Factsheet

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Small Modular Reactors (SMR)

When it comes to a zero-emission future for the energy sector, we increasingly hear the term Small Modular Reactors (SMRs) – but does everyone truly understand what they are? This factsheet is designed to answer the most pressing questions.

For more insights, be sure to read our article “Revitalizing Nuclear Energy in North America” (here).

What is an SMR?

Small Modular Reactors (SMRs) are compact nuclear power plants, often referred to as mini-NPPs. They can be prefabricated and assembled in a factory, then transported to the site ready for use. This significantly reduces construction time, complexity and costs.

- They require significantly less space than conventional nuclear power plants.
- Electricity production can be flexibly adjusted to meet actual demand.
- The safety systems and standards are identical to those of traditional NPPs.

How does a Small Modular Reactor work?

An SMR operates similarly to traditional nuclear reactors but on a smaller scale. The core contains nuclear fuel, typically uranium, which releases a significant amount of heat through nuclear fission. This heat converts water into steam, which drives a turbine connected to a generator, thus producing electricity. The technology is essentially the same as that of a conventional nuclear power plant.

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How small are SMRs? Can they fit in a backyard?

SMRs are significantly smaller than conventional nuclear reactors. They can be prefabricated in a factory and transported to the site. The exact size varies depending on the design and power output, but generally, they occupy only a fraction of the space required by a conventional reactor. Let's assume an SMR requires only about 0.01 square kilometers, that is less than two soccer pitches. However, they are not small enough to fit in a backyard.
As a comparison: A conventional nuclear power plant requires about 1 to 2 square kilometers, that's approximately 140 to 280 football pitches.

Is the output of an SMR comparable to that of a conventional nuclear power plant?

No, the output is not identical. Most SMR designs generate between 200 to 300 MW of energy. There are also plans for larger SMRs in the 400-500 MW range, such as those being developed by Rolls-Royce SMR in collaboration with Siemens Energy. In contrast, a conventional nuclear power plant typically has a capacity of about 1 Gigawatt (GW), making SMRs about two to five times smaller in output.

Do SMRs produce nuclear waste?

SMRs produce nuclear waste. The amount and type of waste can vary depending on the specific design and technology of the SMR. The question whether SMRs produce less, similar, or more nuclear waste than conventional reactors cannot be fully answered today. Conclusive results will require the construction and operation of several SMRs.

Are there any operational SMRs?

Yes, there are two operational SMRs worldwide. China and Russia have built and commissioned SMRs, one SMR is under construction in Argentina. For example, China connected its pebble-bed modular high-temperature gas-cooled reactor (HTR-PM) to the grid in 2021. Additionally, many countries are researching SMR technology and plan to use SMRs for their future energy supply.

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When are the first commercial-scale SMRs expected to be operational?

The European Industrial Alliance for SMRs aims to facilitate and accelerate the development, demonstration, and deployment of SMRs in Europe by the early 2030s. Rolls Royce and Siemens Energy are committed to be among the first to bring a SMR into operation.

What is a Generation 3+ reactor?

Nuclear reactors are categorized into different generations based on their design, technology, and safety features. Generation III+ reactors improve upon Generation III reactors, which have been in operation since the 1990s, by offering increased safety, efficiency, and operational lifetimes. These reactors have passive systems that function without human intervention or external power in emergencies.

What is Siemens Energy's contribution?

Although Siemens Energy is not directly involved in developing the reactors, its decades of experience in the conventional nuclear sector make it a natural supplier for such power plants. Siemens Energy's portfolio includes steam turbines, generators, and operational instrumentation and control systems that monitor the entire power plant.

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