Estonia aims to help Europe's rare earth supply chain

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Once a Soviet-era uranium processing plant, the Silmet factory in Sillamäe, Estonia, is now Europe's leading processor of rare earths. Silmet's mother company, Toronto-headquartered Neo Preformance Materials, aims to establish the continent's first manufacturer of high performance magnets for European consumers. These "permanent magnets" have the potential to make a huge impact in the European electric car and offshore wind-turbine industries, which up until now were exclusively dependent on supplies from an increasingly less reliable source – China.

It was during the COVID-19 pandemic, when China's borders temporarily closed, that something clicked in Raivo Vasnu's mind. Silmet, the factory he heads in Sillamäe, Estonia is a former Soviet uranium-processing facility in Europe's north-easternmost tip near the Russian border. It is also Europe's largest processor of rare earths, a crucial category of elements necessary for a wide range of technologies, including electric cars and wind turbine technologies. Where Cold War-era engineers once enriched uranium to feed the Soviet regime's nuclear arsenal, Vasnu's engineers today perform a no-less difficult, and strategic, task: that of chemically separating rare earths into oxides used in green technologies. China controls 85 per cent of rare earth processing and 92 per cent of rare earth magnet production.

(and dominates 90 per cent of the world's processed rare earths). Rare earths are considered critical materials.

Silmet's oxides are used to make catalytic converters in Europe and some of its oxides travel to Thailand to be turned into magnets for European customers, including makers of water circulation pumps. Meanwhile, most European electric cars are powered with Chinese magnets. After the COVID-19 pandemic, customers became increasingly concerned about supply chain resiliency and demanded that rare earth permanent magnets be made closer to them, in Europe.

"With COVID-19, some customers thought that this supply chain will not survive if the country starts to close borders, due to [the pandemic] and sanctions," Vasnu says from his office in the modern part of the old Soviet-era uranium plant, otherwise a sprawling maze of blackening red brick facades, metal pipes and old chimneys. Outside, grey smoke billows over the Baltic Sea.

This industrial port sits in the heart of Estonia's oil shale sector, which has heated and lit Estonia's homes for many decades but which the current government under Kaja Kallas has vowed to end by 2040 to meet EU emission-reduction targets. "They don't have anything against China but they are just afraid of those long supply chains," he adds. "Today we are living in a world of all kinds of sanctions. That is why they prefer to have material which is more or less risk-free for them."

A step for Europe, a boost for a fragile community

Now, three years later, with the war in Ukraine making both industry and governments realize the risks associated with Europe's dependence on concentrated supply chains from single jurisdictions – whether natural gas from Russia, or rare earths from China – Silmet's Toronto-based mother company Neo Performance Materials has taken a step toward strengthening the continent's supply chain of rare earths. This summer, it broke ground for a new factory in Narva, the Estonian city close to the Russian border some 20 minutes from Sillamäe that will use the rare earth oxides produced in its Silmet factory to make high performance, or "permanent" magnets European manufacturers of electric car motors and offshore wind turbines are increasingly scrambling to get their hands on. Rahim Suleman, the CEO and President of Neo Performance Materials, describes it as "the first rare earth magnet facility outside of China built at the technical and ESG (Environmental, Social and Governnance) specifications of European automotive and wind turbine industries". Environmental, social and governance (ESG) is a framework used to assess an organization's business practices and performance on various sustainability and ethical issues.

Silmet, a former Soviet-era uranium-processing plant, was modernized and downsized after Estonia regained its independence. Modern structures have been built, but many old ones still stand, so that, from the outside, it remains a sprawling maze of blackening red brick facades, metal pipes and old chimneys.

Photo: Isabelle de Pommereau


RAAMAT

Sillamäe, a largely Russian-speaking town of some 14,000 people in Estonia's east, on the Gulf of Finland, was a secret, off-limits place. Built in Stalinist architecture, it was designed to attract and please the USSR's best brains.

Photo: Isabelle de Pommereau

The Soviet-era uranium processing facility in Sillamäe, Estonia, was a gigantic city/factory with 4,000 employees. By the 1990s an estimated 100,000 metric tonnes of uranium had been produced in Sillamäe, used in the manufacturing of tens of thousands of nuclear weapons, and the factory also separated rare earths. The place was never to be entered or left without approval. In independent Estonia the plant was privatized and renamed Silmet. Now owned by Canadian Neo Performance Materials, it is Europe's leading processor of rare earths, thus a strategic place for Europe.

Photo: Isabelle de Pommereau

View from the roof of Silmet on the "tailing pond" which contains more than 10 million tonnes of radioactive material linked to Silmet's soviet-era activities and is now a gigantic green hill.

Photo: Isabelle de Pommereau

A Soviet-era control room from Kombinat number 7, which was one of the code names given to the top-secret uranium-processing city-factory in Sillamäe. The room is no longer used.

Photo: Isabelle de Pommereau

Funded with close to 19 million euros from the European Union, the 100-million-euro project could turn this fragile industrial corner into a key player in Europe's effort to regain its grip over critical materials essential to green transition technologies. It also represents "a leap for Estonia and a stride for Europe," as EU Commission President Ursula von der Leyen said this past summer. "The magnets that will be produced here are indispensable to growth and innovation in the sectors of electronic mobility, wind energy, and microelectronics," she added, speaking via video at the new plant's ground-breaking ceremony on June 29th. More than 140 people came to Narva to attend the ceremony, from Estonian ministers to foreign diplomats, scientists to researchers and representatives of car part producers such as Germany-based Schaeffler and the French magnet recycling start-up Carester. "They promise lighter batteries, less consumption of critical material and higher energy efficiency."

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Von der Leyen's address on that June day was doubly symbolic. With the new magnet plant, she said, Estonia was also the first EU country to benefit from the continent's 17.5 billion-euro "Just Transition" fund, set up in 2021 to help EU regions with high-emission industries offset the socio-economic challenges of transitioning to cleaner forms of energy. This region, called Ida-Virumaa, is on the eve of one of its most painful transitions since regaining its independence from the Soviet Union in 1991. This involves phasing out oil shale, an industry that has given this nation of 1.3 million a degree of energy independence, and is the lifeblood of a region that has remained Russian speaking since the Soviet era, but is highly polluting. The Soviet regime imported workers from around the USSR to build and maintain the huge oil shale power plants.

How to gradually end the industry while keeping the stability of the region has been a thorn in the country's side for a long time. "While this bolsters European resilience and security of supply, it primarily benefits the local people," von der Leyen said, referring to the new Narva magnet plant.

European effort

The new magnet plant "is essential for Europe … because access to these strategic raw materials has become a very important security issue we need to react to," says Elvire Fabry, an analyst on energy policies at the Paris-based Jacques Delors Institute, a think tank which authored the report titled "The looming war for minerals".

"We can't afford to be in a situation where we don't have enough supplies," she adds, evoking hidden threats by Beijing. Of course, China blocked the export of rare earths in 2011 over a dispute regarding Japan's detention of a Chinese fishing trawler captain. Indeed, the EU's financial support of the new Narva plant fits into a broader goal of regaining control over the production, exploitation and recycling of critical materials amid growing fears that China's control of the market could jeopardize western strategic interests.

After Russia's invasion of Ukraine, the European commissioner for the internal market, Thierry Breton, warned about the potential risks of Europe's over-reliance on China for rare earth elements and said that the supply of raw materials has become a "real geopolitical tool". "We must avoid becoming dependent again, as we did with oil and gas," von der Leyen added not long ago.

And with its critical raw material acts voted on in December, the European Parliament says it wants to make sure that by 2030 it does not rely on a single country for more than 65 percent of its supply of any strategic raw material.

Gareth Hatch, a rare earth specialist with the UK-based Strategic Materials Advisory, who has followed Silmet's effort to make profit out of the rare earth business since the end of the Soviet era, says that the construction of the new magnet plant "is a long time coming."

"From a diversification point of view, it's important because it provides European users of permanent magnets a regional source of magnets that ultimately won't rely fully on China for supply," says Hatch, who is also advisory board chair of the Rare Earth Industry Association. "There is a recognition in the EU just as there is in the US that having the manufacturing of magnets in your region is potentially strategically important, and if you believe that you are probably going to support that and that is what the EU has said it would do."

Little known, but key

Not as widely known as other critical elements such as lithium and cobalt, rare earths, a family of 17 minerals with exotic names such as dysprosium and gadolinium are, in fact, omnipresent, albeit in tiny portions, on the earth's crust. Mixed together with other elements they are difficult to chemically separate out from one another and that is what makes them "rare". Since uranium mining during the Cold War made their values more apparent, rare earths have been used in an increasing array of applications in civilian and military technologies, from high-efficiency light bulbs to smartphones to smart bombs. In the case of motor applications, rare earths are used to make permanent magnets that make the motor most

energy efficient. With car makers scrambling to switch from internal combustion to electric engines and turbine makers to build ever more efficient machines, demand has been soaring.

Some among those 17 rare elements – praseodymium and neodymium, in particular – are increasingly coveted. They possess spectacular magnetic properties which electric car and off-shore wind turbine makers have craved. One to two kilogrammes of these magnets used in the motor can unlock the energy savings that help reduce the size of an electric vehicle's battery by 30 per cent, experts say.

"You get the most magnetic power for a unit mass or volume from those materials, so it is important that there are ways to produce them," says Hatch. Motors are among the most expensive components of electric cars.

Demand for those rare earths is expected to double between 2020 and 2030 as neodymium magnets are seen as the most efficient way to run electric cars and generate power from wind turbines. However, China dominates the supply, according to a study by the BRGM, France's public institution for earth science applications for the management of surface and sub-surface resources.

Those magnets are "the linchpin of the Green Transition … they are to motors what lithium and cobalt are to batteries," says Rahim Suleman, speaking of the magnets his company will manufacture in Narva starting in 2025. Initially, Neo Performance Materials envisions producing 1,500 tonnes of magnet blocks a year and equipping 1.5 million electric cars in Europe. It also plans to do research and development, recycle old magnets and create hundreds of new high skilled jobs in the region.

With permanent magnets "you make an electric vehicle more affordable for the consumer, and you also save on the need for more mining, more use of other critical raw materials, such as lithium, nickel, cobalt, magnesium, granite, which are used in the battery, the most expensive component of an EV,"" says Vasileios Tsianos, director of corporate development of Neo Performrance Materials and Board Member of the Rare Earth Industry Association. "The most optimal way to reduce our energy consumption without reducing our standard of life in modern societies is by increasing the efficiency of motors," he says. "And that's what permanent magnets do."

A long history with rare earth

Sillamäe's ties with uranium, and the rare earths, date back to the Second World War. The US bombings of Hiroshima and Nagasaki in 1945 unleashed an arms race. After "freeing" Estonia from Nazi Germany, the occupying Soviet regime discov-

ered that "dictyonema" – a sort of oil shale found in Estonia's north-east along the Gulf of Finland – contains traces of uranium. It turned the tranquil coastal village of Sillamäggi into a secret military complex. Off limits and top secret, the place, referred to by code names such as *Kombinat 7*, became the USSR's third largest producer of uranium, used in tens of thousands of nuclear weapons. In the late 1980s the regime ventured into rare earth separation, which requires the same equipment and chemistry know-how as processing uranium, importing the ore by train from Russia's Kola Peninsula.

It was not until the end of the Soviet Union that the world discovered the environmental legacy of Silmet's activity. Some 14 tonnes of radioactive waste had accumulated only metres from the Baltic Sea. It took 28 million euros and 11 years for international experts to contain, thus help make the area safe. In independent Estonia, the uranium-related activities stopped, but rare earth processing continued, in modernized facilities and with only 400 workers, down from 4,000 in Soviet times.

It was after the fall of the USSR that the world discovered the environmental legacy of Silmet's activity.

Even if the factory produces only 3,000 tonnes of rare earth oxides annually – roughly two per cent of the global production dominated by China, "the capacity of the Silmet facility has been long standing and is well known in the industry," says Hatch, the rare earth expert. Silmet uses rare earth imported from the United States, Vietnam and the Kola Peninsula (in Russia).

"The Silmet facility was really the only commercial-scale producer of separated rare earth in Europe, and one of the very few outside of China," Hatch adds. And that makes Sillamäe a strategic asset not only for Estonia but also for the EU. Now, with a new magnet plant in Europe, "Estonia is officially the most strategic jurisdiction not only in Europe but also in the western world for the rare earth supply chain," says Neo's CEO Rahim Suleman.

Estonia was the "obvious" choice for the plant, Neo's CEO argues. He cites a "synergy" of having Europe's largest rare earth separation business at Silmet with Neo's long experience with magnet production through its Magnequench divisions, which run several magnet plants in China, Thailand and the United Kingdom. He says that the support from Estonian and European officials played a key role. The permit-issuing process from the Estonian local community and governments was unusually fast. Neo Performance Materials is looking into mining its own ore in Greenland, in addition to any other mines that other developers bring online globally, company officials say. Its hope is to create Europe's first mines-to-magnets supply chain for rare earths.

Long-awaited development

The region around Narva – called Ida-Virumaa – is not used to the attention, and the investment was greeted as a "positive signal to investors that Europe is interested in this dead end of the EU," says Sergey Stepanov, a long-time journalist for the region's Russian and Estonian-speaking public print and television media. "At long last it's going to bring people from other parts of Estonia, and Europe [to this region]. The government has been saying "Ida-Virumaa is important, we need to invest in it" for the last 30 years, but they have taken only small steps, not huge leaps to improve."

A major industrial hub in Soviet times with huge textile, oil shale and uranium industries fed by Russian-speaking workers, the region has struggled since Estonia regained independence. Simmering tensions between Estonian and Russian-speaking inhabitants have occasionally flared up. For decades the region was sometimes seen as a place apart – a Russian enclave closer to St Petersburg, across the Narva river, than to the Estonian capital, Tallinn.

Yet the support on the part of regional, Estonian and European leaders "gives a clear signal to shareholders and investors that in this part of Europe the government is interested in investing in new jobs, and this bureaucracy can be handled once the government has decided that this is the place," says Raivo Vasnu, head of the Silmet plant, adding that "it is not just words, it's also financial help."

"In Soviet times, the Sillamäe plant was one of three uranium-enrichment facilities in the Soviet Union. There was one in Kazakhstan and another one in Siberia," Vasnu points out. But between going to Siberia in the middle of nowhere or to Kazakhstan in the middle of the desert, if they could choose, the best brains opted for the Sillamäe seaside.

"That is why we had the sort of 'Silicon Valley' of this industry," Vasnu says. "We are trying to keep this tradition." EE

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