◇Interview with Department of Energy, Office of Nuclear Energy

Christopher Smith *7 June 2025*

In an effort to better understand nuclear energy and its role in today's United States as well as tomorrow's, the following is a series of questions and answers in an interview with a Special Assistant in the Office of Nuclear Energy at the Department of Energy.

How efficient is nuclear energy compared to natural gas, coal, hydroelectric, wind and solar?

When comparing these different technologies, the most representative way to think about this is in terms of a reliable capacity, or capacity factor. Nuclear energy has by far the highest capacity factor of any other energy source. In 2024, nuclear power plants were typically producing maximum power more than approximately 92 percent of the time. To put things into perspective, wind and solar need the wind to blow or the sun to shine. When they are running, they generate electricity, but they may only generate electricity 20 to 40 percent of the time. Hydroelectric can operate as long as you have water to run through the system, so it's also a firm resource that can be utilized, but on average in 2024 it was only producing electricity a little more than 34 percent of the time.

Cost of going nuclear? -- How does nuclear energy stack up in terms of cost against natural gas, coal, etc.?

When talking about cost it is important to talk about the total system cost and to talk about large scale deployment. There will be a cost to the first-of-a-kind for any reactor design, but the goal is to get to n-th-of-a-kind and develop the orderbook. Through large-scale deployment we will be able to bring the cost of nuclear energy down by taking advantage of the low operating cost of established nuclear reactors with high-capacity factors.

How 'green' is nuclear? -- Could you discuss the pros and cons of nuclear energy's impacts on the environment?

Nuclear energy overall has a low impact on the environment. The spent nuclear fuel, which is commonly raised as a concern, is contained and does not enter the environment. We have been storing spent nuclear fuel safely for over 50 years. The U.S. government is responsible for safe disposal of the spent nuclear fuel. Currently, DOE is evaluating all options for the safe and secure storage, transportation, and disposal of spent nuclear fuel and high-level waste.

Nuclear power plants do not produce direct carbon dioxide emissions. The U.S.'s current light-water reactor fleet, the largest in the world, helps to avoid more than 430 million metric tons of carbon dioxide emissions each year, which is the equivalent of removing more than 95 million cars off the road. Nuclear power plants also have a small land footprint. A typical 1,000 MW reactor needs a little more than one square mile to operate and produces more power on less land than any other energy source.

Where in the United States should we focus on building up nuclear? -- Why there?

Nuclear offers a firm generator and can run 24/7, so almost anywhere where abundant, reliable, and secure power is needed there is a nuclear energy solution. One area of particular interest is the expanding demand from data centers and AI. There is a great intersection between the needs of the AI/data center world and the power that nuclear energy can provide. In a change from the past, we are seeing these hyperscalers take the lead in deploying future nuclear energy.

The Department recently issued a Request for Information (RFI) on using national laboratory sites and other DOE land to build AI data centers. The RFI lists 16 potential sites and asked stakeholders to comment on siting considerations for nuclear or other technologies to power the data centers.

Where in the United States may struggle to shift to nuclear? -- Why would those areas struggle?

Several U.S. states still have restrictions on nuclear energy development called moratoriums, but even in these states we are starting to see the thoughts on nuclear energy begin to change.

What policy/legal changes would you like to see in order to streamline nuclear energy?

Advancing nuclear technology is key to growing the nation's energy abundance, prosperity, and security. One of the many ways that DOE is helping industry bring advanced reactors to market is by seeking to reduce regulatory risk for early movers. This includes supporting efforts to streamline the licensing process, as well as defray licensing costs through the Advanced Reactor Licensing Cost-Shared Grant Program.

Additionally, we're leveraging federal lands to expedite projects and fostering multilateral relationships and financing mechanisms to export U.S. nuclear technology abroad to enhance energy security.

Demonstration projects also play a key role in bridging technology for commercialization. They reduce regulatory uncertainty and bring down costs for follow on deployments. As examples of where we are helping to reduce risk for early movers, we recently released a request for proposals for Gen III+ Small Modular Reactors and continue to push on our establishment of a domestic low enriched uranium and high assay low enriched uranium supply.

Could we be seeing any potential breakthroughs in nuclear energy in the near future?

The breakthroughs have already happened. The Gen III+ and Gen IV reactor technology has been studied and developed for decades, and they are ready for deployment now. The challenge is breaking through the first of kind deployment barrier and developing an orderbook for large scale deployments. Examples of recent wins include:

- U.S. has one certified SMR in the NuScale Power 50 MW power module.
- The U.S. just brought on online the first two newly built reactors in more than 30 years. AP 1000s are the most advanced light-water reactor systems in the world.
- We've seen several licensing movements for advanced reactor companies.
- TerraPower CPA is being reviewed by NRC. Dow/X-energy recently submitted.
- BWRX-300 is cleared for construction in Darlington, CA. TVA submitted a CPA for BWRX-300 in TN.
- Kairos Power started pouring nuclear-grade concrete in Oak Ridge, TN and has two CPAs approved to build Hermes 1 and 2.

Is there anything else you would like to add?

This is an extremely exciting time for the nuclear energy as Secretary Wright has called for an American nuclear renaissance to launch during President Trump's administration and there is strong bipartisan support for nuclear energy. The United States has a multitude of companies aggressively pushing to advance their nuclear technologies. The power market will have more business models and choices than ever before! It's an exciting time to follow this space and see where we end up as we get closer to deploying these technologies in the market.