

Strengthening the Domestic Nuclear Supply Chain Through State-Level Action

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Abstract:

The accelerating demand for reliable, clean baseload power in the United States, driven by population growth, electrification, and the rapid expansion of energy-intensive industries such as artificial intelligence and advanced manufacturing, has renewed policy interest in Small Modular Reactors (SMRs) as a scalable and flexible nuclear energy solution. Despite their technological promise, SMR deployment remains constrained by capital intensity, regulatory complexity, and fragmented supply chain infrastructure. This playbook presents a five-part state-level policy framework designed to address these barriers by drawing on lessons from analogous industries that have achieved rapid domestic growth under comparable conditions, including liquefied natural gas, geothermal energy, semiconductors, solar, and wind. The framework organizes actionable policy levers across five categories: financial incentives, regulatory and permitting structures, physical infrastructure and supply chain support, governance and economic agreements, and public education and community engagement. Each lever is grounded in documented best practices from analogous sectors and is designed to be adapted by state policymakers seeking to cultivate nuclear-friendly energy ecosystems. An accompanying policy rolodex consolidates over 120 policies and case examples to support comparative analysis across states. Together, these resources offer a structured, evidence-informed approach to accelerating SMR deployment, strengthening domestic nuclear supply chains, and positioning the United States as a global leader in advanced nuclear energy.

Research Question:

What state-level policy levers have proven effective in strengthening energy business ecosystems that can be adapted to the nuclear sector?

Summary:

This five-part policy framework is a tool to help states accelerate the widespread deployment of SMRs across the United States. Using analogous industries as a roadmap can provide insights into how state nuclear policy can support SMR development, strengthen the domestic supply chain, and enable a reliable, clean-energy infrastructure transition.

How to Use This Dashboard:

This dashboard is an interactive tool for X-energy's business development and policy teams to evaluate state-level nuclear engagement opportunities.

The dashboard has two primary views. Map View shows policy activity by state, with darker shading indicating states with more policy activity in the dataset. Clicking a state displays its associated policies and updates the surrounding summary information. Policy Lever View organizes policies by the five lever categories and works best when users want to compare how peer states are approaching a single category, such as financial incentives or regulatory and permitting structures.

The filters narrow the dataset in three ways. The state filter limits results to a single target state. The sector filter narrows the policies to a comparable industry, such as geothermal, LNG, semiconductors, solar, or wind. The filter type narrows the list to a specific policy mechanism within a lever, such as tax credits, intergovernmental coordination, or site development. Used

together, these filters let a user move from a national scan to a short list of relevant policies for a specific briefing.

Status lights help users gauge how established a policy approach appears across the examples collected in this project. Green indicates a proven approach with evidence of implementation and a clear track record in analogous sectors. Yellow indicates an emerging approach with promising use cases but a smaller base of demonstrated results. Red indicates a limited or still-untested approach, where the policy signal exists but evidence of sustained performance remains thin.

The Top Examples star flags the policies our team identified as the highest-priority examples for each lever. These starred entries are the best place to start when preparing a first briefing because they highlight the strongest, most transferable models in the dataset.

The Policy Rolodex is the underlying database for the dashboard and includes the full set of 120-plus policies and examples reviewed for this project. It can be filtered the same way as the dashboard and should be used when a user needs the full policy description, result, and relevance for nuclear adaptation.

Using the Playbook in Practice:

Consider an X-energy business development lead preparing for a meeting with a governor's office in a target state. In a few minutes, the lead can open the dashboard, filter Map View to the state, and see how active the state is across the five policy levers. From there, the lead can switch to Policy Lever View and review the starred Top Examples in Financial Incentives and Regulatory and Permitting Structures, which are often the most immediate areas of state action. The lead can then open the Policy Rolodex, pull two or three peer-state examples the state could realistically adapt, and enter the meeting with a concise, defensible view of where the state stands, which gaps matter most, and which policy options should be discussed first.

Explanation of Findings:

Overall Framework

The proposed framework highlights five analogous industries that have had promising, rapid development in the United States over the last 10-20 years¹. By highlighting these industries, state-specific nuclear sectors can analyze successful industries in their region and use them as a foundation for new nuclear-friendly policies.

After determining the analogous industries, five state-level policy categories were established after thoughtful research. These include:

- Financial Incentives
- Regulatory and Permitting Structures
- Physical Infrastructure and Supply Chain Support
- Public Education and Community Engagement
- Governance and Economic Agreements

¹ Carley, S., & Konisky, D. M. (2020). The justice and equity implications of the clean energy transition. *Nature Energy*, 5, 569-577.

The Five Policy Levers:

By consolidating extensive research and interview data from industry professionals, five policy levers emerged as pivotal to the research question. This is a component of the framework established to assist in nuclear supply chain security in the United States.

Financial Incentives

Nuclear is highly capital-intensive, making financing a primary barrier to deployment. State-level financial incentives are tools that directly target this barrier by lowering the effective cost of capital and risk².

The financial incentives analyzed in this project were organized into five subcategories: **Direct Grants and Appropriations, Tax Credits and Exemptions, Low-Interest Loans and Loan Guarantees, Cost-Recovery and Revenue Support Mechanisms, and Cluster and Supply-Chain Development Programs.**

States that have offset early risk for investors in other advanced manufacturing industries utilizing these incentives have proven that industry will come when the policy environment is favorable. Effective financial incentives can create a bankable project pathway, de-risk first-of-a-kind and early projects, signal long-term state commitment, and lower costs for customers in the long-run³.

Regulatory and Permitting Structures

State-level regulations and approval processes shape how quickly, clearly, and predictably major energy projects move from proposal to operation. This includes policies that affect siting, licensing, interagency coordination, environmental review, and related approvals that either ease or expedite deployment.

Within this policy lever, there are five subcategories: **Siting and Site Readiness, Permitting Coordination and Process Streamlining, Licensing Pathways and Regulatory Certainty, Fuel-Cycle and Supply Chain Enablement, and Market Signaling and Pre-Development Risk Reduction.** Regulatory and permitting structures matter because they reduce delays, clarify responsibilities, and create certainty for developers making long-term investments. States that align permitting, site readiness, and coordination do a better job of attracting large energy projects⁴.

Physical Infrastructure and Supply Chain Support

State actions that build or coordinate the physical infrastructure and industrial capacity needed to support energy projects and their supply chains, such as transmission networks, industrial sites, logistics systems, and manufacturing facilities⁵.

² OECD Nuclear Energy Agency. (2022). *The financing of nuclear power plants: Minimising the cost of capital by optimising risk management*. OECD Nuclear Energy Agency. [Organization for Economic Co-Operation and Development Report Hyperlink](#).

³ International Energy Agency. (2021). *Net zero by 2050: A roadmap for the global energy sector*. International Energy Agency. [International Energy Agency Report Hyperlink](#).

⁴ Rephann, T. J. (2022). State economic impacts of industrial park development: Evidence from Virginia's Tobacco Region Megasite Program. *Review of Regional Studies*, 52(2), 249-273. <https://doi.org/10.52324/001c.37971>

⁵ U.S. Department of Energy. (2024). *2021–2024 Four-Year Review of Supply Chains for the Energy Sector Industrial Base*. [Department of Energy Report Hyperlink](#).

Within this policy lever, there are three subcategories: **Grid and Transmission Infrastructure, Industrial Site Development, and Supply Chain and Industrial Capacity.** Physical infrastructure and supply chain support matter because they eliminate non-regulatory deployment barriers, reduce early-stage cost and risk, and signal supply chain and market readiness. States that invest in infrastructure absorb upfront costs that would otherwise fall to developers, thereby enabling industrial clustering and shortening the time to deployment by preparing shovel-ready sites.

Public Education and Community Engagement

Public education and community engagement are key levers to the longevity of nuclear deployment. Having the support of the population while investing in future career pathways will yield long-term benefits⁶.

Themes across this lever include: **Early Nuclear Literacy, Teacher and Student Energy Education Networks, and Advanced Technology and Nuclear-Adjacent Workforce Programs.** Creating intentional education and community engagement plans has not been a focal point for many of the industries. However, making this change for nuclear could assist with rapid deployment and supply chain sovereignty through educating the public on the need for this technology.

Governance and Economic Agreements

Governance and Economic Agreements are processes for decision-making and coordination among stakeholders that implement policies, facilitate alignment, bolster supply chain resilience, and advance SMR deployment. This is the domain where government and industry converge, translating policy intent into coordinated, actionable projects.

Five major types of mechanisms have been identified: **Intergovernmental Coordination, Institutional Governance, Market Aggregation** initiatives, **Risk-sharing and Finance** structures, and **Commercialization and Deployment** agreements. These arrangements enable stakeholders across sectors to collectively address challenges by eliminating silos that lead to fragmented regulatory and market environments⁷. They define how authority is distributed, how decisions are made, and how strategies move from planning to implementation. Together, they play a central role in determining whether SMR projects are successfully deployed by minimizing risk, generating demand, and attracting investment⁸. Tracking this type of activity helps identify where government priorities and market opportunities intersect, allowing for strategic engagement with decision-makers and positioning firms to secure future deployment opportunities⁹.

⁶ *K-2 Nuclear Energy Workshops*. Tennessee STEM Innovation Network. [TN STEM Innovation Network Hyperlink](#)

⁷ Prats, J., et al. (2019). *The Governance of Public-Private Partnerships: A Comparative Analysis*. Inter-American Development Bank. [The Governance of Public-Private Partnerships Report Hyperlink](#).

⁸ OECD Nuclear Energy Agency. (2020). *Small Modular Reactors: Challenges and Opportunities*. [Organization for Economic Co-Operation and Development Report Hyperlink](#).

⁹ National Association of State Energy Officials. (2025). *Advanced Nuclear First Mover Initiative Orderbook Strategy: Request for Information Responses Summary*. [NASEO Report Hyperlink](#).

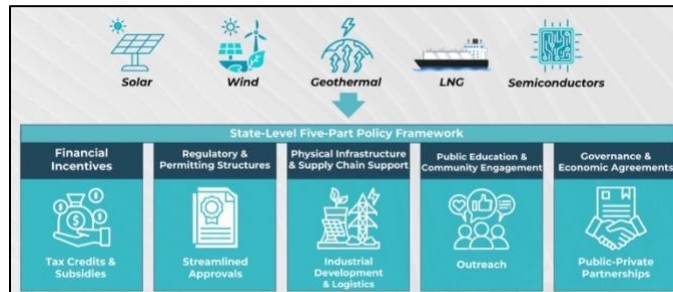
Background and Research Context:

This policy research project examines the research question: *What state-level policy levers have proven effective in strengthening energy business ecosystems that can be adapted to the nuclear sector?* The question is timely because U.S. electricity demand is expected to rise in the coming decades, driven by population growth, electrification, data centers, artificial intelligence, and advanced manufacturing¹⁰. As demand grows, states will face increasing pressure to support reliable, scalable power sources that strengthen grid stability and economic competitiveness¹¹.

Advanced nuclear, especially small modular reactors (SMRs), offer one possible response to this challenge, but deployment in the United States remains limited by high capital costs, regulatory complexity, supply chain constraints, and market uncertainty¹². Because states shape permitting, incentives, infrastructure, workforce systems, and the broader investment climate, they play an important role in determining where projects move from concept to deployment¹³.

To develop this framework, the project draws on five analogous sectors that have experienced strong growth in the United States and offer useful lessons for nuclear: liquefied natural gas, geothermal, semiconductors, solar, and wind. Although these sectors differ in technology and market structure, each scaled through some combination of capital investment, infrastructure buildout, regulatory coordination, workforce preparation, and long-term policy support. Taken together, they provide a practical foundation for identifying the state-level policy levers most likely to support nuclear-friendly energy ecosystems.

Analysis and Recommendation: *What state-level policy levers have proven effective in strengthening energy business ecosystems that can be adapted to the nuclear sector?*



Based on our research, X-energy should adopt this five-part framework as a practical playbook for state engagement in advanced nuclear deployment and supply chain growth. To assist with this, we have consolidated over 120 policies and best practices for each policy lever across all analogous industries in our policy rolodex.

¹⁰ International Energy Agency. (2025, April 10). *AI is set to drive surging electricity demand from data centres while offering the potential to transform how the energy sector works*. [International Energy Agency Report Hyperlink](#).

¹¹ National Association of State Energy Officials. (n.d.). *Powering up the U.S. economy: How state energy offices and economic development organizations advance energy-based economic development*. [National Association of State Energy Officials Report Hyperlink](#).

¹² U.S. Department of Energy. (2024, September). *Pathways to commercial liftoff: Advanced nuclear*. [Department of Energy Report Hyperlink](#).

¹³ Ibid - see *Citation No. 11*

More than a reference tool, this Policy Rolodex gives X-energy a practical roadmap for translating peer-state successes into targeted state engagement, helping the company identify where conditions are strongest for deployment and which policy actions are most likely to move projects forward.

Appendix: Analogous Sector Case Studies:

Five sectors were identified through conversations with the client and extensive policy research. These industries have shown promise for rapid, successful development, including securing their respective supply chains¹⁴. By focusing on these industries, nuclear can gain more clarity on the policy landscape in the United States and best practices moving forward.

Liquefied Natural Gas (LNG)

With another energy crisis looming in the early 2000s, fracking technology and the subsequent shale revolution saved the United States from a significant national security risk: its heavy reliance on foreign alliances for its LNG¹⁵. Since then, the United States has become the world's largest LNG exporter, strengthening our energy security and financial health. This was achieved through the rapid development of LNG terminals, the mapping of ideal siting locations, and policy mechanisms¹⁶.

LNG's success story in the United States can serve as a useful model for the nuclear industry. Through combining previously tested horizontal drilling technology with fracking fluid, energy security became a reality¹⁷. By extension, SMRs could bring similar security to the nation.

Geothermal

Geothermal energy, like nuclear, provides reliable baseload power but has historically been limited in the United States by high upfront development costs, uncertainty in identifying resources, and complex permitting across multiple levels of government. Despite these constraints, recent advances in enhanced geothermal systems (EGS) and drilling technology have expanded their potential beyond traditionally favorable regions. As a result, states such as Nevada and California have begun to reemphasize geothermal as part of their long-term clean energy strategies, signaling renewed confidence in its scalability.

The growth of geothermal highlights the importance of reducing early-stage risk and creating more predictable pathways for private investment¹⁸. State-supported exploration efforts, public-private partnerships, and more coordinated permitting processes have helped move projects forward that

¹⁴ International Energy Agency. (2025). *United States*. In *World energy investment 2025*. International Energy Agency. [International Energy Agency Analysis Hyperlink](#).

¹⁵ U.S. Energy Information Administration. (2014, August 2). *Global natural gas markets overview: A report prepared by the U.S. Energy Information Administration*. [Energy Information Administration Overview Hyperlink](#).

¹⁶ Federal Energy Regulatory Commission. (2026, April 14). *U.S. LNG export terminals: Existing, approved not yet built, and proposed*. [Federal Energy Regulatory Commission Report Hyperlink](#).

¹⁷ U.S. Department of Energy, Office of Nuclear Energy. (2026). *Advantages and challenges of nuclear energy*. [Department of Energy Report Hyperlink](#).

¹⁸ U.S. Department of Energy. (n.d.). *Office of Geothermal*. U.S. Department of Energy. [Department of Energy Report Hyperlink](#).

would otherwise stall due to uncertainty and capital intensity¹⁹. For nuclear, particularly SMRs, these developments offer a clear parallel: states can accelerate deployment by de-risking early site development, improving coordination across regulatory bodies, and creating clearer, more predictable approval structures that allow projects to reach final investment decisions more quickly²⁰.

Semiconductors

Semiconductors are foundational to current federal AI policy priorities. With nearly 50 percent of all semiconductors globally produced in Taiwan, geopolitical conflicts that threaten the supply chain pose a national security risk.²¹ This threat was highlighted during the COVID-19 pandemic and remains a weak link in the United States' technology pipeline. The nuclear industry faces similar supply chain risks due to regional monopolies in specific nuclear-grade materials and specialized manufacturing capabilities.

Analyzing the trajectory and development of the domestic semiconductor industry from 2020 to the present will enable nuclear companies to observe how state government mechanisms can support rapid development. Many state matching funds were created in response to the landmark federal CHIPS and Science Act. Although semiconductors do not fall within the energy sector, they are a proven example of how advanced manufacturing industries can rapidly establish a domestic industrial base, which can serve as an optimal example for nuclear deployment.

Solar

China and other solar companies have proven that rapid and widespread development can lower overall costs through large-scale production, supply chain optimization, and a reduction in the technology's learning curve. Their ability to prioritize deploying this technology demonstrates that it can be replicated with nuclear if the United States takes similarly aggressive action.

Currently, a major challenge for American solar deployment lies with the critical mineral supply chain, as China refines roughly 95 percent of these minerals.²² Similar to nuclear, the United States is heavily dependent on foreign markets and relations to secure the materials needed for photovoltaics (PV) and related solar technologies. By learning from the solar industry, the nuclear industry can effectively map the future of nuclear deployment if the United States fails to secure its supply chain, and vice versa. If supply chain challenges are mitigated, the United States could become known as the global nuclear powerhouse.

Wind

Harnessing wind as a power source is not a new technology; however, recent developments have made it increasingly attractive to private citizens, governments, businesses, and organizations. Higher-elevation or offshore turbines generate more electricity and may offer potential financial

¹⁹ Ibid - See *Citation No. 18*

²⁰ U.S. Department of Energy. (2016, May). *Vision and strategy for the development and deployment of advanced reactors*. U.S. Department of Energy. [Department of Energy Report Hyperlink](#).

²¹ United States Department of Commerce. (2025). *Taiwan Country Commercial Guide*. International Trade Association. [Department of Commerce Guide Hyperlink](#).

²² McCollum, K. (2026). *How China Dominates the World's Critical Mineral Production*. RealClear Defense. [Real Clear Defense Article Hyperlink](#).

incentives for users. By evaluating wind deployment strategies, the nuclear sector can better understand the tradeoffs that have driven wind's popularity in rural areas.

The financial incentives that wind offers can provide meaningful income for landowners and communities. Additional benefits may include increased transmission and distribution lines, thus strengthening their overall grid. Prioritizing communities near SMRs can help the nuclear industry strengthen local support for its technology.

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General Citations:

Webber, Michael; Glazer, Yael. *Energy 101 - Energy Technology and Policy*. The University of Texas at Austin.