



SPLITTING THE ATOM'S SUPPLY CHAIN

BY BRANDT MABUNI

Brandt Mabuni (brandt@pacforum.org) is a resident WSD-Handa Fellow at Pacific Forum.

This article is a primer to a longer forthcoming report by the author titled “Splitting the Atom’s Supply Chain: Analysis & 3S Implications for a Disintegrating Nuclear Fuel Industry,” which goes deeper into the impact and emerging risks of supply chain fragmentation on nuclear safety, security, and safeguards.



Uranium enrichment and the nuclear fuel industry is a globally-integrated complex concentrated in the hands of a few key players. A geopolitically-driven divorce is on the horizon, however. At the outset of the invasion of Ukraine last year, US Sen. John Barrasso (R-Wyoming) [led](#) an effort to ban Russian-origin uranium and nuclear products, following the West’s break with the fossil fuel industries filling the Kremlin’s war chest. The bill stalled, but highlighted America’s [reliance](#) on Russian nuclear imports, and the [need](#) for a comprehensive supply chain rework. When countries are already scrambling to secure supply for nationally-critical materials like rare earths or semiconductors, doing so for nuclear fuel, which

powers one fifth of US electricity generation, is not a bold proposition.

Rosatom, Russia’s sprawling state-owned champion, [dominates](#) chokepoints in the front-end of the nuclear fuel cycle—38% of global uranium conversion and 46% of enrichment. This not only gives Moscow leverage over downstream ‘critical infrastructure’ abroad, but supports its wider energy statecraft agenda. Since 2007, nuclear reactor exports have [become](#) a key channel in Russia’s foreign influence strategy, accounting for about half of the 53 units under construction worldwide. Additionally, leading US small-modular reactor companies like TerraPower and X-energy, [require](#) high-assay low-enriched uranium (HALEU) for their designs, which is only commercially available from Russia. The National Nuclear Security Administration has the ability to [downblend](#) weapons-grade material into HALEU for civil use, but conflicting national security directives necessitate that it be considered a temporary solution at best.

This year, Barrasso is making more headway. The “Nuclear Fuel Security Initiative” (NFSI) [breezed](#) through the Senate as an amendment to the 2024 National Defense Authorization Act (NDAA) rather than as a standalone bill. This would allow Congress more discretionary authority to [ensure](#) that disruptions in the nuclear fuel supply chain neither (1) impact existing commercial reactor operations, nor (2) impede the development of advanced nuclear reactors. A companion bill banning Russian uranium (with allowances through 2027) is [working](#) its way through the House.

Opening the HALEU bottleneck is an acute priority, but the imperative should also address the broader, energy security implications of Russia and China’s growing influence over Kazakhstan and its industry behemoth, Kazatomprom—the world’s largest uranium miner. A disruption to the West would equate to a crisis. Nearly all producers are booked out for years, and [soaring](#) uranium spot prices hint that warehoused sources may be depleted. To avoid sleepwalking into a larger dilemma brought on by a captive Kazakh uranium industry, policymakers should not only empower the Department of Energy

to reshore enrichment, but firm up the broader nuclear fuel supply chain with trusted partners.

A Sino-Russo-Kazakh nuclear industrial complex?

Once known as the steady “floor” for global supply, Kazatomprom has been beset by geopolitical risks, and is on its [fourth](#) CEO in two years. First, its primary transport route through Russia was [impacted](#) by international sanctions. Now, the bubbling Azerbaijan-Armenia conflict threatens to complicate the Trans-Caspian Route it had promoted as an alternate solution. With access to Europe constricted and US influence in Central Asia waning, Kazakhstan has little choice but to be more accommodating towards its two assertive neighbors, who are already (by far) its most important [partners](#) in trade.

In May, Rosatom took a bite out of Kazatomprom, acquiring a 49% stake in its prized Budenovskoye-6 and -7 uranium deposits. Several executives [quit](#) as a result, fueling speculation that it was a ‘backdoor deal’ [imposed](#) by Astana in cooperation with Moscow. Once developed, this uranium mine complex is expected to become the world’s largest, capable of [supporting](#) Rosatom’s downstream dominance in conversion, enrichment, and fuel fabrication for many years to come. When Russia invaded Ukraine, there were signs of Kazakhstani president Kassym-Jomart Tokayev [distancing](#) himself from Vladimir Putin, but the opposite has instead played out. The two have [met](#) in person at least a dozen times since, with energy [cooperation](#) a frequent focus.

Beijing has also factored Kazatomprom into its energy strategy. China is [undergoing](#) a massive buildout of new nuclear power plants, on track to become the world’s top producer by 2030. In his first post-COVID trip abroad, Xi Jinping visited Tokayev to lay the groundwork for deeper bilateral [collaboration](#) – energy, again, a priority area. Since then, the China National Nuclear Corporation has [secured](#) a major long-term uranium supply contract in excess of 50% of Kazatomprom’s total book value. Additionally, the China General Nuclear Power Corporation has started [receiving](#) nuclear fuel assemblies from the Ulba Metallurgical Plant on the Kazakh-Chinese border – a

joint-venture slated to provide 200 tons of nuclear fuel each year until 2041.

Signs of deepening Russia-China cooperation over nuclear fuel may further fan this hotspot of security concerns. In March, the US House Armed Services Subcommittee on Strategic Forces was [briefed](#) on reports of Rosatom supplying highly-enriched uranium to fast breeder reactors in China, a well-established pathway for weapons of mass destruction. While there is no indication that Kazakhstan collaborates with Russia or China towards nuclear arms, evidence of an increasingly captive uranium industry presents a glaring liability for energy security in the US and Europe.

Reshoring & Friend-shoring the front-end of the fuel cycle

All this is coming to a head as demand for uranium is returning in force. With grids around the globe struggling to reliably replace coal with the variable generation of wind and solar, nuclear power is [gaining](#) recognition as a necessary component in the clean energy transition at-large. Nuclear plant developers from China, France, South Korea, and the US are presently [vying](#) for business across Africa, Asia, and the Middle East—eager to catch up with Rosatom’s lead. And the most ominous driver of supply chain bifurcation may be the [resuming](#) buildup of nuclear weapons between great powers. China has been expanding its arsenal for years, and with Russia’s recent suspension of the ‘New START’ arms control treaty, the US is [pressured](#) to modernize its own capabilities.

America should restore long-term nuclear fuel security before a crisis puts critical infrastructure at risk. The NFSI can be maximized by (1) stockpiling uranium as disruption insurance, (2) reshoring critical bottlenecks like HALEU manufacturing and enrichment, and (3) proactively friend-shoring the upstream stages of the supply chain among trusted allies. The first two are already off the ground, with a strategic uranium reserve recently [established](#) and Ohio-based Centrus Energy [beginning](#) enrichment operations just this month. But they require greater urgency. The reserve’s current inventory would only

[cover](#) nine days of US commercial demand, and Centrus has a long way to go in [scaling](#) up to create a meaningful shift away from Rosatom.

The United States is fortunate that Canada and Australia are the No. 2 and No. 4 [suppliers](#) of uranium after Kazakhstan. However, the problem is that [ramping](#) up enough production to quit Kazatomprom would take many years, given the mining sector's [challenging](#) workforce, lending, and regulatory conditions. Friend-shoring through policy incentives or consortium-building can accelerate this process by signaling a commitment to decoupling from the Russian nuclear industry –thereby boosting investor confidence and diverting capital otherwise flowing to marginally-cheaper producers, like Namibia or Uzbekistan. The surprising coup in Niger and its [impact](#) on France's nuclear firm, Orano, should be lesson enough of depending on states with elevated political risk for uranium supply.

Since the dual-use nature of uranium and the oligopolistic conditions of the space will never allow it to become a true commodity market, scruples over government intervention should be saved. The United States allowed Russia to maneuver into its commanding position by privatizing, then outsourcing, this critical supply chain. Expediently rebuilding supply security at home and industrial capacity among allies is the first step to making a comeback in an industry that will undoubtedly remain vital within energy, technology, and national security arenas for decades to come.

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