

Central Europe has put nuclear power at the forefront of efforts to quit Russian oil and gas and decarbonise economies, yet breaking the region's dependency on Russia's giant nuclear holding company **Rosatom** – for fuel, financing and waste disposal – promises to complicate those efforts.

The region's reliance on **Rosatom** is historic. Until last year, all 14 reactors operating in Czechia, Hungary and Slovakia were built by Russia (Slovakia's third reactor at Mochovce, of Soviet design but not built by Rosatom, started up this year). Furthermore, Rosatom is building two more reactors in Hungary.

That latter project, thrown into some disarray by the war in Ukraine, epitomises this longstanding dependency. Rosatom dominates the global nuclear industry because of its ability to act as a "one-stop nuclear shop", which is attractive to countries because it can finance the plant; build the plant; provide training, support and maintenance for the plant; dispose of the nuclear waste produced at the plant; and finally decommission the plant. While Europe is taking steps to reduce its 30 per cent reliance on Russian nuclear fuel – Czech energy company CEZ has signed contracts with US-based Westinghouse Electric Company and French company Framatome – waste disposal will be a much harder nut to crack.

Nuclear energy produces mainly low-level radioactive waste, while high-level radioactive waste, which includes the hot spent fuel, accounts for about 1 per cent of total nuclear waste. Most of this spent fuel – over 60,000 tonnes stored across Europe – is kept in cooling pools located within or near the plants that generated it.

Last year's EU taxonomy of what it considers green energy makes having existing disposal facilities for low-level waste and a detailed plan to have in operation by 2050 a disposal facility for high-level radioactive waste strict requirements for any new nuclear energy projects to qualify as sustainable investments – a definition needed to keep down the huge financing costs of new reactors. In addition, the technical screening criteria for nuclear energy prohibit the export of radioactive waste for disposal in third countries.

While there are many existing disposal facilities for low-level waste dotted around Europe, Finland is the only country currently constructing a permanent disposal facility for used fuel, the deep geological repository (DGR) under construction at Olkiluoto, which is scheduled to be operational around 2025.

From Rosatom with love

Hungary is pretty much stuck with Rosatom, most experts in Hungary believe. They tend to praise the technology and cooperation provided by Russia, though most are aware that political realities have significantly changed since the war in Ukraine. Yet restructuring the

current Paks 1 power plant (four VVER440 reactors) and replacing Rosatom as the main contractor for Paks 2 (two VVER1200 reactors) is regarded as a non-starter by most industry experts. If the EU slaps sanctions on Russia's nuclear industry, a move currently being debated, it would cause major difficulties for Hungary.

Rosatom is Hungary's sole provider of nuclear fuel, which since the war in Ukraine began has had to be airfreighted to Hungary across Belarusian and Polish airspace. "The fact is that Russian nuclear fuel is both technologically and economically excellent," Tamas Pazmandi, head of the Radiation Protection Department of the Centre for Energy Research, tells BIRN.

Pazmandi admits that diversification of the nuclear supply chain is probably necessary, but warns it will take longer than many might hope or expect. "Replacing Rosatom with another supplier would require years, due to the complicated process of development, production and licensing. In a best-case scenario, it would be possible around 2026-2027," he explains. Others point out that currently no alternative fuel is even available for the VVER440-type reactors, dismissing speculation that Westinghouse or Framatome could offer an immediate alternative to Rosatom.

Even for the Paks 2 project, where construction work has not started, a switch to a different company would mean starting again from scratch. "If you want to buy a Mercedes, you don't ask Volvo to manufacture it - it is an entirely different car," Pazmandi says by way of example. "It is the same with nuclear power plants. This is a Russian-designed plant, with all its licenses. On the supplier level there are possibilities for diversification, but the main design and the main contractor cannot be replaced or you will have a completely different project."

Government-close experts like Otto Toldi from the Climate Research Institute have argued that Rosatom holds another unique advantage: it takes care of the nuclear waste, which none of its rivals can do. Yet this, it turns out, is not actually true: although the original contract between Hungary and the Soviet Union in the 1980s included a paragraph about the repatriation of nuclear waste, that ceased in the mid-1990s on Russia's request. When Hungary joined the EU in 2004, it came under Euratom regulations, which basically forbids the export of nuclear waste. Spent fuel is now stored for five years in a cooling pond on-site, and then put in a dry storage facility. Last year, an International Atomic Energy Agency (IAEA) team of experts reported that, "Hungary is moving ahead in the development of a deep geological disposal facility for high level waste."

Media friendly to the government, however, have been speculating that Rosatom could offer in the case of the Paks 2 project to take back some of the spent fuel and recycle it. Remix

technology, which was tested in the Balakovo nuclear power plant in southwest Russia, is based on extracting uranium and plutonium from spent fuel and converting it into new fuel rods. The recycled fuel rods could then be used for nuclear fuel, with the remaining waste sent back to Hungary. Western companies can offer similar technology, called MOX fuel (mixed oxide fuel, consisting of plutonium blended with uranium), with France being one of the pioneers in Europe.

Hungary's only real alternative to Russian-built reactors would be small modular reactors, or SMRs. Though touted as the future of nuclear energy, the technology is still in its infancy: there are only three SMRs operational in the world - in Russia, China and India - with three under construction and another 65 in design. Hungarian Energy Minister Csaba Lantos said recently SMRs are a viable option for the future.

"In an ideal situation, one-third of Hungary's electricity demand would be covered by a regular nuclear power plant, one-third by SMRs and one-third by renewables," Pazmandi says.

NIMBYism

Rosatom does not figure in any of the other Central European countries' nuclear plans, yet the disposal of radioactive waste remains an issue as these countries look to expand or introduce nuclear power.

The Czech Republic wants to raise its use of nuclear power to cover over 50 per cent of its energy mix, and is seeking a role as a European leader of nuclear energy. Yet in order to do so it needs to deal with its nuclear waste - and that's an obstacle it has been trying to navigate for decades. And the deadline has just tightened significantly.

Prague hopes to announce the winner of a tender to add a new reactor at the Dukovany nuclear power plant by next year. The project, estimated to cost at least 6 billion euros, is planned as a first step in a strategy that aims to add up to four new large units at Dukovany and Temelin - the country's other nuclear plant - and potentially SMRs.

"The Czech government believes that nuclear energy is the backbone of the European energy system," a spokesperson for the Ministry of Trade and Industry tells BIRN. "Czechia plans to build new nuclear sources, and prospectively also SMRs, [because] a robust nuclear fleet" is key to energy security.

However, adding even one unit has proved an uphill struggle. Arguments over how to pay for it and who should build it have delayed the effort for at least a decade. But the conundrum over what to do with the radioactive waste from Czechia's reactors has run even longer.

For now, it's stored on-site at Dukovany and Temelin. Eventually, Prague wants to send it to

a deep geological repository to isolate it kilometres beneath the earth for thousands, if not millions, of years.

Progress on the plan, launched in 2002, has been slow. So far, the only major step has been to cut the shortlist of potential sites from nine to four. But that was not seen as a big problem given that the original plan did not call for the opening of the facility until 2065. But now the EU is demanding a 2050 date for such a repository. Prague is hoping to convince Brussels to give it some leeway on that date, but has said it will plan to hit the new deadline, despite having lost 15 years from the original schedule. Deputy Minister of Industry and Trade for Nuclear Resources Tomáš Ehler recently said it would be possible to accelerate the project.

The state Radioactive Waste Repositories Administration says hitting the 2050 deadline is technically possible, and is working hard to assess the quartet of potential sites. But rocks, soil, and water are the (relatively) easy part of the equation – it's the fierce opposition from the municipalities earmarked as potential hosts that officials say is the biggest obstacle. While the state could technically enforce decisions concerning the repository on the basis of public interest, that's a route that governments have been unwilling to take.

Faced with the tightened deadline, Prime Minister Petr Fiala's government introduced a bill in May that it says will offer the municipalities a greater say in the process. However, the Platform Against Deep Storage – a civic group set up by the quartet – is demanding a veto, leaving few signs that an amicable solution is likely as the time pressure builds.

The municipality that turns out to be the eventual "winner" of the repository will earn 4 million koruna (170,000 euros) annually, plus 10,000 koruna for each cubic metre of waste buried.

Slovakia, too, has long had plans to build a deep geological repository, which will be required as new reactors come online. This year, the third unit at the Mochovce nuclear power plant began operations, and the launch of the fourth unit is planned for 2024, which would bring the total number of operating reactors to six.

The JAVYS Nuclear and Decommissioning Company is the implementer of the site selection process for the deep geological repository for Slovakia's used nuclear fuel. There are two sites undergoing detailed site investigations.

In February, the IAEA praised Slovakia for its radioactive waste and spent fuel management, but urged more progress on a deep geological repository. The government, the agency said, should "proactively involve" interested parties, including the public, in selecting the location of the facility.

The Slovakian nuclear industry's historic close cooperation with its Czech neighbour opens

up the possibility for the two countries to participate in a shared international repository project. In 2019, Slovakia's then-prime minister, Petr Pellegrini, told delegates at the European Nuclear Energy Forum in Prague that it would be economically inefficient for the countries to invest billions into two separate sites and should consider building a common deep nuclear waste repository.

Newcomer

The country in the region with no operating nuclear power plants, Poland, is planning to make up for lost time, both to reduce coal-dependency in line with climate change requirements and as a means of ridding itself of dependency on Russian energy.

Last autumn, the Polish state signed a contract with Westinghouse to build the country's first nuclear power station at Choczewo, on the Baltic Coast. Construction is expected to start in 2026 and the first reactor completed by 2033. All in all, the Polish government wants to build up to 9 GW of nuclear capacity, split between six different reactors, which by 2040 could cover 25-36 per cent of Poland energy's needs.

Currently, 70 per cent of the electricity used across Poland comes from coal and Warsaw hopes to use nuclear as one of the key ways of phasing out this dirtiest of [fossil fuels](#) and replacing baseload capacity.

Poland's private sector is interested in investing in nuclear power too. Around the same time as the Choczewo project became more concrete last year, state utility PGE together with private energy company ZEPAK and Korea Hydro Nuclear Power (KHNP) announced plans to build a further three large reactors. And then there are at least two planned major investments in SMRs, one from state-owned copper producer KGHM and another from one of the country's richest businessmen, Michal Solowow, who has joined forces with PKN Orlen.

With so much capacity planned to be built over the coming decades, how to deal with the waste is increasingly an issue under discussion.

The country currently has one operating radioactive storage facility, at Rozan, 90 kilometres from the capital Warsaw, which stores waste coming out of the country's research facilities. "This storage site is pretty full now," Marcin Jaskolski, deputy director of the Nuclear Power Center at the Gdansk University of Technology, tells BIRN. "We need a new one, to bring waste materials from the research capacity and the future nuclear plants."

Poland has a national strategy for dealing with nuclear waste, which was last updated in 2020. It envisages the closure of the Rozan location, the construction of a surface site for the storage of nuclear waste as well as preliminary work for the future construction of a deep geological repository, complete with an underground lab.

In 2020, when the strategy was updated, the government highlighted “delays in the implementation of tasks set out in the strategy”, noting among the main reasons: the lack of sufficient financing for what are very expensive tasks, the “innovative character of the actions”, as well as difficulties in finding specialists and in achieving public support for the projects.

Attitudes to the use of nuclear power are shifting in Poland and the government points to opinion polls showing that a majority of Poles now support the construction of a new nuclear plant. But Jaskolski warns that getting people to accept nuclear waste disposal sites in their area “is a long process, which needs very careful social acceptance building.”

The one piece of good news, however, is that Poland still has time to properly plan the nuclear waste disposal capacity. “There is no immediate need for deep storage,” Jaskolski explains. “It will be necessary towards the end of the lifetime of the first nuclear reactor built,” adds the expert, while cautioning that planning and preparation should nevertheless start much earlier.

Some of the responsibility for managing the waste will lie with the companies, including private ones, operating the power plants, particularly in the earlier stages of the process, when the waste can be stored on site until the level of radioactivity decreases. How to split the responsibility for waste management between the state and those entities is something that remains to be settled in Poland.

Another aspect that remains open to question is whether [Poland](#) will also have a nuclear waste processing plant. Jaskolski says that while the national strategy only envisages one if “economically and technically feasible”, it is hard to imagine not having such a plant if the kind of nuclear capacity being planned today actually gets built.

Source: balkan insight