Congressional Research Service
Informing the legislative debate since 1914

U.S. Nuclear Plant Shutdowns, State Interventions, and Policy Concerns

June 10, 2021

Congressional Research Service
https://crsreports.congress.gov
R46820

CRS REPORT
Prepared for Members and
Committees of Congress

U.S. Nuclear Plant Shutdowns, State Interventions, and Policy Concerns

R46820

June 10, 2021

Mark Holt
Specialist in Energy Policy

Phillip Brown
Specialist in Energy Policy

The United States has the largest nuclear power plant fleet in the world, with 93 reactors that can generate approximately 95,522 megawatts (MW) of electricity. Nuclear power has accounted for about 20% of annual U.S. electricity generation since the late 1980s; in 2020 it was 19.7%. However, the U.S. nuclear power industry in recent years has been facing economic and financial challenges, particularly plants located in competitive power markets where natural gas and renewable power generators influence wholesale electricity prices.

Twelve U.S. nuclear power reactors have permanently closed since 2012, with the most recent being Indian Point 3 on April 30, 2021. Another seven U.S. reactor retirements have been announced through 2025, with total generating capacity of 7,109 MW (equal to roughly 7% of U.S. nuclear capacity). However, announced retirements have not always occurred as planned: 16 reactors previously announced for permanent closure have continued operating pursuant to state interventions that provide them with additional revenue sources. Those 16 reactors, in 6 states, represent 15,734 MW of electricity generation capacity (16% of total U.S. nuclear capacity). Many other U.S. reactors have been identified by recent studies as being "at risk" of shutdown for economic reasons, although their closures have not been announced.

Economic pressure on nuclear power plants is less immediate in areas of the country where electricity prices are set by state regulators rather than markets, such as in much of the Southeast. Under such "traditional" rate regulation, all power plant expenditures must be approved by state regulators, and electricity customers are charged rates sufficient to recover those costs plus a reasonable investment return. However, many other factors can affect plant-specific costs, revenues, and operating profits.

The recent U.S. nuclear power plant retirements and announced future shutdowns have drawn substantial congressional attention, including proposed legislation, committee hearings and markups, and enacted authorizations and appropriations. For example, the Senate Energy and Natural Resources Committee held a hearing on nuclear energy March 25, 2021, at which concerns about nuclear plant shutdowns were raised.

Following are the seven currently operating U.S. reactors that have been announced for closure by their owners:

- Byron 1 and 2, Illinois, scheduled to shut down in September 2021 because of operating losses;
- Dresden 2 and 3, Illinois, scheduled to shut down in November 2021 because of operating losses;
- Palisades, Michigan, scheduled to shut down in spring 2022 because of operating losses and the expiration of a power purchase agreement; and
- Diablo Canyon 1 and 2, California, scheduled to shut down in November 2024 and August 2025, respectively, because of a settlement with labor and environmental groups to replace the plant's output with renewable energy and energy efficiency measures.

Contents

Introduction 1
Scope of Report 3
Nuclear Reactor Shutdowns: 2013-2021 3
Announced Nuclear Reactor Shutdown Plans 6
State Interventions to Support Nuclear Power Generation 8
- Connecticut 10
- Illinois 10
- New Jersey 11
- New York 12
- Ohio 12
- Pennsylvania 13

Congressional Action 14

Figures

Figure 1. U.S. Nuclear Power Plants Currently Operating, Shut Down Since 2013, Announced Plan for Shutdown, and Operating Pursuant to State Intervention 2
Figure 2. Nuclear Reactor Shutdowns, 2013-2021 5
Figure 3. Announced Nuclear Reactor Shutdown Plans 7
Figure 4. U.S. Nuclear Reactors Supported by State Intervention 9

Tables

Table 1. U.S. Nuclear Reactor Shutdowns: 2013-2021 4
Table 2. Announced Nuclear Reactor Shutdown Plans 6
Table 3. U.S. Nuclear Reactors Supported by State Intervention 8

Contacts

Author Information 15

Introduction

The United States has the largest nuclear power plant fleet in the world, with 93 reactors that can generate approximately 95,522 megawatts (MW) of electricity.[1] Nuclear power has accounted for about 20% of annual U.S. electricity generation since the late 1980s; in 2020 it was 19.7%.[2] However, the U.S. nuclear power industry in recent years has been facing economic and financial challenges, particularly plants located in competitive power markets where natural gas and renewable power generators influence wholesale electricity prices.

Twelve U.S. nuclear power reactors have permanently closed since February 2013, following a 14-year period without any shutdowns.[3] The most recent reactor retirement was Indian Point 3 on April 30, 2021.[4] The plant's owner, Entergy, cited low electricity prices driven by low-cost natural gas generation and increased operating costs as major reasons.[5]

Another seven U.S. reactor retirements have been announced through 2025. However, announced retirements have not always occurred as planned: 16 reactors previously scheduled for permanent closure have continued operating pursuant to state interventions that provide them with additional revenue sources (see **Figure 1**). Many other U.S. reactors have been identified by recent studies as being "at risk" of shutdown for economic reasons, although their closures have not been announced.[6]

[1] Energy Information Administration, *Monthly Energy Review*, January 2021. Megawatts in this report reflect "net summer" generating capacity, defined as the maximum electrical output that can be supplied to system load, as demonstrated by a multi-hour test, during summer peak demand (June 1 through September 30). EIA capacity total reduced by 1,038 MW to reflect the April 20, 2021, permanent shutdown of Indian Point 3.

[2] Energy Information Administration, "Electricity Data Browser," https://www.eia.gov/electricity/data/browser, and *Monthly Energy Review*, Table 7.2, February 2021, https://www.eia.gov/totalenergy/data/monthly/. Percentage refers to utility-scale generation.

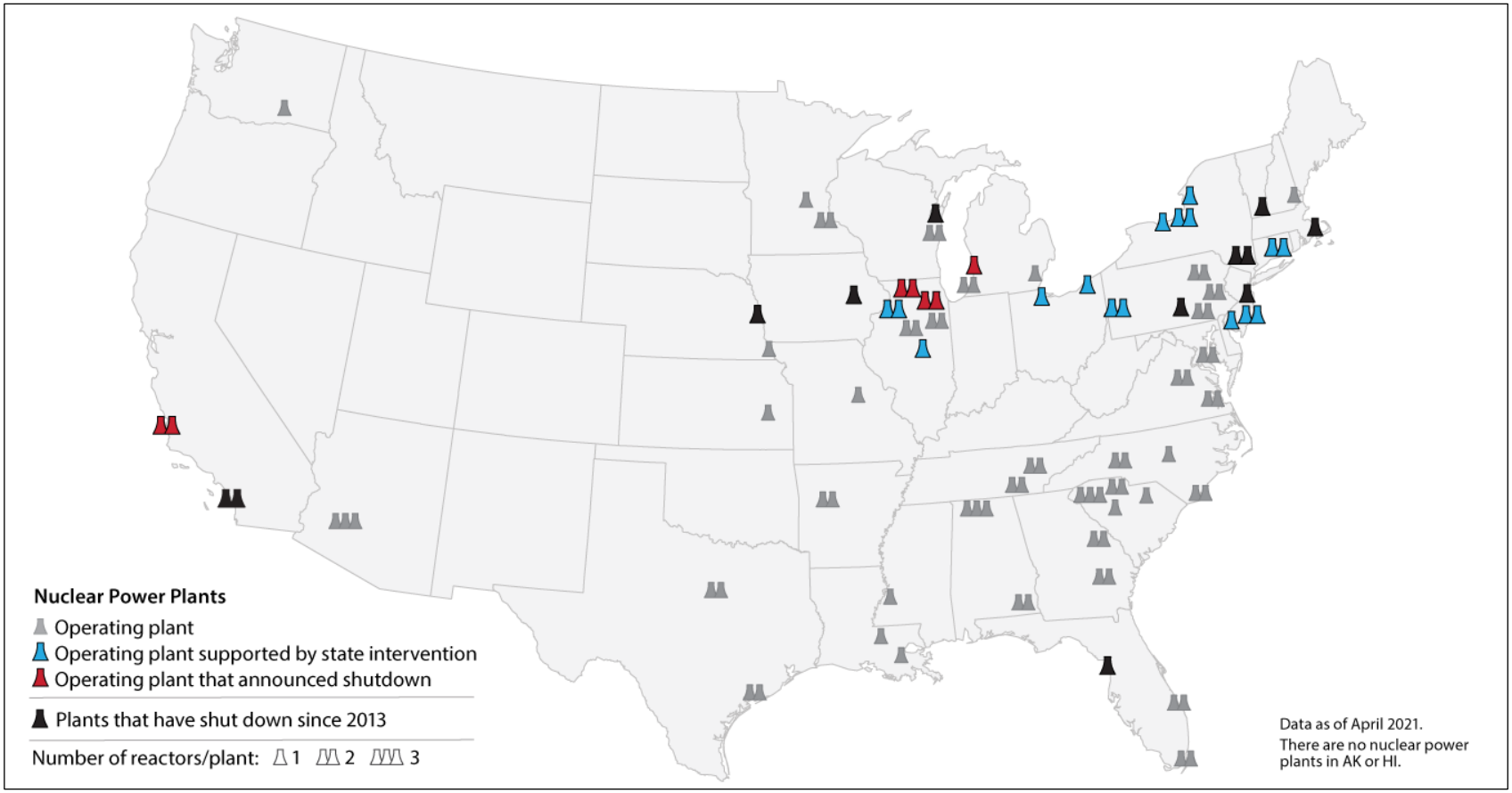
[3] Energy Information Administration, "Nuclear Reactor Shutdown List," https://www.eia.gov/nuclear/reactors/shutdown/.

[4] Indian Point 3 was the last operating reactor at the Indian Point plant, whose initial nuclear reactor began generating electricity in 1962. The plant had been controversial for decades because of its location about 25 miles north of New York City along the Hudson River. The State of New York opposed Indian Point's operating license extension by the U.S. Nuclear Regulatory Commission (NRC) and reached an agreement with the plant's owner, Entergy, in 2017 to close the final operating units in 2020 and 2021. See New York State, "Governor Cuomo Announces 10th Proposal of the 2017 State of the State: Closure of the Indian Point Nuclear Power Plant by 2021," news release, January 9, 2017, https://www.governor.ny.gov/news/governor-cuomo-announces-10th-proposal-2017-state-state-closure-indian-point-nuclear-power.

[5] Entergy Corporation, "Entergy, NY Officials Agree on Indian Point Closure in 2020-2021," news release, January 9, 2017, https://www.prnewswire.com/news-releases/entergy-ny-officials-agree-on-indian-point-closure-in-2020-2021-300387633.html.

[6] For an example of such studies, see Union of Concerned Scientists, *More Than One-Third of Nation's Nuclear Plants at Risk of Early Closure or Slated for Retirement*, November 8, 2018, https://www.ucsusa.org/about/news/nuclear-plants-risk-early-closure.

Figure 1. U.S. Nuclear Power Plants Currently Operating, Shut Down Since 2013, Announced Plan for Shutdown, and Operating Pursuant to State Intervention



Source: CRS, using data from S&P Global Platts, Esri Data and Maps, with information from the U.S. Energy Information Administration and plant operator announcements.

Notes: Plant shutdowns are from February 2013 through the end of April 2021. See **Table 1**. Two U.S. reactors are currently under construction: Units 3 and 4 at the Vogtle nuclear power plant in Georgia. There are no power reactors in U.S. territories.

Reactors that have been identified in recent studies as being "at risk" of near-term retirement, but with no announcement of such action by their owners, are not shown in the accompanying maps and tables, because of widely varying study methodologies, data, and results. Identifying "at risk" reactors with broad screening studies is difficult because each nuclear reactor can have a unique set of market, location, cost, revenue stream, maintenance, contract, and regulatory factors that operators may consider when deciding to shut down reactor operations earlier than previously anticipated.

The maps in this report graphically illustrate that actual and planned reactor shutdowns are mostly concentrated in particular regions of the country, such as the Northeast and Midwest, where supply, demand, transmission constraints, and fuel costs in regional markets largely determine wholesale electricity prices and generator revenues. Wholesale electricity prices have been pushed to historically low levels in recent years by rising amounts of low-cost generation from natural gas and wind and by weak electricity demand growth. If the wholesale market price of electricity (the price received by power plants) is chronically lower than a nuclear plant's operating costs, the owner of the plant may decide to shut it down rather than endure losses indefinitely. Plant owners in such situations also may be unwilling to make large capital investments that may be necessary to keep their reactors operating.

Economic pressure on nuclear power plants is less immediate in areas of the country where electricity prices are set by state regulators rather than markets, such as in much of the Southeast. Under such "traditional" rate regulation, all power plant expenditures must be approved by state regulators, and electricity customers are charged rates sufficient to recover those costs plus a reasonable investment return. However, as noted above, many other factors can affect plant-specific costs, revenues, and operating profits. In particular, plants that have guaranteed revenue streams through long-term power purchase agreements may be somewhat insulated from wholesale price fluctuations. For background information about some of the variables and complexities that affect nuclear power economics, see CRS Report R44715, *Financial Challenges of Operating Nuclear Power Plants in the United States*, by Phillip Brown and Mark Holt.

Concerns about reactor shutdowns, particularly their potential effects on local economies and efforts to reduce power sector greenhouse gas emissions, have prompted congressional interest in providing incentives and financial support for operating nuclear power plants. In addition to congressional hearings, legislative proposals such as a federal Clean Energy Standard (CES), U.S. Environmental Protection Agency (EPA) financial assistance, and tax credits could support existing nuclear power plants and reduce the likelihood of premature shutdowns. These policy topics could be the subject of debate during the 117th Congress.

Scope of Report

This report provides maps and tables that show nuclear reactor shutdowns, announced closures, and state interventions to prevent reactor shutdowns. For clarity, each of those categories is shown in a separate set of maps and tables, along with a general map that shows all currently operating U.S. nuclear reactors and their status. The map of reactors that have been kept operating by state action is accompanied by brief descriptions of those actions; most involve the establishment of "zero emission credits" that electric utilities must purchase from nuclear plants, increasing nuclear plant revenues.

Nuclear Reactor Shutdowns: 2013-2021

From 2013 through April 2021, power plant operators permanently shut down 12 nuclear reactors representing 9,436 MW of electricity generation capacity. **Table 1** contains additional information about each reactor. **Figure 2** includes a map showing the location of each reactor listed in the table.

Table 1. U.S. Nuclear Reactor Shutdowns: 2013-2021

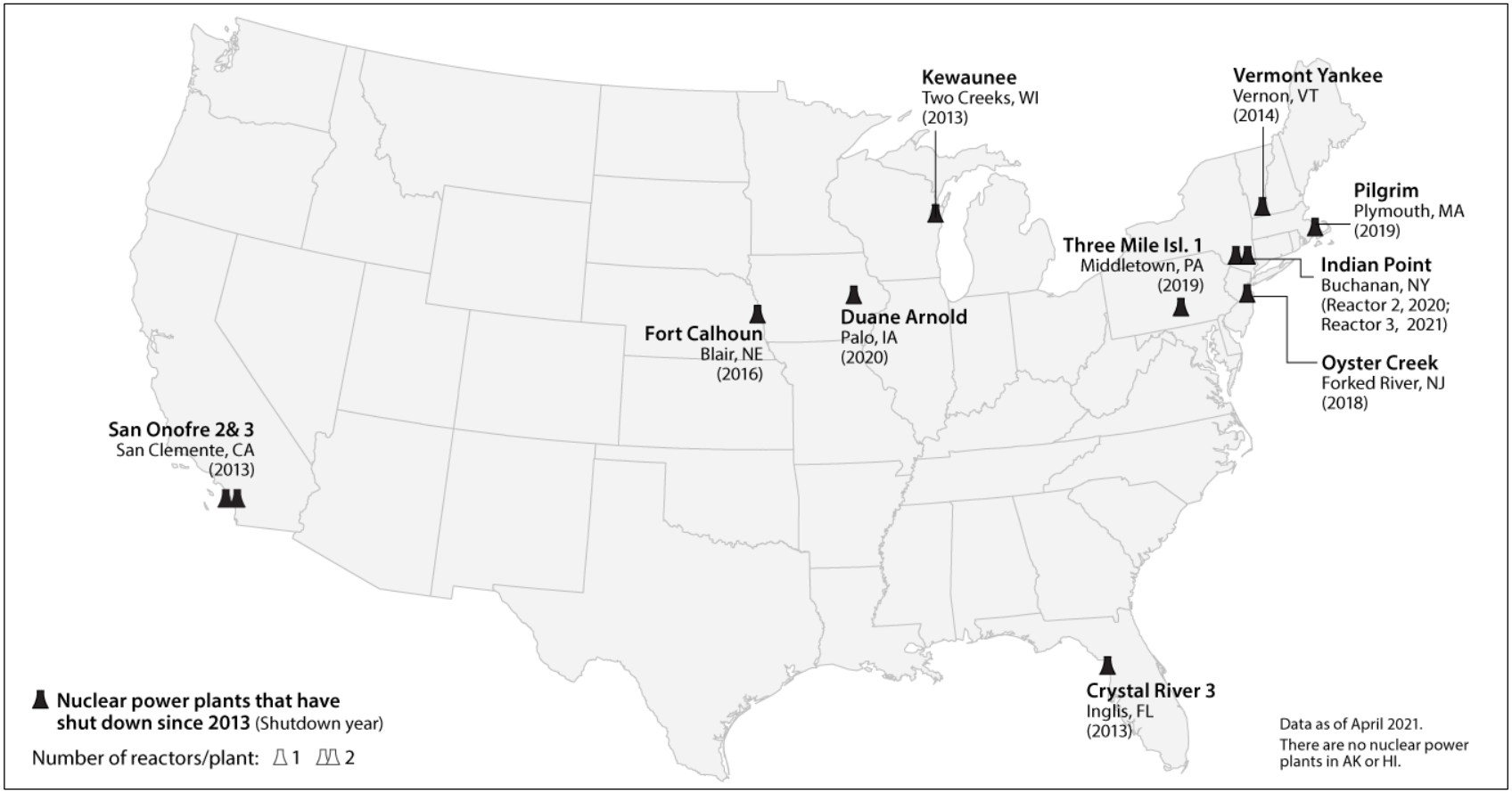
Organized by Shutdown Date

Reactor	State (Cong. District)	Shutdown Date	Generating Capacity (Megawatts)	Start-Up Year	Major Factor(s) Contributing to Shutdown
Crystal River 3	Florida (FL-11)	Feb. 2013	860	1977	Cost of major repairs to reactor containment
Kewaunee	Wisconsin (WI-8)	May 2013	566	1974	Operating losses
San Onofre 2	California (CA-49)	June 2013	1,070	1983	Cost of replacing defective steam generators
San Onofre 3	California (CA-49)	June 2013	1,080	1984	Cost of replacing defective steam generators
Vermont Yankee	Vermont (VT-at large)	Dec. 2014	620	1972	Operating losses
Fort Calhoun	Nebraska (NE-1)	Oct. 2016	479	1973	Operating losses
Oyster Creek	New Jersey (NJ-3)	Sept. 2018	614	1969	Agreement with state to avoid building cooling towers
Pilgrim	Massachusetts (MA-9)	May 2019	685	1972	Operating losses; rising capital expenditures
Three Mile Island 1	Pennsylvania (PA-10)	Oct. 2019	803	1974	Operating losses
Indian Point 2	New York (NY-17)	April 2020	1,020	1974	Low electricity prices; settlement with state
Duane Arnold	Iowa (IA-1)	Aug. 2020	601	1975	Lower-cost alternative power purchases
Indian Point 3	New York (NY-17)	April 2021	1,038	1976	Low electricity prices; settlement with state
		Total	**9,436**		

Source: CRS, with information from the U.S. Energy Information Administration and plant operator announcements.

Notes: Generating capacity numbers reflect "Net Summer" capacity.

Figure 2. Nuclear Reactor Shutdowns, 2013-2021



Source: CRS, using data from S&P Global Platts, Esri Data and Maps, with information from the Energy Information Administration and plant operator announcements.

Announced Nuclear Reactor Shutdown Plans

As of the date of this report, power plant operators have announced their intent to shut down seven operating nuclear reactors, representing 7,109 MW of electricity generation capacity (7.4% of total current U.S. nuclear capacity). **Table 2** contains additional information about each reactor. **Figure 3** includes a map showing the location of each reactor listed in the table, along with all other operating reactors in the country.

Table 2. Announced Nuclear Reactor Shutdown Plans

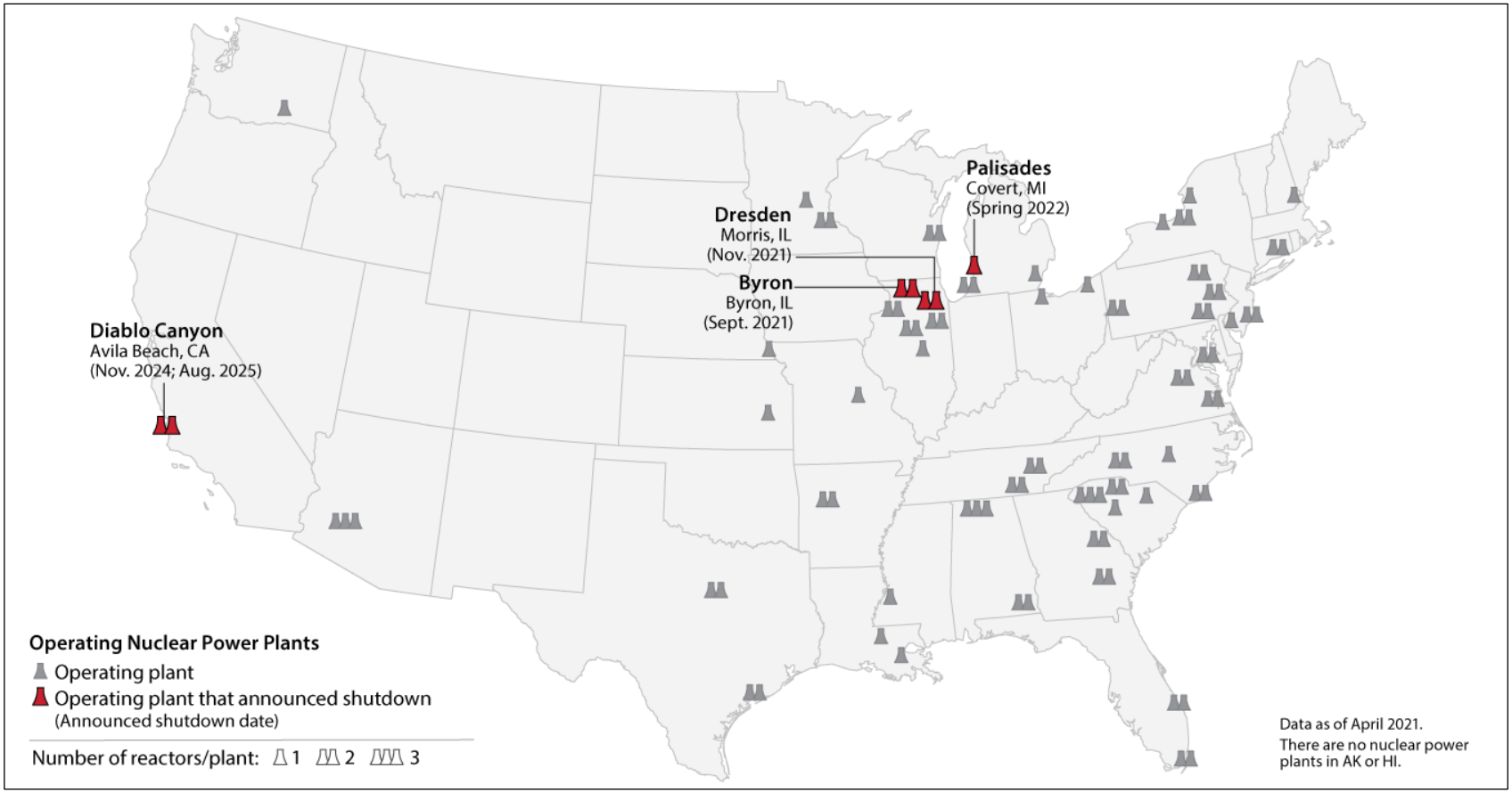
Organized by Announced Shutdown Date

Reactor	State (Cong. District)	Announced Shutdown Date	Generating Capacity (Megawatts)	Start-Up Year	Major Factors Contributing to Announced Shutdown
Byron 1	Illinois (IL-16)	Sept. 2021	1,164	1985	Operating losses
Byron 2	Illinois (IL-16)	Sept. 2021	1,136	1987	Operating losses
Dresden 2	Illinois (IL-16)	Nov. 2021	902	1970	Operating losses
Dresden 3	Illinois (IL-16)	Nov. 2021	895	1971	Operating losses
Palisades	Michigan (MI-6)	Spring 2022	772	1972	Operating losses; end of power purchase agreement
Diablo Canyon 1	California (CA-24)	Nov. 2024	1,122	1985	Settlement with labor and environmental groups to use renewables and efficiency
Diablo Canyon 2	California (CA-24)	Aug. 2025	1,118	1986	Settlement with labor and environmental groups to use renewables and efficiency
		Total	**7,109**		

Source: CRS, with information from the U.S. Energy Information Administration and plant operator announcements.

Notes: Generating capacity numbers reflect "Net Summer" generating capacity.

Figure 3. Announced Nuclear Reactor Shutdown Plans



Source: CRS, using data from S&P Global Platts, Esri Data and Maps, with information from the U.S. Energy Information Administration and plant operator announcements.

State Interventions to Support Nuclear Power Generation

Six states have intervened to provide financial support for 16 nuclear reactors—representing 15,734 MW of electricity generation capacity (16.5% of total current U.S. nuclear capacity)—that had been previously announced for closure or identified as likely to close. **Table 3** contains additional information about each reactor, including the type of intervention. **Figure 4** shows the location of each reactor listed in the table, along with all other operating reactors in the country. Background information, reference materials, and context about the six state nuclear incentive programs are also included below.

Table 3. U.S. Nuclear Reactors Supported by State Intervention

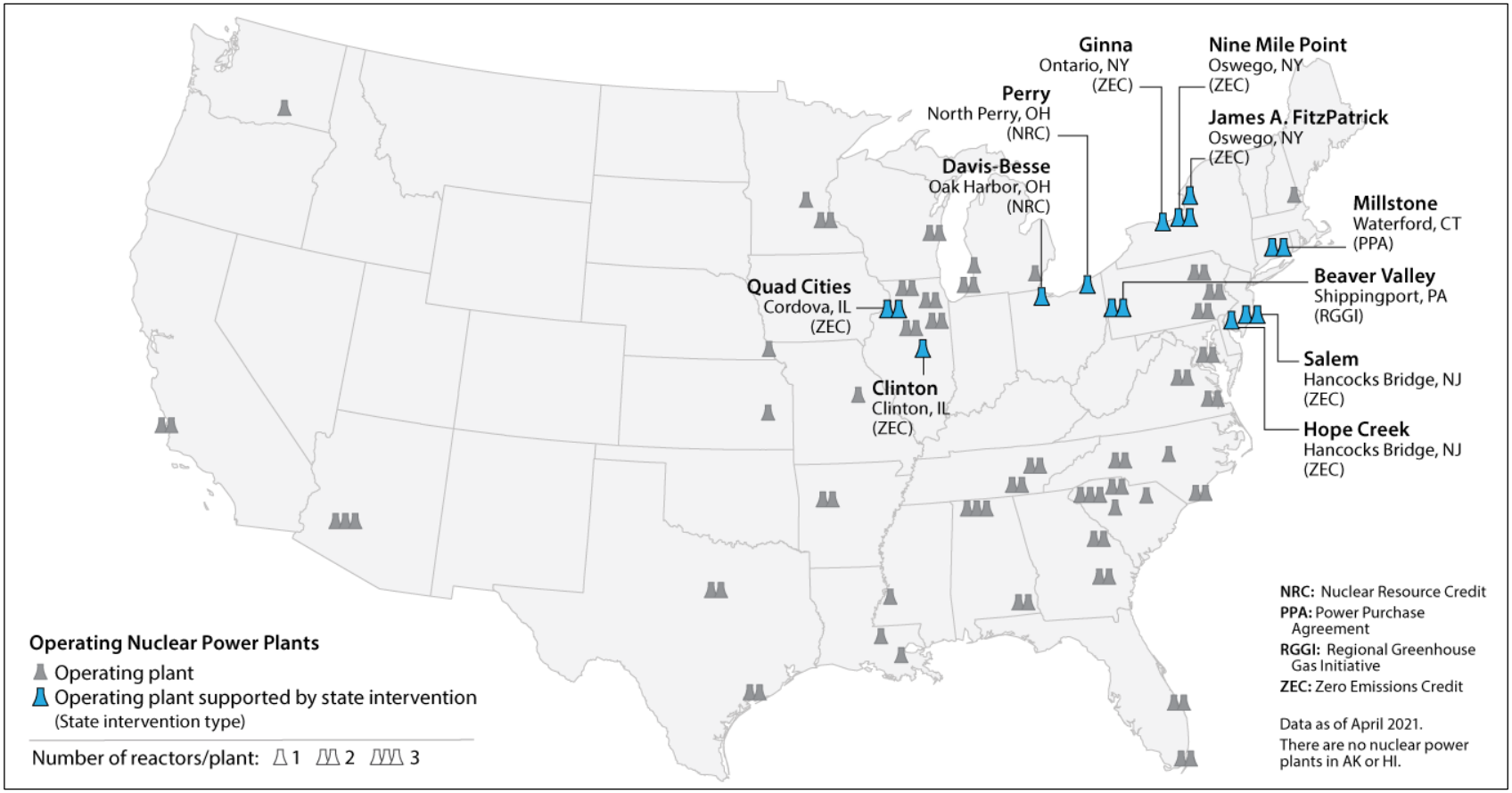
Organized Alphabetically by State

Reactor	State (Cong. District)	Generating Capacity (Megawatts)	Start-Up Year	State Intervention Type
Millstone 2	Connecticut (CT-2)	853	1975	Power Purchase Agreement
Millstone 3	Connecticut (CT-2)	1,233	1986	Power Purchase Agreement
Clinton	Illinois (IL-13)	1,065	1987	Zero Emission Credits
Quad Cities 1	Illinois (IL-17)	908	1972	Zero Emission Credits
Quad Cities 2	Illinois (IL-17)	911	1972	Zero Emission Credits
Hope Creek	New Jersey (NJ-2)	1,172	1986	Zero Emission Credits
Salem 1	New Jersey (NJ-2)	1,153	1977	Zero Emission Credits
Salem 2	New Jersey (NJ-2)	1,142	1981	Zero Emission Credits
Ginna	New York (NY-24)	580	1970	Zero Emission Credits
James A. FitzPatrick	New York (NY-24)	848	1976	Zero Emission Credits
Nine Mile Point 1	New York (NY-24)	621	1969	Zero Emission Credits
Nine Mile Point 2	New York (NY-24)	1,292	1987	Zero Emission Credits
Davis-Besse	Ohio (OH-9)	908	1977	Nuclear Resource Credits
Perry	Ohio (OH-14)	1,240	1987	Nuclear Resource Credits
Beaver Valley 1	Pennsylvania (PA-17)	907	1976	PA joined Regional Greenhouse Gas Initiative (RGGI)
Beaver Valley 2	Pennsylvania (PA-17)	901	1987	PA joined RGGI
	Total	**15,734**		

Source: CRS, with data from the U.S. Energy Information Administration and state policy documents.

Notes: Generating capacity numbers reflect "Net Summer" generating capacity. All nuclear power reactors in Pennsylvania could benefit from the state joining RGGI, a carbon dioxide cap-and-trade system in the Northeast and Mid-Atlantic. Beaver Valley is included in this table because the plant owner rescinded its closure order, and cited RGGI as the reason for not shutting down the reactors. Ohio subsidies were postponed and then repealed without being implemented.

Figure 4. U.S. Nuclear Reactors Supported by State Intervention



Source: CRS, using data from S&P Global Platts, Esri Data and Maps, with data from the Energy Information Administration and state intervention policies.

Notes: NRC = Nuclear Resource Credits (similar to ZECs); PPA = Power Purchase Agreement; RGGI = Regional Greenhouse Gas Initiative; ZEC = Zero Emission Credits. All nuclear power reactors in Pennsylvania could benefit from the state joining RGGI. Beaver Valley is included in this map because the plant owner rescinded its closure order, and cited RGGI as the reason for not shutting down the reactors. Ohio subsidies were postponed and then repealed without being implemented.

Connecticut

Connecticut enacted a law in 2017 to authorize the state's Department of Energy and Environmental Protection (DEEP) to hold competitive procurements for power from nuclear plants found to be at risk of retirement.[7] Two power reactors are currently operating in Connecticut, Millstone 2 and 3 (with unit 1 having been previously retired). DEEP and the Connecticut Office of Consumer Counsel determined in 2019 that Millstone 2 and 3 were at risk of permanent shutdown beginning on June 1, 2023, when the Millstone plant's current capacity obligations with the regional transmission organization expire.[8]

In the power purchase solicitation that took place after Millstone was found to be at risk, DEEP approved Millstone's bid to sell half the plant's output for a 10-year period running through 2029, or 9 million megawatt-hours per year. Connecticut's two regulated electric utilities were required to purchase the power from Millstone at $49.99 per megawatt-hour, for a total of about $450 million per year. The power purchase includes all of Millstone's zero emission credits (ZECs), which can be resold.[9] New England real-time wholesale electricity prices averaged $30.67 per megawatt-hour in 2019,[10] $19.32 below the price in the Millstone power purchase contracts. At those rates, the resulting subsidy to Millstone would average about $174 million per year.

Illinois

Exelon announced in 2016 that it would shut down its single-unit Clinton plant and the two-unit Quad Cities plant in 2017 and 2018, respectively.[11] The Illinois General Assembly enacted a law (Public Act 99-0906) on December 1, 2016, to provide ZECs to keep the plants operating for 10 years. The law set the price of a ZEC at $16.50 per megawatt-hour, based on the social cost of carbon,[12] to be adjusted for market conditions and other factors. Under criteria in the law, the Illinois Power Authority procures the ZECs from the three reactors at Clinton and Quad cities at the mandated price and sells them to utilities in the state. The total cost of the ZECs over 10 years is estimated to be about $3.6 billion, or about $360 million per year for the three eligible

[7] An Act Concerning Zero Carbon Solicitation and Procurement, Public Act No. 17-3, signed October 31, 2017, https://cga.ct.gov/asp/cgabillstatus/CGAbillstatus.asp?selBillType=Bill&bill_num=1501&which_year=2017IS. Connecticut Governor Dannel P. Malloy had signed Executive Order 59 with similar provisions July 25, 2017.

[8] Connecticut Public Utilities Regulatory Authority, *Brief of the Department of Energy and Environmental Protection's Bureau of Energy and Technology Policy and the Office of Consumer Counsel*, September 28, 2018, http://www.dpuc.state.ct.us/DOCKCURR.NSF/60903cc7b9de44728525746b006e8ffb/45b46c73aeca4c6285258319003d9a97/$FILE/68115619.pdf/scanned%20DEEP-OCC%20At%20Risk%20brief%20with%20attachments%2018-09-28.pdf.

[9] Connecticut Legislature, Office of Legislative Research, *Millstone Power Procurement*, September 1, 2020, https://www.cga.ct.gov/2020/rpt/pdf/2020-R-0203.pdf.

[10] ISO New England, "Markets: Fast Stats," https://www.iso-ne.com/about/key-stats/markets.

[11] Exelon, "Exelon Announces Early Retirement of Clinton and Quad Cities Nuclear Plants," news release, June 2, 2016, http://www.exeloncorp.com/newsroom/clinton-and-quad-cities-retirement.

[12] Estimated by the U.S. Interagency Working Group on Social Cost of Greenhouse Gases, https://www.epa.gov/sites/production/files/2016-12/documents/sc_co2_tsd_august_2016.pdf.

reactors.[13] The Illinois ZEC program and a similar program in New York were challenged in federal court but ultimately upheld.[14]

Four more Illinois reactors are currently scheduled for permanent shutdown. As shown in **Table 2**, Exelon announced in August 2020 that it would retire its two-unit Byron plant in September 2021 and the final two operating reactors at its Dresden plant in November 2021. Exelon said the two plants "face revenue shortfalls in the hundreds of millions of dollars" despite efficient and reliable operation.[15] In response to the shutdown announcement, the Illinois Environmental Protection Agency contracted for a study released in April that concluded "that Byron and Dresden do face real risk of becoming uneconomic in the near term" and that "State support could be part of a strategy for the Illinois economy to transition to less carbon-emitting resources."[16]

New Jersey

New Jersey enacted a law in 2018 to provide ZECs to nuclear power plants in the state that could demonstrate a need for subsidies to continue operating.[17] PSEG Nuclear, the operator of New Jersey's three nuclear reactors—Salem 1 and 2 and Hope Creek—applied for the ZECs in December 2018. The application stated that "PSEG intends to retire the plants within the next three years unless there [is] a material beneficial financial change."[18]

The New Jersey Board of Public Utilities (BPU) in April 2019 awarded ZECs to the three reactors worth about $100 million each for three years. The BPU staff concluded that the reactors were financially viable without the subsidies. However, the BPU Board found that "operational risks" and "market risk" as defined by the law made the three reactors eligible for ZECs. In dissenting from the BPU decision, one commissioner contended that the three reactors had not "satisfactorily demonstrated" that they would shut down without state subsidies.[19]

---

[13] Illinois Commerce Commission, *Report to the General Assembly in Compliance with Section 1-75(d-5) of the Illinois Power Agency Act*, August 2019, https://www.ilga.gov/reports/ReportsSubmitted/553RSGAEmail1216RSGAAttach2019%20Report%20to%20General%20Assembly%20in%20Compliance%20with%20Section%201-75(d-5)%20IL%20Power%20Agency%20Act.pdf.

[14] Walton, Rod, "Supreme Court Refuses to Hear Appeals Against Nuclear Subsidies in New York, Illinois," *Power Engineering*, April 16, 2019, https://www.power-eng.com/emissions/supreme-court-refuses-to-hear-appeals-against-nuclear-subsidies-in-new-york-illinois/#gref.

[15] Exelon, "Exelon Generation to Retire Illinois' Byron and Dresden Nuclear Plants in 2021," news release, August 27, 2020, https://www.exeloncorp.com/newsroom/exelon-generation-to-retire-illinois%E2%80%99-byron-and-dresden-nuclear-plants-in-2021.

[16] Synapse Energy Economics, Inc., *Exelon Illinois Nuclear Fleet Audit*, redacted version, April 14, 2021, https://www.documentcloud.org/documents/20615638-2021-4-14-exelon-illinois-nuclear-fleet-audit-report.

[17] NJ Rev Stat § 48:3-87.3 (2018), Findings, declarations relative to nuclear energy, https://law.justia.com/codes/new-jersey/2018/title-48/chapter-3/section-48-3-87.3/.

[18] PSEG Services Corporation, Application to New Jersey Board of Public Utilities for Hope Creek Generating Station to receive ZECs, December 19, 2018, p. 5, https://corporate.pseg.com/aboutpseg/companyinformation/thepsegfamilyofcompanies/-/media/E26DB24D6B074FEB8CD0895A1ED1D45C.ashx.

[19] McAuliffe, Michael, "New Jersey Customer Advocate Mulls ZEC Appeal," *Nucleonics Week*, April 25, 2019; New Jersey Board of Public Utilities, *Order Determining the Eligibility of Hope Creek, Salem 1, and Salem 2 Nuclear Generators to Receive ZECs*, April 17, 2019, https://www.bpu.state.nj.us/bpu/pdf/boardorders/2019/20190418/4-18-19-9A.pdf.

New York

The owners of four nuclear reactors in upstate New York announced in 2016 that they would permanently be closed for economic reasons.[20] To keep the plants operating, the State of New York Public Service Commission approved a ZEC system in August 2016 that provided additional revenue for the four reactors and required them to continue operating through 2029.[21] The order required the New York State Energy Research and Development Authority (NYSERDA) to purchase ZECs from the four reactors and resell them to state-regulated electric utilities ("load serving entities"). The initial ZEC price was set at $17.48 per megawatt-hour at a cap of 27.618 million megawatt-hours per year. This yielded a maximum annual ZEC subsidy for the four reactors of $483 million for the first two years of the program, with adjustments to be made every two years.

Ohio

The permanent shutdown of Ohio's two nuclear power plants, Davis-Besse and Perry, was announced in an April 25, 2018, filing with the Nuclear Regulatory Commission (NRC) by the plants' owner, FirstEnergy Solutions (now Energy Harbor after a bankruptcy reorganization). The NRC filing said FirstEnergy Solutions would cease operation of Davis-Besse by May 31, 2020, and Perry by May 31, 2021.[22]

FirstEnergy Solutions rescinded the shutdown notice for the two nuclear plants on July 26, 2019,[23] three days after the Ohio Legislature enacted a bill, H.B. 6, to provide subsidies to keep them operating.[24] H.B. 6 authorized the collection of $150 million per year from ratepayers for a "nuclear generation fund," which would provide financial support to Davis-Besse and Perry. The nuclear subsidy collections were to begin on January 1, 2021.[25]

A proposed referendum to repeal H.B. 6 was abandoned in January 2020 after sufficient signatures were not gathered in time.[26] However, on July 16, 2020, the U.S. Attorney for the Southern District of Ohio filed a criminal complaint that the enactment of H.B. 6 and failure of

---

[20] Entergy, "Entergy to Close James A. FitzPatrick Nuclear Power Plant in Central New York," news release, February 23, 2016, http://www.entergynewsroom.com/latest-news/entergy-close-jamesfitzpatrick-nuclear-power-plant-central-new-york-1829/; Knauss, Tim, "Another Oswego County Nuke Threatens to Close: Nine Mile 1 on the Brink," *Syracuse.com*, June 15, 2016, updated March 22, 2019, https://www.syracuse.com/news/2016/06/another_oswego_county_nuke_threatens_to_close_nine_mile_1_on_the_brink.html.

[21] State of New York Public Service Commission, *Order Adopting a Clean Energy Standard*, Issued and Effective August 1, 2016, https://www.nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Standard/Important-Orders-Reports-and-Filings/Filings-Orders-and-Reports. See Appendix E.

[22] Ryser, Jeffrey, "FirstEnergy Reaches Creditor Agreements Related to Subsidiary Bankruptcy," *Nucleonics Week*, April 26, 2018.

[23] FirstEnergy Solutions, "FirstEnergy Solutions Rescinds Deactivation Notices for Competitive Generating Plants in Ohio," news release, July 26, 2019, https://www.prnewswire.com/news-releases/firstenergy-solutions-rescinds-deactivation-notices-for-competitive-generating-plants-in-ohio-300891786.html.

[24] Ohio Legislature, 133rd General Assembly, House Bill 6 Status, https://www.legislature.ohio.gov/legislation/legislation-status?id=GA133-HB-6.

[25] Ohio Legislature, 133rd General Assembly, House Bill 6 as enrolled, Sec. 3706.46, https://www.legislature.ohio.gov/legislation/legislation-summary?id=GA133-HB-6. Other electric generation subsidies were also included in the legislation.

[26] "House Bill 6 Referendum Effort Is Dead After Group Drops Lawsuit Appeal," January 22, 2020, https://www.cleveland.com/open/2020/01/house-bill-6-referendum-effort-is-dead-after-group-drops-lawsuit-appeal.html.

the repeal effort had been directly affected by "multiple acts of bribery" by the Ohio Speaker of the House and other state officials.[27]

Citing the scandal and other concerns about the implementation of H.B. 6, an Ohio industry association appealed to the Ohio Supreme Court to stay the scheduled January 1, 2021, initiation of ratepayer charges for the act's nuclear and other electric generation subsidies.[28] The Ohio Supreme Court granted the temporary stay on December 28, 2020.[29] Ohio Governor Mike DeWine signed legislation on March 31, 2021, that repeals the H.B. 6 nuclear subsidies.[30] Following the nuclear subsidy suspension and repeal, Energy Harbor has not announced any changes to the status of Davis-Besse and Perry, which are continuing to operate.

Future use of any Ohio subsidies could also be affected by a Federal Energy Regulatory Commission (FERC) order to expand the Minimum Offer Price Rule (MOPR) issued by the PJM regional transmission organization. The Ohio nuclear plants are in the PJM region. FERC may revisit its order under the Biden Administration. For more information, see CRS Insight IN11223, *FERC Directs PJM to Expand Minimum Offer Price Rule*, by Richard J. Campbell.

Pennsylvania

FirstEnergy (now Energy Harbor), owner of the two-unit Beaver Valley nuclear plant in western Pennsylvania, announced in March 2018 that the plant would close in 2021.[31] Energy Harbor rescinded Beaver Valley's planned retirement in March 2020, after observing Pennsylvania Governor's efforts to join the Regional Greenhouse Gas Initiative (RGGI), a carbon dioxide cap-and-trade program in the Northeast and Mid-Atlantic. Energy Harbor said its decision to keep the plant operating was "largely driven" by the governor's actions to join RGGI, "which will begin to help level the playing field for our carbon-free nuclear generators."[32]

Governor Wolf issued an Executive Order in October 2019 directing the Pennsylvania Department of Environmental Protection (DEP) to develop a rulemaking that would establish the framework to join RGGI.[33] DEP issued a proposed rulemaking in September 2020 and, to date, is conducting outreach as the final rule is developed.[34] Policymakers in Pennsylvania's legislative

[27] Criminal Complaint Before the U.S. District Court for the Southern District of Ohio, United States of America v. Matthew Borges, Case No. 1:20-MJ-00526, July 16, 2020, https://fox8.com/wp-content/uploads/sites/12/2020/07/show_temp.pdf.

[28] Supreme Court of Ohio, "Motion to Stay Charges Assessed to Customers to Subsidize the H.B. 6 Clean Air Fund by the Ohio Manufacturers' Association Energy Group," Case No. 2020-1488, December 17, 2020, http://supremecourt.ohio.gov/pdf_viewer/pdf_viewer.aspx?pdf=895795.pdf.

[29] Supreme Court of Ohio, In re Matter of Establishing the Clean Air Fund Rider Pursuant to R.C. 3706.46, December 28, 2020, http://supremecourt.ohio.gov/pdf_viewer/pdf_viewer.aspx?pdf=895795.pdf.

[30] Mike DeWine, Governor of Ohio, "Governor DeWine Signs Ohio Transportation Budget," news release, March 31, 2021, https://governor.ohio.gov/wps/portal/gov/governor/media/news-and-media/transportation-budget-signed-03312021.

[31] FirstEnergy Solutions, "FirstEnergy Solutions Files Deactivation Notice for Three Competitive Nuclear Generating Plants in Ohio and Pennsylvania," news release, March 28, 2018, https://www.sec.gov/Archives/edgar/data/1407703/000119312518104000/d561242dex991.htm.

[32] Energy Harbor, "Energy Harbor Corp Rescinds Deactivation Notice for Nuclear Generating Plant in Pennsylvania," news release, March 13, 2020, https://energyharbor.com/en/about/news-and-information/energy-harbor-corp-rescinds-deactivation-notice-for-nuclear-gene.

[33] Governor Wolf Executive Order 2019-07, first signed October 3 2019, amended June 22, 2020, https://www.oa.pa.gov/Policies/eo/Documents/2019-07.pdf.

[34] For more information, see the Pennsylvania Department of Environmental Protection RGGI website,

bodies have voiced strong opposition to joining RGGI and the governor's actions to join the program without enacting new legislation.[35]

The 11 northeastern and mid-Atlantic states that participate in RGGI have agreed to a regional cap on carbon dioxide (CO_2) emissions from fossil-fuel-fired electric power plants. The RGGI emissions cap increases costs for fossil fuel plants relative to non-emitting generating sources such as nuclear plants. To demonstrate compliance with the emissions cap, covered power plants must submit emission allowances to the implementing state agency to cover the number of short tons of CO_2 the plant emitted over past the compliance period (three years in the RGGI program). The vast majority of RGGI emission allowances are initially distributed through quarterly auctions, and power plants may buy and sell allowances among themselves throughout the compliance period. In RGGI's most recent auction (March 2021), the auction clearing price for allowances was $7.60 per short ton of CO_2, the highest price in RGGI's history. For more information, see CRS Report R41836, *The Regional Greenhouse Gas Initiative: Background, Impacts, and Selected Issues*, by Jonathan L. Ramseur.

Congressional Action

The recent U.S. nuclear power plant retirements and announced future shutdowns have drawn substantial congressional attention, including proposed legislation, committee hearings and markups, and enacted authorizations and appropriations.

The Senate Energy and Natural Resources Committee held a hearing on nuclear energy March 25, 2021, which included a focus on existing U.S. nuclear plants. Chair Joe Manchin said in his opening statement, "Lifetime extensions are cheaper than new builds and are generally cost competitive with other generation technologies. We cannot afford to let this carbon-free energy resource fade out."[36] Manchin subsequently sent a letter to President Biden urging him "to take action to preserve our existing nuclear fleet and prevent further closures."[37] An amendment to provide a production tax credit for existing nuclear power plants was proposed by Senator Ben Cardin in the Senate Finance Committee but not offered for a vote during a markup of draft energy tax legislation on May 26, 2021.[38]

Nuclear plant closures were discussed at a May 6, 2021, hearing by the House Appropriations Subcommittee on Energy and Water Development on the DOE FY2022 budget request.[39] Under questioning, Energy Secretary Jennifer M. Granholm pledged to work with Congress to find ways

https://www.dep.pa.gov/Citizens/climate/Pages/RGGI.aspx.

[35] See, e.g., EnergyWire, "Battle Rages over Pa. Plan to Join RGGI," May 6, 2021, https://www.eenews.net/energywire/2021/05/06/stories/1063731853.

[36] Chairman Joe Manchin's Opening Statement, *Hearing to Examine the Latest Developments in the Nuclear Energy Sector*, Senate Committee on Energy and Natural Resources, March 25, 2021, https://www.energy.senate.gov/services/files/FD68DDC9-1352-4189-B1C8-4AF3A44E7235.

[37] Senate Energy and Natural Resources Committee Chairman Joe Manchin, letter to President Joseph R. Biden, April 20, 2021, https://www.energy.senate.gov/2021/4/manchin-urges-biden-to-support-domestic-nuclear-fleet-prevent-plant-closures.

[38] Senate Committee on Finance, "Open Executive Session to Consider an Original Bill Entitled The Clean Energy for America Act," May 26, 2021, https://www.finance.senate.gov/hearings/open-executive-session-to-consider-an-original-bill-entitled-the-clean-energy-for-america-act.

[39] House Committee on Appropriations, Subcommittee on Energy and Water Development and Related Agencies, *FY2022 Budget Request for the Department of Energy*, Hearing, May 6, 2021, https://appropriations.house.gov/events/hearings/fy-2022-budget-request-for-the-department-of-energy.

to keep existing reactors operating, a goal that was supported by Subcommittee Chair Marcy Kaptur.

The 10th anniversary of the March 2011 Fukushima nuclear reactor meltdowns in Japan also prompted congressional comment on the future of U.S. nuclear power, especially the safety of existing plants. Senator Ed Markey, Chair of the Subcommittee on Clean Energy, Climate, and Nuclear Safety of the Environment and Public Works Committee, issued a statement on the Fukushima anniversary calling on the Nuclear Regulatory Commission (NRC) to ensure that the lessons of Fukushima are applied to existing U.S. reactors and not relaxed to ensure nuclear industry profitability.[40]

Legislation has been introduced in the 117th Congress to establish a national clean energy standard (CES), which would require electric utilities to provide specific amounts of power to their customers from eligible low- or zero-carbon generators. A CES that includes nuclear energy could increase the demand for electricity from existing reactors and possibly provide an economic incentive for building new ones. The CLEAN Future Act (H.R. 1512), introduced March 2, 2021, by House Energy and Commerce Committee Chair Frank Pallone Jr., includes a CES that would gradually rise to 100% zero-emission electricity generation by 2035 and afterward. Nuclear power is eligible in the CLEAN Future Act. The House Energy and Commerce Committee held a hearing on the bill March 24, 2021.[41]

The 116th Congress enacted the Energy Act of 2020 (Division Z of P.L. 116-260), which authorized appropriations for DOE's ongoing "sustainability" research and development program to improve the economics, safety, and continued operation of existing nuclear power plants. Division D of P.L. 116-260 provided appropriations of $47 million for the sustainability program for FY2021, the same as in FY2020.

Also in the 116th Congress, the Senate Environment and Public Works Committee approved legislation (S. 4897) on December 2, 2020, that included assistance to operating reactors at risk of permanent shutdown. Under that provision, nuclear reactors certified for the program were to submit bids to the U.S. Environmental Protection Agency for the amount of assistance per megawatt-hour of electric generation they would require to continue operating for the next four years. Based on the bids, the available appropriations for the program were to be awarded to "as many certified nuclear reactors as possible." The legislation was not enacted.

Author Information

Mark Holt
Specialist in Energy Policy

Phillip Brown
Specialist in Energy Policy

[40] Senator Markey, Statement on U.S. Nuclear Safety Agenda on 10th Anniversary of Fukushima Nuclear Disaster, March 11, 2021, cited by Indian Point Safe Energy Coalition, https://www.ipsecinfo.org/2021/03/17/lap-dogs-for-the-industry-senator-markey-statement-on-u-s-nuclear-safety-agenda-on-10th-anniversary-of-fukushima-nuclear-disaster/.

[41] House Committee on Energy and Commerce, "The Clean Future Act: Powering a Resilient and Prosperous America," hearing, March 24, 2021, https://energycommerce.house.gov/committee-activity/hearings/hearing-on-the-clean-future-act-powering-a-resilient-and-prosperous.

Disclaimer

This document was prepared by the Congressional Research Service (CRS). CRS serves as nonpartisan shared staff to congressional committees and Members of Congress. It operates solely at the behest of and under the direction of Congress. Information in a CRS Report should not be relied upon for purposes other than public understanding of information that has been provided by CRS to Members of Congress in connection with CRS's institutional role. CRS Reports, as a work of the United States Government, are not subject to copyright protection in the United States. Any CRS Report may be reproduced and distributed in its entirety without permission from CRS. However, as a CRS Report may include copyrighted images or material from a third party, you may need to obtain the permission of the copyright holder if you wish to copy or otherwise use copyrighted material.