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Powered By Possibilities

The United States pioneered the development of nuclear power to produce electricity in the late 1940s. Since then, U.S. leadership in nuclear energy technology has given citizens the benefit of clean, reliable electricity for close to seven decades. Our fleet of nuclear power plants supplies nearly 20 percent of the electricity generated in the U.S., while avoiding millions of tons of carbon dioxide emissions each year. It is by far the largest source of clean, carbon-free energy and the most reliable, operating at over 90 percent capacity factor.

New Generation of Technology

With help from the U.S. Department of Energy (DOE) and our world-class national laboratories, a new generation of nuclear prototype reactors is expected to arrive in the mid 2020s.

DOE funds innovative advanced reactor designs with the potential to transform the nuclear energy sector. The national labs offer the unique research capabilities and technical expertise needed to bring these designs to fruition.

Small Modular Reactors (SMRs)

SMRs are an advanced nuclear reactor concept with a power output of 300 MWe or less. Major components or modules of SMRs can be factory fabricated and shipped to a construction site by truck, rail, or barge. SMRs are roughly one-third the size of a typical nuclear power plant. They’re smaller, scalable, flexible, and less expensive.

Benefits of SMRs

Because SMRs have a simple, compact design, utilities have more options to deploy nuclear power. This includes developing reactors in locations unable to support larger nuclear power plants. SMRs can power smaller electrical markets and grids, isolated areas, and sites with limited water. They require less time up front to build and can drastically reduce initial costs for plant construction. This is partly because SMR parts and components can be manufactured in a factory and shipped to the construction site. Using SMR technology also allows operators to scale up or down to meet energy demands.

SMRs are also right-sized to replace aging and retiring fossil energy plants. Utilities and developers could take advantage of existing infrastructure, such as water intakes and electric distribution equipment, as they identify locations to deploy SMRs.

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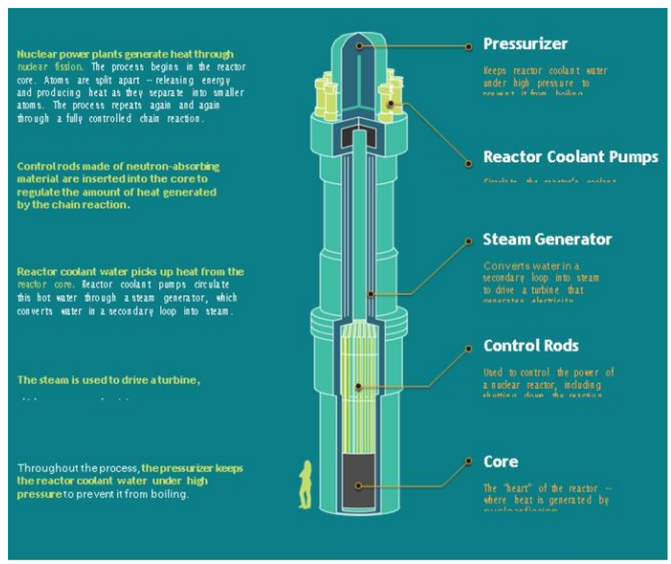
For More Information

- Facebook (@NuclearEnergyGov), Twitter (@GovNuclear), LinkedIn (@NuclearEnergyGov)
- https://www.energy.gov/ne/nuclear-reactor-technologies/ small-modular-nuclear-reactors
- https://www.energy.gov/ne/articles/5-key-resilient- features-small-modular-reactors
- https://inl.gov/trending-topic/carbon-free-power-project/

Demonstrating SMR Technology

Idaho National Laboratory is working with Utah Associated Municipal Power Systems (UAMPS) to site an SMR as part of its Carbon Free Power Project. UAMPS plans to construct a multi-module SMR system designed by NuScale Power on the Idaho National Laboratory (INL)site.



How a small modular reactor works.

Microreactors

Microreactors are smaller, factory-built systems that can be transported by truck, rail, barge, or airplane.

They provide between 1 and 50 megawatts of power and can operate independently from the electric grid.

Benefits of Microreactors

Microreactors will be factory fabricated. All components of the reactors can be fully assembled in a factory and shipped to a location. This eliminates difficulties associated with large- scale construction, reduces capital costs, and significantly reduces the time it takes to begin operating a new reactor.

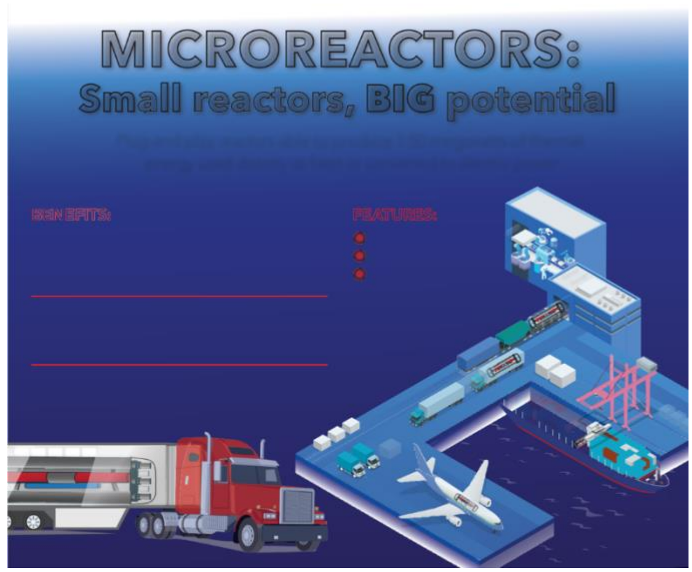
Due to their smaller size, microreactors will be very transportable. Vendors will be able to ship the entire reactor by truck, shipping vessel, airplane, or rail car.

Their smaller size and transportability mean that microreactors can supply continuous power to remote, rural communities.

Many very remote communities must currently rely on periodic shipments of diesel to run generators. Microreactors will provide an important option for these communities to have access to a continuous, reliable source of electricity for up to 10 years at a time without refueling.

These small, agile systems could also be dispatched to restore power to areas hit by natural disasters or used to power microgrids. Some microreactors can be set up in days to restore power. Due to their smaller size and transportability, microreactors can be quickly dispatched to sites and as well as removed and exchanged for new ones.

Microreactors can operate in places large reactors cannot. They provide an important choice for communities that need a reliable source of clean electricity without the costs or infrastructure of a large construction project.



Features and benefits of microreactors.

For More Information

- Facebook (@NuclearEnergyGov) and Twitter (@GovNuclear)
- https://www.energy.gov/ne/articles/what-nuclear- micro-reactor
- https://www.energy.gov/ne/articles/big-potential- nuclear-micro-reactors

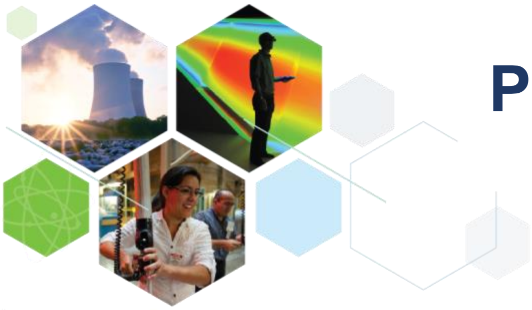
Advanced Reactors

Dozens of U.S. companies are developing advanced reactor designs. To spur innovation in advanced reactor development, DOE has awarded more than $200 million as part of the U.S. Industry Opportunities for Advanced Nuclear Technology Development funding opportunity.

The United States is developing a wide range of advanced reactor types. Some of these innovative systems are discussed below.

Liquid Metal-Cooled Fast Reactor

Instead of water, these reactors use liquid metal—such as sodium or lead—as a coolant. This allows for higher temperatures and lower pressure than current reactors, improving both safety and efficiency. Because they use a fast neutron spectrum (neutrons can be used to cause fission without having to be slowed down), these reactors can consume used fuel from current reactors to produce energy.



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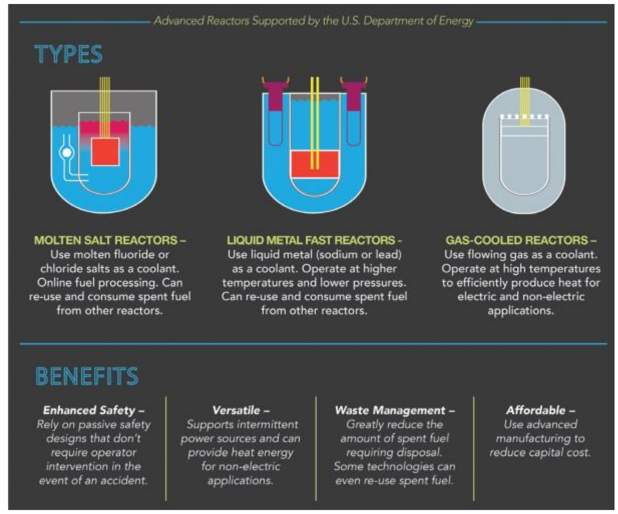

Advanced reactors supported by the U.S. Department of Energy

Gas-Cooled Reactor

Designed to operate at high temperatures that can produce electricity extremely efficiently, these reactors are cooled by flowing gas. They can be used in energy-intensive processes that currently rely on fossil fuels, including hydrogen production, desalination, district heating, and ammonia production.

Molten Salt Reactor (MSR)

Using molten fluoride or chloride salts as a coolant, MSRs are designed to use less fuel and produce shorter-lived radioactive waste than other reactor types. They have the potential to significantly change the safety profile and economics of nuclear energy by processing fuel online, removing waste products, and adding fresh fuel without lengthy refueling outages. Their operation can be tailored for efficient burn-up of fuel and minor actinides, which may allow MSRs to consume waste from other reactors. They can also be used for electricity or other nonelectric industrial applications.

Integrated Energy Systems

DOE's national laboratories are developing new applications for nuclear energy, including hydrogen production, industrial manufacturing, chemical production, and water desalination. Using nuclear to support energy-intensive industrial processes could decarbonize those areas.

DOE is also developing advanced integrated energy systems that couple nuclear, renewable, and fossil energy sources to produce electricity and nonelectric energy products such as heat. These integrated systems allow for flexible energy production, making them more responsive to market dynamics–and more profitable. INL's designation as the lead for DOE's National Reactor Innovation Center and the lab's legacy as a national test bed for transformative nuclear energy technology makes it the perfect place to demonstrate leading-edge design.

The Tennessee Valley Authority (TVA) also is considering building a SMR at the Clinch River site near Oak Ridge, Tennessee. TVA's application for an early site permit was approved by the U.S. Nuclear Regulatory Commission on December 19, 2019.

They plan to apply for a site operating license in the next several years. TVA is coordinating its site licensing efforts with UAMPS to develop standard licensing content for the NuScale design and bring this exciting technology to the market.

Demonstrating SMR technologies will pave the way for a range of advanced reactor designs in the future.

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For More Information

- Facebook (@NuclearEnergyGov) and Twitter (@GovNuclear)
- https://www.energy.gov/ne/nuclear-reactor-technologies/ advanced-reactor-technologies
- https://www.energy.gov/ne/initiatives/funding-opportunities