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Coal to Nuclear Repowering:
Considerations for State Energy Offices and Public Utility Commissions

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I. Introduction

In April 2023, the National Association of State Energy Officials (NASEO) and the National Association of Regulatory Utility Commissioners (NARUC) launched the Advanced Nuclear State Collaborative (ANSC)[A] with support from the U.S. Department of Energy (DOE) Office of Nuclear Energy. The NARUC-NASEO ANSC convenes State Energy Offices and Public Utility Commissions for peer sharing and information exchange on the policy, programmatic, and regulatory considerations needed to facilitate the deployment of advanced nuclear power. With participation from 31 states across the country, the ANSC allows State Public Utility Commissions and State Energy Offices to share challenges (e.g., cost and community engagement) and opportunities (e.g., coal to nuclear repowering and economic development) with a goal of identifying pathways to move advanced nuclear projects forward.

Closures of coal power plants are expected to continue as the long-term economic viability of many of these facilities diminishes and states work to meet federal and state environmental and climate goals and reduce emissions negatively affecting public health and the environment. States are exploring opportunities to use infrastructure and existing workforce located at the sites of retiring or retired coal power plants to potentially site other energy infrastructure, such as solar and/or battery storage or small modular nuclear reactors (SMRs). Coal to nuclear repowering occurs when a nuclear plant is sited at the location of a former coal plant. According to findings from a 2022 DOE-led study of 157 retired coal power plants, 80% of the sites are conducive to siting advanced reactors, such as SMRs. DOE found this percentage is the same for the 237 sites with still operational coal power plants.[1]

Transitioning these sites to host SMRs could be beneficial to states looking for reliable, clean energy solutions to replace aging coal plants. Some of the benefits of coal to nuclear repowering include reduced emissions, workforce and economic development potential, improved electric reliability, and opportunities to save time and money relative to greenfield deployment by repurposing existing infrastructure.

This report highlights some of the benefits and challenges associated with the coal to nuclear repowering process, with a particular focus on the policy, programmatic, and regulatory considerations of relevance to State Energy Offices and Public Utility Commissions. Additional resources that walk through the practical steps involved in the coal to nuclear process include DOE's *Investigating Benefits and Challenges of Converting Retiring Coal Plants into Nuclear Plants*, the Bipartisan Policy Center's *Can Advanced Nuclear Repower Coal Country?*, the Nuclear Innovation Alliance's *Resources for Coal Repowering with Nuclear Energy*, and EPRI's *Coal to Nuclear: A Practical Guide for Developing Nuclear Energy Facilities in Coal Plant Communities*.

A For more information, https://www.naseo.org/issues/electricity/nuclear

II. Benefits of Nuclear Energy and Repowering

Repurposing a coal power plant site to host an SMR will involve a variety of considerations and actors across the state and federal government. Several of the guides linked above provide practical steps on the process and how to weigh whether repowering is the best application for a site given its context in the community. State Energy Offices and Public Utility Commissions involved in the policy, programmatic, and regulatory aspects of this transition might be looking for a snapshot of some of the potential benefits associated with coal to nuclear repowering. Benefits described below include existing infrastructure, economic development, reliability, and decarbonization.

Existing Infrastructure

One of the biggest opportunities provided by coal to nuclear repowering is the repurposing of existing infrastructure. According to DOE, repurposing the infrastructure at coal power plants could lead to capital cost savings on areas such as construction and manufacturing ranging from 15 to 35%.[2] Redeveloping and remediating the site leaves many valuable assets for an SMR to repurpose including electric grid interconnection, waterways, sewage systems, roadways, and equipment. A coal to nuclear feasibility study in Virginia (explored in more detail in section IV below) outlined three categories of equipment that could be reused: (1) transmission, switchyard, and office buildings; (2) ultimate heat sink infrastructure; and (3) steam cycle components. Some of the biggest cost savings would come from existing transmission interconnection as new transmission lines cost can exceed $3 million/mile[3] and can face planning challenges from advocacy groups and landowner opposition. SMRs also require less land so they would not require additional acreage or space. Solar or wind as a direct on-site replacement for coal generation can be more challenging in that regard as much more land is usually required for the same amount of electricity generation to be replaced. According to DOE, the land use efficiency (both direct and indirect) for nuclear is 57,000 MWh/year per acre, 410 MWh/year per acre for coal, and 200 MWh/year per acre for solar.[4] Looking specifically at the VOYGR-12 NuScale SMR plant (made up of 12 modules), it can generate 924 MWe on 0.05 square miles (35 acres) compared to 94 square miles for wind and 17 square miles for solar.[5]

In developing a feasibility study of coal plants set to retire, a state can take stock of existing infrastructure and understand the potential at different locations. Because the siting and permitting of new infrastructure can be extremely challenging and time-consuming, reusing existing infrastructure helps eliminate some of those additional hurdles and permitting needs.

Economic Development and Workforce

As more coal power plants close, the workforce at and supporting coal plants is losing key income and growth opportunities, and surrounding communities are losing tax revenue and economic development opportunities, including indirect benefits for local businesses. **Table 1** below lists the top 25 areas most dependent on coal, highlighting the geographic diversity of impacted communities, located in most parts of the country. DOE determined these figures based on the number of direct coal-related jobs as a percentage of the total jobs in each area.[6] With the current and impending closures of coal power plants, it will be important for impacted communities to have access to additional workforce and revenue opportunities.

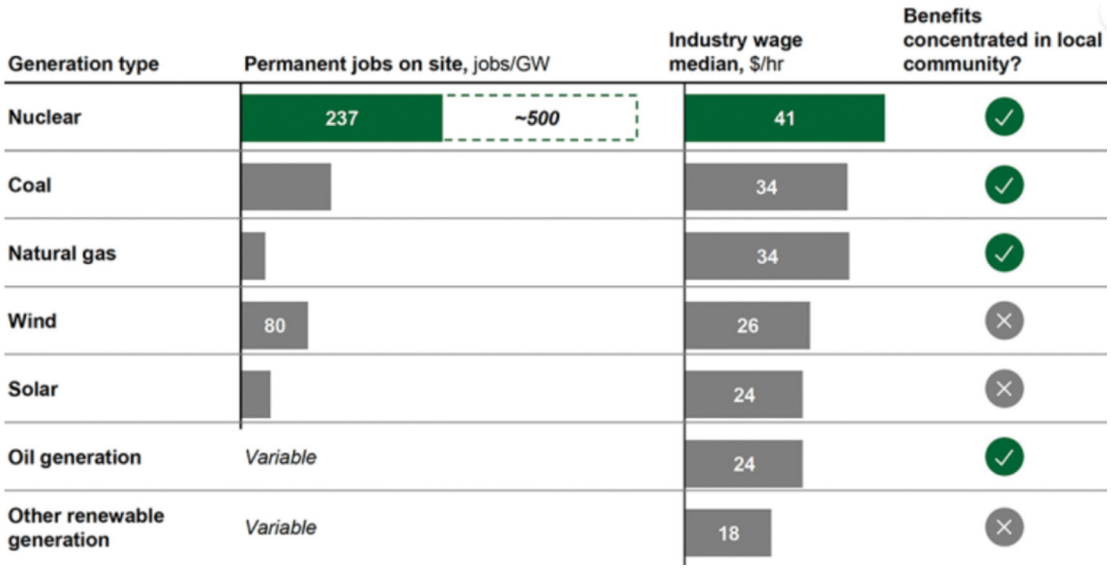
By replacing coal power plants with SMRs, the impact of closures might be softened, and the communities will have access to new economic and job opportunities. Specifically, coal plant operators and maintenance staff can be retrained to operate and maintain SMRs, although the specific process will depend on existing qualifications and project timelines.[7] According to research by DOE (see **Figure 1** below), advanced nuclear has higher permanent job potential and median wages than coal (and other electricity sources) per gigawatt hour.[8]

Table 1: Bureau of Labor Statistics Areas Associated with Coal Occupations[9]

Rank	BLS area name	Rank	BLS area name
1	Southern West Virginia non-metropolitan area	14	Southern Indiana non-metropolitan area
2	East Kentucky non-metropolitan area	15	California-Lexington Park, Maryland
3	Wheeling, West Virginia-Ohio	16	Farmington, New Mexico
4	Southwest Virginia non-metropolitan area	17	Northeast Virginia non-metropolitan area
5	Alaska non-metropolitan area	18	West North Dakota non-metropolitan area
6	West Kentucky non-metropolitan area	19	Greeley, Colorado
7	Bremerton-Silverdale, Washington	20	College Station-Bryan, Texas
8	Eastern Wyoming non-metropolitan area	21	Southwest Alabama non-metropolitan area
9	Western Wyoming non-metropolitan area	22	Grand Junction, Colorado
10	Arizona non-metropolitan area	23	Beckley, West Virginia
11	Northern West Virginia non-metropolitan area	24	Charleston, West Virginia
12	South Illinois non-metropolitan area	25*	Western Pennsylvania non-metropolitan area
13	Central Utah non-metropolitan area	** Added for geographic diversity.*	

Source: Interagency Working Group on Coal and Power Plant Communities and Economic Revitalization

Figure 1: Electricity Generation Jobs and Wage Comparison[10]



Source: U.S. Department of Energy

Note: The 237 jobs number is an estimate for an SMR, the ~500 represents the current large reactor operating fleet.

Importantly, state governments can support retraining and reskilling programs of former coal workers and training programs for a new generation (**Table 2** below details positions with transferable skills and the degree of retraining needed to prepare workers for the transition). A report developed by the **Kentucky** Nuclear Development Workgroup and submitted by the Kentucky Office of Energy Policy to the state legislature in November 2023 identifies a path forward. The Workgroup recommends that universities, community colleges, and K-12 institutions coordinate with utilities, participate in public meetings and take advantage of other engagement opportunities around Integrated Resource Plans (IRPs) to better understand timelines and workforce needs associated with SMR projects. The goal would be to ensure programs are available that prepare and graduate technicians, high-voltage electricians, and construction engineers for when project development begins. While SMR facilities can retain certain operators and staff from coal plants, it will be necessary to have specialized staff ready to work on SMR construction and operation.

Table 2: Coal to SMR Job Retraining Opportunities[11]

Coal Plant Position	# Dedicated Coal Positions	SMR Position	# Dedicated SMR Positions	Position Type	Degree of Retraining Required
Operations Supervisor	5	Senior Reactor Operator	5	Supervisor	High
Control Room Operator	10	Reactor Operator	15	Operator	High
Field Operator	15	Non-Licensed Operator	25	Operator	Low
Lab Operator/Chemistry/Scrubber	4	Chem Tech	14	Craft	Medium
Maintenance Supervisor	2	Maintenance Supervisor	3	Supervisor	Medium
Mechanical Craft	12	Mechanical Craft	21	Craft	Low
I&C Craft	9	I&C Craft	10	Craft	Medium
Electrician Craft	5	Electrician Craft	11	Craft	Low
Technician	11	Technician	13	Laborer	Low
Security Officer	20	Security Officer	48	Laborer	Low
Sub-Total	**93**		**165**		
All Other Positions	14		72	42 are O&M Support (Planners, Outage, etc.)	Medium
Total On-Site Positions	**107**		**237**		
Possible Centralized Positions			33		
Total Positions			**270**		

Source: ScottMadden

In addition to enabling workforce opportunities, deploying SMRs would also result in an increase in local, state, and federal tax revenue,[B] which would have particular benefits for areas with coal plant retirements experiencing economic downturn. A study in **Maryland** found that the loss of a coal power plant in a rural part of the state would lead to a community losing as much as $122 million of its local economic output.[12] This could be mitigated by repowering the site with an SMR. A 2021 study on the economics of SMRs estimated some of the tax impacts that could be expected from a 600 MWe SMR plant, comprised of four 150 MWe reactors: around $10 million in state and local taxes and $40 million on the federal level each year.[13] A specific local example is outlined in a feasibility study done in **Virginia** on coal to nuclear repowering. The study compares the tax benefit of a hypothetical SMR to the existing Virginia City Hybrid Energy Center in Wise County which paid over $11 million in property taxes to the county in 2022.[14] The Virginia City Hybrid Energy Center is a power station that processes and converts gob coal and biomass into electricity.[15] Its annual electricity generation is similar to that of a 300 MWe SMR. Indirect economic benefits, such as spending by workers on local businesses, are an additional positive impact that will be felt by communities.

Electric Reliability

With coal plant retirements increasing every year, states are looking for new ways to maintain baseload power and electric reliability, which is important during extreme weather events and other power system disruptions. In addition to providing baseload power, SMRs can be dispatched at all hours of the day to match changes in power supply and demand. In addition, newer designs are incorporating increased flexibility to vary output in response to energy demand and availability. In **Wyoming**, the TerraPower Natrium reactor will be located near a retiring coal plant. It will be made up of a 345 MWe advanced nuclear reactor paired with a molten salt-based energy storage system. According to TerraPower, the storage will allow the system's output to reach 500 MWe for more than five and a half hours when needed.[16] The retiring plant has an output of 448 MWe.[17] This ability of

B For certain states, such as those in Tennessee Valley Authority's (TVA) service area, there may also be impacts on payment in lieu of taxes (PILOT). Since TVA is a federal entity, it is exempt from state and local taxes and so PILOT is used to compensate state and local governments. https://www.tn.gov/tacir/tva-pilots.html

advanced nuclear to match or exceed the output of a coal plant is important in ensuring the state maintains a similar level of reliability and resilience. The added flexibility of the nuclear plant will enable it to act as a load-following resource. SMRs also do not need to be refueled as frequently as coal plants, increasing reliability. Additionally, the transportation of coal to power plants relies on rail, barge, and other forms of transportation that can be disrupted by severe weather.[18]

Decarbonization

Coal plants are large emitters of pollutants that have a negative impact on surrounding communities and residents. According to the DOE study referenced earlier, an analysis by the U.S. Environmental Protection Agency (EPA) determined that carbon dioxide emissions at a coal power plant average 2,180 lbs/MWh.[19] This is in addition to other harmful emissions from a coal plant including nitrogen oxides, mercury, particulate matter, and others. Repowering coal sites with nuclear energy would reduce emissions significantly and improve public health and environmental welfare in the site community and beyond. DOE determined that repurposing a coal plant to host an SMR could reduce greenhouse gas emissions in a community by up to 86%. DOE considered the total impact of the process including the emissions associated with increased economic activity related to the SMR.[20]

Additionally, nuclear energy can support decarbonization of other emitting sectors such as hydrogen production and advanced manufacturing. Clean hydrogen is a pathway for decarbonizing the electricity system, manufacturing, industry and heating applications, and medium-and-heavy-duty transportation. As such, more states are exploring opportunities to move clean hydrogen projects forward and identify the best production opportunities. According to DOE, a 1,000 MWe reactor could produce up to 150,000 tons of hydrogen each year.[21]

III. Nuclear Energy Repowering Challenges

While there are significant benefits associated with coal to nuclear repowering, states should be aware of potential challenges – many of which can be addressed with the proper resources and advanced planning. This section will explore some of these challenges, such as cost, the timeline for repowering, addressing public opinion, managing regulations, and spent nuclear fuel.

Cost

One of the biggest questions State Energy Offices and Public Utility Commissions will grapple with in advanced nuclear planning centers around cost. According to the DOE Pathways to Commercial Liftoff: Advanced Nuclear report, for a first of its kind technology, overnight capital costs for advanced nuclear are expected to range from around $6,000 - $10,000/kw.[22] For Nth-of-a-kind (repeat deployments) costs will drop by 40% and, according to Idaho National Laboratory, coal to nuclear repowering would additionally reduce overnight capital costs by 15-35%. Some of the key drivers for reducing cost include improved pre-project planning, standardization, and supply chain development.[23]

When looking at the costs for first-of-a kind SMR projects, they may not initially seem comparable to the costs of wind, solar, and natural gas, which are much lower and have less technology and regulatory risk. Yet, when looking at potential federal and state support for SMRs, including tax credits, loan guarantees, power purchase agreements, and other incentives the costs become more comparable.[24] A study on the economics of SMRs finds that the lowest Levelized Cost of Electricity (LCOE) for SMRS with government support is around $48.4/MWh for investor-owned utilities (IOUs) and $43.4/MWh for municipal utilities. For a natural gas plant those costs range from $38.6 - $43.4/MWh for IOUs and $35.9 - $40.6/MWh for municipal utilities and for wind $41.1/MWh for IOUs and $33.5/MWh for municipal utilities.[25]

Repowering Timeline

As mentioned in the previous section, several studies have looked at potential timelines for coal to nuclear repowering. The process will vary depending on the site, but generally involves the following steps, not necessarily in this order, as outlined in a report by EPRI: (1) define the owner-operator's mission and business objectives; (2) identify a site; (3) define physical site characteristics and select technology; (4) evaluate site infrastructure and existing assets; (5) secure land, transmission, and water rights and other permits; (6) evaluate cost and other economic factors; (7) obtain an early site permit; and (8) conduct community outreach.[26] Community outreach should be done throughout the process and often is best done early. Importantly, states should also consider the time needed for the coal plant shut down and site remediation. According to a report by the Nuclear Innovation Alliance, some of the key steps involved in the remediation process include conducting an environment assessment, site clean-up and remediation (including removing pollutants and other toxic substances), water remediation, ash removal, and land reclamation and restoration.[27] The cost and timing of this process will vary depending on the levels of pollutants and other variables to ensure the health and safety of the environment and local communities.[28] Additionally, obtaining Nuclear Regulatory Commission licenses will be a priority. A feasibility study in Maryland outlined a potential project schedule for repowering a coal site with X-energy's Xe-100 Standard Nuclear Plant (which is made up of four 80 MWe SMRs). According to the analysis, it would take around 8-10 years from the first stage of site-specific engineering to the unit being built and operational.[29] See **Table 3** below for more details.

It will also be important to have a schedule in place to provide time to reskill and train coal plant workers and to have new staff on hand with the proper training and credentials to work on the SMR.

Table 3: Initial Feasibility Schedule for Xe-100 Project at a Maryland Coal Facility[30]

Activity	Key Project Start and End Dates	
Site-Specific Engineering	June 30, 2025	June 30, 2027
COLA Preparation	June 30, 2025	September 30, 2027
COLA Submittal	September 30, 2027	
Interconnection Studies	September 30, 2026	September 30, 2029
Site Preparation	October 1, 2029	September 30, 2030
Long Lead-Time Material Procurement	March 30, 2028	June 1, 2031
COL Issued	October 1, 2030	
Site Demolition and Remediation	October 1, 2030	October 1, 2033
Interconnection Upgrades	June 1, 2030	June 1, 2032
Unit Build (Xe-100 80 MWe reactor)	June 1, 2030	November 30, 2032
Unit Start-Up (Xe-100 80 MWe reactor)	December 1, 2032	May 31, 2033

Source: X-energy

Public Opinion

When exploring coal to nuclear repowering, state and local governments should be prepared to provide educational resources and materials to communities about the project and what the transition process will look like. Concerns from communities may range from uncertainty or misinformation related to nuclear safety or storage of spent nuclear fuel (explored in more detail below), objections to closing the coal plant, or an interest in transitioning the site to serve another purpose. In a report submitted by the **Kentucky** Office of Energy Policy to the state legislature on the potential for a Nuclear Energy Development Authority in the state, one of the goals of that Authority would be to grow public acceptance of nuclear energy opportunities by ensuring communities understand basic information on advanced nuclear, the importance of having a secure and cost-competitive baseload power source, and opportunities for economic benefit and tax revenue.[31] This approach can be used for general SMR deployment or for repowering opportunities. In addition, the Potential Energy Coalition conducted research in 2022 to better understand perceptions and levels of support for coal to nuclear repowering in several communities. They found that baseline support for nuclear in coal communities outweighs opposition by nearly five times and that support did not drop off with different political affiliations.[32] Still, the results emphasized the importance of communities being educated on an issue – finding that nuclear support directly correlated with nuclear knowledge. One of the topline messages that resonated with coal communities was the role nuclear energy could play in supporting energy independence and reliability.[33]

Overall, State Energy Offices are well positioned to coordinate with other state entities on community outreach and convenings and to bring in universities, national labs, and other stakeholders to provide educational materials and resources. Community engagement is explored in more detail later in this report.

Permitting and Siting

The coal to nuclear repowering process will involve numerous regulatory considerations on the local, state, and federal level. The site selection process (outlined in **Figure 2** below) is critical, particularly when it comes to getting a license from the Nuclear Regulatory Commission – for example, proposed and alternative sites must be explored and considered. The report by EPRI looked at some of the key considerations of a site including (1) the site property, including additional adjacent utility owned land (2) access to a transmission

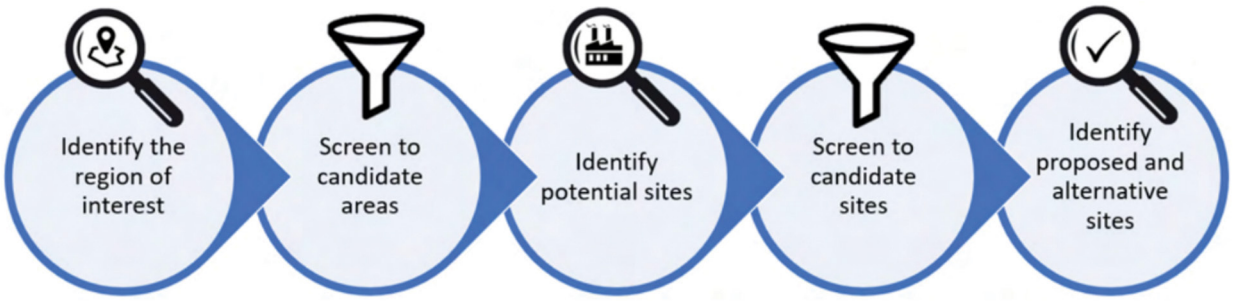
corridor and lines and (3) access to water.[34] Permits must be secured for all of these items along with air and water, building codes, waste disposal, and more.[35]

Sample site selection processes are outlined in feasibility studies led by the states of **Virginia** and **Maryland**. The Maryland study also outlines the specific permits and approvals that will be required including:

- Interconnection Study and Agreement
- Water Use Permit
- County Building Permits
- NRC Construction and Operating Approvals
- Title V Air Emissions Permit
- NPDES Permit
- Fire Protection and Emergency Services Permit
- Sewer Connection Permit
- Maryland DOT Permit
- EPA Environmental Impact Statement
- County Conservation District Erosion and Sedimentation Control Plan
- Maryland Department of the Environment[36]

Some of these permits may be incorporated into other applications, such as early site permits, and may not all be required separately.

Figure 2: Site Selection Process[37]



Source: Nuclear Innovation Alliance

State roadmaps or frameworks are an opportunity to outline some of the regulatory challenges and barriers to advanced nuclear deployment and repowering. For example, the **Wyoming** Energy Authority released a nuclear energy framework for the state and outlined some of the challenges for the state to overcome including (1) a complex and lengthy permitting and regulatory process and (2) the uncertainty and risks inherent to technology development combined with regulatory uncertainty.

Spent Nuclear Fuel

While leftover coal ash is significantly more radioactive than spent nuclear fuel[38], states interested in the coal to nuclear repowering process will need to be prepared to address community and stakeholder concerns around spent nuclear fuel and have a plan in place for interim storage. There will be different infrastructure needs and levels of waste depending on the SMR design, but, overall, according to DOE, advanced reactors would produce a smaller volume of spent nuclear fuel per unit of power generated compared to large scale reactors, although the number of radioactive isotopes would not change.[39] To address issues around spent nuclear fuel storage, DOE has funded Consent-Based Siting Consortia that look at equitable community engagement and seek to get feedback from the public on siting, managing spent nuclear fuel, and federal consolidated

interim storage.[40] The lack of a permanent storage facility for nuclear waste is an impediment for certain states in even building new nuclear. For example, several states have nuclear moratoriums in place that restrict new project development until a permanent storage solution is in place.[41] Still, other states have recognized the opportunities provided by SMRs, including coal to nuclear repowering, and have repealed moratoriums in recent years – including states like Kentucky, Montana, and West Virginia.[42]

Importantly, SMRs require less frequent refueling and there are efforts underway to explore potential options for reducing or recycling waste from SMRs. For example, in 2022, DOE's Advanced Research Projects Agency-Energy (ARPA-E) awarded $36 million to reduce waste from advanced nuclear reactors. The funding went to eleven projects in California, Idaho, New Jersey, New York, North Carolina, Utah, and Washington.[43] In **Arkansas**, legislation was passed in 2023 that explores opportunities for importing nuclear waste to the state and recycling it for continued use.

Overall, the spent nuclear fuel conversation will be an important part of coal to nuclear repowering, and states can support efforts by exploring opportunities for public engagement and comment sessions to ensure any future process is equitable and has consent from the community. States can also work with the DOE Consent-Based Siting Consortia and explore considerations around spent nuclear fuel through coal to nuclear feasibility studies and other analyses.

IV. State Energy Offices and Public Utility Commissions – Policy, Programmatic, and Regulatory Considerations

State Energy Offices and Public Utility Commissions can play an important role in facilitating policies, programs, and regulations to advance coal to nuclear repowering in support of state energy, economic development, decarbonization, reliability, and resilience goals. Coal to nuclear repowering also provides an avenue for other priority issues such as hydrogen production and supports efforts to move a just energy transition forward for coal communities.

Federal and State Funding and Financing Models

There are several different funding opportunities and financing mechanisms available to support the coal to nuclear repowering process, including funding to develop SMRs and resources for conducting feasibility studies. Funds may be available from the federal government, state government, and/or private sector.

From the **federal** perspective, key funding and financing is associated with the 2021 Infrastructure, Investment, and Jobs Act (IIJA), the 2022 Inflation Reduction Act (IRA), and the Creating Helpful Incentives to Produce Semiconductors (CHIPS) and Science Act of 2022. For example, through IIJA, the Clean Energy Demonstration Program on Current and Former Mine Land program (CEML) received $500 million to advance the demonstration of innovative mine land conversion to clean energy projects. Advanced nuclear technologies were eligible. Relevant tax credits through the IRA include the Clean Electricity Production Credit (PTC) and the Clean Electricity Investment Credit (ITC). Additionally, the Energy Communities Bonus Credit can be combined with the ITC and PTC for projects located in energy communities, which include census tracts with coal mines that closed after 1999 or a coal plant that has retired after 2009.[44] The Loan Programs Office within DOE operates the Title 17 program, which provides loans for clean energy projects.[45] The U.S. Congress has also been exploring additional supportive legislation, such as the bipartisan Accelerating Deployment of Versatile, Advanced Nuclear for Clean Energy (ADVANCE) Act which would, among other things, fund a prize to incentivize the development of new nuclear generation.[46] For additional information on federal funding opportunities, states are encouraged to explore the database of competitive funding, formula funding, and tax credits on the Interagency Working Group on Coal and Power Plant Communities and Economic Revitalization website. Additionally, the Working Group supports Rapid Response Teams (RRT) to offer technical assistance directly to communities, which includes identifying relevant federal funding opportunities.[47]

On the state level, there has been momentum in several states. For example, the $50 million **Tennessee** Nuclear Fund (announced in April 2023) provides grants to nuclear businesses in or relocating to the state. The first project through the fund has been announced, with funds going to support the development of a nuclear fusion prototype sited at the retired Tennessee Valley Authority Bull Run Fossil Plant.[48] In **Idaho**, HB 591 (2018) allows tax exemptions for the research and development of SMRs in the state. The **Colorado** Energy Office was awarded funds from the state's just transition cash fund in 2023 to assess energy solutions, including advanced nuclear, in rural parts of the state.[49] Several State Energy Offices have also used U.S. State Energy Program funds to facilitate feasibility studies and other reports. For example, the **Indiana** Office of Energy Development issued a Request for Proposals in November 2023 for a partner to develop a state-wide SMR study that looks at the benefits and drawbacks of SMR deployment and other considerations, such as state and local economic impact, workforce development, safety, and community engagement.[50] From the regulatory perspective, **North Carolina** Utilities Commission (NCUC) Docket No. E-100 Sub 179 authorized Duke Energy Carolinas to incur up to $75 million in project development costs associated with new nuclear generation and requires the utility to report on activities and costs incurred.[51]

State Studies and Working Groups

In addition to funding and financing mechanisms from the state, there are also efforts on the state-level to facilitate state working groups or committees, develop roadmaps or studies, and other activities related to the deployment of SMRs. Within these different avenues, states could also explore opportunities for coal to nuclear repowering and how that aligns with broader SMR deployment goals and coal retirements, if they have not already.

State-led roadmaps and feasibility studies are an avenue for exploring SMR opportunities within states. Several states mentioned above are in the early stages, while other states have finalized relevant studies including Wyoming, Virginia, and Maryland. The **Virginia** Department of Energy and GO Virginia Region One released a feasibility study of potential sites for hosting an SMR. The study was released in May 2023 and evaluated the counties of Lee, Scott, and Wise because the counties have inexpensive brownfield sites, mine water for cooling, existing right of way for transmission infrastructure, and existing rail infrastructure. Each county has also experienced a decrease in employment at local coal mines and a need for transformative industries to spur economic and workforce opportunity growth. The study identified seven potential sites and considered technical feasibility, estimated cost, health and safety considerations, socioeconomic factors, and economic effects. It also looked at co-benefits from siting SMRs in the region, including interest from data centers and other industrial developers.[52]

The **Maryland** Energy Administration (MEA) funded a study, Feasibility Assessment and Economic Evaluation: Repurposing a Coal Power Plant Site to Deploy an Advanced Small Modular Reactor Plant, that was released in January 2023. All of the currently operating coal plants in the state have announced their retirements, and the state has a goal of 100% clean energy by 2035. The study looked at the feasibility and economic impact of siting a four-unit Xe-100 SMR at an existing coal plant. In **Michigan**, HB 6019 (2022) provided funds to the Michigan Public Service Commission to facilitate an SMR feasibility study. A draft of the report was released in December 2023. In **Nebraska**, $1 million was appropriated by the state legislature to the state department of economic development to conduct an SMR feasibility study of options for siting new advanced reactors in the state and at existing electric generation facilities based on compatibility.[53]

This kind of research and analysis is important on the state and local level to determine the applicability of the process for coal plants and how SMRs can take advantage of existing infrastructure (e.g. water and roadways or transmission lines) and workforce, and support reliability, climate, and economic goals.

Wyoming's study was a comprehensive framework and roadmap released in August 2023. The Wyoming Energy Authority led the study and facilitated state-wide listening sessions, meetings, and industry events and worked closely with several state agencies; industry leaders; Idaho National Laboratory; and other key stakeholders to develop the workstream and final document. The document focused on three issues: value chain (industrial applications of heat and power), supply chain (from raw materials to finished products), and generation. Some of the strategic priorities outlined in the framework include (1) supporting the development of end-use cases and facilitating advanced reactor demonstrations; (2) identifying opportunities and developing markets for Wyoming's natural resources such as uranium; (3) creating the basic structure for a thriving nuclear energy industrial ecosystem; (4) working with stakeholders to identify barriers and develop specific solutions to address these barriers; (5) investing in developing infrastructure that serves the needs of nuclear energy; and (6) developing policy and regulatory recommendations, financing mechanisms, revenue structures, workforce training, and other solutions to support the nuclear energy industry.[54]

In **Louisiana**, the Public Service Commission opened Docket X-36987 in September 2023 to assess the development of advanced nuclear in the state. Specifically, the docket will include a study of SMRs and microreactors that evaluates relevant statutes across the country and internationally, and regulatory barriers and opportunities in the state.[55]

Working groups create important opportunities for intra-state collaboration and peer sharing on what role advanced nuclear can play in supporting energy reliability, economic development, and decarbonization in different states while determining solutions to potential barriers and drawbacks. This can also be a platform to share ideas and solutions for exploring coal to nuclear repowering. Many of the entities involved in the working groups would play a key role in the process and when developing recommendations for the governor, state legislature, or other entities; state working groups could benefit from including information and details on what is needed to move coal to nuclear repowering opportunities forward.

In **Kentucky**, a state Nuclear Energy Development Workgroup was established in 2023 to identify barriers to nuclear energy deployment. The Workgroup also was required to consult stakeholders to develop recommendations for a potential Nuclear Energy Development Authority in the state. The Kentucky State Energy Office, Public Service Commission, University of Kentucky, Tennessee Valley Authority, national labs, and state legislators were a few of the entities involved in the Working Group.[56] The final report produced by the Workgroup looked at the state's current energy landscape, including the fact that in recent years coal production and mining has declined in the state. Employment at coal mines in Kentucky fell from 19,000 jobs in 2009 to 4,600 jobs in 2023. The report acknowledges the potential for retiring coal facilities and repowering and redeveloping the infrastructure and utilizing the skilled workforce already present in the community.[57] The report also looked at identifying community engagement strategies in coal communities as a goal of the potential state Nuclear Energy Development Authority.

In May 2023, **Tennessee** Governor Bill Lee issued an executive order that established the Tennessee Nuclear Energy Advisory Council. The Advisory Council includes representatives from the state Department of Environment and Conservation, Department of Economic and Community Development, Emergency Management Agency, universities, national labs, industry, and Tennessee Valley Authority. Some of the goals of the Council are to explore barriers to nuclear energy deployment in the state (and potential legislative, policy, and budgetary changes); funding opportunities for state government, local government, and the private sector; storage and waste practices; and federal actions that Tennessee can partner on.[58]

The state of **New Hampshire** facilitates a Commission to Investigate the Implementation of Next Generation Nuclear Reactor Technology. The Commission is made up of representatives from the state legislature, the Governor's Office, industry, New Hampshire Department of Environmental Services, New Hampshire Department of Energy, the New Hampshire Department of Business and Economic Affairs, and the general public. A report of the key findings from the Commission was released in December 2023 and provided, among other information, a discussion on coal to nuclear with examples from across the country and considerations in New Hampshire.[59]

Additionally, in August 2023, **Texas** Governor Greg Abbott established an Advanced Reactor Working Group under the leadership of Texas Public Utility Commissioner Jimmy Glotfelty. The goals of the Working Group are to understand the state's role in deployment and use of advanced reactors, explore opportunities for advanced nuclear in the state with a focus on financial incentives, state and federal regulatory impediments, electricity market impacts, technical challenges, nuclear-specific changes needed in the Electric Reliability Council of Texas (ERCOT) market, and other considerations.[60] Recommendations from the Working Group are due to the Governor by December 1, 2024.

Environmental Justice and Community Engagement

A key component of advanced nuclear development is community engagement and environmental justice. Many communities that are home to existing coal facilities are considered disadvantaged or low-income and have experienced disproportionate health and environmental impacts from these facilities. It will be important for states to properly engage these communities to ensure their buy-in and support for potential coal to nuclear repowering opportunities. When a coal plant retirement is announced, communities should have an

opportunity to provide input into what comes next for the site. This means that states leading conversations or community outreach should be prepared to answer questions and address any concerns that may arise – while also highlighting many of the benefits outlined previously. Communities may be interested in SMRs, but also may want to hear about the potential for remediating and redeveloping the site to host renewable energy or cleaning it up to host a park or other facility.

As part of the **Virginia** feasibility study, partially funded by the Virginia State Energy Office, a community engagement questionnaire was sent out to stakeholders in the counties being studied as potential repowering locations. Early engagement is important to ensure communities are aware of potential projects and that their perspective is heard early in the process. Some of the questions included:

1. Would you support additional studies to determine the feasibility of utilizing SMRs in the coalfields of Southwest Virginia if the new technologies receive approvals from the NRC?
2. Do you have suggestions as to other community leaders and organizations whose input should be sought in the future? If so, please specify whom.
3. Who do you feel could/would best provide public information related to SMR development in the coalfields of Southwest Virginia?
4. How would you prefer to be engaged and informed pertaining to the technological development of SMRs in the coalfields of Southwest Virginia?
5. Who do you feel would best be positioned to facilitate community informational meetings related to the development of SMRs in the coalfields of Southwest Virginia?
6. What future topics should be included in subsequent SMR feasibility reviews?
7. What additional methods of community education and involvement would you suggest be utilized throughout this process?[61]

The survey included twelve total questions and was shared with ten key stakeholders from the community and surrounding county. Some of the responses from the community included a preference for community forums/meetings to provide input, an overall interest in exploring nuclear energy as a source of electricity generation in the state, and a need for additional resources on issues like supply chain and workforce, risk management, and fuel disposal. County representatives were excited about the tax revenue and workforce opportunities but flagged a need for more public education and outreach.[62] Other states conducting or interested in conducting feasibility studies or facilitating a coal to nuclear repowering process could look at developing and sharing a similar questionnaire in their coal communities. Additional questions, depending on the stage of the process, could be asked about potential concerns and what other uses the community may envision for the site. Communities could also serve on advisory committees or other working groups related to the redevelopment of the site to ensure their perspective is heard throughout the process.

There are also federal programs available that provide support, such as DOE's Communities Local Energy Action Program (C-LEAP). C-LEAP will provide technical assistance to disadvantaged communities, as well as communities shifting from fossil fuel reliance to support these communities in developing plans that advance clean energy and economic development through topics that include advanced nuclear reactors.[63]

Statewide Coordination Among Agencies and Utilities

State Energy Offices and Public Utility Commissions are key decision-makers in the repowering process and play a large role in facilitating supportive policies, programs, and regulations. Importantly, these entities should also plan to coordinate closely with other state agencies and utilities in the state. State agencies focused on economic development, environmental protection, and labor should be partners and able to provide input and perspective on the feasibility and implementation of repowering projects. Some states, like **Colorado**,

also have specific offices focused on just transition that could help with implementing workforce programs, identifying community liaisons, and supporting pathways to spur economic growth and development. State Energy Offices are also often responsible for developing comprehensive State Energy Plans, which provide an assessment of current and future energy supply and demand, examine existing energy policies, and identify emerging energy challenges and opportunities.[64] These plans involve coordination across the state and could be an opportunity to highlight potential coal to nuclear repowering in the state.

State Public Utility Commissions play a particularly important role for coal-to-nuclear transition in states where the utilities are vertically integrated (own and operate generation, transmission, and distribution assets). Commissions are responsible for ensuring power is available safely, reliably, and affordably to customers, so questions about safety and cost will be foremost. Commissions also have responsibility for issuing Certificates of Public Convenience and Necessity,[65] which provide an owner-operator with permission to build the generation facility and begin securing permits on air quality and water appropriations.[66] A report by EPRI outlines some of the questions that the owner-operator can work with the Commission to better understand, including:

- Can, or should, any decommissioning costs be recovered from ratepayers as new development costs?
- When can site-related development work be considered as new development?
- How will construction, operation, and maintenance costs over the lifetime of the plant be recovered?
- What are the power needs of the owner-operator?
- Will the SMR generate more or less power than the coal plant?
- Will any transmission line upgrades be needed?[67]

Additionally, most investor-owned utilities submit periodic Integrated Resource Plans (IRPs) to their Commission. IRPs provide information on current and expected future power plants, how the utility will meet future demand, what their resource mix will look like, and more. Incorporating energy from existing and new nuclear generation resource technologies into IRP processes has a substantial bearing on both the market for nuclear energy and the ability of utilities to achieve voluntary and statutory goals for zero-carbon electricity generation. Through the IRP process, regulated utilities convey long-term generation investment decisions to state utility regulators.

For example, in August 2023, Duke Energy filed a plan with the **North Carolina** Utilities Commission that highlights opportunities to repower retiring coal sites with advanced nuclear. Belews Creek 1 and 2 coal sites are considered well suited to host advanced nuclear, and early site permits are being pursued. Duke Energy outlined several potential energy transition pathways in their IRP, including one where the retirements of Belews Creek 1 and 2 are delayed until 2036 to align with potential operation of an SMR at the site.[68] Duke Energy notes that this date aligns with state clean energy goals of achieving net-zero greenhouse gas emissions no later than 2050 and would allow for an earlier retirement for other coal facilities, while maintaining reliability on the system.[69]

V. Conclusion

As states explore new opportunities to repurpose coal power plant sites and support decarbonization, reliability, and economic development goals, the repowering process of these sites is being considered in more and more parts of the country. State Energy Offices and Public Utility Commissions play an important role in the coal to nuclear repowering process through their policy, planning, programmatic, and regulatory activities.

This report is designed to provide a brief overview of some of those considerations for states, but state officials are encouraged to also explore the other resources linked and referenced throughout to get a more comprehensive overview on the practical steps and detailed regulatory and policy opportunities and barriers. As a first step, states may look into developing a state nuclear energy framework, SMR study, or coal to nuclear feasibility study to determine appropriate next steps and the landscape for repowering former coal sites in their communities. The ANSC will continue to serve as a resource for State Energy Offices and Public Utility Commissions as they explore repowering opportunities.

For additional resources, NASEO and NARUC encourage State Energy Offices and Public Utility Commissions to explore:

- DOE's *Coal-to-Nuclear Transitions: An Information Guide (April 2024)*

  This guide provides information on economic impacts, workforce, policy and funding, utility considerations and more for communities looking at replacing their retired or retiring coal power plants with nuclear power plants.

- EPRI's *From Coal to Nuclear: A Practical Guide for Developing Nuclear Energy Facilities in Coal Plant Communities (October 2023)*

  This report walks through the practical steps involved in coal to nuclear repowering with detailed information on the process, including technical and engineering considerations, community engagement, workforce, and regulatory questions.

- Nuclear Innovation Alliance's *Resources for Coal Repowering with Nuclear Energy (September 2023)*

  This report provides a high-level overview of coal to nuclear repowering with examples from states highlighted throughout. It begins by walking through current initiatives from utilities, states, and the federal government, followed by information on siting, cost, regulation, remediation, and timing.

- The Bipartisan Policy Center's *Can Advanced Nuclear Repower Coal Country? (March 2023)*

  This study provides an overview of benefits and challenges associated with coal to nuclear repowering with a particular focus on supportive legislation and policy progress.

- DOE's *Investigating Benefits and Challenges of Converting Retiring Coal Plants into Nuclear Plants (September 2022)*

  This study is a comprehensive evaluation of siting characteristics of coal plants (operating and recently retired) to identify locations feasible for nuclear plants. It also explores the outcomes and impacts of coal to nuclear repowering. A detailed siting analysis, techno-economic analysis, regional study, and project cost and timeline overview are included.

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