Nuclear Policy in the States: A National Review

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Introduction

The nuclear energy industry has regained momentum over the past several years, with state policy serving as a major springboard for that change in fortune. Following a decade characterized by disaster and disappointment for the nuclear industry, policy decisions in the early 2020s have propelled nuclear power forward as a viable resource to support decarbonization efforts while maintaining power system reliability.

Despite only constituting 8% of electric generating capacity in the United States, nuclear power produces nearly 20% of total electricity because nuclear reactors are nearly always operating—outperforming all other resources in this statistic [1] [2]. Perhaps more significantly, given recent trends in public opinion and energy policy, nuclear power accounts for around half of all carbon-free electricity in the U.S.[3] [4] [5]. As lawmakers from across the political spectrum reckon with how the energy transition could affect their communities and constituents, many have increasingly found common ground in the role nuclear energy can play in the process.

While recent federal legislation will have an outsized effect on nuclear power developments over the coming years, state policies have paved the way for many of the clean energy technologies that will transform the U.S. electric grid over the coming decades. State legislatures, in particular, oversee the regulatory environment in which electric utilities operate; these policies affect how utilities plan for the future and the investments they make. While states have widely focused on renewable energy and energy efficiency, a growing number are considering the role nuclear power might play moving forward.

The National Conference of State Legislatures (NCSL) tracks state energy policies across a variety of topic areas[6]. Since 2016, NCSL has seen a near-doubling

1 "Electricity generation, capacity, and sales in the United States," U.S. Energy Information Administration, Washington DC, July 2022.

2 "What is Generation Capacity," U.S. Department of Energy, Office of Nuclear Energy, Washington DC, May 2020.

3 A. Tyson, C. Funk, B. Kennedy, "Americans Largely Favor U.S. Taking Steps to Become Carbon Neutral by 2050," Washington DC, March 2022.

4 A. Ray, D. Shea, C. McMichael, A. Igleheart, "2021 Legislative Energy Trends," National Council of State Legislatures, Washington DC, April 2022.

5 J. McDermott, "Majority of US states pursue nuclear power for emissions cuts," Associated Press, Washington DC, January 2022.

6 "Energy State Bill Tracking Database," National Council of State Legislatures, Washington DC, November 2022.

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in nuclear energy-related policies considered by state legislatures—up from 74 total bills considered in 2016 to more than 160 bills during the current legislative session. State legislatures have also enacted a greater number of bills over that same timeframe. While five states enacted nine bills in 2016, at least 12 states have enacted 14 bills in 2022.

These policies vary in their approach and scope. In the mid-2010s, the focus among state policymakers mainly involved existing reactor preservation. Many operating nuclear power plants were struggling to compete with natural gas and renewable generation, leading to the premature closure of several nuclear power plants. In response, at least six states enacted policies to prevent the premature closure of existing reactors. While those efforts have remained poignant, in more recent years, a growing number of states enacted policies aimed at developing new nuclear capacity to support of clean energy goals or reliability. This represents a shift from defensive posturing toward a more proactive posture.

These policies have been enacted by both red and blue states—a reflection of the increasingly bipartisan position nuclear power occupies in U.S. political discourse. The passage of recent federal legislation—in particular, the Infrastructure Investment and Jobs Act (IIJA) and the Inflation Reduction Act (IRA)—only appears to have added momentum to initiatives that began at the state level. In the coming years, NCSL anticipates that state legislatures will continue to enact policies in support of nuclear power to leverage funding and financing opportunities in the IIJA and IRA. This article provides a review of these recent state and federal initiatives, along with a brief historical review of nuclear developments in the U.S. over the past two decades.

How We Got Here

The nuclear power industry has experienced a whirlwind over the last 20 years. Following the passage of the 2005 Energy Policy Act, many anticipated a “nuclear renaissance” in the United States. It had been nearly a decade since the last nuclear reactor was brought into service—Watts Bar Unit 1, which began construction in 1973 and wasn’t completed until 1996. Since then, new reactor development largely dried up due to high upfront costs and a history of construction delays. But the Energy Policy Act promised to change those dynamics with loan guarantees, cost-overrun support and a production tax credit (PTC) for the first 6,000 megawatts (MW) of new nuclear capacity to come online.

To leverage the federal incentive, Florida, Georgia and South Carolina enacted state policies to further incentivize utilities to pursue new nuclear. Understanding that the upfront costs were still a major hurdle for utilities, state legislators in these states enacted construction work in progress (CWIP) laws for new nuclear projects. CWIP is a financing mechanism that enables utilities to finance capital projects by periodically recovering costs from customers throughout the duration of construction. Normally, utilities can't recover those costs until the project has been brought into service. However, since large nuclear projects can take upwards of a decade to build, CWIP laws aim to make those initial hurdles easier to clear by allowing utilities to recover costs throughout project development, thereby reducing the risk to utility companies and their shareholders, and reducing the overall amount that is needed to finance a project. While state utility regulatory commissions (PUCs) approve costs and oversee progress, consumer advocates have argued these laws shift too much risk to customers.

Between the federal incentives and state CWIP laws, a flurry of activity between 2007 and 2010 suggested that a nuclear renaissance would materialize. In fact, the Nuclear Regulatory Commission (NRC) received applications for construction and operating licenses to build nearly 30 new reactors—a staggering figure since the combined capacity of those units would represent more than a third of the existing fleet.[7]

Disaster and Economic Troubles

However, that momentum came to a sudden halt in March 2011 after the disaster at the Fukushima Daiichi nuclear power plant in Japan. Triggered by an earthquake and tsunami, the event catalyzed opposition to nuclear power over safety concerns. Ultimately, only four of the new reactors broke ground—two at Plant Vogtle in Georgia, and two at V.C. Summer Nuclear Generating Station in South Carolina.

Not only had public sentiment turned against nuclear power, but so had the economics of power generation. In 2005, the average price of electricity in the PJM Interconnection, the largest wholesale electricity market in the U.S., was $63.46 per megawatt-hour (MWh).[8] By 2009, the average price had dropped to $39.04 per MWh. This was no aberration. It was the first hint at the Shale Revolution's impact on the U.S. power market. Hydraulic fracturing unlocked vast natural gas resources, causing the price of natural gas to plummet and—until this past year—largely stabilize.

Over the ensuing decade, natural gas has taken on a larger share of electricity generation, recently accounting for nearly 40% of total electric generation in the U.S.[9] Not only did natural gas almost halve the emissions from coal-fired power, but it complemented another increasingly cheap source of power: renewable ener-

7 "Combined License Applications for New Reactors," U.S. Nuclear Regulatory Commission, Bethesda, Maryland, September 2022.

8 "2020 State of the Market Report for PJM," Monitoring Analytics, Eagleville PA, March 2021.

9 "What is U.S. electricity generation by energy source?," U.S. Energy Information Administration, Washington DC, November 2022.

gy[10]. Together, natural gas and renewables set wholesale power prices in organized wholesale electricity markets throughout much of the 2010s. Until this year, those power prices trended lower and lower—generally between $30 and $40 per MWh in the PJM region, but dropping as low as $21.77 per MWh in 2021.

Generally, that's a good thing. Lower wholesale power prices translate into lower power bills for customers. But for nuclear power plants in wholesale markets, those prices led to thinner and thinner operating margins, ultimately causing many nuclear plants in wholesale markets to operate in the red. Since 2013, 13 nuclear reactors with more than 10,000 MW in combined capacity closed prematurely due to these market conditions[11]. That capacity has been replaced largely by new natural gas-fired generation.[12]

States Decide to Act

As nuclear plants began to close, policymakers began considering whether to respond. Nuclear power accounts for only around 8% of total electric generating capacity in the U.S., but generates nearly 20% of total electricity.[13] That is because most nuclear plants operate around-the-clock, with a capacity factor of nearly 93% in 2021[14]. That means that, on average, nuclear plants in the U.S. generated at maximum capacity around 93% of the time last year—nearly twice the capacity factor of resources like coal and natural gas, and triple that of wind and solar. In all, nuclear generates around half of the carbon-free electrons that flow on the U.S. power grid. At a time when electric grid decarbonization became a growing priority, some policymakers felt the need to prevent these large, reliable sources of carbon-free power from closing.

In an effort to preserve carbon-free energy and high-paying jobs, six states have enacted policies since 2016 to provide financial support to struggling nuclear power plants. Four of those states—Connecticut, Illinois, New Jersey and New York—have active policies that provide nuclear power plants with additional revenue. These policies were designed to provide support only to nuclear plants that demonstrate they would likely shut down without state assistance—largely justified based on the avoided carbon dioxide emissions that those power plants represent. Three of those policies were designed in the form of zero emissions credits

10 G. McGrath, "Electric power sector CO2 emissions drop as generation mix shifts from coal to natural gas," U.S. Energy Information Administration, Washington DC, July 2021.

11 M. Holt, P. Brown, "U.S. Nuclear Plant Shutdowns, State Interventions, and Policy Concerns," Congressional Research Service, Washington, D.C., June 2021.

12 J. Anderson, K. Hallahan, "Gas-fired power increased with nuclear plant closure; path to climate goals unclear," S&P Global Commodity Insights, New York NY, November 2021.

13 "Electricity generation, capacity, and sales in the United States," U.S. Energy Information Administration, Washington DC, July 2022.

14 "What is Generation Capacity," U.S. Department of Energy, Office of Nuclear Energy, Washington DC, May 2020.

(ZECs), which provide qualifying reactors with a supplemental payment for every MWh of carbon-free electricity sold. A new federal program created by the IIJA, the Civil Nuclear Credit Program, was predicated on these state ZECs programs.

Most recently, the Illinois General Assembly doubled down on supporting the state's nuclear fleet with the passage of the Climate and Equitable Jobs Act in 2021. The new law expanded the state's programs to support five nuclear power plants in the state—up from two nuclear plants that were supported under initial legislation passed in 2016. Last year, the Ohio legislature repealed a similar program designed to support the state's two existing nuclear plants just two years after the law was enacted. The legislature's decision to repeal the program followed federal corruption charges related to individuals involved in the original bill's passage.

The U.S. Congress recently enacted legislation establishing a similar program at the federal level. The new policy is substantially similar to these state ZECs policies. The U.S. Department of Energy is in the process of implementing this new program, which will be discussed in more detail below.

Struggles Persist for New Projects

While some states in the North were acting to preserve their existing reactor fleets, states in the South found themselves managing the new-build projects. The Tennessee Valley Authority became the first U.S. utility to bring a new reactor online in the 21st century. In an interesting twist, it was Watts Bar Unit 2—the sister unit to the last reactor brought online in the 20th century. While construction on Watts Bar Unit 2 began in 1973 alongside Unit 1, the reactor was 60% complete when TVA mothballed the project in 1985[15]. In 2007, TVA decided to complete Unit 2, which became operational in 2016. The project experienced nominal cost-overruns and construction delays—though nowhere near those happening at two projects in Georgia and South Carolina.

Projects in Georgia and South Carolina were building Westinghouse Electric Company's AP1000 reactor—a pressurized water reactor with a designed capacity of 1,110 MW, which represents a significant upgrade from the previous generation of large, light-water reactors. Georgia Power was developing two AP1000s at its Plant Vogtle, while two more AP1000s were being developed at the V.C. Summer plant in South Carolina by Santee Cooper, a state-owned utility, and SCANA Corp., an investor-owned utility.

In March 2017, Westinghouse entered Chapter 11 bankruptcy, throwing both projects into crisis—especially in South Carolina. By August 2017, the V.C. Summer reactors had been abandoned after the developers had already charged customers $2 billion for the project. Neither utility survived unscathed; Domin-

15 S. Hoff, M. Gospodarczyk, "First new U.S. nuclear reactor in almost two decades set to begin operating," U.S. Energy Information Administration, Washington DC, June 2016.

ion Energy purchased SCANA Corp., while the South Carolina state legislature required closer state oversight of Santee Cooper. The legislature also repealed its CWIP for nuclear policy, while Florida did the same and Georgia amended its statute to expire following the completion of the Vogtle project.

Ultimately, only the two reactors at Plant Vogtle survived. The plant's first AP1000 is now scheduled to come online in the first quarter of 2023, while the second is expected to follow by the end of 2023. The projects total cost is expected to exceed $30 billion—more than double the original price tag[16].

These events served as a deterrent to large reactor construction. Slowing growth in electricity demand, recent cost-overruns, along with the long timelines to development large reactors—on average, between 10 and 15 years from initial construction to when the reactor is brought online—have led many to question whether there's a role for new nuclear in the clean energy transition[17]. This is perhaps the reason the emphasis in recent years has shifted away from large reactors to prioritize small modular reactors (SMRs), which promise a departure from the previous generation's problems. Whether the industry can deliver on the promise of SMRs will be tested over the coming decade.

State Action to Support New Nuclear

In spite of the beleaguered projects in the South, the nuclear power industry finds itself with wind in its sails once again. While recent federal legislation has added considerably to this progress, state policies led the way. However, the focus has shifted considerably since 2005. The problems associated with large reactor development have not gone unnoticed, and the clear emphasis has been on technologies that tend to be smaller and modular in their design.

If a traditional reactor has a generating capacity around 1,000 MW, small modular reactors tend to be under 300 MW capacity, while microreactors have been designed to generate less than 10 MW. On a basic level, these reactors are scaled to the times. Utilities are no longer experiencing the rapid growth in electricity demand that required huge capacity additions throughout the 20th century; in some regions, demand has flattened or decreased.[18] However, the real advantage according to nuclear advocates is in the modular design and what that means for construction efficiency[19].

16 J. Amy, "Georgia nuclear plant's cost now forecast to top $30 billion," Associated Press, Washington DC, May 2022.

17 S. Hoff, M. Gospodarczyk, "First new U.S. nuclear reactor in almost two decades set to begin operating," U.S. Energy Information Administration, Washington DC, June 2016.

18 F. Kahrl, "Why have U.S. electricity sales flattened?," Energy Policy, December 2021.

19 J. Liou, "What are Small Modular Reactors (SMRs)?," International Atomic Energy Agency, New York NY, November 2021.

Building a traditional reactor is an enormous endeavor. At Vogtle, the new-build project required around 9,000 workers at its peak.[20] The reactor components are also built to specification on-site. These factors contributed to cost-overruns and delays. By contrast, SMRs are designed to benefit from factory fabrication and assembly for systems and components, which are then transported and assembled on-site. While still theoretical, centralized, standardized design and fabrication could significantly reduce the problems associated with traditional reactor projects and diminish the upfront barrier due to capital costs.

The reduced size of these reactors holds additional benefits, making these projects easier to site and tie into the existing transmission grid. Their size and capacity is similar to many coal-fired generating units, making siting SMRs at retired or retiring coal power plants of particular interest as the electric sector continues to decarbonize. Not only do these facilities have existing transmission infrastructure and water access that would benefit SMRs, but these projects could support communities and workers affected by the clean energy transition through lost jobs and tax revenue when coal plants shut down.

The U.S. Department of Energy released a recent report on this topic to investigate the potential challenges and benefits of converting retired coal plant sites into SMR sites and concluded that 80% of the nearly 400 retired and operating coal plants identified for the study could be good candidates to host SMRs[21]. In total, these sites could host a combined capacity of 265 gigawatts (GW) in generating capacity—a staggering figure in relation to existing nuclear generating capacity in the U.S., which is around 95 GW. Additionally, the report claims the use of existing transmission and other infrastructure could reduce the cost of capital for "coal-to-nuclear" projects by 15% to 35% compared with greenfield projects.

Increasingly, states are also turning to nuclear power to address reliability concerns as the resource mix shifts toward more variable resources, such as wind and solar[22]. As more variable generation comes online, the grid will require additional "dispatchable" generation to fill in the gaps in generating capacity—resources that can reliably provide power whenever the grid operator calls upon them. Nuclear is one such resource, and one of the few that does so at capacity without generating carbon emissions. In fact, recent research notes that nuclear power plant regulatory standards require these facilities to be designed to safely withstand weather events far beyond those considered for other critical infrastruc-

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20 "5 Things You Should Know About Plant Vogtle," U.S. Department of Energy, Office of Nuclear Energy, Washington DC, April 2019.

21 J. Hansen, W. Jenson, A. Wrobel, N. Stauff, K. Biegel, T. Kim, R. Belles, F. Omitaomu, "Investigating Benefits and Challenges of Converting Retiring Coal Plants into Nuclear Plants," U.S. Department of Energy, Office of Nuclear Energy, Washington DC, September 2022.

22 "Nuclear Power is the Most Reliable Energy Source and It's Not Even Close," U.S. Department of Energy, Office of Nuclear Energy, Washington DC, March 2021.

ture facilities[23]. As a result, researchers found that nuclear plant operations in the U.S. were rarely affected by extreme weather between 2011 and 2020—causing an average 0.1% loss of capacity factor[24]. While this argument is often a driving force in Republican-controlled states, several Democratic-controlled states have also taken action to support nuclear power for reliability.

California, with the passage of a bill aimed at extending the operating life of the state's last remaining nuclear power plant, is the latest example. Under a 2018 agreement between Pacific Gas & Electric (PG&E), state regulators and environmental groups, PG&E's Diablo Canyon nuclear power plant—a 2,250 MW plant that generates 9% of the state's total electricity—is scheduled to close its two reactors in 2024 and 2025[25]. However, the state's grid has struggled in recent years to cope with several heat waves, leading to rolling blackouts across the state and recent calls to consider extending the life of the plant to support reliability and avoid increasing the use of natural gas-fired generation.

In response to these concerns—and to recently available federal incentives—California lawmakers enacted Senate Bill 846 in September. The law allows Diablo Canyon to operate through 2030, contingent on several requirements. First, PG&E must apply to receive financial support through a new program administered by DOE: the Civil Nuclear Credit Program. Second, PG&E must relicense the two reactors—a costly process addressed by lawmakers through a $1.4 billion forgivable loan from the state. If those two requirements are met, the plant is likely to continue operations through the end of the decade. In late November, DOE announced that Diablo Canyon had been conditionally selected to receive up to $1.1 billion in credits from the Civil Nuclear Credit Program[26]. While the final terms are still subject to negotiation between DOE and PG&E, the news represents another step toward the plant's continued operation.

In the context of advancements in nuclear technologies, coupled with state and utility decarbonization goals and reliability concerns, a growing number of states have started to enact policies to either explore or support new nuclear reactor development or the preservation of existing reactors. As noted, both red and blue states have enacted these policies, demonstrating that nuclear power has increasingly attained consistent bipartisan support in recent years.

Not only has the number of nuclear energy-related bills steadily increased since 2016, but the number of enacted bills has too[27]. In 2016, the National Confer-

23 "Nuclear Plant Resilience to Weather-Related Events Between 2011 to 2020," Electric Power Research Institute, Palo Alto CA, September 2022.

24 Ibid.

25 N. Rott, "California lawmakers extend the life of the state's last nuclear power plant," National Public Radio, Washington DC, September 2022.

26 "Biden-Harris Administration Announces Major Investment to Preserve America's Clean Nuclear Energy Infrastructure," U.S. Department of Energy, Washington, D.C., November 2022.

27 "Energy State Bill Tracking Database," National Council of State Legislatures, Washington DC,

ence of State Legislatures tracked 74 bills related to nuclear energy in 17 states. Of those, five states enacted nine bills. In 2022, NCSL is tracking more than 160 bills in 31 states. Of those, at least 12 states have enacted 14 bills in 2022.

And while the ideological and policy reasons for supporting nuclear power may differ, the end result appears to be beneficial to the nuclear power industry. Beyond the preservation of existing reactors, which has already been addressed in this article, these trends can be grouped into the following categories.

Clean Energy Standards

One of the more notable developments in energy policy following the 2016 presidential election was that a large number of Democratic-controlled state legislatures strengthened their support for clean energy. The primary vehicle for state clean energy goals over the past two decades has been through renewable portfolio standards (RPS) that required a certain percent of a regulated utility's retail electricity sales to come from renewable resources[28]. Prior to 2016, most standards were set at relatively modest levels—usually between 10% and 25% of retail sales by a certain date. However, those standards have evolved in two notable ways since 2016.

In the first trend, states increased the requirements—often substantially. Overall, 15 states, two territories and Washington, D.C., have increased their requirements in that timeframe. Of those, 10 states, two territories and Washington, D.C., increased their standards to 100% of retail sales with deadlines ranging from 2030 to 2050, while another three states increased their standards to 50% or greater.

The second trend is that some of those states expanded the types of resources included in their standards. Perhaps unsurprisingly, RPS have traditionally included renewable resources like wind, solar, geothermal and hydropower. Resources like nuclear power or fossil generation outfitted with carbon capture and sequestration (CCS) technologies did not quality, because the purpose of the RPS model was to support nascent technologies to bring them to cost parity with existing resources. Given that renewables are cheaper to build than most other current energy, it can be said that the RPS model has been successful[29].

However, even with that success, emissions in some markets rose with the closure of nuclear power plants as grid operators relied on natural gas-fired generation to balance variable renewable output[30]. In response to these and other concerns, lawmakers in a number of states shifted the focus slightly from supporting

November 2022.

28 C. McMichael, "State Renewable Portfolio Standards and Goals," National Council of State Legislatures, Washington DC, August 2022.

29 D. Baker, "Renewable Power Costs Rise, Just Not as Much as Fossil Fuels," Bloomberg News, New York NY, June 2022.

30 B. Storrow, "3 states with shuttered nuclear plants see emissions rise," Politico, Washington DC, February 2022.

renewable power with the side-benefit of emissions reductions, to prioritizing emissions reductions with the side-benefit of supporting renewable power.

This is where clean energy standards (CES) emerged, with at least eight states deciding to broaden the list of resources supported beyond traditional renewable resources. The focus with CES policies is on emissions reductions, so most of these policies support "carbon-free" or "carbon-neutral" technologies. In states without restrictions on new nuclear, that opens the door for nuclear power and CCS-equipped fossil-fired power plants to qualify under these programs.

It's important to note that renewables in these states still receive the lion's share of the support. CES policies have generally been enacted while strengthening the state's RPS policy. For example, California's CES policy still maintains an RPS requiring 60% renewable power by 2030; New Mexico's requires 80% renewables by 2040. However, the balance—whether 20% or 40%–must come from carbon-free resources, giving nuclear power a potential role to play in meeting state clean energy goals.

Repealing Restrictions on New Nuclear

While states like California and Oregon have enacted CES policies, both states would need to repeal existing restrictions on the development of new nuclear power before additional nuclear capacity could be used to comply with the state CES. Like 10 other states, California and Oregon have restrictions on the construction of new nuclear power facilities.[31]

In many cases, these restrictions are less about nuclear power and more about nuclear waste. Given the impasse in Congress about how to—or whether to—move on from Yucca Mountain as the nation's designated site to house a deep geologic repository for commercial spent nuclear fuel, states have been reluctant to build more nuclear generation without a clear waste disposal solution. A waste solution is at the heart of restrictions on new nuclear in six states. The remaining states either require the state legislature or voters to approve a project before it can commence, while Minnesota is the only state with an outright ban on all new nuclear power facilities.

Of course, these are statutory restrictions and subject to change. Kentucky, Montana, West Virginia and Wisconsin have all repealed similar restrictions since 2016. Similarly, Connecticut enacted a partial repeal—providing for an exemption to its restrictions. While these repeals do nothing more than remove a barrier to development, it is another indication of how states have opened the door once again to nuclear—particularly in states with a historic connection to coal.

31 D. Shea, C. McMichael, "States Restrictions on New Nuclear Power Facility Construction," National Council of State Legislatures, Washington DC, August 2022.

Coal-to-Nuclear

Repurposing retired or retiring coal-fired power plants to be used for new nuclear is not a new concept. There are a number of logical similarities between nuclear and coal—the two resources that have long served as the backbone of the electric grid, providing steady, "baseload power." The scale of SMRs theoretically would fit within the parameters of existing coal sites. Existing switchyard, transmission infrastructure and water rights, could be utilized to reduce costs and regulatory hurdles. The existing labor force could be re-trained to operate the nuclear facility—after all, when you boil it down to the basics, both are thermoelectric power plants. These similarities and more have been explored in a variety of research papers, and DOE has recently added to the literature with its own study exploring the potential[32].

It is not surprising that states with historic ties to the coal industry have begun exploring this possibility. Nuclear represents a familiar industry for policymakers in these states, where an emphasis on power reliability and economic contributions—including high-paying jobs—are foundational to the debate over the energy transition.

While Kentucky, Montana and West Virginia have all repealed restrictions on new nuclear development, the two most influential pieces of legislation in this area have been enacted by lawmakers in Indiana and Wyoming.

Wyoming was the first state to pass "coal-to-nuclear" legislation in 2020. House Bill 74 directs state regulators to develop rules and regulations to authorize SMR permitting for owners of existing coal and natural gas power plants that want to replace those facilities with SMRs. The bill requires SMR developers to acquire all of the necessary licenses and permits from the NRC, while providing a streamlined process at the state level—along with the state's explicit support for such projects.

The following year, TerraPower, an advanced reactor company, announced that it had selected a retiring coal-fired power plant in Kemmerer, Wyo., as the site on which to build its first reactor. DOE is investing nearly $2 billion in the project, which has benefitted from the department's Advanced Reactor Demonstration Program[33]. Upon successful completion, PacifiCorp, an investor-owned utility operating across six Western states, plans to acquire and operate the new reactor. In October 2022, PacifiCorp and TerraPower announced plans to explore the potential of deploying up to five additional TerraPower reactors, paired with energy storage systems, in the utility's service territory by 2035.

32 J. Hansen, W. Jenson, A. Wrobel, N. Stauff, K. Biegel, T. Kim, R. Belles, F. Omitaomu, "Investigating Benefits and Challenges of Converting Retiring Coal Plants into Nuclear Plants," U.S. Department of Energy, Office of Nuclear Energy, Washington DC, September 2022.

33 "Next-Gen Nuclear Plant and Jobs Are Coming to Wyoming," U.S. Department of Energy, Office of Nuclear Energy, Washington DC, November 2021.

In 2022, the Wyoming legislature enacted Senate Bill 131, which made several technical changes to the original law, including broadening its definition of qualifying reactors to accommodate TerraPower's specific design. The legislation also added spent fuel management requirements and established certain tax exemptions if the nuclear facility sources at least 80% of its fuel from domestic supplies.

Indiana enacted its own coal-to-nuclear legislation in 2022. Senate Bill 271 similarly directs state regulators to develop rules and regulations that accommodate the construction and operation of SMRs at retiring coal and natural gas facilities. However, the bill also addressed some of the financial uncertainty around nuclear development by authorizing utilities to receive CWIP financing for these projects. Other states are also exploring the potential role for new nuclear, including Montana, which approved a study to explore the feasibility of replacing coal units with SMRs.

Support for New Nuclear

For all the interest in coal-to-nuclear, this is but one distinct trend in broader support for advanced nuclear among states. Like Montana, a number of states are exploring this by commissioning studies to consider the role new nuclear could play in the energy transition. Michigan, Nebraska, New Hampshire and Virginia have all funded studies to this effect, while a handful of additional states have considered doing so.

And while studies can often be a precursor for more substantive legislation, they're not a prerequisite. Alaska, Connecticut, Nebraska and Virginia enacted legislation over the past two years that would support new nuclear development, while Missouri has also shown signs of interest.

In 2022, Alaska enacted Senate Bill 177, which aims to streamline the permitting of microreactors—defined by the statute as reactors with a generating capacity of 50 MW or less. The bill empowers municipal governments to approve microreactor projects and requires the state to develop regulations overseeing microreactor permitting.

Connecticut enacted two relevant bills in 2022. The first, House Bill 5202, would allow the state's lone nuclear power plant, Millstone, to expand and construct another reactor on-site. However, the bill does not allow that reactor to be a large, traditional reactor. While the plant operator currently has no plans to pursue an SMR, the legislation allows for that in the future. The second bill, House Bill 5200, aims to position the state as a leader in hydrogen production and generation. The role of nuclear power in hydrogen production is currently being explored through DOE pilot programs, and this legislation includes nuclear as a potential resource to consider in developing carbon-free hydrogen as a clean energy fuel.

Nebraska Legislative Bill 84, enacted in 2021, extended existing incentives for renewable energy under its ImagiNE Nebraska Act to apply to advanced reactor companies. Meanwhile, Virginia House Bill 894, enacted in 2022, directs state agencies to convene stakeholders and identify strategies and policies to promote SMR development in the state while minimizing the impact on prime farmland and encouraging investment in industrial sites.

Finally, the Missouri House passed House Bill 1684 in early 2022, which would have provided an exception to the state's ban on CWIP financing for advanced nuclear and renewable facilities of 200 MW capacity or greater. It is the second year in a row that the House passed the measure but it failed to move in the Senate. If enacted, the bill would certainly shift the conversation around new nuclear development in the state.

However, the dynamics have shifted since the Missouri Senate decided not to take up House Bill 1684 earlier this year, following Congress' passage of the Inflation Reduction Act (IRA) in August 2022. The new federal package has several provisions that could support new reactor development regardless of additional state policies. However, it seems likely that states will consider policies moving forward that leverage the federal incentives to further incentivize a broad swathe of clean technologies—nuclear among them—that are supported by the IRA and the IIJA, which Congress enacted in November 2021.

The Impact of Recent Federal Action

While state legislative action has played an important role in preserving existing reactors and laying the groundwork for new nuclear development, recent federal action is likely to have a dramatic effect across the energy sector in its scope and breadth. Congress has acted on nuclear issues in recent years—most notably in an effort to streamline the NRC's regulations and licensing procedures to accommodate advanced reactor designs. However, the IIJA and IRA are expected to have a profound effect on the energy sector, and the nuclear energy industry is widely expected to benefit through several key provisions from those laws.

The IIJA invested $73 billion in decarbonizing and improving the reliability of the energy sector. The nuclear power industry, in particular, will benefit from several provisions. Primary among those is through the Civil Nuclear Credit Program (CNCP), discussed earlier in relation to the Diablo Canyon nuclear power plant in California. The law allocated $6 billion for the CNCP program, which is modeled off state ZECs programs to provide financial support to struggling nuclear power plants through payments for every MWh of electricity generated. Nuclear power plant owners have been calling for a program like the CNCP for some time, given that many reactors operating in states without ZECs or other programs have also been at risk of premature closure. The CNCP, which is administered by the DOE, now has the potential to support existing reactors nationwide into the

2030s, with priority allocated to reactors that source their fuel domestically. DOE has recently concluded the first award cycle, conditionally awarding Diablo Canyon with up to $1.1 billion in credits. The department issued draft guidance on the second award cycle.

Additionally, the IIJA supports the DOE's Advanced Reactor Demonstration Program (ARDP), which aims to speed up the commercialization of advanced nuclear technologies. The ARDP received an additional $2.5 billion through 2025 to support demonstrations. These awards have been instrumental in developing the TerraPower demonstration project in Wyoming, along with a second project being developed in eastern Washington by X-energy, an advanced reactor company.

Several other provisions require DOE to develop a report on how nuclear energy can contribute to meeting the nation's resilience and carbon-reduction goals, and requires the development of a standard for qualifying "clean hydrogen" from a variety of sources, including nuclear power.

While the IIJA was considered beneficial to nuclear, the IRA has only increased the industry's enthusiasm for what the future may hold for advanced nuclear in the U.S. The IRA includes a number of tax credits that could be used by nuclear power facilities—particularly for developers of new nuclear facilities—including:

- Investment tax credit for owners of new carbon-free generation, worth 30% of the amount paid to build a facility;
- A new clean electricity production tax credit for any carbon-free generator that begins construction in 2025 or later, worth at least $25 per MWh of electricity generated;
- Coal-to-nuclear bonus tax credit, offering a 10% addition for new facilities sited in coal and other fossil fuel communities that are affected by the clean energy transition;
- Clean hydrogen production tax credit based on the carbon-intensity of the hydrogen production;
- Nuclear power production tax credit for existing reactors of up to $15 per MWh from 2024 through 2032 to prevent premature closure.

The IRA also addresses growing concerns over the U.S. nuclear sector's reliance on foreign-sourced fuel. The commercial fleet of nuclear reactors in the U.S. imports most of its uranium from countries like Kazakhstan, Canada, Australia and Russia[34]. In fact, the U.S. only produces 5% of the uranium used by the cur-

34 "Nuclear Explained: Where our uranium comes from," U.S. Energy Information Administration, Washington DC, July 2022.

rent reactor fleet. And that's just the raw uranium. Russia is the leading producer of enriched uranium—the form required to be used as fuel[35]. Nearly 40% of the world's supply of enriched uranium came from Russia in 2020, and the recent war in Ukraine has only exacerbated these concerns.

This is even more pronounced when it comes to the production of high-assay low-enriched uranium (HALEU) fuel, which is required for most advanced nuclear technologies[36]. To support domestic production of HALEU fuel, the IRA provided $700 million to DOE to support the development of HALEU facilities in the U.S.

The allure of the nuclear power industry—from an economic, workforce, decarbonization and grid reliability perspective—has been enhanced by the passage of these federal packages. It seems inevitable that states will spend the next several years positioning themselves to benefit from the suite of incentives provided under these new laws.

Conclusion

As the U.S. moves forward with the clean energy transition, the role of nuclear power remains to be seen. While many states are exploring its potential, the nuclear energy industry and advanced reactor companies leading the way in new technology development will ultimately need to deliver on the promise in order for nuclear to gain broad acceptance as a technology solution.

State legislative policy has been increasingly supportive of the potential for nuclear power. NCSL's bill-tracking database reveals the increased interest in this topic area, and a growing number of states have enacted legislation to support new and existing reactors. These policies have been enacted by states across the political divide, reflecting the increasingly bipartisan nature of nuclear power.

Recent federal legislation is likely to accelerate these trends. In the coming years, NCSL anticipates that state legislatures will continue to enact policies in support of nuclear power to leverage funding and financing opportunities in the IIJA and IRA.

Author Capsule Bio

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35 K. Foltynova, "Russia's Stranglehold On The World's Nuclear Power Cycle," RadioFreeEurope, Washington, DC, September 2022.

36 "What is High-Assay Low-Enriched Uranium (HALEU)?," U.S. Department of Energy, Office of Nuclear Energy, Washington DC, April 2020.