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Proryv: Breaking Through

In late October, Rosatom organized the fifth conference on the Proryv (Breakthrough) Project aiming to close the nuclear fuel cycle with the help of fast neutron reactors. Top managers and researchers from Rosatom and other companies presented the latest developments in the project and discussed priority tasks.

Alexey Likhachev, Director General of Rosatom, opened the conference reminding that Russia would have every element of technology to close the nuclear fuel cycle with a two-component approach by 2035 that provided for thermal neutron and fast neutron reactors working in a combination. As a result, nuclear generation facilities will become independent of natural uranium and follow the principles of enhanced safety, zero carbon emissions and non-proliferation. Alexey Likhachev called the task 'tremendous.' **"Successful delivery of the project will strengthen our global leadership in nuclear power technologies and give another advantage to nuclear as a source of clean and sustainable energy. It is of strategic importance for both the Russian and global nuclear industries,"** Rosatom's Director General pointed out, noting that the Proryv Project was running on schedule.

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The closed nuclear fuel cycle will be test-run at a pilot energy facility (PDEC), which is currently under construction at the Siberian Chemical Plant (part of Rosatom's fuel division) in the Tomsk Region. PDEC will consist of a fuel fabrication and refabrication module (to be completed in 2023), a lead-cooled fast neutron reactor BREST-OD-300 (to be commissioned in 2027), and a spent fuel reprocessing module (to be put in operation in 2030).

Closing the nuclear fuel cycle is one of five national projects included in the Program for Nuclear Energy Technology and Research until 2024 approved by the Russian government earlier this year. According to Natalya Ilyina, Director for R&D Programs and Projects at Rosatom, RUB354.7 billion (USD 5 billion) will be spent on the program until 2024. The budget approved for the Proryv Project is RUB 64.2 billion (USD 900 million).

Inherent safety through technology

An equilibrium core of fast reactors minimizes fuel burnup reactivity margins and virtually excludes reactor runaways caused by prompt neutrons, i. e., Chernobyl-like accidents. An integrated design of the reactor core excludes accidents like those occurred at Three Mile Island and Fukushima. Russian scientists have developed high-density uranium-plutonium nitride fuel that makes it possible to build a core with the conversion ratio of nearly 1 and enable the fast reactor to operate as a breeder without a uranium blanket. Heavy liquid-metal coolant provides for natural circulation that is sufficient to remove afterheat with the use of an air heat exchanger.

Lead-cooled and sodium-cooled

Last summer, first concrete was poured for the BREST reactor unit at the Siberian Chemical Plant. According to Vadim Lemekhov, Chief Designer of the Proryv Project, orders for BREST key components, including a steam generator, primary coolant pump, reactor pressure vessel and reactor internals, have been placed with Rosatom companies. This became possible after Rosatom obtained a construction license for the BREST reactor in early 2021. Thus, BREST-OD-300 is the first Generation IV reactor under construction in the world. It is inherently safe due to the maximum use of natural properties of its structural materials and design solutions that rely on passive safety principles. BREST uses lead as coolant. Unlike water, lead has higher boiling and solidifying points, thus helping avoid loss-of-coolant accidents, fires, chemical or thermal explosions and producing prompt neutrons for fuel breeding. The reactor has a two-loop design: nuclear fuel heats lead (primary loop); lead then flows into the steam generator and transfers heat to water in the secondary loop.

A sodium-cooled fast neutron reactor, BN-1200M, is also developed as part of

the Proryv Project. The sodium-cooled fast reactor technology has long been tested and piloted in Russia at the Beloyarsk Nuclear Power Plant, which operates two reactors of this type, BN-600 and BN-800. As told by Sergei Shepelev, Chief Designer for Fast Neutron Reactors at OKBM Afrikantov (part of Rosatom), the main purpose of upgrading BN-1200 (M stands for 'modernized') was to make it competitive with other energy sources, including combined cycle gas turbine plants. Key parameters of BN-1200M will be better than those of BN-800: the upgraded reactor will have a lower specific weight; the structural and layout designs of its core for MUPN (mixed uranium-plutonium nitride) and MOX (mixed oxide) fuels will be unified, etc. At present, engineers are working to improve some of its technical parameters and overall cost efficiency and doing necessary calculations for the design feasibility assessment.

Fuel fabrication and reprocessing

PDEC will be equipped with on-site facilities to process nuclear fuel locally. These facilities will include two essential units, a fuel fabrication and refabrication module (FRM) and a fuel reprocessing module, both having a common radioactive waste handling system. The FRM will be the first facility in the world to fabricate mixed nitride fuel from energy-grade plutonium and depleted uranium by means of carbothermal synthesis. Combining fabrication and refabrication functions in a single module makes it possible to use both source materials and reprocessed spent fuel from BREST-OD-300, as well as incorporate minor actinides into fuel for their subsequent transmutation.

Yuri Mochalov, Chief Technology Officer of the Proryv Project, said at the conference that the most impressive results had been achieved in the development of high-density MUPN fuel. Pilot fuel assemblies manufactured at the Siberian Chemical Plant proved to be efficient in a series of in-pile tests and post-irradiation studies. In order to enable the production of MUPN fuel, the FRM will be fitted out with unparalleled multi-purpose units for carbothermal synthesis and fuel pelletizing and with sophisticated auxiliary equipment. **"We are now assembling and installing equipment for the FRM. The pre-commissioning phase will begin in 2022 to be followed by commissioning and pilot testing the fuel fabrication line in 2023,"** Yuri Mochalov explains. At PDEC, the FRM will be designed to make fuel specifically for BREST, but it can be easily modified to supply fuel for BN-1200M. The modification will follow the 'from automation to unmanned operation' path.

The radioactive waste handling system serves both fuel fabrication and spent fuel reprocessing and is designed to extract as many transuranium elements from liquid radioactive waste as possible. **"We have built a full-size prototype of a facility for the vitrification of high-level radioactive waste from the hydrometallurgical**

and pyrochemical spent fuel treatment processes," Yuri Mochalov said.

Key risks and problems of the nuclear power industry are related to the handling of irradiated nuclear fuel and radioactive waste in accordance with the latest environmental safety standards. Speaking at the conference, Viktor Ivanov, Chief Radioecologist of the Proryv Project, explained that, with fast reactors used to close the nuclear fuel cycle, radioactive waste and natural uranium would become comparable in terms of carcinogenic potential after 100 years of storage.

As noted by Dmitri Tolstoukhov, Chief Economist of the Proryv Project, sustainable and competitive development of the nuclear power industry could not be separated from closing the nuclear fuel cycle. The share of nuclear power in the Russian energy mix might grow from about the current 20% to nearly 31% by 2050, he cited data from the forecast made by the Energy Research Institute of the Russian Academy of Sciences. The current plan approved by the government provides for the nuclear share to reach 25% by 2045.

From piloting to commercialization

PDEC is expected to demonstrate the feasibility of new designs and solutions, as well as the possibility of closing the nuclear fuel cycle. However, available data is sufficient to move on to developing commercial power generation facilities with fast neutron reactors (abbreviated PEK in Russian). **"Proryv's ultimate goal is to initiate massive construction of nuclear power plants based on fast reactors,"** Chief Engineer of Proryv Andrei Petrenko said at the conference.

PDEC and PEK will have similar operating principles but PEK will comprise a two-unit power plant with two 1,200 MW fast neutron reactors. It is yet to be decided whether they will be lead or sodium cooled. Like PDEC, PEK can be combined with on-site fuel fabrication and reprocessing modules. The first module will produce MUPN or MOX fuel assemblies, and the second module will reprocess spent fuel to be refabricated into new fuel assemblies. It is also possible that the fuel fabrication and refabrication modules will be located away from the power plant, at Rosatom's fuel processing sites. According to Andrei Petrenko, a concept design for PEK is ready. The work is going on to carry out a feasibility study for the initial stage of closing the nuclear fuel cycle.

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Small Reactor, Large Benefit

Small modular reactors excited much interest at the Russian Energy Week (REW) international forum. Four most feasible arguments voiced for SMRs were long-term predictability of prices, sustainability, relatively low capital expenditures, and efficiency in hydrogen production. Rosatom is currently working on its new project to build floating power reactors for Baimsky GOK.

“We are satisfied to be finally heard. This is really good news that nuclear energy has been mentioned in favorable terms over the last weeks. The trend is clear: everyone needs a safe, stable and reliable energy system. No less important are energy prices and the possibility of predicting them, as well as its sustainability,” Rosatom Director General Alexey Likhachev said at the REW.

His belief that nuclear power is essential for the zero-carbon future is based on facts and figures. In 2020, renewable sources of energy accounted for 45% of the German energy mix and 25% in France. The share of nuclear power is 11% in Germany and almost 70% in France. Germany produced 617 million tons of carbon dioxide equivalent (a unit of measurement that is used to standardize the climate effects of various greenhouse gases) in 2020, while France produced 272 million tons of CO2-eq over the same period. All despite the fact that Germany generated 60.9 TWh of electricity in 2020, and France 379.5 TWh. **“We should shift from statements and proclamations to figures in solving environmental problems,”** Alexey Likhachev called on the audience.

Nuclear power benefits for consumers were also proved by figures. According to Rosatom’s Director General, Baimsky GOK, a mining and processing plant that will develop one of Russia’s largest gold and copper deposits Peschanka, will pay about RUB6 (USD 0.08) per kilowatt-hour of electricity. **“I think the solution is just brilliant. At first, we considered two options — either a gas-fueled power station or a floating nuclear power plant. And never for a moment did I doubt, especially considering the current situation on the gas market, that we were absolutely right in choosing nuclear. We need a long-term guarantee of flat prices. I am sure that what we do in partnership with Rosatom will be one of the most technologically advanced solutions worldwide,”** said Oleg Novachuk, Chairman of the Board of KAZ Minerals, which owns the Baimsky GOK. It is also important that copper and gold produced by Baimsky will not be subject to the carbon tax thanks to carbon-free nuclear generation. **“Exploration of remote regions will not be possible without floating nuclear power plants,”** Oleg Novachuk concluded confidently.

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Rosatom will construct four upgraded floating nuclear power units for Baimsky GOK. Their service life will be 40 years, with a possibility of extension. A RUB190.2bn contract to this effect between AtomEnergoMash and Atomflot (both are subsidiaries of Rosatom) was signed this October. The upgraded power units will have almost the same dimensions as the only one existing now, Akademik Lomonosov, but their reactors will be different. The 35 MWe reactor KLT-40 will be replaced with RITM-200S with a power capacity of 55 MWe. The turbine will also be more powerful. Unlike Akademik Lomonosov, the floating nuclear power units for Baimsky will not produce heat as it will not be needed. Besides, they will have a smaller crew compartment since some of the functions will be relocated onshore. Another difference is the upgraded floating power units will have no refueling area — their reactors will be refueled at Atomflot's naval base in Murmansk in a manner similar to nuclear icebreakers.

Orders for key components have already been placed with manufacturers. OKBM Afrikantov (part of AtomEnergoMash) will produce eight reactors. Kirov Energomash (part of Kirov Plant Group) will produce eight steam turbines.

AtomEnergoMash will supply the first two floating power units to Atomflot by the end of 2026. The contract had to be fulfilled by July 31, 2031.

Onshore SMRs have no fewer advantages than floating ones. According to the head of the Republic of Sakha (Yakutia) Aysen Nikolaev, Yakutia despite being the largest Russian region had no district heating. Diesel generators remain the only source of electric

power in many cities and towns, driving up electricity prices. For example, people living in the town of Belaya Gora pay more than RUB100 (USD 1.4) per kilowatt-hour, so local authorities seek every opportunity to cut electricity costs. **"If we want to carry out large industrial projects here in the Arctic, where there is no power supply, nuclear stations seem to me to be the safest and most cost-efficient option," Aysen Nikolaev stressed. "The price of electricity will be several times lower than now,"** Alexey Likhachev confirmed.

In Yakutia, Rosatom will construct an onshore small nuclear plant with RITM-200 reactor to supply power to the Kyuchus gold mine during its commercial development. This sustainable source of energy will help overcome power shortage in the region, the head of Yakutia said.

Interest towards SMRs is growing. According to Mikhail Chudakov, IAEA Deputy Director General and Head of the Department of Nuclear Energy, many countries showed interest in SMRs after the first floating power plant Akademik Lomonosov was put in operation. SMRs are considered by island

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AtomEnergoMash (AEM) is Rosatom's power engineering division and one of Russia's largest power machinery producers providing comprehensive solutions in design, manufacture and supply of machinery and equipment for nuclear, thermal, petroleum, shipbuilding and steel-making industries. Its production facilities are located in Russia, the Czech Republic, Hungary and other countries.

countries such as the Philippines, Malaysia and Indonesia. Small modular reactors do not require large initial investments into construction and electric power infrastructure. What is more, SMRs suit better to produce hydrogen by electrolysis than renewable energy sources proposed for this purpose. Nuclear power plants generate 75–80 times more energy than they consume, while solar farms produce only two times more. **"Nuclear plants are best fit to make hydrogen, even by electrolysis,"** Mikhail Chudakov pointed out.

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Atomic Polyphony

Hungary has a long track record of nuclear cooperation with Russia. This article deals with Rosatom's business, educational, social and cultural activities in the European country.

Large-scale power generation

Hungary is celebrating 65 years of its nuclear industry in 2021. It all started in 1956 when the National Atomic Energy Committee was set up in the country. Hungary's first research reactor in Budapest went critical three years later, in 1959. It was upgraded in 2009 to use low-enriched uranium as fuel.

In 1966, Hungary and the Soviet Union signed an agreement to build a nuclear power plant near the town of Paks on the bank of the Danube, 100 km south of Budapest.

In August 1974, first concrete was poured for the first two units of the Paks Nuclear Power Plant. The first unit was brought online in December 1982, followed by Unit 2 in September 1984. The third and fourth units were connected to the national grid in September 1986 and August 1987, respectively. Each of the four power units uses Russian-designed VVER-440 reactors.

Today, the total installed capacity of the plant is 2 GW. In 2020, according to PRIS, the Paks NPP generated 15,179 GWh of electricity, which accounted for 48% of total power consumption in the country. However, the existing units will be decommissioned one by one in the 2030s. With this in mind, the Hungarian government made an early decision to replace the retiring capacity.

In 2014, Hungary and Russia signed a framework agreement and three basic contracts that provided for the construction of two new power units with Generation 3+ VVER-1200 reactors. A prototype for the new plant is Leningrad II in Russia. In June 2020, Rosatom's ASE and Hungarian project owner MVM Paks II submitted a license application and 283,000 pages of licensing documents to the Hungarian Atomic Energy Authority.

Construction will begin after the license is obtained. The first unit of Paks II is planned to be commissioned in 2029, with the second unit to follow in 2030.

Meanwhile, preparations are underway on the site and construction yard, with almost 120 auxiliary buildings and structures to be erected, including workshops, warehouses, parking lots and a road. Currently under construction are a steel structure fabrication shop with the annual capacity of about 45,000 tons of prefabricated steel structures, an anti-corrosion treatment facility, and a batching plant with the capacity of 300,000 cu m of ready-mix concrete per year.

Construction of nuclear power plants is not the only area of nuclear cooperation between Rosatom and Hungary. For instance, Rosatom produces a new modification of nuclear fuel for Paks. The modified fuel optimizes a water-uranium ratio in the reactor core and thus makes reactor operation more cost-efficient.

Another example is Ganz EEM, a Hungary-based subsidiary of Rosatom's power engineering division AtomEnergoMash. Ganz EEM produces high-capacity pumps for nuclear power plants and is currently manufacturing coolant pumps for Kudankulam in India, Akkuyu in Turkey and Rooppur in Bangladesh. Of course, the company counts on orders from Paks II.

Education

Positioning itself as a 'corporation of knowledge', Rosatom invests in local educational projects, and Hungary is no exception. Last April, Rosatom organized HackAtom Hungary, the first Russian-Hungarian atomic hackathon. It started with lectures delivered by teachers from Russian universities on nuclear physics, reactor technologies and other related topics. Then, nearly 100 people from the University of Debrecen, University of Dunaújváros and University of Pécs received two tasks. Twenty-four teams had 24 hours to find the best solution to the problem of forecasting power utilization efficiency at nuclear power plants and analyzing equipment control parameters.

Five months later, the participants of HackAtom Hungary had an opportunity to visit Paks Unit 4. The students visited the main control room, turbine and reactor islands and had a lecture on how a nuclear power plant works.

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Supporting communities

In June 2021, employees of Russian and Hungarian nuclear companies worked together in an elderly care home in the town of Kalosca. They repaired and painted benches, built cozy pergolas, decorated them with national ornaments, and planted flowers. A similar initiative was undertaken in the community of Dunaszentgyörgy in October. The volunteers repaired and painted fences around the local school and the kindergarten and also planted flowers.

Cultural accord

In the first half of October, two Hungarian cities, Budapest and Debrecen, and the town of Tihany hosted the Russian Music Festival sponsored by Rosatom. Even kids had a chance to learn about Russian culture. They listened to Sergei Prokofiev's symphonic fairy tale Peter and the Wolf, music from Tchaikovsky's ballet The Nutcracker, and Mussorgsky's Pictures at an Exhibition. Adults had a choice of more serious pieces of music, both for symphonic orchestras and for individual instruments. This can be inferred from the names of thematic evenings, such as Russian Harp, Russian Piano, Russian Violin and even Russian Pipe Organ. There is nothing to wonder — Russian composers Mikhail Glinka and César Cui wrote polyphonic works for the pipe organ.

AtomEnergoMash (AEM) is Rosatom's power engineering division and one of Russia's largest power machinery producers providing comprehensive solutions in design, manufacture and supply of machinery and equipment for nuclear, thermal, petroleum, shipbuilding and steel-making industries. Its production facilities are located in Russia, the Czech Republic, Hungary and other countries.

TVEL is Rosatom's fuel division and one of the world's largest suppliers of nuclear fuel. TVEL is a monopoly supplier of nuclear fuel to all power, marine and research reactors in Russia. The company fuels nuclear power plants in 15 countries, or every sixth power reactor in the world.

Nuclear medicine planned

Obviously, the history and scale of cooperation between Rosatom and Hungary pave the way for a number of other joint projects. Along with constructing new power units at Paks II, Rosatom holds talks with some Hungarian companies to launch partnership initiatives in nuclear medicine and other high-tech fields. NL

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Energy Crisis Through 1973 Prism

Global gas shortage coupled with rising demand reached critical levels in October and shows no signs of relief. A similar situation occurred in 1973 when the price of oil tripled, and the scale of new nuclear construction increased as a consequence. Let us take a closer look and explore whether the current processes are similar to those half a century ago and whether construction of new reactors is to be expected to grow worldwide.

Causes of the crisis

"A worldwide economic boom, with high inflation and an even higher growth in resource use, was taking place at the same time that American oil reserves were declining and both American imports and worldwide energy use were rising dramatically. Moreover, the new environmental consciousness was beginning to reconfigure public policy in the industrial world and to force changes in corporate strategies." This is a quote from Daniel Yergin's bestseller The Prize: The Epic Quest for Oil, Money, and Power about the events of the early 1970s. It is remarkable how similar the circumstances of that time are to the situation that took shape in the autumn of 2021.

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The World Bank forecast in June said the global economy would grow 5.6% in 2021, showing the fastest post-recession recovery for the last 80 years. China is expected to grow most rapidly (8.5%). Despite a slowdown in the second half of the year, China still believes an 8% growth is achievable. According to the World Bank estimates, India will grow 8.3%, the US 6.8%, and Argentina 6.4%. The estimate for Turkey is 5%, but its president speaks about a 'double-digit growth.' As for Russia, the IMF has raised growth expectations for its GDP from 4.4% to 4.8%.

The filling level of European gas storage facilities, which is estimated as 'extremely low,' speaks volumes about the rising demand for gas as the most popular source of energy now. In September, Europe's largest gas storage site, Rehden, was only 9.47% full. Consumption on the other side of the planet is growing, too. In October, China imported 9.38 million tons of natural gas, up 24.6% year-on-year.

Curiously, gas now and oil half a century ago are comparable even if viewed from the environmental perspective. **"The impact of environmentalism on the energy balance was manifold. The retreat from coal was accelerated, and reliance on cleaner-burning oil grew,"** Daniel Yergin writes. Until recently, gas was considered to be a transitional energy source on the way towards a carbon-free future. However, early November showed signs of natural gas to become the source of energy — at least in Germany, which has always been a trendsetter in the European energy market (see details below).

Solutions to the energy crisis proposed by authorities are also similar. **"In April 1973… Akins, now from his White House post, tried again. He prepared a secret report filled with proposals to counter the growing energy threat, among which were expanded coal use, development of synthetic fuels, stepped-up conservation efforts (including a stiff gasoline tax), and much-increased research and development spending in order to get beyond hydrocarbons. His ideas were met with incredulity."** Hydrogen production technologies developed today are planned to serve the same purpose. China, which has already faced electricity shortages, proposes to prioritize domestic consumers and supply power to facilities in foreign ownership secondly. Japanese media also discuss how electric power should be distributed when it is not enough to go round. **"According to Sumiko Takeuchi from the International Environment and Economy Institute, we should consider the possibility of requesting large plants to suspend operation,"** Fuji News Network (fnn.jp) writes.

Crisis effect

The 1973 crisis manifested itself in a reduction of supply and a resulting feverish demand for oil. **"Fear and uncertainty were pervasive and had a self-fulfilling effect: both oil companies and consumers frantically sought additional supplies not only for current use but also for storage against future shortages and the unknown. Panic buying meant extra demand in the market,"** Daniel Yergin writes. The oil price rose 600% as compared to the pre-crisis level in early October 1973.

On October 1, 2021, the price of gas at London's stock exchange exceeded USD 1,200 per 1,000 cu m although it had not climbed above USD 400 for almost eight previous years and even went under USD 100 per 1,000 cu m in mid-2000. Now there is understandable anxiety on the market, accusations against Russia as a major gas supplier, rebuttals of such accusations, meetings, shutdowns of smaller utility companies, suspensions of production, and heated debates over what to do next.

Nuclear in focus

New nuclear construction was seen as one of the ways to reduce dependence on oil after the 1973 crisis. It was the strategy chosen by France and Japan. According to IAEA PRIS, France commissioned 43 nuclear reactors in the 1980s. First concrete for all of them, even those launched in 1980, was poured after 1973. Japan built 17 reactor units over the same period. In the USA, first concrete for 31 out of 47 reactors brought online in the 1980s was also poured after the 1973 crisis.

A logical question emerges: can the current situation in the energy market lead to similar consequences for the nuclear power industry as it happened half a century ago?

We contacted Kissinger Associates to ask Henry Kissinger this question, after all he played a key role in solving the global energy crisis after October 1973 (as you may know, the Watergate scandal broke out at the very same time and, having shaken the public confidence in President Nixon, restricting his capacity to influence the situation). Unfortunately, Mr. Kissinger did not answer our questions.

Other experts whom we asked agreed that this scenario was very likely because environmental and economic factors overlapped.

"You are basically right. The world is clearly moving to a nuclear renaissance although it is not made public. Executive Vice President of the European Commission for the European Green Deal Frans Timmermans said that the EU would help Bulgaria resume its nuclear project. The UK and France announced they would make nuclear power a foundation of their net zero strategy. Even Japan believes that re-launch of its nuclear power plants is key to achieving carbon emission targets," says Ukrainian political expert Dmitri Dzhangirov.

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"I agree with your conclusion. Judging by what Ursula von der Leyen and Frans Timmermans have said and written recently, European politicians seem to change their attitude regarding nuclear technology as gas and electricity prices are growing," Elena Anankina, Senior Analytic Director for Ratings and Infrastructure at S&P Global Ratings Moscow, replied.

The events of October and November show that large-scale construction of new nuclear reactors might well become a global reality.

China has the most ambitious plans. According to Bloomberg, Beijing is going to build at least 150 reactors in the next 15 years. **"The effort could cost as much as USD440 billion; as early as the middle of this decade, the country will surpass the US as the world's largest generator of nuclear power,"** Bloomberg writes.

President of France Emmanuel Macron said in his address to the nation on November 9 that France would resume construction of nuclear reactors for the first time in decades. New power reactors combined with renewable energy sources will 'ensure energy security and sufficient supply of power.' Earlier in October, he said nuclear stations could be used to produce hydrogen by electrolysis with zero emissions. A small modular reactor and two 'mega factories' will be built for that purpose.

Also in October, authorities of ten European countries (Bulgaria, Croatia, Finland, France, Hungary, Poland, Romania, Slovakia, Slovenia, and the Czech Republic) published a joint statement in large European newspapers calling for a wider use of nuclear energy to protect people from the volatility of energy prices, and inclusion of nuclear energy in the European Taxonomy. **"It is absolutely essential for nuclear energy to be included in the European Taxonomy by the end of 2021,"** the statement says. The authors of the letter support their requirement with multiple benefits of nuclear generations. **"It is a clean, safe, independent and competitive source of energy. It gives us, Europeans, a chance to continue developing the industry with a high added value, create thousands of qualified jobs, strengthen our environmental ambitions and make Europe autonomous in terms of strategy and power. Let us not lose this critical opportunity."**

New nuclear construction is discussed in the UK, too. **"The government has said that nuclear is vital for its plans to reach net-zero emissions by the middle of this century, but has struggled to get large scale projects built. The latest push for atomic power comes as Britain struggles with an energy crunch, with surging natural gas and electricity prices increasing the risk of blackouts this winter,"** Bloomberg writes, analyzing the plans to resume construction of the Wylfa nuclear station in Wales.

However, not all European countries share the conviction that it is necessary to construct

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new reactors. **"I do not think that political decisions to phase out nuclear power in Germany, Belgium and Switzerland can be reversed or stopped,"** Elena Anankina believes.

Germany's unwillingness to retain nuclear generation even at the expense of its energy system reliability may be explained by direct access to, and prioritization of, natural gas. **"Germany will embark on massive construction of new gas-fired power plants. Those plants will serve to back up renewables after the nuclear phase-out and accelerated shutdown of coal-fired capacity. This seems to be a strategic plan of the next yet-to-be-formed German government, and it is clearly supported by large businesses in the country," Deutsche Welle reports. "We will continue using gas for a long time yet and building new gas-fired power plants because they will help us ever transition through the period of change,"** DW quotes Germany's chancellor-in-waiting Olaf Scholz as saying. Here are the figures: gas generating capacity should grow from the current 31 GW to 74 GW in 2030 to meet the growing demand.

Nuclear power plants have an advantage, though — they are not connected to a gas pipe, Dmitri Dzhangirov notes. A nuclear station can be built anywhere and thus be more than just interesting to the other countries dealing with appetites of German gas traders.

The competition between gas and nuclear should factor in capabilities of national industries and local plants. In other words, if a country can locally produce most of the machinery and equipment for a nuclear power plant, it will benefit more from developing nuclear power. This is one of the arguments voiced by Japanese media in support of nuclear revival in the country. **"Local content in Japanese nuclear power plants is about 99%, while nearly 85% of solar panels is imported from China,"** says an article published on plaza.rakuten.co.

Summing it up: just like 50 years ago, the energy crisis caused by growing demand on the back of economic growth seems to have resulted in the decision to build new reactors in the countries that have sufficient resources and competencies. Other countries, which do not have broad public support of nuclear yet (like Japan or Kazakhstan) or lack financial resources and technological competencies (like Central European countries), need more supporting factors. First, they need to increase public awareness and confidence. Second, nuclear energy should be included in the Taxonomy as this will facilitate access to subsidized finance.

And what about the USA? Making decisions about new construction stumbles upon the absence of a company that can build a nuclear power plant or possess reactor technologies that can be offered to customers (utility companies). No nuclear plant has been constructed recently in the USA. Watts Bar 2 is the only new reactor brought online in the 21st century. Watts Bar 1 was put in operation as long ago as 1996. The situation might change, though as US President Joe Biden signed a USD 1.2 trillion infrastructure bill in mid-November, including USD 6 billion to be spent to prevent early retirement of nuclear power plants and USD 2.5 billion on new nuclear power project.

It must be thus admitted that nuclear technology can help achieve sustainable development goals that comprise energy security, carbon neutrality, and clean air and water. What we need is technological and political neutrality. And let those properly equipped build new nuclear power plants.

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