THIRD WAY

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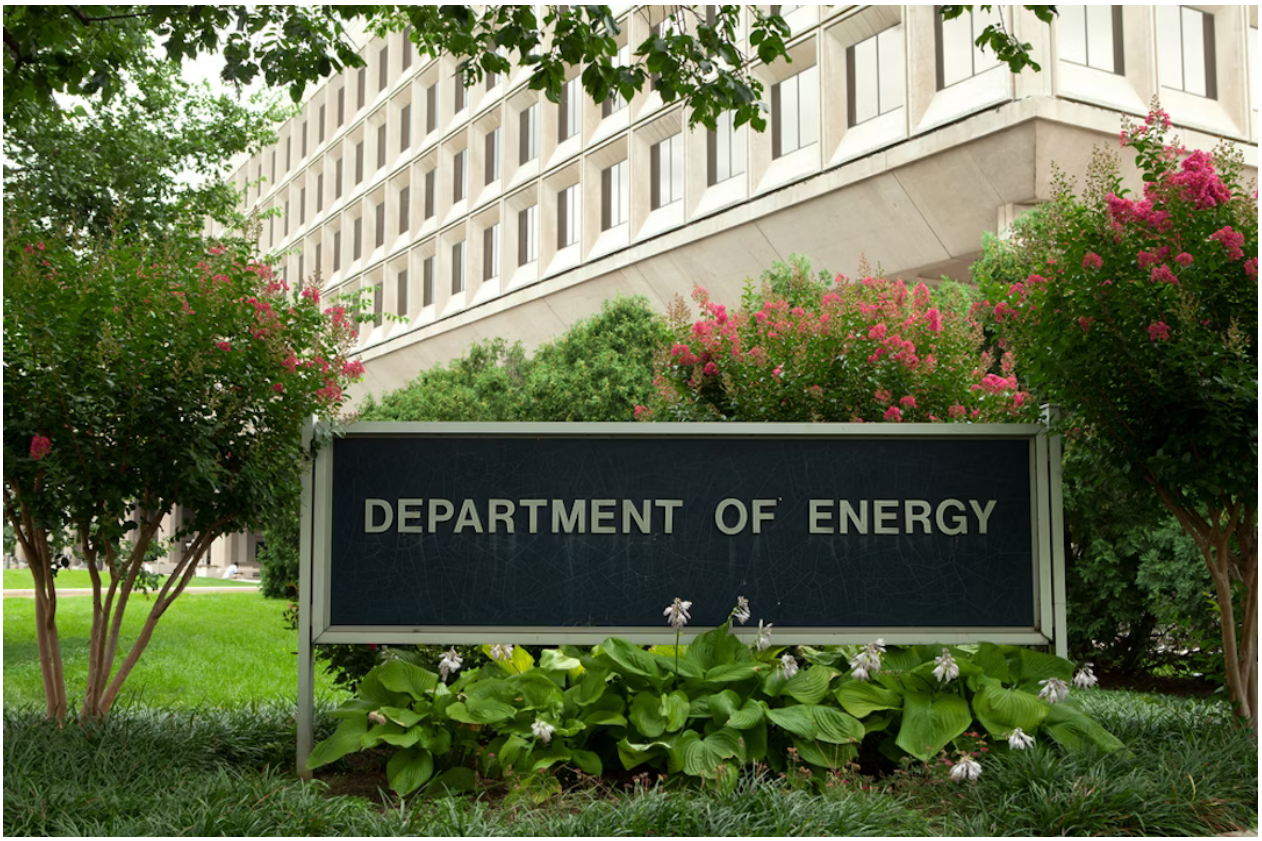
A Step-by-Step Guide to Nuclear Innovation Policy



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Introduction

Advanced nuclear innovation policy is finally taking center stage and Congress has been taking important steps to support nuclear's role in meeting our climate goals. But so far, we've only heard bits and pieces of what's needed, without a complete explanation of exactly how policies proposed by the Administration and Congress (and advocates like us) help nuclear innovators move from a good idea to a demonstration reactor.

To provide that context, we'll follow along step-by-step as Carla—a hypothetical nuclear innovator—secures investments, tests her ideas, and finally builds a demonstration reactor. Along the way, we've identified the challenges Carla faces and italicized the specific policies that can help her overcome each obstacle. Although we describe Carla's path to developing a full nuclear reactor system, the story would be roughly the same if her technology was just one component of a reactor.

Meet Carla

Carla is a graduate nuclear engineering student who wants to provide clean energy to the world and make money at the same time. Luckily, she has a great idea for an advanced nuclear technology that she wants to pursue and take to market. Over the next few years, Carla needs to do two things: start a company and demonstrate her technology. Federal policy could be improved to make both of these steps easier. To better understand what these policies are and why they're needed, we're going to take a step-by-step look at how Carla can go from a good idea on paper to a marketable product and a thriving company.

Just like with any other business, Carla needs to know a few things: what other similar companies or ideas exist? How does she raise capital to start her business? And what legal or regulatory boxes does she need to check? Unlike many other businesses, however, getting this information can be especially tricky. The advanced nuclear industry is relatively new and, until recently, even the Department of Energy (DOE) didn't have an inventory of advanced nuclear companies. High upfront costs and long waits for a return on investment deter many traditional funders. And navigating the Nuclear Regulatory Commission's (NRC) process is daunting and expensive even for established utilities and large companies.

The federal government has already recognized its role in providing resources for traditional small business through infrastructure like Small Business Administration district offices. If innovators like Carla had a similar program tailored to overcoming the unique challenges of advanced reactor development, a greater number of high-potential technologies and entrepreneurs would have a chance to get started down the path to commercialization.

This is why the DOE should establish innovation centers. These centers would be a public-private partnership connecting Carla with other innovators, DOE experts, and potential investors. Innovation centers would also benefit the DOE by providing the agency with valuable information on private sector investment trends that could then inform where they direct research dollars.

Working through the innovation center, Carla has opportunities to troubleshoot her concept with experts at DOE. She is also introduced to venture capital firms and others interested in investing in advanced nuclear companies, which ultimately helps her secure a small investment to fund her company through the next step. Additionally, with access to federal funding through a cost-share program, Carla could leverage her private investment to receive additional federal dollars, which would allow her to move further and more quickly through the initial testing process and signal to investors that her design is especially promising.

The DOE already engages in cost-share programs, like the one that is currently participating in agreements with Southern Company, TerraPower, and X-Energy to encourage the development of

these companies' technologies. These cost-shares allow the DOE to finance many promising ideas with a low level of federal commitment.

DOE should continue current cost-shares and look for ways to implement new cost-share programs. Fostering "many shots on goal," rather than committing large sums to one or two projects at an early stage, will allow the DOE to ensure the most promising technologies move forward.

With private investment and federal cost-share funding, Carla has the capital to begin testing her design. One of the challenges with advanced reactors, however, is that they often require new and untested materials and components. Carla's design uses a new composite material that hasn't yet been tested in the unique environments that it would be exposed to in a nuclear reactor. Testing this particular composite requires specialized and costly facilities. Fortunately, a number of DOE labs have the type of facilities and expertise that Carla needs.

The DOE should allow Carla access to their facilities and resources. Working with the lab, she could utilize the DOE's computer modeling capabilities and lab facilities, making it much more likely for her to get over this hurdle.

Beyond this, the DOE should also independently work on solving common problems that many new reactor companies face. DOE can use its knowledge of the problems facing private sector developers to provide direction on the agency's research and development priorities to best help these companies move towards commercialization.

Once Carla tests her reactor and confirms that it is technologically feasible, she needs to know if it meets NRC regulations. Typically, the NRC begins to permit a new reactor only in the final stages of development. Companies producing traditional light-water reactors (LWRs) can look to decades of LWR licensing to inform decisions. However, Carla's design uses new technologies and is a type of reactor that has not previously been licensed by the NRC. There is no promise that the NRC will approve her final design; investors are less likely to continue to fund her company in the face of such uncertainty.

Legislation that has already been introduced in the Senate aims to improve this situation by creating a "staged" NRC review process. Under this new framework, Carla would be able to go to the NRC with her new material, tested at a DOE facility, to ask if it meets the Commission's requirements. While NRC is not bound in any way to provide final approval for Carla's reactor, getting *preliminary* approval would reassure investors and hopefully encourage them to continue supporting Carla's technology.

Carla now has preliminary approval from the NRC and, because of this, a better chance of attracting private investment. As with any new and capital-intensive technology, Carla needs to build a demonstration of her reactor before moving on to a full-scale commercial reactor. Nuclear reactors,

however, are (rightfully) more heavily regulated than most other technologies. Building a demonstration nuclear reactor poses many more challenges than building, say, building a new type of solar cell. When building a nuclear reactor, there are land use permits, security requirements, and many other boxes to check.

To address this, the DOE should allow innovators like Carla the chance to build their demonstrations at one of their labs that already meet strict requirements and have experience running nuclear reactors. Allowing Carla to build her reactor at Idaho or Oak Ridge, for example, could help her more affordably test her design and make any final changes needed to commercialize her product.

While allowing Carla to build her demonstration reactor on DOE land would streamline some of the regulatory processes, it is still important for the NRC to be involved. Currently, the NRC does not regulate the existing test and research reactors built by DOE and while the DOE has built research and test reactors before, an advanced nuclear company has not yet built a demonstration reactor on DOE land. However, because Carla is hoping her demonstration reactor design will eventually be commercialized, which would require her to go through the NRC licensing process, it would benefit her if the NRC were involved in the construction of her demonstration reactor.

Current legislation in the Senate directs the NRC to begin preparing to efficiently license advanced test reactors.

When Carla's test reactor works, she's ready to work with her investors and the NRC to get the final design approval and funding for commercialization.

Conclusion

Step 6 isn't the end of the line. The road from demonstration reactor to commercial reactor is similar to the path Carla took from paper reactor to demonstration reactor. As they progress toward commercialization, advanced nuclear innovators like Carla will continue pushing into uncharted territory. They'll need carefully crafted policies that create a viable regulatory path forward for their technologies and encourage investment from the private sector, as well as long-term commitments and intensive investments from the federal government. The benefits the United States will receive from advanced nuclear – carbon-free baseload electricity, highly-paid jobs, export potential – far outweigh the cost of these investments.

The Senate and House have already begun to act by funding important DOE programs and introducing NRC modernization legislation. Now policymakers need to work on establishing innovation centers, opening up DOE facilities and resources to innovators, and ensuring DOE's research and development programs are helping to solve the real-world problems faced by Carla and her peers.

TOPICS

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