, saying that, without it, the company would have had to close its Ginna plant.

Moreover, Exelon and Entergy have since agreed to the sale of FitzPatrick. Given that Nine Mile Point and FitzPatrick are situated close together, it has been suggested that the two plants could operate more economically as a single, three-unit facility if Exelon were to purchase and incorporate FitzPatrick as the plant's third reactor.

While ZECs will provide certainty for New York's upstate plants, uncertainty remained surrounding Indian Point. Entergy and the Cuomo administration have disagreed for some time on the future of Indian Point. The administration has sought to shut down the plant, claiming that Indian Point is a safety hazard due to its proximity to New York City. In turn, Entergy sued New York over several actions taken by the state.

In January 2017, Entergy reached an agreement with the state that will see Indian Point shut down by 2021. As part of the deal, Entergy has agreed to make repairs and upgrades at the facility, including to its waste storage system. In exchange, the state and environmental groups have agreed to drop legal challenges and support the plant through its closure. Given that Indian Point provides around a quarter of greater New York City's power and accounts for around 10 percent of the state's total electricity demand, some observers have begun to question what replacement generation will fill its lost capacity.

Throughout the 2016 legislative session, members of the New York Legislature worked to offer additional solutions to the issues surrounding nuclear power in the state. The New York Senate considered earmarking $100 million to pay for refueling FitzPatrick before a number of other ideas were introduced. NCSL has

highlighted a number of these bills below; however, none of them moved out of committee.

- **S.B. 7937** (failed—adjournment) would have directed the New York State Energy Research and Development Authority (NYSERDA) to expend up to $100 million of the proceeds from the auction of carbon dioxide emissions allowances to create an expedited program to benefit the state's struggling nuclear plants.
- **S.B. 8032** (failed—adjournment) would have authorized the New York State Power Authority to purchase the FitzPatrick plant—if necessary, through eminent domain.
- **A.B. 9033** (failed) and **S.B. 6476** (failed—adjournment) would replace the renewable portfolio standard with a low-carbon portfolio standard. This standard would include at least 17 percent nuclear power.
- **A.B. 8688, A.B. 9552** and **S.B. 6477** (failed—adjournment) would establish a zero emissions tax credit from which nuclear plants could benefit.

Wisconsin

The power sector in Wisconsin is vertically integrated and subject to traditional state oversight, although utilities and power plants can buy and sell electricity on the wholesale market through MISO. Wisconsin has two operating nuclear reactors at one nuclear power plant, the Point Beach Nuclear Plant, which is owned by NextEra Energy Inc. That single plant, with a total generating capacity of around 1,200 MW, produces 15 percent of the state's electricity. Coal has gone from generating around two-thirds of the state's electricity just a few years ago to generating only around half in 2015. During the same time, natural gas grew from around 13 percent of the electricity mix to 20 percent in 2015.[34]

From 1973 through May 2013, Wisconsin had the Kewaunee nuclear plant in operation with a 550 MW capacity. Kewaunee was a high-performing plant, with few operational or regulatory problems. It received a 20-year license extension from the NRC in 2011.

In 2005, Kewaunee was purchased by Dominion Resources Inc. and run as a merchant plant, selling electricity to two companies through power purchase agreements. However, when its contracts with those companies expired, they were not renewed. In the absence of power purchase agreements, the company was unable to keep the plant operating and decided to shut it down. Since Kewaunee shut down, the state has become a net importer of electricity to meet demand.[35]

On the other hand, the Point Beach facility is operating under a PPA agreed to in 2006 with Wisconsin Electric Power Co.[36] The contract for Unit 1 runs through 2030, and the contract for Unit 2 runs through 2033. These PPAs have guaranteed the Point Beach facility revenue—even as nuclear plants elsewhere are struggling to compete in the current market—and offer the plant some much-needed stability.

Although no nuclear projects are proposed or pending in the state, the Wisconsin Legislature recently passed legislation that ends a moratorium on new nuclear construction. The governor signed the bill into law on April 1, 2016. Kewaunee was the last nuclear reactor approved for construction by the state in 1974. However, the move signals support from policymakers, some of whom have said they would prefer to use nuclear power to meet federal carbon reduction requirements. In addition, the Wisconsin Legislature introduced Senate Bill 288 in the 2016 legislative session. The measure would have required including nuclear power as a preferred option for meeting future energy demands, as an official policy of the state, though it ultimately failed after passing out of committee.

The State Legislative Role

While primary oversight of nuclear facilities falls to the NRC and wholesale market operations are regulated by FERC, state legislatures play a role in developing policies that can affect the viability of nuclear power. State legislatures may propose measures that urge or require state or federal agencies and Congress to act in a particular way. For example, several states have proposed legislation requiring that nuclear power be included as states consider ways to meet EPA's Clean Power Plan. However, no measures have been introduced since the U.S. Supreme Court stayed EPA's implementation of the program pending the resolution of legal challenges. In 2014, New Mexico adopted House Memorial 57, which directs the state's Department of Energy, Mineral and Natural Resources to include—as part of the development of a state energy plan—an evaluation of the feasibility and economic benefits of constructing and operating a small modular reactor. In addition, states may pass resolutions urging the federal government to take some particular action. In 2015, Tennessee adopted Senate Joint Resolution 92, which encourages the Nuclear Regulatory Commission to support the license application of the Tennessee Valley Authority's Watts Bar Unit 2.

State legislatures also are considering a variety of other measures that encourage continued use of nuclear power, such as finance mechanisms that may help utilities recover operating costs, measures that enable construction of new nuclear plants, and efforts that engage the public and raise awareness of a particular nuclear issue. In addition, there are measures in opposition to the continued use or expansion of nuclear power within states. The following policies offer some examples of the most common trends among state legislatures.

Photo courtesy of Oak Ridge National Laboratory

Supporting Nuclear Energy

Since 2011, bills have been introduced in at least six states—Illinois, New York, Tennessee, Virginia, Washington and Wyoming—expressing support for nuclear power or attempting to address current market concerns to retain nuclear generation. Illinois, for example, in 2014 enacted House Resolution 1146 urging FERC and the regional transmission organizations to adopt policies and rules to protect Illinois' nuclear plants. The Virginia General Assembly passed a measure in 2013 establishing the Virginia Nuclear Energy Consortium "to make Virginia a national and global leader in nuclear energy." The consortium is made up of stakeholders invested in the development of nuclear energy, including the state of Virginia, several universities and nuclear energy companies and suppliers. In 2011, Wyoming created a task force on nuclear energy production to study ways to encourage nuclear power in the state. The task force, made up of legislators, is not currently active, but reviewed a variety of nuclear-related measures in previous legislative sessions.

Several states, including Washington and Wisconsin, introduced legislation that would require nuclear power to be considered as a preferred option as states develop ways to reduce greenhouse gas emissions as outlined in the EPA's Clean Power Plan. Although Washington and Wisconsin have not passed these bills and the future of the Clean Power Plan is uncertain, these measures show support for continued use of nuclear power in a number of states.

In addition, at least four states—Indiana, New Mexico, Tennessee and Washington—have considered measures to support development of advanced reactor technologies such as small modular reactors. For example, Indiana adopted House Resolution 54 in 2013, which urges the Indiana Legislative Council to study small modular reactors. In addition, Tennessee's House Joint Resolution 507, which passed in March 2016, supports the research and development of liquid core molten salt reactor and small modular reactor technologies as long-term solution to Tennessee's energy needs. Compared to traditional reactors—typically 1,000 MW or larger—small modular reactors are significantly smaller and projected to be more affordable and incorporate passive safety features into their designs. They feature simple, compact designs and have condensed site footprints, with the reactors housed underground. The reactors are small enough to have major components assembled in factories and shipped by truck, rail or barge and assembled on site. Small modular reactors remain in the design phase, but, with the support of federal, state and private investments, several models are expected to be operational by the mid-2020s.

Finance Mechanisms

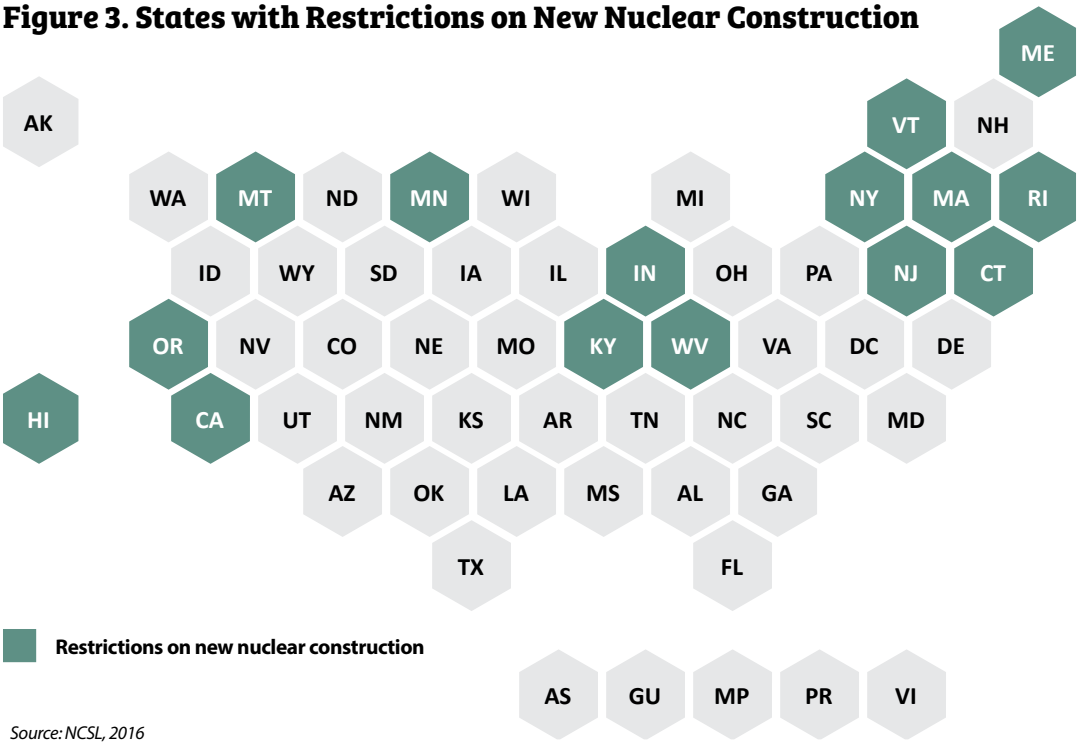
Florida passed legislation in 2015 that created a financing mechanism for investor-owned utilities to petition the Florida Public Service Commission to recover certain costs stemming from early retirement of a nuclear power plant. The bill deals with issues stemming from the premature decommissioning of the Crystal River nuclear plant, which was permanently shuttered in 2013 due to damage to a containment building. It allows Duke Energy Florida to petition the state Public Service Commission to issue bonds to pay off costs, which would normally have been paid by ratepayers over the life of the plant's operation.

Indiana's 2011 measure, Senate Bill 251, provides financial incentives to assist electric companies with nuclear generating facilities to recover costs and expenses incurred during comprehensive life cycle management upgrades to existing facilities. In addition, an early version of New York's latest budget bill included $100 million to pay for refueling the FitzPatrick plant and to help retain the plant's services and its jobs. The Senate passed the measure in March 2016, although the appropriation was not included in the final budget. However, the New York Senate has not stopped searching for ways to help its struggling nuclear fleet weather current market conditions. In late May and early June, two bills were introduced that would address financial issues. One measure, Senate Bill 7937, would offer expedited financial support to nuclear facilities that can prove financial support is needed to continue operations. Senate Bill 8032 would address the issue by directing the state to purchase the FitzPatrick plant.

Moratoriums

A number of state legislatures have passed laws pertaining to nuclear power, many of which have imposed moratoriums on construction of new nuclear facilities.[37] Fifteen states—California, Connecticut, Hawaii, Illinois, Kentucky, Maine, Massachusetts, Minnesota, Montana, New Jersey, New York, Oregon, Rhode Island, Vermont and West Virginia—have restrictions on the construction of new nuclear power fa-

Figure 3. States with Restrictions on New Nuclear Construction



Source: NCSL, 2016

cilities (Figure 3). However, Illinois, Kentucky and Minnesota introduced measures and Wisconsin passed legislation in 2016 to remove these barriers.

Wisconsin Governor Scott Walker signed Assembly Bill 384 into law in April 2016, ending the state moratorium. According to a 1983 law, the state Public Service Commission could not approve new nuclear power plants until a federal waste storage facility existed that would be capable of disposing of all high-level nuclear waste produced in the state. Seven other states with restrictions in place have passed similar laws in an effort to encourage the federal government to resolve the issue of establishing a national repository for high-level commercial waste.

Other restrictions require legislative approval, voter approval, or proof of economic and environmental viability. Hawaii, Illinois, Massachusetts, Rhode Island and Vermont require approval of the state legislature before any new nuclear plant can be constructed or operated in those states. In addition, Maine, Massachusetts, Montana and Oregon require voter approval in a statewide election. West Virginia requires that construction of a new nuclear facility be economically feasible for state ratepayers. Only Minnesota has an outright statewide ban, while New York has banned new nuclear construction in a limited area.

Education and Outreach

In the absence of legislation, state legislatures have the power to initiate dialogue and inform the public on these issues. By holding hearings in which presenters discuss the impacts of early closures on communities, the economy, the environment and electric system reliability, legislators can raise awareness of the issue.

This occurred in the Connecticut General Assembly in March 2016. The joint Energy and Technology Committee opened discussion on the economic threats to nuclear power in the state and whether the legislature should take action to make the state's lone nuclear plant more profitable.

The Energy and Technology Committee considered Senate Bill 344, which would have allowed the nuclear plant to bypass the competitive wholesale markets and enter into PPAs for up to 50 percent of its capacity. The bill passed unanimously in the Senate, but was ultimately tabled in the House. The General Assembly may revisit the measure during the 2017 legislative session.

Photo courtesy of the Nuclear Energy Institute

Policy Options

States may consider a number of policy options if the goal is to retain the current U.S. nuclear fleet. The following suggestions are designed to provide legislators with a suite of possible options to address the current pressures placed on operating nuclear facilities. The approaches in this paper have been informed by recent state actions and legislative efforts, but do not necessarily provide a comprehensive list of policy options, since state needs may differ. State legislatures may want to consider a variety of policies, including those outlined below, to retain the nuclear plants most at risk of shutting down.

Zero Emissions Credits

Illinois and New York adopted Zero Emissions Credits programs in 2016. ZECs are similar to the renewable energy credits wind and solar generators receive that compensate certain generating facilities, based on avoided carbon emissions. Under these programs, nuclear plants will receive a credit—a payment at a set rate—for every megawatt-hour of carbon-free electricity generated. Since the concept is fairly simple and separate from the wholesale market—based on compensation for environmental attributes—it could avoid tripping FERC's jurisdiction.

The test for how well such a program holds up in court will likely be decided in New York. The state's ZECs program has been challenged by a number of groups, although the state has said it is confident in the program's legality because it was designed specifically with FERC challenges in mind.

Under New York's 12-year plan, nuclear plants will receive ZECs from the New York State Energy Research

and Development Authority (NYSERDA) based on the number of megawatt-hours of electricity generated. For the first two years of the program, ZECs compensation has been set at $17.48 per MWh. This rate has been calculated based on the social cost of carbon and the avoided carbon emissions that the state's nuclear plants represent. According to the Public Service Commission, that equates to around 15 million metric tons of avoided carbon dioxide emissions each year.

The first two years of the program are expected to cost $965 million. This will be paid for by ratepayers, who will be charged by distribution utilities based on electricity consumption. Distribution utilities collect this fee and use it to pay NYSERDA, which pays the nuclear plants. On average, the Public Service Commission predicts that the average customer in the state will pay an additional $2 per month on their electricity bill.

Every two years, the state will recalculate the rate of compensation based on the social cost of carbon and the forecast price of electricity and capacity markets in NYISO. If electricity prices fall, ZECs would likely rise to compensate for the lost revenue. If electricity prices rise to more than $39 per MWh, then ZECs would drop correspondingly.

The Public Service Commission justified the program as an "environmental attributes purchase program" that incorporates payments based on the "value of the environmental and carbon benefits to the State and society at large." It also claimed that the program was the least-cost mechanism to achieve the state's goal of reducing carbon emissions. In short, the cost of rapidly replacing lost nuclear capacity with sufficient renewable capacity would be greater than the cost of retaining existing nuclear capacity. In addition, the Public Service Commission determined that most of the lost nuclear capacity would be replaced by natural gas-fired generation, not renewables.

Although the Illinois General Assembly was considering a bill early in 2016 that included ZECs, the program would have functioned differently than New York's. Illinois' original proposal would have set ZECs compensation based on operating losses at specific nuclear plants, essentially creating "make-whole" payments some observers believed to be more susceptible to FERC challenges. That measure did not pass, but the legislature reconvened for a veto session in November, where it considered another bill that contained a ZECs program similar to New York's, with ZECs compensation based on the social cost of carbon.

The 2016 Illinois veto session saw passage of Senate Bill 2814—an all-encompassing energy reform package that includes changes to the state RPS, along with financial support for struggling power plants.

Known as the Future Energy Jobs Bill, the legislation will offer around $235 million per year in ratepayer subsidies to the Clinton and Quad Cities plants through establishing a Zero Emission Standard, designed to increase the state's reliance on nuclear by purchasing ZECs from nuclear plants. ZECs are calculated, in part, based on the social cost of carbon, but will be reduced if the price of electricity rises. The contract for purchasing ZECs runs 10 years.

Nuclear and Renewable Energy Standard

State legislatures have increasingly taken action to support state renewable portfolio standards; 29 states and the District of Columbia now have adopted such measures. These standards—that primarily apply to investor owned utilities (IOUs)—require utilities to sell a specified percentage or amount of renewable electricity. Some states also include municipalities and electric cooperatives, although their requirements are equivalent or lower.

Most states currently do not include nuclear energy in their renewable portfolio standards. However, state legislatures could modify existing legislation to account for nuclear generation. In 2015, Arizona considered Senate Bill 1134, which would have changed the definition of renewable energy to include "solar, wind, hydroelectric, pumped storage, flywheel storage, hydrogen, geothermal, biomass and biomass baseload energy and nuclear energy from sources that are fueled by uranium fuel rods that include 80 percent or more of recycled nuclear fuel and natural thorium reactor resources under development." This bill reached the Senate floor during the 2015 session, but its immediate applicability for nuclear power would not have been realized unless a fuel recycling mechanism could be found, since no such facility exists in the United States.

Similarly, in New Jersey, the state legislature considered a measure that would have included aneutronic fusion as a type of Class I renewable technology, while the Washington Legislature considered a bill that would have amended the state RPS to include small modular reactors.

States also could consider establishing a separate set of standards to support nuclear facilities as Illinois did with their Low Carbon Portfolio Standard, introduced in the state General Assembly in 2015. The bill, which did not pass, would have required the state's IOUs to purchase credits from low-carbon energy sources—including nuclear energy—to match 70 percent of the electricity used on the distribution system. Similarly, New York considered establishing nuclear as a separate category within its Clean Energy Standard. It would have been treated differently than renewable energy sources, and would have been given a different set of mandates.

What's in a name? A lot, actually.

State legislators who are interested in developing a separate standard specific to nuclear power may want to consider framing the new standards with one of the following:

- Nuclear Energy Standard
- Low-Carbon Portfolio Standard
- Alternative Energy Standard
- Sustainable Energy Standard
- Zero Emission Standard
- Clean Energy Standard
- Advanced Energy Standard
- Reliable Energy Standard
- Electric Diversity Standard

State Legislation Supporting Nuclear Energy

State legislators can signal their support for nuclear power in many other ways. Resolutions have the power to demonstrate a state's position to the nuclear power industry. In the same way that state moratoriums have signaled opposition, other states have demonstrated their openness to nuclear by declaring support for certain facilities or projects. The New Mexico Legislature adopted measures (House Memorial 40 and Senate Memorial 34) that support development of a consolidated interim storage site in the southeastern part of the state. They also support a specific interim storage project that is co-owned by local governments. This action serves several purposes. It demonstrates legislative support for an industry and project and signals that the state might be inclined to pass further legislation, as necessary.

Initiatives also could target specific projects or contracts. For instance, a state legislature could express its support for the transfer of ownership of a nuclear plant to a new owner that agrees to keep the plant online. Similarly, a legislature could signal support for PPAs or reliability contracts with nuclear plants.

While Wisconsin's recent repeal of its ban on new nuclear construction will have no immediate effect since there are no pending projects, the legislation could make it easier for other states to reconsider similar bans and the role nuclear power can play in the energy mix.

Advanced Cost Recovery

State legislatures may not only consider policies that support the retention of existing nuclear facilities, but also can support new reactor development. To help regulated utilities with the financing for new nuclear power plants, states may enact policies allowing or directing a utility to collect costs from customers during construction. This mechanism, known as Advanced Cost Recovery or Construction Work in Progress (CWIP), allows the utility to collect financing costs for a project before the plant construction is completed. By allowing the costs to be recovered during construction, CWIP reduces the overall amount needed to finance a project and may reduce the total project costs that eventually are included in the customer rate base.

Florida, Georgia and South Carolina have used advanced cost recovery policies to lower the risk and total cost in order to increase investment in these projects. However, some consumer advocates oppose these mechanisms, contending that the tools place too much risk on the consumer. Bills have been proposed in Florida and Georgia to repeal or prevent the use of CWIP. In 2006, Florida passed legislation to promote development of nuclear electricity generation, which provided for recovery of costs incurred in siting, design, licensing and construction of new nuclear plants. The statute was amended in 2008 to include uprate projects that increase the generating capacity of existing nuclear plants and expanded or relocated electrical transmission lines.

Most recently, Florida considered House Bill 67, which would have repealed the statute, but the bill died in committee. Similar measures have been introduced in previous state legislative sessions, but none have passed. Similarly, House Bill 931 was introduced in the 2016 session in the Georgia

General Assembly that called for an end to the Nuclear Construction Cost Recovery surcharge on Georgia Power electric bills after March 2017. However, the bill was never debated and failed when the legislature adjourned.

State Carbon Tax or Cap and Trade Policies

Some nuclear advocates, along with a number of other groups, feel that a state tax on carbon emissions could serve to even the playing field by forcing generation technologies to account for their environmental costs. While nuclear plants must account for the plant's decommissioning and handling of spent nuclear fuel in the price at which they sell electricity, other technologies do not have to account for many of their environmental impacts. Through a carbon tax, fossil fuel plants would have to include the cost of carbon pollution in their electricity prices, which would make nuclear more competitive.

Although two Canadian provinces—British Columbia and Alberta—have enacted carbon taxes, no U.S. state has done so. In November, voters in Washington rejected a ballot measure that would have imposed a carbon tax in the state through higher prices for gasoline and fossil fuel-fired electricity. The initiative received only about 40 percent support. However, there currently are several other state carbon tax initiatives. Massachusetts, New York, Oregon, Rhode Island and Vermont have either ballot initiatives or legislators who are pushing for some version of a carbon tax.

The following bills would implement some type of carbon tax, although none of these measures has moved out of committee since being introduced.

- **New York: A.B. 8372** and **S.B. 6037** (failed—adjourned) would establish a tax on carbon-based fuels.
- **New York: A.B. 8401** (failed—adjourned) would establish a tax on carbon emissions.
- **Rhode Island: S.B. 417** (failed—adjourned) would establish an excise tax on all fossil fuels entering the state to fund a "Clean Energy Fund."
- **Vermont: H.B. 395** and **H.B. 412** (failed—adjourned) would establish a carbon pollution tax.
- **Vermont H.J.R. 20** (failed—adjourned) would request the governor to advocate for a regional carbon tax.
- **Washington: S.B. 6306** (failed—adjourned) would establish a carbon pollution tax on fossil fuels.

Cap and trade policies also could be used to increase the cost of carbon emissions by rewarding low-carbon power producers, including nuclear. California and the nine states in the Northeast that make up the Regional Greenhouse Gas Initiative have established a carbon price to this effect, although it is far too low to close the revenue gap to the extent required to help nuclear compete. Entergy has called for a technology-neutral "clean energy credit" to compensate any clean generation that avoids carbon emissions. This would function much the same as zero emissions credits by compensating zero- and low-emission generators for offsetting carbon emissions. In fact, the ZECs program in New York takes this approach, although it counts only toward nuclear power facilities.

The New York Senate also considered Senate Bill 7937, which would have taken up to $100 million of the proceeds from the state auction of carbon dioxide allowances to provide expedited financial assistance to struggling nuclear facilities in the state.

State-Mandated PPAs

Legislators in Connecticut considered Senate Bill 344 during the 2016 session, which would have assisted the state's lone nuclear plant and a number of other potential beneficiaries. The bill would have allowed the plant to bypass regional energy markets for up to 50 percent of its capacity by entering into PPAs with local distribution utilities. Although the legislature adjourned before passage of the measure, other restructured states could consider similar legislation for enabling PPAs.

Photo courtesy of the Idaho National Laboratory

Tax Incentives

Most electric generating technologies receive financial breaks or incentives from federal or state governments. The Energy Policy Act of 2005, for example, provides production tax credits for new nuclear power plants, investment tax credits for advanced coal technology projects, and an authorization for a loan guarantee program administered through the U.S. Department of Energy to support financing and commercial deployment of innovative technologies that reduce emissions. The tax credit is available for the first 6,000 MW of new nuclear generating capacity and lasts for the first eight years of operation. To qualify for the credit, a new nuclear power plant must be in service on or before Dec. 31, 2020.

This same approach, whether for new or existing nuclear plants, could be applied through state programs. In 2009, Utah enacted House Bill 430—the Renewable Energy Development Act—to provide incentives to develop renewable energy projects that include nuclear generation facilities.

State Acts as "Caretaker"

This certainly is the most direct approach. However, it may serve as the only method for retaining some nuclear facilities, as appeared might be the case for the FitzPatrick plant in New York. For some time, the plant owner, Entergy, rebuffed any policy options as having come too late to reverse its decision to close FitzPatrick. Even with state action, it appeared that Entergy would move forward with the plant's shutdown. Therefore, if the state was interested in keeping the plant operational, it would have needed to find another buyer for the plant—a caretaker owner, one willing to incur near-term financial losses with the expectation that it would receive state support and return to future financial viability. In some ways, this would have been a philanthropic venture. However, in the absence of a private buyer, the state could have acted as the caretaker owner of the plant by purchasing it from Entergy and running it through the current market conditions. To this end, Senate Bill 8032 was introduced in the New York Senate, directing the New York State Power Authority to purchase the FitzPatrick plant—if necessary through eminent domain—in order to keep the plant in operation.

Given the developments between Entergy and Exelon, with the sale of FitzPatrick now pending regulatory approval, the legislation does not appear necessary. However, it offers an example of another option for states that have a strong desire to retain nuclear power plants.

Conclusion

Nuclear generation faces a number of challenges—from economic pressures to competition with other energy sources—that have not been seen in this sector until recently. Competition in restructured electricity markets and pressures from competing technologies continue to challenge the nation's nuclear fleet.

Since these relatively short-term challenges in the market are threatening long-term capital investments in nuclear plants, state legislatures are taking a number of actions to support the continued use of nuclear in the U.S. energy mix. This includes passing measures that encourage nuclear power in the nation's generation mix, considering finance mechanisms that may help utilities recover operating costs, supporting the construction of new nuclear plants, and making efforts to engage the public and raise awareness of a particular nuclear issue.

This publication is intended to inform state legislators who are interested in learning more about the current market conditions that are causing the closure of nuclear power plants across the United States. It also is intended to offer possible policy strategies legislators could consider to keep the nation's nuclear fleet online in the near-term.

Appendix A

Legislative Activity Related to Nuclear Generation

The following list summarizes recent nuclear legislation (2010 – 2016) that affects nuclear generation.

ALASKA

S.B. 220 (enacted, 2010) repealed Alaska's moratorium on nuclear electric power.

ARKANSAS

S.B. 246 (enacted, 2013) created an Institutional Energy Research Committee to develop a report that includes research and data on the costs of additional energy production facilities, including nuclear power.

CALIFORNIA

Assembly Joint Resolution 29 (adopted, 2016) urges the passage of the Interim Consolidated Storage Act of 2015 and urges the U.S. Department of Energy to implement the prompt and safe relocation of spent nuclear fuel from the San Onofre Nuclear Generating Station to a licensed and regulated interim consolidated storage facility.

Senate Joint Resolution 23 (enacted, 2016) urges the passage of the Interim Consolidated Storage Act of 2016 and urges the U.S. Department of Energy to implement the prompt and safe relocation of spent nuclear fuel from the San Onofre Nuclear Generating Station to a licensed and regulated interim consolidated storage facility.

S.B. 968 (enacted, 2016) directs the Public Utilities Commission to require an assessment, conducted by an independent party, of the adverse and beneficial economic impacts, and net economic effects that could occur, and ways to mitigate the impact, if the Diablo Canyon Units 1 and 2 power plant were to temporarily or permanently shut down before the power plant's current operating licenses expire, or if it is decided not to pursue license renewal. Requires consideration of actions to offset closure.

S.B. 657 (enacted, 2016) requires the Public Utilities Commission to convene an independent peer review panel to conduct an independent review of enhanced seismic studies and surveys of Diablo Canyon Units 1 and 2 power plant, including the surrounding areas of the facility and areas of nuclear waste storage.

CONNECTICUT

H.B. 5382 (failed, 2016) assures Connecticut's standards under its Radiological Emergency Preparedness and Response program and incorporate certain recommendations of the National Research Council.

S.B. 344 (failed—adjourned, 2016) authorizes the Commissioner of Energy and Environmental Protection, with oversight from the state Attorney General and Office of Consumer Counsel, to direct electric distribution companies to enter into agreements for energy, capacity or any environmental attributes for a period of not more than 10 years with nuclear facilities.

FLORIDA

H.B. 7109 (enacted, 2015) created a financing mechanism for investor-owned utilities to petition the Florida Public Service Commission to recover certain costs stemming from the early retirement of a nuclear power plant. The bill deals with issues stemming from the premature decommissioning of the Crystal River nuclear plant, which was permanently shuttered in 2013 due to damage to a containment building. It allows Duke Energy Florida to petition the state Public Service Commission to issue bonds to pay off costs, which would have normally been paid by ratepayers over the life of the plant's operation.

House Memorial 1209 (failed, 2016) memorializes the U.S. Congress to stop increases in the federal loan guarantee program for new nuclear energy facility construction; includes a moratorium on nuclear waste operations until a safe way to transport and store nuclear waste and protect storage sites against terrorist attacks is secured.

GEORGIA

H.B. 931 (failed, 2016) allows a utility to recover costs associated with financing a nuclear plant and establishes an accounting method to be used in the event the scheduled date of commercial operation is exceeded.

House Resolution 1862 (failed, 2016) would have created the House Study Committee on Georgia Nuclear Energy Financing.

ILLINOIS

S.B. 2814 (enacted, 2016) as amended, this bill is called the Future Energy Jobs Bill, which, among other things, provides financial support to struggling nuclear plants through a Zero Emissions Credits program. The bill will provide around $235 million per year in ratepayer subsidies to the Clinton and Quad Cities nuclear plants by purchasing ZECs from nuclear plants for every megawatt-hour of carbon-free electricity that goes onto the grid. ZECs are calculated, in part, based on the social cost of carbon, although rate increases are capped for businesses and residential customers. The contract for purchasing ZECs runs 10 years.

H.B. 5815 (failed—adjourned, 2015) provides that no public utility shall begin the construction of any nuclear power plant extension, alteration, or addition unless and until it has obtained from the Commerce Commission a certificate that public convenience and necessity require such construction.

H.B. 4542 (failed—adjourned, 2016) removes language that provides that no construction shall commence on any new nuclear power plant to be located within the state.

H.B. 348 (failed—adjourned, 2015) would remove language prohibiting the construction of new nuclear power plants in the state.

S.B. 1585 and **H.B. 3293** (failed—adjourned, 2016) as amended, this bill is called the Next Generation Energy Plan, which would, among other things, implement a zero emissions standard, which would provide financial support to struggling nuclear plants that can demonstrate revenues that are insufficient to cover their costs and operating risks. Exelon has proposed the amended bill, and said the passage of adequate legislation would be required to keep it from closing two nuclear power plants in the state.

House Resolution 1146 (enacted, 2014) urged the federal government and the Midwest grid operator to adopt policies and rules to protect Illinois' nuclear plants.

Senate Resolution 1719 (adopted, 2016) urges Congress to pass legislation to allocate funds from the Interim Storage Fund to the local authorities in Zion and other similarly situated communities to mitigate social and economic impacts arising from the storage of nuclear material.

INDIANA

House Resolution 54 (adopted, 2013) urges the Indiana Legislative Council to study small modular reactors.

S.B. 251 (enacted, 2011) provides financial incentives to assist electric companies with nuclear generating facilities to recover costs and expenses incurred during comprehensive life cycle management upgrades to existing facilities.

IOWA

House File 2399 (enacted, 2010) requires certain Iowa utilities to analyze and prepare for the possible construction of new nuclear generating facilities.

KENTUCKY

S.B. 89 (failed, 2016) removes the state's moratorium on the construction of new nuclear power facilities, but requires facilities to have a plan for storage.

H.B. 103 (failed, 2016) allows for construction of a nuclear power facility on or within 50 miles of a site previously used for the manufacture of nuclear products.

H.B. 559 (enacted, 2012) allows for the construction of facilities that use certain nuclear technologies, but the state's moratorium on the building of new nuclear facilities to generate electricity remains in place.

MASSACHUSETTS

H.B. 2167 (failed—adjourned, 2015) directs the state Emergency Management Agency to assess and report on the preparedness plans for a radiological accident at the Pilgrim Nuclear Power Station and Seabrook Nuclear Power Plant.

S.B. 1797 (failed—adjourned, 2015) would establish a fee on the storage of spent nuclear fuel in pools.

MICHIGAN

House Resolution 220 (adopted, 2016) urges the president and Congress to abandon President Jimmy Carter's April 1977 nuclear power policy and explore and support policies that will lead to the establishment of facilities within the United States for the reprocessing and recycling of spent nuclear fuel.

Senate Concurrent Resolution 6 (adopted, 2016) memorializes Congress to appropriate funds from the Nuclear Waste Fund for the establishment of a permanent repository for high-level nuclear waste or reimburse electric utility customers who paid into the fund.

Senate Concurrent Resolution 8 (adopted, 2016) urges the U.S. Department of Energy and the U.S. Nuclear Regulatory Commission to fulfill their obligation to establish a permanent repository for high-level nuclear waste.

MINNESOTA

H.B. 338 (failed—adjourned, 2015) would allow for construction of a new nuclear-powered electric generating unit at Monticello.

H.B. 1400 (failed—adjourned, 2016) and S.B. 95 (pending, 2015) would abolish the prohibition on issuing a certificate of need for new nuclear power plants.

NEW JERSEY

S.B. 1536 (pending, 2016) would add aneutronic fusion to types of Class I renewable energies.

NEW MEXICO

Senate Memorial 34 (adopted, 2016) and House Memorial 40 (adopted, 2016) requests the Eddy-Lea Energy Alliance to develop a consolidated interim storage facility.

House Memorial 57 (enacted, 2014) directs the state's Department of Energy, Mineral and Natural Resources to include—as part of the development of a state energy plan—an evaluation of the feasibility and economic benefits of constructing and operating a small modular reactor.

NEW YORK

A.B. 2939 (failed—adjourned, 2015) would require the approval of the state legislature in a joint resolution for the construction or continued operation of nuclear electric generating facilities.

S.B. 7937 (failed—adjourned, 2016) would authorize the New York State Energy Research and Development Authority (NYSERDA) to expend not more than $100 million from the proceeds collected from the auction of carbon dioxide emissions allowances to effectuate an expedited program, pending approval by the state Public Service Commission, that would provide financial support to certain nuclear power plants that can demonstrate the lack of financial viability absent additional financial support.

S.B. 8032 (failed—adjourned, 2016) authorizes and directs the New York State Power Authority to purchase the James A. FitzPatrick Nuclear Power Plant.

TENNESSEE

House Joint Resolution 507 (enacted, 2016) supports the research and development of liquid core molten salt reactor and small modular reactor technologies as a long-term solution to the state's energy needs.

Senate Joint Resolution 92 (enacted, 2015) encourages the Nuclear Regulatory Commission to support the license application of the Tennessee Valley Authority related to the safe operation of Watts Bar Unit 2.

VERMONT

H.B. 135 (enacted, 2015) allows the state Department of Health to charge the fees necessary to support its responsibilities should Vermont enter into an agreement with the Nuclear Regulatory Commission of the Atomic Energy Act to assume some of the federal responsibilities with respect to byproduct, source, and special nuclear materials.

VIRGINIA

S.B. 459 (enacted, 2014) establishes that planning and development of new nuclear generation facilities are in the public interest and allows nuclear development costs to be included in base rates.

S.B. 1138 and **H.B. 1790** (enacted, 2013) established the Virginia Nuclear Energy Consortium "to make Virginia a national and global leader in nuclear energy."

WASHINGTON

S.B. 6224 (failed—adjourned, 2016) would require the state Energy Facility Site Evaluation Council to expedite certain of its processes in reviewing alternative energy resource facility applications.

S.B. 6217 (failed—adjourned, 2016) would require the state to consider nuclear generation when developing a plan to reduce greenhouse gas emissions as outlined in the EPA's Clean Power Plan.

S.B. 5089 and **S.B. 5090** (failed—adjourned, 2015) would modify the state's renewable energy standard so that nuclear energy from small reactors is included as a compliance option.

S.B. 5091 (failed—adjourned, 2015) would include nuclear energy in the definition of a qualified alternative energy resource for the purposes of existing law.

S.B. 5092 (failed—adjourned, 2015) would include nuclear energy in the principles that guide development and implementation of the state's energy strategy.

S.B. 5093 (failed—adjourned, 2015) would establish a nuclear energy education program for students in the eighth through 12th grades.

S.B. 5113 (failed—adjourned, 2015) would require the state Department of Commerce to coordinate and advance the siting and manufacturing of SMRs.

S.B. 5114 (failed, 2015) which would provide a tax exemption for the production of small-scale reactors

S.B. 5115 (failed, 2015) would require the study of siting of small modular reactors in Washington.

WISCONSIN

A.B. 384 (enacted, 2016) ends the ban on building new nuclear reactors in the state. Under a 1983 law, the state Public Service Commission cannot approve new nuclear plants until a federal waste storage facility exists which is capable of disposing of all high-level nuclear waste produced in the state.

S.B. 228 (failed, 2015) would have required that nuclear power be included as a preferred option for meeting future energy demands, as an official policy of the state.

WYOMING

H.B. 129 (enacted, 2011) created a task force on nuclear energy production to study ways to encourage nuclear power in Wyoming.

PUERTO RICO

House Resolution 1069 (failed—adjourned, 2014) would direct the House Joint Committee on Public-Private to conduct research on the feasibility of using nuclear power as an alternative source for the production of electricity.

Appendix B

Electricity Generation Profiles

State/Jurisdiction	Nuclear	Natural Gas	Coal	Renewables	Petroleum	Hydroelectric	Other	Biomass	Percent of U.S. Generation
Alabama	28%	32%	32%	0%	0%	6%	0%	2%	3.58%
Alaska	0%	73%	12%	3%	10%	0%	0%	1%	0.11%
Arizona	29%	24%	38%	3%	0%	5%	0%	0%	2.69%
Arkansas	24%	16%	54%	0%	0%	4%	0%	2%	1.48%
California	9%	61%	0%	18%	0%	8%	1%	3%	4.77%
Colorado	0%	22%	60%	14%	0%	3%	0%	0%	1.29%
Connecticut	47%	44%	2%	0%	2%	1%	2%	2%	0.81%
Delaware	0%	82%	11%	1%	2%	0%	3%	1%	0.18%
Florida	12%	62%	23%	0%	1%	0%	0%	2%	5.44%
Georgia	26%	33%	36%	0%	0%	2%	0%	3%	3.02%
Hawaii	0%	0%	15%	9%	68%	1%	4%	3%	0.24%
Idaho	0%	17%	1%	19%	0%	59%	0%	4%	0.36%
Illnois	49%	3%	43%	5%	0%	0%	0%	0%	4.83%
Indiana	0%	8%	85%	3%	1%	0%	2%	0%	2.77%
Iowa	7%	2%	59%	29%	0%	2%	0%	0%	1.36%
Kansas	17%	3%	58%	22%	0%	0%	0%	0%	1.19%
Kentucky	0%	3%	92%	0%	1%	3%	0%	0%	2.18%
Louisiana	17%	54%	18%	0%	5%	1%	2%	3%	2.50%
Maine	0%	33%	1%	8%	2%	27%	3%	26%	0.32%
Maryland	34%	7%	49%	1%	1%	5%	1%	2%	0.86%
Massachusetts	19%	59%	9%	2%	3%	1%	3%	4%	0.75%
Michigan	29%	12%	50%	4%	1%	1%	1%	3%	2.56%
Minnesota	22%	7%	49%	17%	0%	1%	1%	3%	1.37%
Mississippi	19%	59%	19%	0%	0%	0%	0%	3%	1.32%
Missouri	11%	5%	82%	1%	0%	1%	0%	0%	2.10%
Montana	0%	2%	51%	7%	1%	38%	1%	0%	0.73%
Nebraska	26%	1%	63%	7%	0%	3%	0%	0%	0.95%
Nevada	0%	68%	19%	12%	0%	0%	0%	0%	0.81%
New Hampshire	52%	22%	7%	2%	1%	7%	0%	8%	0.47%

State/Jurisdiction	Nuclear	Natural Gas	Coal	Renewables	Petroleum	Hydroelectric	Other	Biomass	Percent of U.S. Generation
New Jersey	46%	46%	4%	1%	1%	0%	1%	1%	1.63%
New Mexico	0%	28%	63%	9%	0%	0%	0%	0%	0.77%
New York	31%	40%	3%	3%	2%	19%	1%	2%	3.29%
North Carolina	32%	22%	38%	1%	0%	4%	0%	2%	3.07%
North Dakota	0%	1%	75%	17%	0%	7%	0%	0%	0.87%
Ohio	12%	18%	67%	1%	1%	0%	1%	1%	3.22%
Oklahoma	0%	38%	43%	17%	0%	2%	0%	0%	1.68%
Oregon	0%	21%	5%	13%	0%	59%	0%	2%	1.44%
Pennsylvania	36%	24%	36%	2%	0%	1%	1%	1%	5.30%
Rhode Island	0%	95%	0%	0%	1%	0%	0%	3%	0.15%
South Carolina	54%	12%	30%	0%	0%	2%	0%	3%	2.34%
South Dakota	0%	4%	24%	21%	0%	50%	0%	0%	0.26%
Tennessee	35%	8%	45%	0%	0%	11%	0%	1%	1.91%
Texas	9%	47%	34%	9%	0%	0%	1%	0%	10.49%
Utah	0%	19%	77%	2%	0%	1%	0%	0%	1.04%
Vermont	72%	0%	0%	5%	0%	17%	0%	6%	0.17%
Virginia	39%	27%	27%	0%	2%	0%	1%	5%	1.85%
Washington	8%	10%	6%	6%	0%	68%	0%	2%	2.79%
West Virginia	0%	1%	96%	2%	0%	2%	0%	0%	1.94%
Wisconsin	15%	13%	61%	3%	1%	4%	0%	3%	1.46%
Wyoming	0%	1%	87%	9%	0%	2%	1%	0%	1.19%
District of Columbia	0%	0%	0%	0%	0%	0%	0%	0%	0.00%
Total									**100%**

Source: U.S. Energy Information Administration, 2014 data

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