# The Importance of New Nuclear Generation to Emissions Reduction

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**ABSTRACT**

Deep decarbonization scenarios will become twice as expensive to achieve if nuclear energy technologies are taken off the table. Advanced nuclear technologies with enhanced thermal systems can provide significant decarbonization. Furthermore, advanced nuclear technologies such as SMRs and microreactors can offer wider deployment of nuclear technologies from their flexible siting and reduced costs. New nuclear technologies can also be integrated with renewables such as hydrogen to form a more reliable and cleaner energy infrastructure. Additionally, as coal plants are retired, new nuclear technologies can fill the demand gap for baseload power. In order to achieve this future of widespread new nuclear technology deployment and significant emissions reductions, federal and state policies that drive carbon-free innovation will be invaluable to helping industry commercialize and deploy these new nuclear technologies on a wide scale.



**SUMMARY**

*The COVID-19 pandemic has created a global scenario in which global emissions are significantly decreased. However, once the pandemic is over, the emissions are expected to rise to the level they were before the pandemic started. Thus, it's important for the global community to find significant ways to reduce emissions to keep the emissions level relatively low.*

- Deep decarbonization scenarios will become twice as expensive to achieve if nuclear energy technologies are taken off the table. Advanced nuclear technologies with enhanced thermal systems can provide significant decarbonization.
- In the last year and a half in the United States, a number of utilities have made deep decarbonization goals, such as 80-100% reduction by 2050.

*There are a number of developments in advanced nuclear technologies that may be promising for clean energy agendas.*

- The Department of Energy received unprecedented resources in the FY20 budget to bring advanced reactors to the demonstration stage over the next decade. The reactor demonstration program is expected to see an RFP to come out before the end of the year.
- Oklo Aurora submitted the first combined license proposal to the DOE. They are the first non-LWR design to be submitted.
- GE has entered the licensing stage for their SMR. Oklo, GE, and NuScale are all in the NRC process.
- DoD announced their awards for the SCO microreactor program. This microreactor will be used in the military, and the demonstration for military uses will be conducted by 2023.

- The NRC made an announcement on the NRC early site permit and EPZ rule making that limits the safety zone regarding varying risk profiles for advanced reactor technologies.

*Large reactors are experiencing economic challenges due to their constant operation while competing with lower energy prices. These are causing reactors to shut down early, which is contrary to the goal of clean energy.*

- SMRs and microreactors are a technology opportunity to correct this economic problem by lowering operational and construction costs to allow nuclear to become more cost competitive with other baseload generation sources.
- Integrated energy systems couple and tightly use multiple different sources of clean energy. Renewables, fossil fuels with sequestration, and nuclear can all be combined to produce hydrogen, provide input for chemical processes, and support the electrical grid as well as industry. SMRs and microreactors can allow for more versatile siting of reactors, and can help realize this integrated hybrid energy system.

*From 2019-2025, 3,357 MW of coal generation is expected to retire in the Northwest USA. No new generating projects are planned, and there is a void that needs to be filled. However the CEDA act prohibits coal from being imported from other states.*

- The current Loss of Load Probability is at 5-6%, which is the maximum threshold for normal operations. The closures in NW suggest that starting in 2021 and through 2024, the LOLP will rise to a concerning level. SMRs are a solution to this problem.
- A study found that the optimal mix of energy in the NW region is a mix of new nuclear and renewable generation sources.

*Utilities are not poised to perform the R&D necessary to move these technologies to market, but they are poised to buy these technologies once they are moved to market. In this aspect, state and federal policies can drive innovation towards carbon-free technologies. Xcel Energy hopes to provide 100% clean energy to its customers by 2050.*

- Before that, the milestone is to reach 80% emissions reduction by 2030. Shuttering much of the fossil fuel profile and expanding the renewable profile will achieve this. Furthermore, running nuclear plants to the end of their license lifetime is the most cost effective way to decarbonize currently.
- Renewables and nuclear can work together in areas such as chemical process inputs and hydrogen production.
- In order to reach full decarbonization by 2050, Xcel Energy will have to include advanced, dispatchable renewables; zero-carbon fuels such as hydrogen; advanced nuclear, carbon capture, utilization, and sequestration; and storage technologies.

**QUESTION & ANSWER**

**Q:** *As your companies look to transition to a low carbon future, what do you see as the biggest challenge or largest uncertainty?*

**A:** There are 2 things: the transmission infrastructure in the NW is largely at capacity, and cost. What may be an expensive MWh could be very affordable 10 years from now when we have additional carbon constraints on the system. However, predicting these is difficult.
**A:** The vision for 2030 is a very clear picture, and we're going to be accomplishing that through regulatory proceedings. We see a pathway using existing technologies to reach that goal affordably and reliably. The current gap is looking forward to the 2050 goal. We see multiple potential pathways, but none of those are possible without a dedicated development of these technologies.

**Q:** *Can you discuss the long-term scalability for hybrid energy systems? What other roles can nuclear play in outside of electricity generation?*
**A:** Low temperature electrolysis machines use electricity rather than thermal energy. However, soon we can site and demonstrate the high temperature electrolyzers. As electrolyzer technologies are developed, they can be sited next to plants to allow for hydrogen production both for on-site and off-site use. Hydrogen is one of the first adopters of the hybrid-integrated systems because it's a commodity that can go towards many different applications. Water desalination is another area that we're looking at in the Palo Verde site. We're also looking to better utilize carbon-based sources such as coal. NETL is looking to utilize coal differently.

**Q:** *Can you discuss the potential for multiple SMR projects? Would it be beneficial for competition and manufacturing?*
**A:** Having multiple SMR projects will be beneficial to the workforce, manufacturing, and local supply chain. There are many different applications in the manufacturing and agricultural sectors where nuclear can establish its role.
**A:** We see it as being a benefit for several reasons. One, the optimal portfolio is 5.5GW of SMRs being added. We'd love to see two being built prior to 2030 where demands and shortfalls will be at their greatest.

**Q:** *As we look at deep decarbonization, how will utilities look to broader emissions reductions?*
**A:** We're working on the transportation sector, as that's the biggest sector. We have EV pilots going on with electric buses.
**A:** Even from a broader perspective, deep decarbonization is looking at a societal system rather than individual sectors. We see our role in that as moving our electric generations to zero emissions by 2050. The electric sector will be more important to the transportation sector, so to meet that goal, the electric sector piece of that will have to go to zero.

**Q:** *Georgia is advancing the two additional Vogtle AP-1000 reactors that may be placed in service in a couple years. What are some military applications for the advanced nuclear technologies?*
**A:** The army is looking at a microreactor sited at a forward military base for reliable power.

**A:** The role of the national laboratory system is to buy down the risk and understand what we can learn so that a company adopting a new technology is taking on a significant operational risk. Military operations are a little different, and one of the main drivers of a microreactor on a military base is having reliable power. I don't think ratepayers would be impacted by that.
**A:** The army's program is to be a customer of a reliable power source in the form of an SMR.