Istituto Affari Internazionali

Are Small Modular Reactors Europe's Energy Salvation?

by Manuel Herrera

Nuclear power has never lived up to expectations due to its enormous development, construction and maintenance costs, as well as safety concerns. However, governments committed to ambitious climate change targets have taken a second look at it. In Europe, for instance, in January this year, the European Commission added nuclear power to the list of projects eligible for green financing and, in July, included it in its taxonomy.[1] Russia's invasion of Ukraine, meanwhile, has sent fossil fuel prices soaring and put energy security at the top of the political agenda in Europe.

The nuclear industry believes it has the answer both for guaranteeing energy security in Europe and reducing greenhouse gas emissions: a new generation of small modular reactors (SMRs), designed to be cheaper, faster to build and less financially risky. The main differences between SMRs and classical nuclear power plants are the former's smaller power output (typically less than 300 Mwe per unit) and modularity, which allows working in a more controllable environment and the standardisation of design, as well as shorter construction time.

Against this backdrop, last June, the International Energy Agency (IEA) published a report recognising the unique opportunity for nuclear power in the context of the current energy crisis and ambitious decarbonisation goals. The report notes that both the net-zero challenge and the impacts of the Russian invasion of Ukraine are rekindling global interest in nuclear power and, in particular, advanced nuclear technology, including SMRs.[2]

[1] The taxonomy regulation is part of the Commission's action plan on financing sustainable growth and aims to boost green investment and prevent greenwashing. See European Commission, *Renewed Sustainable Finance Strategy and Implementation of the Action Plan on Financing Sustainable Growth*, last updated on 5 August 2020, https://europa.eu/!vFDJMw.

[2] International Energy Agency (IEA), *Nuclear Power and Secure Energy Transitions. From*

Manuel Herrera is a researcher in the Multilateralism and Global Governance programme at the Istituto Affari Internazionali (IAI).

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However, as with any new technology, the pros and cons of SMRs must be carefully examined, to assess their viability as an alternative energy source in Europe.

Pros and cons of SMRs

From an economic point of view, SMRs are expected to be competitive vis-à-vis classical large reactors. Their smaller size and shorter lead times could reduce the initial investment required, resulting in a lower financial risk for potential customers and investors.[3] Furthermore, total construction costs of SMRs are expected to be lower than those of traditional light water power plants[4] and, in terms of safety and security, most SMRs will be significantly safer than existing reactors as their smaller size means that there is much less waste heat to remove and much less radioactivity to handle in the event of an accident.

The increasing interest in SMRs might also have a positive effect on regulation and licensing. Several international organisations and governmental and industrial groups have proposed to overcome barriers to the licensing of SMRs through greater harmonisation of national regulations.[5] One approach is to establish an ad-hoc international regulatory system with the support and participation of the main national nuclear regulators around the world.

However, SMRs are not without their own set of challenges, notable among them existing nuclear regulation. While the safety of SMRs could generally be addressed within the existing regulatory framework, there are issues that need to be resolved. In particular, current regulatory practices may not be fully compatible with a standardised factory assembly model. Another main challenge for SMRs will be the need to obtain design and operating licences within a reasonable timeframe and at an acceptable cost.

Furthermore, the safety of the proposed SMR designs is unproven: for example, most designs require weaker containment structures, and reactor owners may be tempted to reduce costs. Also, due to the specifics of SMRs, the volume of waste to be managed will increase, and questions related to the centralisation of storage and disposal of such waste will emerge.

While the costs of nuclear power have been rising steadily for decades, those of renewables have plummeted and are now much lower than nuclear power. In this sense, the industry must overcome many of the perceptions of previous generations of nuclear power: that projects are too costly, complex

Today's Challenges to Tomorrow's Clean Energy Systems, June 2022, https://www.iea.org/reports/nuclear-power-and-secure-energy-transitions.

[3] Joanne Liou, "What Are Small Modular Reactors (SMRs)?", in *IAEA Nuclear Explained*, 4 November 2021, https://www.iaea.org/node/97956.

[4] Benito Mignacca and Giorgio Locatelli, "Economics and Finance of Small Modular Reactors: A Systematic Review and Research Agenda", in *Renewable and Sustainable Energy Reviews*, Vol. 118 (February 2020), Article 109519, https://doi.org/10.1016/j.rser.2019.109519.

[5] Jeffrey Donovan and Paula Calle Vives, "Accelerating SMR Deployment: New IAEA Initiative on Regulatory and Industrial Harmonization", in *IAEA Articles*, 1 April 2022, https://www.iaea.org/node/103112.

and unsafe, especially when compared to traditional fossil fuels and the rapid deployment of renewables.

At the moment, there is no guarantee of convincing industrial users that these reactors can compete with low-cost natural gas or renewables such as wind and solar, as SMRs real competitiveness vis-à-vis renewables has not been proved yet. Renewables, however, are unlikely to become a viable alternative in the short term as a substitute energy source to power activities such as heavy industry and the likes. Thus, a technology-neutral energy transition will probably need to include nuclear energy, including fission-based SMRs.

Ongoing SMRs projects in Europe

Despite such uncertainty, countries such as the United States, the United Kingdom and Canada are taking intensive policy measures for the development of SMRs: they are not only securing huge budgets, but also the sites, facilities and technical data from national laboratories. Regulators are also holding many discussions to prepare flexible and predictable schemes for SMRs.

In Europe, nowhere has this attention been greater than in Central and Eastern Europe (CEE), a region particularly vulnerable to dependence on Russian gas and other hydrocarbons.[6] CEE countries have embarked on ambitious plans to deploy large numbers of these new types of reactors in the coming years.[7]

The most ambitious and advanced projects are in Romania. This country has reached a number of nuclear cooperation agreements with the United States, including a US–Romania intergovernmental agreement signed in December 2020[8] and a cooperation agreement on SMRs.[9] Within this framework, the US government has funded a number of nuclear initiatives such as the NuScale[10] SMR simulator ("E2 Centre") installed at the Politehnica University of Romania. Another example is the US Trade and Development Agency (USTDA) grant of 1.28 million US dollars awarded to the Romanian nuclear company Nuclearelectrica, for a site suitability study to identify potential locations in Romania to host SMRs.

Poland is also working on a number of new nuclear initiatives supported by the US government to replace coal and Russian gas. For example, in 2021, the USTDA awarded a grant to

[6] World Nuclear Association, *Nuclear Power in the European Union*, updated October 2022, https://www.world-nuclear.org/information-library/country-profiles/others/european-union.aspx.

[7] World Nuclear Association, *Plans for New Reactors Worldwide*, updated November 2022, https://world-nuclear.org/information-library/current-and-future-generation/plans-for-new-reactors-worldwide.aspx.

[8] USA and Romania, *Agreement between the Government of the United States of America and the Government of Romania on Cooperation towards the Cernavoda Nuclear Power Projects and the Civil Nuclear Power Sector in Romania*, Upper Marlboro and Bucharest, 4 and 9 December 2020, https://www.state.gov/romania-21-728.

[9] US Embassy in Romania, *U.S.-Romania Cooperation on Small Modular Reactors (Fact Sheet)*, 2 November 2021, https://ro.usembassy.gov/?p=28721.

[10] NuScale Power is a US company that designs and markets SMRs.

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Westinghouse "to advance" nuclear energy and launch engineering and design work in Poland.[11] Also, the Polish state-owned Enea SA signed a letter of intent with Last Energy, a US developer of SMRs, to partner in the deployment of SMRs in Poland.[12]

For its part, the Czech Republic is exploring alternative nuclear fuel supply options to reduce its dependence on Russia such as the possibility of deploying SMRs. Czech company ČEZ and NuScale have a memorandum of understanding to exchange nuclear and technical expertise, in particular on the development, construction and operation of the nuclear supply chain, as they begin the application process to deploy NuScale's SMR technology.[13]

Finally, Bulgaria has also announced its interest in deploying US nuclear technology for its next round of reactors. To this end, Bulgarian Energy Holdings, Fluor and NuScale signed a memorandum of understanding in October 2021 regarding new SMR facilities.[14]

SMRs in Europe: The way forward?

The development of all these SMRs projects is relevant for European energy security as it may provide diversification and a viable source for energy transition. At the same time, it may foster a new relationship of unequal dependence on US nuclear technology and nuclear fuel. In the long-run, the solution to Europe's energy security dilemma is to switch to indigenous energy sources. However, as mentioned above, opting for a single set of solutions would not be feasible. Renewables will be needed, as well as gas with carbon capture and storage, hydrogen, nuclear power and, of course, improvements in storage capacity.

Over the past thirty years, however, USTDA – rather than European institutions – has been the main driver of energy security across CEE, funding more than 130 energy sector activities in 18 European countries.[15] This may lead not only to potential energy dependence of these countries on the US, but to a complete geopolitical alignment with Washington's decisions and views vis-à-vis Russia, as well as an increase in intra-European brinkmanship between Eastern and Western Europe in foreign policy.

So far, the only glimmer of a "European" initiative in this area has been French President Emmanuel Macron's announcement that he will

[11] "Westinghouse Launches Polish Nuclear FEED Work", in *World Nuclear News*, 1 July 2022, https://world-nuclear-news.org/Articles/Westinghouse-launches-FEED-work-for-Polish-project.

[12] "Poland Expands Cooperation on SMRs and Large Reactors" in *World Nuclear News*, 23 June 2022, https://world-nuclear-news.org/Articles/Poland-expands-cooperation-on-SMRs-and-large-react.

[13] NuScale, *NuScale Partners with ČEZ to Explore SMR Deployment in the Czech Republic*, 26 September 2019, https://newsroom.nuscalepower.com/press-releases/news-details/2019/NuScale-Partners-with-EZ-to-Explore-SMR-Deployment-in-the-Czech-Republic/default.aspx.

[14] "Bulgaria Enlists Fluor and NuScale", in *World Nuclear News*, 29 October 2021, https://www.world-nuclear-news.org/Articles/Bulgaria-enlists-Fluor-and-NuScale.

[15] USTDA, *Eastern Europe: Energy Security through Diversification*, 25 March 2022, https://ustda.gov/?p=19529.

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invest 1 billion euro in research and development of SMRs. Notably, though, this has been framed as a French industrial priority,[16] potentially fuelling intra-European competition rather than collaboration. If Western European countries were instead to invest in this technology through a European programme that would diversify the sources of funding so that the total cost would not be borne at the member states level, the potential dependence on the United States could be mitigated - and thus, at least in principle, a greater divide between Western and Eastern European countries in formulating foreign policy towards Russia could be avoided.

By including nuclear energy in its taxonomy, the European Commission has opened the door to developing an industrial strategy promoted by the EU institutions for the design of indigenous European SMRs. This should be supported by substantial funding and regulatory standardisation for compliance with IAEA/Euratom safeguards and nuclear safety legislation. In this way, Europe could quickly become a world leader in SMRs.

True, the economic competitiveness and overall viability will be really tested once wider implementation has taken place: for SMRs to become game changers, they must be able to take full advantage of the technological learning offered by modularity. Therefore, the adoption of a strategy for the development of SMRs in Europe would be more of a "gamble" on the part of the EU than a certainty in terms of energy diversification. In light of the current geopolitical situation, however, it makes sense to take the risk.

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[16] Aneta Zachová and Michal Hudec, "EU Pro-Nuke Club Explores Small Modular Reactors with US Assistance", in *Euractiv*, 7 April 2022, https://www.euractiv.com/?p=1740338.

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Via dei Montecatini, 17
I-00186 Rome, Italy
Tel. +39 066976831
iai@iai.it
www.iai.it

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Director: Leo Goretti (l.goretti@iai.it)