

Advanced Reactors: The Future of Nuclear Energy

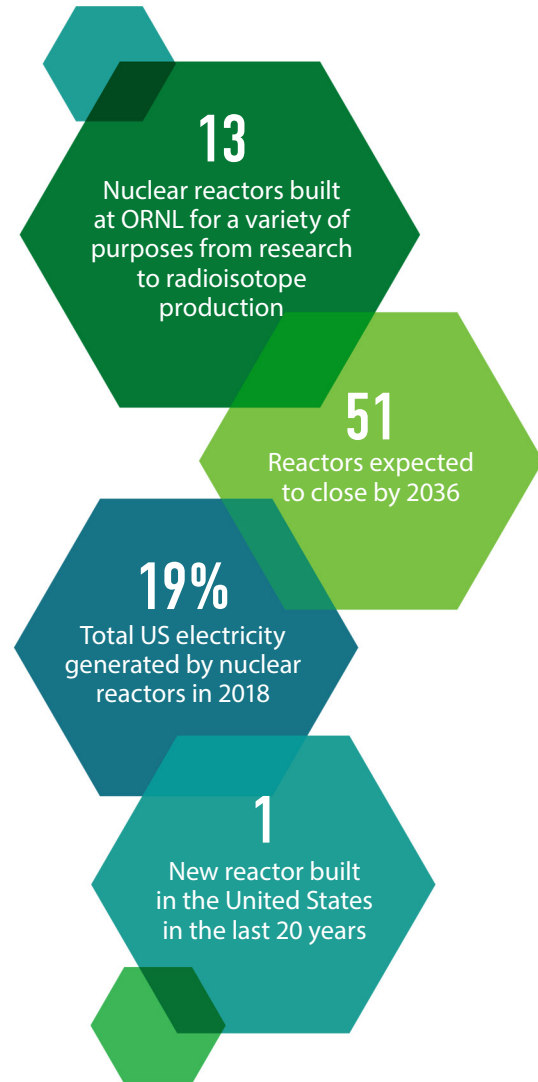
Oak Ridge National Laboratory pioneered nuclear energy and is ushering in the next era of nuclear innovation. Since building and operating the first permanent nuclear reactor more than 75 years ago, ORNL has shaped the development of reactors that now generate nearly 20% of the United States' electricity. Today, ORNL leads efforts in advanced reactor technologies to address challenges related to our nation's aging reactor fleet and the demand for safe, clean energy.

Reactors Reimagined

US nuclear reactors operate on 40-year licenses from the Nuclear Regulatory Commission, with 20 year extensions possible. Because most reactor licenses will expire in the next 15 years, the United States could face a significant energy deficit, with devastating effects on our power grid and economy.

To address this challenge, ORNL is working with other national laboratories, universities, and industry leaders to research, develop, and eventually commercialize new nuclear power plants. These advanced reactors could improve nuclear energy's performance through enhanced safety features, increased power production, and significant decreases in nuclear waste. ORNL offers important resources to assist in deploying advanced reactors.

- **Computing**—ORNL's supercomputing facilities provide tools for modeling and simulation to investigate advanced reactor designs and safety features, potentially reducing the time required to develop and license new designs.
- **Nuclear materials and fuels science**—ORNL facilities and instruments at the Spallation Neutron Source, High Flux Isotope Reactor, and hot cells allow ORNL scientists to develop and test materials—including current and new types of nuclear fuels—used in nuclear environments.
- **Design expertise**—ORNL is equipped to support the development of any advanced reactor design, including molten salt reactors and high-temperature gas reactors, with numerous private companies pursuing different versions of these reactors.



"If we are going to reduce carbon emissions on a global scale, then nuclear energy has to be a part of the mix."

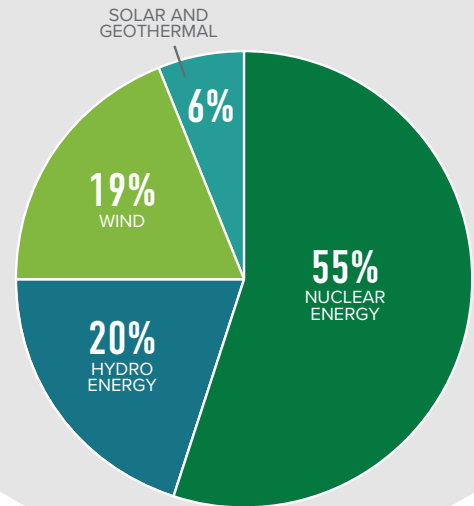
Eva Davidson,
Reactor Physics Analysis Engineer

Partnerships and Collaborations

ORNL is a part of a variety of efforts to support the development and implementation of advanced reactors, including the following.

- Through DOE's Gateway for Accelerated Innovation in Nuclear, ORNL participates in various projects to move nuclear energy technologies toward commercialization. These projects include a diverse collection of industry and university partners from across the country and focus on a wide range of research challenges—from building reactor components to investigating new types of fuel.
- Additional agreements connect ORNL's expertise to industry efforts to make reactor designs a reality. Partners on these projects include Terrestrial Energy Inc., the Tennessee Valley Authority, and NuScale Power.
- ORNL worked with other national laboratories on initial drafts of advanced reactor design criteria, which are instrumental in the NRC's guide for new reactor development. This regulatory guide will help designers and applicants through the licensing process.
- The fifth Molten Salt Reactor Workshop, held at ORNL in 2019, offered an opportunity for attendees from industry, utilities, reactor design firms, DOE, NRC, and universities to discuss the latest efforts to deploy new MSRs in the next decade.

Clean energy produced by source in 2018



MiniFuel—a small-scale, ORNL-designed experiment—drastically decreases the size of fuel specimens and capsules irradiated in HFIR. The unique platform will allow for faster qualification of new nuclear fuels, providing economic benefits to nuclear power plant operators.



Future nuclear reactors could use new types of sensors developed at ORNL to provide real-time plant monitoring. The capability to better understand a reactor's performance would improve operations and enhance safety.



ORNL has a legacy of groundbreaking work in nuclear fuels. Today, ORNL engineers are researching advanced fuel types that could be used in the next generation of nuclear reactors.

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