

Why Advanced Nuclear Reactors (SMRs) May Be Here Sooner Than Many Imagine

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A REVIEW w/Links

Nordhaus and Lovering report that over the last several years, there has been growing recognition **[by previous naysayers?]** that nuclear energy is an important climate mitigation technology. Several states around the country have shifted from renewable energy mandates to technology-neutral clean energy standards that include nuclear energy, with [more states likely to follow suit](#). Even prominent environmental organizations, including the [World Resources Institute](#), the [Environmental Defense Fund](#), and the Union of Concerned Scientists, have supported efforts in states around the country to keep nuclear plants threatened with closure operating.

Building new nuclear plants, however, has been a different story, **[even though the costs are similar to building new hydroelectric dams these days]**. Construction of two large conventional light-water reactors (LWRs) in Georgia is years behind schedule and billions over budget. Cost overruns and construction delays have led to the cancellation of two new reactors in South Carolina. As the prospects for a nuclear renaissance in the U.S. based on conventional nuclear technology have **[been put on hold for now]**, many nuclear advocates have directed their hopes to advanced reactors that are smaller and utilize different technologies. **[Yet many people ignorant of the facts]** remain skeptical. Edwin Lyman of the Union of Concerned Scientists told the Washington Post earlier this year that developers of advanced reactors, [like Bill Gates](#), are “misleading the public on how fast and effective” they could be commercialized or widely deployed, **[although Lyman's "crystal ball" is no clearer than Gates because the latter is in a position to know more than Lyman]**.

Doubts about the timely commercialization of advanced nuclear reactors are not limited to longstanding nuclear opponents like Lyman, **[who are likely harboring unfounded residual anti-nuclear fears.]** In a damning review of the Department of Energy’s nuclear innovation programs, [David Victor, Granger Morgan, Ahmed Abdullah and Michael Ford](#) conclude that DOE has “neither the funding levels nor the programmatic focus that it needs to deliver on its mission of developing and demonstrating one or two advanced reactor designs by mid-century.” **[Fact Check ! - Of course, that is not the mission of DOE, other than helping to maintain the nuclear power plants currently in operation within our armed forces (submarines, aircraft carriers, etc.), but it is industry's job to commercialize the new designs]**. Even our former colleague Michael Shellenberger, a vociferous advocate of nuclear energy, has dismissed advanced nuclear reactor technology as a “magic box” that distracts nuclear proponents from the hard work of getting conventional reactors built. **[Fact Check! This does not sound like a characterization of what Shellenberger's [current views in a short post?](#)]**

All of these assessments, coming from both nuclear opponents and proponents, share a common assumption: that new advanced reactors will be developed and commercialized in the same way that large light-water reactors were developed — through state-led research, development and demonstration programs led by the national laboratories and the Department of Energy. Recent developments, however, suggest that assumption may be outmoded. Many advanced reactors are

already moving toward commercialization, and on much faster timelines and with much less government support than many thought possible.

NuScale submitted its design certification application to the Nuclear Regulatory Commission (NRC) in 2016 and expects to receive its license by early 2021. The company plans to build its first commercial power plant in eastern Idaho, providing electricity to Utah Associated Municipal Power Systems, with construction starting in 2023.

Beyond light-water small modular reactors (SMRs), five companies developing non-LWRs have begun preclicensing activities with the NRC, including three molten salt designs, one gas-cooled, and one sodium-cooled fast reactor. Canada's nuclear regulator also just received its first SMR license application, and surprisingly it wasn't an LWR but a tiny high-temperature gas-cooled reactor. The utility Southern Company has agreements with several advanced nuclear developers for possible demonstrations at its site in Georgia. In 2016, the DOE invited Terrestrial Energy to apply for a \$1.2 billion loan guarantee to construct its first plant in the U.S.

Federal policymakers are also moving forward with plans to support deployment of the first advanced reactors within a decade, reflected in the Nuclear Energy Leadership Act legislation introduced in the Senate last month. NELA sets short-term targets for advanced nuclear deployment, including signing at least one federal power-purchase [agreement by 2023](#) (with a design that received its license after 2019).

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NuScale could qualify for these PPAs, but NELA also directs the DOE to complete at least two advanced reactor demonstrations by 2025 and up to five additional demonstrations by 2035. Of course, there's no guarantee that reactor developers will be able to meet these deadlines; we've certainly seen long and costly delays in recent nuclear projects. But advanced reactors could be different, principally because of their size.

Almost all of the advanced reactors under development in the U.S. are far smaller than traditional LWRs — from 10 to 100 times smaller in both electricity output and physical footprint. Smaller sizes help reduce total funding necessary for the first build, but they can also simplify the engineering, making the reactor safer and easier to model, speeding licensing and

commercialization. Their size also makes advanced reactors more attractive to utilities. Funding a 2-megawatt reactor, for example, is feasible for a much broader range of utilities than a 1,000-megawatt power plant. And it's not just the reactor technology itself that could hasten commercialization. Improvements in computing over the last few decades have made it cheaper, faster and easier to model internal workings of new nuclear reactor designs and validate their functionality.

Capitalizing on these improvements, [ARPA-E's MEITNER](#) program is funding cross-cutting innovations designed to reduce cost and improve safety for advanced reactors, which can now be validated through computer simulation, something that might have required a physical demonstration a few decades ago. All of this flies in the face of the conventional wisdom about what it would take to commercialize advanced reactors. Developing new reactor technology is "an expensive, decades-long undertaking," Victor and colleagues concluded in their assessment. [A 2016 report by the Secretary of Energy Advisory Board](#) similarly concluded that it would take 25 years and \$12 billion to commercialize a single advanced reactor concept. Insofar as advanced nuclear commercialization depends upon the old, state-led innovation model, that assessment is almost certainly correct. But events appear to be rapidly overtaking the old model, and assumptions about nuclear development and innovation based upon it are ripe for reconsideration.

Today, as we suggested would be the case in [How to Make Nuclear Innovative](#), new reactor development is being led by private companies, with the federal government supporting nuclear innovation through targeted investments at key stages of the R&D and commercialization process, and helping to create an initial market for innovative new reactors through things like [federal PPAs](#) and a [DOD-supported pilot of microreactors \(SMRs\)](#). Smaller reactors that allow more flexible deployment and operation have also allowed advanced nuclear developers to target niche markets like off-grid communities in Alaska or mining sites in Canada that are infeasible for large conventional reactors. Small advanced reactors not only simplify engineering and licensing, they also allow for radically different business and finance models.

So while we certainly shouldn't uncritically accept the timelines advertised by developers of advanced reactors, it is worth considering that with so many developers already so far along in the engineering and licensing process, assessments and timelines based upon the history of state-led reactor development initiatives — even those conducted relatively recently — may already be well past their sell date. Ultimately, advanced nuclear will succeed or fail based upon whether developers are able to find initial markets, develop technologies that meet the needs of modern utilities and other users, and scale their operations and supply chains fast enough to accelerate technological learning and cost reductions.

It appears likely that we are going to find out whether they are able to do so much sooner than many observers have long assumed.

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I2M Web Portal Editorial Staff
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