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## Isotope Interaction

**In late June, Saint Petersburg hosted the first BRICS International Forum on Nuclear Medicine. Co-organized by Rosatom, the forum brought together over 250 experts from the BRICS countries to discuss the current challenges in this field.**

Welcoming the participants, Russian Deputy Prime Minister Tatyana Golikova stated the need for the member countries to adopt a common strategy for the development of

nuclear medicine, including common approaches to the treatments and application of radiopharmaceuticals (RPs). She proposed to concentrate efforts on three areas. First, the BRICS countries need to strengthen technological sovereignty by increasing domestic production of RPs and related equipment. Second, they should promote nuclear medicine technologies both within the BRICS and beyond. Third, the member countries should increase mutual trade in nuclear medicine.

To achieve these goals, Tatyana Golikova suggested identifying the most promising areas for scientific and technical cooperation

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and production of innovative RPs, as well as compiling and publishing a review of BRICS best practices in nuclear medicine.

Russian Health Minister Mikhail Murashko noted that the best practice review would be published by the 14th BRICS Health Ministers' Meeting scheduled for October this year. "Initiatives of the BRICS countries can lay a foundation for the global healthcare architecture," the Minister pointed out. The brochure will be submitted to the UN, WHO, International Agency for Research on Cancer, and IAEA.

Mikhail Murashko said that radiopharmaceuticals were included into the priority technology list approved by the President of the Russian Federation. Every year, over 800 thousand diagnostic procedures are carried out in Russia under the Fight against cancer federal project. These procedures are covered by public health insurance and free of charge for Russians. Radio pharmacies have been established to build an end-to-end supply chain, spanning from the fabrication of isotopes to the sale of ready-to-use RPs. The regulatory framework has been modified in Russia and the EAEU to ease patients' access to the latest nuclear medicine solutions. Mikhail Murashko suggested that the BRICS countries should jointly conduct research and develop new RPs.

Yury Olenin, Deputy Director General for Science and Strategy at Rosatom, said that nuclear medicine was a priority business for the Russian nuclear corporation. Rosatom builds infrastructure for medical care, produces and supplies medical isotopes and radiopharmaceuticals, creates equipment for diagnostics and therapy, and develops irradiation solutions for medical products. In particular, Rosatom accounts for up to 90% of isotope supplies in Iran, a third in Brazil, 22% in China, and 13% in India.

Yury Olenin emphasized the importance of harmonizing national rules for pharmaceutical supply chains, preclinical and clinical trials, etc.

As noted by Boris Dolgushin, a member of the Russian Academy of Sciences and Director of the Institute of Clinical and Experimental Radiology of the N. N. Blokhin Cancer Research Center, Russia has much to offer the BRICS countries in nuclear medicine. The first thing is education as Russia, one of the leaders in this field, can provide training under the IAEA programs. The second is equipment, including nuclear reactors, accelerators and cyclotrons. Third come nuclear materials and, finally, new technologies. For example, a boron neutron capture therapy device is being installed at the Blokhin Center to become operational by the end of this year.

Prabhu Ethiraj, Director of the Nuclear Medicine Institute at the Government Multi Super Specialty Hospital and President of the Society of Nuclear Medicine India, said that India had seen an explosive growth of nuclear medicine since 1970. About 80–90% of nuclear medicine organizations are private in India. "This provides an opportunity to develop technology and creativity in nuclear medicine," Prabhu Ethiraj explained. The government has taken over the training of nuclear medical workers.

Rafael Lopes, Director of the Nuclear Medicine Department at the Cardiology Hospital and President of the Brazilian Society of Nuclear Medicine, spoke about the use of RPs in cardiology. It accounts for about a million diagnostic procedures per year, which is half of the total. The most common procedure is SPECT because it is relatively easy and inexpensive. The challenge for Brazil is to increase the number of PET scanners and

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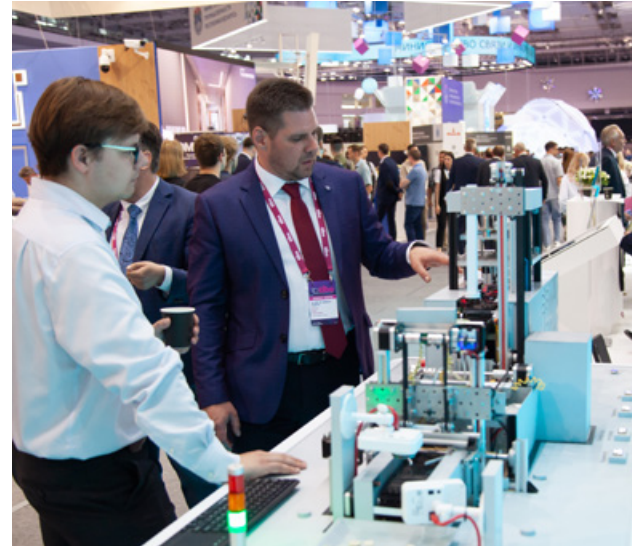
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PET procedures but the country needs expensive rubidium generators for this purpose. “We need to think together about how to make nuclear medicine solutions affordable so that patients live longer and healthier lives,” Rafael Lopes suggested.

Mohammadreza Davarpanah, CEO of Pars Isotope (Iran), said he saw potential in using different combinations of alpha and beta isotopes. The country plans to double its SPECT fleet (over 220 machines so far) and install up to 60 PET scanners. The country produces around 60 RPs, more than half of which are diagnostic. 18 new products are in the clinical trial phase, with another eleven in the initial research phase. “We will be happy to help other countries with research and development. This is very important because cancer is our common enemy,” Mohammadreza Davarpanah summarized.

Representatives of leading nuclear medicine organizations from China, South Africa, Egypt and Saudi Arabia also shared their experience.

A total of 16 sessions were held at the forum to discuss the production of basic radio-nuclides, innovations, registration of RPs, various nuclear medicine solutions, their application in cardiology and endocrinology, and other issues. The results of the forum will set the framework for discussions on nuclear medicine at the BRICS Summit to be held in Kazan (Russia) on October 22–24, 2024.



## TIBO Brings New Deals

**Top IT managers from Rosatom Group companies took part in the TIBO 2024 International Information and Communication Technologies Forum in Belarus to showcase IT solutions developed by the Russian nuclear corporation and demonstrate their performance. Three agreements were concluded at the forum. Here are the details.**

### **Product quality improvement system**

Rosatom’s booth featured the REPEAT mathematical modeling system and the Smart City line of digital products, but the most interesting exhibit was, perhaps, a mock-up of the AtomMind predictive analytics system developed by Rosatom’s fuel division TVEL to improve product quality by monitoring and analyzing equipment performance. The system presented at the exhibition simulated the application of artificial intelligence in

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a real production process. The demonstration conveyor was loaded with feedstock (modeling clay), which was analyzed online using various sensors and then processed into a tablet in several stages. The system suggested optimal equipment settings for specific feedstock parameters to reduce scrap and, at the last stage, used video data to determine the quality of the final product.

When installed at a production facility, the system can monitor millions of parameters, collect and analyze data sourced from equipment sensors, logging units, and other information systems. “This machine learning enabled system processes the data received and tells the operator what to do if any changes are detected in equipment performance or feedstock parameters, thus reducing batch inconsistencies,” says Mikhail Erofeev, Chief Commercial Officer at Rosatom Digital Solutions.

AtomMind was the subject of the first agreement signed at the Forum. TVEL and Belarus-based IT company International Business Alliance signed a roadmap that implies the use of AtomMind in digitization projects at Belarusian industrial enterprises. It is expected that

the first site for the deployment of the system will be chosen by the end of this August. “AtomMind has proven itself as a reliable tool for making industrial facilities more efficient. We are improving the platform’s functionality, creating new services, and striving to expand partnerships with other companies that can benefit from our experience. Today’s agreement is a huge step towards expanding international cooperation,” said Evgeny Garanin, Vice President for Digitalization and Information Technologies at TVEL.

### **Simulators for power stations**

The second agreement was signed between the JET Engineering and Technical Center (part of Rosatom) and the Belarusian company BelEnergoRemNaladka. It provides for the development of a staff training simulator for Minsk Combined Heat and Power Plant (CHPP) No. 4. According to JET CEO Alexey Kovalevich, Belarusian CHPPs are not yet equipped with comprehensive personnel training facilities. The deployment of training simulators will improve safety and efficiency of the power plant operation, reducing employee-related downtime. “This is a big step in developing Russia–Belarus cooperation to make thermal power generation safer. We hope our cooperation will be continued and we will sign a contract for one more simulator to be installed at another plant. When this work is completed, we will be able to proceed with building simulators for every large thermal power plant in Belarus,” Alexey Kovalevich commented.

### **Tractor robotics**

The third agreement was signed by Rusatom Service (part of Rosatom) and the Minsk

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Tractor Plant. The parties agreed on the strategic cooperation in implementing innovative solutions for robotic automation and digital transformation of the tractor production processes, including production of the flagship Belarus-branded tractors. As part of Rosatom Group, Rusatom Service engineers and manufactures robotic equipment and other custom-made systems for the nuclear industry and beyond. “The partnership with the Minsk Tractor Plant provides tangible benefits for our parties. Rosatom keeps on gaining competencies in robotics both in Russia and abroad, while the leading tractor manufacturer, the hallmark of industrial and agricultural machinery in Belarus, gets an opportunity to embark on innovative production processes,” said Dmitry Kainov, Commercial Director at the Robotics Project Office, who signed the agreement.

### And more...

Olga Tolstunova, Vice President for Digitalization and Information Technology at Rosatom’s engineering division AtomStroyExport, spoke about the use of digital technology in the construction of complex industrial facilities, including nuclear power plants.

The theme of using IT systems in the construction sector was continued by Oleg Pokrovsky, Chief Software Development Officer at Rosatom’s Cifrum, who spoke about the latest developments in the Building Information Modeling (BIM) segment. Rosatom develops BIM software both for its

own needs and for sale to external customers. The Russian nuclear corporation also contributes to the development of a national BIM solution based on the Multi-D platform and other software applications by Rosatom and third-party software vendors.

Anton Zubkov, Deputy CEO for Strategy and New Businesses at Rosatom Infrastructure Solutions (RIS), spoke about smart city solutions. Their role in creating safe and comfortable environments is growing worldwide. Anton Zubkov demonstrated how RIS digital solutions benefit Russian cities through more efficient use of resources.

Sergey Martynov, Director of Rosatom’s Industrial Solutions Program, presented a product life management system, Sarus, and spoke about its potential commercial applications.

In general, Rosatom offers the market over 60 IT products that are in use at more than 300 companies operating in different sectors. “We presented Rosatom’s proven digital solutions to our Belarusian colleagues at the TIBO Forum. This is not about business contacts alone, but about strategic partnerships with IT companies and system integrators from Belarus. We held over two dozen meetings that, I am sure, will result in a broader cooperation,” summarized Mikhail Erofeev, Chief Commercial Officer at Rosatom Digital Solutions. [NL](#)

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## Charging Business

Along with producing or contributing to the production of electric car parts, Rosatom is engaged in deploying the charging infrastructure. The logic is clear: the broader the charging network, including fast and ultrafast charging stations, the more likely it is that people and businesses will favor electric vehicles. Rosatom aims to become a leader in the Russian electric charging market with a share of at least 25% by 2030.

Rosatom’s electric power division RosEnergAtom plans to become a roaming operator facilitating the roaming of EV charging services. The decision to enter the electric charging market was taken back in 2019 but little effort was made to push it forward until 2022. Then the situation changed dramatically, and the sector began to evolve at pace.

RosEnergAtom’s subsidiary AtomEnerg will be the operator of charging stations under construction. The company is establishing contacts with taxi fleets, carsharing and logistics companies, developers, property management companies, and car fleets of federal companies.

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RosEnergoAtom is running two charging network construction programs, both scheduled to be completed by 2030. Two charging points were installed in Kaliningrad in 2023, one in Sosnovy Bor, and 89 in Moscow under the two programs.

This year's latest news has come from Obninsk (Kaluga Region): a network of electric charging stations (ECS) built by AtomEnergo was inaugurated in the city as part of the celebrations dedicated to the 70th anniversary of the world's first nuclear power plant. With almost 70 charging sessions in the first two days, which is more than at some stations in Moscow, the pilot period showed the interest of city residents in the new EV charging service. Overall, RosEnergoAtom plans to build 292 ECSs this year. "To become a leader in the ECS market, we need to accelerate the deployment of EV charging infrastructure," says Alexander Khvalko, Deputy CEO and Chief Sales Officer at RosEnergoAtom.

The company aims to expand its charging network beyond Moscow and the Moscow region to cover million-plus cities and major highways in Russia. Regional governments have launched their own programs for the construction of EV charging stations, with costs financed from regional budgets. One of the most attractive locations is the Moscow-Minsk highway, which will be part of the new Silk Road.

Rosatom's ECSs feature proprietary charging equipment produced by a joint venture between Rosatom's electrical engineering division and Parus Elektro, Russia's leading manufacturer of electric charging stations. The joint venture will have capacity for the production of 2,000 ECSs per year. And since Parus Elektro has the widest product range in the country with its ECSs supporting both

fast and slow charging, the Russian nuclear state corporation becomes fully self-sufficient in this segment.

RosEnergoAtom pays great attention to electric charging hubs, a combination of charging points and parking lots, which can be equipped with load balancing, power storage and electricity metering systems, transformer substations, etc. Such hubs are best suited for busy highways so that drivers can charge several electric cars at the same time without waiting in lines for hours.

Noteworthy is that RosEnergoAtom is a wholesale electricity market player with stakes in both power generating and distributing companies, so it has the right to enter into direct power supply contracts with charging network operators. Nuclear power plants are officially recognized in Russia to be low-carbon energy sources, so charging sessions at the ECSs supplied with power from nuclear plants are environmentally neutral. This is important for the companies disclosing information about their carbon footprint. RosEnergoAtom is holding talks with local ECS operators to supply their charging points with carbon-free electricity from nuclear power plants.





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What is more, the company is able to supply electricity at the most favorable price thanks to the demand-side management and access to the wholesale market. Its ECSs will be branded as ‘Clean Energy Rosatom’.

RosEnergAtom is also involved in the development of Russian national standards for ECSs. The common standards are essential to ensure compatibility between ECS and EV protocols for a car to start charging.

To address all the challenges, the Digital Energy Association has established an electric mobility center that facilitates standardization and certification, provides support for the development and promotion of electric mobility, studies and adopts best practices from China, the US and the EU. [NL](#)

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## China Becomes Home to Energy Transition

In June, the International Energy Agency (IEA) published its **Global Critical Minerals Outlook 2024**. The executive summary that precedes the publication makes an emphasis on the future prospects for the markets of key energy transition minerals. More

interesting, however, seems to be the last-year market review that details the data from, and processes in, the metal consuming sectors (wind and solar energy, battery industry, etc.) and metal markets.

According to the IEA, energy transition minerals include lithium, cobalt, graphite and nickel (used for the production of energy storage systems), copper (cables and power grids), and rare earth elements (REEs, needed for wind turbine engines, electric vehicles and other high-tech applications).

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### End market trends

This section is intriguing because it describes events that have already taken place and are, therefore, the only reliable basis for an independent forecast. Data shows that energy transition pathways are anything but easy and often directly dependent on government support measures, such as tax breaks, subsidies, streamlined permitting processes, etc., although there are exceptions.

With 420 GW of new capacity installed globally in 2023, solar photovoltaic (PV) installations accounted for three quarters of renewable capacity additions worldwide. China alone accounted for 62% of this increase despite the phase-out of government subsidies. The country commissioned as much solar PV capacity in 2023 as the rest of the world did in 2022. In the EU, solar PV additions rose by a quarter and reached a record high of 52 GW in 2023. In the US, solar capacity additions grew 50% year-on-year following supply chain improvements, federal tax incentives, and support from state governments.

After a 20% drop in 2022, the wind power segment showed a 60% increase in global capacity additions nearing 120 GW, with China accounting for over 60% of the increase. China almost doubled its capacity additions compared to 2022. In the EU, onshore wind deployment slowed down as new capacity grew by less than 10% in 2023. “Developers have been facing multiple challenges, including rising equipment costs, inflation, and supply chain constraints, which have made them less eager to participate in competitive auctions. Most countries in Europe have introduced policies to address the challenges posed by slow and complex permitting procedures for wind projects. However, the impact of these policies will take time to be visible in deploy-

ment trends,” the survey says. In the US, wind additions declined by more than a quarter, which was mostly due to the uncertainty over the future of tax credits under the Inflation Reduction Act (IRA). IEA analysts believe that wind capacity additions will accelerate in the coming years thanks to the IRA.

Onshore wind projects accounted for over 85% of global wind deployment in 2023. The offshore wind industry outside of China is facing challenges with investment costs, which are more than 20% higher today than a few years ago. As a result, developers canceled or postponed 15 GW of offshore wind projects in the United States and the United Kingdom in 2023 because the previously agreed pricing no longer covered construction costs.

IEA experts assume that renewable capacity additions would accelerate significantly all over the world as more than 130 countries have announced support measures. However, high interest rates and low returns will be major challenges. Demand for copper, silicon and REEs will depend on the rate of renewable capacity deployment.



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The electrolyzer segment is now also dominated by China. Back in 2020, the country accounted for less than 10% of global capacity and ramped it up to 650 MW by the end of 2023 to operate almost half of the global electrolyzer capacity now. This transformation was fueled by the scaling up of project sizes by Chinese developers, with several projects now exceeding 100 MW in capacity. The European Union has ceded its leading position, having added only 70 MW of electrolyzer capacity in 2023. The US added more than 30 MW in the same year to become the third largest market in terms of installed capacity. “Demand uncertainty and lack of regulatory clarity, coupled with recent challenges such as inflation and slow implementation of support mechanisms are hindering faster adoption of electrolyzers in other regions,” the market survey says.

As for electric cars, their sales neared 14 million in 2023 to make 18% of total car sales that year, up from 14% in 2022. Almost 95% of total EV sales were in China, Europe and the US, while China alone accounted for 60% of the global total. At present, over a third of new cars registered in the country are electric, but the growth of electric car

sales slowed down from 80% in 2022 to 35% in 2023 on the back of terminated purchase subsidies for electric cars. The Chinese market is now entering a phase of price competition and consolidation and taking a turn to exports. In 2023, China exported 1.2 million electric vehicles, an 80% increase from 2022. Europe and Asia Pacific were primary export destinations. According to estimates, around 45% of all cars sold in China in 2024 could be electric.

Europe is the second largest market for electric vehicles, accounting for 25% of global sales or 3.2 million cars in 2023. Overall, electric car sales accelerated from 15% in 2022 to 20%, but the trends differed by country. In Germany, the share of EV sales fell from 30% in 2022 to 25% in 2023 due to the sudden termination of all subsidies, which were originally intended to be in place until the end of 2024. Sales of electric cars in other European countries increased, growing 30% in the Netherlands, 25% in the UK and France, and 60% in Sweden.

In the US, electric car sales rose to 1.4 million in 2023, up 40% from 2022, although the share of electric vehicles was only 10% of total car sales. Sales were supported by the incentives provided by the IRA but, as noted in the survey, new guidance significantly reduced the number of electric vehicles eligible for tax credits in 2024.

EV sales across other countries of the world grew 70% to nearly 1 million cars.

### **Metal market trends**

In 2023, demand for energy transition minerals from energy transition technologies was higher than from other segments. For exam-



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ple, demand for copper grew 24% while the total copper demand increased by as little as 3%; demand for lithium grew 56% against the overall growth of 30%. The figures for nickel were 15% and 8%, respectively.

However, the prices for them fell as supply dominated demand, sometimes significantly, in the markets for all energy transition minerals. Lithium prices fell most dramatically by 75%, while prices for nickel, cobalt and graphite fell by 30–40%. Copper was the most stable, with prices remaining generally flat. “The ramp-up of new supply outpaced demand growth in the past two years. From Africa to Indonesia, and to China, new projects came online relatively quickly, adding sizable volumes to the supply pool. The remarkable increase in nickel supply from Indonesia is a notable example,” the IEA experts emphasize. As a result, the market for energy transition minerals shrank by 10% to USD 325 billion in 2023 despite rising demand.

The authors of the survey also name the inventory accumulation as another reason for the decline in battery metal prices, driven by reduced demand for electric cars and, consequently, batteries and metals themselves as manufacturers had built up inventories to ensure production continuity and protect themselves from rising prices.

In the metals mining segment, the picture of mining countries and mine owners is generally patchy, with only nickel and cobalt production concentrated in Indonesia and the Democratic Republic of Congo, each holding a share of over 50% and about 70%, respectively. The processing segment is dominated by China, though, primarily in the production of graphite (about 95%) REE (over 90%), cobalt (over 70%) and lithium (over 60%). Other significant shares in the processing segment belong



only to Chile (lithium, little below 30%) and Indonesia (nickel, 37%). Interestingly, the authors avoid mentioning China when describing the processing segment and focus on other countries as sources of supply.

Thus, the countries that stimulate the energy transition most are the ‘advanced economies’ (as they are called in the IEA survey) and China, but only the latter is fully self-sufficient on the minerals needed for energy transition. The others, on the contrary, depend on supplies from China. In the mining segment, China provides itself with necessary materials, if not geographically, but as the owner of mines at least.

### Outlooks

According to the models developed by the IEA analysts, clean energy deployment will continue in each of the three scenarios presented: Stated Policies Scenario (STEPS), Announced Pledges Scenario (APS), and Net Zero Emissions by 2050 (NZE). Solar and wind farms will account for the largest share of capacity additions, the electricity grid will expand,

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production of electric vehicles will increase, and so will demand for batteries.

Demand for critical minerals will continue to grow, doubling by 2030 in the STEPS and being even higher in the APS. The NZE Scenario envisages it to triple by 2030 and quadruple by 2040. Lithium will show the fastest growth, with demand for it in the NZE Scenario to skyrocket ninefold by 2040. “Today’s well-supplied market may not be a good guide for the future, as demand for critical minerals continues to rise,” the authors of the survey give a warning.

Following the rising demand, the market size for energy transition minerals will also grow. According to IEA estimates, the total market value of energy transition minerals — copper, lithium, nickel, cobalt, graphite, and rare earth elements — will more than double by 2040 to reach USD 770 billion in the NZE scenario. The current estimate of the same market stands at about USD 325 billion, which is roughly equal to the size of today’s iron ore market. This is the size that will be reached by the copper market by 2040, the IEA believes.

When broken down by region, Latin America captures the largest amount of market value for mined output with around USD 120 billion by 2030. Indonesia will show the fastest growth, with the market value of its products doubling by 2030 on the back of burgeoning nickel production. In Africa, the same indicator will grow 65% by 2030. Almost 50% of the refining market value will be concentrated in China. Important is the reservation made by the authors of the market survey that their “analysis of announced projects shows limited progress in diversifying supply.” <sup>NL</sup>

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Rosatom contributes to building an end-to-end production and supply chain in the lithium and REE segment, from ore mining to final products such as wind turbines and electric cars. In partnership with Nornickel, Rosatom plans to build a lithium mine at the Kolmozerskoye lithium deposit and is constructing two gigafactories for the full-cycle production of lithium-ion batteries to be installed in Russian electric cars.

Rosatom owns Lovozersky GOK producing loparite concentrate, and Solikamsk Magnesium Plant (SMP) extracting titanium, tantalum, niobium and a mixed REE concentrate from the loparite concentrate. SMP is currently working on setting up a separation process to obtain individual REE concentrates. Neodymium and praseodymium concentrates, in turn, will be used to manufacture permanent magnets. Construction of a magnet factory is also on Rosatom’s plans. Permanent magnets will be supplied, in particular, to Rosatom’s wind power division and electric car manufacturers.