CLEAN AIR TASK FORCE

Diversifying nuclear energy supply chains

Clean Air Task Force (CATF) welcomes the EU's effort to diversify its nuclear energy fuel acquisition pathways and boost its critical supply chain resilience. Nuclear energy, a carbon-free energy generation pathway with an energy-dense output and a minimal land footprint, can make an important contribution to the EU's climate, energy, and economic objectives. It is therefore key that its enabling supply chains are reliable, resilient, and able to cater to both current and future energy demand.

State of play

Key challenges in the EU's nuclear energy supply chains relate to the procurement of manufactured nuclear energy fuel. As it stands, 19 out of 101 reactors operational in the EU are pressurised water reactors (VVERs), originally designed in the Soviet Union, that depend on fuel (and services) provided by Russian state-owned entities[1]:

- Dukovany (four VVER-440 reactors) and Temelin (two VVER-1000 reactors) power plants, Czechia
- Mochovce and Bohunice power plants (five VVER-440 reactors), Slovakia
- Kozloduy power plant (two VVER-1000 reactors), Bulgaria
- Paks power plant (four VVER-440 reactors), Hungary
- Loviisa power plant (two VVER-440 reactors), Finland

In 2021, 11,975 tonnes of uranium were delivered to the EU-27, 20% of which was sourced from Russia.[2] This share increased to 23% in 2023[3], when the EU power plant operators increased their purchases of Russian nuclear fuel, stockpiling against potential supply disruptions that would occur with potential EU sanctions on Russia's nuclear sector. This increment was in part driven as well by intensified Russian natural uranium enrichment services.

Imports of nuclear fuel from Russia to Western countries dropped sharply from 253t in 2023 to 97t in 2024.[4] This was in part made possible by EU buyers seeking fuel supplies elsewhere: for instance, power plant operators in Bulgaria and Czechia entered into contracts for VVER fuel supplies with Westinghouse (United States) and Framatome (France), and Hungary signed a contract for VVER fuel assemblies with Framatome. With all EU buyers of Russian nuclear fuel having secured alternative supply contracts, and countries like Bulgaria and Finland already using alternative fuel, **further peaks in nuclear fuel purchases from Russia are unlikely.**

Nonetheless, **EU countries still procure a significant share of their nuclear fuel supplies[5] from Russia.** Nuclear fuel produced in Russia is likely to remain a part of the EU's supply chain in the 2020s and possibly beyond.

1 Nuclear Engineering International

2 Supply Agency of the European Atomic Energy Community

3 Supply Agency of the European Atomic Energy Community

4 Eurostat

5 And VVER reactor components

A key structural reason for this dependency has been a relatively lower price of Russian-produced fuel, compared to other providers, which incentivised purchases as power plant operators endeavoured to minimise costs. Russia has routinely undercut the prices of other suppliers, in order to maximise the export of the nuclear fuel it produced. **In addition, several power plant operators have been relying on a single provider of nuclear fuel.**

How to diversify and strengthen nuclear energy supply chains

As the European Commission develops the EU 'Roadmap towards ending Russian energy imports', there are a number of measures it can consider implementing in order to diversify and strengthen the EU's nuclear fuel supply chains:

- Most immediately, there are several (Western) nuclear fuel suppliers that can provide fuel for existing VVER reactors, as demonstrated by the recent supply agreements. **The operators of power plants with VVER reactors should be encouraged to enter into contracts with those fuel suppliers that can be deemed more reliable.** In due course, this may have to be complemented with a stronger enforcement structure, e.g. sanctions or duties.

  The EU may want to boost the domestic VVER fuel production in particular. Efforts are ongoing within individual projects financed by the Euratom Research and Training Programme (i.e. APIS, SAVE), but the bloc would benefit from a more proactive, unified approach.

- Second, **buyers need to pursue multiple nuclear fuel acquisition pathways in parallel.** Relying on a single supplier does not constitute a robust business strategy, particularly in a world riddled with geopolitical tensions. As a measure of best practice, the EU could recommend, or mandate, that **buyers enter into supply contracts with at least two different suppliers from different world regions**, so as to mitigate the geopolitical risk for the EU's energy security.

- In the longer term, **EU Member States may want to move away from VVER reactor designs completely**, so as to effectively end any reliance on Russia for fuel provision, but also for the related spare parts and services, some of which have no alternative suppliers.

- More broadly, to support an uninterrupted supply of uranium ore, **the EU should strengthen its political and economic cooperation with countries with the largest deposits of natural uranium:** Canada, Australia, Mongolia, and Kazakhstan.[6]

- The EU is relatively well positioned when it comes to uranium enrichment services, with two thirds being provided by domestically owned companies (Urenco, Orano). **However, further support should be provided to the EU-owned companies in expanding their uranium enrichment capacity**, of both low-enriched uranium and high-assay low-enriched uranium (HALEU). As the world's uranium enrichment capacity is limited, **this could be a sector of comparative advantage for the EU in global terms**, and is therefore deserving of support.

- Generally, the **EU nuclear energy industry should be fully transparent in laying out clear, time-bound plans for diversifying and strengthening their supply chains.** In order for the civil society to be able to effectively perform its watchdog role in a democratic society, including monitoring and verifying supply flows, access to quality data needs to be improved.

All in all, there are multiple strategies the EU could pursue to progressively end dependence on a single unreliable supplier. Ultimately, **diversified supply chains, effective cooperation with different global regions, and a strong domestic nuclear industry are best guarantees of being able to leverage an uninterrupted supply of clean energy for the EU's sustainable prosperity.**

Learn more about Clean Air Task Force and advanced nuclear energy at cleanairtaskforce.org.

6 Note that Russian-owned companies are involved in the production of uranium in Kazakhstan, therefore that supply pathway should be carefully monitored.