

Commentary

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Small nuclear reactors – a new chapter in nuclear power

Russia's aggression against Ukraine and the ongoing war have caused a Europe-wide energy crisis, the consequences of which we are all facing today. A lively discussion is under way, both at EU level and in all Member States, among politicians and experts, who are jointly trying to work out solutions that will best protect us from a gas shortage both during the coming winter and over the next several months.

The current situation has ruthlessly exposed how dangerous and short-sighted the growing dependence of our continent on a single source of raw material supply has been. What lessons can be drawn from this? What lessons will we learn for the future? Finally, how do we try to bridge the gap that has arisen in a way that simultaneously combines the needs of decarbonisation and building a zero-carbon economy with the need to provide further conditions for the development of our economy?

One possible and noteworthy solution is certainly Small Modular Reactors (SMRs). Small Modular Reactors - a technology that has been known and developed since the 1960s, but has only now been refined to the point where widespread commercial use is possible.

Small Modular Reactors are defined as reactors of up to 300 MWe, mass-produced in production facilities and delivered in their entirety to the target site. Nuclear power sector is nowadays dominated by large-scale light-water reactors and power units, each with a capacity exceeding 1 GW. They entered the world economy several decades ago. They achieved great success after 1973, when Europe, with their help, overcame the energy crisis caused by the war in the Middle East. In France alone, more than forty large-scale light-water reactors were built over a fifteen-year period.

However, for all its advantages like highest safety standards and the guarantee of stable supplies, large-scale nuclear also has some disadvantages – the most significant are high costs of investment and the need to have or create appropriate infrastructure facilities.

Small scale but enormous flexibility

So why the concept of Small Modular Reactors seems so promising option for advanced industrial economies seek to decarbonize and boost their energy independence?

First of all – considerably smaller costs. Thanks to experience gained from large-scale nuclear power, but with the modular structure of reactors and power units, SMRs are to be manufactured in series at production facilities and delivered in their entirety to the target site. This makes it possible to take advantage of the economies of scale of series production and to achieve relatively short construction times.

Smaller scale also means less complexity in the construction itself, which - while maintaining strict safety requirements - allows for a significant reduction in the number of pipelines needed, meaning significant savings not only at the construction stage itself, but also over many years of operation and maintenance.

Another important advantage of SMRs is that they can be installed close to consumers, which reduces the costs of network construction and energy transmission to end users (e.g., energy-intensive industrial plants).

The ability to take advantage of the economies of scale of series production and the relatively short construction time, as well as the much lower water requirements, are also important.

Just as important as the issue of lower costs is the possibility to tailor the plant to specific needs and, depending on local conditions, to create small or larger energy complexes. The small reactors can be installed individually or as a group of multiple modules that are commissioned in succession, making the entire investment relatively easy to scale up as, for example, production at a particular plant expands or a city that uses this type of power supply expands. And at the end of its life, the SMR can be removed or dismantled in whole or in part by relocating to another site.

For whom?

Due to their specific characteristics, SMRs are not in competition with "traditional" high-power reactors operating as core elements of the energy system in many EU and non-EU countries.

They can, however, complement them in specific applications and circumstances, such as the supply of energy and heat to remote and inaccessible communities (e.g., in the USA, Canada, Norway or Finland), as local heat sources for industry, district heating networks or seawater desalination, as well as for replacing coal-fired power stations that are being phased out and have reached the end of their useful life, whose capacity for individual units usually does not exceed 500 MWe.

Small-scale nuclear is also an ideal solution for creating a stable base for the energy system of developing countries with low total grid capacity, restrictions on access to cooling water and little experience in implementing nuclear power.

Polish case study

Currently, several light water SMR projects are almost ready for the commercial deployment. KGHM is Poland's second-largest industrial consumer of electricity, has chosen to work with, among others, NuScale Power, LLC. With an annual consumption of about 3 TWh and with the nature of the metal processing industry, the company requires nearly constant access to sources with the capacity of about 400 MWe.

It is subject to further verification within the framework of KGHM's nuclear power project, whether the design of NuScale's 462 MW modular VOYGR™-6 plant meets the company needs and at the same time is mature enough in three key areas: technological, regulatory, and business to be successfully deployed.

The future

The coming years will show whether the technologies currently under development will live up to the hopes placed in them. A steady stream of work at several different centres around the world indicates that there is a good chance that at least some of these projects will find commercial application.

At the same time, work should be intensified to adapt the licensing procedure for large blocks to small units as well.

The successful implementation of the small-scale nuclear power plant programme will demonstrate not only the ability to achieve nuclear industry objectives, but also will bring us closer to answering the question about the possible role of SMR units in building modern, resilient and green economy.