

Analysis highlights failings in US's advanced nuclear program

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Despite repeated promises over the past 18 years, the US Office of Nuclear Energy (NE) is unlikely to deliver on its mission to develop and demonstrate an advanced nuclear reactor by the mid-21st century.

That is the conclusion of a new study from the University of California,

San Diego and Carnegie Mellon University, published today in the journal *Environmental Research Letters*, which used data obtained through the Freedom of Information Act to reconstruct the program's budget history.

Lead researcher Dr Ahmed Abdulla, from UC San Diego, said: "In theory, advanced, non-light water reactors are a promising carbon-free technology, which could complement or replace light water reactors. Some of these reactors would operate at higher temperatures, providing energy services that existing reactors cannot. Others, meanwhile, could reduce future nuclear waste burdens by operating for decades without refuelling, burning up more of their [fuel](#) and generating smaller volumes of waste.

"However, despite repeated commitments to non-light water reactors, and substantial investments by NE (more than \$2 billion of public money), no such design is remotely ready for deployment today."

The researchers investigated how effectively those resources were allocated, and how NE has performed as a steward of nuclear technology innovation. What they found was an office beset by problems and violating much of the wisdom about how to effectively run an applied energy research program.

Dr Abdulla said: "There were often inconsistencies in the annual budget documents. The budget itself varies significantly over the period of study, which is fine if these variations are part of a coherent vision that is being pursued, but that is not the case. At all levels, NE favours existing technologies and fuels over innovation, and, where it does support truly innovative research, it is prone to changing priorities before any concrete progress has been made.

"One example of this lack of vision is the gap that exists between the

advanced reactor and advanced fuel programs. Investing in advanced fuels research is critical to developing a new [nuclear reactor technology](#). However, NE has mostly invested in one fuel type while exploring multiple reactor designs, most of which do not use that fuel. This disjunction between the two programs is naturally problematic."

In addition, the team found that large proportions of the NE budget were spent maintaining research infrastructure that only marginally supports advanced reactors. Much of this infrastructure supports other programs, mainly related to defence, where research expenditures are even more removed from commercial opportunities.

Dr Abdulla said: "Despite substantial expenditure and commitments to this future, NE lacks the funding and programmatic focus required to execute its mission. Even if the program had been well designed, it still would have been insufficient to demonstrate even one non-light water technology.

"It has dedicated only \$2 billion over the past 18 years to all advanced reactor and fuel initiatives. While that may appear to be a substantial sum, by NE's own estimates it is not enough to ready even one such design for commercial deployment."

The authors recommend NE takes a new approach, exercising stricter programmatic discipline by channelling its resources into fewer efforts that are likely to generate a greater impact.

They also argue NE should establish a transparent process for evaluating the various advanced [reactor](#) concepts it supports across key performance requirements, in order to enable robust debate on the economic, safety, security and waste implications of various designs. An independent panel of experts should then identify, in consultation with key stakeholders, the one or two that best meet these key performance

requirements.

Dr Abdulla said: "If adopted, this would allow NE to better focus its limited funding, and would be in harmony with the industry's desire for risk-informed, performance-based guidance from government."

Overall, the technology's prospects appear grim, with implications that go beyond energy. Dr Abdulla warned: "Without a sense of urgency among NE and its political leaders, the likelihood of advanced reactors playing a substantial role in the transition to a low-carbon US energy portfolio is exceedingly low. From a broader perspective, this failure means that the US will cede its leadership on nuclear matters to other nations, limiting its ability to exert influence in key areas such as safety and non-proliferation as well."

More information: "A retrospective analysis of funding and focus in U.S. advanced fission innovation" Abdulla A et al 2017 *Environ. Res. Lett.* 12 084016 , [DOI: 10.1088/1748-9326/aa7f10](https://doi.org/10.1088/1748-9326/aa7f10)

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