

# Raising the Next Generation of Nuclear: A Road Map for Deployment



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## Topline

Right now, we have an opportunity to accelerate the development and deployment of advanced nuclear technology in a way that aligns to the scale of the climate challenge- but to do this, American innovators and the US government must work together to build a new and ambitious policy agenda creating a 2.0 version of advanced nuclear innovation. Over the last decade there has been significant technological, financial, and policy progress toward developing advanced nuclear reactors in the US. There are multiple designs that can be built before 2030, but this will require partnerships between the public and private sectors to scale up quickly. Primarily- this means providing the infrastructure and funding to develop and commercialize multiple American advanced nuclear power plants by the end of the next decade. As we enter this next phase, we've outlined the

policy goals that need to be addressed, and the steps Congress and federal agencies should take to put American advanced reactors on the fast track to commercialization.

## **Introduction**

The increased urgency to address climate change combined with fierce competition from Russia and China are serving as a wake-up call to America's nuclear energy innovation community. If the US wants to be a leader in carbon-free advanced reactor technologies, it's time to take this effort to the next level with a more aggressive national strategy supported by federal policy.

Over the next three decades, countries with developing markets will need enormous amounts of scalable, flexible, clean power and industrial process heat.<sup>1</sup> Nuclear energy can help meet this new demand, especially with the addition of advanced reactor designs that can serve a wider variety of needs. However, this raises a number of questions: Who will benefit economically from designing and building these plants? Will they be compliant with the highest international nuclear security, safety, and non-proliferation standards? Will viable new products hit the market in time to make a sizable impact on the world's mid-century emissions goals?

These are all questions American innovators and the US government must work together to answer. We need to build a new and ambitious policy agenda for the next phase of developing advanced nuclear power, including both small modular light-water reactors and non-light-water reactors. This coordination is the only way the U.S. can accelerate the development and deployment of domestic advanced nuclear technology in a timeframe that can also make a substantial difference in reducing carbon pollution.

## **The U.S. Has Made Great Progress**

For nearly a half-century after the first wave of reactors were built, innovation in the field of nuclear energy was slow and sporadic. R&D was limited to US National Labs and universities, and technological improvements were incremental and modest. Starting in the mid-2000's, however, technical progress, growing urgency around climate solutions, and a surge in early private investment rapidly accelerated research and the number of companies developing new reactors. By the early part of the 2010's the advanced nuclear community had evolved into an actual industry that continues to expand. Thanks to implementation of smart policies, modernization of the licensing process, and an increase in both private and federal investments, the number of advanced nuclear projects increased by 50% in the three-year span from 2015 to 2018.<sup>2</sup>

More than \$1.3 billion in private capital from a variety of venture capital firms, companies like Fluor, and big-name funders like Bill Gates and Nathan Myhrvold, has been invested in advanced nuclear startups and projects by established companies.<sup>3</sup> Support for the industry is growing in Washington as well. The Obama Administration launched the Gateway for Accelerated Innovation in Nuclear initiative (GAIN), which continues to provide needed coordination and leadership for

innovators working with the National Labs. The Department of Energy has issued more than \$100 million in grants for private innovators to work with the labs on research to move advanced reactors closer to commercialization. <sup>4</sup> Overwhelmingly bipartisan majorities in congress passed, and President Trump signed into law, the Nuclear Energy Innovation and Modernization Act (NEIMA) and the Nuclear Energy Innovation Capabilities Act (NEICA). <sup>5</sup> These proposals were the highest priorities for advanced nuclear innovators and will accelerate the modernization of the Nuclear Regulatory Commission (NRC), provide needed financial support and resources towards the development of advanced reactor fuel, and increase opportunities for developers to collaborate with universities and the national labs. Five companies are already working with the NRC to prepare for licensing, and NuScale just completed the third phase of the first ever, small modular reactor-design-certification application process. <sup>6</sup> Even before Congress passed legislation to mandate it, substantial efforts were in progress at the NRC to modernize its structure and processes to better accommodate advanced reactor developers. <sup>7</sup>

Advanced nuclear innovators, clean energy advocates, and policymakers set out some ambitious initial policy goals to get advanced nuclear innovation moving. Now, the U.S. government must take the next step and commit to creating a 2.0 version of advanced nuclear innovation policy. This will require providing the infrastructure and funding to develop and commercialize multiple American advanced nuclear power plants by the end of the next decade.

## **The Clock Is Ticking: Climate and Security Concerns**

Whether it's the United Nations Intergovernmental Panel on Climate Change (IPCC) Report released in October 2018 or the U.S. government's National Climate Assessment released in November 2018, analysis is more stark than ever that we must take decisive action right away to address climate change. <sup>8</sup> This means taking every step possible to eliminate climate pollution and limit warming to 1.5 degrees Celsius. That should include accelerating the development of advanced nuclear to provide power, process heat, and other services that can displace fossil fuels in the developed world and help meet growing energy demand in emerging markets.

As the recent climate assessments, along with new reports from the Union of Concerned Scientists and The Nature Conservancy, made amply clear, nuclear should be a part of the climate solution. <sup>9</sup> We do not have the luxury of picking and choosing the perfect solutions – we need every option that will get us to net zero carbon emissions as quickly and affordably as possible. Advanced nuclear could play a critical role in getting there. It can complement renewables, efficiency, storage, and carbon capture for electricity generation, and provide power in remote locations. It can also provide desalination, hydrogen production, and process heat for some industries that currently rely on dirty fossil fuels. <sup>10</sup>

As mentioned, the United States is making good headway toward the development and deployment of advanced nuclear—but it is not alone in this pursuit. The Chinese and Russians are using their nuclear technology to develop important, long-term relationships with neighbors and potential

allies. Both countries have long understood the geopolitical importance of energy resources. When their state-owned companies sell a reactor to a developing country, they often promise to sell the fuel, take back the waste, and service and operate the reactors for many decades. This gives these governments multi-decade strategic relationships that can reshape geopolitical alliances.<sup>11</sup> Both countries are aggressively developing new reactor designs to capture the emerging market for advanced nuclear and the global influence that will come with it.

One thing is certain – advanced nuclear reactors are coming. The country that leads in this field will define the safety, security, and nonproliferation values that are exported along with this technology. It is in the best interest of the world for economic, safety, proliferation, labor, and climate reasons, if the U.S. leads the charge.

## **Advanced Nuclear 2.0**

The first phase of policy work from 2014 to 2019 transformed the landscape for the advanced nuclear sector. Legislation was signed into law codifying our core recommendations to modernize the NRC and open the doors of our national labs to support the 70 plus advanced nuclear projects underway in the United States. We think of this as Advanced Nuclear 1.0 – intended to prove whether there was truly an emerging advanced nuclear sector and sufficient support from policymakers to modernize how the government engages in nuclear innovation.

Now, we are entering the next phase, Advanced Nuclear 2.0, focused on providing the U.S. advanced nuclear industry the tools to get its products to market. This will require many complementary efforts. Congress and US federal agencies both have important roles to play. As we enter this next phase we've outlined the policy goals that need to be addressed and the steps Congress and federal agencies should take to put American reactors on the fast track to commercialization.

## **Congress**

*Ultimately, advanced nuclear technologies will succeed or fail in the marketplace based on their ability to provide cost-competitive electricity and services. New technologies need three things: investment, deadlines, and customers. Bipartisan legislation introduced in March 2019, the Nuclear Energy Leadership Act, or NELEA, addresses these needs.<sup>12</sup> It generates investment by authorizing funding for cost-sharing agreements with the companies designing the reactors. It sets deadlines for two completed demonstration projects by 2025, and at least two more by 2035. And it creates customers by allowing the federal government to enter longer-term contracts to purchase power from early deployments of advanced reactors at a price that can support the completion of these initial projects.*

*While much of the investment will come from the private sector, Congress has the power to set the tone— sending signals to investors and potential customers that illustrate the value of advanced nuclear. Congress can assist by passing a number of supportive policies, several of which are in NELEA:*

### **Establish cost and deployment targets**

- Set firm goals to demonstrate multiple advanced nuclear technologies to ensure a timeline for commercialization in line with reaching a target of zero emissions by 2050. This should include a requirement for at least two completed demonstration projects by no later than 2025.
- Establish clearly defined public-private partnerships to demonstrate the advanced nuclear technologies that meet technical milestones and can match federal funding.
- Establish a program to make high-assay low enriched uranium fuel available for use in advanced reactors, on a timeline that matches early reactor deployment goals.

### **Bridge the gap for emerging clean energy technologies**

- Pass a comprehensive clean electricity standard or a technology neutral, real or imputed carbon price that will provide a strong signal that the carbon-free power produced by an advanced reactor will be valued.
- Continue to build the infrastructure needed for development of longer-term advanced reactor concepts, such as the Versatile Test Reactor, but prioritize funding and support for the deployment and commercialization of reactor technologies that will help meet near term demonstration targets.

### **Ease the path to market**

- Expand the current production tax credit and add new tax incentives for advanced nuclear, such as an investment tax credit that could be taken upfront as cash, which the government used to rapidly deploy solar projects.<sup>13</sup>
- Institute a pilot program for long-term power purchase agreements for early deployments of innovative nuclear technologies, with the potential for some reactors to receive a reasonable price premium to help offset the higher cost of initial projects.
- Ensure there are smart export controls that enable international sales of US advanced nuclear technologies, and that balance the need to protect against nonproliferation with the importance of allowing American companies to compete against the Chinese and Russian global market share.
- Amend the Environmental Social Policy of the newly established US International Development Finance Corporation and remove policies that explicitly prohibit funding any projects with a nuclear reactor. An updated policy should allow consideration of advanced nuclear projects as defined by NEIMA and NEICA.

### **Provide the NRC resources to ensure efficient, transparent, and affordable licensing for small and large companies to commercialize advanced reactor technologies**

- Provide sufficient NRC funding for advanced reactor licensing to ensure they can prepare for anticipated demand.
- Identify with partner organizations and advanced nuclear innovators additional modernizations needed within the NRC, or existing actions that should be accelerated.<sup>14</sup>

## **Federal Agencies**

*While the next generation of US nuclear technologies will be driven by private investment, America's companies are competing with massive, sovereign-backed rivals from countries like China, Russia and South Korea. The United States has economic competitiveness and national security motivations for ensuring America's continued role as leader in the field, making this a national priority worth committing to and investing in. Federal agencies can help ensure American leadership by allowing access to research and testing facilities, expertise, and strategic investments designed to help accelerate learning and cost reductions. It is time to kick things into high gear if the United States is to lead the world in the development and commercialization of this next generation of advanced nuclear technology. Federal agencies can take the following steps to move the ball forward:*

### **Improve coordination across federal agencies and facilitate international engagement**

- Establish a centralized office that is responsible for tracking, organizing, and improving communication between different projects and programs related to advanced nuclear within the federal government.
- Maintain federal financing programs like the DOE Loan Program to provide a variety of financial instruments that reduce risks and barriers associated with deploying new technologies, and make these programs easier to access and navigate.
- Create a centralized resource that leverages national labs, universities, and private industry partners for facilitating international collaborations, managing projects, and ensuring compliance with federal regulations for export controls.

### **Make federal facilities available for siting first-of-a-kind reactors**

- Identify federal sites for deployment of reactors or more comprehensive clean energy systems which will include nuclear as a component.
- Develop procurement tools and demonstration programs to allow the government to be a customer for first or second of a kind reactors to meet specific federal missions.
- Create partnerships between the Department of Energy, the Department of Defense, General Services Administration, and other relevant agencies to procure power from first- or second-of-a-kind reactors.

- Where appropriate, provide long-term leases for first-of-a-kind reactors to access federal facilities for siting.

### **Adapt the NRC licensing procedure and culture to ensure a viable path for advanced nuclear technologies**

- Expand efforts to adapt longstanding processes in order to efficiently review and license advanced reactors, and reflect this in appropriations requests to Congress.
- Formalize the modernization of the licensing process to ensure cultural change is internalized by all staff members. Change must permeate to all levels of NRC staff if there is to be lasting and practical impact.<sup>15</sup>
- Modernize international licensing agreements, and work to ensure companies licensed in the United States can compete in foreign markets.

## **Conclusion**

A challenge as complex and overwhelming as combating climate change calls for a comprehensive and relentless response. No individual stakeholder or recommendation listed above will single-handedly drive the development of the nation's advanced nuclear power industry. Congress, federal agencies, developers, NGO's and universities each form a part of a larger innovation system- a village that can collectively raise an industry and bring it to market.

The question is—can these combined efforts get us there by the end of the next decade? The answer is yes. The United States has the ability to lead the world in the development and deployment of advanced nuclear technologies both domestically and internationally- but the Congress and US federal agencies must work together to create a robust support system that can give the advanced nuclear community the boost it needs to succeed.

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## ENDNOTES

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