2023

FISSION FOR THE FUTURE

Ensuring American primacy in new nuclear for geopolitical, climate, and economic security

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Energy and Environment

“The United States pledges its determination to help solve the fearful atomic dilemma - to devote its entire heart and mind to finding the way by which the miraculous inventiveness of man shall not be dedicated to his death, but consecrated to his life.”

President Dwight D. Eisenhower

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Executive Summary

Nuclear power represents a bedrock of global electricity systems, producing stable, clean baseload electricity at long-lived plants worldwide. Successive U.S. Administrations have made a comprehensive shift to promote the importance and maintenance of U.S.-made nuclear technology, seeking to counter Russian and Chinese influence in this space.

In the coming decades, Small Modular Reactor (SMR) technology will play a distinct role in the landscape of nuclear energy and policy. The modularity of SMRs allows them to address many concerns centered around cost, geographical placement, construction time, and sourcing concerns. This will place SMRs squarely as a geopolitically competitive technology that will be used to address growing energy security needs in a low-carbon world. With energy mixes changing, SMRs provide the foundation for countries to pursue a pathway to modular, clean, and stable energy sources. Additionally, the likely benefits of nuclear energy expansion include domestic and international job growth, nuclear education expansion, and meeting emissions reduction goals.

Given the immense financial requirements and concerns about security and safety, nuclear energy projects are oftentimes intertwined with wider government affairs. Even with the future expected viability of SMRs and the American desire to prioritize nuclear collaborations, there are several challenges and opportunities for SMRs on the fronts of regulation, financing, technology, and policy. These challenges inhibit the progression of nuclear projects and create a paradox. SMRs are financially and politically difficult to implement. However, as more projects exist and create track records of success, these difficulties may be alleviated. Economically smaller countries find it difficult to justify the large expenditures needed for nuclear projects. This concern also affects larger countries that have no state-owned nuclear enterprise. As such, SMR projects will require various foreign and domestic governmental tools and mechanisms and collaboration with private-sector entities to advance a reactor from “paper” form to its actual construction and commissioning.

We conducted a country-specific case study and, after narrowing down countries based on geopolitical and economic criteria, we chose the Czech Republic. In this relationship, the Czech Republic would be the recipient of SMRs developed in the U.S. From October 2022 to May 2023, we conducted over 30 informational interviews with government and private entities across the U.S. and the Czech Republic to understand the obstacles and possibilities for regulation, financing, technology, and policy in the U.S. SMR collaboration. The recommendations outlined in this report aim to interconnect vital segments of government and commercial entities in both countries to facilitate faster and more effective SMR deployment.

Recommendations to U.S. Policymakers

- ***Congress should pass, and the President should sign, the following bipartisan pieces of legislation before the end of 2023:***
    - *International Nuclear Energy Act*
    - *Accelerating Deployment of Versatile, Advanced Nuclear for Clean Energy (ADVANCE) Act*
    - *Nuclear Fuel Security Act*

- ***Building on the proposed ADVANCE Act, Congress should direct the NRC to adopt more ambitious targets for project approval.***
    - Those project approval timelines should come with an upper ceiling on the NRC accomplishing the approval. Furthermore, the targets that the NRC sets for itself should be required to be revised upon passage of the ADVANCE Act, as the current Sec. 503 of the proposed legislation is ambiguous: "*Not less frequently than once every 3 years, the Commission shall review and assess performance metrics*". This ambiguity means the NRC could wait until 2026 before commencing a review of performance metric assessments, a needless delay. The legislation should be changed to read: "***Not later than 1 year after the enactment of this Act****, and thereafter, not less frequently than once every 3 years, the Commission shall review and assess performance metrics"*.

- ***The Biden Administration should prioritize ensuring effective future governance of the NRC as soon as possible.***
    - The upcoming vacancies on the NRC of Commissioner Baran (June 30, 2023) and Chairman Hanson (June 30, 2024) should be filled by the Senate before their expiry to ensure the NRC can function at full capacity.

- ***Congress should direct the NRC to work with European allies to align and accelerate SMR approval pathways.***

- ***Brownfields should be prioritized for redevelopment to potential nuclear generation.***

    - As identified in Sec. 206 of the *ADVANCE Act*, brownfields should be a priority for examination by the NRC to address potential regulatory roadblocks to redevelopment. Addressing these barriers will help to redevelop retired or retiring fossil fuel generation sites, so increasing employment opportunities and clean energy sources.

- ***Congress should help to remove key barriers to finance international nuclear energy projects.***

    - Congress should approve the Department of Energy Loans Program Office to provide forgivable loans to utilities.
    - The United States Senate Committee on Banking, Housing, and Urban Affairs should provide more incentives that enable the U.S. International Development Finance Corporation and the Export–Import Bank of the United States to provide stronger financial assistance for nuclear projects.

- ***A single authoritative entity should lead American nuclear export efforts to clarify for countries seeking U.S. SMRs and to eliminate bureaucratic delays.***

    - The *International Nuclear Energy Act* addresses this issue by requiring U.S. Presidents to create an "Office of the Assistant to the President and Director for International Nuclear Energy Policy", housed in the Executive Office of the

President. Centralization of this role can allow for clearer strategic decision-making across Departments and policy strategies and will endow the position with the political will and weight required to drive change within the system.

- ***Services offered by Project Phoenix need to be clarified and expanded.***

    - Eastern and Central European countries are interested in the U.S.'s support to convert their coal-fuel power plant sites to SMR plants. However, the details regarding the services and tools offered by Project Phoenix, a State Department initiative launched through the Foundational Infrastructure for Responsible Use of Small Modular Reactor Technology (FIRST) Program, are unclear and lacking.

Recommendations to Czech Policymakers

- ***The Czech Republic should seek high-level authoritative support to engage with the U.S. on the Czech Republic's SMR interest.***
    - Although there has been recognized support from the Czech parliament and their president, it is the Prime Minister of the Czech Republic who makes the final decision in regard to high-level nuclear collaborations and their eventual commissioning.

- ***The EU Commission needs to take a stronger lead in helping resolve EU member energy project siting disputes and creating EU regulatory harmonization.***

    - As a result of the blocking of large nuclear reactor builds by Germany and Austria through the utilization of existing regulatory levers, Czech nuclear projects are in danger of reaching an apex before being obstructed and, in some cases, completely halted by German and Austrian intervention.
    - The EU Commission must engage member countries to discuss a single SMR regulatory harmonization pathway while ensuring members are free to enact their national energy policies without interference by bloc members.

- ***While private sectors in both the Czech Republic and the U.S. should remain optimistic about global frameworks for regulatory approval, it should not be a determining factor in SMR partnerships.***

    - Czech and U.S. private sector deployment timelines for SMRs are earlier than the currently projected timelines for regulatory harmonization projects occurring within the International Atomic Energy Agency (IAEA). International SMR deployment will not wait for regulatory harmonization.

- The IAEA, through the Nuclear Harmonization and Standardization Initiative, should accelerate the establishment of a harmonized framework to reduce permitting, siting, and licensing timeframes. For instance, approvals for SMRs in the Czech Republic can take up to 13 years, or 8-10 years in the best-case scenario. This process involves site evaluations, environmental assessments, and other local processes.

- ***The Czech Republic government should focus on developing pathways to garner additional support and break the taboo of "Not in my backyard."***

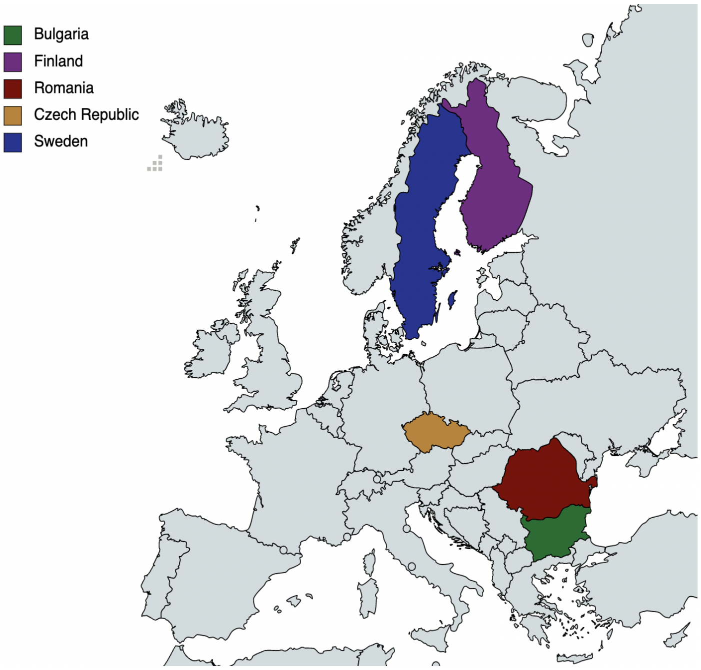
  - 72% of people in the Czech Republic support the switch to nuclear, which is the highest since 1990. However, the population is still wary of having a nuclear power plant close to their commercial or private residence. This could be achieved by rewarding cooperation and raising awareness about SMR development.

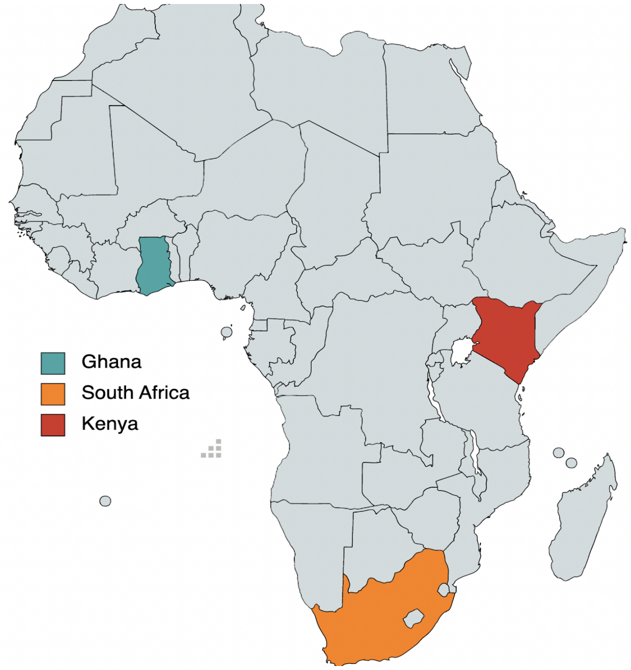
Initial Analysis

Our research focuses on how to promote the export of American SMRs using domestic supply chains to promising recipient countries to align with their energy security and emissions reduction targets. Thus, a major focus of our initial research was identifying ideal countries to receive the units. Because our project involves exporting American-developed SMRs, selecting recipient countries depends on United States geopolitics, specifically the intent to compete with the nuclear influence of China and Russia. To export nuclear technology (and so SMRs), the United States requires recipient countries to have a signed 123 Agreement. These Agreements require countries receiving nuclear material and equipment from the United States to engage in non-proliferation, which ensures the safe usage of exported nuclear materials.[1] It is legally required for American nuclear partnerships to have 123 Agreements in place. As the U.S. sets 123 Agreements with additional countries, we focused on countries with positive American relations as well as a high geopolitical significance to the United States.

With that broad list of countries, we began identifying additional criteria. These criteria included a minimum population of two million people, a national GDP of at least $200 million, countries with publicly stated emission reduction goals such as net zero, and an analysis of country grid capacities. We also eliminated countries that posed potential American national security concerns. For the report, we additionally foresaw the importance of selecting a country with pre-existing nuclear interest and a degree of the technical nuclear workforce to ensure feasibility. After this process, we were left with eight countries as ideal recipient countries for the U.S. SMRs. In no particular order, these were: Bulgaria, South Africa, Finland, Kenya, Romania, Ghana, Sweden, and the Czech Republic.

[1] U.S. Department of Energy. “123 Agreements for Peaceful Cooperation." https://www.energy.gov/nnsa/123-agreements-peaceful-cooperation





We considered the main pillars of the report as we engaged with different countries: U.S. perspectives on geopolitics, the feasibility of the country to implement significant commercial nuclear action, the quality of the ongoing relationship with the U.S. government and private sector, and finally as stated above, clean energy necessity.

The landscape of the Czech Republic fulfilled all our needs for the framework of this report. The Czechs are at the front of geopolitical confrontations with both Russia and China as well as having a deep relationship with the U.S. formed as a NATO partner. They also have pre-existing nuclear capacity, high levels of private-sector participation in energy matters, and unmet energy security needs. Therefore, we felt the Czech Republic was the perfect opportunity to model a case study.

1. ***Pre-Existing Nuclear Familiarity:*** The Czech Republic currently uses nuclear energy domestically, with two reactors producing about 30% of all Czech electricity.[2] Nuclear energy requires a large degree of education and training and knowledge

[2] World Nuclear. "Nuclear Power in Czech Republic." *World Nuclear*, https://world-nuclear.org/information-library/country-profiles/countries-a-f/czech-republic.aspx

management to maintain a labor force equipped to operate reactors and approve regulatory components for safe and secure operation. Without this human capital, we felt it would be a more difficult lift (though not impossible) to import a nuclear project. This especially applies in the case of SMRs where countries with existing nuclear plants are attempting to find the best path for regulation, construction, and operation.

2. ***Geopolitical Significance:*** As Czechoslovakia (succeeded by the Czech Republic) was a member of the former Warsaw Pact, the Czech reactors today are aging Soviet models. With the Russian invasion of Ukraine, the Czechs disallowed the Russians from bidding for new reactors, and have also disallowed the Chinese for national security reasons. Imports of American SMRs have strategic interests on both sides and could help to counter subversive Russian influence. With many European countries intending to distance themselves from Russian energy influence following the Russian invasion of Ukraine, there is an exceptional opportunity for American SMRs to strengthen strategic independence from Russia.

3. ***Relationship with the United States:*** The Czech Republic currently has a 123 Agreement with the U.S. government permitting collaboration between the U.S. and the Czech Republic. In addition, the Czech Republic is currently in the exploratory stages of an SMR nuclear collaboration with the U.S.

4. ***Private Sector Engagement:*** The Czech Republic has been facilitating engagement with private-sector entities on SMR technology. In 2019, they signed a Memorandum of Understanding with NuScale to explore its SMR reactor technology applied in the Czech Republic. In addition, they also have been in discussions with Holtec International for potential SMR designs. Given the private sector engagement, facilitating SMR presents demonstrated early progress. However, it also presents a risk for the interest to not turn into actual concerted action.

5. ***Energy Security and Emissions Reductions:*** The Czech Republic, like many EU members, faces increasing pressure to prioritize clean energy needs. With legislation

passed at the EU level such as *Fit for55* and *RePower EU,* which place strict emissions reductions into legislation, the Czech Republic is looking to meet wider EU clean energy goals while also meeting energy security needs within their own country. SMRs are a viable option given the general energy landscape of the Czech Republic to fulfill their growing low-carbon emitting energy needs.

With these criteria in mind, we felt that the Czech Republic was the perfect stage to create a roadmap for other countries in facilitating collaboration with the U.S. on SMR technology. Given the landscape of pre-existing nuclear knowledge and expressed interest in nuclear collaboration with the U.S., it is important to examine what obstacles arise and inhibit the execution of action on SMR projects. Therefore, this report aims to focus on the Czech Republic as a case study for how to facilitate nuclear collaboration with the U.S., particularly the integration of SMR technologies, from start to finish.

U.S. SMR Technology

One of the key challenges facing the deployment of SMRs is technology development. Unlike traditional nuclear reactors, which have been in operation for several decades, SMRs are relatively unproven technology. As such, they face several technological challenges, including the development of advanced fuels, the intent to mass manufacture, and the design of safety and security mechanisms.

The United States has a competitive advantage in leading the charge for SMR technologies and their respective standards due in part to their market economy and U.S. governmental support. At this point in time, the U.S. Trade and Development Agency has provided grant funding for three projects in front-end engineering and design.[3]

Several American companies are working towards developing light-water reactor designs, the most common type of nuclear reactor around the world. These light-water designs will likely be the first to be approved for licensing and build due to the familiarity regulators and consumers will have with such designs. Most manufacturers that are expected to build light-water SMRs will use low-enriched uranium, which is comparable to current deployed nuclear reactors.[4]

When exploring the safety and security aspects of SMRs, a challenge faced by SMR developers and future consumers is nonproliferation. Specifically, it is vital that refueling cycles can be extended for longer periods of time and done so in a safe and secure manner.

SMRs are an attractive option for communities in need of clean energy. With the launch of Project Phoenix through the Foundational Infrastructure for Responsible Use of Small Modular Reactor Technology (FIRST) Program, the U.S. will be able to support countries in the Central and Eastern regions of Europe to convert coal-fuel power plant sites to SMR

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[3] U.S.TDA, (2023, April 30). https://www.ustda.gov/?s=smr
[4] Department of Energy, Office of Nuclear Energy, (2023, April 30). https://www.energy.gov/ne/benefits-small-modular-reactors-smrs

plants.[5] In the case of the Czech Republic, their state-owned power utility ČEZ has identified six coal-fuel power plant sites that they would like to convert into SMR plants.[6] However, the U.S. State Department should clarify the exact capacity-building tools and mechanisms they will deploy to ensure the successful implementation of these projects. Additionally, Project Phoenix should pull together additional financial resources to help alleviate the financial burden that Central and Eastern European countries currently face in nuclear development projects.

[5] U.S. Department of State, Bureau of International Security and Nonproliferation, (2022, November 12) https://www.smr-first-program.net/project-phoenix/

[6] ČEZ, (2023 February 27). https://www.cez.cz/en/media/press-releases/after-preliminary-assessment-cez-has-identified-two-preferred-construction-sites-for-small-modular-reactors-in-addition-to-the-temelin-pilot-location-in-detmaro-173427/index.shtml

Nuclear Regulation

The U.S. Nuclear Regulatory Commission (NRC) has established itself as the global gold standard for nuclear regulation. Despite this leading role, there is still extreme difficulty surrounding licensing for nuclear reactor projects. Many projects struggle to progress past the point of the lengthy and costly regulatory approval processes.

But, as U.S. sentiments towards nuclear shift both in regard to support from the Biden Administration and public approval, it is clear that this shift has positive momentum as displayed in a recent poll from Gallup.[7] With the passage of the *Inflation Reduction Act*, Congress, the White House, and U.S. agencies have been making concerted efforts to secure a low-carbon future. The $150 million of funding devoted to the U.S. Department of Energy's Office of Nuclear Energy, alongside proposed legislation like the *International Nuclear Energy Act* are indicators of a new American priority to accelerate the global deployment of particularly advanced reactor projects[8]. This priority must translate to the NRC and the regulatory processes they implement.

Licensing for SMRs needs regulatory policy tools to ensure that SMRs do not encounter the same challenges that larger reactors have in the past. To be commercially viable, SMRs must get through the regulatory process to demonstrate a proof-of-concept. The proof-of-concept, in turn, supports the development of financial tools and investment to facilitate SMRs beyond first-of-a-kind designs[9]. This is a necessary step toward the full deployment of SMR technology domestically and abroad. With this in mind, Congress has been applying pressure

[7] Brenan, Megan. "American's Support for Nuclear Energy in a Decade." *Gallup*, 15 Apr. 2023, https://news.gallup.com/poll/474650/americans-support-nuclear-energy-highest-decade.aspx

[8] Department of Energy . "Biden-Harris Administration Announces $150 Million to Improve Nuclear Research and Development Infrastructure at Idaho National Laboratory." Energy.gov, 25 Oct. 2022, https://www.energy.gov/articles/biden-harris-administration-announces-150-million-improve-nuclear-research-and-development.

[9] Roma, Amy, et al. "Nuclear Innovation and NEPA: Streamlining NRC NEPA Reviews for Advanced Reactor Demonstration Projects While Safeguarding Environmental Protection." Nuclear Innovation Alliance, Sept. 2019, https://www.nuclearinnovationalliance.org/sites/default/files/2019-10/5b05b3_e661eba94a224b28aac2a7e11d60e0c6.pdf.

on the NRC and the White House to accelerate standardization and support for advanced reactor licensing[10].

Congress has specifically indicated that the NRC should accelerate the completion of a Rule called 10 CFR Part 53 (Risk-Informed, Technology-Inclusive Regulatory Framework for Commercial Nuclear Plants). This Rule, which focuses on establishing a regulatory framework for licensing advanced reactor prototypes, is currently scheduled for issuance in July 2025. It could allow American SMR companies to progress past the first-of-a-kind phase to build model reactors, demonstrate proof-of-concept and secure funding for future reactor builds much more quickly and certainly. The NRC must accelerate this Rule from the 2025 completion timeline to assist U.S. efforts abroad. In addition, widespread support for regulatory reform of the *National Environmental Policy Act* indicates a positive future for speedier licensing of nuclear projects in regard to current environmental impact assessments. With Congressional attention on the NRC regulatory processes for advanced reactor licensing and accelerated environmental assessments, there is a clear signal of expectations that the NRC will move in the direction necessary to support facilitated SMR deployment.

Two NRC Commissioners will reach their term limits between now and November 2024, Commissioner Jeff Baran (June 30, 2023) and Chairman Christopher Hanson (June 30, 2024). If the NRC is to function to its fullest ability, the addition of the new chairs would be valuable. If added, we can be confident that nuclear regulation in the United States will progress on a timeline supportive of SMR technology.

[10] Capito, Shelley Moore. "Capito Touts Ania, Presses President Biden to Fill NRC Vacancies: U.S. Senator Shelley Moore Capito of West Virginia." Senator Shelley Capito, 9 Feb. 2022, https://www.capito.senate.gov/news/videos/watch/capito-touts-ania-presses-president-biden-to-fill-nrc-vacancies.

Economic Outlook

While there are political and operational difficulties involving implementing SMRs, a major concern that surfaced throughout our research involves the economics – it's difficult to determine the avenues to finance SMR projects. Currently, there are few government or public sources for funding United States-developed projects. However, these individual funding instances are not available for larger-scale SMR production. Concerns about funding arise for both the public and private sectors.

In order to address the financial difficulties, our team analyzed the economics of SMR projects first to determine if private financing was an option. We created a traditional renewable energy financial model to assess a general debt and equity financing structure for an individual SMR module. The model's results suggest these projects are financially viable investments but even with the economic benefits, many concerns need to be addressed before private organizations invest in SMRs.

To summarize, in terms of financing, private opportunities will be viable in the future, but, at the current moment, the issues concerning risk and a lack of current SMR projects pose too many restrictions to achieving consistent funding. Public sources of funding provide similar risk concerns, but finding consistent sources is difficult - sources exist. Still, the number of projects they've funded is minimal, along with some of the SMR project financial awards being of relatively small amounts.

Economic Model

On paper, SMR projects present economically beneficial options for traditional debt and equity financing. To help illustrate this, we created a traditional renewable energy debt and equity financial model. The main purpose of this model is to show investors that SMR projects are financially viable options. This model utilizes basic assumptions of SMR projects along with publicly available data for clarity. Economic models for future real projects will follow similar structures and logic to our model. Still, they will incorporate much more complexity, including country-specific tax incentives and additional governmental and policy implications. The model also calculates a benefit per SMR module, whereas many fully implemented SMRs will incorporate more modules. Often, plans for new SMRs show around six modules.

Our model uses the data relevant to a 77MW SMR module from NuScale, which has publicly available data pertaining to capital costs.[11] The company has provided a low- and high-end metric for the SMRs capital costs per kW capacity, which is $6,025 to $9,800. For the economic model, we used the capital costs from NuScale and created three scenarios - low-end, average, and high-end. The low end takes the $6,025 per kW cost, the high end takes the $9,800 per kW, and the average takes the mean of the two - $7,912.50 per kW. Our team's primary metric for our analysis is the average scenario. However, we have included all three scenarios in our calculations.

SMR projects are expected to last many years, much longer than 20 years. However, we've decided to use a 20-year project life for our model. One primary concern resulting in our decision involves the potential that some SMR projects, like many renewable energy projects, might be shut down early. In order to project an economic model with the lowest possible risk, we wanted to utilize a project life much smaller than an actual project. Realistically, the IAEA has indicated that SMRs can last 30 years without refueling whereas the lifespan is much longer.

The economic model uses a 5% interest rate for debt and a 9% equity hurdle rate, both of which are traditional metrics for renewable energy financing. For similar reasons, the project's revenues and expenses are increased by 1.5% annually. Last, the model is built to require a minimum debt service coverage ratio (DSCR) of 1.3x in any individual year. For context, any ratio below 1.3x will usually result in financial organizations viewing the project as too risky and refraining from investing. To maintain this 1.3x minimum DSCR in all years,

[11] NuScale. "VOYGR Power Plants." https://www.nuscalepower.com/en/products/voygr-smr-plants

the model calculates a 14-year debt payback, which includes paying the project principal and interest. The first year for the debt payback is the year with the lowest DSCR - it steadily increases throughout the remaining periods. The average DSCR is 1.83x, which is financially attractive to investors. Once the debt is paid off, equity financing covers the remainder of the project costs and upon the 14-year debt payback, the annual project revenue only needs to pay for operating expenses.

Exhibit 1: Economic Model Performance Graph

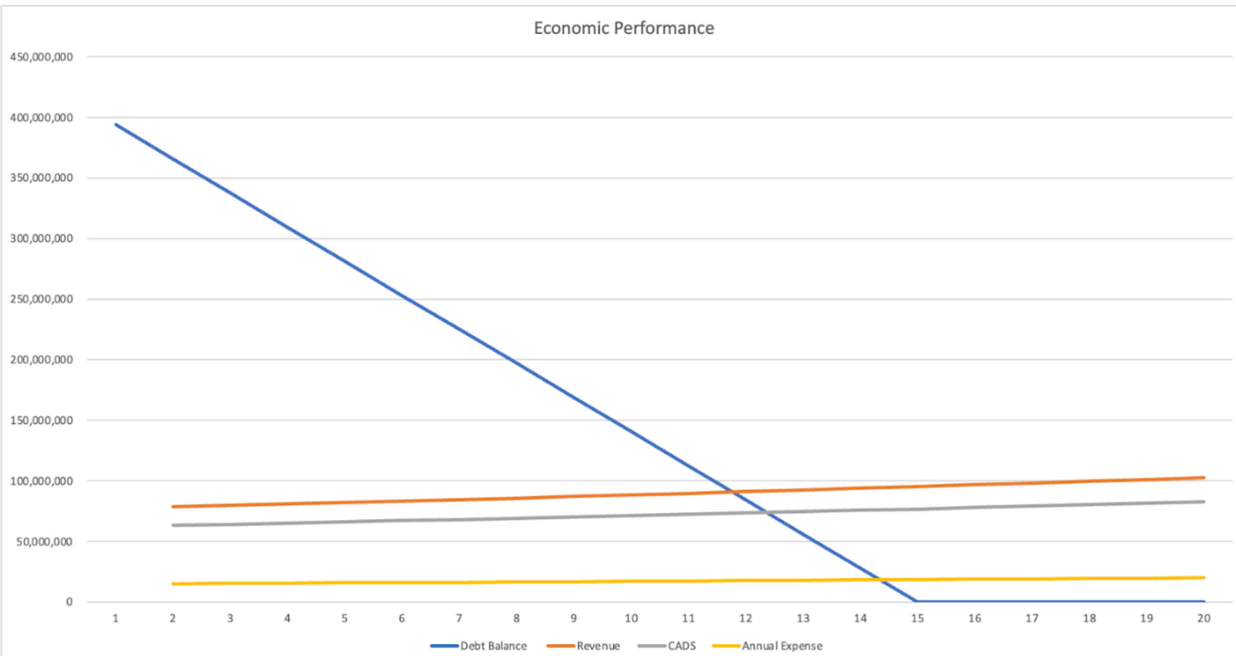

Exhibit 1 provides the summary of the economic performance from an operations and debt payback perspective. The blue line represents the debt balance, fully paid in the first 14 years of operation using a straight-line debt payback process. The annual expense and revenue are escalated at 1.5% annually, resulting in a small annual increase in each line. As a result, the cash available for debt service (CADS), which is the difference between revenue and expense, displays a similar trend.

Exhibit 2: Results of the Economic Model

Case Name	Debt Closing Balance	Average DSCR	Equity IRR	Equity NPV
Low End	$393,801,811	1.83x	31.6%	$244,973,135
Average	$393,801,811	1.83x	13.1%	$99,635,635
High End	$393,801,811	1.83x	7.7%	($45,701,865)

Exhibit 2 shows the overall economic results of the model. These results suggest debt and equity financial organizations would achieve tremendous profits from financing SMR projects. As seen in Exhibit 2, per each of the NuScale 77 MW modules, the average internal rate of return (IRR) for equity is 13.1%, which is higher than their equity hurdle rate of 9%, suggesting the project is very profitable. Additionally, the 20-year net present value (NPV) of equity is roughly $99 million, the approximate 20-year economic benefit. On paper, the average scenario presents an outstanding financial opportunity. In addition, the low-end cost scenario shows a much better investment - the equity IRR is 31.6%, and the equity NPV is about $255 million. However, achieving the low-end cost scenario is much less likely than the average scenario.

The high-end cost scenario presents an issue - the return on equity is negative at an approximately $45 million loss. This loss results in an equity IRR of 7.7%, lower than the 9% hurdle rate. However, it's important to reiterate that the economic model uses a 20-year project life. Since these projects are very likely to last much longer than 20 years, the high-end cost scenario will produce a stronger economic performance in the long run. This stronger economic performance is likely to result in positive returns to equity. For the overall model, the project would be funded by 64.6% debt financing and the remainder of 35.4% by equity financing.

Some limitations to the model's accuracy cannot be avoided. First, since no SMR projects are currently in operation, it's very difficult to calculate any operations costs. These costs represent annual expenses related to operating the SMR project and are essential to economically modeling SMRs. Since these costs aren't publicly available, we gathered the general operations costs of traditional nuclear power plants, which are reported in costs per kW capacity. Next, we gathered the capital costs per kW for traditional nuclear power plants and compared those costs to SMR capital costs. Taking the percentage variance from that comparison, we multiplied that percentage by the operations costs per kW capacity for traditional nuclear power plants, which gave us our final per kW operations expense for SMRs. Since this calculation is an estimated projection of project costs, they are likely to be inaccurate, but it's unclear how inaccurate they are. The second limitation involves the accuracy of the NuScale data. Our economic model relies on NuScale's capacity cost data being accurate. The company publicly reported its capacity costs, but there is limited data to help support or reject their metrics. For our model, we are accepting their metrics as valid. Third, not all countries that intend to import United States-developed SMRs are looking at using NuScale as a producer. Some of our interviews indicated many countries are looking at Westinghouse, GE-Hitachi, and Rolls Royce. If countries use different developers and SMR models, our economic model will likely be inaccurate in representing those projects' results.

Fourth, the model does not integrate economic risk mitigation methodologies based on the performance of the project. Many renewable energy project agreements, such as power purchase agreements, have certain guaranteed metrics to ensure adequate project performance. These can include revenue and general performance guarantees. A performance guarantee, for example, will have a minimum energy production metric that must be achieved - any level of production below that agreed-upon amount will result in a payment, usually a predetermined rate multiplied by the kWh difference between the actual production and the performance guarantee level. Similar to a performance guarantee, a revenue guarantee presents a required minimum revenue for the project. If the metric isn't met, the project financier would be required to pay the difference. Revenue and performance guarantees offer more protections to SMR off-takers and would likely be integrated into any official SMR contract. Though these guaranteed metrics would be difficult to generalize, implying adding this component to the economic model isn't adequate.

Difficulties in Financing SMR Projects

Despite the outlined benefits from the economic model, private sector financing for SMR projects is a difficult opportunity. The first main difficulty involves the viability of the model. Our model benefit and many other economic results are being viewed as "paper results," which means there isn't hard evidence from existing development projects to prove these metrics. Our research has revealed many investors are interested in viewing existing projects to ensure the reliability of the project's energy performance and economic results before investing. This desire from investors keeps many risk-averse investors away from investing in SMR projects.

Another concern involves the general risk and liability of nuclear projects. While nuclear has a very safe track record compared to many large-scale investments, nuclear meltdowns, and catastrophes scare away some investors. On paper, SMRs are relatively safe, but the continuing theme of a lack of existing projects results in investors being risk averse. With investors waiting to see existing projects in operation, action from investors might not occur until an SMR project goes online at the Idaho National Laboratory in 2029.[12]

However, some private sector investment entities aren't excited about the economic benefits portrayed by our model and other organizations' models. These economic models show average scenarios that produce positive returns. Unfortunately, these returns might be too low for some financial entities. For example, from our interviews, we've found venture capital firms are hoping to achieve a 20-30% return on investment for these types of projects. While the low-end cost option of our economic model presents the opportunity for a 31.6% return, venture capital firms are going to accurately assess the investment based on the 13.1% return in the average cost scenario. The 13.1% return will be too low for these firms to invest. It's not

[12] Department of Energy, (2023, January 20). "NRC Certifies First U.S. Small Modular Reactor Design." *Department of Energy*, https://www.energy.gov/ne/articles/nrc-certifies-first-us-small-modular-reactor-design

to say venture capital firms might reduce these expected returns in the future, but, as of now, venture capital firms aren't strong opportunities to obtain SMR funding.

Public sector financing of SMR projects is difficult in the United States but not in China and Russia. Our interviews tangibly demonstrated the financial advantage of China and Russia - their producers are directly state-funded, which means, most of the time, their governments provide 100% of the funding requirements to construct SMRs. According to our interviews, there's some conflict between the United States and the type of financial strategies utilized by China and Russia as they are not following OECD guidelines. Due to this financing dichotomy, the United States, which cannot fully fund these projects with government funding, has difficulties in international competition.

The two entities of the United States government that could be potential financiers of SMR reactor exports are the United States International Development Finance Corporation (DFC) and the Export-Import Bank of the United States (EXIM). In 2020, DFC implemented a change to its definition of renewable energy, which aligns with the United States Energy Information Administration's (EIA) definition.[13] This change is significant because it enables DFC to finance nuclear and SMR projects. Within the announcement, DFC highlighted the potential of SMRs to offer clean, stable energy to developing countries while promoting economic growth and energy access to underserved regions. In addition, in late 2022, a bipartisan congressional letter was sent to DFC to remove limitations on financing civil nuclear projects.[14] With the changed definition of renewable energy and bipartisan support for reducing SMR funding barriers, DFC has the potential to finance SMR projects in the future.

[13] DFC, (2020, June 10). "DFC Begins Public Comment Period on Proposed Change to Nuclear Energy Policy." *DFC*. https://www.dfc.gov/media/press-releases/dfc-begins-public-comment-period-proposed-change-nuclear-energy-policy

[14] Capito. (2022, December 8). "Capito, Colleagues Urge U.S. International Development Finance Corporation to Eliminate Prohibition on Supporting Civil Nuclear Energy Projects. *Capito*. https://www.capito.senate.gov/news/press-releases/capito-colleagues-urge-us-international-development-finance-corporation-to-eliminate-prohibition-on-supporting-civil-nuclear-energy-projects

On the other hand, EXIM is already providing or publicly agreeing to provide funding for specific projects. For example, in late 2022, they offered up to $3 billion for the domestic development of an SMR that would be exported to Romania.[15] Additionally, as of April 2023, there are currently discussions about EXIM providing $4 billion to finance SMR development in Poland.[16] Aside from EXIM and DFC, there are limited public sector financial opportunities for SMRs, but some options exist. For example, in 2020, the Department of Energy approved a cost-share agreement of $1 billion to build an SMR in Utah. Last, Congress has the ability to approve the Department of Energy Loans Program Office to provide forgivable loans to utilities and it's recommended they do so.[17] These forgivable loans will provide more financial security for utilities trying to implement SMR projects.

Aside from the United States government, multilateral international organizations do not provide a whole lot of other options. However, the World Bank currently doesn't fund SMR projects and hasn't indicated its position will change in the future. Other international entities are in conversations with various developers and countries about internationally financing SMR projects. Still, these conversations are relatively introductory, and it's not clear if they will lead to actual funding. As a whole, government and international organizations have funding opportunities available but more could be done.

Outside of difficulties in sourcing funding, the timelines of countries implementing SMRs provided problems for financial modeling and projections. For example, we learned in our interviews that the government red tape for the Czech Republic to fully approve designs, conduct environmental assessments, explore financing, and begin constructing the facilities is, in a best-case scenario, a 13-year process. In those 13 years, financing and technologies are guaranteed to change, which can impact economics in multiple ways. One of these impacts

[15] Todorovic, Igor. (2022, November 11). "U.S. EXIM Bank to Finance Construction of Nuclear Reactors in Romania." *Balkan Green Energy News*. https://balkangreenenergynews.com/us-exim-bank-to-finance-construction-of-nuclear-reactors-in-romania/
[16] Reuters, (2023, April 17). "Polish Small Reactors Project May Get Up to $4B in U.S. Financing." *Reuters*. https://www.reuters.com/business/sustainable-business/polish-small-reactors-project-may-get-up-4-bln-us-financing-2023-04-17/
[17] Department of Energy. "Innovative Clean Energy Loans Guarantees." *Department of Energy*, https://www.energy.gov/lpo/innovative-clean-energy-loan-guarantees

can include current technologies becoming obsolete and requiring new technologies, which can provide multiple financing concerns to newly implemented SMR projects - the capital costs of projects could increase.

Additional concerns involve the volatile economics of energy markets where prices can change drastically - for example, natural gas and general energy prices during the Russian invasion of Ukraine have spiked. Over the span of a decade, energy prices are likely to change, which might destroy economic projections countries are basing their projects on. Adding to long-term economic concerns, some European countries, for example, are in desperate need of large energy supplies, especially since the Russian invasion of Ukraine. From this desperation, some countries might view the decade-long waiting period to construct SMRs as too much of a risk.

A last difficulty in the economics of SMR projects involves the varied requirements in the production phase from different countries. While some countries will need SMR projects completely constructed, other countries have existing infrastructure that can be partially converted into SMR units. For example, from our interviews with representatives in the Czech Republic, the country is looking to expand its nuclear portfolio by modifying some existing coal power plants.

The economic differences between multiple types of projects make generalizing the economics for SMR projects difficult. Specifically, the Czech Republic's options involving modifying existing coal power plants will require less infrastructural investment than similar SMR projects from scratch and be cheaper. As a result, United States developers need to build multiple specified economic projections. The implication of government red tape complicates this requirement. In contrast, some countries aren't willing to provide many details about potential SMR project locations and existing technologies to United States developers. Thus, projects are prone to long delays.

Ultimately, SMR projects are financial options that have the potential to provide exceptionally profitable returns. However, there aren't SMR projects in operation for investors, countries, and other entities to use as an example of the financial and production viability of SMRs. Due to the "paper only" models, SMR projects are viewed as risky investment opportunities. In addition, securing non-private sector funding is difficult for United States developers. Ultimately, our research indicates the United States Senate Committee on Banking, Housing, and Urban Affairs should provide stronger incentives that enable EXIM to provide stronger financial assistance for SMR projects. At the moment, constructing SMRs is very challenging due to these economic constraints. In the future, if projects in operation prove to be economically and energy efficient, SMR investment will be much more realistic.

Geopolitical Assessment

The geopolitics considerations of nuclear technology in general and by extension, SMRs, have taken on a new life with Russia's war and China's desire to subsume the U.S.-led world order. Civil nuclear technology acts as a multi-faceted policy matter with wide-ranging interests, including electricity generation, nuclear non-proliferation, and advanced technology and manufacturing. The leader in civil nuclear technology stands to gain much and operates from a clear position of geopolitical strength.

For much of the 20th century, the United States was the leader in civil nuclear technology, viewing it not only as a potential influence tool in the Cold War but also as a way to decrease global nuclear arms proliferation. Having been the first to develop nuclear weapons, the U.S. immediately recognized the significance of what was to happen should more countries seek to develop their nuclear weapons. While it was impossible to remain the only power with the atomic bomb, U.S. leadership helped to tamp down even wider proliferation, making the world safer for everyone.

With prescience, in 1953, President Eisenhower spoke at the United Nations, outlining that: "the United States would be more than willing - it would be proud to take up with others the development of plans whereby such peaceful use of atomic energy would be expedited." American foreign civil nuclear policy was organized under the "Atoms for Peace" initiative and viewed the export of U.S. civilian nuclear power reactors as discouraging other countries from developing their nuclear programs while enjoying the benefits of mass electrification.[18] These goals were backed by bilateral 123 Agreements, which prohibited the importing country from developing nuclear weapons. Today, the U.S. maintains 123 Agreements with 47 different countries in places as diverse as Argentina, Vietnam, Norway, and Kazakhstan.[19] This is a testament to the efforts to reduce nuclear tensions and the ongoing global trust that the U.S. maintains on this file.

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[18] IAEA. "Atoms for Peace Speech." *IAEA*, https://www.iaea.org/about/history/atoms-for-peace-speech

[19] U.S. Department of Energy. "123 Agreements for Peaceful Cooperation." https://www.energy.gov/nnsa/123-agreements-peaceful-cooperation

American companies like Westinghouse and GE took advantage of Cold War American policy. They exported their reactor designs across the globe, from Japan to Sweden to Mexico, as well as developing domestic reactors for a burgeoning nuclear industry. These exports served the envisioned dual policy purpose of providing safe and reliable electricity while also tamping down nuclear proliferation by prohibiting those importing countries from developing nuclear weapons as part of the import agreement. Nuclear power was seen as the way of the future, with widespread optimism, as in 1954, the Chairman of the United States Atomic Energy Commission declared that: "It is not too much to expect that our children will enjoy in their homes electrical energy too cheap to meter." [20]

This global leadership position began to wane in the late 1970s, as American domestic electric utilities began to defer their investments in nuclear power plants amid rising costs, cheaper substitutes, and misplaced safety concerns. As it was, no U.S. nuclear plants were constructed between 1978 and 2013, and as plants continue to age, the American civil nuclear fleet shrinks. As American influence in the civil nuclear industry has waned, Russia and China have sought to fill the void to maximize their influence at the expense of the United States.

However, this decline in American influence is not a foregone conclusion and still has time to be reversed should appropriate steps be taken soon. Our research has found that many U.S. allies like Poland, the Czech Republic, and Romania, alongside more non-aligned nations such as Ghana and Kenya, continue to seek U.S. involvement in this space.

[20] Nuclear Regulatory Commission. "Too Cheap to Meter - A History of the Phrase." https://www.nrc.gov/reading-rm/basic-ref/students/history-101/too-cheap-to-meter.html

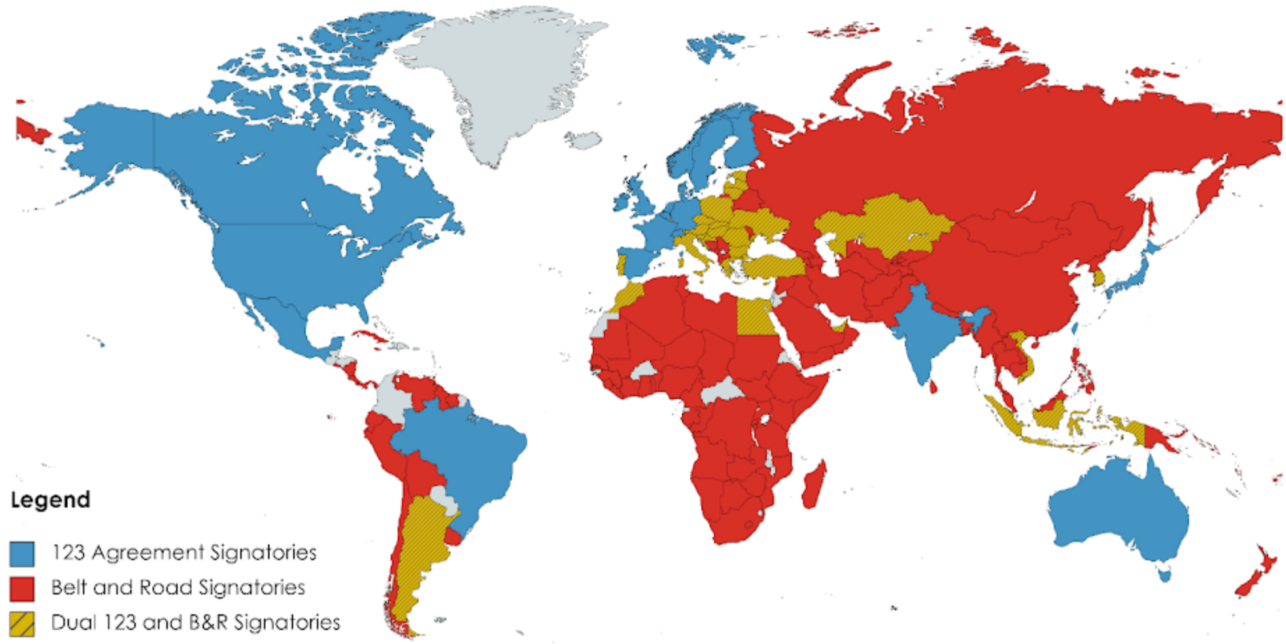

Image: 123 Agreement, Belt and Road, and Dual 123 and B&R Signatories[21]

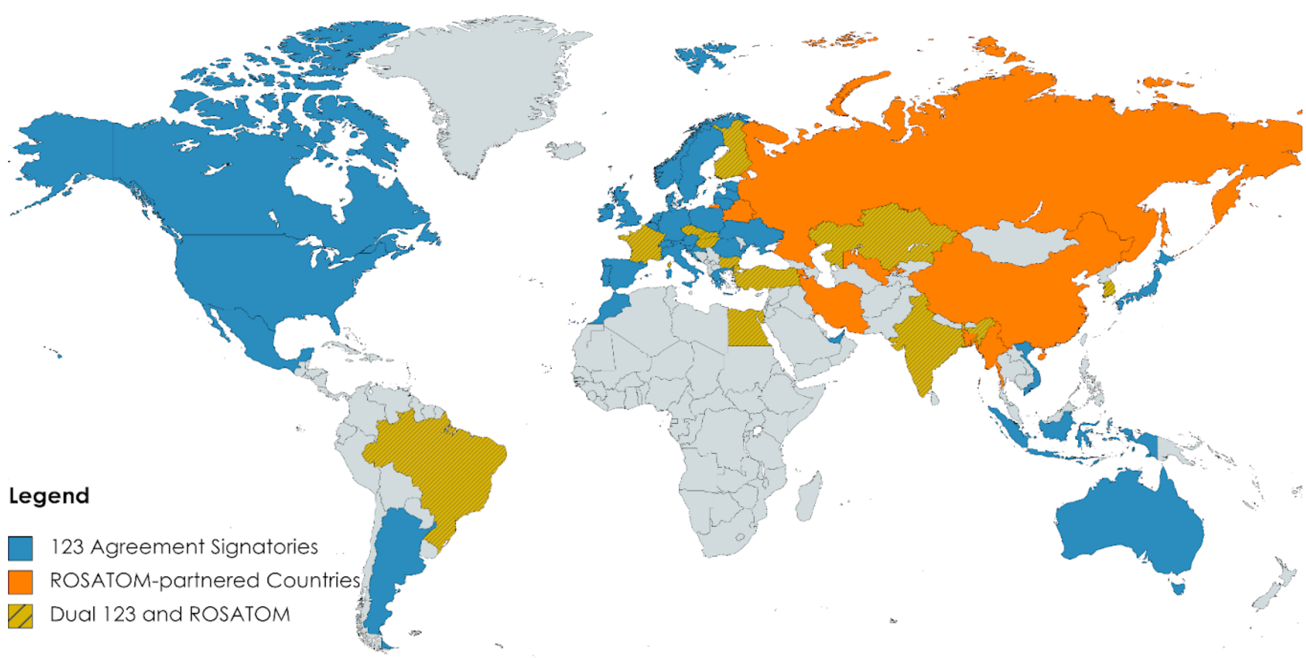

Image: 123 Agreement, ROSATOM-Partnered Countries, and Dual 123 and B&R Signatories[22]

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[21] U.S. Department of Energy. “123 Agreements for Peaceful Cooperation." https://www.energy.gov/nnsa/123-agreements-peaceful-cooperation

[22] U.S. Department of Energy. “123 Agreements for Peaceful Cooperation." https://www.energy.gov/nnsa/123-agreements-peaceful-cooperation

Russia

Russian influence in civil nuclear technology originates from the Soviet Union, which like the Eisenhower Administration, recognized the value of nuclear reactor exports in advancing their geopolitical position. During the Cold War, it required Warsaw Pact members who bought Soviet nuclear reactors (Bulgaria, Czechoslovakia, East Germany, Hungary, and Romania) to obtain all fuel, technology, construction, and waste disposal from the U.S.S.R., as well as prohibiting nuclear weapons developments.[23] After the fall of the Soviet Union, Russia continued to maintain those links, with the state-controlled nuclear company, ROSATOM, assuming the mantle of Soviet state providers. Today, ROSATOM is the worldwide leading company in new reactor builds, uranium enrichment, and research reactors, as well as supplying fuel to 78 reactors in 15 countries worldwide.[24]

The Russian invasion of Ukraine in 2022 has caused many countries formerly reliant on Russian nuclear energy to cancel plans for the future Russian construction of domestic nuclear plants. In our interviews with members of the Czech Republic, we consistently heard the same narrative - the country didn't want to be reliant on or involved with Russia for its energy supply. Other countries are adopting similar positions, such as Finland and Romania. The position of Finland is exacerbated by its recent joining NATO, which shows the country is directly positioning itself to counter Russia[25]. Directly rejecting Russia, those countries are instead turning to the United States and Western allies for nuclear technology.

China

Chinese civil nuclear development began with the Soviet export of nuclear technology in the 1950s that lacked sufficient non-proliferation safeguards. Ultimately, the Chinese developed nuclear weapon capabilities more than a decade later in 1964.[26] Chinese civil nuclear technology, led by the China National Nuclear Corporation (CNNC), has used French, Canadian, Russian, and American reactor designs to create fully independent Chinese

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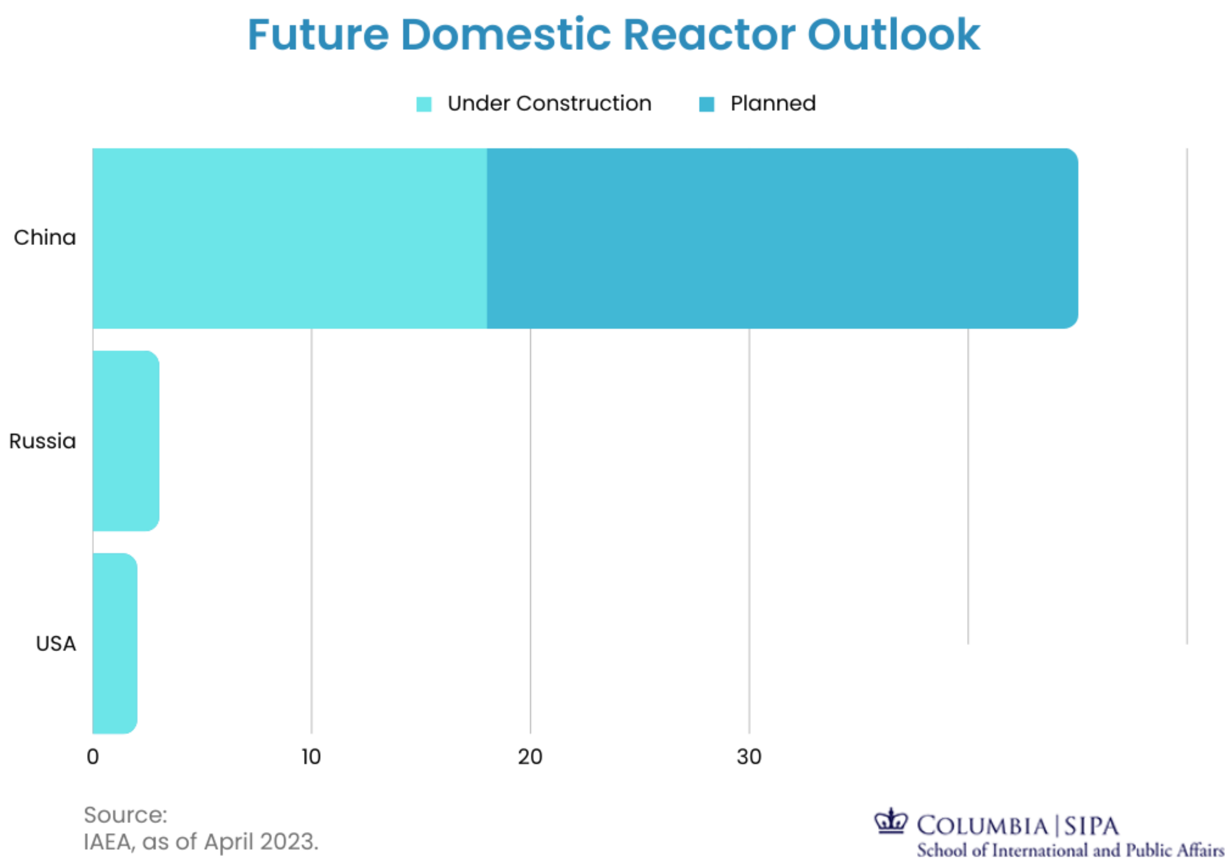
[23] IAEA. (1997, June). "Nuclear Power Development: Global Challenges and Strategies." https://www.iaea.org/sites/default/files/vol39no2.pdf

[24] ROSATUM. "ROSATUM About Us." *ROSATUM*, https://www.rosatom.ru/en/about-us/

[25] NATO. (2023, April 3). "Finland Joins NATO as 31 Ally." *NATO*, https://www.nato.int/cps/en/natohq/news_213448.htm

[26] AtomicArchive. "Chinese Become a Nuclear Nation." *AtomicArchive*, https://www.atomicarchive.com/history/cold-war/page-12.html

designs. Nuclear power generation in China is now the third largest in the world and threatens to overtake the United States shortly. The CNNC has planned for an additional 150 reactors to be built by 2035, which would endow China with the largest civil reactor fleet in the world. While these plans to build 150 are unconfirmed beyond corporate statements, China already has 18 domestic nuclear reactors under construction and concrete plans to build another 27 more. Upon completion of these 45 reactors already underway, China will surpass the United States in total domestic commercial reactors.

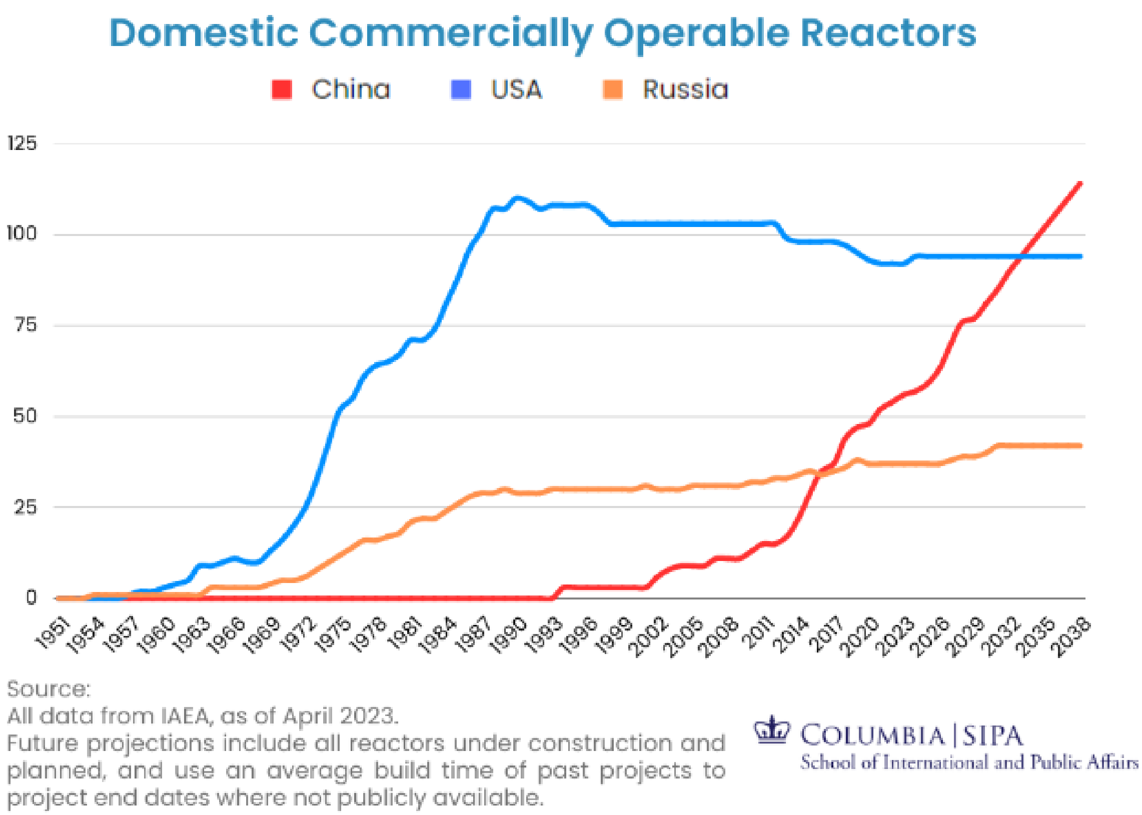


Meanwhile, China also sees a growing role in exporting nuclear reactors as a key part of the Belt and Road Initiative, with a strategy of "going out" with 30 planned overseas reactors to build influence abroad[27]. Chinese nuclear plants are already operational in Pakistan, while plans in Argentina are stalled pending further commercial negotiations about China bearing

[27]https://www.cipe.org/resources/chinas-nuclear-dragon-goes-abroad-exporting-nuclear-power-infrastructure-through-the-belt-and-road-initiative/

even more than the 85% funding it already provides. As shown in the map above, the locations of the remaining plants have plenty of possibilities for export, posing a clear strategic threat to the United States.

China views an expanded nuclear sector and more Chinese reactors as vital to long-term, generational foundations of strategically undermining the United States and is willing to take large commercial losses to achieve political benefits. This closely resembles the Russian strategy before the invasion of Ukraine, which attempted to use natural gas exports to bind countries to Russia. The core difference is that China is a current competitor in the nuclear space whereas Russia has lost influence due to the war.



America/Congress

In the 70 years after President Eisenhower made his "Atoms for Peace" speech at the UN, U.S. nuclear leadership provided benign global non-proliferation leadership and safe electricity generation around the world. This stability is one that we must seek to preserve, as a world without that leadership would be much more dangerous for all, regardless of their nuclear status. Without a clear response, the uncertainty in American civil nuclear policy will leave strategic allies nervous, creating the chance that they will turn to America's geopolitical rivals for their energy needs, resulting in a major coercive potential for generations to come.

American politicians and policymakers understand the urgency and have taken several steps to help reverse the trends, having secured a number of bilateral nuclear export and cooperation deals in the wake of the Russian invasion of Ukraine with the Czech Republic, Poland, Bulgaria, and Romania.[28] Globally, there is continued strong demand for safe and secure American reactors and benign American leadership.

In addition, from our discussions with Congressional staffers from both sides of the aisle, there was genuine support for creating a stronger American policy through the promotion of American civil nuclear reactors. The first of two clear examples are exemplified by the bipartisan *International Nuclear Energy Act* (INEA), proposed by Senator Manchin and Senator Risch on March 15, 2023.[29] Having been previously introduced in the 117th Congress but failing to be passed out of the Senate, INEA is a critical piece of reviving American nuclear leadership. Its major highlights include that it would direct the President to create an international initiative modernizing civil nuclear outreach, establish financing relationships with partner countries, and develop a cohesive, whole-of-government policy concerning international efforts related to civil nuclear energy.

Further, INEA recognizes the inherent geopolitical question in this field, with specific direction to the Administration that implementation should occur "*with a focus on countries that have increased civil nuclear cooperation with the Russian Federation or the People's*

[28] Associated Press. (2023, March 29). "U.S. Westinghouse to Supply Fuel to Both Czech Nuclear Plants." *Associated Press*, https://apnews.com/article/czech-westinghouse-nuclear-fuel-cez-rosatom-42bd1f8b2be09fa9cb218157bfd122c3
[29] U.S. Congress. "Risch, Manchin Introduce International Nuclear Energy Act." *U.S. Congress*, https://www.foreign.senate.gov/press/rep/release/risch-manchin-introduce-international-nuclear-energy-act

Republic of China (Section 7, subsection 3)." This clear recognition in the proposed legislation demonstrates the political commitment of the Senators and the staff and elevates it from mere talking points.

Another important Bill is from Senator Capito, Senator Carper, and Senator Whitehouse, who introduced another bipartisan Bill in April 2023 – the *Accelerating Deployment of Versatile, Advanced Nuclear for Clean Energy (*ADVANCE*) Act,* which specifically aims to help increase deployment of American-made technology to counter China and Russia.[30] A key part of this is in reducing excessive regulatory compliance costs from the NRC that American companies have to abide by to compete with Chinese and Russian companies. That political leaders understand the need to free American companies bodes well for future competition.

Without continued American leadership in civil nuclear usage, global nuclear rule-setting may be bestowed on China at the expense of global peace and security. American political leaders in Congress have shown the same prescience as President Eisenhower in 1953 by recognizing the importance of this issue and should be applauded for their efforts.

[30] U.S. Congress. "Accelerating Deployment of Versatile Advanced Nuclear for Clean Energy Act of 2023 (ADVANCE Act)." *U.S. Congress*, https://www.epw.senate.gov/public/_cache/files/a/8/a804f8d7-0142-47c3-87e1-413259c13967/D5974E051150760B7CFFB2D2420F46E1.capito-advance-act-one-pager.pdf

Case Study – Czech Republic

Czech Republic Policy

The Czech Republic's policy levers and mechanisms to make final decisions on Nuclear SMR technology can be separated into four key areas: state-level policy-makers such as the Prime Minister and Czech Parliament, the Czech Ministry of Trade and Industry (where most if not all energy-related policy work is centralized), ČEZ (the 70% Czech state-owned electric utility), and finally the European Union.

- **State-Level Policy:** In the Czech Republic, the President, and Parliament have both approved a nuclear agenda in the country encompassing a Small Modular Reactor future. The Czech Republic has about 3TW of clean energy capacity, which is unaccounted for in their net-zero future, and seeks to fill that using nuclear power. The Parliament and the President of the Czech Republic have a harmonized view for SMRs to work towards a resolution to this remaining power gap potentially. Although this is the case for a subset of the higher-level state policy regime, the final call on SMR development is in the decision-making of the Prime Minister.

- **Ministry of Trade and Industry:** The Ministry of Trade and Industry has been instructed to conduct an exploratory phase for SMR technology. Without the final decision of the Prime Minister, the Czech Ministry of Trade and Industry, alongside a few other relevant agencies, is working to create a roadmap of what international partnerships, financial mechanisms, and site planning SMR will require within the Czech Republic to begin commissioning reactors. With the intended harmonization of the Prime Minister's higher-level decision-making and the Ministry's exploratory road mapping, overall, the Czech Republic is expected to make final decisions about future SMRs this April of 2023 in terms of congruent policy agenda.

- **ČEZ:** Although ČEZ is 70% owned by the Czech government, given their current level of autonomy, they still have disparate prioritizations in regard to SMR deployment. In relevance to identifying sites for possible reactors, ČEZ is the primary leader in this decision-making. In addition, ČEZ also seems to be involved in the discussions in relation to choosing their specific SMR design technology. They have been engaging with various SMR developers through formalized memoranda of understanding (i.e., NuScale, GE Hitachi, Rolls-Royce SMR, EDF, Westinghouse, Korea Hydro & Nuclear Power, and Holtec).

- **EU and other Regional Influences:** Although this is the case for the wider Czech Republic policy timeline on SMRs, there is the additional added context of wider European Union policy and regional influence. Historically, countries that are intensely anti-nuclear have impeded the nuclear agendas of the Czech Republic, even for large-scale reactors. In 2012, the Austrian Prime Minister proclaimed it would like to position itself as a head of an anti-nuclear alliance in the EU. This positioning of Austria has led to a number of de-facto roadblocks to Czech Republic reactor projects with support or additional pressure from Germany. According to the Czech Republic, Germany, and Austria have been able to utilize a variety of regulatory appeals at the wider-European Union court level to effectively shut down and discontinue large reactor projects in the Czech Republic.

Investment, Economics, and Financial Tools

There is a major additional question in finding sufficient financing for SMRs. The Czech Republic, with a population of 10.5 million, is a relatively small country with limited financial resources. As a result, finding financial mechanisms to support funding SMR projects is a major challenge for the Czechs. The Czech Republic is looking to the U.S. and other potential partners to provide financial tools to support their SMR deployment. Particularly, the Czechs have been in discussions with the U.S. Export-Import Bank (EXIM) and other financial institutions within the U.S. to determine potential financing options for their SMR future. Regardless of these discussions, the Czech Republic has not been able to harmonize adequate funding opportunities from offered U.S. sources. Engagement with U.S. public financial institutions such as EXIM, the State Department's Project Phoenix, and others has not seemed fruitful in providing the necessary opportunities for SMR funding needs in the Czech Republic. Until concrete options are available to fund these projects, the Czech Republic isn't able to implement an SMR project.

Geopolitics

As a former Warsaw Pact member, the two nuclear power plant sites in the Czech Republic (Dukovany and Temelín) were built using Soviet nuclear power plant models with strict export controls from the Soviet Union. In a dramatic reversal, today, the Czechs are strongly aligned with the Americans and seek to remove malignant Russian influence in their nuclear sector. Most explicitly, the country banned Chinese and Russian bids from competition for a future build-out of the Dukovany and Temelín nuclear plants, citing national security concerns. Bids for these projects have now been received from Korea Hydro and Nuclear Power, Westinghouse, and Électricité de France. Furthermore, the Czechs have taken additional measures by seeking to decouple from the Russian state nuclear company, ROSATOM, by awarding Westinghouse a contract to supply fuel to the existing Dukovany nuclear power plant on March 29, 2023, for a period of seven years. The Ministry of Trade and Industry is actively working to pursue other opportunities for fuel supply chains outside of those which Russia and ROSATOM provide.

By clearly and actively trying to reduce their supply chain reliance on ROSATOM, the Czechs provide fertile ground for geopolitical realignment. The U.S. can benefit themselves and the Czechs by helping bridge the gap and assisting with import deals. This can take the form of providing business facilitation and intergovernmental coordination. ČEZ, as a well-known and reputable nuclear company, having already entered into contracts with Westinghouse, and accepted bids from them for future plants, does not need assistance with creating individual business deals, making this process even easier for U.S. policymakers. Where the U.S. can assist in helping facilitate potential bridge financing on SMRs from federal agencies and wider U.S. state support to the Czechs in countering potential Russian backlash to the Czech efforts to disentangle themselves.

Despite this progress in a Western-aligned country, it is clear from the discussion that the Czech Republic still encounters difficulties in working with the United States. For instance, the Czech government has difficulty understanding the accountability structures and disparate segments of government in the United States working to harmonize SMR policy. Although there has been consistent discussion across the U.S. government vis-à-vis SMR policy, the Czechs have found it challenging to engage in fruitful discussions with the United States. This is due to the fact that although the U.S. executive branch has driven policy towards SMRs, it is sometimes difficult for foreign entities to understand how each segment of the U.S. government executes and harmonizes an administration-level policy.

Czech SMR Regulation

Currently, within the Czech Republic, there are two levels of regulatory decrees carried out by the State Office for Nuclear Security (SUJB): supervision of the radiation sources set out in Atomic Act Section 207(1), in addition to maintenance of nuclear security and design.[31] On the lower level, many of the details of SUJB decrees in relevance to SMRs center around Light Water Reactor designs. Regulatory decrees need to be changed to make them more applicable for approvals to all types of SMR designs, and the SUJB is working towards this on a three-to-four-year timeline. Their goal is to shift the regulatory framework around SMRs from less of a prescriptive angle to a more goal-oriented approach. With these shifts, the SUJB hopes to be prepared in three-to-four years to approve any type of future SMR design within a five-year time frame through a highly standardized format for licensing. In addition, the SUJB is willing to utilize NRC licensing approvals to accelerate the process of licensing approval in the Czech Republic, excluding citing issues. They are not waiting for regulatory harmonization to ensure they are ready to approve SMR designs in the potential timeline of the Czech Republic Ministry of Trade and Industry, in addition to the higher-level final decisions of the Prime Minister on SMR policy.

[31] "Atomic Energy Act of 1953." *U.S. Government*, https://www.govinfo.gov/content/pkg/COMPS-1630/pdf/COMPS-1630.pdf

Conclusion

The Czech Republic has a unique opportunity to pursue the import of American SMRs, and both sides should act now to ensure this comes to fruition. With the war in Ukraine, Russia has become an unreliable source of energy, providing both energy security concerns and upcoming domestic power supply gaps for the Czech Republic. The war in Ukraine has served to remind the European Union of the severity of its energy dependence on Russia. As a result, the European Union is contending with questions about its energy future, especially considering the dueling policies of recent legislation like *Fit for 55* and *RePower EU*.[32] SMRs are a tremendous opportunity to fill the long-term needs of the European Union by providing clean, stable energy and fulfilling needed geopolitical objectives of deviating from Russian controlled energy. Aspects of traditional EU energy policy have been called into question while attempting to continue on a clean energy transition, despite the reactivation of coal plants on the Continent. Many EU members, including ones that would typically interfere with the Czech Republic's nuclear plans, are dealing with hard questions about continued energy supplies and energy security for the upcoming winter of 2024 while actively relying on coal and nuclear energy sources.

The Czech Republic has already made significant progress to import SMRs from the United States. A 123 Agreement is in place, and the next steps to implement importation are being coordinated. The Czech Republic wants SMRs, and they want them soon for geopolitical and energy security reasons. However, the import process is not without speed bumps, which arise from bureaucratic red tape, permissions processes, and financing. The limitations of American bureaucracy contribute to poor inter-country communication with counterparts in the Czech Republic. Czech nuclear regulations and permissions pathways also are delayed and require more work. Last, except for limited examples of EXIM and other United States public entities providing funding, SMR projects require private-sector funding. The private sector currently isn't willing to accept the riskiness and liability of new technologies like SMRs.

[32] European Council. "Fit for 55." *European Council*, https://www.google.com/search?q=fit+for+55&oq=fit+for+55&aqs =chrome.0.0i433i512j0i512l9.6083j0j4&sourceid=chrome&ie=UTF-8

With an implemented 123 Agreement and cooperation between both the United States and the Czech Republic, both countries are in a place where they can capitalize on the current situation and benefit each other's economies and geopolitics. While there are policy and economic limitations, the Czech Republic wants SMRs, and the United States can provide them. The countries need to overcome their limitations to give the Czech Republic a chance to seize this unique opportunity and become a leader in nuclear SMR energy.