Title

PATHWAYS TO A SMR-TER FUTURE: Exploring the policy and market variables that will influence the development, deployment, and diffusion of Small Modular Reactors in the Unites States

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Exploring the policy and market variables that will influence the development, deployment, and diffusion of Small Modular Reactors in the Unites States

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Pathways to an SMR-ter Future

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ABSTRACT

The United States faces a dual challenge: rising electricity demand driven by data center expansion, manufacturing growth, and broad electrification, alongside the urgent need to decarbonize its power sector. Variable renewable energy alone cannot cost-effectively meet both objectives, creating a growing demand for clean, firm power resources. Small modular reactors (SMRs) have emerged as a leading candidate to fill this role, but their commercial viability remains unproven. This capstone examines how policy and market variables will influence the development, deployment, and geographic diffusion of SMRs in the United States.

The analysis is structured in three parts. First, I assess the federal and state policy environment shaping initial SMR development, including recent regulatory reforms, direct federal investment programs, and fiscal incentives. Second, I develop a parametric cost model to evaluate how industrial learning and supportive policy can reduce overnight capital costs (OCC) and levelized cost of energy (LCOE) as cumulative SMR deployment increases, with separate cost tracks for light water SMRs (LW-SMRs) and molten salt SMRs (MS-SMRs). Third, I conduct a geospatial diffusion analysis in QGIS that integrates site feasibility criteria, state-level policy variables, and the parametric model's cost trajectories to project where and in what sequence SMRs could deploy across the continental United States.

Through my capstone analysis, three findings emerge. Learning rates are the single most influential variable driving SMR cost reductions, with the spread between optimistic and pessimistic learning assumptions exceeding that of any other parameter. Federal policy support, particularly tax credits and loan guarantees, is essential for bridging the cost gap during early deployment but cannot sustain competitiveness alone. And the geographic pattern of SMR deployment diverges significantly depending on whether market price competitiveness or decarbonization is prioritized as the primary deployment objective. The analysis suggests that the conditions for initiating the deployment-learning-cost reduction cycle central to the SMR value proposition are more favorable now than at any prior point, but that realizing this potential depends on whether the industry can deliver the manufacturing standardization and deployment consistency that the entire economic case requires.

INTRODUCTION

After nearly two decades of relatively flat demand, US electricity consumption is rising again, driven by data center buildouts, new manufacturing, and the electrification of transportation and industry (EIA, 2024). Simultaneously, the United States must drastically reduce emissions to mitigate the worst impacts of anthropogenic climate change. The need for more power with fewer emissions has led to a rapid buildout of clean energy generation, primarily variable renewable energy (VRE) resources, like wind and solar. Due to geographic, technological, and operational constraints, VRE resources cannot feasibly or cost-effectively decarbonize electricity generation alone (Sepulveda et al., 2018; Jenkins & Thernstrom, 2017). That has increased the importance of clean firm power (CFP) generation resources, like hydroelectric, geothermal, energy storage, and nuclear in the electricity matrix. Nuclear energy has been a backbone of US electricity generation for almost seven decades, generating over 18% of electricity in the US in 2024 (U.S. Energy Information Administration, 2025; U.S. Department of Energy, 2017). Due to nuclear's limited geophysical constraints compared to hydroelectric and geothermal generation (including enhanced geothermal, which increases the feasible deployment range of geothermal) and is higher technological maturity than batteries for grid level CFP, there has been renewed interest from policymakers and investors in the role nuclear can play in the energy future of the United States.

Through my capstone project, I examined how policy and market variables may influence the technological development, initial deployment, and geographic diffusion of SMRs within the US. The goal of my project is to assess the current nuclear regulatory and economic environment and explore the policy and market factors that will influence the realization of *a SMR-ter future.* To achieve this, I execute three distinct, but complimentary analyses. The first analysis examines the state of United States nuclear development and deployment policy at the federal and evaluates state-level policy environments based on there supportiveness for new nuclear deployment. The policy analysis is a direct input a parametric model, assessing how different policy and market variables will influence SMR costs as they are deployed. Finally, a geographic diffusion analysis examines how differing policy approaches and market drivers may influence where SMRs are deployed and diffuse in the United States. Through this project, I argue that the trajectory of SMR deployment will be determined primarily by three factors: the learning rates achieved through standardized manufacturing, the duration and structure of federal policy support during SMR development and deployment, and the alignment between market conditions and deployment objectives at the state level.

The promise of nuclear lies in its energy density, low carbon intensity, stable load profile, and operational safety. Commercial nuclear power plants generate energy via nuclear fission reactions, which are roughly 1-2 million times more energy dense than the chemical reactions caused by burning fossil fuels to power thermal power plants (European Nuclear Society, n.d.). Unlike other forms of thermal generation, nuclear generation is carbon-free during operation and has among the lowest lifecycle greenhouse gas emissions of any electricity generation technology, comparable to wind and solar photovoltaics (UNECE, 2021). Public perception of nuclear risk remains shaped by high-profile accidents, yet empirical data consistently ranks nuclear among the safest electricity sources. Even accounting for Chernobyl and Fukushima, nuclear energy results in 99.7% fewer deaths per unit of electricity than fossil fuels and is comparable in safety to wind and solar (Ritchie, 2024; Markandya & Wilkinson, 2007).

New nuclear development in the US has continued to prove time- and cost-intensive, with the latest completion of reactors 3 and 4 at the Vogtle Power Station coming in $17 billion over budget and seven years late (EIA, 2023; Georgia Public Broadcasting, 2024). The nuclear energy industry is working systematically to address these challenges with a new series of advanced reactor technologies and development strategies. The most widely pursued of these next-generation nuclear technologies are small modular reactors, or SMRs, with over 80 designs in various stages of development globally (IAEA, 2024). SMRs represent a deliberate tradeoff within nuclear development: surrendering economies of scale for economies of multiples. The bet is that building many identical reactors will prove cheaper as industrial learning leads to efficiencies in development, permitting, siting, and construction being unlocked. Currently, these advantages remain largely speculative, contingent on regulatory adaptation and demonstrated deployment success.

As of early 2026, there are only two operational SMRs globally (Russia's floating Akademik Lomonosov and China's HTR-PM at Shidao Bay), and only one SMR design has received design certification from the Nuclear Regulatory Commission in the United States (NuScale's VOYGR power module), though several other designs are advancing through the licensing pipeline (IAEA, 2024; NRC, 2025). Optimistic timelines target the early 2030s for early deployments within the US. While initial SMR deployments are almost certain to run over cost and time budgets, if SMR developers can demonstrate deployment standardization and cost reduction, SMRs are positioned to truly revolutionize the US's power generation profile.

A SMR-RY

Small modular reactors (SMRs) are one subset of the "advanced nuclear" technology category. SMRs are differentiated from legacy nuclear reactors (LNR) and other advanced nuclear fission reactors on two main fronts. Firstly, SMRs are smaller than traditional LNR and other advanced nuclear reactors. The IAEA defines SMRs as nuclear reactors with an electrical output of up to 300 MWe per unit (IAEA, 2024). While this means individual SMR modules will experience limited economies of scale compared to legacy nuclear reactors, as costs do not raise linearly with generation capacity, their smaller size translates to substantially reduced physical footprints and emergency planning zones (EPZs). NRC regulations require that traditional nuclear plants have a 10-mile-radius plume exposure EPZ around reactors. By contrast, the NRC has approved site-boundary EPZs for certain SMR designs, reducing the EPZ from a 10-mile radius to the plant's property line, which typically less than 100 acres (NRC, 2022; NuScale Power, 2022). If this advantage is ubiquitously realized for SMRs, it would expand the locations that SMRs can deploy, as SMRs will be able to be placed closer to population centers and electrical or thermal loads.

Secondly, SMRs are designed with standardized, modular configurations. The goal of modular design is to shift as much fabrication as possible from on-site construction to controlled factory environments, where components can be manufactured in series and transported to the site for assembly. Factory fabrication of standardized modules typically yields higher learning rates than onsite construction, leading to compounding time and cost efficiencies as production volume increases (Vanatta et al., 2024; Stewart & Shirvan, 2022). Additionally, design standardization seeks to improve regulatory review and certification timelines, as regulators can evaluate a single reference design rather than bespoke, site-specific configurations. The modular design of SMRs also supports flexible project development. Operators can add generating capacity incrementally by deploying additional modules as demand grows, reducing the upfront capital commitment compared to a single large reactor build and allowing a multi-module site to begin generating revenue before the full plant is complete (Abou-Jaoude et al., 2024). Unfortunately, none of this is guaranteed, and it principally depends on SMRs, and advanced reactors generally, being regulated differently than LNRs.

SMR reactor design is unique, with varying levels of technological and regulatory maturity, cost assumptions, end-use cases, and safety profiles. The focus of this capstone is 300Mwe systems. Smaller systems of <20 MWe, known as microreactors, are interesting because they are easily transported (DOE, 2023) and have distinct use cases, but are not considered in my capstone analysis. The remaining SMR technologies are principally differentiated by coolant type and neutron spectrum. While this capstone does not purport to provide a comprehensive analysis of all different SMR technologies and their relative advantages and disadvantages. The **Table 1** provides a brief overview of the different SMR technology readiness levels (TRL), fuel type, electrical output, thermal outlet temperature, operating pressure, representative designs, and comparative advantages and disadvantages for four different SMR technologies: Light Water Reactor (LWR), High-Temperature Gas-Cooled Reactor (HTGR), Molten Salt Reactor (MSR), and Lead-Cooled Fast Reactor (LFR). Two key operational differentiators that will be important for later analyses are thermal outlet temperature and operating pressure. SMRs with high thermal outlet temperatures can provide industrial processes and district heating (IAEA, 2022)—potentially creating a larger addressable market and supporting decarbonization in hard-to-abate industries, like heavy industry. SMRs with lower operating pressures typically have reduced containment requirements, potentially leading to material cost reductions and fewer siting constraints.

Table 1. Comparison of SMR reactor technologies by design characteristics, maturity, and representative designs. *Values reflect per-module specifications from lead vendor designs unless otherwise noted. TRL ratings are author estimates based on regulatory status and demonstration progress as of mid-2025. LWR specifications from NuScale Power (2025) and GE-Hitachi (2023). HTGR specifications from X-energy (n.d.) and World Nuclear Association (2024). MSR specifications from Kairos Power (n.d.) and Serp et al. (2014). LFR specifications from Westinghouse Nuclear (n.d.) and the Generation IV International Forum (2014). General reactor type characteristics and TRL context drawn from IAEA (2024). Operating pressure and temperature ranges compiled from the World Nuclear Association (2024) and DOE Office of Nuclear Energy (2023).*

Parameter	Light Water Reactor (LWR)	High-Temp Gas-Cooled Reactor (HTGR)	Molten Salt Reactor (MSR)	Lead-Cooled Fast Reactor (LFR)
Fuel Type	Low-enriched Uranium (LEU, <5%)	TRISO particles (HALEU, 15.5–19.75%)	Uranium fluoride salt/TRISO (HALEU, 15.5–19.75%)	Metallic uranium or MOX (HALEU)
Coolant	Light water (H_2O)	Helium gas	Molten fluoride salts	Liquid lead or LBE
TRL	6–8 (NRC design cert. Achieved)	5–6 (demo construction phase; HTR prototype operational)	3–5 (experimental heritage, no demo)	3–5 (demo construction in Russia)
Electrical Output (per module)	77 MWe (NuScale); 300 MWe (BWRX-300)	80 MWe (Xe-100); 105 MWe (HTR-PM)	140 MWe (KP-FHR commercial target)	210 MWe (Westinghouse LFR demo); 300 MWe (BREST-OD-300)
Outlet Temperature	~300°C	750–950°C	700–800°C	~500–550°C
Operating Pressure	~155 bar (PWR)	~70 bar	Near atmospheric	Near atmospheric

Representative Design(s)	NuScale VOYGR, GE-Hitachi BWRX-300, Westinghouse AP300 (based on approved AP1000)	X-energy Xe-100, HTR-PM (China)	Kairos Power KP-FHR, Terrestrial Energy IMSR	Westinghouse LFR, BREST-OD-300 (Russia)
Advantages	Highest regulatory maturity; leverages existing supply chains and operational expertise; well-understood fuel cycle; negative void coefficient provides inherent safety; existing workforce and training infrastructure	Very high outlet temperatures enable industrial process heat and hydrogen production; continuous online refueling in pebble bed designs; high thermal efficiency (40–50%); inherent safety through low-power density and large graphite thermal mass	Low-pressure operation reduces containment requirements; high outlet temperatures for process heat; potential for online refueling and fission product removal; simplified fuel fabrication if using liquid fuel; reduced waste volume in some designs	Chemically inert coolant with a very high boiling point, providing a large thermal safety margin; atmospheric pressure operation; fast neutron spectrum enables fuel breeding and actinide burning; compact design; long refueling intervals
Disadvantages	Lower outlet temperatures (~300°C) limit industrial heat applications; high operating pressure increases containment complexity; it produces more spent fuel per MWh relative to some advanced designs; it is limited to LEU fuel, constraining fuel cycle flexibility	HALEU fuel supply chain is immature; there are operational contamination challenges; higher capital and O&M cost estimates; limited commercial-scale track record; fuel qualification and licensing for TRISO are still in progress in the US	Lowest TRL of reactor types considered; fluoride salt corrosion of structural materials; no commercial-scale operational; HALEU fuel dependence; tritium management concerns; regulatory framework not yet adapted to liquid-fueled designs	Lead corrosion of structural steels at high temperatures; lead toxicity and radioactive polonium-210 formation risk; high coolant density increases pumping power requirements; lead solidification risk below ~327°C; limited operational experience

The following analyses focuses on two different SMR technologies: light water reactors (LW-SMR) and molten salt reactors (MS-SMR). These technologies were chosen due to their distinct ranges in materials cost, market potential, and siting criteria. MS-SMRs, although less technologically mature, have several potential technological and market-based advantages compared to LW-SMRs. The competitive advantages of MS-SMRs include higher outlet temperatures, opening industrial process and district heating applications; simplified design, reducing footprint and lowering bottom-up cost estimates; and a lower operational pressure, increasing safety and decreasing siting constraint (LeBlanc, 2010). The main competitive advantage of LW-SMRs is that they are the most technologically and regulatorily mature of all the SMR technologies. Light water reactors currently comprise the entirety of the US commercial nuclear fleet, with all 94 operating reactors using either pressurized water (PWR) or boiling water (BWR) designs (NRC, 2025), meaning that the permitting, siting, and development of LW-SMRs could be comparatively more efficient than other SMR technologies.

The policy environment has an outsized influence on the development and deployment trajectory of any capital-intensive energy technology, and nuclear is no exception. The large upfront investment requirements and historical record of cost and schedule overruns make SMR development particularly sensitive to policy signals.

PATHWAYS TO A SMR-TER FUTURE: EVALUATING THE DEVELOPMENT, DEPLOYMENT, AND DIFFUSION FACTORS OF SMRS IN THE US.

DEVELOPMENT FACTORS: POLICY ENVIRONMENT

In this section, I discuss the different public policy approaches within the United States at the federal and state levels that support initial SMR development and deployment and examine their specific effects. Public policy plays a critical role in supporting the initial development and deployment of complex, capital-intensive technologies (Hanna et al., 2017). Supportive policy regimes are essential for advancing "first-of-a-kind" (FOAK) technologies through technical demonstration and proof of concept to "Nth-of-a-kind" (NOAK) deployment, where design and delivery processes are standardized and costs can be reliably estimated by market actors. This progression is essential for any emerging technology and particularly important for next-generation nuclear, where the cost overruns and schedule delays of legacy reactor construction weigh heavily on potential investors (Lovering et al., 2016). Policy approaches differ depending on the stage of technological development and the governmental systems in which they operate. A complete review of SMR-related federal and state policies is outside the scope of this project, but several key policy changes at the federal and state-level are poised to support the initial development and deployment of SMRs.

THE FEDERAL POLICY ENVIRONMENT

Due to project size, complexity, security concerns, and cost, federal-level policies are the primary drivers of nuclear development and early deployment. The importance of supportive public policy is highest during the initial innovation and deployment stages of a new, capital-intensive technology. Governments support initial development through three primary strategies: direct investment in research and development, regulatory reform to reduce barriers to deployment, and fiscal incentives to improve market competitiveness (Mazzucato, 2013). Over the past two presidential administrations, there have been significant policy changes in each track to facilitate advanced nuclear development.

Regulatory Reform

Historically, challenges in the licensing and regulatory process have been the primary constraint on nuclear development and deployment (Iraola et al., 2023; Budnitz et al., 2018). A suite of recent federal policies aims to adapt and streamline the regulatory environment for the next generation of nuclear technologies:

- **The ADVANCE Act** (Pub. L. 118-67, July 2024): The principal piece of legislation for advanced nuclear technologies. Among other things, it reduces NRC fees for advanced reactor applicants, directs the NRC to prioritize efficient regulation and initiate rulemaking to support SMR siting, and establishes prize competitions for reactor design milestones, a direct federal investment policy (ADVANCE Act, 2024).

- **10 C.F.R. Part 53** (final rule March 30, 2026; effective April 29, 2026): The first new reactor licensing framework since Part 52 was established in 1989. Part 53 creates a risk-informed, performance-based, technology-inclusive licensing pathway for advanced reactors, allowing non-light-water designs to be licensed under a framework tailored to their safety characteristics rather than requiring them to conform to LWR-based regulations (91 Fed. Reg. 18,294, 2026).
- **Executive Order 14300** (May 2025): Directs the NRC to undertake a wholesale revision of its regulations within 18 months, establishes binding licensing deadlines of 18 months for new reactor applications and 12 months for license renewals, and streamlines NEPA compliance for DOE- and DOD-tested reactor designs (Exec. Order No. 14,300, 2025).

Direct Federal Investment

Regulatory reform is combined with direct federal investment to accelerate SMR development. Key programs include:

- **Advanced Reactor Demonstration Program (ARDP)**: A $3.2 billion cost-shared program funding two full-scale reactor demonstrations (TerraPower's Natrium sodium-cooled fast reactor and X-energy's Xe-100 high-temperature gas-cooled reactor), five risk reduction projects, and two advanced reactor concept studies. ARDP represents the largest federal commitment to advanced reactor development in decades (DOE, 2020).
- **Gen III+ SMR Program**: $900 million in funding for the initial deployment of LWR-based SMR designs (DOE, 2012).
- **DOE Loan Programs Office (LPO)**: Loan guarantee authority under Title XVII of the Energy Policy Act of 2005 to support nuclear project financing and reduce the cost of capital for developers.
- **Gateway for Accelerated Innovation in Nuclear (GAIN)**: Administered through Idaho National Laboratory, GAIN provides nuclear innovators with a single point of access to national laboratory expertise and facilities through cost-shared vouchers. Since its founding in 2015, GAIN has awarded 108 vouchers totaling $38.6 million, with 65 completed projects (DOE, 2025).
- **HALEU Supply Investment**: The DOE has committed $2.7 billion across three enrichment contracts (Centrus Energy, General Matter, and Orano Federal Services) to scale domestic production of high-assay, low-enriched uranium (HALEU), the advanced fuel type required by most non-LWR SMR designs. (DOE, 2024).

Fiscal Incentives

While the development phases of SMRs are principally supported by regulatory reform and direct investment, fiscal incentives support initial deployment by improving the cost competitiveness of SMRs. The primary incentive mechanisms were established through the Inflation Reduction Act (2022) and preserved by the One Big Beautiful Bill Act (OBBBA, 2025):

- **Section 45Y Clean Electricity Production Tax Credit (PTC)**: Approximately $25/MWh (inflation-adjusted) for zero-carbon electricity generation facilities placed in service after December 31, 2024. The credit is currently technology-neutral, meaning it applies equally to nuclear, wind, solar, and other zero-emission sources, but policy support for wind and solar projects phase-out at the end of 2027, favoring future nuclear development. Nuclear facilities that begin construction before 2034 are eligible, with a phase-out over three years thereafter. Facilities in designated "nuclear energy communities" receive an additional 10% adder (CRS, 2025). Because the PTC is technology-neutral, it only improves nuclear's competitiveness relative to unabated fossil fuel generation, not relative to other clean energy sources.

- **Section 48E Clean Electricity Investment Tax Credit (ITC)**: Up to a 30% tax credit for qualified clean energy investments placed in service after December 31, 2024. The credit phases out for facilities that begin construction after 2033, consistent with the PTC timeline. The ITC is particularly relevant for capital-intensive projects like SMRs, where upfront costs are the primary barrier to deployment.

Other federal policy tools that have been proposed or are being pursued internationally but are not currently implemented in the US include direct national involvement in reactor development, a strategy used by China and Russia; government-backed contracts for difference (CfDs), used in the UK; regulated asset base (RAB) financing models; and taxes on carbon emissions (World Nuclear Association, 2024). While carbon taxes do not directly support cost reductions or regulatory streamlining that would influence initial development, they do make nuclear more cost competitive with fossil generation, impacting subsequent deployment and diffusion.
Federal policy variables for each of the three tracks were integrated into the subsequent analyses. Tax credits, loan guarantees, licensing timelines, and carbon taxes were included in the parametric analysis to evaluate their impacts on SMR deployment via increased cost competitiveness. In the geospatial diffusion analysis, licensing reform and siting support parameters were included with state-level policy variables to evaluate the impact that multiple layers of policy will have on SMR diffusion in the US.

STATE-LEVEL POLICY APPROACHES

State approaches in the US are varied, with some states creating regulatory and legislative incentives to attract SMR investment and others maintaining policies that hinder or prohibit nuclear development. While national policy plays the primary role in the development, approval, and initial deployment of SMR technologies, state-level policies like siting authority, permitting, utility regulation, and ratepayer cost recovery, will be a key driver of how mature SMR technology will diffuse throughout the US. These policies have large impacts on local siting and cost competitiveness.

Examples of pro-nuclear state policies include Indiana's SMR partnership pilot program, which offers a 20% manufacturing tax credit and a minimum of $280 million in incentives; Texas's creation of the Texas Advanced Nuclear Energy Office (TANEO) to coordinate advanced reactor deployment; Tennessee's $50 million SMR grant fund to support TVA's SMR project; and Maryland's Next Generation Energy Act, which directs the state to pursue cost-sharing agreements and federal partnerships for SMR siting (MultiState, 2026; Morgan Lewis, 2025). These state incentives generally stack with federal support:

grants like Texas's Advanced Nuclear Development Fund and state tax credits like Indiana's manufacturing credit are additive to the federal ITC/PTC, since they do not reduce the basis on which federal credits are calculated.

On the other end, ten states currently have policy restrictions on the construction of new nuclear power facilities: California, Connecticut, Hawaii, Maine, Massachusetts, Minnesota, New York, Oregon, Rhode Island, and Vermont (NCSL, 2025). These restrictions take several forms. Minnesota maintains an outright ban on new nuclear construction. Several states, including California, Connecticut, Maine, and Oregon, condition new nuclear construction on the federal government approving a viable nuclear waste disposal pathway, a condition that functions as an effective ban. Other states, including Hawaii, Massachusetts, Rhode Island, and Vermont, require legislative or voter approval before new reactors can be permitted. There have been recent positive shifts in state level restrictions: five states (Wisconsin, Kentucky, Montana, West Virginia, and Illinois) have fully repealed their moratoria since 2016, and California has introduced legislation to create exceptions for advanced reactor designs (NCSL, 2025; ANS, 2026).

A simple quantitative assessment, supported by generative AI data collection and literature review, was used to assess and score each state's SMR policy environment. The scoring cirteria is detailed in ***Table 2*** and state-level results are depicted in ***Figure 1***. Unweighted scores ranged from 0 to 100, with 100 signifying the most favorable policy environments and 0 signifying states with effective bans. An overview of the scoring range and criteria and a map of current state policy environments are included below. State policy environment scores were incorporated as a variable in the subsequent geospatial nuclear diffusion analysis.

Table 2. *State nuclear policy scoring categories used to inform the geospatial diffusion model. Each state was assigned a composite score (0–100) based on the presence or absence of enabling legislation, nuclear moratoria, state-level incentives, existing nuclear infrastructure, and active SMR development activity. Scores were used to weight state-level policy favorability in the site feasibility layer of the diffusion model. States scoring below 25 were excluded from the diffusion analysis due to active legislative barriers to new nuclear construction. Scoring criteria were developed by the author based on policy data from NCSL (2025), NEI (2025), and state legislative tracking via Morgan Lewis (2025) and MultiState (2026).*

Score Range	Category	Description
75 - 100	Strong	Active nuclear infrastructure, enabling legislation, state incentives, SMR site studies or demos underway. Moratorium-free.
50 - 75	Pro-nuclear	Supportive political environment, no moratorium (or recently lifted), some enabling legislation. May lack specific SMR incentives or have limited nuclear infrastructure.
25 - 50	Neutral-to-anti	No active nuclear policy, or mixed signals. May have operating reactors but no expansion framework. Includes states with soft moratoriums or political ambivalence.
0 - 25	Hostile	Active moratoriums, legislative barriers to new nuclear, or recent plant closures driven by policy rather than economics.

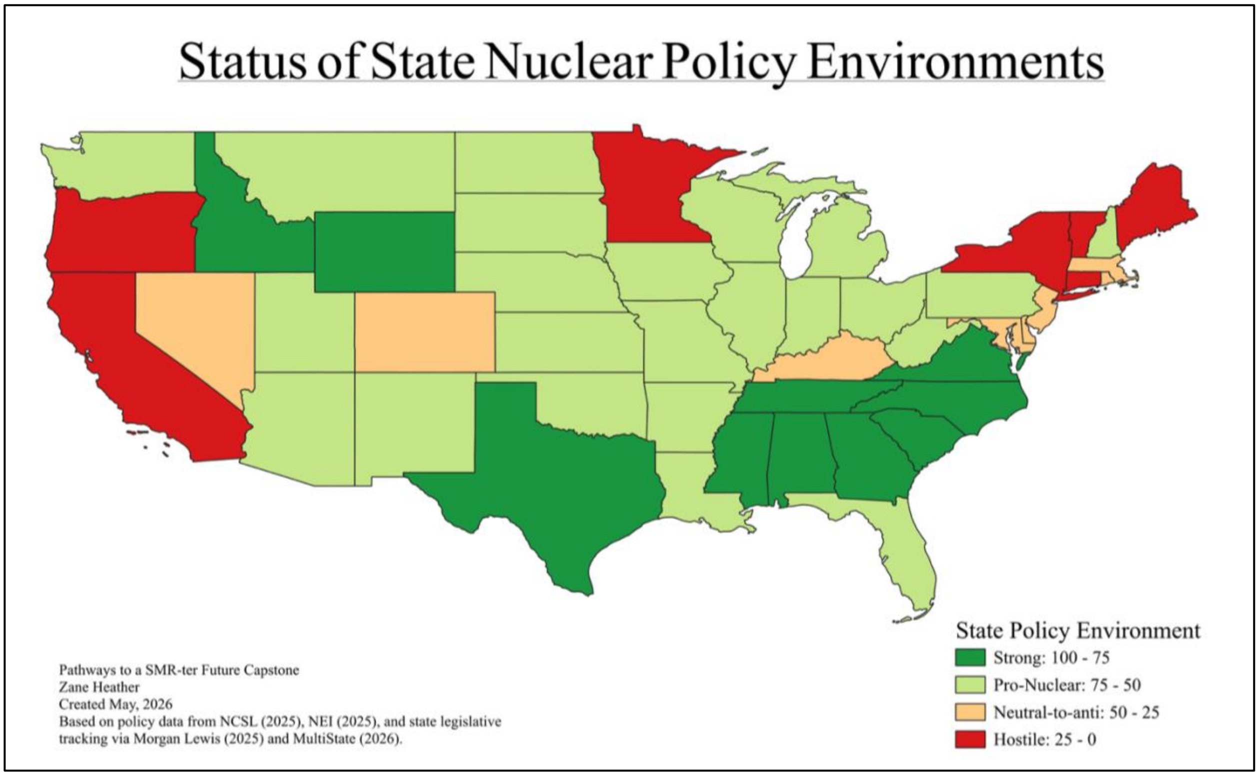


Figure 1. Status of State Nuclear Policy Environments. *Composite policy scores for the continental US, scored on a 0-100 scale based on the weighted policy scorecard described in the Development Variables section. States are classified into four tiers: Strong (75-100, dark green), Pro-Nuclear (50-75, light green), Neutral-to-Anti (25-50, yellow), and Hostile (0-25, red). Hostile-rated states include those with active nuclear moratoria, outright construction bans, or conditional restrictions tied to federal waste disposal policy or legislative approval.*

Federal and state policies will shape the technological development and initial deployment of SMRs in the US. Policy support is critical for derisking the early stages of SMR integration and for establishing the true costs of these FOAK technologies. Once the technology has been proven and deployment costs and risks are better understood, market actors can properly assess and price SMRs, and market forces will be the primary driver of its future diffusion.

DEPLOYMENT FACTORS: MARKET VARIABLES

While federal and state policy support are essential for the initial development and derisking of SMRs, once SMR technology matures and deployment costs and timelines are better defined, market factors will become the primary drivers of diffusion. The central proposition of the SMR business case is that SMRs can achieve cost competitiveness through economies of multiples, where standardized design, production and deployment of modules drive learning-based cost reductions over time (Abou-Jaoude et al., 2024). This creates the potential for a virtuous cycle: deployment drives learning, learning drives cost reductions, and cost reductions drive further deployment.

In this section, I overview the different potential markets that SMRs can address, explore the role of learning rates in driving cost reductions, and describe how these variables were incorporated into a parametric model analyzing SMR overnight cost of capital (OCC) and levelized cost of energy (LCOE) trajectories. The results of the parametric model are then incorporated into the geospatial diffusion model in the final section.

Potential SMR Market Segments

The markets that SMRs can address depend on several variables. First, markets are limited to locations where SMRs can feasibly be developed given geographic, regulatory, and policy constraints. This variable is explored in the geographic diffusion analysis in subsequent sections and is not addressed in the market deployment analysis here. Suffice to say, the more that legacy nuclear siting regulation is adapted to the safety characteristics of SMRs and the more supportive state level nuclear environments are, the larger the prospective SMR market will be.

The second variable defining which markets SMRs can address is the technological and operating characteristics of specific SMR designs. As discussed in the SMR Overview, a subset of SMRs in development, namely molten salt and liquid metal reactors, can operate safely at significantly higher temperatures than traditional light water reactors. Higher-temperature reactors can be used to supply industrial process heat, opening market opportunities in heavy industries such as petrochemical refining, steel and cement manufacturing, aluminum smelting, and district heating (IAEA, 2022). The industrial sectors that these reactors could serve are traditionally among the hardest to decarbonize, meaning high-temperature SMRs could not only be more economically competitive in those markets but also contribute more to deep decarbonization than electricity-only reactor technologies. Industrial process heat can be used to support other sectors important to decarbonization and climate change resiliency, such as hydrogen production and desalination. Additionally, the fact that heavy industrial sectors are also heavily regulated and typically sited away from civilian populations could further support deployment. The potential future markets for SMRs can therefore be distinguished by reactor technology: LW-SMRs primarily addressing electricity generation markets and MS-SMRs addressing both electricity generation and industrial process heat markets.

While the section above provides a broad overview of the different market segments that SMRs may be able to address, it is unlikely that SMRs will be deployed ubiquitously into all electricity generation and industrial process heat markets. Rather, SMRs will most likely be initially deployed and diffuse into market segments where SMRs have strong value propositions when compared to other generation resources. Examples of these markets include grid-scale baseload generation (particularly replacement of retiring fossil fuel plants), behind-the-meter applications for large load entities (i.e., data centers and industrial complexes), load following for areas with high VRE penetration, supporting military and defense installations, and microgrid or off-grid applications. While the geospatial diffusion analysis integrates several of these specific use cases for early market diffusion, a comprehensive analysis of site-specific viability was outside the scope of this project.

SMR Cost Competitiveness

The persistent impediment to nuclear deployment has been prohibitively high costs and unpredictable timelines. As discussed earlier, SMRs attempt to mitigate both challenges through standardized designs and modular construction. Once standard designs are finalized, production in a controlled settings provides greater certainty around component manufacturing schedules and budgets. Additionally, mass production of SMR components enables learning by doing on an industrial scale. This combination is expected to drive decreases in both cost and schedule overrun risk as more units are deployed. The factory manufacturing process has direct implications for component costs, learning rates, and construction timelines, all of which have the potential to lower the overnight capital costs (OCC) and levelized cost of energy (LCOE) of SMRs and make them more competitive with other generating technologies.

SMR Learning Rates

Learning rates are the cost reductions achieved through repeated production. First formalized by Theodore Wright in 1936 based on aircraft production data, Wright's Law calculates the percentage of cost reduction achieved for every doubling of cumulative production (Wright, 1936). In Wright's original study, every doubling of aircraft production reduced labor costs by 10–15%. Learning rates have since been empirically observed across a wide range of manufacturing operations, from automobiles to gas turbines to wind turbines, with rates typically ranging from 5% to 30%, depending on the complexity and standardization of the product (McDonald & Schrattenholzer, 2001).

SMRs are expected to realize cost reductions from three distinct learning channels: manufacturing learning, onsite, and materials learning. Manufacturing learning relates to the learning experienced through producing SMR components at scale in factory settings. Production systems that move from bespoke to standardized manufacturing models typically see high initial learning rates. Wright's original aircraft data showed 10–15% rates per doubling, and modern gas turbines and wind turbines have exhibited rates in the 10–20% range (McDonald & Schrattenholzer, 2001). This channel is expected to produce the largest share of SMR cost reductions, as factory fabrication of standardized modules represents a fundamental departure from traditional stick-built nuclear construction.

Onsite learning is gained through repeated construction and assembly projects. SMRs may also see meaningful onsite learning because the construction process, like the manufacturing process, is designed to be standardized and streamlined, moving away from large bespoke projects to modular assembly of pre-manufactured components. This differs from traditional nuclear construction, which has historically exhibited negative learning rates in the US, with overnight capital costs increasing rather than decreasing as more plants were built (Lovering et al., 2016). The negative learning observed in legacy nuclear was driven by the one-off nature of each construction project, evolving regulatory requirements mid-build, and the absence of design standardization. SMRs are designed to avoid these dynamics through modular, repeatable deployment.

After initial deployment, learning channels will operate in parallel but manufacturing learning requires factory throughput (order books) while onsite learning accrues per project. Manufacturing learning will most likely be the binding constraint to SMR deployment, as volumes will be limited by manufacturing capacity. While both learning channels are critical to the cost trajectory of SMRs, I have combined the two into a single, general learning rate in my parametric model. This approach simplifies the model's assumptions, as the factors driving cost reductions will differ significantly and interact in complex ways across SMR technologies and deployment contexts. The goal of the model is to understand how learning rates influence SMR cost reductions at a macro level, which can be achieved through a single adjustable learning rate parameter. Future models can expand on this by incorporating separate manufacturing and on-site learning rate parameters, as well as including other cost and time reduction parameters, such as materials cost and build time reductions. Additionally, this model to not meaningly incorporate limiting production factors, such as manufacturing capacity, fuel availability (particularly important for reactors that use HALEU fuel), and labor constraints.

Parametric Cost Models

I developed the parametric model using data from the literature review, with generative AI tools used to assist with model construction, code development, and iterative analysis. I used the parametric model to analyze how overnight capital costs (OCC) and the levelized cost of energy (LCOE) are affected by a range of policy and market variables as SMRs are deployed. OCC represents the hypothetical cost of building an SMR instantaneously. It includes materials, equipment, labor, and construction costs but excludes the time value of money, debt during construction, and interest associated with project financing. The LCOE calculates the cost per megawatt-hour that an energy generation technology must earn to break even over its operating lifetime. It is the standard metric for normalizing and comparing different generation technologies.

The models evaluate the range of potential SMR cost reductions under different assumptions, with parameter inputs informed by published academic techno-economic analyses and cost assumptions from SMR industry participants. I used these two source categories to inform the bounds of future cost projections. Realized SMR OCC and LCOE will depend on complex interactions between numerous variables internal and external to the development and construction process. This analysis does not attempt to predict what SMR costs will be but rather examines which variables are most critical to driving cost reductions, their relative importance, and the range of plausible outcomes given available information.

OCC and LCOE models were developed for both LW-SMRs and MS-SMRs. The primary differentiator between the two technologies is their anticipated FOAK overnight capital costs. Early techno-economic estimates place LW-SMR FOAK OCC at approximately $4,800/kW and MS-SMR FOAK OCC at approximately $4,000/kW, reflecting the simpler containment and lower-pressure systems of molten salt designs (Stewart & Shirvan, 2022). This cost differential, combined with the different markets each technology can address, means MS-SMRs and LW-SMRs are expected to diffuse differently across markets and geographies, a distinction that is carried forward into the diffusion model.

OVERNIGHT CAPITAL COST MODEL PARAMETERS

Table 3. OCC Parametric Model Design Parameters. *Base case values and ranges for SMR overnight capital cost and learning rate assumptions used in the parametric cost model.*

Type	Parameter	Base Case	Range	Notes
Design	LW-SMR: FOAK OCC ($/kW)	$5,812	$4,844 - $15,000/kW	Informed by techno-economic analyses and industry cost projections.
	MS-SMR: FOAK OCC ($/kW)	$4,782	$3,985- $11,600/kW	
	Learning rate	16%	8% - 33%	Combines manufacturing, on-site, and materials

- **FOAK Overnight Capital Cost (OCC_FOAK, $/kW):** The anticipated cost of constructing the first SMR of a given technology. Based on techno-economic analyses, MS-SMRs are expected to have lower FOAK costs than LW-SMRs due to reduced containment and safety system requirements. The lower bound (optimistic) case for LW-SMR and MS-SMR FOAK costs were informed by techno-economic analysis done by Asuega, Limb & Quinn (2023), developed by aggregating the input component costs for each reactor type. The base case was calculated by multiplying the component level costs by a 20% FOAK penalty to each technology. The pessimistic case (upper scenario bound) was chosen based off early SMR development projects. For the LW-SMR, $15,000/kW was based on the final investment decision reached in 2025 to build a GE Hitachi BWRX-300 (LW-SMR) in Ontario, Canada (Ontario Ministry of Energy, 2025). For the MS-SMR, $11,600 was based off TerraPower's Natrium in Wyoming, budgeted at roughly $11,600/kW (U.S. DOE, 2023; Swartz, 2026).
- **Learning Rate:** The rate of cost reduction per doubling of SMRs deployed. As discussed earlier, I used a learning rate inclusive of both manufacturing and onsite learning to simplify the analysis and better understand the impact that learning has on overall cost reductions. The base learning rate was set at 16% for the base case, drawn from empirical cost data on comparable complex manufactured products, including aircraft, gas turbines, and wind turbines (Wright, 1936; McDonald & Schrattenholzer, 2001; Vanatta et al., 2024). The pessimistic (lower bound scenario) learning rate of 8% is based off the INL/NREL Annual Technology Baseline (Abou-Jaoude et al. 2024). The optimistic (upper bound) learning rate of 33% is based off the sustained learning rate that South Korea has been able to achieve over the past 50 years of nuclear development (Lang 2017).

- **Learning Exponent (b):** Converts the learning rate percentage into the exponent used by Wright's Law to calculate cost reductions for every doubling of cumulative production. The equation for the learning exponent is $b = -ln(1 - LR) / ln(2)$.

OCC is given by

$$OCC(N) = FOAK\_OCC * N^{-b} \quad \text{Eq. 1}$$

Where FOAK_OCC is the individual FOAK costs for each technology, N is the number of SMRs deployed, and b = $ln(1 - LR) / ln(2)$ is the learning exponent.

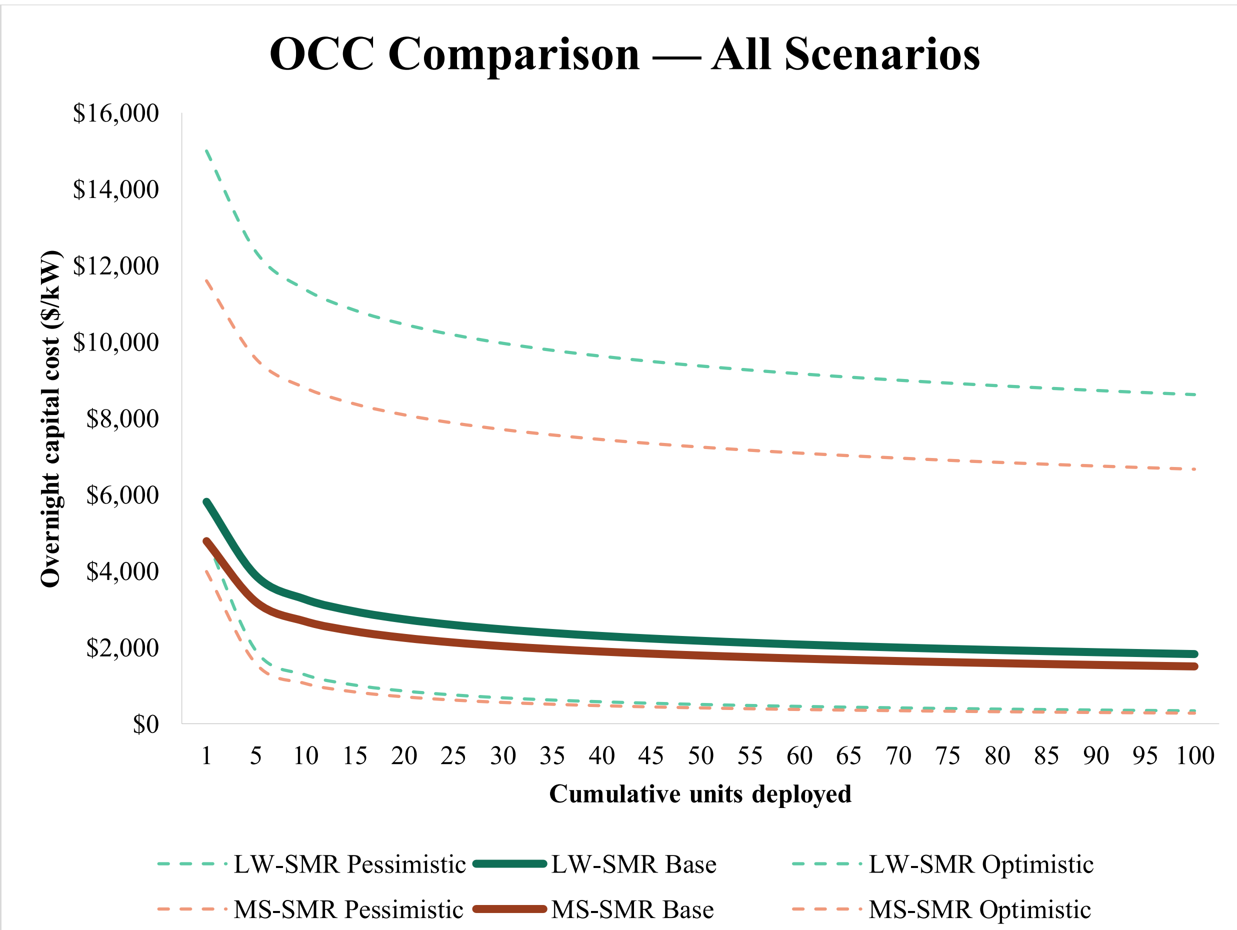


Figure 2. Overnight Capital Cost (OCC) by Cumulative Units Deployed, Scenario Comparison. *Projected OCC trajectories for LW-SMR (blue) and MS-SMR (red) technologies under pessimistic (dashed, dark), base (solid), and optimistic (dashed, light) learning rate assumptions.*

OCC Cost Reduction Discussion

The power of learning-driven cost reductions is evident in the parametric model. In the base case, FOAK costs begin at approximately $5,812/kW (LW-SMR) and $4,782/kW (MS-SMR), declining as cumulative deployment drives learning-based cost reductions per Wright's Law. Cost curves flatten significantly after approximately 10-15 units, reflecting the diminishing marginal effect of each subsequent doubling as cumulative production grows. Under base case assumptions, LW-SMR OCC declines from $5,812/kW to approximately $1,825/kW by the 100th unit, while MS-SMR OCC declines from ~$4,782/kW to approximately $1,502/kW. The spread between optimistic and pessimistic scenarios widens as units accumulate, illustrating the compounding effect of learning rate assumptions over time. As depicted by the difference between the base and pessimistic scenarios in the model, there is substantial FOAK cost escalation risk in early SMR deployment, and early FOAK cost overruns can keep OCC costs high even as deployments increase. MS-SMR costs remain below LW-SMR costs across all scenarios, driven by lower FOAK costs and identical learning rate assumptions. This is a simplified model exploring how learning rates will impact OCC as SMRs are deployed. A complex interaction of internal and external factors will determine what learning rates are achieved, and an SMR cost floor may be established before the 100th deployment. Of note, OCC costs in my model diverge from cost reduction models evaluated in the literature review around them midway point of deployment, most likely due to unconstrained, learning-based cost reductions.

LCOE MODEL PARAMETERS

Table 4. LCOE Parametric Model Design Parameters. *Base case values and ranges for SMR design, economic, and policy assumptions used in the parametric LCOE model.*

Type	Parameter	Base Case	Range	Notes
Design	LW-SMR: FOAK OCC ($/kW)	$5,812	$4,844 - $15,000/kW	Informed by techno-economic analyses and industry cost projections.
	MS-SMR: FOAK OCC ($/kW)	$4,782	$3,985- $11,600/kW	
	Learning rate	16%	8% - 33%	Combines manufacturing, on-site, and materials
Economic	WACC / Discount rate	-	10.0%	Blended cost of project financing

	Capacity factor	-	92.0%	% of time plant generates power
	Fixed O&M ($/kW-yr)	-	$120	Comparatively higher than LNR
	Variable O&M ($/MWh)	-	$2.5	Comparatively lower than LNR
	Fuel cost ($/MWh)	-	$7.5	Most likely higher for advanced fuels
	Plant lifetime (years)	60	40 -80	Dependent on design and regulation
	Construction duration (years)	5	3 - 10	Part of SMR promise
	Interest rate (debt)	-	5.0%	Interest during construction (DOE, 2024)
Policy	Investment Tax Credit	-	-	Reduces % of capital cost
	Production Tax Credit ($/MWh)	$25	$0 -$50	Reduces the LCOE
	Loan guarantee	2%	0% - 3.0%	Reduces WACC

- **Weighted Average Cost of Capital (WACC):** Set at 10% as a base case for nuclear projects, which face higher capital costs than renewables due to construction risk and long payback periods (DOE, 2024). This parameter is held static but could be adjusted in future model runs to analyze the impact of derisking on financing costs. As SMR construction is standardized and derisked, WACC should decrease.

- **Capacity Factor (CF):** Held static at 92%, consistent with the historical performance of the US nuclear fleet (DOE, 2021). Some next-generation SMR designs are being developed for flexible operation at varying capacity factors, which could expand their addressable market by enabling load-following and integration with variable renewable generation.

- **Fixed O&M (FOM, $/kW-yr):** Fixed operation and maintenance costs, standardized across technologies and held constant. This parameter can be adjusted in future model runs as SMR-specific O&M data becomes available.

- **Variable O&M (VOM, $/MWh):** Variable operation and maintenance costs, also standardized and held constant.

- **Fuel Cost (FUEL, $/MWh):** Nuclear fuel costs are significantly lower and less volatile than fossil fuel costs. In recent years, nuclear fuel has averaged approximately $6/MWh compared to $25–36/MWh for coal and natural gas (EIA, 2024; WNA, 2024). One caveat is that several proposed SMR designs, particularly those with high thermal output like MS-SMRs, require HALEU fuel, which is currently more expensive and faces supply chain constraints.

- **Plant Lifetime (years):** The assumed operational lifespan of the plant, over which capital costs are amortized. The base case reflects the initial operating license granted to nuclear plants by the NRC plus a 20-year license renewal (LR), which is routinely granted to currently operational nuclear plants. The optimistic case includes another 20-year subsequent license renewal, which has been granted to 12 reactor units. The pessimistic case covers the 40-year initial operating license (NRC, 2026).

- **Construction Duration (years):** The time required to build and commission the plant. Longer construction periods increase interest incurred during construction (IDC) and delay revenue generation. The base case is informed based off the recent global mean for reactor development of 5.7 years (Ritchie 2023). The pessimistic case (upper bound) is informed by the time it took to build the latest Vogtle reactors. The optimistic case (lower bound) is informed by the Abdulla et al. (2013) analysis and closely aligns with developer claims of 24-36 month deployments.

Two categories of policy parameters are incorporated into the LCOE analysis to capture the effect of federal policy on SMR cost competitiveness: tax credits and federal loan guarantees.

- **Investment Tax Credit (ITC):** Modeled after the Section 48E Clean Electricity ITC, the investment tax credit is applied as a percentage reduction to the effective capital cost (ECC) of the project. Due to the anti-stacking nature of federal tax credits, the ITC is turned off by default in the model. If turned on, the ITC enters the model through the ECC equation, directly reducing the capital cost that must be recovered over the plant's operating lifetime. Future analyses could be conducted to measure the impacts of a policy approaches that allow for tax credit stacking or a higher ITC.

- **Production Tax Credit (PTC):** Modeled after the Section 45Y Clean Electricity PTC, the production tax credit provides a per-MWh credit for electricity generated by zero-carbon facilities. The base case applies a credit of approximately $25/MWh consistent with the statutory rate for qualifying facilities. The pessimistic case (lower bound) is set at $0, to model what would happen if support were to expire. The optimist case (upper bound) is set at $35, representing a $10 increse of the current PTC. The PTC enters the model as a direct reduction to the calculated LCOE.

- **Loan Guarantee (LG):** Federal loan guarantees issued through the DOE Loan Programs Office under Title XVII of the Energy Policy Act of 2005 reduce the cost of debt financing for nuclear projects by shifting default risk from private lenders to the federal government. This lowers the interest rate on project debt, which in turn reduces both the weighted average cost of capital (WACC) and the interest accrued during construction (IDC). The pessimistic case (lower bound) is set at 0%, to model what would happen if support were to expire. The optimist case (upper bound) is set at 5%. In the model, the loan guarantee is captured through a reduction in the WACC parameter, which flows into the capital recovery factor (CRF) used to annualize capital costs in the LCOE calculation. Lower WACC also reduces IDC in the ECC equation, compounding the effect on final project cost. The base case WACC of 10% reflects financing conditions without a loan guarantee; the optimistic case models the impact of a guarantee on financing costs.

LCOE is given by

$$LCOE = (CRF \times ECC \times 1000 + FOM \times 1000) / (CF \times 8760) + VOM + Fuel \quad \text{Eq. 2}$$

Where CRF is the capital recovery factor, a function of WACC and plant lifetime. ECC is the effective capital cost, which translates the OCC into the actual capital cost of the project by incorporating construction financing costs (IDC) and policy incentives (ITC). Unlike OCC, which represents only the physical cost of building the reactor, ECC reflects what a developer pays after accounting for the time value of money during construction and any applicable tax credits. ECC and FOM are multiplied by 1,000 to convert units from kW to MW, and the CF is multiplied by 8,760 to calculate the number of hours the plant is operational throughout the year. The results of the parametric analysis are depicted below.

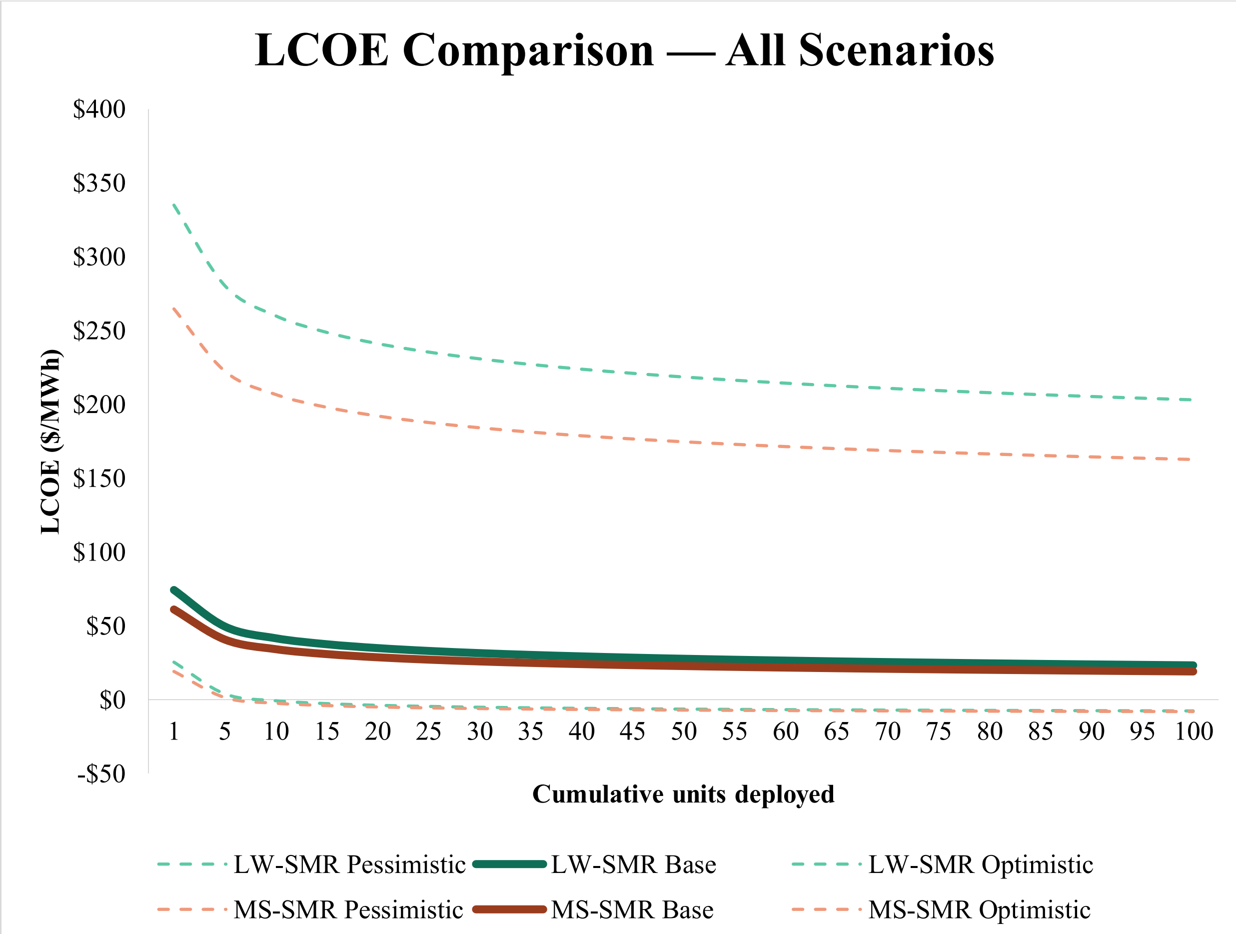


Figure 3. Levelized Cost of Electricity by Cumulative Units Deployed Under Three Scenarios. *Solid lines represent the base case for each SMR track; dashed lines show pessimistic (upper) and optimistic (lower) bounds. Scenario parameters vary across learning rate (8%/16%/33%), PTC ($0/$255/$50 per MWh), loan guarantee (0%/2%/5%), FOAK overnight capital cost, plant lifetime (40/60/80 years), and construction duration (3/5/10 years).*

As demonstrated in the OCC parametric analysis, costs can come down substantially through learning alone, but policy support, production tax credits and loan guarantees, makes SMRs significantly more cost competitive by directly reducing the effective capital cost and the per-MWh cost of production. This is clearly shown in the optimistic MS-SMR trajectory, where LCOE approaches zero after just 10 cumulative deployments, reflecting a scenario in which aggressive learning, favorable policy support, and a long operating life reduce unsubsidized generation costs to approximately $35/MWh, at which point the PTC fully offsets the remaining cost of generation. It is important to note that this model is simplified when compared to current and anticipated future operational realities in the nuclear space. While clean energy production tax credits substantially support nuclear competitiveness compared to fossil fuel powered generation, it is unlikely that it will lead to a negative LCOE.

Carbon Pricing and Competitiveness

One policy variable not captured in the parametric model but potentially critical for SMR cost competitiveness is carbon pricing. As a carbon-free generation technology, carbon taxes have no substantive impact on SMR LCOE but significantly increase the LCOE of unabated fossil fuel generation. The most cost-efficient fossil competitor, combined cycle gas turbines (CCGT), emits approximately 0.33–0.37 tCO2/MWh in emissions (Gassner et al. 2023). the NEA/OECD (2019) found that carbon pricing in the range of $40–70/tCO2 reinforces nuclear competitiveness against gas. Vanatta, Stewart, and Craig (2025) examined industrial heat decarbonization and found that a carbon tax at the EPA's updated social cost of carbon ($185/tCO2e) unlocked 61–65 GWt of SMR deployment across 925 U.S. facilities, while aggressive carbon taxes and investment tax credits proved effective long-run deployment levers where direct subsidies did not. While the U.S. lacks a federal carbon price, the EU ETS trades at ~€77/tCO2 (~$84) as of mid-2026 and Canada's industrial carbon price stands at CAD $110/tCO2, both approaching the lower breakeven range.

DIFFUSION FACTORS: SMR FEASIBILITY & VIABILITY

To explore the where, how, and at what rate SMRs could diffuse in the United States, I built a series of geospatial models in QGIS. The models are structured in three layers, each addressing a different question in the siting and deployment process.

The first layer evaluates the continental US for geographic SMR site feasibility, identifying areas where SMRs could be built given current regulatory guidelines for nuclear deployment. In essence, answering the question: can we build an SMR here? This layer is supplemented by a state policy analysis layer, informed by the previous state policy analysis, that can be toggled on and off and weighted based on importance. This allows users to decide how important state policy environments are to siting decisions. While state policy environments will be one of the primary determinants for final SMR siting decisions, as discussed earlier, nuclear state policies are changing constantly, which is why this layer can be user defined. The second layer integrates market variables to prioritize states for development, answering the question: where should we build an SMR? The third layer identifies specific sites that may offer competitive advantages for SMR construction, including brownfield sites, retiring generation facilities, energy-intensive industrial clusters, and military installations. Finally, I combined these layers with the cost trajectories from the LCOE parametric model, state-level retail electricity prices, and state-level electricity generation carbon intensity information to project how SMRs could diffuse geographically as deployment-driven learning and supportive policy reduces costs and the United States decarbonizes.

SMR FEASIBILITY LAYER

The first step in understanding how SMRs could diffuse geographically was to identify where they could feasibly be deployed based on geographic, regulatory, and policy constraints. To build this layer, I conducted a multistage analysis, researching and mapping each siting parameter individually before integrating them into a composite feasibility model.

The SMR siting process is actively evolving. Recent regulatory actions, including the NRC's 2023 final rule on emergency preparedness for SMRs and other new technologies, allow applicants to develop performance-based emergency preparedness programs with scalable emergency planning zones (EPZs), rather than applying the prescriptive requirements originally designed for large light water reactors (88 Fed. Reg. 80,078, 2023). Under this framework, SMR applicants may be able to demonstrate that no offsite EPZ is required or that the EPZ does not extend beyond the site boundary, significantly expanding the range of feasible siting locations. Additional siting reforms are being pursued under EO 14300 and the ADVANCE Act, though many of these changes have not yet been finalized and several current flexibilities have been enacted as temporary exemptions rather than permanent rules (NRC, 2026).

Geographic Siting Parameters

The geographic feasibility layer was developed using the Geospatial Energy Mapper (GEM), a siting and mapping tool developed by Argonne National Laboratory for the US Department of Energy (Argonne National Laboratory, n.d.). GEM provides over 190 mapping layers and models for more than 40 types of energy infrastructure, allowing users to generate customized suitability maps based on weighted parameter inputs.

The siting variables considered in the feasibility model were informed by NRC reactor site criteria (10 CFR 100) and operational requirements for nuclear facilities. The parameters, their weights, and relevant notes are presented in table 5. A full description of the parameters, weights, variables scoring, and descriptions can be found in the annex. Of note, any variables with a score of 0 were rated as not suitable, regardless of parameter weight.

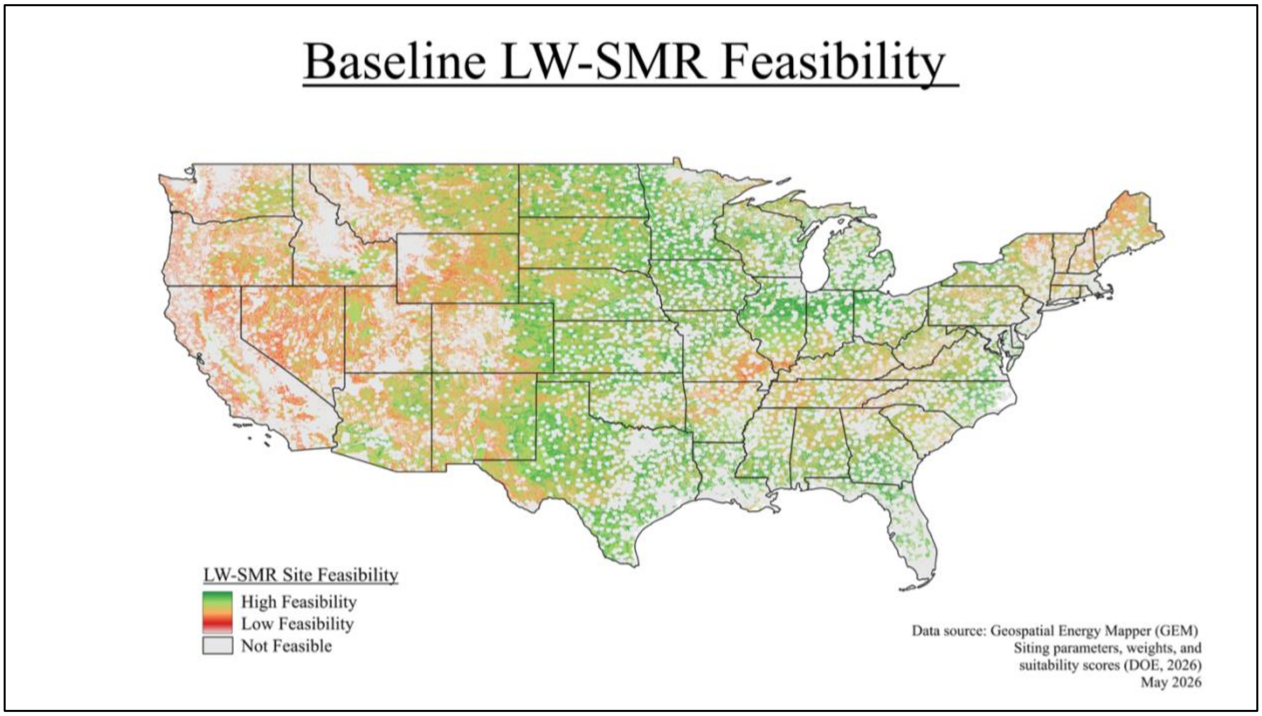
Table 5. Geospatial Energy Mapper (GEM) Siting Parameters, Weights, and Suitability Scores. *Parameters used to develop the SMR geographic feasibility layer in QGIS, with input data sourced from Argonne National Laboratory's Geospatial Energy Mapper. Each parameter is assigned a weight (1-5) reflecting its relative importance to nuclear siting feasibility, with 5 indicating the highest importance. Parameters are organized into three categories: Health and Safety, Ecological and Land Use, and Infrastructure and Engineering. Parameter weighting reflects the author's judgment based on the relative regulatory and operational significance of each criterion to nuclear facility siting. Future users of the GIS diffusion tool can tailor the feasibility parameters to individual preference (Argonne National Laboratory, n.d.).*

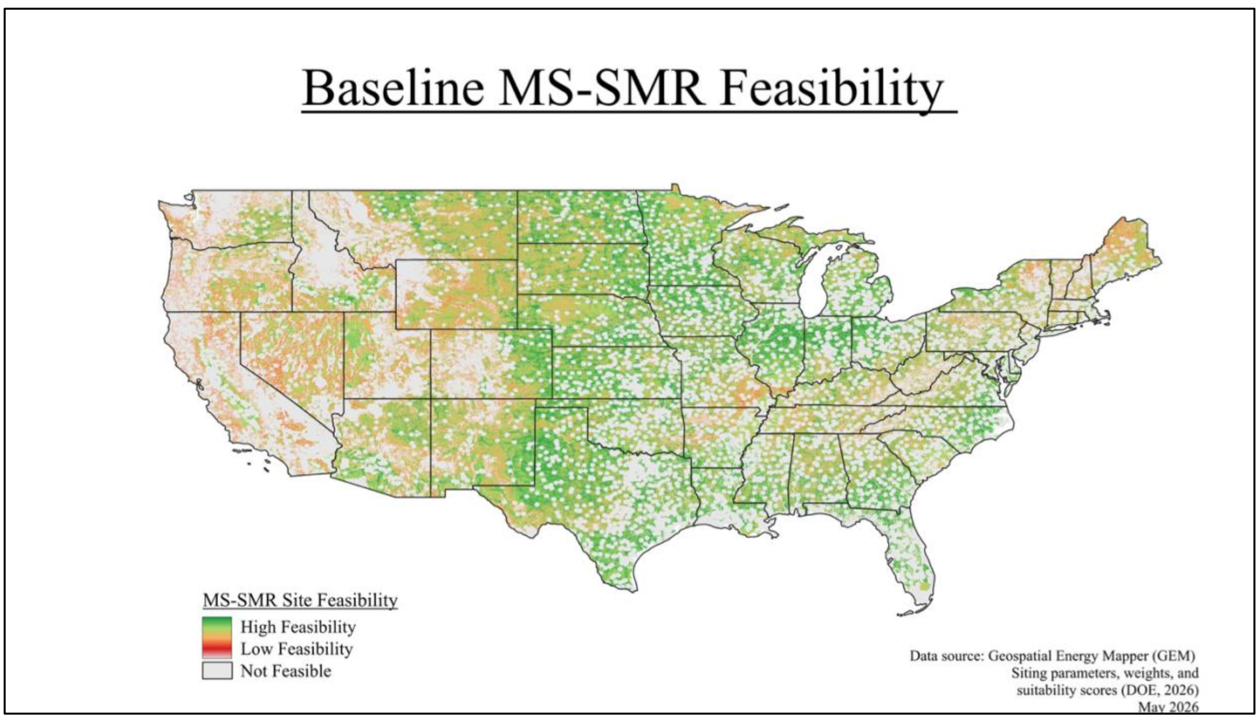
Category	Parameter	Weights LW-SMR	Weights MS-SMR	Notes
Health and Safety	**Seismic Hazard**	**5**	**3**	Based on NRC requirements for seismic and geologic siting criteria. Dependent on regulatory updates, seismic hazard could be an area of competitive advantage within SMR designs and compared to LNR, due to inherent safety features and seismic isolation.

	Population Density	**4**	**2**	Based on NRC reactor site criteria requiring distance from densely populated centers (>25,000 residents). Sites with >500 persons/sq mi are excluded. Potential competitive advantage within SMR designs and compared to LNR due to smaller EPZ footprints and inherent safety features.
	Flood Hazard Zones	**1**	**1**	FEMA flood hazard designations. All active flood zones are excluded.
	National Risk Index Score	**1**	**1**	FEMA composite risk score incorporating 18 natural hazards to account for cumulative natural hazard exposure beyond seismic risk alone.
	Quaternary Fault Exclusion	**1**	**1**	USGS quaternary fault data identifying areas with known active faulting.
Ecological and Land Use	**Protected Land and Water**	**4**	**4**	Federal and state land protection designations.
	Habitat Suitability	**3**	**3**	Sensitive habitat designations including critical habitat for threatened/endangered species.
	Slope (Lower 48)	**3**	**3**	Terrain grade from USGS elevation data. Slopes above 8% are generally unsuitable for large-scale construction
	Land Cover (NLCD 2023)	**2**	**2**	National Land Cover classifications. Open, barren, and agricultural lands score highest. Wetlands are excluded; developed areas receive moderate scores reflecting existing infrastructure.
	Land/Water Mask	**1**	**1**	Binary exclusion layer. Water bodies are not suitable for reactor siting.
Infrastructure and Engineering	**Distance to Transmission Line**	**3**	**3**	Proximity to existing grid interconnection.
	Distance to Major Road	**3**	**3**	

	Distance to Navigable Waterway	**2**	**2**	Proximity to major transportation infrastructure for construction access, equipment delivery, and ongoing operations and maintenance support.
	Distance to Railroad	**2**	**2**	
	Distance to Airport	**1**	**1**	Exclusion zone around airports per FAA and NRC siting guidance.
	Surface Water Flow (≥50,000 gpm)	**3**	**1**	Proximity to surface water sources with sufficient flow for reactor cooling. Competitive advantage for advanced reactors that do not use water as coolant.

The resulting feasibility layer evaluates the suitability of each point in the contiguous United States based on the parameter inputs and weights. The most significant determinants of siting feasibility are surrounding population density, terrain slope, proximity to natural hazards (particularly seismic hazards, which are prominent along the West Coast, the New Madrid seismic zone, and portions of the Southeast), and access to sufficient water for cooling. Several of these constraints may be relaxed in the future through regulatory reform or technological advancement. Population proximity and seismic hazard thresholds are actively being reevaluated based on the enhanced safety characteristics of SMR designs, and reactors that do not use water as their primary coolant (i.e., gas-cooled, liquid metal, and molten salt designs) have substantially lower requirements for proximity to cooling water sources. Two different feasibility layers were developed, one for LW-SMRs and the other for MS-SMRs. The primary difference between LW-SMR and MS-MSR feasibility assessment was that proximity to population centers, seismic hazards and access to water were down-weighted in the MS-SMR in the feasibility criteria leading to a larger feasible area and improvements in location-specific feasibility scores.


Baseline LW-SMR Feasibility
LW-SMR Site Feasibility
High Feasibility
Low Feasibility
Not Feasible
Data source: Geospatial Energy Mapper (GEM)
Siting parameters, weights, and
suitability scores (DOE, 2026)
May 2026


Baseline MS-SMR Feasibility
MS-SMR Site Feasibility
High Feasibility
Low Feasibility
Not Feasible
Data source: Geospatial Energy Mapper (GEM)
Siting parameters, weights, and
suitability scores (DOE, 2026)
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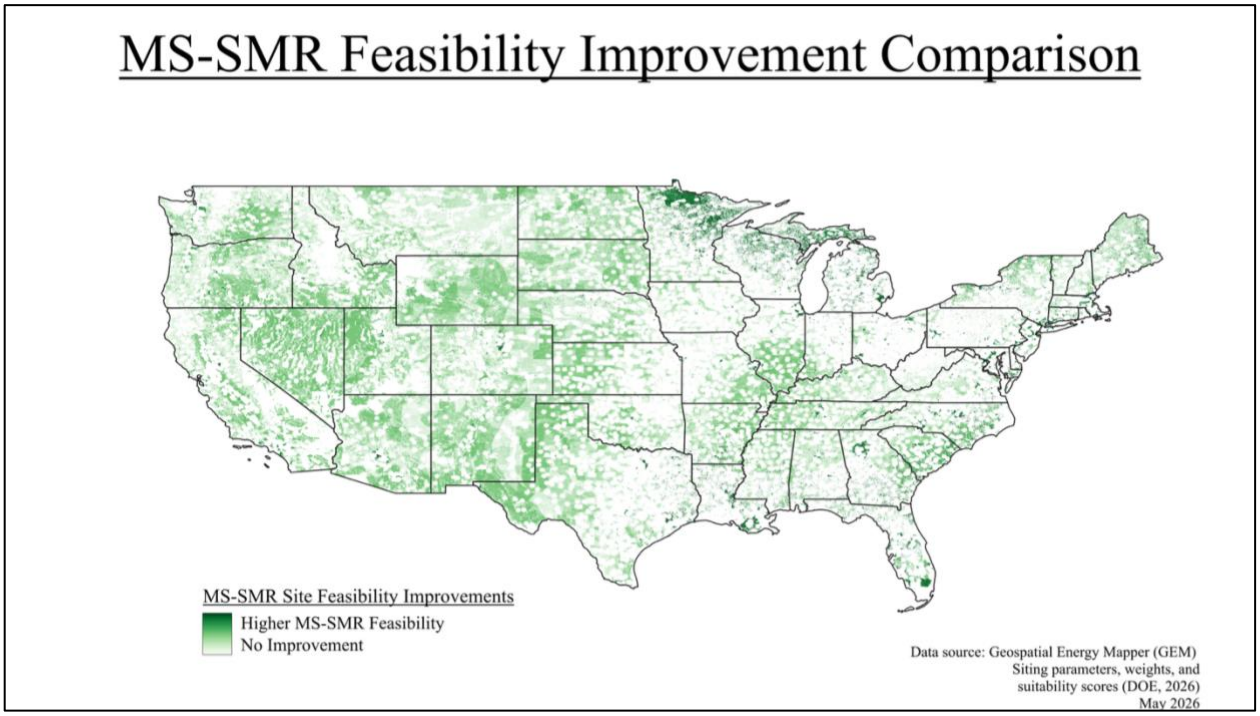

Figure 4, 5, 6. Baseline LW-SMR and MS-SMR Site Feasibility and MS-SMR Feasibility Improvement Comparison. *The first two maps display the composite geographic feasibility layer for LW-SMR and MS-SMR siting across CONUS, with suitability scores derived from the weighted GEM parameter inputs described in Table 5. Areas range from high feasibility (dark green) to low feasibility (red) to not feasible (gray). Major constraints visible in the feasibility layer include the seismically active West Coast and Intermountain West, high-population-density corridors along the Eastern Seaboard, and protected lands and steep terrain across the Appalachian and Rocky Mountain ranges. The third map illustrates where MS-SMR designs gain additional siting feasibility relative to LW-SMRs, driven primarily by reduced requirements related to population density, seismic hazard, and cooling water availability. Areas that are more feasible are identified in dark green. White areas have no change in feasibility scores. Data derived from Geospatial Energy Mapper (GEM) siting parameters, weights, and suitability scores (Argonne National Laboratory, n.d.).*

State Policy Layer

After geographic and regulatory feasibility were evaluated, state policy constraints were integrated into the feasibility model. As discussed in the Development Variables section, ten states currently maintain policy restrictions on new nuclear construction, ranging from outright bans to conditional moratoria tied to federal waste disposal policy or legislative and/or voter approval requirements (NCSL, 2025). States with active nuclear moratoria were excluded from consideration in the diffusion model, while the remaining states were scored using the weighted policy scorecard described in the Development Variables section.

The state policy layer is maintained as a separate input to the feasibility model rather than being embedded in the geographic layer. This design allows model users to choose whether to incorporate state policy constraints and to adjust the weighting based on their assessment of policy durability. Given the recent trend of states repealing or modifying nuclear moratoria, this flexibility is important for scenario analysis.

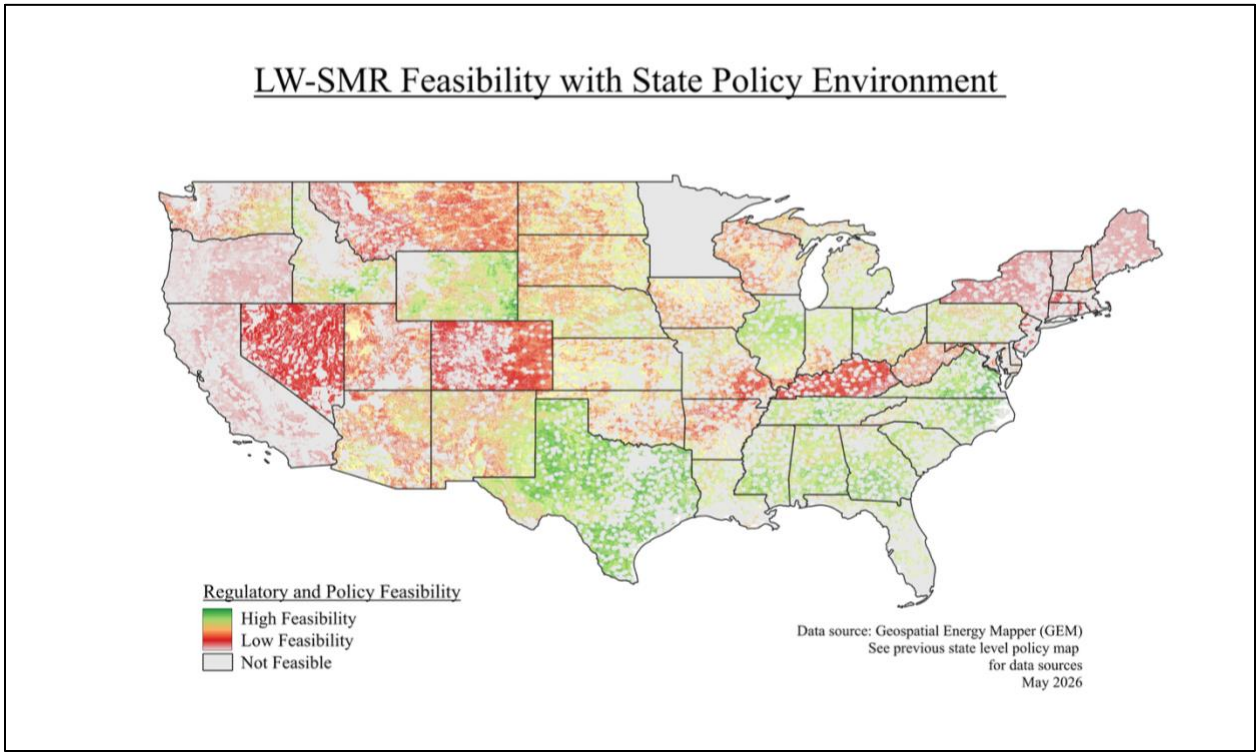

Figure 7. LW-SMR Siting Feasibility Across the Contiguous United States, Adjusted for State Policy Environment. *Site feasibility scores are derived from the Department of Energy's Geospatial Energy Mapper (GEM) siting parameters, and a state-level policy overlay that accounts for legislative and regulatory posture toward nuclear energy, including moratoria, permitting frameworks, and stated deployment interest.*

SITE PRIORITIZATION MODEL

While the feasibility layer identifies where SMRs can be built, the prioritization model helps identify where they should be built. There are numerous factors that developers consider when prospecting and selecting nuclear sites, but the state-level variables I integrated into the prioritization model are retail electricity prices and the carbon intensity of state electricity generation. These two indicators allow developers to evaluate states based on two macro-level development objectives: market price competition and decarbonization impact.

Retail electricity price data was sourced from the EIA's state electricity profiles, providing average retail rates by state (EIA, 2025). Carbon intensity data was derived from EIA state-level generation and emissions data, measured in tons of emissions per MWh of electricity generated. Based on this approach, SMRs are most competitive in states where electricity prices are high and electricity generation is carbon intensive, as these are the markets where SMR-generated electricity can most readily displace incumbent fossil fuel generation on both cost and emissions grounds.

Additional factors that developers could integrate into the decision-making process include previous nuclear operating experience, labor rates and skilled workforce access, land costs and property rights, VRE penetration levels, public sentiment toward nuclear energy, planned generator retirements, and other state-level industrial policy incentives. To keep the prioritization model tractable and broadly applicable, these variables were not included in this analysis but could be incorporated in future iterations.

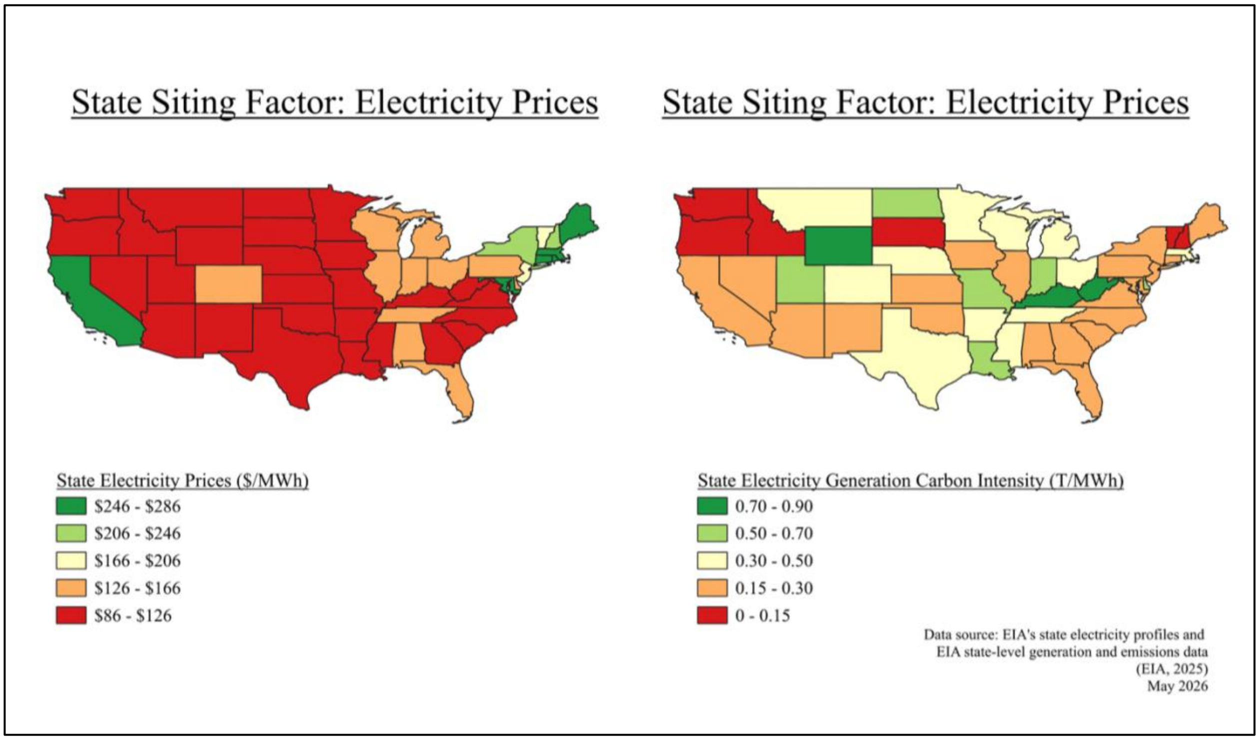

Figure 8. State Siting Factors: Retail Electricity Prices and Electricity Generation Carbon Intensity. *State-level inputs to the SMR site prioritization model. The left panel displays average state retail electricity prices ($/MWh), ranging from $86 to $286. The right panel displays the carbon intensity of state electricity generation, measured in metric tons of greenhouse gas emissions per MWh (T/MWh), ranging from 0.0 to 0.9. Of note, states that are green have the most carbon intense electricity generation matrix. While counterintuitive to color schemes we typically associate with carbon intensity, green in this context signifies areas where developers should target. States where electricity prices are highest and generation is most carbon intensive represent the most favorable near-term markets for SMR deployment, as SMRs can compete on both cost and emissions grounds. These two variables serve as the prioritization layer in the diffusion model, identifying where SMR-generated electricity is most likely to displace incumbent fossil fuel generation. States with nuclear moratoria are included in the maps but excluded from the diffusion analysis. Data sourced from EIA state electricity profiles and EIA state-level generation and emissions data (EIA, 2025).*

Site Identification Layer

The final layer identifies specific sites that may offer competitive advantages for SMR construction. Site-specific factors such as existing infrastructure, permitting pathways, and proximity to end users can significantly reduce development costs and timelines relative to undeveloped greenfield sites. The sites included in this layer fall into four main categories:

Existing and Decommissioned Generation Sites. Sites of currently operating or recently decommissioned electricity generation facilities offer several advantages for SMR development, including existing grid interconnections, transmission infrastructure, trained workforces, and established relationships with regulators and host communities. Special emphasis was placed on three subcategories: previously licensed nuclear sites, which have existing NRC site characterization data and community familiarity with nuclear operations; coal-fired power plants, particularly those planned for retirement within the next two decades; and other fossil fuel generation facilities scheduled for decommissioning. A 2024 DOE study found that approximately 300 of the roughly 400 retiring or retired US coal plant sites are potentially viable for conversion to nuclear generation, representing a significant near-term deployment opportunity (DOE, 2022; Abdulla et al., 2024).

Brownfield Sites. Brownfield sites are previously developed or contaminated properties that may be less suitable for general development but can be repurposed for energy generation. The brownfield sites included in this model were identified through the EPA's RE-Powering America's Land Initiative, which has pre-screened over 190,000 contaminated lands, landfills, and mine sites for energy development suitability (EPA, 2024). While the RE-Powering program was originally designed for renewable energy siting, the site characterization data (including environmental assessments, land use designations, and infrastructure proximity) is applicable to SMR siting evaluations as well. Individual brownfield sites require further assessment for nuclear-specific viability, including evaluation of subsurface contamination, seismic stability, and cooling water access.

Military Installations. While military installations are classified as hazardous facilities to be considered during nuclear siting, their unique characteristics make them strong candidates for future SMR deployment. Military bases offer controlled land access, established security perimeters, existing energy infrastructure, energy security requirements, and in many cases a skilled nuclear workforce (particularly Navy installations with nuclear propulsion experience). The Department of Defense is actively pursuing microreactor deployment through Project Pele, a transportable high-temperature gas-cooled microreactor being developed by BWXT at Idaho National Laboratory, with initial demonstration planned for 2027-2028 (DOD, 2024). The Army's Janus Program, announced in 2025, extends this effort toward delivering commercial nuclear power to critical military infrastructure.

Energy-Intensive Industrial Facilities. One of the strongest use cases for SMRs is pairing them with large-load entities that require reliable baseload electricity and, in the case of high-temperature SMR designs, industrial process heat. Industrial facilities are often clustered in areas where siting and zoning may be more favorable to SMR development, as they tend to be located away from dense population centers and close to necessary operational and logistical infrastructure. This layer includes data on energy-intensive industrial clusters, data center concentrations, and other large-load facilities.

The map below depicts which of these sites currently resides in an area feasible for SMR development. While the map is very busy, it gives a good overview of the multitude of potential sites available for development (3,554 identified). Additionally, these identified sites are integrated into the diffusion analysis.

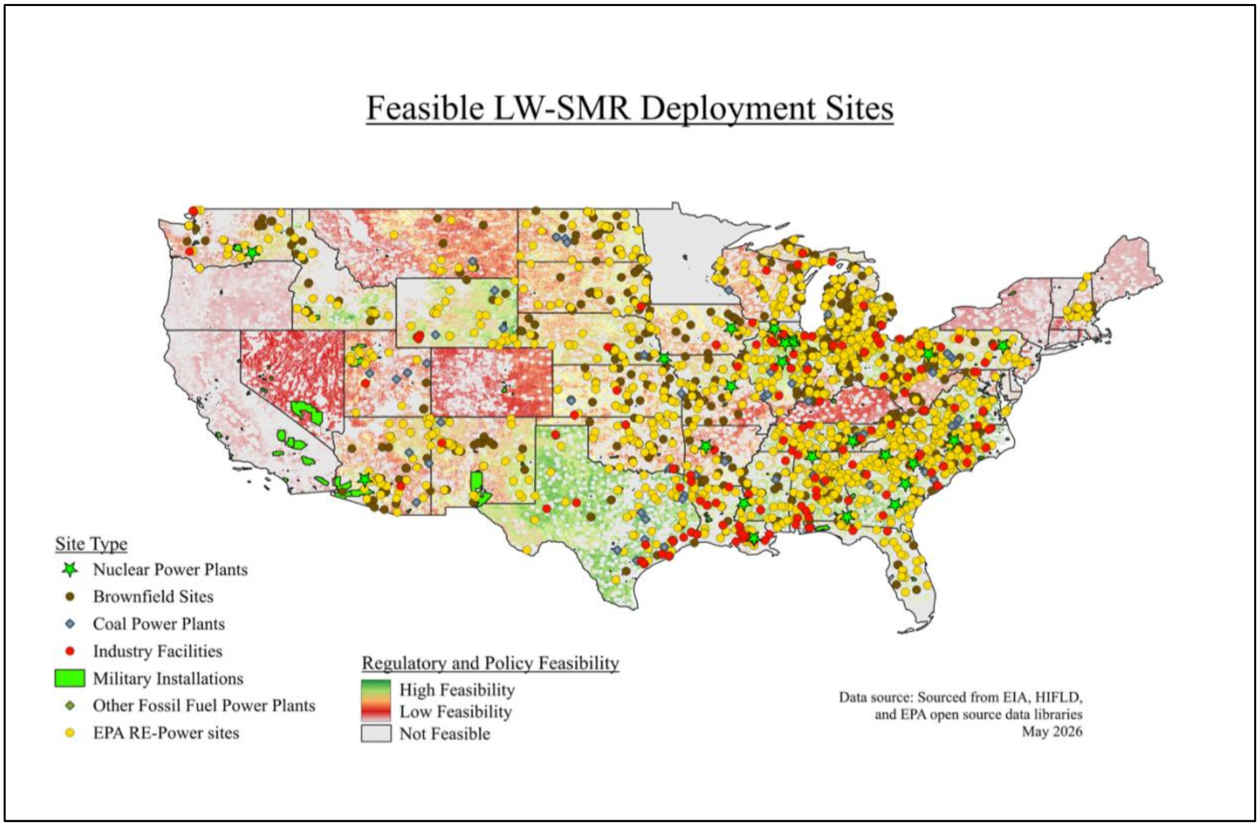

Figure 9. Feasible SMR Development Sites Across the Contiguous United States. *Candidate sites for SMR deployment overlaid on the composite geographic feasibility layer. Seven site categories are displayed: existing nuclear power plants (green stars), industrial facilities (red circles), coal power plants (blue diamonds), EPA RE-Powering facilities (yellow circles), other fossil fuel power plants (green diamonds), brownfield sites (brown circles), and military installations (green polygons). Data sourced from EIA, Homeland Infrastructure Foundation-Level Data (HIFLD), and EPA open source data libraries (May 2026).*

PRICE-BASED SMR DIFFUSION ANALYSIS

To project how SMRs could diffuse across the US over time, I combined the feasibility, prioritization, and site identification layers with the cost trajectories generated by the parametric model. The diffusion model operates on the principle that SMR deployment will begin in locations where they are most cost competitive and expand outward as learning-driven cost reductions make them viable in progressively more markets.

The mechanism is straightforward: my parametric model generates LCOE projections at different stages of cumulative deployment, and the diffusion analysis compares those LCOE values against state-level wholesale electricity prices. Where the projected SMR LCOE falls below the prevailing retail electricity price, SMRs are modeled as cost competitive and deployment can proceed. As cumulative units are deployed and learning reduces costs, the LCOE threshold drops and additional states become viable markets for SMR development. This scenario represents a market-driven deployment pathway where developers prioritize sites that offer the best economic returns.

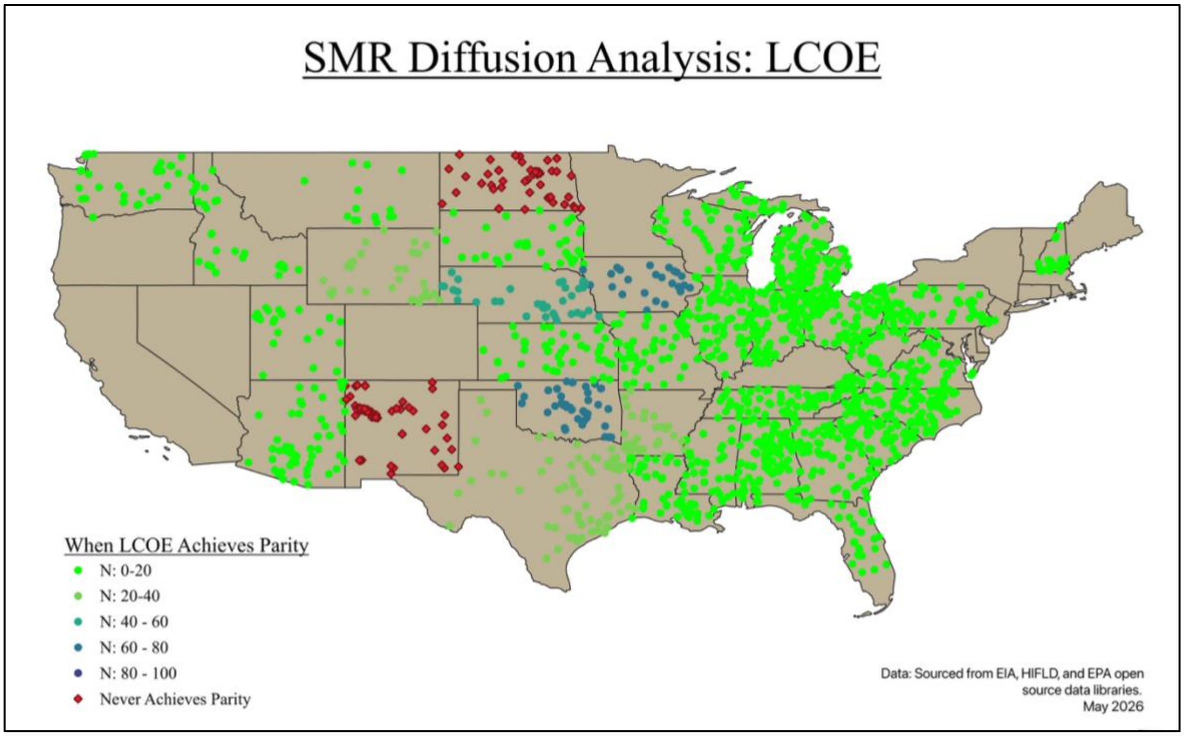

Figure 10. Price-Based SMR Diffusion Analysis: LCOE Parity by Cumulative Deployment. *Projected diffusion of cost-competitive SMR deployment across candidate sites in the contiguous United States under the price-based scenario, using base case LCOE projections from the parametric model. Sites are color-coded by the cumulative deployment stage (N) at which the projected SMR LCOE falls below the prevailing state retail electricity price: bright green (N: 0–20) indicates sites where SMRs are cost competitive earliest in the deployment cycle, progressing through yellow-green (N: 20–40), teal (N: 40–60), and blue (N: 60–80, N: 80–100) as learning-driven cost reductions open progressively cheaper markets. Red diamonds indicate sites where SMR LCOE does not achieve parity with state retail electricity prices within 100 cumulative deployments under base case assumptions. Data sourced from EIA, HIFLD, and EPA open source data libraries (May 2026); LCOE projections from the parametric cost model described in the Deployment Factors section.*

Decarbonization-Based Diffusion Analysis

In this scenario, SMR deployment is driven by emissions reduction objectives. SMRs are prioritized for states with the most carbon-intensive electricity generation, regardless of price competitiveness. This scenario represents a policy-driven deployment pathway where decarbonization goals take precedence over pure market economics. Under stricter climate policy, such as a federal carbon pricing or clean electricity standard, this diffusion pattern becomes more likely, as the effective cost of carbon-intensive generation increases and the relative competitiveness of SMRs improves.

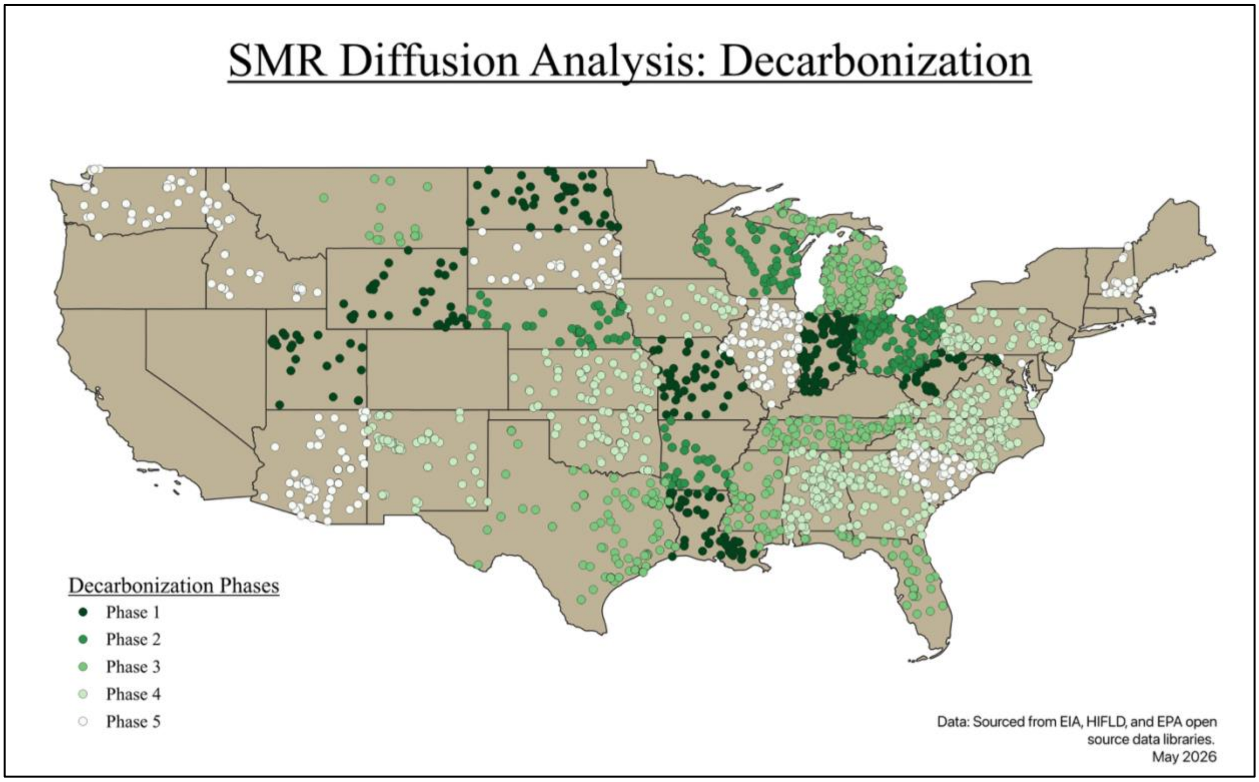

Figure 11. Decarbonization-Based SMR Diffusion Analysis: Deployment Prioritized by State Electricity Generation Carbon Intensity. *Projected phased deployment of SMRs across candidate sites in the contiguous United States under the decarbonization scenario, where sites are prioritized based on the carbon intensity of state-level electricity generation rather than price competitiveness. Sites are classified into five deployment phases, with Phase 1 (darkest green) representing states with the most carbon-intensive generation and Phase 5 (white) representing states with the least carbon-intensive generation. This contrast illustrates the central tension identified in the diffusion analysis: optimizing for emissions reductions and optimizing for market competitiveness do not always point to the same states. Data sourced from EIA, HIFLD, and EPA open source data libraries (May 2026); carbon intensity data derived from EIA state-level generation and emissions profiles (EIA, 2025).*

The diffusion analysis demonstrates that the geographic pattern of SMR deployment is not fixed but depends on which development objective, market competitiveness or decarbonization, is prioritized. In practice, deployment will likely reflect a combination of both, with initial builds concentrated in states that offer both high electricity prices and carbon-intensive generation, and subsequent deployment expanding based on the policy and market environment. The parametric model results from the previous section directly inform the pace of this diffusion: higher learning rates and stronger policy support accelerate cost reductions, which accelerate geographic expansion, reinforcing the virtuous cycle of deployment, learning, and cost reduction that is central to the SMR value proposition.

CONCLUSION: THE PATHWAYS TO A SMR-TER FUTURE

Through my capstone, I set out to assess how policy and market variables will influence the development, deployment, and diffusion of small modular reactors in the United States. The analysis was structured around a central question: under what conditions can SMRs transition from a promising but unproven technology to a cost-competitive, scalable component of the US energy system? To answer that question, I examined the policy environment shaping initial SMR development, built parametric models to analyze how costs evolve as deployment scales, and conducted a geospatial diffusion analysis to project where SMRs could deploy across the continental US. The findings point to three primary drivers that will determine whether the current nuclear moment produces lasting results or follows the trajectory of previous false starts.

Learning Rates Are the Most Critical Variable

The parametric model results demonstrate that learning rates are the single most influential variable driving SMR cost reductions. The difference between optimistic and pessimistic learning rate assumptions produces a wider spread in both OCC and LCOE outcomes than any other parameter in the model. This finding is consistent with the core economic thesis of SMRs: that cost competitiveness comes not from economies of scale, as with legacy nuclear, but from economies of multiples, where the repeated factory production and deployment of standardized modules drive learning-based cost reductions over time (Abou-Jaoude et al., 2024).

The implication is that the volume of deployment matters as much as the design of the reactor. High learning rates require high production volumes, and high production volumes require large addressable markets to generate order books. This creates a direct link between the market analysis and the cost analysis: the broader the range of applications SMRs can serve, the more units get built, the faster learning accumulates, and the more competitive SMRs become. MS-SMRs and other high-temperature reactor designs have a structural advantage here because they can access both electricity and industrial heat markets, expanding the total addressable market and accelerating the learning cycle. Whether realized learning rates fall closer to the optimistic or pessimistic end of the range will depend on factors only partially within the control of developers and policymakers: the degree of design standardization achieved across deployments, the pace of factory manufacturing scale-up, and the extent to which onsite construction processes are truly modularized rather than reverting to bespoke practices.

Policy Support Is Essential for Early Deployment but Cannot Sustain Competitiveness Alone

The second major finding is that federal policy support, particularly production tax credits and loan guarantees, significantly improves SMR cost competitiveness in the near term but is not sufficient on its own to make SMRs viable in the long run. The LCOE model shows a meaningful gap between policy-supported and unsupported scenarios: with the PTC and favorable financing conditions, SMRs reach LCOE cost parity with state electricity rates earlier in the deployment cycle. Without these incentives, parity requires either higher learning rates or a sustained increase in the price of non-nuclear generation.

This has practical implications for how policymakers think about SMR support. The value of current fiscal incentives is not that they make SMRs permanently competitive, but that they bridge the cost gap during the critical early deployment period when FOAK costs are highest, and learning has not yet accumulated. The risk is that if policy support is withdrawn before enough units have been deployed to drive meaningful cost reductions, SMRs could stall in the cost valley between FOAK and NOAK deployment, a period where the technology has been derisked but is not yet commercially competitive. The preservation of the Section 45Y PTC and Section 48E ITC for nuclear facilities through 2033 under the One Big Beautiful Bill Act provides a runway, but the window is finite. Whether that runway is long enough depends on how quickly the first wave of SMR demonstrations and initial commercial deployments can be executed.

Regulatory reform operates on a parallel track. The ADVANCE Act, 10 CFR Part 53, and Executive Order 14300 collectively represent the most significant overhaul of the US nuclear regulatory framework in decades. These reforms do not directly reduce costs, but they reduce the regulatory uncertainty and timeline risk that have historically driven cost overruns in nuclear construction. The NRC's 2023 emergency preparedness rule, which allows SMRs to demonstrate that no offsite emergency planning zone is required, is a concrete example of how risk-informed regulation can expand the range of feasible siting locations. As siting constraints are relaxed and licensing timelines compressed, the addressable market for SMRs grows, reinforcing the connection between regulatory reform and cost reduction.

Geographic Deployment Depends on Which Objective Is Prioritized

The geospatial diffusion analysis illustrates that the pattern of SMR deployment across the US is not a single pathway but a set of pathways that diverge based on whether market competitiveness or decarbonization is the primary deployment objective. In the price-based scenario, SMRs enter the highest-cost electricity markets first and expand outward as learning-driven cost reductions make them viable in progressively cheaper markets, but SMRs do not become competitive in all markets on cost alone. In the decarbonization scenario, deployment is concentrated in states with the most carbon-intensive generation, regardless of electricity price. Both pathways converge over time as costs decline, but the sequencing and pace of deployment differ substantially.

This distinction highlights a tension in SMR deployment strategy. The states where SMRs can make the greatest contribution to decarbonization are not always the states where they are most cost competitive. A purely market-driven deployment pathway may bypass carbon-intensive states with low electricity prices, while a policy-driven pathway may direct deployment to markets where SMRs face stiffer economic headwinds. The interaction between federal incentives, state-level policy environments, and market conditions will determine which pathway predominates. States that combine supportive nuclear policy, high electricity prices, and strong decarbonization plans represent the most likely early deployment markets under either scenario.

The site identification layer adds a practical dimension to the diffusion analysis. The roughly 300 retiring coal plant sites identified as viable for nuclear conversion, combined with brownfield sites, military installations, and energy-intensive industrial clusters, represent a substantial near-term pipeline of development-ready locations. These sites offer existing infrastructure, established grid connections, and in many cases community and workforce familiarity with large-scale energy operations. The coal-to-nuclear transition opportunity aligns both the market and decarbonization objectives: these sites are often located in states with carbon-intensive generation and host communities facing economic transition as coal plants retire.

LIMITATIONS

This analysis is subject to several important limitations. The parametric model combines manufacturing and onsite learning into a single learning rate parameter, which simplifies the cost dynamics but obscures the distinct contributions and interactions of each learning channel. The FOAK cost estimates used as starting points for the OCC model are drawn from techno-economic analyses and industry projections, not from realized construction data, because no SMR of any design has yet been built at commercial scale in the United States. These estimates carry substantial uncertainty, and actual FOAK costs could diverge significantly from projections in either direction. The parametric model's value is in illustrating relative sensitivities and directional relationships, not in predicting specific cost outcomes.

The geospatial diffusion analysis uses retail electricity prices and carbon intensity as its two prioritization variables, which provides a tractable framework but does not capture the full range of factors that drive real-world siting decisions, including labor market conditions, public sentiment, transmission capacity, and state-level permitting timelines. The model also treats state policy environments as static, when in practice they are evolving rapidly.

Finally, the technological, regulatory, and policy environments of next generation nuclear are complex, and relatively immature. Several prominent variables were simplified or excluded from my capstone entirely. These include, but are not limited to, nuclear component and fuel supply chain challenges, skilled labor shortages, radioactive waste disposal, nuclear proliferation risk, and the contentious politics around new nuclear development.

CLOSING

The current enthusiasm around SMRs is grounded in a real and defensible proposition: that standardized, modular nuclear reactors can break the cost and schedule dynamics that have stalled nuclear deployment in the US for decades. But enthusiasm alone does not build reactors. The pathways to an SMR-ter future depend on whether the cycle at the center of the SMR value proposition, where deployment drives learning, learning drives cost reductions, and cost reductions drive further deployment, can be initiated and sustained.

The analysis presented in this capstone suggests that the conditions for initiating that cycle are favorable. Federal policy support is broad and, for the moment, durable. The regulatory framework is being modernized. Market demand for clean firm power is growing rapidly. And the first demonstration projects are underway. What remains to be seen is whether the industry can deliver on the manufacturing and deployment standardization that the entire economic case rests on. If it can, SMRs have a credible path to cost competitiveness across a wide range of markets and geographies. If it cannot, the current moment will join the list of nuclear renaissances that promised transformation and delivered disappointment. The variables examined in this capstone, learning rates, policy support, market access, and geographic deployment strategy, are the ones that will determine which outcome prevails.

ANNEX

FULL SMR FEASIBILITY CRITERIA

The table below outlines the full set of the parameters, weights, variables, and scores used to develop the SMR feasibility layer. Of note, any variables with a score of 0 were rated as not suitable, regardless of parameter weight. The main difference between LW-SMRs and MS-MSRs was how close they could be potentially deployed to population centers, and how heavily weighted seismic hazards and access to water were in the feasibility criteria.

Table 5. Geospatial Energy Mapper (GEM) Siting Parameters, Weights, and Suitability Scores. *Parameters used to develop the SMR geographic feasibility layer in QGIS, with input data sourced from Argonne National Laboratory's Geospatial Energy Mapper. Each parameter is assigned a weight (1-5) reflecting its relative importance to nuclear siting feasibility, with 5 indicating the highest importance. Individual variable classes within each parameter are scored on a 0-100 suitability scale, where 100 indicates full suitability and 0 indicates exclusion. Parameters are organized into three categories: Health and Safety, Ecological and Land Use, and Infrastructure and Engineering. The composite suitability score for each point in CONUS is calculated as the weighted sum of individual parameter scores. Weights and suitability scores were informed by NRC reactor site criteria (10 CFR 100), FEMA flood hazard and natural risk designations, USGS seismic hazard maps and quaternary fault data, NLCD 2023 land cover classifications, and FAA airspace requirements. Parameter weighting reflects the author's judgment based on the relative regulatory and operational significance of each criterion to nuclear facility siting (Argonne National Laboratory, n.d.).*

Category	Parameter	Weight LW-SMR	Weight MS- SMR	Variables	Score
Health and Safety	**Seismic Hazard**	**5**	2	0–4 %g	100
				4–8 %g	100
				8–16 %g	50
				16–32 %g	25
				32+ %g	10
				Background	0
	Population Density	**4**	**2**	0–100 per sq mi	100
				101–150	100

				151–200	100
				201–300	100
				301–400	100
				401–500	100
				Over 500	0
	Flood Hazard Zones	1	1	Zone A, A99, AE, AH, AO	0
				Zone V, VE	0
				Open Water	0
				Zone D	100
				Zone X	100
				Area Not Included / No Data	100
	National Risk Index Score	1	1	Very Low (0–10)	100
				Low (11–20)	100
				Moderately Low (21–30)	100
				Slightly Below Average (31–40)	100
				Average (41–50)	100
				Slightly Above Average (51–60)	100
				Moderately High (61–70)	60
				High (71–80)	35
				Very High (81–90)	35
				Extremely High (91–100)	10
	Quaternary Fault Exclusion	1	1	Background	100
				Fault Exclusion Area	75

Ecological and Land Use	**Protected Land and Water**	**4**	**4**	Background	100
				Likely Low Conflict	95
				Conditional	40
				Avoidance	20
				Exclusion	0
	Habitat Suitability	**3**	**3**	No Sensitive Habitat	100
				Medium Importance	50
				High Importance	20
	Slope (Lower 48)	**3**	**3**	0–2%	100
				2–4%	100
				4–6%	100
				6–8%	50
				8–10%	0
				10–15%	0
				15–20%	0
				20–25%	0
				Over 25%	0
	Land Cover (NLCD 2023)	**2**	**2**	Barren Land (31)	100
				Herbaceous (71)	100
				Unclassified (0)	100
				Shrub/Scrub (52)	90
				Hay/Pasture (81)	90
				Cultivated Crops (82)	90
				Developed — Open Space (21)	75
				Developed — Low Intensity (22)	75

				Developed — Medium Intensity (23)	75
				Developed — High Intensity (24)	75
				Deciduous Forest (41)	50
				Evergreen Forest (42)	50
				Mixed Forest (43)	50
				Perennial Snow/Ice (12)	10
				Open Water (11)	0
				Woody Wetlands (90)	0
				Emergent Herbaceous Wetlands (95)	0
	Land/Water Mask	**1**	**1**	Land	100
				Water	0
Infrastructure and Engineering	**Distance to Transmission Line**	**3**	**3**	0–0.15 mi	100
				0.15–0.5 mi	100
				0.5–1 mi	100
				1–5 mi	100
				5–10 mi	75
				Over 10 mi	50
	Distance to Major Road	**3**	**3**	0–0.15 mi	100
				0.15–0.5 mi	100
				0.5–1.0 mi	100
				1.0–5.0 mi	70
				5.0–10.0 mi	40
				Over 10.0 mi	40
		2	**2**	0–0.15 mi	100
				0.15–0.5 mi	100

	Distance to Navigable Waterway			0.5–1 mi	100
				1–5 mi	80
				5–10 mi	75
				Over 10 mi	60
	Distance to Railroad	**2**	**2**	0–0.15 mi	100
				0.15–0.5 mi	100
				0.5–1.0 mi	100
				1.0–5.0 mi	90
				5.0–10.0 mi	75
				Over 10.0 mi	60
	Distance to Airport	**1**	**1**	0–1 mi	0
				1–2 mi	0
				3–4 mi	0
				5–10 mi	0
				10–15 mi	100
				15–20 mi	100
				20+ mi	100
	Surface Water Flow (≥50,000 gpm)	**3**	**1**	0–0.15 mi	100
				0.15–0.5 mi	100
				0.5–1.0 mi	100
				1.0–5.0 mi	100
				5.0–10.0 mi	100
				Over 10.0 mi	30

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