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EVGENY PETROV: «ROSNEDRA SHOULD BECOME THE LEADING GEOLOGICAL SERVICE IN THE WORLD»

Today, the Federal Agency for Subsoil Use (Rosnedra) is undergoing a large-scale transformation in response to the dynamically changing conditions of the modern world. In an exclusive interview with the Oil and Gas Vertical, the Head of Rosnedra Evgeny PETROV told us how to become transparent, open, technological while maintaining connection with the richest traditions and heritage of Russian geology.

NGV: *Evgeny Ignatievich, let's start with a "warming-up" question. In November, you got rid of the prefix "temporary acting…". Almost half a year has passed since that moment.*

E. Petrov: Before my appointment, I temporarily acted as the head of Rosnedra for almost six months, and before that I held the position of deputy head for about a year, so in general, just little has changed in my work. My colleagues and I continue to work as a team. Last year we formulated key goals and objectives for ourselves – and they have justified themselves today, in a rapidly changing economic situation.

NGV: *What are these goals?*

E. Petrov: The most important one is to ensure the sustainability of the industry, its effective growth and transition for the work in new conditions. The strategic stability of the entire state largely depends on this. The key institutional objectives are transparency of the institution and public services, reduction of deadlines and maximum focus on results. All the information that we operate on, on the basis of which we make decisions, should be as reliable as possible, should be formed as transparently as possible.

NGV: *You also advocated the creation of a "powerful geological service" in Russia by analogy with the Soviet Ministry of Geology. But it was a huge institution that included production and mining structures, conducted a huge number of expeditions, and so on. Is this possible today, especially in the format of the federal service?*

E. Petrov: Unfortunately, we will never return to the model that functioned in Soviet Union. In Soviet times fundamentally different economic mechanisms functioned in terms of geology. Today market conditions prevail; subsoil use, geological exploration are in market environment. And the most important thing is that some of the stages of geological exploration were transferred from the state to subsoil users.

But no matter how the life of our country changes, Russia, as one of the largest mining countries, must have a powerful geological service. And Rosnedra should be not just a powerful, but the most advanced geological service in the world. Today, our team, our industry is on a new evolutionary turn both in terms of methods of prospecting and extraction, and in terms of the distribution of mineral raw materials in general in conditions of energy transition. Today we are beginning to form new trends, including the level of the international agenda. This concerns first of all, the search and evaluation of minerals, methodological and analytical work with the substance. Probably only Chinese colleagues can compete with us here, because they absorb ideas and adapt very quickly. At some points we are comparable, but in general, of course, we are far ahead.

The scale of these changes is another issue. We started changes from the inside, engaged in transformation and optimization of internal processes. As they say, if you want to change the world, start with yourself. In order to reach the external perimeter, Rosnedra first of all must rebuild itself, and the changes that have already taken place inside, we will soon carry outside, including changing the work with subsoil users, largely introducing predictive services and working methods. There is still a lot of work to be done.

Separately, I would like to note that Rosnedra definitely needs to develop and strengthen competencies in those areas of geology that have been and still remain economically profitable. Today, the geological service has a lot of purely state functions that are an expenditure part, it is impossible to earn money on them, there are a lot of absolutely non-commercial objectives that the market cannot provide. And we need some kind of a minimum set of competencies, including field, production, which would allow us to provide these functions, effectively solve such objectives. We are gradually moving towards these changes, and our internal production competencies, primarily the laboratory and analytical unit, will soon be strengthened. It is a State objective to carry out these tasks at the highest level.

NGV: *So we are talking about optimizing the institution, moving towards its greater compactness, flexibility, a clearer focus in relation to the tasks set?*

E. Petrov: Yes, absolutely right. Rosnedra should adapt to changing conditions as quickly as possible. Geological exploration, subsoil use is a very conservative industry in itself. This is "long-playing" money, and you can't take too drastic steps here. But, on the other hand, talking about the today's response to the challenges of the changing world, to international economic conditions, we must react very quickly. The changes taking place in the world open up fundamentally new opportunities, new markets, and at the same time require us to make accurate long-term forecasts so that in 5, 10 or 20 years we will be competitors not only in the domestic, but also in the international mineral raw materials markets. In this situation, the industry needs a strategic management body, the headquarters of the industry, systematically programming its development in the interests of the state. This is the role of the Federal Agency for Subsoil Use today, and this is our responsibility.

NGV: *Earlier you have said that Rosnedra should determine new trends in the development of the global mineral raw materials market. And what trends are most relevant today?*

E. Petrov: The structure of the mineral resource base is changing in all producing countries, including Russia. We are moving to work with fields that are very complex, talking about prospecting and development. Both in hydrocarbons and in solid minerals, we work with deposits that are on the edge and often already beyond the sensitivity of the existing instrument base. Despite the fact that formally Russia is currently completely covered with million-scale filming, we cannot use most of the filming in solving modern tasks that require a new level of accuracy. Some of the methods, especially remote geophysical methods, are now simply irrelevant, because the equipment and technologies that were used in the sixties and seventies, XX, when the surveys were carried out, do not mach with our modern requirements for accuracy and sensitivity. The main objective is the development of the Russian instrumental base, the most mobile, efficient, aimed at reducing the cost of field work as much as possible.

NGV: *So another key objective of Rosnedra at the moment is to stimulate new scientific approaches and practices in the field of geological exploration?*

E. Petrov: Rather, in the field of Earth sciences in general. Geology as a science is a scientific complex in which methods of various disciplines are used. Today, with the development of

remote methods, automation, and the emergence of new technologies, the general scientific approaches that have been developing for decades, are changing. This is a long evolutionary process that takes place against the background of the changes in the general technological structure. We are witnessing the acceleration of many global mechanisms that change the distribution of consumption and production, which, of course, affects our industry as a very knowledge-intensive and technologically advanced one.

As for the actual directions of development, I would focus on two main trends in the mining industry.

The first clear trend of recent decades is the increasingly active involvement in the development of very large deposits with poor ores that are available for open-pit mining and are able to provide super-large volumes of production for a long time. First of all, we are talking about the so-called porphyry deposits. The most famous among them are copper–porphyry, porphyry deposits of gold, molybdenum, tungsten and tin are also common.

The prospects for studying such deposits in Russia are quite high. Thus, over the last 15 years, five deposits with total reserves of 20 million tons of copper have been discovered, this discoveries have increased the Russian raw material base of copper by almost a quarter. At the same time, the same deposits contain almost 900 tons of simultaneously extracted gold.

Another global trend of the last decade is the rapid development of electronics, "green" energy and electric vehicles, which influenced the formation of a large-scale sphere of consumption of new energy raw materials, including battery metals, which include lithium, nickel, cobalt, copper, graphite and a number of others.

Thus, according to our experts, over the last 15 years, the global demand for nickel, cobalt and lithium has increased 5, 7 and 11 times, respectively. All this, of course, served as a powerful impetus to the development of nickel-cobalt and lithium deposits all over the world.

At the same time, as Russia is one of the world leaders in nickel and cobalt production, the domestic lithium mineral resource base, one of the largest in the world, is not yet being developed. We expect that in the near future, domestic subsoil users will start the development of priority lithium facilities in the Murmansk region with total reserves of 1.2 million tons of lithium oxide.

NGV: *You have already mentioned the complex fields, and since 2019 there has been a tendency for drilling to decrease in the Russian oil industry. Only last year, according to the data of the Central Department of Fuel and Energy, the dynamics of exploration wells at Russian vertical-integrated oil and gas companies decreased by 14.8%, and production wells – by 3.3% compared to 2020. If last year there was a recovery in demand on world markets, then what are the reasons for the decline in drilling in your opinion?*

E. Petrov: There is no stable tendency to decrease drilling volumes, but there are local corrections caused by general market restrictions. The latest changes were caused by the terms of the OPEC+ deal, and the economic crisis caused by the pandemic also affected drilling performance, which led to increase in the cost of materials, primarily metals.

On the other hand, we must pay tribute to the development of technology. If we are talking about horizontal drilling, then the efficiency of working with the reservoir is growing. Today we are seeing both an increase in the length of the drilling shaft through the formation, and a significant development of methods of influencing the formation itself, which makes it possible to increase the flow rates of wells. In the future, this may also contribute to reducing drilling volumes while increasing efficiency and marginality.

NGV: *But we are also reducing the number of new deposits. How do you assess this trend?*

E. Petrov: We are opening new deposits. As for hydrocarbons, over the past 20 years, 9,000 new oil-bearing facilities with reserves of more than 10 billion tons of oil (about 30% of those discovered in the entire history of oil production in Russia) have been opened, 5 billion tons of which have already been involved in development. Since 2016 over the five-year period, 322 new hydrocarbon deposits have been discovered in our country, including a number of gas and gas condensate fields unique in reserves: named after 75 years of Victory, named after G.K. Zhukov, named after K.K. Rokossovsky, named after V.A. Dinkov, named after E. Zinichev. The Zapadno-Irkinskoye oil field, which is unique in terms of oil reserves, located in the Krasnoyarsk Territory, has also become a significant discovery in recent years.

We will continue to discover the large deposits in the future, but these will definitely be the deposits of an unconventional type that will require new, and perhaps well–forgotten old methods of geological study.

Today we are mainly working within the framework of existing, well-studied oil and gas provinces and descending to deeper horizons, are working with deeper intervals, increasingly complex reservoirs. Deep horizons and unconventional reservoirs, intervals are difficult for studying and subsequent extraction, and here, as I have said many times, the issue of technologies and their cost plays a big role.

As for solid minerals, in the last five years we have opened more than 100 facilities annually. Among them there are both small deposits and very large ones. For example, the Malmyzhskoye copper deposit in the Khabarovsk Territory, the Pyzhem titanium-zirconium deposit in the Komi Republic, the Mikhailov deposit in the Kabardino-Balkar Republic.

In solid minerals today there is a paradigm shift in terms of approaches to identifying deposits. And the paradigm shift will again require new geophysical methods, a new instrument base. And we need to increase this research base very quickly, unfortunately, we are very far behind here. This is extremely important today, because it will increase the number of discoveries of deposits of non-classical types, even in already well-studied regions.

NGV: *And what is the situation in Russia as a whole with the structure of reserves? Is it safe to say that our future is connected with deposits with unfavorable geological and physical characteristics of deposits and hard-to-extract reserves?*

E. Petrov: Changing the structure of the mineral resource base of our country is the most important issue that determines the future of Russian subsoil use and the welfare of our country.

The structure of the mineral resource base, to which, we can say, the domestic subsoil use has become accustomed, to which methods, technologies, transport infrastructure, fiscal mechanisms are oriented - this structure is gradually disappearing.

If we are talking about hydrocarbon raw materials, then about 66% are already hard to extract. For solid minerals, the situation is perhaps even more dramatic, because each deposit there is such a separate case for studying. That is, somewhere for certain types of solid minerals, it can reach up to 80%.

The prospective development of subsoil use in our country depends on how successfully the industry will be able to reorient itself to unconventional deposits, deep-lying deposits, deposits of poorly studied provinces.

Such deposits have fundamental differences from the traditional ones in terms of the applied technologies of prospecting, exploration, production and, consequently, profitability.

Changing the structure of the mineral resource base in favor of deposits with low profitability requires complex transformations of the geological industry in all directions. I have been talking about this many times today, but this is the general line that we are following today. And we will be able to cope with this only by conducting constant and systematic work on improving the assessment of deposits, on technical re-equipment of the industry, on complex data analysis and mechanisms of their turnover.

But here's what's important to note here. Back in the seventies and eighties, XX - in the blossoming period of Soviet geology – the development of Achimovka or Jura collectors was considered a task hardly feasible. And today these are traditional collectors with which subsoil users successfully work. This is the result of the technological development of the industry. And if today we do not engage in the further development of technology, then pretty soon there will really be only hard to extract reserves everywhere. But if we stimulate and develop technologies, then hard-to-extractability will simply become one of the parameters of the economic profitability of field development.

NGV: *Then which scenario is Russia now more inclined to – the development and introduction of technologies that facilitate the extractability of reserves, or still to an increase in the share of hard-to-extract reserves when no one is engaged in them?*

E. Petrov: There are many companies that are engaged in hard-to-extract reserves. It's just that hard-to-extract reserves are a kind of reserve for the future for companies. If we take the most striking example – shale gas, then in Russia they are not engaged in it, because we have a lot of traditional gas, which is both cheaper and economically more rational from the point of view of production. But again, they are engaged in shale gas development technologies, because they need to be developed so that, relatively speaking, in 10-15 years we will be ready to start developing the corresponding reservoirs. It's the same with hard-to-extract reserves in general: this is a reserve for the future.

Rosnedra, for its part, is doing a lot of work to encourage not only subsoil users, but also development companies to invest in the creation of technologies for hard-to-extract reserves. We have specially made a separate type of licensing with certain benefits. Already at the beginning of the year there was a fairly high demand, but now the companies have taken a pause. I am sure that the process of technological development will continue, moreover, in the current economic situation it will accelerate significantly, because Russia simply has to be a leader in this direction. We have people, huge scientific potential, and most importantly, we have development technologies. They need to be brought to industrial use, prepared for scaling at all existing and potential fields.

NGV: *But while this process is still underway, it has not been fully implemented, the question arises: do you think that in the current conditions s the implementation of the resource conservation policy that should be at the forefront of Rosnedra? If so, what measures are being implemented?*

E. Petrov: Ensuring the rational use of the country's mineral resources is our key function: on the one hand, the state should receive maximum benefits from the provision of mineral resources to companies, it should certainly be economically feasible for business, and on the other hand, environmental legislation should be observed, damage to the environment should be minimal.

Any subsoil use implies a violation of the integrity of the subsurface. This contradiction, alas, is at the heart of the question. Of course, Rosnedra, first of all, look at the fact that the damage during the development of deposits is minimized. And again, we will return to the issue of technology here. What kind of technologies are used? How much does the company invest in the development of these technologies? After all, it is possible to extract with explosives, pickaxes and crowbars, and it is possible to use a more modern energy-saving technology that will extract this or that type of minerals with the least harm to the environment, extracting all the main and associated components as fully as possible, involving all the waste of subsoil use in secondary circulation.

Here it is necessary to maintain a balance, so that, on the one hand, the state helps companies, guides them in the development of technologies, investments in this development, and on the other hand, so that the subsoil companies themselves not only think about making a profit, but also improve their technologies from the point of view of environmental legislation. This is the balance we try to keep.

NGV: *The development of hard-to-extract reserves requires significant costs. Do you agree with the statement that they can be leveled by reducing the cost of technically complex geological exploration?*

E. Petrov: Yes. If we are talking about geology, then I believe that the cost of technology is at the heart of everything. Even the costs of those state functions performed by the institution, which are a priori unprofitable, we try to minimize. And it is possible to do this only at the expense of technology, because the geological conditions are what they are, we will not change them. Since we cannot change the geology, we can only change the technologies and reduce their cost. Well, another factor, as I said earlier, is to reduce the impact of these technologies and the results of field development on the environment.

NGV: *Is the creation of a Data Processing Center (DPC) under the auspices of Rosnedra and the Ministry of Natural Resources of Russia a step in this direction?*

E. Petrov: In the context of discussing hard-to-extract reserves, I would rather talk about the projects of technological integration of the industry that we are developing in Rosnedra. We are talking about end-to-end registers of all exploration and production technologies, both used and promising. Ideally, we should come to the conclusion that any subsoil user, and, for ex-

ample, an investor who does not have competencies in this area, will be able to assemble a chain of technologies like a puzzle and see what effect he will get at the end, with what final price of products. Simplifying it very much, we can say that our objective is to switch to "boxed solutions" that a subsoil user can collect in his personal account and automatically see the economic model of field development at the macro level.

Thanks to such a technological map of the industry, we will see bottlenecks where we have maximum import dependence in terms of providing certain services. And this will be the right signal for equipment developers: they will see where, in the development of which specific technologies we need to invest money today in order to replace or reduce the cost in this chain in the coming years. Technology developers will understand both the demand in the short term and the general trend of technology development. This will greatly reduce the risks for small innovative companies, give them confidence in the demand for their developments. As a result, it will reduce the total cost of production and form a healthy market environment – and this is probably the main thing.

As for data centers, they are created for the storage and circulation of geological information in digital form. This, of course, will also affect the development of hard-to-extract reserves. Here we need a really huge Big Data, which we will form almost online and make the state balance sheet a tool for state planning.

NGV: *Will this information be useful for investors?*

E. Petrov: Absolutely. Such maximum transparency and reliability of geological information forms the stock mechanisms that will attract money not only from large investors, but also from private individuals.

NGV: *That is, like on a regular stock exchange, where there are professional and unskilled investors?*

E. Petrov: Absolutely. The only criterion is the reliability of the geological forecast made, working with geological risks. If the state says that there is, for example, 10 tons of gold on the site, then the winning company of the auction must extract at least 10 tons of gold on this site. Unfortunately, the current geological knowledge, especially for loose sites, is quite low, because all the most studied sites have been licensed over the past 5-8 years, and often what we put up for auctions today needs to be rechecked, since the information was obtained a very long time ago – 20-30 years ago. Today, companies using the declarative principle of obtaining plots take as a basis the author's reports, make forecasts based on them, which may not be confirmed. Therefore, our task is to provide the market with reliable geological information to confirm resources or reserves. In other words, we strive to ensure that any expert can "raise" a clear justification for geological information, say: "Yes, it is so," and then make any economic or investment decisions.

NGV: *Rosnedra has a lot of digital initiatives, but the software for geological exploration is mostly imported. Taking into account the sanctions and restrictions, will this affect the timing of their launch?*

E. Petrov: So far, this does not affect the timing, because we initially put mainly Russian solutions into the project. Of course, the share of imported software in geological exploration is huge in all companies. This is our objective reality. But we have started working on creating a single platform at the beginning of last year.

There are very good software developments in Russia, but most of them cover a rather narrow functionality. And our objective over the past period has been to integrate the solutions of various vendors into a single space, to create a seamless movement of data and processes based on Russian software.

I think that today we have solved this problem in the oil and gas sector. Now we are testing the functioning of such a single platform in terms of public services. Of course, there were and still are technical difficulties – compatibility of data formats, copyright compliance, etc. I am sure that the improvement of the system will accelerate in the few months. Today, vendors have begun to understand that integration into a single state industry platform is an opportunity to scale their business. The same applies to large companies-subsoil users, in which business processes are automated at a high level. We also integrate their internal developments into the general chain.

Thanks to the work carried out today, we are fully ready for such a transition to domestic software, which will not affect the quality of public services.

But again, here we have to look significantly further ahead in the development of our own software, because the presence of western products was very discouraging. Everyone always knew that it was possible to go to one or another foreign software and qualitatively simulate one or another scenario. Today, the state needs to support and stimulate the development of not so much software as algorithms for the same scenario modeling. Moreover, we need incentives from the state, in order not develop something once and sit on it for 10 years, but for constant evolution, constant dynamics. Since we are moving to very complex deposits, we will no longer be able to do anything with a standard package, because it really needs to be adapted to the most difficult geological conditions.

Our country has the necessary scientific school and the strongest mathematical base: many of the algorithms underlying Western software were developed by people from MIPT or Baumansky Technical University. But, of course, we also need constant feedback from those who use our software. It is necessary to work with companies and subsoil users, a working mechanism is needed and an understanding of what needs to be improved, what needs to be finalized. There should be the most open exchange of information – only then there will be development. The state should ensure this, in fact, which is what Rosnedra is doing now.

NGV: *But Western IT companies, as you know, are picking up our specialists with a "fat check" – benefits and prospects. Then what incentives can our country and, in particular, Rosnedra offer for domestic programmers?*

E. Petrov: We have a huge demand for the development of technologies, their adaptation to work on various platforms. Also our main objective today is to adapt algorithms from the point of view of counting, because if we take separate models, they can be considered days depending on the computing power used. We need to reduce the counting time so that as many scenarios as possible are calculated. I can say that in our part (in geological exploration), a very large IT community is already working to

adapt these algorithms. This is on the one hand. On the other hand, the demand for the development of internal corporate software will grow enormously now.

Here, again, we will try to develop some "boxed solutions" and, for example, within the framework of the technology park, "highlight" technologies that today we "drop out" or form too high added value. For small companies, groups of developers, this will just be an incentive. The fact is that now no one understands what to do, because, for example, we invested, we did something for two years, but no one needed it on the market. And so, with the help of our initiative, companies and startups will see that the bottleneck really exists, they say, let's pile on now and offer some kind of industry solution that will be in demand 100% within 5-10 years. This is exactly where you need to make a marketplace, and the market will adapt and adjust itself.

NGV: *Concluding the topic of technology, let's play the role of visionary! It's no secret that the era of simple discoveries in geology has passed. They say that drones are already "walking" in the expedition. What will exploration in Russia look like in the foreseeable future? Should we expect widespread automation?*

E. Petrov: We are indeed introducing drones in our exploration work, but, unfortunately, this is not a panacea. Even today, no one can replace a person, and, as we joke, any artificial intelligence is helpless in the absence of a natural one. Therefore, people both went to field parties, and will go, because it is impossible to automate, describe all possible scenarios in geology. There are thousands, millions of them! And every nuance can actually change the idea of a particular region. It is very difficult to train a car to do this. The only thing that can significantly make life easier for a geologist is the use of the same drones in remote methods of studying the earth.

What is the current problem facing drones, which greatly restricts us? Firstly, it is their bearing capacity, since the complex of equipment used by us is becoming wider and wider. As you understand, the carrying capacity of drones is not unlimited. If we take already large, heavy UAVs, then there are requirements for a pilot's license, and not all geologists have such a license. Secondly, the cost of an error increases significantly if this drone falls, because the equipment it carries is very expensive and its loss will be very sensitive for a field party or a small company performing work.

But the fact that drones are developing and the future is behind them is objective, since the detail of the work and the scale of filming will only grow, and we will no longer be able to shoot large areas using traditional methods. What is good about the UAV is that it can take pictures of any area with any scale, thanks to which there will be a clear prediction and an understandable cost of work. All our institutions – each in its own direction – are engaged in this.

Another important area is the work we are doing with Roscosmos to create a remote sensing system for the Earth. Satellite sensing methods have gone very far. Their implementation will allow us to give many times more accurate forecasts of dangerous geological processes, because the accuracy of modern satellite observations is the first centimeters.

From the point of view of geological study, the optical resolution of satellites increases so significantly that the geologist actually comes just to certify the survey. It is no longer necessary to carry out large area works. All this is the same Big Data on the basis of which decisions will be formed and made. That is, the number of materials involved will only increase, due to which the very reliability of inventory units will increase.

At the same time, this will create a mechanism for objective monitoring of subsoil use and compliance with licensing obligations.

NGV: *If, as you say, nothing can replace a person, then what is the situation with attracting new personnel? Isn't it time to revive the movement of young geologists that existed in the Soviet Union?*

E. Petrov: The movement of young geologists, indeed, was created to popularize geology in 1937, so that a certain way of thinking was formed right from school. In the Rosnedra system, probably, almost all the heads of subordinate institutions at one time went through the movement of young geologists and the system of Olympiads. And today this movement is gaining a large scale in our country, because there are many regions, many initiative people, who want to participate in geological Olympiads. And now we are trying to accompany schoolchildren – young geologists already within the framework of university movements. But it is more difficult to work with universities than with schools, since there are fundamentally different costs, but we still strive to expand the movement with the help of university support.

NGV: *It is an interesting initiative, because 10 years ago, within the framework of school geography lessons, which also included geology, there were not enough field trips so that a student could touch, look, study...*

E. Petrov: We have teams of young geologists going on almost full-fledged expeditions. This is an educational process through which students learn the fundamentals. For example, two years ago we held small educational seminars. And we try to invite the leading scientists to such events. They participate with pleasure, because they once came out of young geologists themselves. Previously, geology was presented, popularized as a kind of romance, a way of life. That's something like we would like to revive today.

NGV: *Since we have already concerned the investors in our conversation, what is the situation with investments in the industry today? How will sanctions affect the investment climate in the foreseeable future? Should we expect an outflow of investments?*

E. Petrov: Today all companies spend about 400 billion rubles a year on investments in geological exploration. In fact, this is a relatively small amount of money. And at the moment, all companies are still confirming the amount of funding, no one is reducing anything yet.

The question is different. Now, on the contrary, we expect increasing of demand for investments in geological exploration, because the current economic situation has shown what it really makes sense to invest in. The only thing that has preserved and increased its value is mineral raw materials, which have beaten almost all historical price highs. And this shows that the most valuable raw materials are minerals. The most important thing is that it is "very long-playing money". On the one hand, there is a minus here, because we are talking about funds frozen for a very long period, but on the other hand, in the long term, profit-

ability from them is ensured, and it is a way for preserving and multiplying investments.

It is also important that now quite large funds will be released inside the country due to external economic factors, with the reduction of a number of projects. It is clear that money must work, and most companies, even non-core ones, which are not related to geological exploration, are considering options for investing these funds in geological exploration, in the subsoil. Therefore, we expect a surge in investment, including in the development of technology.

NGV: *Talking about the solid minerals, are we taking into account only precious metals or, in general, all types of such resources: coal, ores, gold, platinum and so on?*

E. Petrov: Again, we have broken historical highs for almost the entire range of minerals now, so we are waiting for demand almost everywhere. From the point of view of metals, take, for example, copper. It is expected to be very much in demand due to the development of global industry. This surge will also occur in the domestic market, so here we expect an investment boom in the exploration and production block.

NGV: *And is there any progress on the initiative of extending state contracts for geological exploration from 3 to 4 years?*

ИRegarding the timing, there is no progress, but the work is in process. Last year, Rosnedra together with the Accounts Chamber, have made quite a lot of progress and set of amendments to the 44th Federal Law (on public procurement) in terms of geological exploration, but, unfortunately, we have not yet overcome this problem of the three-year budget cycle, however, as I said above, we will still work on it. Indeed, the exploration process in a number of areas can stretch up to 5-7 years, because we are going to very difficult areas talking about the logistics. We are losing a whole field season just to bring equipment there, and after the work we still need to reclaim everything and to take the equipment out, so within the three-year cycle we do not have time for the work itself. The first year is the delivery of equipment, and the last year is demobilization and reclamation, and we have only one field season in stock, which is not enough for exploration directly. Sometimes it's volumes simply physically do not allow us to meet this time interval. In addition, there are various force majeure events, such as fires, floods, which, for obvious reasons, do not allow work to be carried out.

Accordingly, we took such a step as dividing the work into a three–year cycle, but there were situations when one company ended the work on the first three-year cycle, and a completely different one could come out for the second cycle – according to the 44th Federal Law. And it turned out that one company had a party, another won, and this could not but affect the quality of work, the timing of their implementation, which turned out to be on the verge of failure. It's easier for us when one company does everything "turnkey".

On the other hand, there was no mechanism to break the state contract. It had to be completed completely. And for a number of objects, we have already seen that the results are not confirmed, that there are no prospects there, but there is no way to finish these works. Since this year, we have made these amendments to the 44th Federal Law, and we can terminate these works in order not to simply spend money. And, accordingly, vice versa. When a company is working on a site and we see that there are very good results, then mechanisms for extending the state contract are needed here, and not breaking off and announcing a new competition. The companies incur losses, the equipment is idle, it is extremely inefficient. Rosnedra is now working to rectify the situation. This work is very difficult, there are some kind of obstacles in our progress towards the desired result, but we will continue to move it, because, indeed, it is impossible to put geological exploration within the budget cycle.

NGV: *Just about the budget, will the budget items for exploration and development be adjusted this year?*

E. Petrov: As for today, I can say that there are no significant changes for the facilities that are in process, which we are starting. We practically do not depend on external economic factors in terms of carrying out the work within the country. We are somewhat dependent on the equipment and technologies that we use, but we have a fairly large reserve of spare parts and equipment itself. Therefore, we see practically no problems during this field season, and I am more than confident that we will finish all the current work without any changes.

What will happen next? Here, the planning horizon is already somewhat shortened, but in any case, we will always insist on the full execution of the geological task without lagging behind the schedule of work, first of all, on obtaining high-quality geological information. As a last resort, if the contractor who won all these works from us ran into problems, then we will all sit down together and decide what to do about it.

NGV: *In the current international economic conditions, the issue of forming a system of sovereign audit of reserves also arises. How the work in this direction is moving?*

E. Petrov: Indeed, Western companies currently dominate the international inventory audit market, with four American companies controlling the lion's share of the market, all their auditors are US citizens.

These companies control the access of most of the world's suppliers of mineral raw materials to both international and domestic capital markets, have access to strategically important information about reserves and can have a significant impact on the liquidity of these companies' securities, their perceived reliability as suppliers, and thereby on the stability of the financial systems of the countries supplying mineral raw materials.

Russian suppliers of mineral raw materials have a significant dependence on the services of these four companies, whose services they are forced to use not only in the international, but also in the domestic financial market.

It is obvious that in the conditions of aggravating economic constraints, the issue of creating a sovereign inventory audit system is urgent.

We started this work ahead of time. On our initiative, together with the UNECE, back in 2020, the world's first UNECE competence center was established in Russia, working on the modernization of the international mineral reserves audit system. In 2021-22, a number of domestic expert organizations and subsoil users were involved in this work.

Today we are accelerating this work even more: it cannot be delayed and is a matter of national economic sovereignty.

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REVIVING THE HYDROCARBON AGENDA

DMITRY SEREGIN
Oil and Gas Vertical

Excess of demand over supply and high prices for hydrocarbon raw materials - this is the global scenario for the development of the energy industry. This is both a challenge and a prospect for those who will respond to it competently.

Comparison of decarbonization scenarios

The main factors	Fast decarbonization	Slow decarbonization
The introduction of electric vehicles (EV)	EV is developing in accordance with the reasonably reduced plans of current EV manufacturers	the introduction of electric vehicles is slow, outside the OECD, the lack of charging infrastructure and a stable market for used cars with internal combustion engines will support the demand for oil
Plastic recycling	By 2050, for some types of plastic, the level of plastic recycling will approach the level observed for aluminum cans and glass (about 75%)	The rate of plastic recycling increases linearly and lags behind the indicators of glass and metals
"Green" hydrogen	By 2050, about 30% of primary petrochemical raw materials for some types of plastic will be derived from green hydrogen	
Oil substitution in the economy	Oil substitution in other sectors is developing in accordance with the current decarbonization policy	Oil displacement in electricity generation is not significantly accelerated compared to the historical rate of decline
Result: global temperature increase by:	1,8°C	2°C

Both analytical agencies and development of the situation in the main producing regions indicate that there is a revival of the hydrocarbon agenda in the world. Last November, Rystad Energy published its conclusion that "the volumes of oil and gas that have yet to be discovered will be crucial to meet future energy demand," making a reservation, that this conclusion should be made "despite the global desire to reduce emissions in the face of a rapid transition of energy to cleaner energy sources."

Of course, the transition to cleaner energy sources is not removed from the agenda. Carbon neutrality is maintained as a global goal. But the speed of the transition will slow down. And first of all because of the obvious benefits that the continuing global shortage of energy resources brings to those companies and states that will be able to stake out the largest piece of the market with the least cost for themselves.

As a confirmation, we can refer to the statements of the governments of the leading oil and gas producing states about the increase in hydrocarbon production.

In part, these calls are justified by the need to replace supplies from the Russian Federation. US Secretary of Energy Jennifer Granholm refers to this, urging American oil companies to "increase supplies in the near future." The call will not go unanswered.

In April, the US Energy Information Administration (EIA) forecasts an increase in oil production by 117 thousand barrels per day, to 8,708 million barrels. At the same time, natural gas production will increase.

From the economic side, the sanctions themselves can be viewed as a starting shot, opening a new round of struggle for hydrocarbon markets, in which the United States has had new arguments over the past two decades. The EIA forecast indicates that shale oil will account for a "significant part" of the increase. And the deficit caused by the sanctions regime becomes an incentive for major players. Indeed, Rystad Energy analysts have calculated that European countries' support for decisions on US sanctions will lead to an increase in oil prices to $ 240 per barrel by the summer of this year.

Other major players are in a hurry to demonstrate the same desire to compete for markets – the need to increase their own oil production is stated in China's development plans for 2022, Venezuela has declared its readiness to double daily oil production per year, Iran is restoring its production, and so on.

For the UK, the sanctions have become a convenient excuse to yield to the pressure of its companies seeking greater certainty with long-term plans for the production of hydrocarbons in the North Sea. The British authorities have already announced the possibility of revising their attitude to the seismic hazard of hydraulic fracturing technologies. Apparently, we can expect concessions to oil companies in terms of unscheduled taxation, the plans of which have already been announced by the UK and caused protests by OGUK (the industry association of the offshore oil and gas industry).

It's for long

Of course, the observed splash in activity is a reaction to a hit to Russia's positions in the hydrocarbon market, no matter what or by whom this hit was provoked. But it would be a mistake to think that there is no longer-term trend behind all this, with which the oil and gas industry associates its future. In confirmation, we will give the parameters of the scenarios for the development of demand for hydrocarbons, which were published by

Rystad Energy in November 2021, when there was still a whole quarter left before the events of February-March 2022.

The basic conclusions of the report are based on the collision of two trends. On the one hand, there is a significant decrease in the annual volume of newly discovered oil reserves. The fact that the pace is declining can be judged by comparing the first and second half of the 2010s. 72% of the newly opened volumes fall on the first five years. Average volumes fluctuated around 40 million barrels per opening for the entire period. New large deposits designed for traditional mining methods are becoming increasingly rare in the world, their geography is becoming more complicated, and exploration costs are growing accordingly. The tendency to slow down the growth of reserves, opened and forecasted, makes us fear an increase in the shortage of energy resources in the horizon until 2050.

"We believe that even under the revised scenario after Rystad Energy's previous analysis, the current field reserves and open volumes will not be sufficient to meet future demand," the November report said. Peak demand is expected in 2024, it is projected at 103 million barrels per day in the average scenario. Then a plateau is expected and a gradual decline in demand to 50 million barrels per day in 2050.

This scenario proceeds from the rapid decarbonization of the economy – despite the fact that Rystad Energy analysts are cautiously skeptical about the speed of this process in the medium term.

That raises the alternative scenario, which corresponds to slow decarbonization and, accordingly, higher oil prices on the world market. In this case, the demand for oil reaches a peak in 2026 at the level of 105 million barrels per day and decreases to 74 million barrels per day in 2050. The reasons for the first and second forecasts can be seen in the following comparison (see "Comparison of decarbonization scenarios").

The shortage in the supply of hydrocarbons, primarily oil, can only be covered by undiscovered reserves. Their value will increase from 3% in 2030 to 30% in 2050. And also – and this is important - due to the involvement of old stocks from among those that have been recognized as unprofitable or technologically impossible to develop.

Currently, it is predicted that projects in both of the categories, mentioned above, will yield about 265 billion barrels (according to the average scenario) and 300 billion barrels (according to the alternative one) of liquid hydrocarbon supplies in the period from 2021 to 2050. Of these, new discoveries will account for up to 120 billion barrels and 160 billion barrels in both scenarios, respectively.

These calculations naturally put hard-to-extract reserves in the spotlight, and more specifically, the experience of developing shale and bitumen deposits, which in the last two decades have become technologically much more accessible, and the economic profitability of production, although fluctuating, is coming today even with not the greatest increase in world oil prices.

It is clear that such a future opens up the most serious prospects for US and Canadian companies, as well as for those players who will be able to learn the lessons from the experience of producing and oilfield service companies associated with shale and bitumen oil.

Why not do it now?

No matter how threatening the event horizon looks from the first quarter of 2022, the forecast until 2050 contains the same conclusions also for Russian fuel and energy companies: namely, the excess of demand over supply and high prices for hydrocarbon raw materials. This is both a challenge and a prospect for those who will respond to it competently.

There are a lot of reasons for pessimistic forecasts. But there were enough of them even before. You never know what you can do till you try. What we had to observe in Russian oil and gas and petrochemical companies in the last 10-15 years was exactly about this. Management structures were changing, business processes were being revised and automated, modern platforms and digital twins were being introduced, and, of course, continuous optimization was carried out. At the same time, modernization and new construction projects were formed, project teams accumulated experience, the projects themselves were enlarged, and the face of the industry was gradually changing.

Therefore, it is unwise to give up in advance and predict the collapse of business, retreat on all fronts and the surrender of markets. Yes, the international context is changing and at the same time the internal situation with the extraction and processing of hydrocarbons is changing also. Its strategy will obviously have to be reviewed both by the state, which makes serious decisions, and by business, which, in general, has known about it for a long time and was preparing for it. Both sides are interested in an agreed picture of the future. Why not do it right now?

The three pillars

The three biggest strokes in this picture have been obvious for a long time: (1) an export shift to the east, towards the Asia-Pacific region, (2) the development of the domestic market, including through import substitution, and (3) increased attention to the development of hard-to-extract reserves due to a drop in the coefficient of recoverable oil.

In fact, the current changes of Russia's international situation have added little to these three points, which have been well known for a long time. Perhaps they added some contrast to the picture. In a sense, this is even good. Because the evidence of overdue measures, hopefully, will push them. You can complain that everything now has to be done in the circumstances of force majeure.

On the other hand, it would be a mistake to say that nothing has being done in these areas in previous years – it is better to say that many steps were "ill-conceived". For example, tax incentives for ultra-viscous oil deposits were canceled in 2020, and mining companies adjusted their plans in a direction that does not favor investments in the development of such reserves.

But there is still no long-term alternative to projects with hard-to-extract reserves. And the regulator's priorities are changing not only in Russia, as can be seen from the example of the UK.

A detailed consideration of all the objectives is a matter of a separate analysis concerning each of them. Now it is more important to state that all three major objectives highlighted above are interrelated.

It is obvious that the shift of the extractive industry in the direction of Eastern Siberia, the development of domestic logistics

and the domestic market in the same direction, the development of hard–to-extract reserves are processes so interconnected that, with proper scaling, they can be considered as one process, and not obliged to the current foreign policy complications either by their origin or by their objective goals.

Rather, today we are talking about speed and at the same time consistency – indicators that have not yet stood in such an urgent relationship. And now they're standing.

The Power of Siberia pipeline and the latitudinal railway connection, for example, are the primary logistics framework for an economy focused on the Asia-Pacific region. Projects such as the Amur Gas Processing Plant and the Amur Gas Chemical Plant confirm the capabilities of large businesses to base their new production facilities on existing infrastructure.

The investments of the largest Russian companies may be sufficient for the construction of housing, road and other infrastructure, for the active involvement of small and medium–sized businesses - in general, for an active socio-economic policy in the regions of work. But without territorial planning throughout the country and Siberia in particular, without government investments in new latitudinal and meridional highways, all these changes will remain at the local level.

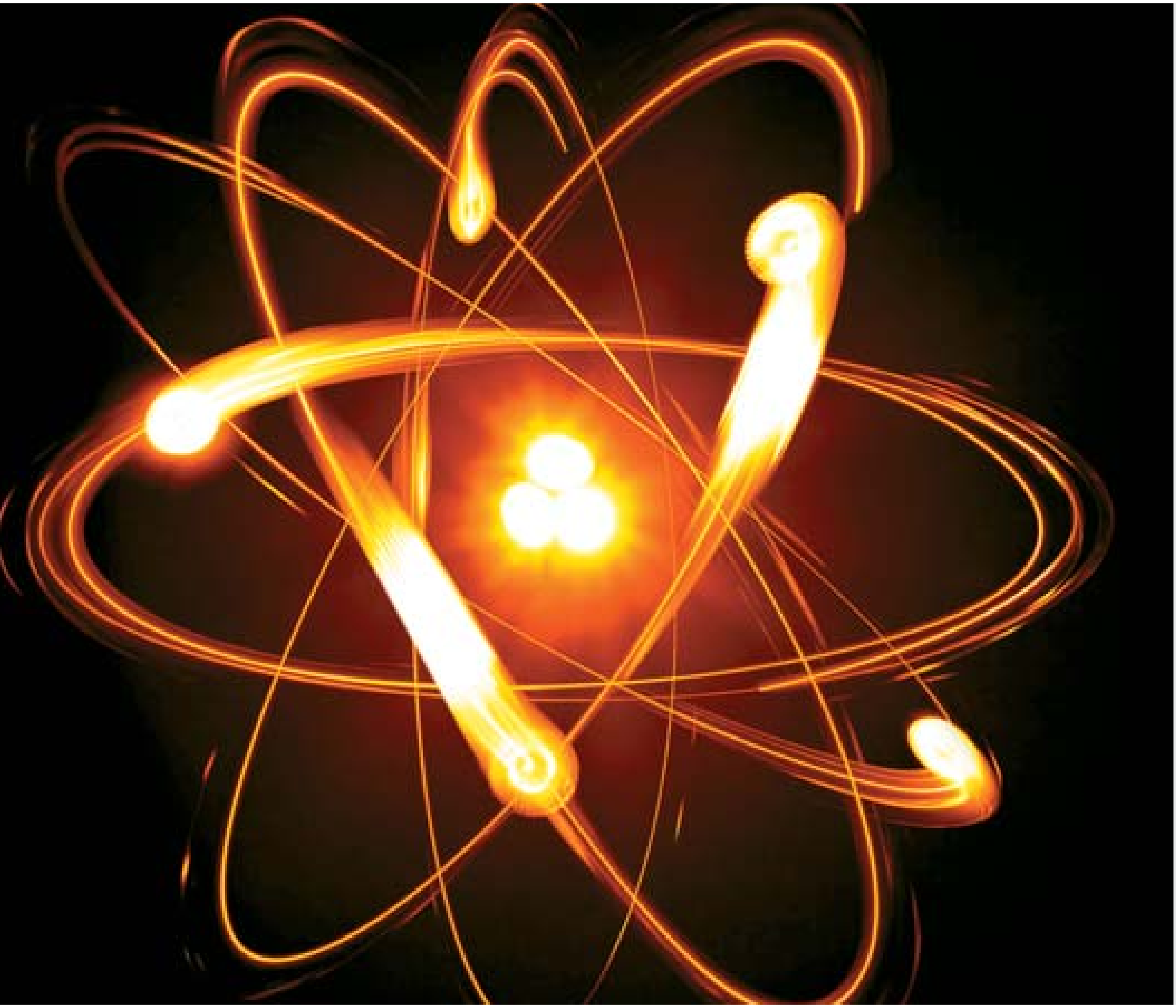
In general, there are reasons to think that the very possibility of implementing projects of this scale proves that understanding between the state and business is quite achievable. The crystallization of formulations and the growth of mutual demands in the conditions of an acute struggle for survival (far exceeding the scale of a separate industry) are in themselves capable of advancing the outlined contours of interaction.

It is worth emphasizing once again that the problems, associated with hard-to-extract reserves, are not specific to Russia and are facing many global players. Of course, North American companies that have already implemented digital process management practices and achieved stable drilling efficiency have a significant market handicap. But, on the other hand, their experience is open, it can be analyzed and adopted, the measures of state support are also quite obvious (see the generalizing article by D.Vasyukova and D.Lebedeva "How to find the keys to difficult oil", "Oil and Gas Vertical" No. 1, 2022).

And in general, the international experience of recent decades teaches that "conservative" industries turn out to be much more flexible than expected. The renaissance of the hydrocarbon agenda only confirms their potential and relevance in the modern global economy.

At the same time, another lesson is that the crisis of the oil and gas industry is, if not permanent, then periodic. For example, the restructuring of the business of oilfield service companies is caused by processes that developed before 2020. According to the analytical developments of REnergyCO, in 2020 the oilfield services market of the USA and Canada decreased by 53%. Both Halliburton and Schlumberger had to react to the losses, having carried out massive write-offs and reductions, having developed large-scale plans to optimize their work.

Actually, this is what the XXI century teaches majors and small players in the oil and gas industry – a constant crisis is the key to high adaptability, of course, for those who will learn to live in these conditions. For Russia in this sense, now is just the moment of truth.



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SMALL ATOM ON A LARGE SCALE

IVAN MISHIN
Oil and Gas Vertical

Literally before our eyes, a genuine renaissance of nuclear energy is taking place right now. But, as in the case of the historical Renaissance, which was only inspired by ancient art, our nuclear renaissance is also only indirectly connected with "traditional" nuclear power plants. More and more attention from states, businesses, and investors is focused on the small forms. But will it be able to conquer our big world, and what does this new trend in global energy transition promise Russia?

Convenient disposition

The year 2021 was a moment of rethinking the approaches to global energy transition. On January 1 the share of renewable energy in European electricity generation was 38%, and in some EU countries this indicator was even higher: in Denmark - 64%, in Ireland - 49%, in Germany - 42%. It would seem that here it is - the road to a bright "green" future for all mankind, the construction of which nothing will stop. But the "heavenly chancellery" which is not subject to the plans and directives of official Brussels, intervened in the matter. A windless and cloudy summer in Europe stopped wind turbines, and solar panels did not accumulate energy. At the same time, the demand postponed due to the advent of the coronavirus returned, and for the first time since 2008, the underground gas storage facilities were only 68% filled. Excessive confidence in renewable energy came out sideways for the EU and provoked an energy shortage, followed by an energy collapse. Prices for "traditional" energy resources began to rise by leaps and bounds. And if at the beginning of March 1 thousand cubic meters of gas cost $214.8, by December the price "broke" the historical bar of $ 2200! European officials, in order just not to freeze, had nothing left but to buy gas and coal, which also broke all records by October, having risen in price by more than 2.5 times! The increase in the consumption of "dirty" energy resources, their high prices directly pushes Europe to use “peaceful atom”. And hardly anyone will deny that today it is in a very convenient disposition.

Until this winter, the world's nuclear power industry was at the crossroads. The USA, Japan, Great Britain, Germany and a number of other countries of the Western world have frozen their nuclear capacities. In Great Britain and Germany, as well as in Sweden and Bulgaria, more than half of the entire reactor fleet was suspended. Italy and Latvia have completely stopped the operation of all their nuclear power plants. On the other hand, 52 new nuclear power plants are currently under construction in the world, 13 of them are being built in China, 7 in India, and 4 in South Korea. Japan, which suspended its nuclear power program after the Fukushima-1 accident, also decided to resume the construction of nuclear power plants. Small states are also investing in the peaceful atom: Turkey, the UAE, Poland, Bangladesh, Egypt, Jordan, Nigeria and Vietnam.

It is hardly worth expecting decrease of the investor's interest in nuclear energy. After the autumn energy crisis in Europe, the risks of investments in renewable energy began to grow. It is becoming increasingly obvious to investors that nuclear power plants are a more reliable (in every sense) asset than renewable energy, dependent on the vagaries of the weather and ... leaving a larger carbon footprint! Experts of the European Joint Research Center came to such a rather sensational conclusion. During 2021, they analyzed several hundred scientific studies and publications, reports of other experts, concluding that the emissions of nuclear power plants equipped with the latest generation 3+ reactors are comparable to the emissions of hydroelectric and wind power plants and even lower than from solar panels, and the impact of nuclear energy on ecosystems and biodiversity is less compared to solar and wind energy, if we take into account the entire production chain.

A marker of the investor's growing interest in the “peaceful atom” is the dynamics of uranium prices. According to EY, by October they had soared by 64.7% since the beginning of 2021 and reached the maximum level since the summer of 2012 - $50.8 per pound.

Atomic "war"

It was the first bell for the pro-development of “peaceful atom” opposition in the EU, which includes Austria, Luxembourg, Germany, Spain and a number of European officials. The second and more vociferous call was an appeal of 10 countries to the European Commission with a request to recognize nuclear energy as low-carbon in order to reduce energy dependence on third countries and protect the population from fluctuations in electricity prices against the background of the energy collapse. The signatories were the Czech Republic, Poland, Hungary, Romania, Finland, Slovenia, Slovakia, Croatia and Bulgaria. And France played the "first fiddle" in all this. If some of the countries that joined the appeal simply have experience in the production of nuclear energy, then France itself today ranks first in the world in terms of the share of nuclear generation in the energy balance (70.6%) and second in terms of the total amount of energy produced at nuclear power plants.

Of course, there is a very strong "atomic" lobby in Paris, which is not going to give up its positions to adherents of alternative energy. On the contrary, President Emmanuel Macron have recently announced that the new generation of reactors, which are already under construction, will eventually replace the currently operating 56 nuclear installations of the old type. And the resumption of this construction, according to him, is designed to ensure the achievement of carbon neutrality by 2050.

For Berlin this whole situation probably came as a surprise. Germany has been systematically implementing the European "green" course for the last decade. And the last German nuclear reactor was supposed to be closed at the end of this year. However, after Angela Merkel's resignation from the post of German Chancellor, the ruling coalition is mainly engaged in organizing joint work and has not had time to formulate a position regarding the emerging turn in the European energy sector. Emmanuel Macron, on the contrary, managed to mobilize his supporters in EU countries at the right moment. And we are talking here not only about the change of the government in Germany, but also about the fact that from January 1, 2022, France assumes the presidency of the European Council, which is the highest political body of the European Union.

Against the backdrop of this "Game of Thrones" or, if you like, “the atomic war" in Europe, the UN climate summit was held in Glasgow in November 2021. That was an event of historical scale, which was designed to determine which way the low-carbon future of humanity will go and, accordingly, how the global energy transition will develop in the foreseeable future. Naturally, the fate of nuclear energy was also discussed animatedly on the sidelines of the forum. And this is what Alexey Likhachev, CEO of the Rosatom State Corporation, said at the end of the forum: "Now it is possible to divide the history of the world nuclear energy into "before SOR26" and "after SOR26", when the discussion came to a positive result for most participants. The answer to the question of whether nuclear energy should or should not be in a carbon-free world balance, after SOR26 became obvious - "yes, it should."

There is an obvious, and most importantly, a conventional request from the world community to legalize “peaceful atom” as green energy, which meets the national interests of many countries.

In fact, the opponents of nuclear power plants have found themselves in a stalemate by today, and the European Commission has nothing left but to proclaim nuclear energy "climate friendly" and include it in its green taxonomy.

It's f little thing?

But long before the rehabilitation of nuclear energy in the EU, some European countries began to take concrete steps towards its development. Back in last September, Poland signed two memorandums of understanding with foreign manufacturers of small modular reactor up to 60 MW, becoming the first EU country to introduce such nuclear installations. Their launch is expected in 2029.

For Poland who now use mainly coal-fired generation, and, at the same time, do not want to pay fines to European officials for the high level of greenhouse gas emissions, the national energy transition to the small modular reactors creates great decarbonization opportunities. By the way, among a number of Eastern European countries whose energy has historically been based on coal – first of all, Hungary, the Czech Republic, Bulgaria – there is also an interest in a small atom. Romania, where 7 out of 30 coal-fired thermal power plants operating in the Balkans are located, stands apart here. Hence, it is no wonder that this country decided to build a nuclear power plant with small modular reactor on its territory immediately after Poland, in October 2021.

Of course, in addition to good intentions for the benefit of the environment, there is also a political background. Both in Romania and Poland, the development of small reactors is ordered by the American startup NuScale Power, the American-Japanese alliance GE Hitachi Nuclear Energy and several other companies from the same place - from the USA and Japan. The US State Department, not hiding its satisfaction with the first nuclear deal in Europe, on which "several billion dollars" will be spent, simultaneously stated that it "strengthens the energy security of Europe." Recall, that 10 years ago, the United States, under the banner of saving Europeans from "bad Russian gas," actively initiated the construction of many regasification terminals in the EU, but since the beginning of 2021 unexpectedly deployed a significant part of its gas carriers to China. This begs the question: will the Americans now "save" Europe with nuclear technology?

Here there is a great risk of a foreign policy nature, which may lead the Europeans in the opposite direction from the manifest of "strengthening of energy security". By creating a "turnkey" and placing its nuclear reactors on the territory of other countries, the United States gets a serious tool to influence the decisions of these states. In other words, after the launch of the American small modular reactors in Europe, the approach of the building manager from the famous Soviet comedy can get involved: "if they don't take it, we'll turn off the gas." It is obvious that in such a situation, European officials may lose a significant part of control over Poland or Romania. And instead of the European Union, we will see a completely different alliance, which will be governed far from Brussels. At the same time, the customer leverages are associated with other, more applied and specific risks.

The first and most obvious is technological risk. If the EU states start ordering small modular reactors in the USA, that means that American nuclear physicists have "bypassed" their European and, above all, French colleagues. By being the first to create a commercially modified small reactor, the Americans gain a serious competitive technological advantage.

Another risk is investment risk. All the companies involved in the development of small modular reactors for Poland and Romania, which has already been noted above, have a noticeable, and in some places – overwhelming American participation. Accordingly, if the United States "loops" the entire investment process, then the Eastern European customer countries will also become borrowers of Americans, falling even deeper into financial dependence on Washington.

Finally, it is no secret that we all now live in conditions of, as they would say during the Cold War, "international tension", and Europe is clearly experiencing it for itself. Meanwhile, the consequences of damage to a nuclear reactor, even the small, are much higher than from the destruction of entire gas or coal-fired power plants! And why should Western "hawks" inflate their aggressive rhetoric into mass hysteria under the pretext of the vulnerability of Eastern European nuclear power plants? The question is rhetorical. Therefore, it is obvious that the American small modular reactors can also act as a tool to strengthen the military influence of NATO and, first of all, of course, the United States in Eastern Europe.

David and Goliath

The spread of a small atom is also associated with the risk of high prices for generated electricity. Last December Europe has already faced a record rise of the cost of electricity. In Belgium, Austria and Germany the average price for the day ahead broke the bar at €430 per MWh, and in France even higher - at €440/MW-h. Meanwhile, the total present cost of electricity of the new small modular reactor today is $120 or slightly more than €107 per Mwh. It would seem not so bad, but it is higher than in the case of using gas generation and most alternative energy sources.

However, according to Wood Mackenzie estimates, if there is some support from the state by 2030, this indicator may decrease to $80/MW-h. And there is reason to believe that such a trend will be set. Today, most of the small modular reactor projects in the world are implemented on preferential terms. Moreover, their range is quite wide: from public-private partnerships to subsidies and tax credits. If the further development of technologies ensures the supply of electricity at $65, then the "yellow" hydrogen produced using small reactors will be able to compete with its "green" fellow produced using renewable energy.

In the field of electricity pricing, small modular reactors has another trump card up its sleeve. If at traditional nuclear power plants it is required to restart fuel every 1-2 years, then for small ones this period increases almost 3 (!) times – up to 3-7 years. In a scenario where the prices of fossil fuels for nuclear fuel will continue to increase due to the global development of nuclear energy, this operational aspect appears to be a significant competitive advantage of the small modular reactor.

By the way, the IEA looks at the development of nuclear energy with restrained optimism. On the one hand, the agency's latest forecasts declare that in the next two years the share of "peaceful atom" in world energy supplies will slightly decrease – from 9.8% in 2021 to 9.4% in 2024. But these are gross figures. Growth is expected inside the industry itself. The average annual rate of nuclear energy production increase will be 1%. At the same time, an important note

needs to be made here. The IEA prepared its forecasts long before the European energy crisis, the Glasgow summit and the decision of the European Commission to include nuclear energy in the "green" taxonomy. Accordingly, the indicators given by the agency are due exclusively to the tendency for increasing the use of nuclear power plants in the Asia-Pacific countries, whose accelerated economic growth needs more and more energy.

The realities in which atom "turned the game" on the field of global energy transfer are already taken into account in other forecasts. So, Bloomberg NEF has published a new scenario where, in order to achieve carbon neutrality by 2050, small modular reactors are being actively introduced for both electricity generation and hydrogen production. But due to what small reactors can overcome large ones in terms of sustainable development?

Well, first of all due to the availability of production and supply of energy. Small modular reactors have greater flexibility compared to traditional nuclear installations due to the possibility of choosing the power and modular design, that is, if one of the modules breaks, it can be repaired without stopping work completely. This makes small nuclear power plants a fairly optimal solution for power supply to sparsely populated and isolated areas.

We have already talked about the environmental friendliness of even large modern reactors, so we will only note that small modular reactor can be built next to carbon-intensive industries, thus providing a significant reserve of energy efficiency of such enterprises. Also, we have already discussed the focus on the transition to small nuclear power plants in those countries where the lion's share of the energy balance is coal-fired generation. And here we can see not only a purely "green" agenda, but also practical considerations. The capacity of one coal-fired thermal power plant unit ranges on average from 50 to 300 MW, which is comparable to the capacity of small modular reactor. This makes it possible to consider small nuclear power plants as a replacement for existing coal-fired generation without creating a shortage of electricity in the domestic market.

Finally, for almost 40 years the "shadow of Chernobyl" has been hanging over the world, inspiring public fear of the development of nuclear energy. The accident at Fukushima-1 a decade ago almost completely gave up on it. Therefore, small nuclear power plants can become a kind of "cure" for phobias for the world community. The fact is that small modular reactors are safer than their larger "fellows" due to the use of passive cooling systems, since their active zone is less radioactive.

Originally from the Arctic

Currently, at least 70 companies around the world are engaged in small modular reactor projects. For example, the Chinese CNP-300 small reactor has been implemented at the local Qinshan nuclear power plant and at the Chashma nuclear power plant in Pakistan. 18 of the 22 operating power units in India are also equipped with small modular reactor. As for Russia, our country has been engaged in scientific and technical research in this area since Soviet times. So, from 1974 to 1976, the Bilibinsk nuclear power station in Chukotka was equipped with four small EGP-6 reactors. Moreover, they are working successfully today. At the end of the designated service life of 30 years, their operation was extended for another 15! The latest Russian small reactors RITM-200 are installed on icebreakers of Rosatomflot. And the floating nuclear thermal power plant "Akademik Lomonosov", which is nothing more than a small nuclear power plant, is equipped with another modern type of domestic small modular reactor - KLT-40S.

The long-term development of these Arctic technologies are being transferred to the "civil" energy sector. For three years now, Rosatom has been implementing the project of the world's first land-based small nuclear power plant, which, according to the plan, will be built in the Ust-Yansky district of Yakutia in 2029. According to the Rosatom State Corporation: "Currently, preparations for the main environmental assessment are being completed, engineering surveys have been completed at the pre-project phase, public hearings on the project materials have been held."

This is not the only project for the development of a small atom in Russia. According to media reports, in August 2021, the Government of the Russian Federation agreed on the maximum amount of funding for the program for the construction of small nuclear reactors. From 2021 to 2024, 24 billion rubles will be allocated from the federal budget for the "New Nuclear Energy" initiative, as well as up to 55.9 billion rubles from the SWF. As part of this program, in addition to the nuclear power plant in Yakutia, Rosatom will develop a technical design of the “Shelf M” installation with a capacity of up to 10 MW and a draft design of “Elena AM” installation up to 400 kW, which may be useful for energy and heat supply to the population living in remote areas.

Obviously, in the foreseeable future, we can expect a dynamic growth of the small modular reactors market. The lively interests of states, businesses, and investors converge here. Rosatom estimates that the demand for small nuclear power plants will reach a volume of 23 GW by 2040. To understand the scale of this indicator, we recall that the capacity of the small modular reactors varies from 50 to 300 MW. That is the demand will be quite high, and the number of potential buyers of small reactors, as the State Corporation expects, will include almost half the world - countries of Latin America, Africa, Asia and Eastern Europe.

At the same time, competition is expected to be quite high, and it is too early to say that the same USA has "staked out" a monopoly with its nuclear deal with Poland and Romania. Moreover, American nuclear scientists face serious problems. So, this January, the US federal regulatory authorities rejected the application of the startup "Oklo" from Silicon Valley for the construction and operation of the small modular reactor in Idaho, called "Aurora". American regulators have doubts about the security issues. "Oklo's application still contains significant information gaps in the description of potential Aurora accidents, as well as in the classification of safety systems and components," said in a written statement by Andrea Weil from the Nuclear Regulatory Commission.

This may damage the Napoleonic plans of the United States to conquer the global small modular reactors market. In these circumstances, an excellent window of opportunity opens for Russia? Who can not only to occupy its niche there, but also to achieve leadership positions, especially since Rosatom sets itself such a task and plans to fulfill it by 2030. And it's quite real! The competitive advantages of our country are not only the most valuable scientific and technical background, but also the correspondence of the global trend for a small atom with the peculiarities of the national economy and energy sector. It seems, this has never happened since the very beginning of the fourth energy transition.

OIL AND GAS
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VALENTINA MATVIENKO: «NO ENVIRONMENTAL, CLIMATE OR ANY OTHER GLOBAL PROJECT CAN BE IMPLEMENTED WITHOUT RUSSIA»

The climate agenda is actively making adjustments to national legislation and global business processes. The position of the supreme legislative authority determines the vector of legal relations in all spheres of the state, including ecology. "Oil and Gas Vertical" took an exclusive interview with the Speaker of the Federation Council of the Federal Assembly of the Russian Federation Valentina Matvienko.

Oil and Gas Vertical: *Mrs. Matvienko, you have repeatedly noted that environment is an unconditional priority for the Federation Council. Which issues on the environmental agenda were considered by the Chamber during the spring session? Which are to be discussed at the already started autumn session?*

V. Matvienko: The State environmental policy and its enforcement are among the key areas of the work of the Federation Council and the activity of the Russian State in general.

Laws and regulations approved by the senators this year are a compelling confirmation of that. I give the prime place to the Law on Environmental Information. For the first time in the Russian legislation, it gives a definition of "information on the environmental situation (environmental information)" and sets forth the principle of its availability and the modality of its provision. I believe that the adoption of this Law has political as well as legal significance, because it makes public the information important for every person and thus expands the opportunities for participation of citizens in discussion and resolution of all issues related to the environmental situation.

In my view, laws that are particularly important for citizens include the one aimed to reduce pollutants in the atmospheric air in industrial centres. There were other legal acts adopted that extend the scope of the Clear Air project to cover all Russian cities with the acute problem of air quality.

The Law limiting greenhouse gas emissions was approved. I would like to underline that it contains instruments that help oversee its implementation. In particular, under the Law, the regulated organizations are to annually submit a relevant report to an authorized body.

During the spring session, much attention was given to the discussion with experts of issues related to de-carbonization and adaptation to climate risks. The significance of all this for countering the climate change is evident.

Of primary importance for the environmental well-being of the country is the approval of a package of legal acts aimed at conservation and reproduction of our national wealth – forests.

The list is far from being exhaustive. Generally speaking, the spring session has been one of the most productive in terms of legal support of the environmental security of our country and its citizens.

We will continue this course at the autumn session. In particular, we plan to consider a package of laws concerning such a pressing issue as the marine environment, including the legal regulation of refloating, modalities for reimbursement of related expenses, and control of cargo trans-shipment. A number of environmental laws are being drafted.

We have considered and will further consider the quality of environmental legal acts in a most thorough manner, as inadequacies, mistakes and gaps in the legal regulation of such documents sometimes come at a high price, and it takes many years, even decades, to address them.

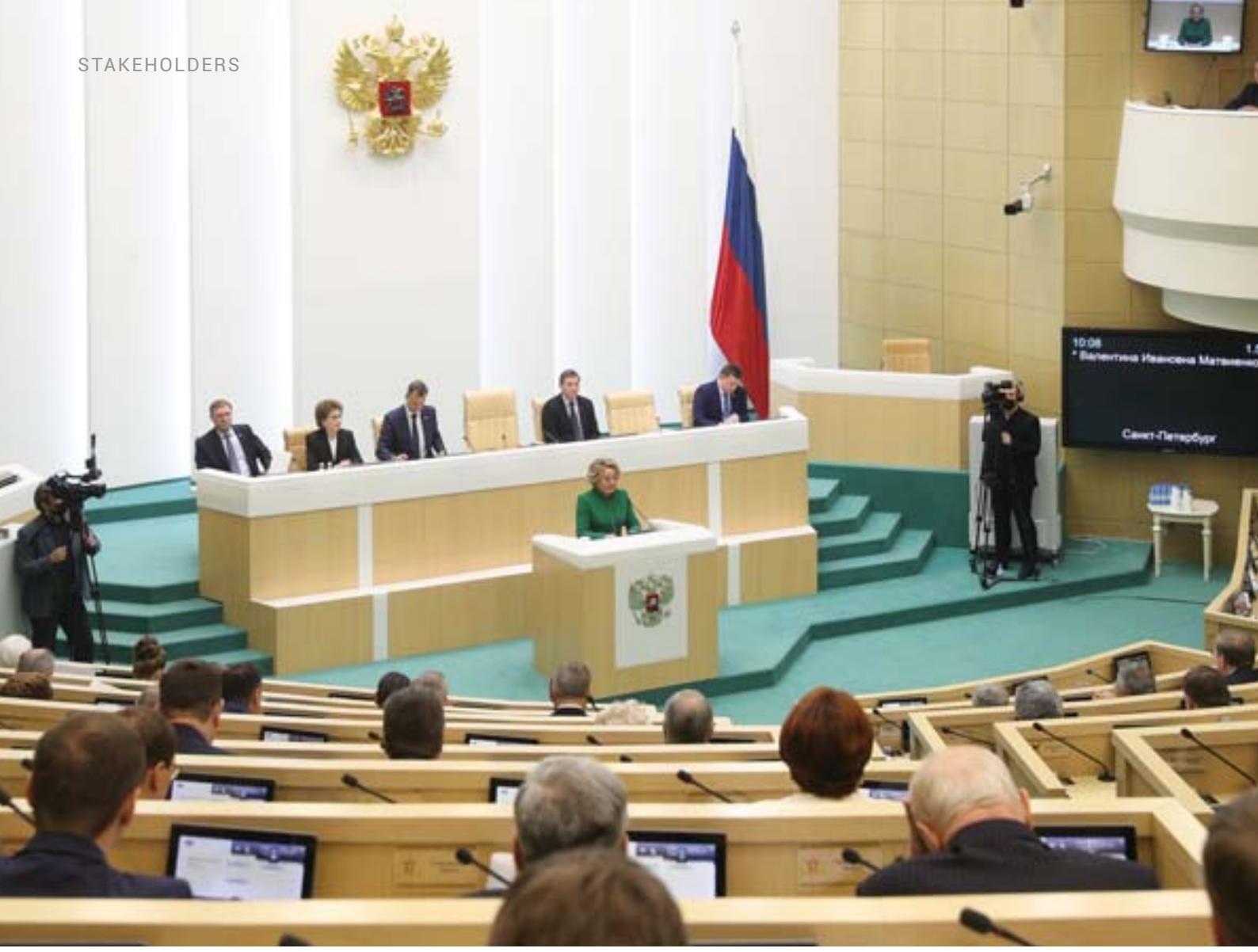
Oil and Gas Vertical: *Has the drafting of the Environmental Code been started? When can we expect its approval?*

V. Matvienko: The creation of a code is among the most important as well the most complex legal tasks. The work you are referring to will be no exception, as today's environmental law contains dozens of legal acts, which are often incompatible and can be interpreted differently. We will have to establish a system of laws fully free from conflicts, overlaps, gaps and disparities in interpretation of legal norms. It should cover the highly increased role of society in developing and implementing the State environmental policy, such new realities, as climate change, green energy transition, waste re-use, etc.

It is clear that the drafting of an environmental code will take time. We, as legislators, have taken the first step. Following its meeting the Council of Legislators' Presidium recommended the Russian Government to consider creating an environmental code. It will not be started from scratch. Environmental codes exist in some entities of the Russian Federation, and in the Republic of Kazakhstan. Thus, there is experience to rely on. Essentially, we will further monitor this issue and promote its resolution.

Oil and Gas Vertical: *In his Address to the Federal Assembly Russian President Vladimir Putin said that polluters should pay. At the legislative level, what is done to make this principle defining in our environmental and economic legislation?*

V. Matvienko: The Federation Council approved amendments to the Budget Code that helped transfer 145.5 billion roubles to the federal budget as compensation for the damage as a result of the oil spill in Norilsk caused by the Nornickel company. Funds were allocated to implement environmental projects. Undoubtedly, this is major progress in our environmental legislation, in its part that addresses compensation for damage



to the environment caused by economic entities. It is important that they have seen once again that in our country the principle «no one is above the law» is not a mere statement but a guideline to follow.

Besides, it is evident that acute environmental problems in a number of Russian regions and sectors of our society and the fact that a big part of the domestic businesses and citizens do not fully understand them require further development of the environmental law. We should bring it to such a level that it contains no more loopholes for those who voraciously pollute the air, water, soil and towns.

I would call this legislative area traditional. But recently, companies' compensation for the environmental damage caused by their professional, legal activity becomes more pertinent. Pressing issues to be addressed are the establishment of financial or other liability for re-cultivation of an industrial, construction site used before, and the recycling of packaging and goods they produced. Briefly, for everything that is directly or indirectly related to negative impact on the environment we live in.

The first steps have been taken. For example, car-manufacturing companies pay the so called "disposal fee". In April 2021, the roadmap to implement the Extended Responsibility Concept for Producers and Importers of Goods and Packaging was approved; this is the basis for the ongoing drafting of relevant amendments to the Law on Production and Consumption Waste.

We will further work on the legal acts determining the liability of business for preserving the nature, and establishing mechanisms of compensation for damage caused by production or other activity. There are many to be adopted. The business circles of our country should fully understand that there will be no deviation from this course because the clean and healthy environment is a prerequisite for a decent quality of people's life.

Oil and Gas Vertical: *The Russian business is preoccupied with the «environmental law dictatorship» emerging in Russia. How can the balance of interests of the State and business in the context of the increased environmental responsibility for companies be maintained?*

V. Matvienko: I see no grounds for such concerns. The State requirements to strictly and fully comply with the environmental law in fact do not differ from similar requirements in other spheres, e.g., tax, family or labour law. Unconditional implementation of existing laws is the principle of any legal State, the condition for its capacity to act.

The other thing is that there should be no haste or unsystematic work in the ongoing shift in the environmental policy

of the State and its enforcement. The domestic business needs time to adapt to new environmental realities and State's and society's related requirements. I am convinced that law-making and legislation in this area should be based on close interaction with business circles, their organizations and care for the business legitimate interests and concerns. In the opposite case, there is a risk to achieve quite healthy environment but poor and sick economy. To avoid this, the State environmental policy should be well-conceived, considered and balanced, as well as the position and actions of the business. In the meantime, we often encounter a low level of the environmental responsibility of many owners of enterprises and their unwillingness to repair damage to nature. One of the reasons consists in small fines for environmental law violations. It is more beneficial for enterprises to pay them than spend money on addressing the causes of offences, including to replace the worn-out equipment and update technologies.

Clearly, sanctions for violation of environmental laws should be sensitive for perpetrators. At the same time, I believe it is not right to place an accent only on this. Life proves that no smaller but even higher impact have stimulating legal acts that contain instruments, mechanisms of support and encouragement of law-abiding and socially responsible businesses. In my view, our country lacks such stimulating laws, we should have more of them, both in environmental and other spheres.

Oil and Gas Vertical: *You have already mentioned the climate change countering and the green economy transition. One of the challenges here is the absence of effective legal instruments for funding relevant projects. Is there ongoing work to create them?*

V. Matvienko: Yes, our Chamber considers this issue strategically important and monitors it. Last December, the Federation Council recommended the Russian Government to develop an integrated approach to legal regulation of green projects. In the framework of the 9th Neva International Environment Congress, the theme of one round table was «Green finances: how to mobilize resources for environmental modernization».

Such work is underway. The Russian Government approved the national taxonomy that determines actual parameters, which, if achieved, make it possible to raise concessional funding for a green project through special bonds or loans. The Bank of Russia initiated the preparation of offers on support measures, including tax exemptions, subsidy mechanisms and State guarantees both for organizations raising funds in the framework of green financing and relevant investors. It is natural that as soon as these or those projects reach the level requiring legislative regulation, our Chamber will take necessary steps.

Oil and Gas Vertical: *The climate and environmental agenda is increasingly used by certain circles in Western countries to occupy the domineering place in the world markets, and to meet political goals, including the so called "containment of Russia". How great is the threat? What does our country have against those efforts?*

V. Matvienko: It is useless to exert pressure on, frighten or blackmail us. Owing to our vast territory, unique natural resources, including energy, robust scientific and technical and

staff capacity, we have a lot of underlying strength to counter environmental and energy challenges. Probably, the world biggest one. It was clearly stated, in particular, at the recent Eurasian Women's Forum, where climate was among the key issues. The representatives of Russia spoke about measures we take to reduce climate-change risks. This is actually the State strategy – integrated and detailed.

I will say more, no environmental, climate or any other global project can be implemented without Russia. This is an indisputable fact, an axiom. Besides, we fully understand the scale of the problems the international community has faced and our responsibility to resolve them.

That was what Russian President Vladimir Putin said at the Russian Energy Week International Forum. The Head of the State underlined that climate and planet health preservation is a common goal for the entire humankind. That is why climate and environmental agendas should not be "weaponized" to promote someone's economic or political interests. Joint considered and responsible long-term actions of all countries are needed to ensure energy and environmental security of our planet.

In fact, the Russian President presented to the international community a particular programme of such cooperation, which also takes into account specific development of various economic sectors. The oil and gas industry takes an important place in the programme, i.e., its steady and seamless transformation and inclusion in the emerging green economy.

Our Chamber closely monitors this process and analyses its short- and long-term consequences. We will do everything to make related technological, economic, social and cultural developments work for human benefit.

http://www.siapress.ru/images/news/main/56337.jpg

PAVEL ZAVALNY:
«RUSSIAN ENERGY MARKETS WILL BECOME THE BASIS FOR THE FORMATION OF THE COMMON ENERGY MARKET OF THE EAEU»

About the upcoming regulatory changes in the legislation of the oil and gas sector, Russia's position on climate regulation, and the development of market pricing of hydrocarbons and energy resources the "Oil and Gas Vertical" had a conversation with the Chairman of Committee on Energy of the the State Duma of the Russian Federation Pavel Zavalny.

Oil and Gas Vertical: *You have retained your position as a chairman of the committee on energy. At the very least, this means that both the industry community and the government are quite satisfied with the work of the committee under your leadership. What would you credit yourself and the committee for the last convocation in the part of the oil and gas industry?*

P. Zavalny: Let's turn to the statistics – the bills considered for the convocation – there were 190 of them, 120 of which were co-execution, 44 adopted laws, 65 round tables and parliamentary hearings, which are also important for goal-setting and formulating of a strategic vision for the development of the fuel and energy complex, including oil and gas complex.

In the oil industry I would first of all highlight the adoption of the law, which launched the experiment on Income added tax, where we were a co-executing committee. It is already possible to analyze the first practice of application – the mechanism is working, we can see the intention of the companies to work in this mode, and today we are talking about further expansion of the experiment. That is, we have finally moved towards changing the taxation regime for the oil and gas industry to the stimulating mode.

The second important thing is the improvement of the damper mechanism on the domestic market of petroleum products in the circumstances of a big tax maneuver, which should end in 2024. The task is to maintain market pricing for petroleum products, and at the same time to ensure the growth of prices for them at a level below inflation. This is very important, because the social and economic situation greatly depends on the prices of petroleum products, and here we all – the government, the relevant ministries, the Duma committees on budget and taxes and on energy – had to adopt many regulation acts to fine-tune the system. In principle, we have received a good result, the price of gasoline and diesel is growing below inflation, even in the difficult economic situation of a covid crisis. Now, perhaps, a new phase of readjustment is required, taking into account the new realities, tand his will become the subject of the committee's work in the new convocation.

This is with regard to oil. In terms of natural gas industry, there were two most significant laws during the convocation: expanding access to LNG exports and, of course, a new gasification model.

The "LNG Law" made it possible to launch a number of LNG projects. It's not only for the monetization of reserves, which is difficult and even impossible to monetize in another way, but also for the loading of the northern sea rout, plenty of orders for related industries, as the new projects will mainly use Russian equipment. The development of the LNG industry gives a large cumulative economic effect, and our ambitious plans in this area are the opportunity to maintain and strengthen our position on the global gas market in the future, in the context of an energy transition.

Oil and Gas Vertical: *Do you believe in these plans?*

P. Zavalny: Yes, I believe in these plans. LNG allows us to monetize our gas reserves, to reach those consumers who cannot be reached by the pipeline. And taking into consideration our gas reserves, the circumstances of the energy transition, in which gas will still be a popular resource, and the prospects for hydrogen energy, where natural gas will also play an important role in the first, rather long-term stage, our gas will be in demand for the long time period, and it is important to be able to supply it different ways.

Oil and Gas Vertical: *You have repeatedly drawn attention to the emerging competition between Russian LNG and Russian pipeline gas...*

P. Zavalny: It does exist on the European market, and in many respects this is a consequence of the EU's policy of diversification of supplies and development of spot market. Of course, this year this approach played a cruel joke on European consumers when Qatari and American LNG sailed away from Europe to the Asian market. And this shortage opened up additional export opportunities for us, but at the same time did not lead to a decrease in prices. This shows that both Russian pipeline gas and Russian LNG strengthen Russia's reputation as a reliable and flexible supplier, our position as the largest player in the global gas market. And this is important. Of course, the revenues from LNG export to the budget of the state and the regions cannot be compared with revenues from the export of pipeline gas, but, as I have already said, the development of LNG projects is a driver for the development of related industries, that means accelerating the development of the country's economy. And as the costs are returned to investors (and prices today contribute to this), the issue of income to the budgets will also be resolved.

Oil and Gas Vertical: *The second law, which you mentioned, concerns the so-called social gasification, which will certainly require attention from the committee and the Duma in this convocation as well. It is clear what it will give the country in social terms. And what will it give the industry, except for very difficult tasks?*

P. Zavalny: In general, in the case of the gas industry, the principle works: "not the state for the industry, but the industry for the state," therefore the social effect of gasification is a priority. At the same time, there are advantages for the industry as well. The simplest one is to establish order with gas distribution organizations, on which the reliability and safety of power supply depends. A bill on the possibility of privatizing municipal gas distribution networks has already been submitted to the State Duma; the Energy Committee will be a co-executor on it. If we talk about the larger and longer-term advantages, the new gasification will increase the demand for gas in the domestic market, moreover, it will be stable and long-term. According to our estimates, domestic gas consumption will increase by 30 billion cubic meters each year. In addition, the need to look for sources of financing for gasification is pushing the industry to improve the gas pricing model.

At the same time, of course, the current operating and pricing model of the gas industry, when supplies to the domestic market are subsidized due to gas exports, will remain in the short term. In fact, the same model works for oil and petroleum products, we protect the domestic market and support the development and competitiveness of our industry with the help of low domestic energy prices. True, this negatively affects its energy intensity, energy efficiency, and this is already a direct threat to our competitiveness.

Oil and Gas Vertical: *What should we do with the Russian gas market? You are the main advocate of the transition to market-based gas pricing. But so far there is a feeling that if the transition to it does begin, it will obviously not be in the coming years. But the common gas market of the EAEU will be, and soon. Is there a contradiction here, and is Russia ready for this common gas market?*

P. Zavalny: The cross-subsidization is already being formed in our country as apart of the implementation of the new gasification model, and this, on the one hand, is a kind of compensation for non-market pricing, and, on the other hand, is another signal that the gas pricing model does not correspond to the tasks facing the industry. And this is serious. Ii order to understand this is enough to see how the cross-subsidization hinders the development of the electric power industry.

In general, in many countries the reform of the gas market and the reform of the electric power industry proceeded in parallel. We have been reforming the electric power industry for more

than 10 years, and there is still no true market pricing, primarily in the retail electricity markets. But it is much easier to create it there than in the gas industry, because there is electricity generation in almost every region, but 90% of gas is produced in one region and goes through one channel. Therefore, it is very difficult to create real competition between gas producers. I I have to admit that we will not have a true market price for gas on the domestic market for a very long time. At the same time, some elements, at least inter-fuel competition and exchange trade, need to be developed. The work of SPIMEX contributes to the establishment of indicative gas prices in the regions and in the country as a whole, but in order for this tool to work correctly, we must release the maximum wholesale gas price little by little, to build a field for competition.

And this is especially important on the of the launch of the common energy market of the EAEU, which you mentioned. Moreover, the Russian energy markets of energy resources, and even more gas market, will become the basis for its formation.

In principle, Russia is preparing for this event, both in terms of gas and in terms of electricity. And in terms of trading in oil and oil products, for example, the big tax maneuver is element of this preparation.

It is more difficult with gas than with other energy resources. But in the near future we still need to create at least a full-fledged roadmap for the transition from the current model of the gas market in the country to a more "market" one, with greater use of exchange instruments, inter-fuel competition, a clearly built model of gas transport, entry-exit, taking into account export netback, so that this model could earn in the common market, taking into account the requirements of the EAEU.

In a new convocation of the Duma we plan to hold at least a round table on this topic in the near future. Expert and analytical work is being carried out, including at the site of the Russian Gas Society. We will formulate our recommendations, we will propose them to the government. I believe that this work cannot be postponed any longer.

Oil and Gas Vertical: *Hydrogen is a really popular theme. Now it is customary to talk about this direction with great optimism, as something that will "save" Russian gas exports. But won 't it work like this, that steam reforming of methane, even with CO_2 capture, will not be included in the list of "clean" in Europe for political or some other reasons?*

P. Zavalny: I don't think it will work this way. There will be a rather long transition period to the pure green hydrogen, and gray, and then blue hydrogen will take their place in European energy mix, for instance, during this period simply due to security of energy supply. Otherwise, the price of the issue will be excessive, and the depth, duration and, most importantly, the unpredictability of energy crises will be much greater than those that so frightened everyone this year. It seems that everyone saw how dangerous the imbalance in the energy balance and the underinvestment in traditional energy are. It is possible, of course, to argue that green energy has failed, because it is not yet green enough, and we need to invest even more in it, but this is shortsighted even from a political point of view – your citizens will not say "thank you".

Therefore, I think there will be some period of transition, where methane, then methane-hydrogen mix, and then pure hydrogen will play an important role – this will be the most relevant way of energy transition. More ambitious emission reduction targets should be achieved through energy efficiency or compensation measures related to absorption capacity of forests, swamps and so on. In the end, let's not forget that the European Green Deal is not only about renewable energy sources and refusal to invest in traditional energy resources, but, in many respects, it is about increasing the energy efficiency of the entire European economy.

Oil and Gas Vertical: *When will work on the hydrogen legislation begin? So far, after all, we don't have it at all. There is a feeling that we are late...*

P. Zavalny: I don't have that feeling. Certain normative regulation, primarily technical, exists, because hydrogen is used in one way or another today. Of course, these are slightly different areas and scales of application than those, which discussed in connection with the energy transition. An expansion and change in the regulatory framework will be required simultaneously with the expansion of application. It will be necessary to finalize the legislative norms for the transport of hydrogen, especially by pipeline, on the safety of production, transportation and use, on economic incentives for this new industry on tax and customs issues, if we are talking about exports, and so on. Today a high-level working group on hydrogen has been formed, I plan to join it, preliminary agreements have already been made. The committee seems to be a good public platform for discussing hydrogen-related issues; we have already formed an expert group on hydrogen topics.

At the same time, in my opinion, when creating a Russian regulatory framework for hydrogen energy, it is important to harmonize it with international legislation in parallel, especially since it is in the formative stage. This is a field for cooperation. In this context, preliminary agreements at the government level between Russia and Germany are important, for example, aimed at joint actions not only on the technological aspects of the development of hydrogen energy, but also on its regulatory support. I look forward to joining this work both as chairman of the committee and, I hope, as coordinator of the friendship group with the German Bundestag, when such a group is formed both in the Duma of the new convocation and in the Bundestag. In the last convocation, our work was recognized as effective.

Oil and Gas Vertical: *The Committee got involved in work on the topic of carbon taxation. At the same time, if many of your colleagues talk only about external challenges and seem to hope that the topic will subside, then you have repeatedly said that a carbon tax should be introduced in Russia as well. Why? Judging by your statements, you see this not only as a tool for achieving climate goals, but also as some kind of whip for wasteful consumers. Is it so?*

P. Zavalny: The energy intensity of our Gross domestic product is really insufficient, not only because we are a northern country, but because the low price of energy resources. It does not stimulate either the large energy sector, or industry, or the utilities sector to save the energy. We have a huge potential for energy saving, and this makes it possible to reduce CO_2 emissions significantly. In conditions when proper economic incentives are lacking, the state needs to create some kind of whip, the system of penalties. The carbon tax can also become such a whip – the introduction of payments for emissions will force consumers to look for technologies that will reduce it, and at the same time will increase the energy efficiency of industries, commerce, and so on. Of course, carbon regulation can be more stringent, such as carbon tax, or more lenient, like implementing the green and white certifications.

So far, our legislation in Russia follows a softer path. This year, the State Duma adopted a draft law "On limiting carbon emissions," and the Committee on Energy was a co-executor.

There are two major blocks in this law. The first is the introduction of mandatory carbon reporting for the largest issuers and the submission of this reporting to a government-authorized body. The largest emitters of greenhouse gas emissions are considered to be enterprises that emit more than 150 thousand tons of CO_2 equivalent. Other organizations are free to submit carbon reporting on a voluntary basis. Thus, an information basis will be created for the management of carbon emission in the economy and its industries.

The second block is the formation of a legal framework for the circulation of carbon units as a tool to reduce the carbon footprint and to attract investment. Any organization will be able to implement a climate project on a voluntary basis. The emergence of a new class of investment projects aimed at fulfilling the climate goals of the Paris Agreement will make it possible to create a new market in Russia associated with the circulation of carbon units, and this stimulates investment in climate projects and a market mechanism will form the price of greenhouse gas emissions in Russia. At the same time, the bill does not provide any restrictive measures for business, there are no quotas and payments for greenhouse gas emissions.

For a long time I have been a supporter of this approach, mitigating the "climatic burden" on Russian business, at least at this stage. But today it is becoming more and more obvious that we have to act more strictly and make decisions faster. The "Fit for 55" package, approved by the EU, envisages the introduction of cross-border carbon regulation, the so-called CBAM, already in 2026. And this is a serious risk for Russian producers of cement, fertilizers, metallurgical products, and electricity supplied to the EU. According to the CBAM project, importers will be able to reduce payments on it to the EU budget by the amount of the carbon tax paid in the country from which the goods were exported, but only the payment of the carbon tax or the carbon price in the exporting country will be taken into account, and no green certificates will be taken into account. will be. So, understanding the importance of the European market for us, we will have to introduce carbon taxes so that our companies pay them to the Russian budget, and not to the European one, which is, in fact, what the EU is striving for.

I have no illusions about what goals the European Union is pursuing by introducing CBAM. But this does not mean that we can resist these intentions by ignoring them. Moreover, following the EU, other countries are planning to introduce similar mechanisms, for example, Japan, the United States. Therefore, if today we carry out the same selection of projects for the construction of capacities in the electric power industry under the COMMOD program for 2026-27, securing energy-ineffective modernization, we risk laying a mine under all products that will be produced using this electricity, and, accordingly, under the global competitiveness of our economy.

We are part of the global economy, and it will not work out that all developed countries will go one way in matters of carbon regulation, and we will be able to go the other way without damaging ourselves.

Oil and Gas Vertical: *Will the methane cut agreement, which was signed during COP 26 in Glasgow, be more potentially dangerous for Russia than cross-border carbon regulation? Despite the fact that Russia has not signed this agreement.*

P. Zavalny: It is too early to talk about it, this agreement at the moment is rather a declaration of intentions; it does not contain any instruments for calculating volumes and setting quotas for methane emissions. But this does not mean that they will not appear at some stage, especially since the countries that signed the agreement are going to reduce methane emissions by 30% by 2030. And from this point of view, the agreement is a potential source of risk, and we need to work with it. In fact, our oil and gas industry is already working to reduce methane leaks along the entire production and transportation chain, this is part of the policy of our companies, so Russian plans in this regard do not contradict the intentions declared in the agreement.

In my opinion, if more than 100 countries of the world sign such an agreement, Russia should not ignore it. Moreover, considering that gas and, more broadly, energy exports are one of the most important items in our budget replenishment, we will have to synchronize and harmonize our regulatory framework, our requirements for emissions, for climatic and environmental goals with international ones. Otherwise our data on these parameters will not be recognized, and this will restrain our economic opportunities and slow down our development.

Of course, at the same time, we need to defend our interests at all international platforms, in the G20, within the framework of the Paris Agreement, which, in fact, is what our President is doing. This is and will be done by parliamentarians, within the framework of inter-parliamentary interaction. Recognizing nuclear and hydropower as carbon free resources, taking into account the absorptive capacity of our ecosystem – these are all critical points. Climate issues should not be allowed to be used for political purposes as a weapon in global competition. In this context, I want to note that an agreement on forests and land use was signed there in Glasgow, and Russia also signed it. It is in line with our climate strategy, as stated in Glasgow by the President of the Russian Federation.

Oil and Gas Vertical: *Let's return to the oil topic. The Energy Committee is more likely to deal with oil legislation, rather as a co-executor, with your colleagues from on the budget committee taking priority. Do we have the feeling that the approach of financial and tax officials to the oil sector outweighs the industry one?*

P. Zavalny: There are three committees, responsible for oil industry, first of all, the committee on budget and taxes, the committee on natural resources and ecology and our committee. The fact that the committee on budget is playing the first fiddle is normal, given the importance of the oil industry for replenishment the country's budget. At the site of these three committees, there is a constant dialogue, a search for a balance between the interests of the state, society, and the industry. There are no good or bad here, there is one common task – to ensure both the development of the country and the sustainable development of the industry. Moreover, we, the Energy Committee, often act as representatives of the oil industry, defending their interests.

Now, for example, there is a very complicated dialogue on the issues of adjusting the taxation system for the oil industry, taking into account the deteriorating structure of reserves. The task is to make such amendments to the legislation that will allow companies to include in the development the reserves, which are unprofitable today, to continue the profitable development of depleted fields. For this, a working group of the Expert Council under the State Duma committee on budget and taxes has been created. It included representatives of the State Duma committee on budget and taxes, the committee on energy, representatives of relevant ministries, regional authorities and oil and gas companies. Work is underway to adjust the income-added tax regime; its effect can be extended to fields in Western Siberia if they meet a number of criteria.

These criteria have already been determined, in particular, the company must produce no less oil than is planned in the field development project, in the horizon of 5 years and then the total budgetary effect must be positive, the threshold for field depletion must be at least 50% for the third group of the tax (it includes mature fields in Western Siberia), and not more than 1% for the fourth group (it includes new fields in Western Siberia). For the fields of the third group, the total production volume should not exceed 15 million tons per year, for the fields of the fourth group, restrictions on the size of the total reserves are set – up to 300 million tons.

Oil companies have already submitted to the Ministry the packages of documents on 72 license areas that could become candidates for transfer to the income-added tax. The bill is in progress, our task is to have time to do everything quickly so that the expansion of the experiment takes place in 2022 for the 3rd group and 2023 for the 4th.

Oil and Gas Vertical: *What will happen to the income-added tax? Do you believe that this incentive approach can still replace the current systems of taxation, and if so, in what time frame?*

P. Zavalny: I think the industry will continue to transition to income-added tax, practice has shown that its introduction was the right decision. As I said at the very beginning of the interview, he proved himself well, interested oil workers, did not disappoint the state, and really opened up new opportunities to involve in the development of those reserves that are simply unprofitable to develop outside the framework of this tax. Otherwise, there would have been no talk of expanding it. I believe we have a chance to move to income-added tax regime in the prospect of 5-7 years. Of course, if there are no emergency events, such as those faced by the global oil industry in the spring of 2020.

Oil and Gas Vertical: *How does the oil industry get into the energy transition? You often say that the age of oil will end faster than the age of natural gas, and perhaps sooner than we think...*

P. Zavalny: Natural gas really has very good prospects for at least the next 40 years. As for oil, I believe that oil will also be in demand for more than a dozen years, only in a different way, not in the way we are used to. 150 years ago the great Mendeleev said that burning oil is the same as stoking the stove with banknotes. And now, on our very eyes, this statement is becoming a given, an axiom. The further, the less oil will be used as fuel, will be replaced by other types of fuel in the energy sector and in transport, becoming more of a raw material for deep petrochemistry.

Oil and Gas Vertical: *Isn't a little bit late to fight for this market? In recent years, many serious players from all over the world have invested in this industry, and there is already enormous competition in this market.*

P. Zavalny: We were not late, but, of course, we are noticeably lagging behind, and not only from Europe and the United States. China will soon close its market with the entire range of petrochemical products. Our task is to f satisfy our market in both large-tonnage and medium and low-tonnage products, and try to occupy some export niches. The rates of development of petrochemicals in our country are really insufficient, lower than even those of some neighbors in the former USSR, obviously, some regulatory solutions are needed, the existing ones are still not enough. Their search will be one of the issue for our committee.

Oil and Gas Vertical: *If I ask you to name briefly a few actual issues, that are also in priority for the committee on in this convocation, what will it be?*

P. Zavalny: For oil – expanding the tax rate, developing landfills for testing new technologies, accelerating the development of petroleum chemistry, and import substitution. For natural gas – regulatory support for the new gasification model, regulatory support for the transition to the common EAEU market and gas pricing in the domestic market, and the related regulatory support.

A very important topic for both industries – the legal regulation of protected zones and zones of minimum distances to main or industrial pipelines, we have already held a round table on this topic and are preparing our recommendations. It is necessary to lay in the legislation a mechanism that, due to various engineering, technical and organizational measures to improve the safety and reliability of pipelines, will allow companies to reduce the zones of minimum distances up to the boundaries of the protected zones, ensuring the safety of people and, at the same time, giving the territories the opportunity to develop.

For the entire fuel and energy complex as a whole, the most important issues that we will work on in this convocation are energy efficiency as well as carbon regulation, the creation of carbon landfills, and, more broadly, environmental problems, and the digitalization of industries.

http://council.gov.ru/media/photos/image_huge/T1yOkGPpSK6At0St8XI6KHH3T00dMQCC.jpg

ILYA TOROSOV:
«WE FOLLOW GLOBAL TRENDS, BUT WE HAVE GONE FURTHER...»

About the differences between the international and Russian taxonomy, the measures taken by government authorities to mitigate the turbulence of energy transition for the Russian business, and why a companies should become «green» Deputy Minister of Economic Development of Russia Ilya Torosov told in an interview with «Oil and Gas Vertical» on the eve of COP26.

Oil and Gas Vertical: *Mr Torosov, the Ministry of Economic Development of the Russian Federation has recently presented a new version of the strategy of low-carbon development of Russia, which contains two scenarios: inertial and target (intensive). What is their difference? What effect can their implementation have on the country's economy? Which of the scenarios is more realistic and preferable for the sustainable development of Russia?*

I. Torosov: The main objective of the strategy is to ensure economic growth in the context of global energy transition. For that we need to understand how to take advantage of the opportunities that the energy transition gives. Inertial scenario implies that we are not taking special measures to adapt the economy to the energy transition. As a result, there is an accelerated reduction in energy exports following a decline in global demand. At the same time, the pace of non-energy exports is slowing down due to the high carbon footprint (we are becoming the «end supplier» in a number of industries). Investments and economic growth rates are declining. The decline of GDP growth and profitability of energy exports reduce budget revenues and the ability to pursue an active social policy. This leads to low rates of income growth of the population also.

Intensive scenario implies active decarbonization measures in order to maintain economic growth rates at a level of at least 3%. As a target, we suggest taking an intensive scenario. It allows us to maintain a 3% GDP growth rate after 2030. The carbon intensity is decreasing at a high rate due to intensive decarbonization measures and the implementation of climate projects in the country. The competitiveness of exports increases, which means that the revenues of the budget system in the long term. The opportunities to conduct an active social policy stays, the growth of real incomes of the population remains at a level of at least 2.3% per year.

Oil and Gas Vertical: *Is there already an understanding in which format the emissions trading will be carried out: on a voluntary basis, cap-and-trade, baseline-and-credit? Who will coordinate the process of buying and selling quotas?*

I. Torosov: We are currently deciding with the regional government and business about the methodology for allocating quotas between companies and the fee for non-fulfillment of the quota.

Oil and Gas Vertical: *As a part the formation of the carbon market, the Ministry of Economic Development of the Russian Federation is working to create an emissions verification system and plans to achieve its recognition at the international level by the end of 2023. Is work currently underway to prepare an agreement with the International Accreditation Forum (IAF) on mutual recognition of greenhouse gas validation and verification bodies? At what stage is this work now, and what has been achieved so far?*

I. Torosov: On behalf of the President of the Russian Federation, Ministry of Economic Development have been prepared amendments on the mandatory verification of carbon reporting, providing for the adoption of more than 30 by-laws in the areas of accreditation, standardization, as well as in the formation of lists of regulated greenhouse gases.

The Russian manufacturers have the opportunity to conclude contracts for services for the validation of climate projects and verification of the results of their activities with legal entities whose independence and competence have been confirmed by the national accreditation body. Greenhouse gas validation and certification bodies are subject to strict requirements for their compliance with established standards. These standards are GOST R ISO 14065-2014 «Greenhouse gases. Requirements for greenhouse gas validation and verification bodies», GOST R ISO 14066-2013 «Greenhouse gases. Competence requirements», GOST R ISO 14064-3-2007 «Greenhouse gases. Requirements and guidelines for the validation and verification of statements concerning greenhouse gases».

According to our information, about ten companies have confirmed their readiness to undergo the accreditation procedure as greenhouse gas validation and verification bodies, including a subsidiary of Gazprom PJSC, Innopolis University, subordinate organizations of the Federal Service for Supervision of Natural Resources, RUDN University, the Bauman Moscow State Technical University. It is remarkable that the Russian Energy Agency (REA), the institution subordinate to the Ministry of Energy of the Russian Federation, has also been actively involved in this project and is already preparing materials for accreditation.

Some of them plan to get accreditation in foreign accreditation bodies of the European Union countries to receive international recognition of the results of their activities.

The Federal Accreditation Service plans to submit an application to expand the field of mutual recognition within the framework of the International Accreditation Forum (IAF) in the field of accreditation of greenhouse gas validation and verification bodies in the first half of 2022.

The result of the expansion of the recognition area will be the opportunity for Russian greenhouse gas validation and verification bodies to use the IAF mark and receive recognition of their activities abroad without the need for accreditation with foreign accreditation bodies in the future.

Oil and Gas Vertical: *Taxonomy is a counting stuff, but the calculation of harmful effects may differ from country to country. Accordingly, how will the international recognition of the Russian taxonomy be achieved in terms of the applied quantitative criteria of «greenness» of projects?*

I. Torosov: Here is needed to separate what an ESG project and an ESG company are. An ESG project is a project that meets the criteria of specific green projects that we have prescribed in the taxonomy. There is described the criteria, types of activities that define the project as green or adaptive. When we talk about the company itself, an ESG company is primarily a company that has priorities in these three areas in its development, in its operational activities, in its daily routine. Specific goals and mechanisms of achievement are indicated. Therefore, when a company says that it has an emission, conditionally, and the company will stick to it, this is not ESG. If the company says that yes, it has such and such an emisson, but it understands that this is a negative effect, the company starts working and has such an investment strategy, it will spend so many rubles on it. As a result, the company will have such and such an

effect on emissions. Such a company can be called committed to the principles of ESG. Based on this, the rating of ESG companies is also formed.

When we worked on the taxonomy, it was important to make such criteria for green projects that would correspond to the European ones, so that in the future there would be the possibility of mutual recognition. The Russian taxonomy of green projects is almost identical to the European one, including additional criteria and counting parameters of projects. The only difference is that we consider the atomic energy as green. Therefore, we will discuss mutual recognition in Glasgow so that foreign investors do not have problems from their creditors with investments in Russia.

The criteria in the taxonomy is not only the reduction of CO2-equivalent emissions. Indeed, now there is a question on the world agenda how to count it. And we will also bring this issue to Glasgow. We base the carbon dioxide emissions accounting system on international ISO standards. These standards establish the basic requirements for reporting, verifiers and national accreditation bodies of verifiers.

But here the question is rather about modernization or the creation of new production facilities. In this case, there is technical documentation for the equipment, according to which it is clear how much CO2 emissions will be reduced. So, there is no need for the enterprise itself to count. It's all known. Therefore, the verifiers will determine compliance with the criteria based on the current emission parameters and those that will be in the case of modernization, according to technical documentation.

Oil and Gas Vertical: *There are risks that with the launch of a sustainable financing system in Russia, some companies will want to be «green» by any means. How clearly does the national taxonomy make it possible to separate really eco-friendly projects from greenwashing?*

I. Torosov: As you yourself said, the criteria for green projects are the strictly countable stuff. In most cases, there are also additional ones that are also registered there. The project that corresponds to them (and then it is green), or not. For example, the production of biodegradable materials. Here, an additional criterion is the absence of microplastic formation during decomposition. It will be necessary to prove its absence both at the verification stage when receiving a green loan, and during the implementation of the project. So, the verifier's control will be repeated. And in case of violations, various measures can be applied, up to the withdrawal of funding.

Oil and Gas Vertical: *What about those businesses that implement adaptation projects according to taxonomy criteria? Will they be able to attract a responsible investor?*

I. Torosov: We follow global trends, but we have gone further. We created the taxonomy of adaptation projects that takes into account Russian specifics. These are unique and individual projects in those industries that are highly developed in our country. For example, the same oil and gas production, processing. They are not de facto green.

It is impossible to completely eliminate emissions in these industries. But if they are significantly reduced, then this is a positive effect for the country.

Any investor who cares directly about the environment, he understands that yes, there is certainly a solar power industry, which is minimal in terms of emissions. But, there is, for example, a project on filters at refineries that reduce emissions. Yes, the process itself is not green, but the ecological effect is significant.

There are many investors whose ESG principles are not so strict. There is an opportunity to open representative offices in Russia and direct part of the funds to adaptation projects, especially the positive impact on the environment of an adaptation project is often higher and more significant than that of a green one.

Oil and Gas Vertical: *What instruments of green lending are provided for small and medium-sized businesses? Can an the small and medium-sized businesses issue green bonds? What steps should the enterprise take in this process?*

I. Torosov: The same sustainable or green financial instruments (for example, loans and bonds) are available for the small and medium-sized businesses as well as for other companies. But here we must understand that loans will be more profitable for the small and medium-sized businesses, because there are associated costs (for example, state duty, exchange commission, consulting services.) when issuing bonds. The bonds will be more profitable with large borrowings. For example, the minimum volume of the green bonds, traded on the stock exchange, is 100 million rubles now.

As for the steps, first of all, the entrepreneur should evaluate independently whether his project meets the criteria of green or adaptation projects and then apply to the bank for financing and further verify the loan as green or adaptive.

Oil and Gas Vertical: *What will happen to the Russian system of green financing in the future? Will the market develop independently?*

I. Torosov: The state has created the regulatory base. We went out and set the standarts. The framework green, as well as adaptive, was formed to exclude the same greenwashing, because objectively companies will be interested in calling everything «green».

Our task is to set these standards so that companies are not severely limited and they have the opportunity to implement these projects. A foreign investor, coming to us, can be sure that according to the European standards, the project is also green, if there is a label «green» according to Russian standards. The green taxonomies are almost identical. And further the state will withdraw.

We initially created the system of green financing at the request of business. And the business did not link the creation of this toolkit with subsidies or tax benefits.

The presence of the label of the green project indicates the sustainability of this project to medium- and long-term risks, including climate, energy transition risks, etc. Therefore, the business is interested in this tool, there is a demand for it even without additional subsidies.

We have created the necessary conditions, but life will show whether they are sufficient. We are ready to constantly upgrade the system together with the business.

IGOR IGIN:
«THE ATTENTION OF THE WHOLE WORLD IS FOCUSED ON US»

The National Operator for Radioactive Waste Management NO RWM was established in 2012 by Resolution of the Government of the Russian Federation. This year the company is 10 years old. CEO of the company Igor Igin tells in an interview for the Oil and Gas Vertical about what has been done during this time, about the prospects for dealing with RAW in the world and in Russia in the frame of high attention of the world community to environmental problems.

Oil and Gas Vertical: *The issues of radioactive waste management are probably the most difficult and "frightening" among all related to the nuclear industry. Let's start with the simplest, with definitions that are understandable to all nuclear scientists and incomprehensible to everyone else: what is the fundamental difference between spent nuclear fuel and radioactive waste and what is the share of one and the other in what remains of the operation of nuclear facilities?*

I. Igin: I would say, It is not "frightening", but rather a sensitive topic for the public. Russia has accumulated 500 million cubic meters of RAW. In general, people understand that the problem must be solved and not shifted to the shoulders of future generations. However, they want to isolate the RAW somewhere else. But, as a rule, these wastes are already in the territories of their formation and will not disappear by themselves.

As for the difference between spent nuclear fuel (SNF) and radioactive waste (RAW), it is fundamental. Spent fuel contains radionuclides that can be returned to the nuclear fuel cycle, therefore, in accordance with the Russian concept of nuclear energy development, it should be recycled. In other words, it is not waste, but a valuable resource.

Radioactive waste is the materials and substances that will never be used and therefore must be recycled and placed in special storage facilities for the entire period of their potential danger, because over time the radioactivity of all radioactive waste decreases – this is the law of physics.

There are six classes of RAW. The National Operator actually deals with five of them, since the 6th class mainly includes waste from the processing of uranium ores, mineral and organic raw materials with a high content of natural radionuclides, the isolation of which is possible directly at the place of their formation.

The first and second classes are high- and medium-active long-lived radioactive waste, whose half-life, depending on the radionuclide, can be up to a million years. There are not so many of these RAW, but due to their high potential danger, special attention is paid to them. The long-term safety of the storage of such RAW must be justified not just for centuries, but at least for several hundred thousand years. According to international standards, the isolation of such waste should occur in geological formations at depths of more than 100 meters.

Initially, these wastes were formed during the implementation of the nuclear program, during the production of plutonium for nuclear charges. Now such RAW are formed in fuel assemblies.

The amount of such waste is not huge. For example, the Russian storage project is designed for 4.5 thousand cubic meters of Class 1 RAW in packages and 155 thousand cubic meters of Class 2. RAW of the 1st class in vitrified form are stored at the "Mayak" (the enterprise of the Rosatom State Corporation, located in the Chelyabinsk region).

In order to create a repository for these wastes, today we are constructing a unique scientific center in the Krasnoyarsk Territory, near the nuclear city of Zheleznogorsk, an underground research laboratory, which should confirm preliminary calculations about the possibility of environmentally safe placement of high- and medium-effective long-lived radioactive waste at a depth of 500 meters in an integral rocky gneiss rock more than 2.5 billion years old.

Wastes of the 3rd and 4th classes are the most common RAW. Most of them are formed during the operational activities of enterprises handling radioactive substances. These are low- and medium-active short-lived wastes, which include contaminated workwear (gloves, bathrobes, shoes), construction debris (formed, for example, during decommissioning of nuclear industry facilities), different equipment (appliances, filters). According to Russian and international standards, such waste after processing and placing in special packages is isolated in near-surface points of final isolation of RAW.

In 2016, we started the operation of Russia's first point of final isolation of RAW of the 3rd and 4th classes in Novouralsk, Sverdlovsk region. Now similar storage facilities are also being built near Ozersk and Seversk (in the Chelyabinsk and Tomsk regions). The commissioning of these facilities is scheduled for 2024. Subsequently, it is also planned to build additional facilities there. The possibility of implementing projects in the Moscow and Ulyanovsk regions is being considered.

And finally, the 5th class is liquid RAW. In Russia, we have the unique technology for pumping liquid radioactive waste into deep isolated geological formations. The technology has been used since the 60s of the XX century as part of the technological cycle of three enterprises located near Dimitrovgrad, Ulyanovsk region, Seversk, Tomsk region and Zheleznogorsk, Krasnoyarsk Territory. All three points were put into commercial operation in the period from 1963 to 1966, and after 2012 they were transferred to NO RWM.

By the way, what is the difference between the modern concept of RAW management and those facilities that were used earlier, for example, in the Soviet "Radon" system (it is the title of the system of enterprises that collected, processed, packaged and stored RAW)? The main difference is the fact that it was mostly temporary storage. They were built for a period of 30-60 years with the possibility of extending the service life depending on the physical condition of building structures.

As a result, today, for example, RAW are being extracted from there, overloaded, and these points are being liquidated. The system has been formed for decades from the real situation. But we must pay tribute to our predecessors – they carefully calculated everything, and we had no serious accidents of a regional nature, except Chernobyl. But Chernobyl is a separate topic, where the human factor played an important role.

Oil and Gas Vertical: *What are the volumes of SNF and RAW in the world and in Russia? How it is increasing now and will continue to increase in the future? Can this increase in volumes be considered the biggest challenge and problem of the nuclear industry in the medium term?*

I. Igin: In many countries, the final isolation has been carried out as planned for a long time. For example, in France, since the 90s, the final isolation point of RAW has been operated in the historical region of Champagne, when the first point in Normandy was filled and closed.

If we talk about the volumes of waste produced, then over the 10 years of work after the adoption of the fundamental law "About treatment of RAW" in 2011, there has been a tendency to reduce them, as the law has created tangible economic prerequisites for this. Now the manufacturer pays for each cubic meter in accordance with the tariff, and this motivates the development of technologies leading to a decrease in the volume of RAW education.

As for the processing of spent nuclear fuel, Russia is literally ahead of the whole planet. We already have concrete practical steps in this direction. Today, fuel assemblies with the so-called MOX fuel obtained from recycled SNF are loaded into the fast neutron reactor of the Beloyarsk nuclear power plant. Their production on an industrial scale is very close.

The most interesting thing is that determining the possible number of repeated cycles – four, five, ten, twenty, and their technological features – is a matter of the future. This will happen over the next fifty years (and maybe more) years.

The process, perhaps, should be compared with alcoholic distillation on a moonshine still, where the first distillation gives a result of average quality, repeated distillation is already a purified product, stronger and cleaner. And if you do several cycles, then in the end it turns out, for example, chacha (Georgian kind of vodka) – close in strength to clear alcohol.

For a National operator, for example, the development of SNF processing technology is refracted into a practical task, because the point of deep final isolation in geological formations, which we plan to place in the Krasnoyarsk Territory, in case of success of research in the underground research laboratory, is intended, among other things, for these wastes.

Oil and Gas Vertical: *And how may the long-term safety be proven? There is no empirical experience.*

I. Igin: In fact, the concept looks like this: the guarantee of safety must be provided primarily geologicaly. So, we chose the Nizhnekansk rock massif in the Krasnoyarsk Territory for the final isolation of the RAW primarily due to its unique geological characteristics. The massif has existed for more than 2.5 billion years without significant changes. As geologists say, this is such an ellipsoid, an egg with a diameter of about three kilometers on the major axis, somewhere about two on the small axis. This gneiss massif is one of the hardest of those that exist in nature at all on the globe, and it has been in an unchanged state for more than 2.5 billion years. This was determined by drilling and core material research.

It is quite clear, that on the horizon of hundreds of thousands of years, all the technological safety barriers (metal, concrete, etc.) will collapse or degrade. Over time, the only efficient barrier will be the geological environment. And here the granitoid massif gives the reason for optimistic forecasts. What is, for example, a million years against the background of 2.5 billion years of age of the geological environment? Moreover, taking into account the general trend towards a decrease in the geological activity of the planet Earth. Over time, after several tens of centuries, it is the gneiss monolith that will prevent groundwater from carrying radionuclides to the surface into the environment. In general, water is the greatest problem for the final isolation of any radioactive waste. It should be avoided, but its analysis is the basis of the monitoring of the safety of our facilities.

For example, where we pump liquid radioactive waste into isolated geological formations near Seversk, a whole network of observation wells has been created around injection wells and the injection zone. With a certain frequency, approved by the supervisory authorities, water samples are taken and laboratory studied there. This is done to control the territory of the spread of radionuclides. Based on the data obtained, long-term mathematical models are built. They take into account different scenarios of the situation and predict the likelihood of contamination by radionuclides of the environment, for example, rivers or water supply sources. NO RWM will not be able to conduct its work if such scenarios have at least a hypothetical probability.

But we carefully analyze the state of the environment not only during the operation of our facilities, but also during the construction of new ones. While building our facility near "Mayak" (Rosatom State Corporation enterprise, Chelyabinsk Region), we encountered traces of an accident in 1953, when reactor cooling liquid got into the environment. And now, during the construction of the facility, when we started digging a trench for the water supply, we came across local source of increased radiation. We marked the area so that no one could walk freely there.

Oil and Gas Vertical: *What are our competitive advantages in terms of waste disposal compared to other countries?*

I. Igin: First of all, it should be noted that there is no direct economic competition, because the import of foreign RAW is prohibited in most countries, and Russia is no exception here.

Indirectly, for example, deep injection of liquid RAW is more economically efficient than their conversion to solid form (evaporation). For the rest, everyone in the world uses similar approaches and technologies, the key of which is the creation of a multi-barrier security system and careful selection of sites based on their geological characteristics.

Oil and Gas Vertical: *In Europe, and not only there, various countries have raised the issue of the nuclear industry becoming "green", since the energy crisis has begun. France, India, China and Poland are announcing their intentions on nuclear energy. Do they turn to you to share your experience? What developments are there in international cooperation?*

I. Igin: There are some. Research and technologies in the final isolation of RAW are relevant not only for countries developing nuclear energy, but also for those who refused to use it. For example, Germany will shut down the last three reactors this year, since on June 6, 2011 this decision was made by the government to abandon the production of nuclear energy. However, German scientists and nuclear scientists continue to look for sites for storing accumulated radioactive waste. By the way, we have signed a five-party cooperation agreement with Germany. The parties to the agreement: NO RWM, Institute for problems of safe development of nuclear energy, Russian Science Academy, the Federal Institute of Geological Sciences and Natural Resources of Germany, BGE Technology (German company, authorized to carry out tasks for the final disposal of radioactive waste), the German Plant and Reactor Safety Society. This is the first agreement in the nuclear industry with Germany in the last 20 years. We work closely with colleagues from Switzerland, South Korea, and China. We also have concluded some agreements on scientific and technical cooperation with these countries. We have the plans of the development of cooperation with Finland, Hungary and Italy. In accordance with the strategy approved by the Rosatom State Corporation for the creation of a deep isolation point for Class 1 and 2 radioactive waste near Zheleznogorsk as part of the scientific activities of the underground laboratory, we are forming an international expert pool.

France is a separate topic. The distance between French nuclear facilities (no matter, nuclear power plants, storage of radioactive waste) is a maximum of 230 km. Therefore, the entire population is interested in solving the atomic problem. At the same time, they have the largest number of energy reactors and they are not going to stop them. The first point for 500 thousand cubic meters of RAW in Normandy was closed in the 90s. Now there are two points: "millionaire" (we are talking about the volume) for medium- and low-level radioactive waste and for very low-level radioactive waste in the Department of Ob, in one of the most famous French regions – Champagne. They have already completed their research in the underground laboratory, and now our colleagues from ANDRA – France's national agency for the treatment of radioactive waste – are preparing for the licensing process for the construction of a facility for high- and medium-active radioactive waste.

We visited them several times. The subject of their pride is that they have been dealing with this problem for over 20 years. We raise a question of finding a site for the construction of a final isolation point for RAW 1 and 2 classes in the early 90s. At the same time, the first geological surveys began. But the French went ahead a little bit.

The Chinese are walking side by side with us. They have a simpler situation – they have chosen a place in the Gobi Desert for the construction of an object, and they simply will not have many problems, for example, with public hearings, there are more disciplines and they know how to build. We took a swing at a unique underground structure. Therefore, the attention of the whole world is focused on us. Realizing that the justification of long-term security for licensing our activities will not be an easy walk, we decided to form an international expert community.

Of course, the requirements of Rostechnadzor are tougher in many respects than those of the IAEA, but the international community must also have its say. Many people want to participate in the research program of our underground laboratory.

Oil and Gas Vertical: *We have recently signed an agreement with TVEL (fuel division of Rosatom). What is the essence of the agreement?*

I. Igin: TVEL, by an internal order of Rosatom, received the right to engage in "backend" on the international market, to sell the experience that we have. The cooperation agreement affects the implementation of projects in the field of decommissioning of nuclear energy facilities, as well as the management of radioactive waste and spent nuclear fuel. The joint work will be aimed at the development and promotion of Rosatom products abroad.

Over 10 years of activity, NO RWM has accumulated enough competencies to set ambitious goals and be in the general context of solving global problems.

The main thing we are moving towards within the country is the creation of the infrastructure for the final isolation of RAW in the full planned volume at the level of world standards.

And the main tasks in the foreign market (taking into account the legislative prohibition on the import of RAW from abroad) are the creation of an export-oriented product (primarily of a design and consulting nature), the development of a scientific base, the search and introduction of new technologies and materials.

Countries that have contracts with Rosatom for the construction of nuclear power plant units are thinking about how to create not only facilities, but also the legislative system for the treatment of radioactive waste. Therefore, we had a proposal: to take the storage facility in Novouralsk for classes 3 and 4 of radioactive waste as a model. The facility fully complies with all international standards, even outwardly it is very similar to what we, for example, saw at ANDRA.

Oil and Gas Vertical: *How does the population relate to such objects? How do you arrange accommodation? Is there a need for changes in the regulatory framework?*

I. Igin: Initially, NO RWM followed the path of studying Russian sites from the point of view of geology, scientists were involved and 64 sites were selected according to this geological criterion, of which 30 promising ones were then identified.

Then another criterion was added, logistics. For example, from the point of view of geology, Novaya Zemlya and Kalmykia were ideally suited, but the costs that would be needed to create infrastructure and then deliver RAW there would exceed all reasonable limits, so they had to be abandoned.

Then a criterion related to the location of manufacturers was added – as a rule, these are large-scale nuclear industry productions, such as Mining and Chemical Plant, Electrochemical Plant, "Mayak", Seversk Chemical Plant and others.

I started managing the NO RWM at that very moment. At our stage, we added the important criterionor the achievement of public acceptability.

After a difficult job, declarations of intent were signed for the placement of facilities with the Chelyabinsk, Ulyanovsk, Sverdlovsk regions, and the Krasnoyarsk Territory.

A big role in the success, in the end, was played by the fact that our so called closed administrative territorial entities and city-forming enterprises are located in these territories, people who live there are literate, competent in terms of understanding the specifics of the industry.

In general, there is good international experience to increase the public acceptance of nuclear facilities, including ours: for example, in France, municipalities that host nuclear facilities, receive a special tax on nuclear energy.

Of course, it is difficult to compare our Zheleznogorskwith its 80-thousands population and small French towns and villages, but we face problems of the same order. And of course, when a city knows that it is provided with substantial tax revenues for several decades and longer, this is a weighty argument. This experience is worth studying and applying with us.

During the visits of members of the Federal Assembly to Zheleznogorsk and Novouralsk at the end of 2021, the mayors of the cities raised this issue: there is a burden, which the territory is bearing, and it would be rational to compensate it with appropriate subsidies. For example, the mayor of Novouralsk, a city of one hundred thousand population with a budget of about a billion, said that 300 million rubles a year, which theoretically, if appropriate regulatory decisions appeared, could be contributed to the city budget by the National Operator, or a budget transfer of such a volume would be enough for construction the roads and for the development of the urban environment, would make it possible to keep people in the city so that they would not leave, for example, to Yekaterinburg.

To do this, it is necessary to change the legislation, and we have a common understanding with representatives of the Federal Assembly about the expediency of such changes.

I would also like to draw your attention to the work of the National Operator for the maintenance and improvement of the system of state accounting and control over the circulation of radioactive substances and radioactive waste. Every region sends us a summary of all radioactive waste, isotope sources, including newly discovered ones, every 10 days. We have a complete picture

of all territories. Roughly speaking, if someone wants to find out if there are radiation pollution zones around his country village, for example, he can send us a cadastral number, and I will give an answer, unless, of course, it is related to the secrecy regime.

Oil and Gas Vertical: *But this information is not freely available, if someone wants to know something, they should send you a request?*

I. Igin: Naturally, it is not freely available. But getting it is a normal everyday practice: before starting any construction, developers necessarily ask us if there is any radiation pollution in the territory falling under the development.

My dream is to create a situational center for radioactive control. So that the information is not stored in separate computers, but is received in real time in one place, and it is possible to see the whole picture at any time. It seems to me that this is relevant, especially since modern digital technologies allow it.

Oil and Gas Vertical: *Are adjustments to the regulatory framework required?*

I. Igin: The Corporation has ongoing work to improve legislation. Together with colleagues from the State Corporation division that oversees us, we interact, for example, with Rostechnadzor to improve the regulatory framework of our work. One of the most urgent tasks concerns very low-level radioactive waste, which does not require as many safety barriers as medium- and low-level waste. In this regard, a proposal has been formed to do, as in France– to create a separate type of final isolation points, which will solve the problem more efficiently and much faster.

Oil and Gas Vertical: *Burial is provided only by state (budgetary) funds?*

I. Igin: One of the achievements of the 2011 law is that it divided the accumulated RAW (produced before 2011) and subsequent (newly formed). There was an audit, the enterprises calculated how much RAW they had stored, and it was established that everything, that was produced before 2011 was federal property. Federal funds are allocated for the final isolation of these RAW. And for everything that appeared after July 15, 2011, enterprises pay to a special reserve fund at established state rates. That is, the producers of RAW themselves pay for their final isolation. Tariffs for each class of RAW are set by the Federal Antimonopoly Service. The funds are used for the operational activities of NO RWM and the construction of new facilities. There is no profit line of the National Operator in the tariff. The more RAW is produced, the more contributions to the state fund are paid. The main contributions come from enterprises such as Rosenergoatom, TVEL, 98% of the Fund's payers are Rosatom enterprises.

Oil and Gas Vertical: *What can we say about radioactive waste in oil and gas? How will the situation develop there in terms of waste management?*

I. Igin: From the extraction of minerals, RAW of the 6th class is formed. Any pipe extracted from the depths, even oil, even gas, has some kind of "background radiation". It should be processed (cleaned) before being put into secondary circulation. It is necessary to remove the contaminated layer before processing or further use. This is the RAW of the 6th grade, oil and gas companies must pay for its final isolation. Radioactive pipes should not fall into secondary circulation. And this is not often, but it happens. I think that in the next 10 years the legislation will be tightened so much that as a result all pipes from oil and gas fields will have to undergo mandatory processing.

DMITRY KHOLKIN:
«THE GLOBAL NEW ENERGY MARKET IS LARGE, AND THERE IS AN OPPORTUNITY FOR RUSSIAN COMPANIES TO TAKE A POSITION IN IT AS WELL»

Climate change is pushing humanity to find new solutions for living comfortably on the planet and for further development. New technologies will help to cope with adaptation to these changes, as well as to develop northern territories, the ocean floor and space. Dmitry Kholkin, Director of the EnergyNet Infrastructure Centre and Head of the Legislative Working Group of the EnergyNet National Technology Initiative, spoke about the package of promising technological innovations and the potential of domestic developments in the energy transition.

Oil and Gas Vertical: W*hich technologies do you consider to be breakthrough and competitive in the context of the new energy transition?*

D. Kholkin: To answer the question about the promise of technology in the context of the energy transition, we need to understand where we are going and why we are going there. It seems to us that the treatment of energy transformation for the purposes of the low-carbon transition is tactical. The strategic purpose of the energy transition is different – to create high-performance energy to develop infrastructure, economic and geo-climatic "gaps", that is, areas that do not lend themselves to development using the technologies and practices of the previous way of life. Even without climate threats, this purpose is now relevant for the electrification of developing countries with growing populations. And in the long term, it will serve to spread civilisation to the northern territories, to the ocean floor, to outer space.

The alarming rate of climate warming as well as the challenges of implementing global policies to limit greenhouse gas emissions confirm the strategic relevance of this statement of purpose. These were the key issues on the agenda at the recent COP26 climate change conference in Glasgow. It seems that the energy sector has to be prepared for extremely adverse scenarios, it is necessary to plan measures to adapt to the changing climate, to the relocation of agricultural activities, to large-scale migration. And to do this, off-grid and low-carbon, rapidly deployable and scalable, economically affordable energy solutions will be in demand.

And technologies that support the new principles of energy transition will be most important here: co-sufficiency, co-assembly, co-development. In this regard, three promising technology areas can be identified: technologies for hydrogen production, transportation and storage; technologies for flexible integration and management of distributed energy sources and flexibility (Internet of Energy); and technologies for designing and tuning economic relations using digital platforms.

Oil and Gas Vertical: *What stage of implementation and adoption is this technology at? Within how many years will these developments begin to scale?*

D. Kholkin: Solutions with a high degree of technological readiness already exist in all three technology areas, some of which have already been applied to the market. Electrolysers, hydrogen fuel cells, power flow control systems based on power electronics, intelligent microgrid management systems, digital platforms – all of these can already be bought on the market and used. But for new technologies to be applied on a large scale, costs need to fall, which will be made possible by scaling up production and increasing technological sophistication. It will take 5-10 years. Here is just one example. The State Grid Corporation of China announced plans in March this year to create the world's first Internet of Energy by 2025. Russia has good technological groundwork in these technological areas, and a lot of development is taking place within the EnergyNet community. In particular, a consortium of universities and technology companies has developed the architectural approach of the Internet of Distributed Energy Architecture (IDEA), is also building the basic technology components for this architecture and is implementing the first pilot projects. I think that under the right conditions for using these technologies in the domestic market, Russian companies will be able to create competitive technical solutions and sufficiently strong competencies to implement them in 5-7 years.

Oil and Gas Vertical: *Are hydrogen market conditions already clear? Which production and transportation model do you find most effective?*

D. Kholkin: The global low-carbon hydrogen market is still shrouded in a fog of uncertainty, and the domestic hydrogen market will develop very slowly under conservative carbon regulation. But that doesn't mean you have to take a wait-and-see attitude. We need to be proactive in shaping hydrogen markets by implementing pilot projects for hydrogen production and exports, as well as establishing hydrogen clusters in Russia.

A hydrogen production and transportation model is currently being worked on by a team of experts preparing a comprehensive programme for the development of the low-carbon hydrogen energy industry in Russia. Our Infrastructure Centre is also involved in this work. Preliminarily it can be said that Russia's clear competitive advantage will be the production of hydrogen from natural gas, if the issue of CO2 capture and disposal is solved in an appropriate way. Russia could also have a competitive advantage in hydrogen production through electrolysis of water, using comparatively inexpensive energy from nuclear power plants and hydroelectric power stations. However, it must be remembered that both of these hydrogen production options are not considered acceptable and green under EU climate regulation.

Pilot projects for green hydrogen production based on water electrolysis using renewable solar and wind energy are therefore also relevant.

As far as hydrogen transportation is concerned, Russian experts and politicians have not yet reached a compromise on the possibility of using the main gas transmission networks for this purpose, but we believe that over time this issue will be resolved in hydrogen's favour. Another technologically feasible way to transport hydrogen on a large scale is to transport it as ammonia or in liquefied form.

Oil and Gas Vertical: *What are the prospects for the Russian nuclear industry as a green energy source?*

D. Kholkin: Nuclear power still has a good chance of achieving green energy status. A large number of experts and politicians, not only in Russia but also abroad, point out that without nuclear power it will be difficult to achieve reliable and economically acceptable solutions for the decarbonisation of global energy. France is an obvious ally in achieving low-carbon status for nuclear generation. Bloomberg released a report this year presenting a "red" decarbonisation scenario based on a substantial build-up of nuclear generation and the production of hydrogen from it. Therefore, Russian nuclear industry has great market prospects. The development of safe, low-power nuclear reactors is particularly promising.

Oil and Gas Vertical: *Do you think it is worthwhile to develop the Siberian and Arctic regions in terms of energy? And how to supply electricity to infrastructure projects and factories in Arctic latitudes?*

D. Kholkin: The new generation energy solutions that we are working on at EnergyNet will be tested by the possibility and efficiency of their application in the development of Siberia, the Arctic and the Far East – those very "gaps". In particular, the project to build the Arctic Snezhinka station, which is being established as part of Russia's chairmanship of the Arctic Council, has been initiated to test integrated energy solutions based on a package of new technologies in the Arctic environment. The project plans to create a carbon-free, highly autonomous energy supply system based on wind generation and using energy flexibility resources such as thermal and electric storage, as well as hydrogen. The power system will be designed to supply consumers without the need for back-up diesel generators, even in a week's calm. This is made possible by the storage of energy in the hydrogen cycle. And the cost-effectiveness of such a complex system with hybrid generation, various energy storage systems, and a huge variety of load-controlled devices can only be achieved through Internet of Energy technologies. The Snezhinka station in the Yamalo-Nenets Autonomous District (YNAO) is scheduled to open in test mode in 2024. Following the results of the project, a new generation of industrial solutions can be prepared for powering infrastructure, industrial facilities and settlements in Arctic latitudes.

Oil and Gas Vertical: *What kind of requests are you receiving from the FEC market today? Judging by these requests, what tasks are being addressed in this segment?*

D. Kholkin: As we work in shaping new markets and business practices, we are approached by energy companies with active innovation policies, electricity consumers, energy equipment manufacturers, technology companies and property developers. We see interest in integrated solutions for the digital transformation of electricity distribution networks, the integration of energy storage systems, and the organisation of autonomous hybrid energy systems in remote and isolated areas. There is now a lot of interest in hydrogen technology in the hype wave, with participants in the FEC market and equipment manufacturers asking for estimates of economics and technical solutions for implementing hydrogen pilot projects and assessing markets for hydrogen energy equipment. In addition, in the near future, due to the tightening of regional global carbon policy, we expect an increased interest in solutions for industrial microgrids using renewables and requests for integrated solutions to reduce the carbon footprint.

Oil and Gas Vertical: *Is there a request from foreign companies for your Centre's technology? Which areas are in demand?*

D. Kholkin: Yes, we have interesting experiences with foreign customers and investors in Singapore, the United Arab Emirates, Luxembourg and Iraq. Communication with them reinforced our understanding that it makes more sense for Russian companies to enter foreign markets with integrated solutions, rather than individual technologies. In particular, there is a demand for solutions for transactional energy services, microgrids with distributed energy exchange management and flexibility, and digital upgrades of electricity distribution networks that provide increased security of energy supply to consumers without increasing the cost of ownership. There is an increasing demand for flexible customisation and easy scalability of such solutions.

Oil and Gas Vertical: *How do you estimate the volume of domestic technology exports?*

D. Kholkin: Back in 2015, we estimated the potential volume of exports of domestic technologies in the energy sector at $40 billion. Reaching such sales volumes is a very ambitious goal (for example, arms exports are $15 billion a year). But we have no intention of giving it up. The global new energy market is large and dynamic, and there is an opportunity for Russian companies to take a position there as well. At the same time, we understand that there are many obstacles for Russian companies to enter foreign markets. To work on removing some of these barriers, we are currently establishing an export office at the EnergyNet Infrastructure Centre.

Oil and Gas Vertical: *What is the ratio of developments in import-substitution projects to developments in ground-breaking technologies? How do you assess the competencies and potential of Russian developers in general? What will it take to ramp up the speed to achieve breakthrough technology outcomes?*

D. Kholkin: Several hundred technology companies have passed through us. 80% of them are involved in import-substitution projects. We work with the remaining 20% – those who have promising technological ideas and ambitions to enter foreign markets. This category of developers usually has a very good level of technical competence and a more or less acceptable level of entrepreneurial competence.

In order to achieve good results in the development and implementation of new technologies in the energy sector, modern knowledge-sharing practices are lacking. Many research centres and technology teams, conducting research and development in the same field, start from the same starting point, and try to build competencies independently of one another. However, with close and intensive communication among themselves and with investors and potential clients, results could be achieved much more quickly. The second challenge relates to the very limited capacity in the Russian energy sector to develop new business practices and thus to apply new technologies on a large scale. For this reason, many interesting developments that could find wide application in foreign markets do not leave the laboratories and testing grounds. As part of our centre's activities, we address these problems to some extent by holding professional conferences and project sessions, removing regulatory barriers to the development of new business practices, initiating complex pilot projects and forming consortia to implement them, helping these consortia find their first customers in Russia and abroad. But these are all one-off cases, and it takes much more efforts and resources to scale them up.

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ULF HEITMÜLLER: «RUSSIAN NATURAL GAS WILL CONTINUE TO PLAY A VERY IMPORTANT ROLE IN GERMANY»

Ulf Heitmüller, Chairman of the Management Board of VNG AG (Germany), spoke about the role of Russian natural gas in the European economy, the development of the hydrogen market, and the company's 2030+ strategy in an interview with Oil and Gas Vertical.

Oil and Gas Vertical: *How is Europe experiencing the energy price crisis that began in the fall of 2021, is it possible to hope for its ending? What does this crisis mean for your company?*

U. Heitmüller: Since last fall we have been experiencing a special situation that has actually never been seen before, especially with regard to the extreme price swings. At the moment, however, we are seeing a certain, but not fundamental, relaxation. In this special situation, VNG has succeeded in supplying municipal utilities, distributors, industrial customers and power plants with gas safely and reliably at all times. Our customers were able to continuously cover additional requirements.

Oil and Gas Vertical: *What conclusions were drawn following the results of this crisis at the level of companies, the German government and the EU, and are they correct, from your point of view?*

U. Heitmüller: In view of the current situation on the international gas markets, it has become clear to the public for the first time in a long time that security of supply cannot be taken for granted. Now we are realizing again that long-term contracts that bring secured quantities to Germany are very important. Especially since they are a safeguard against precisely those short-term extreme price swings that we experienced at the end of last year. As many delivery routes as possible, like Nord Stream 2 as an additional option, are also very important.

Oil and Gas Vertical: *What is the future of long-term gas contracts, will the attitude towards them become more loyal as a result of this crisis? Does VNG AG intend to conclude such a contract with Gazprom in the future?*

U. Heitmüller: The VNG subsidiary VNG Handel & Vertrieb GmbH draws on a diversified procurement portfolio. These include, in particular, flexible long-term contracts. Even and especially in times like these, long-term, trusting relationships that guarantee security of supply in Germany prove their worth.

VNG, together with Gazprom, has made a significant contribution to supply security over many years. We already import roundabout 10 billion cubic meters annually and are prepared to increase this further.

Oil and Gas Vertical: *How do you see the future of natural gas in Europe in the context of energy transition? How much does your vision as a gas business professional differ from the «generally accepted" or accepted at the state and EU level? Is there a possibility of convergence of positions?*

U. Heitmüller: The German government has recognized natural gas as indispensable for the transition to climate neutrality. This commitment is an important signal for our entire industry. Because natural gas secures the necessary expansion of renewable energies and is available regardless of the weather conditions. The opening balance of climate protection issued by the German Federal Ministry for Climate and Economic Affairs assesses the expansion of gas-fired power plants, which will also run on hydrogen in the future, as a central key to achieving these goals. That´s good and right.

Oil and Gas Vertical: *What do you expect from the new German government, how do you see the future of energy cooperation between Russia and Germany? What does this mean for your company? In your opinion, what should the governments of our countries do to ensure that this cooperation develops and is useful to citizens and the economy?*

U. Heitmüller: The new German government has clearly stated the importance and further development of the existing international energy partnerships. It is quite clear that we need the German-Russian energy partnership in order to achieve both the European and the ambitious German climate targets. VNG has been working together with Gazprom on a trustful basis for almost 50 years now, and we want to continue to open up new fields for an energy partnership with Russian energy companies in the future. Therefore, Russian natural gas will continue to play a very important role in Germany.

Oil and Gas Vertical: *The energy crisis, as well as the covid crisis, obviously affects the plans for energy transition, the achievement of carbon neutrality by Europe. To what extent, in your opinion, is it realistic and necessary to achieve neutrality by 2050? How are the goals of accelerated decarbonization matching with the goals of sustainable development, or is there some kind of contradiction?*

U. Heitmüller: With the amendment to the Climate Protection Act, the Federal Government has tightened the climate protection requirements and anchored the goal of greenhouse gas neutrality by 2045. By 2030, emissions are to be reduced by 65 percent compared to 1990. These goals are very ambitious, achieving them is certainly a challenge we face, but one that we are resolutely accepting. We can see that politicians have recognized that the energy transition will not succeed without natural gas and, above all, in a longer perspective without hydrogen. We really appreciate that. From my point of view, however, it is also important that the natural gas industry reduces methane emissions when providing natural gas and, in the future, also when producing blue and turquoise hydrogen. Because avoiding methane emissions along the gas supply chain is an important step for a climate-neutral future.

Oil and Gas Vertical: *What is VNG AG's ESG strategy? What do you think is the most difficult thing in its implementation? What factors will influence its implementation, and what can become a real brake?*

U. Heitmüller: For some time now, VNG has been dealing more and more intensively with the topic of sustainability. We see our mission in contributing a secure, affordable, and environmentally friendly energy supply now and in the future. On the one hand, this involves the further greening of our core product natural gas towards biogas and hydrogen.

On the other hand, the topic of sustainability has other important facets. Examples include the promotion and use of sustainable technologies, the company's own consumption of resources and the promotion of sustainable behavior by employees.

Oil and Gas Vertical: *Do you believe in the occurrence of a new hydrogen energy in the short term? What is the main difficulty – technologies, their complexity, their cost, bureaucratic factors? How is the company developing the hydrogen sector?*

U. Heitmüller: I am convinced that we need hydrogen to achieve the German and European climate goals by 2045. This requires increased development of a hydrogen infrastructure, an accelerated phase-up of low-carbon hydrogen, a fitting regulatory framework and the further development of existing and new in-

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ternational energy partnerships. Based on our core competence of gas, VNG is increasingly focusing on decarbonized gases with our "VNG 2030+" strategy. We are aiming for a firm place in the hydrogen market and see ourselves as part of the solution in the decarbonization of industry and society. VNG wants to identify and test these paths and bring them to large-scale market maturity. Which strategies will prevail depends not only on the technology, but above all on the aspects of economic viability and broad acceptance in politics, business and society.

Oil and Gas Vertical: *Do you think there is a future for hydrogen produced from natural gas, or only for «green»? What are the main reasons and does a purely political factor play a role here?*

U. Heitmüller: With our goals for the year 2030 – not only in Germany – in mind, we need to consider blue or turquoise hydrogen in addition to green hydrogen. Because the energy demand in the areas of industry, transport, heat and electricity will increase in the future and cannot be met with renewable energy from wind, sun and green hydrogen alone. Together with partners, we want to make an important contribution to providing the quantities of hydrogen needed to decarbonize our economy as quickly as possible.

Oil and Gas Vertical: *How important is international cooperation for the development of the hydrogen industry? How do you see such cooperation between Russia and Germany, for example? Is there any real movement in this direction?*

U. Heitmüller: Our aspired hydrogen projects require strong partnerships even across national borders. That is why VNG is working with various national and international partners from different stages of the hydrogen value chain to promote hydrogen and establish it as an integral part of the energy mix. Of course, Russia can play a key role here, because they have enormous resources in natural gas and renewables. I think it´s very positive that we notice a very strong push in hydrogen cooperation between the two countries and that the partnership with Russia is even highlighted in the German coalition agreement.

Oil and Gas Vertical: *VNG AG and Wintershall DEA recently announced a project for the production of turquoise hydrogen at a site in East Germany. The plant is to be commissioned in 2023 and has a nominal capacity of 400 kg of hydrogen per day. Do you already know the consumers and the sales price? How are you going to transport hydrogen to the place of consumption? Have the logistics costs been estimated already?*

U. Heitmüller: The plant will be one of the first of its kind to produce turquoise hydrogen in Germany. We are already speaking to potential buyers about the produced hydrogen as well as a possible location for the plant in eastern Germany. Unfortunately, we can't say anything more about the project at the moment.

Oil and Gas Vertical: *What is the reason for your intention to implement the "turquoise" hydrogen project in Germany? What is the outlook for natural gas in Europe? Including as a raw material for the production of hydrogen without direct CO2 emissions by pyrolysis and as a source of obtaining an important emission-neutral by-product – solid carbon? Where, in this case, should the production of "turquoise" hydrogen be concentrated – at the producer of natural gas or at the end consumer of hydrogen?*

U. Heitmüller: We are planning to implement the "turquoise hydrogen" project because low-carbon hydrogen can be a way of significant CO2 savings as a bridging technology, since not enough green hydrogen will be available by 2030. Today, there are already a variety of solutions that are technically functioning and can bring this future role to life. VNG will identify and test these paths and bring them to large-scale marketability. Which strategies will prevail depends not only on the technology, but above all on the aspects of economic viability and common acceptance in politics, business and society. We see also natural gas companies in a good starting position to produce turquoise hydrogen. We accept this role at VNG and with our high level of technical expertise we want to be part of a solution and position ourselves broadly in the hydrogen sector. To this end, the company is developing parallel projects for green, turquoise and blue hydrogen and is contributing its experience at almost all levels of the added value.

VYACHESLAV MISHCHENKO: «WE MUST BE INITIATORS, AND NOT TAKE THE POSITION OF OUTSIDERS»

Vyacheslav Mishchenko, Director of the Meteorological and Climate Center of the Fuel and Energy Complex of the Gubkin Russian State University of Oil and Gas, said in an interview with "Oil and Gas Vertical" about how Russia can form a national concept of energy transition in the framework of global climate discussions, as well as the role of educational institutions and scientific organizations in this process.

Oil and Gas Vertical: *You headed the Weather and Climate Center of the Fuel and Energy Complex. This is such an interesting symbiosis on the basis of two leading industry research centers: Gubkin University and Hydrometcenter of Russia. What are the tasks and goals of this structure?*

V. Mishchenko: First of all, these are research and educational activities. We need to support or refute the ideas that were voiced during the global discussions of the Climate Agenda, and try to land them on domestic basis. In order not to act within the framework of illusions that can be created by different political forces. We will do this to support government decisions and at the corporate level, so that Russian oil and gas companies feel comfortable in the process of accelerating energy transition.

And of course, one of the main tasks of the center is the training of personnel for our industry, taking into account the new realities.

At the international level, the topic of climate and emissions has been discussed for a long time. In 1997, the Kyoto Protocol was signed, according to which developed countries assumed obligations to reduce greenhouse gas emissions, and this protocol worked until 2020. This included energy-intensive projects, in particular in the steel industry, which included emissions in their investment projects. In Russia, this protocol was also actively used in the 2000s and 2010s, when the topic was relevant, as there was funding from international financial institutions.

The Kyoto Protocol (based on which, in my opinion, no serious and public conclusions were drawn) was replaced by the Paris Agreement. It was signed by 197 countries in December 2015. The fundamental difference from Kyoto is that developing countries have also joined the agreement. Russia is a consistent and active participant in both the Paris Agreement and the Kyoto Protocol. However, Russia did not ratify the Paris Agreement, but accepted it. This did not require changes in any legislative acts at the level of the Parliament. The entry into force of the Paris Agreement was formalized by the decision of the Prime Minister of the Russian Federation. It is important to emphasize here that only national legislation determines the functioning of the restrictions under the Paris Agreement. The meaning of the agreement itself is to keep the increase in the global average temperature by at least 2 °C until the end of the century compared to the pre-industrial era, and ideally to limit its growth to 1.5 °C. And since we have adopted the parameters of the Paris Agreement, we must begin to act. At the state level, this topic is being actively discussed, there are various platforms where legislative initiatives are voiced, and in the scientific community there is a need to combine research efforts in order to form an objective picture of what is happening, since the topic of global warming and climate in the current period is highly politicized.

In 2019, the so-called Green Deal was adopted at the EU level, where the European authorities announced certain obligations and legislatively fixed measures to reduce emissions. The agenda became multifaceted, it included both technological and environmental solutions, as well as tax, financial and social aspects. The European Union has committed itself to complete the energy transition by 2050 and completely move away from fossil fuels and switch to new energy sources – hydrogen, renewable energy, electricity as a replacement for internal combustion engines. By the 30th year, there should already be some intermediate results.

All this cannot but affect the Russian economy and the domestic oil and gas sector, since the European market is key for us in terms of hydrocarbon exports. Our oil and gas industry must be ready for all the changes and it must have an objective picture of the world. At the same time, our industry position should be supported by a research, scientific base, modeling of the international market in the new conditions and our positions on it. In this regard, the interests of Gubkin University and Roshydrometcenter coincided, we need to determine what function and fundamental position of Russia is on the green agenda. We must be the initiators of ideas and solutions, and not take the position of outsiders in the climate race.

We must clearly define what our national, economic and political interests are based on.

It is important to realize at all levels that today there is a complex and rather painful process of destruction of the global economic model that has developed over the past 30 years, and we live in a regional economy. This can also be seen from the sanctions policy that is applied to Russia and other subjects of world politics, trade and economic wars are being waged, which are expressed in the conduct of protective duties, various prohibitions and restrictions. We are building a model of a sovereign state with a strong diversified economy almost on the go. On the one hand, we cannot isolate ourselves and go behind the next political and economic «Iron Curtain», but we must already now think about how we will build our economic activity in the face of growing restrictions and conflicts. We need our own economic parameters, market indicators, development theories. It is risky to build a sovereign economy based only on the data of its global competitors.

Oil and Gas Vertical: *Is this model already looming? It is clear where to move today, what are the priority areas, what we need to specifically develop?*

V. Mishchenko: Russia's position was announced by Russian President Vladimir Putin at the G20 summit in Rome, which took place before Glasgow. We are ready to actively cooperate in all areas. The President announced the terms. What is important in this whole story is the timing of the implementation of the climate program. Russia has set a realistic deadline for itself – no later than 2060. We take another 10-year time lag for the commitments that united Europe has taken on. And we're talking carbon neutral. And Europe is talking about climate-neutral status. By 2050, their economies should be climate neutral.

For the next 40 years, we are ready to deal with these issues. It is possible to implement this strategy at the international level, but it is more practical to implement it within the framework of the national economy.

For example, if we are talking about the production of hydrogen as an energy raw material, then it is easier and more realistic for us to build a hydrogen infrastructure within the country. We will have to do this as part of the regionalization process, since no one is waiting for us with open arms in our key export markets (primarily in Europe). Of course, we can try to deliver our hydrogen somewhere, but what will happen to it next is not entirely clear. Within the framework of the national economy, we can build work on the inclusion of new energy sources – renewable energy sources in projects on Sakhalin, Kamchatka and other

regions of the country. This should be done gradually, experimentally and with a certain economic logic. It is necessary to take into account an important factor, and officials say this, that we are a country with a cold climate. We have a significant part of the territory located in the range of low temperatures, so energy for us is an important basis for human life. We cannot experiment by increasing risks, by destabilizing the energy system of a particular region. All these projects for the inclusion of renewable energy sources, hydrogen raw materials in the country's energy structure should be implemented in stages, without risk to industry and the population.

As I already mentioned, in 2019 the Green Deal was adopted in Europe, a certain image breakthrough was made, but the moment of security of energy supplies was missed. For the second year we have been observing an imbalance in the European direction. The cold winter, the lack of wind and solar resources, plus the shortage of natural gas reserves, which has not yet been compensated by anything, led to abnormally high price hikes that no one could even imagine two years ago – under $2,000 per thousand cubic meters! And this imbalance along the chain extends to the agricultural sector, which, by the way, consumes mineral fertilizers produced from gas. The next stage of the crisis is a sharp rise in the price of food, consumer goods, and so on. We must not allow such an experience.

Oil and Gas Vertical: *What can you say about the results of the Climate Summit in Glasgow? The agenda of the conference correlates with the directions of the Center and you probably followed the event.*

V. Mishchenko: The organizers of the Glasgow Summit (primarily the British authorities and the establishment) positioned this event as another important step, even a breakthrough, towards the implementation of the Paris Agreement. But when the results of the summit (November 14) became known, it became clear that no breakthrough had occurred.

Within the framework of deglobalization, with the emergence of new centers of power, Russia, China, and India are actively delineating their positions. These centers should build a dialogue among themselves. As long as the US and the Euro-Atlantic Partnership do not recognize the right of other powers to leadership and to their own interests, international cooperation will degrade. The first persons of Russia and China were not in Glasgow. And without Russia and China, this summit cannot be called successful. . However, in the Western media this event is presented as a great success. But the media is the media – and it is unlikely that the problem of global warming can be solved at the informational level alone.

What was finally adopted was a document on the reduction of methane emissions, which, together with greenhouse gas, affects global warming. More than 100 states have signed a declaration on the reduction of methane emissions by 30% by 2030. Russia and China did not sign this agreement. The struggle continues around coal as a fossil fuel, which should leave the countries' energy balances in the near future. The task of the summit organizers was to remove coal as a fuel in the horizon until 2030. But countries such as India, where the share of coal is about 40%, refused to follow this agenda, so the phrase "withdrawal completely" was replaced by "reduction". Western media present it as a victory. Vladimir Putin's proposal to reduce deforestation was not included in the final decisions of the summit as a Russian initiative. We own a large number of forests that absorb carbon dioxide, but this balance has not been taken into account. Nevertheless, there is a response to the initiative of the Russian president: in the final declaration of Glasgow, obligations were adopted to reduce deforestation and to develop the forest fund in many countries. But the summit participants did not formulate specific instructions on who does what and who does what.

One more aspect I would like to highlight – earlier, when signing the Paris Agreement, developed countries undertook to organize a climate fund at the UN, which would redistribute financial assistance to developing countries that could suffer from decarbonization processes. During the summit in Glasgow, representatives of developing countries noted that this fund does not work and money is allocated on a very modest scale. and practically do not participate in projects. In this regard, developing countries are accumulating negative experience on the climate agenda and undermining confidence in climate decisions.

And the difference in living standards should always be remembered when adopting climate initiatives. For example, while an ordinary European inhabitant can afford to plan on purchasing a still expensive electric car, an ordinary resident of Southeast Asia, Latin America or Africa is concerned about survival in conditions of hunger and cold. In order to carry out the energy transition without «climate genocide» of a certain part of the planet's population, large-scale funding for the energy transition is needed, which is currently not working. At the last summit in Glasgow, no one made commitments to developing countries, for which the climate agenda is more of a threat than a boon.

Oil and Gas Vertical: *Which position is more beneficial for Russia following the summit, on the climate agenda?*

V. Mishchenko: As far as the coal industry is concerned, of course, the adopted agreements are not beneficial for us. We have capital-intensive projects to expand the Baikal-Amur Railway and the Trans-Siberian Railway, a private-state partnership is being implemented to expand the capacity of the eastern ports, and the Eastern Polygon is being developed

And even if we assume that China will now "fall" as an export destination due to the climate agenda, since the Chinese leadership has committed itself to withdrawing coal-fired power plants and switching to gas, then India is becoming an attractive market for Russian coal producers and exporters. The coal industry must develop. We are second in terms of thermal coal reserves in the world, and we could well use new technologies in the extraction and transportation of coal, and switch to better technological processes. But removing coal from our energy balance for 10 years is wrong.

The same applies to reducing methane emissions. Russia needs to act based solely on its own interests. The time period for reducing emissions should also be longer than until 2030.

We must continue to fight for recognition of our position on the forest fund, since the partners in the Paris Agreement do not recognize Russia's key role as a carbon sink. In the developed methodology, which the members of the agreement are guided by, only cultivated forests are taken into account. If these are wild forests, then the country, as it were, has no direct relation to this, it's just that she was so lucky. This discriminates against

the position of our country and we need to promote new accounting parameters for this forest fund.

Oil and Gas Vertical: *On the eve of the new year, can you make forecasts on the climate agenda, the development of the fuel and energy complex?*

V. Mishchenko: No matter how we feel about Glasgow, this forum determines the global trend. And on the one hand, it is dangerous to be "in the tail", but there is no sense in "running ahead of the locomotive", that is, incurring any obligations that may be risky for the energy sector. The next year will be marked by an active reflection on the trends identified by the summit. We need to analyze all positions and find an industry and general economic consensus in order to identify our priorities. It is necessary to discuss new trends with the same coal companies in terms of their expectations, in terms of compliance with their investment program. By the middle of the year, it is desirable to have already decided on our position at the next climate summit.

Of course, I would like to emphasize once again that the climate agenda creates more and more risks for the oil and gas industry and the domestic oil and gas industry is still the main taxpayer in our country. . However, we see that the process of incorporating the carbon tax into the audit methodology has been launched and the Big Four have already begun to adapt their audit programs to the new climate parameters.

Another very important aspect is that we need to actively work with public opinion regarding global environmental processes. It is desirable that the climate agenda does not destabilize the situation in the country and in the regions, since the social factor plays a significant role in the implementation of climate initiatives. This is especially important for regions where coal and oil are mined.

Climate change is not some distant future – we are already feeling the detrimental effects of global warming in various regions. For example, the past summer season was indicative in this sense. At abnormally high temperatures, we observed a huge amount of precipitation in the southern regions, floods, and floods. This happened on the Black Sea coast of the Caucasus, in the Crimea. This is the echo of the process of global warming. If we assume that the temperature on the planet will increase by the next century within two degrees, then most likely the process will not run linearly, but along a sinusoid. Somewhere in the winter season will be accompanied by a sharp cold snap with snowfalls, in summer there may be abnormal heat with tornadoes and hurricanes.

In social terms, we must adapt ourselves to the fact that everything will change and the measures that states will take in the course of implementing the climate strategy will not always be popular.

Oil and Gas Vertical: *And what about the price environment? This year, prices for all energy carriers have risen in parallel, and for gas prices have risen as never before. What to expect next year? Are markets expecting price shocks?*

V. Mishchenko: We are at the beginning of the energy transition. In this sense, the destabilization of the global energy system is guaranteed. With the approach that we see in the Western community, energy crises are unlikely to be avoided. For example, last winter brought anomalous cold weather throughout the Northern Hemisphere, we remember well the pictures of freezing Texas. peace. In those countries where the climate agenda has prevailed over common sense, there is a high risk of the stability of the energy sector. Look at what is happening now in the countries of the European Union. For obvious reasons, no one in the EU leadership talks about the real causes of this crisis. That they miscalculated with the balance, that they created an artificial shortage of fuel, that pricing was completely transferred to exchange and spot mechanisms, which are subject to strong volatility and, accordingly, speculative attacks. wow. It is entirely possible that the beneficiaries of price hikes are speculators, and not real producers and suppliers of fuel. The speculative part of the markets is warmed up by the imbalance of supply and demand, as well as the lack of a sane and sustainable strategy in relations with resource suppliers. And while there are no prerequisites to believe that the European market will work differently. They will look for someone to blame, and now we have hydrocarbons and large suppliers of hydrocarbons to blame. First of all, Russia. Russia is accused of creating the current European gas crisis. Next year, the economic situation will also be affected by weather disasters and a pandemic. So far, it is impossible to assume the removal of all lockdowns. If the coronavirus infection does not recede, then quarantine measures will be tightened and the movement of goods and passengers will be limited. This of course will affect the amount of fuel consumption. Today, the supply of energy resources from key producers remains stable. For example, gas production can be increased, but whether Russia alone can cope with such surges in demand, I doubt. In the eastern direction for the supply of raw materials, we can consistently interact with such giants as China or India without political conjuncture, while in the European direction, we are still waiting for conflicts and crises.

Oil and Gas Vertical: *What about global warming? How can it affect Russia?*

V. Mishchenko: There are advantages for us. For example, ice-free Northern Sea Route (NSR) and year-round operation of this route. The NSR can become a powerful global driver of international trade, since the routes through the NSR to the Atlantic will be much shorter, cheaper, and this gives us a huge advantage, since this is an internal Russian route.

But at the same time, the precipitation map and temperature values will change. The southern regions of Russia can expect drought, in the middle lane more precipitation is predicted, which will affect our daily life. Seasonal patterns may change.

Oil and Gas Vertical: Will it flood some territories?

V. Mishchenko: An increase in the temperature on the planet by more than two degrees can lead to an increase in the level of the world ocean by four meters or more. The American president at the summit in Glasgow announced the main climate threat to the United States – the flooding of the ocean coast. American cities with a million inhabitants are located on the coast of the ocean and in the event of accelerated melting of glaciers, they will be under a serious threat of flooding in a few decades. Russia is a continental country and such a threat is not so real for us, but nevertheless, it is not correct and frivolous to think that global warming is not as dangerous for us as for other countries.

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ATOM VS WIND AND SUN

HOW DID NUCLEAR POWER PLANTS FALL VICTIM TO RENEWABLE ENERGY SOURCES, AND WHY DO THEY NOT RECEIVE THE STATUS OF A CARBON-FREE TYPE OF ELECTRICITY GENERATION

ALEXANDER FROLOV
Deputy Director, the National Energy Institute

The fate of nuclear energy in the European Union has turned out to be inextricably linked with renewable energy sources (RES). Nuclear power plants were closed in order to clear a market share for renewable energy, and at the same time they were used in statistics when it was profitable to show the growth dynamics of carbon-free energy. All the more ironic is the fact that heated debates have flared up in the EU today about the possibility of granting nuclear generation the official status of a carbon-free type of energy. The disputants are not interested in the environmental side of the issue, they are fighting for financial flows.

Smooth on paper

In the late 2000s, the European Union began to actively reform its energy market. The reforms were supposed to solve multiple problems: simplify market access for suppliers, facilitate competition between them, eliminate the very possibility of monopolization, increase the reliability of supplies, strengthen the energy security of the region and reduce dependence on energy imports. Among the promises that were distributed to citizens, there was also a reduction in prices. Looking ahead, we note that the last promise was not fulfilled, even if we take the averages of 2020, and not the record marks of the year 2021.

In a recent article "On the Way to the Eurasian Super Market" ("Oil and Gas Vertical" No. 17-18 – Ed.), we described how the reforms affected the European gas market and outlined why the current energy crisis has become, perhaps, more painful for Europe than for other regions of the world. And now it is worth considering in detail how generation on renewable energy sources (RES) developed in the European Union. And what types of generation had to be sacrificed to RES.

The bet on renewable energy sources made in the late 2000s seemed to Europe to be winning from two positions at once. The first, and it is also the most obvious, is savings on imported energy resources. And the second is an additional point of growth that could help the region get out of the crisis. The fact is that at the end of the first decade of the XXI century, the EU was the world leader in the production of equipment for wind and solar power plants. In 2010, Germany produced about 10% of all solar panels in the world.

Key decisions on the development of renewable energy generation were made by the European Union against the background of the terrible blow that the global financial crisis inflicted on the economy. Accordingly, the development of the domestic market of wind and solar generation had to provide European industrial enterprises with orders. And in the future, the EU could have revenues from equipment exports. But the bright idea began to fail in the early stages.

Ravines

One of the consequences of the financial crisis of 2007-2008 for Europe was the suspension of growth in demand for electricity. Moreover, by now the European Union and the UK consume less electricity than in 2010. If in 2010 the demand amounted to 3335 TWh, then in 2020 – 3064 TWh ("Electricity consumption in the European Union (+ UK), TWh"). Certainly, we can refer to the specific conditions of last year, but Europe has never been able to exceed or at least repeat the result of the end of the decade before last.

Moreover, the planned recovery in demand was interrupted first by the crisis in the hydrocarbon markets of 2014-2016, then by the collapse in oil prices at the end of 2018. We do not insist on the existence of a causal relationship here. We only note chronological patterns. For us, in this case, it is important to note the following: the rapid development of renewable energy began in conditions when the market volume did not increase, but at best remained the same.

Also, do not overlook the "golden age of gas". Thanks to this concept, multibillion-dollar injections were sent to the newest gas power plants. The growth of installed capacity of gas power plants in Europe in the period from 2000 to 2015 amounted, according to WindEurope (formerly The European Wind Energy Association), to over 122.5 GW. Moreover, the level of electricity consumption in the European Union and the UK, according to Ember, in 2000 was 2,997 TWh. That is, a little less than at the moment.

Yes, since then, the "fuel oil" component has almost halved (from 246 TWh in 2000 to 164 TWh in 2010 and 118 TWh in 2020). But still it was not enough to create a sufficient market niche for renewable energy. Especially in conditions when it was supported by a newly commissioned gas generation.

In order to provide renewable sources with the most favorable conditions for development, RES were given priority access to the networks. This meant that as soon as electricity was produced at a wind or solar power plant, someone from the traditional generation had to "move". Due to technological features, gas power plants were "moving" first of all. Thus, the issue of competition with gas was resolved, and the economy of gas generation deteriorated sharply.

And then the disaster at the Fukushima-1 nuclear power plant occurred in an extremely timely manner. The atom gave a powerful push to the sun.

Atom pushes the sun

The European Union has been giving preference to wind generation for many years. It has been steadily developing since the beginning of the century: from 22 TWh in 2000 to 150 TWh in 2010 and a record 470 TWh in 2020. But solar power plants have long been an extremely unattractive object for investment. In 2010, the sun provided only 23 TWh. The volume of annual commissioning of photovoltaics exceeded 1 GW only in 2007.

According to SolarPower Europe (former European Photovoltaic Industry Association), while 5.8 GW of solar capacity was commissioned in 2009, 13.65 GW was commissioned in 2010. And in 2011, just against the backdrop of Fukushima, the input volume jumped to 22.26 GW (according to WindEurope, 21 GW). After 2011, the volume of new installations began to decrease – to 6.9 GW in 2016, according to the International Energy Agency (IEA). The decline was not

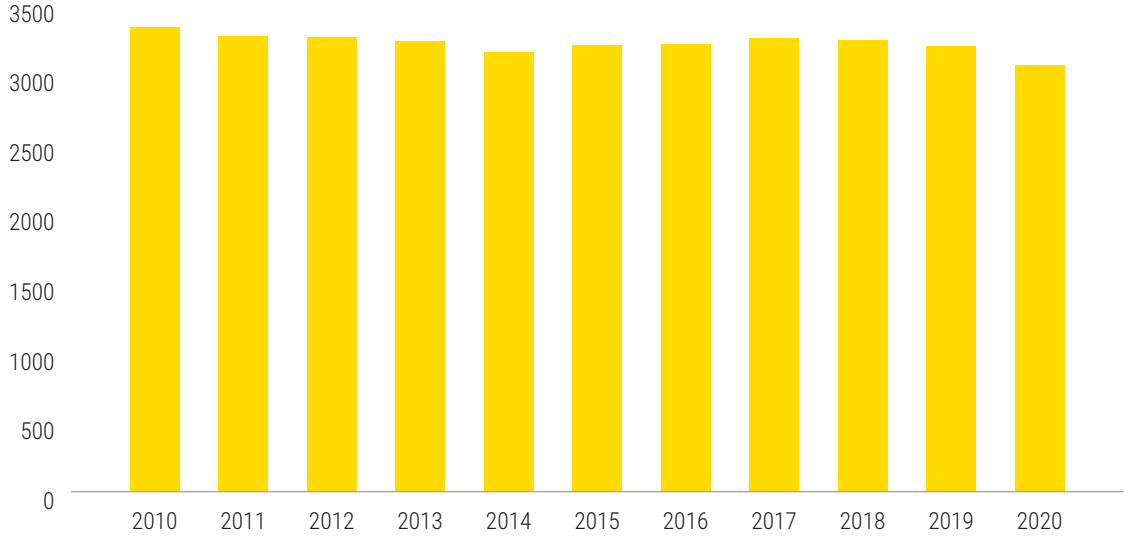
final: in 2019, the volume of commissioning increased again – to 17.2 GW, and in 2020 it amounted to 16.5 GW.

The installed capacity of onshore wind generation over the same period of time varied with much smaller fluctuations (about 10-12 GW). The most dramatic changes in the wind segment were associated with coastal generation.

But let's go back to Fukushima-1. The accident in Japan caused anti-atomic hysteria in Europe. The strongest disturbances affected Germany. Literally during 2011-2012, this country reduced the installed capacity of its nuclear power plants from 20.43 GW to 12.07 GW. To date, this indicator has decreased to 10.8 GW.

As for the volume of production, in 2010 atom provided 133 TWh of electricity in Germany, in 2012 – 94 TWh, in 2019 – 71 TWh, and in 2020 – 61 TWh at all.

Electricity consumption in the European Union (+ UK), TWh



According to Eurostat, Agora Energiewende, Ember

In a certain sense, nuclear power plants were the most profitable "victim" for renewable energy due to the high coefficient of installed capacity utilization. At nuclear power plants, this figure is traditionally more than 80%, wind power plants – up to 25%, and solar – up to 15%. Thus, by removing one atomic GW, a market niche was cleared for about 2.5 wind or 5 solar GW. Of course, in this case we are talking about some conditionality, since we do not take into account the reliability and stability of electricity supplies during the transition from atom to RES.

Not all European countries have followed in the footsteps of Germany. Some states, on the contrary, intend to develop nuclear energy. This is not only France, where atom, according to Agora Energiewende and Ember, occupies 67% of electricity generation. Hungary and the Czech Republic also associate their future with nuclear power plants.

However, there are countries that intend to completely abandon nuclear power plants: These are Germany (in 2022), Belgium (2025), and Spain (2030). At the same time, in Belgium, as of 2020, nuclear power plants occupy 39% of electricity generation, and in Spain – 22%. In the European Union as a whole, this indicator reaches 25%.

Victims on both sides

But not only nuclear power plants have fallen victims for a "green" future. European manufacturers of solar panels have not coped with the number of orders that have suddenly flooded them since 2011. Quite suddenly it turned out that to a large extent the raw materials and components for solar panels are manufactured in China.

Chinese manufacturers have reasoned sensibly: why should they send raw materials and components to the EU, if it is possible to manufacture a photovoltaic panel in China, and send finished products to Europe. Chinese products turned out to be no worse in quality than European ones, and more profitable in price.

European equipment manufacturers have started to go bankrupt en masse. And those who did not go bankrupt were forced to move production sites to China. A series of bankruptcies began in December 2011, at the peak of the development of solar generation in the EU. Within a few months, large companies such as Solon, Solar Millennium, Solarhybrid, Q-Cells (in 2010, the turnover of this company was 1.3 billion euros, for a long time the company controlled up to 40% of the global solar cell market) went into financial oblivion. By 2013 80% of the European solar market was occupied by Chinese companies. The European Union imposed a protective duty on the import of solar panels from China, which had to be abolished after a few years. By a strange coincidence, the cancellation of the duty actually coincided with the resumption of the growth of solar capacity installations.

If the blades and masts for wind turbines would be as convenient to transport by sea as solar panels, then European manufacturers of equipment for wind farms would have hard times. But the market in this segment did not overheat, and logistics turned out to be on the side of the Europeans.

A boxer with his hands tied

At the end of 2020, many victorious statements were made regarding the future of renewable energy in Europe and the world. Last year was characterized by a sharp decline in demand for oil, gas and coal. At the same time, the share of renewable energy sources in European electricity generation has increased dramatically.

14.7 GW of new wind farms have been commissioned in the EU and the UK. According to WindEurope, this is 6% less than the same indicator in 2019. Surprisingly, contrary to usual, the record-breaker was not Germany (1.65 GW), but Netherlands (1.98 GW). Apparently, Netherlands is thus preparing for the decommissioning of the Groningen gas field. By the way, Germany

set an anti-record last year: a total of 219 MW of new offshore wind farms. This is the minimum value for the last ten years.

According to Agora Energiewende, wind power plants in Europe have increased electricity production by 9%, and solar – by 15%. Together, they occupied about 20% of the total generation volume. If we add other types of renewable energy sources, then RES took 38% of European electricity generation by the end of last year. And in Germany, which has the most impressive volumes of renewable energy power plants, renewable provided 50.9% of electricity production (27% – wind, and the sun – 10.5%).

At the same time, production at European coal power plants decreased by 20%. And if we count from 2015, then this indicator has halved. Gas power plants also could not resist the impact of the pandemic, reducing production by 4%.

Nuclear generation demonstrated greater stability than coal, but less than gas – the drop was 10%. But in this case, the problems were different than those of fossil fuels. The reduction of the contribution of nuclear power plants to the electric basket of the European Union is due to the closure of capacities in Germany and Sweden, as well as the suspension of a number of units in France and Belgium.

To all these relative values, it is worth adding another one – 4%. This is how much the demand for electricity in Europe has decreased in 2020. In combination with the priority access to the networks that RES have, traditional generation had no chance to maintain its pre-tandem positions. In fact, it's like boxing, when one of the opponents has his hands tied. The installed capacity of solar and wind power plants increased, the wind was blowing steadily strongly, the sun was shining within normal limits – naturally, the production of electricity from renewable energy sources grew. And in the conditions of a shrinking market, the share of renewable resources increased at a faster pace.

These reasons for the success of renewable energy have not become a hindrance to bravura forecasts. For example, according to BNEF, emissions from burning fossil fuels passed their peak in 2019 and will never return to the same levels. In 2021, the "build-up of ultracompetitive wind and solar energy", the spread of electric vehicles, as well as the growth of emissions energy efficiency in various industries were supposed to protect against increasing in emissions. As practice has shown, this forecast turned out to be erroneous.

Atom is carbon-free

In 2021, renewable generation was let down by the weather. The state of Texas, a number of Asian countries and the European Union experienced difficulties. A prime example is Germany. If in January 2020 in this country wind and solar power plants produced 16.18 TWh and 1.23 TWh of electricity, respectively, then in January 2021 the wind provided 11.68 TWh, and the sun – 0.69 TWh. At the same time, gas-fired power plants generated 7.73 TWh, that is, 1.9 TWh more than in January 2020. Electricity production from coal also jumped (12.79 TWh in January 2020 and 15.5 TWh in 2021).

In February, the situation was repeated. The sun and wind produced 2.24 TWh and 11.31 TWh against last year's 1.88 TWh and 20.56 TWh, respectively. And gas and coal – 6.87 TWh and 11.5 TWh against 4.37 TWh and 7.64 TWh.

As gas prices rose, inter-fuel competition intensified – coal power plants regained positions that were previously lost. And the wind continued to blow weaker than a year earlier.

Agora Energiewende predicted an increase in emissions: by the end of 2021, greenhouse gas emissions in Germany will increase by 47 million tons compared to last year. This is a record annual increase since 1990. However, after such a monstrous increase, the level of emissions will still be 37% less than in 1990.

In parallel with this summer of 2021, a carbon tax (CBAM) was introduced in Europe. It is a special fee that is taken from certain categories of products imported into the European Union: metals, fertilizers, cement and electricity. CBAM is both a way to replenish the budget and a protective mechanism against the transfer of production to other regions.Against this background, the long-standing disputes about the carbon-free nature of nuclear energy have intensified. In terms of physics, everything is extremely obvious: nuclear power plants do not burn non-renewable energy resources, they do not produce greenhouse gas emissions (except for water vapor from cooling towers). But from a legal point of view, everything is not so clear.

Recognition of nuclear power plants as carbon-free will entail a redistribution of financial flows. First, investments in the atom will increase. And then there is the prospect of a rapid takeover of the European market by Rosatom. Secondly, the volume of those carbon taxes will be completely different. It is not surprising that France (and a number of EU member states) are fighting for the carbon-free status of nuclear power plants. Again, it is not surprising that there are appeals to the German leadership with requests not to close German nuclear power plants.

Russia has its own quite obvious interest in this dispute. The share of wind and solar power plants in our country is about 1.1-1.5%, and the share of nuclear power plants is 12%. If we add hydroelectric power plants here, it turns out that carbon-free generation occupies 33.4% of the installed capacity. And this simplifies the work of domestic manufacturers on the European market in the conditions of the current CBAM.

But why don't Europeans listen to the voice of reason and don't give nuclear power plants the status of carbon-free generation? After all, a few years ago, when it was necessary to show how the share of power plants operating on fossil fuels was decreasing, atom also contributed statistics along with RES. In our deep conviction, the matter is in financial flows again.

Today, the respected analytical organizations declare with one voice that the volume of investments in solar and wind power plants is insufficient. Some of them insist that the annual commissioning should be increased fourfold by 2030. And someone thinks that this indicator should triple. In any case, in order to achieve the goals of the European Green Deal by 2030, investments should also grow proportionally. If nuclear power plants are recognized as carbon-free, then they will start investing money in them. Moreover, Russia will receive a significant part of these investments. But at the same time, it is necessary to take into account the interests of such countries as France.

Assuming, the prospects for a controversial battle between renewable energy and the atom today look more than vague. But in the current situation, Russia should act as a united front with the France for the recognition of nuclear power plants as a carbon-free type of electricity generation.

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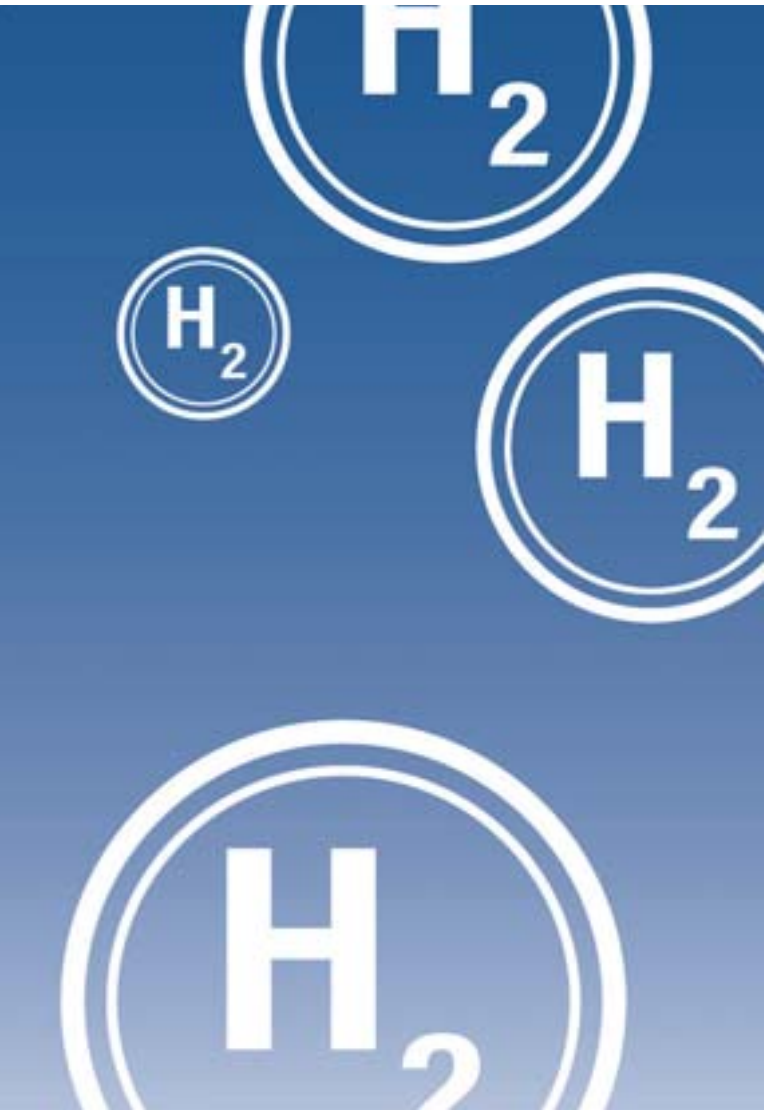
HYDROGEN MARKET INFRASTRUCTURE: THE TRUTH IS SOMEWHERE NEARBY

IGOR RODICHKIN
Expert of the National LNG Association

VLADISLAV KARASEVICH
Associate Professor of the Basic Department of Renewable Energy of the Russian State University of Oil and Gas I.M. Gubkin

The parameters of hydrogen production and transportation are like derivatives of an equation that needs not only to be solved, but also correctly compiled. Which members of the task are needed, to get a result that is beneficial for Russia? We have to find it out. But the rough outline of the task and its solution has already been made and justified.



Hydrogen market conditions. "Pumping" potentials

The Paris Climate Agreement and the subsequent acts to decarbonize the economies of the EU may lead to requirement changes for the production of hydrogen and hydrogen-containing products consumed in the EU countries (fertilizers, ammonia, methanol).

Partial or complete rejection of "gray" (obtained with greenhouse gas emissions) hydrogen will lead to a significant reduction in natural gas consumption, and planned cross-border carbon duties on hydrogen-containing products in the EU can significantly complicate the position of hydrogen-containing products exporters.

For hydrogen-containing products, we can talk about the export of more than 1 million tons of hydrogen from Russia. It is important to note that such hydrogen is produced and consumed in the domestic market too. The strategic documents adopted in the country set the task of exporting from 2 to 12 million tons of hydrogen per year by 2035 (excluding the volume of exports of hydrogen-containing products), which is unlikely to solve without the use of a new gas transportation infrastructure adapted for hydrogen pumping.

Along with the task of preservation and increase of current volumes of export energy revenues, an important factor is the creation of production, logistics and utilization domestic technologies, competencies and equipment for new energy products.

Possible ways of hydrogen exporting. Brief description of the technologies under consideration

Steam reforming of methane:

$$CH_4 + 2H_2O = CO_2 + 4H_2,\ \Delta H = 165\ kJ/mol.$$

This technology has a high yield of hydrogen (since hydrogen is contained in both methane and water). However, carbon dioxide is one of this process results, which, in order to obtain low-carbon blue hydrogen, must be captured and used or buried. The cost of 1 kg of hydrogen with 90% carbon dioxide capture estimated at €1.0-2.2 [2].

Methane pyrolysis technology:

$$CH_4 = C + 2H_2,\ \Delta H = 74{,}8\ kJ/mol.$$

Unlike steam reforming, pyrolysis technology allows carbon and hydrogen separation without carbon dioxide emission. The hydrogen produced in this reaction is called turquoise. The cost of 1 kg of hydrogen with carbon capture estimated at €1.4-1.8 [2].

The technology of pumping methane-hydrogen mixtures (MHM) described in the October'21 issue of the national industry energy magazine Oil and Gas Vertical [1]. This requires hydrogen produced in Russia by pyrolysis or reforming. The production of hydrogen by electrolysis was not considered due to its high cost and therefore futility for export now.

Cost and carbon footprint

Data from [2] and [3] were used to estimate costs and carbon footprint.

It is assumed as initial data for calculation that 95% of methane and 5% of hydrogen are volumetric in MHM. This was proposed by us earlier [1] and coincides with the proposals of the European Commission of 12/15/2021 [4], based on the results of consultations with communities, including European gas distribution organizations [5]. Calculations for the parameters of the GPA-32 Ladoga with a 400-21-1C supercharger at the Slavyanskaya main compressor station showed that when replacing 5% of the methane volume with hydrogen, the total power consumption will rise by 1.8%, and the required power for pumping the hydrogen fraction is higher than for methane by 35% for equal volumes.

The cost of natural gas pumping is adopted similarly to for North Stream, according to the report of PJSC Gazprom [6].

To calculate the carbon footprint and production costs, a mix of 50/50% of SPP+WPP electricity was adopted [7]. This allows, without prejudice to the calculations, the replacement of such sources with a minimum carbon footprint with electricity from the nearby Leningrad and Kola NPPs under direct supply contracts, issues can arise only in the acceptability of NPP energy for the German side.

Thus, it is possible to estimate the cost of hydrogen on the German side, both when transporting it in the MHM from Russia, and when producing blue or turquoise hydrogen in Germany from natural gas obtained from Russia.

The results of the calculations show:

1) The cost of low-carbon hydrogen producing from methane using the technologies of steam reforming and pyrolysis in molten metal (the least expensive pyrolysis technology for today) is approximately the same and amounts to 1.8 Euro/kg (150 RR/kg) on Russian side. On Germany side, it is 1.96-2.02 Euro/kg (depending on the method and place of its production), and the difference of 3% is so insignificant that it can be considered that it does not exist, against the background of the spread + -15-55% between the boundary values of cost of hydrogen production using pyrolysis and steam reforming technologies.
2) Performances of steam reforming and pyrolysis in molten metal technologies also are approximately the same and amounts to 1.6-1.7 cubic meters of hydrogen from 1 cubic meter of methane (steam reforming has more).
3) When producing hydrogen on the Russian side, more hydrogen will be produced from a cubic meter of methane than it is possible to pump it into the Russia-Germany gas pipeline, the remainder (approximately 40%) can and must be used on the Russian market in the North-Western Federal District.

Hydrogen as an incentive for the development and export of domestic technologies

Despite of the fact that the option of hydrogen production in Russia, at first glance, is economically less attractive than the option of producing it near a foreign consumer, this option, in our opinion, is more interesting for Russia, since its implementation is not about the banal export of raw materials, but about the creation and further export of new proprietary technologies. In this case, joint production of hydrogen with foreign anchor consumers is possible, as well as a mutually beneficial exchange of experience with them in the sectors of developing means of transportation and consumption of hydrogen.

Exceptions to the rules

As shown in [1], pipeline transport today is the most powerful and economical way to transfer hydrogen both in pure form and in the MHM. The energy capacity of the gas pipeline for hydrogen is only 30% lower than for methane.

Not all gas pipelines are adapted for pumping MHM and even more for pure hydrogen. Volatility and penetrating power of hydrogen, which are many times greater than that of natural gas, make it practically impossible, in our opinion, to transport it through the Unified Gas Transportation System of Russia.

But there are the pipelines that are capable of MHM pumping in this System. This is Nord Stream and, in the future, Nord Stream 2. Solid welded pipeline from coast to coast with a length of more than 1200 km, internal roughness of 0.005 mm versus 0.03 mm for onshore ones, large wall thickness of 35-41 mm versus conventional 10-20 mm and even against the wall thickness of high-pressure gas cylinders (including for hydrogen) of 10-24 mm. All of the above parameters allow us to assert that these two most modern gas pipelines can be considered as potential channels for pumping MHM with a content of up to 10% (volumetric) hydrogen, which is allowed by regulations in Germany and the Netherlands, and in Russia too.

Creation of a hydrogen cluster in the North-Western Federal District

The development of hydrogen production will initiate the hydrogen cluster creation in the Northwestern Federal District, and other technologies should be developed in it in addition to production: storage and use of hydrogen in transport, manufacturing, housing and communal services, construction.

The organization of such production together with potential consumers of hydrogen from Germany and the Netherlands will allow entering to the markets of cheap capital and most modern technologies. In the case of hydrogen production on the Russian side, there will be a multiplication of production capacity. The surplus value of production and tax deduction will remain in Russia. This is a part, but the most important part, of the advantages of hydrogen production on the Russian side. What are the disadvantages of this option as opposed to the production of hydrogen on the German side?

The main drawback is that not all the hydrogen produced in this way will go to Germany, and, therefore, it will not be sold there. However, the left of produced hydrogen should not be considered only as a loss for export, but also as a contribution to the development of technologies for the production, storage, transport and consumption of hydrogen within Russia, according to the Concept of the Development of Hydrogen Energy in the Russian Federation.

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A LUCKY FORCE MAJEURE FOR COAL INDUSTRY

ANASTASIA SHISHKALOVA
Oil and Gas Vertical

We will remember 2021 not only for the furious rally in natural gas prices in Europe but also for the «second coming» of coal – when countries, which sought to quit up coal, had to increase their coal generation at the expense of their climatic goals. It appeared to be not too easy to give up this fossil fuel. Or maybe it was too soon?

For the past decades the world was preparing for the coal's farewell – there was no place left for it in the bright low-carbon future. All developed countries had an ambitious plan to shift away from one of the world's main polluters. Now there are three countries in Europe which have completely excited coal – Austria, Belgium and Sweden. Portugal is going to close its last coal-fired power plant in December 2021. France and Slovakia decided to stop using coal by 2023, Ireland and Italy – by 2025. Finland and the Netherlands plan to become coal-free by 2029, Denmark and Hungary – by 2030. Germany goals at closing its last coal-fired power plant by 2038. Only Poland is not in a hurry – it currently generates up to 70% of its electricity from coal and plans to give it up only by 2049.

Everything seemed to be going to plan. According to the energy think tanks Ember and Agora Energiewende, in 2020 the share of renewables in power generation in Europe (38%) for the first time exceeded the share of fossil fuels (37%). Coal-fired generation decreased by 20% compared to 2019 and totaled only 13%. Of course, there was the COVID-19 impact but the trend was still «correct». However, in 2021 something went wrong.

Coal speeds up

It's not a secret that the coal's main counterpart in power generation is gas. Gas prices, which shrank in 2020, started to grow up in 2021. First they were boosted by the cold winter of 2020-2021, when demand increased and underground gas storage facilities was rapidly emptying, then – by the hot summer that led to an increase of the electricity consumption. At the same time the wind power generation declined because of the windless weather in the North Sea what led to gas demand growth as well. For example, in June 2021 power generation of wind farms in Germany fell by almost 31% compared to the same period in 2020, in July – by 15%. As a result, by June 14 gas prices (at the NCG hub) reached $363 per thousand cubic meters, which was the highest price in three years.

There was also an «Asian factor» which complicated the situation. The post-pandemic economic growth in the Asia-Pacific region – first of all, in China – boosted the LNG demand what led to an increase of its prices. As a result, the most part of the LNG cargoes went to Asia while Europe faced the deficit.

During the summer gas prices were growing, gradually speeding up. At the same time Europeans were nor seeking to fill their underground gas storages (they were afraid of loosing money because of the high prices). By September 17 the European UGS were filled just to 71% (in 2020 this figure was 93,6%, while in 2019 it was 95,1%). By that time gas prices had already risen above $800 per thousand cubic meters.

There was one more destabilizing factor for the European gas market. On September 13 it came that certification of the Nord Stream-2 pipeline may take longer than expected – the German regulator has time till January 2022. This hurt the chances of receiving additional volumes of gas, which could provide the Nord Stream 2, during for the current heating season.

Futures rally on the European gas market was going on – almost every day gas prices hit the records and on October 6 almost reached $2000 per thousand cubic meters.

Such a situation made Europeans turn to coal. For the energy companies it appeared to be easier to pay a carbon tax than to buy extremely expensive gas. Climate ambitions took the second place in that case. According to Ember, in the first seven months of 2021, coal generation in Germany rose by almost 7 p.p. over the same period last year to 26,1%. In September, it rose from 30,6% to 37,1%. The UK, whose energy companies started went bust, even launched the old mothballed West Burton A coal-fired thermal power plant. According to Argus, at the beginning of October total electricity generation from coal in Germany, Spain, the UK and France was about 7 million MWh – a 35% increase from a pervious year.

The growth in demand pushed up coal prices which on October 5 climbed above $300 per tonne (cif Amsterdam-Rotterdam-Antwerp). There was the Eastern influence as well: as in the case with gas, Europe had to compete for coal export flows with Asia, first of all with China. Energy sector of the country depends a lot on coal (it generates more than 60% of its electricity). Due to some factors such as tougher national environmental standards, disruptions in coal supplies because of the anti-COVID-19 measures, reduced supplies from Australia because of the political discords between the two countries and the decline of the hydropower generation led to the coal prices growth. As a result, in some Chinese provinces power supply was limited, which led to a decline in production in a number of energy intensive industries, such as cement, steel and aluminum production. To overcome the crisis the Chinese government started to ramp up coal production and imports.

«The East is jammed, there's no way to get through Ust-Luga»

The situation could be profitable for Russia which is one of the major producers and exporters of coal. However, if we look at the figures, we see that the growth of exports is not so significant. According to the Institute of Natural Monopolies Research (IPEM), in the first ten months of 2021 coal export increased by 9,5% year on year (but we should remember about the pandemic decline in 2020), and by 2,5% compared to 2019.

According to Refinitiv senior analyst Alexey Yarkovoy, the main obstacle to a significant increase in Russia's coal exports is logistics: the country just does not have any capacity for a crucial buildup of supplies. All export flows from Russia to Asia go by two railroads – Baikal-Amur Mainline and TransSiberian Railway – both of them are overloaded.

«If ports are able to accept large amounts of cargo, these transport highways cannot carry more cargoes, they are just jammed. Traders say that it's impossible to get into these transport lines», – said Yarkovoy.

The main Western transport hub Ust-Luga is also completely busy because of the lack of the cars (which are used for the inner supplies). And those private transport companies, which have their own trains, raise prices to such a level that it becomes a disaster.

«The East is jammed, there's no way to get through Ust-Luga...As logistical problems remain, Russia cannot significantly increase coal exports», – the expert concluded.

The question of increasing the capacity of ports and railways naturally arises. Private investors are wary of investing in the construction of new highways (there are concerns about the coal industry future). Moreover, according to the IPEM, in spite of the fact that now prices on foreign markets are three times higher than in 2020, the owner of the railway infrastructure and carries gains nothing.

«The cost of transporting coal for export doesn't cover the full cost of transportation, taking into account the need for return of investments to expand infrastructure for coal transportation. Probably, the more coal will be transported for export, the more cross-subsidization between cargo classes will be necessary», – said Vladimir Savchuk, deputy general director of IPEM.

He points out that Russian Railways implements a large-scale infrastructure development program for the Far East, mainly focused on the transportation of coal for export. Due to its implementation, the total cargo transportation volume will increase to 180 million tonnes by 2024. Development projects on ports of the North-West and South of Russia are also on the way. However, it is important to understand that development of transport infrastructure and resolving of logistic problems is necessary not only for coal supplies, but also for other cargoes.

There is no alternative to coal yet

The described shift to coal is mostly considered like a short-term trend. China almost coped with the crisis, supply began to answer demand and prices started to fall. What would be next?

The G20 summit was held in late October 2021, the UN Climate Change Conference in Glasgow – in early November. Coal was on in the focus at both events. The G20 countries agreed to stop financing coal plants abroad. The Glasgow summit resulted in something more vague – «gradual reduction of coal use without emissions capture».

US Climate Envoy John Kerry made it clear that to quit coal right now is impossible. Australia, which accounts for 30% of the global coal market and generates about 80% of electricity from coal, stated that it was not going to phase out coal production. According to the Minister of Energy Angus Taylor, Australia plans to achieve carbon neutrality by 2050 without abandoning coal but using technology to capture and storage. China, which always follows its own way, set the goal to reach coal consumption peak by 2025 and then to reduce gradually its share in the country's energy balance. Meanwhile, China's economic growth boosts energy consumption and that supports coal attractiveness as cheap and reliable energy resource. The country doesn't reject the global rules of the climate game, but it prefers to act carefully. India is not in a hurry to give up coal (70% of its electricity is produced from coal), it plans to become carbon neutral only by 2070.

«There is no alternative to coal yet. There are no energy storages capable to accumulate renewable electricity...Coal energy is constant. There are storage facilities, there are power plants, coal is a reliable source of electricity. I truly believe that coal will remain as a source of power generation for a very long time. Even if we're eager to give up coal we will not be able to do it», – said Alexey Yarkovoy.

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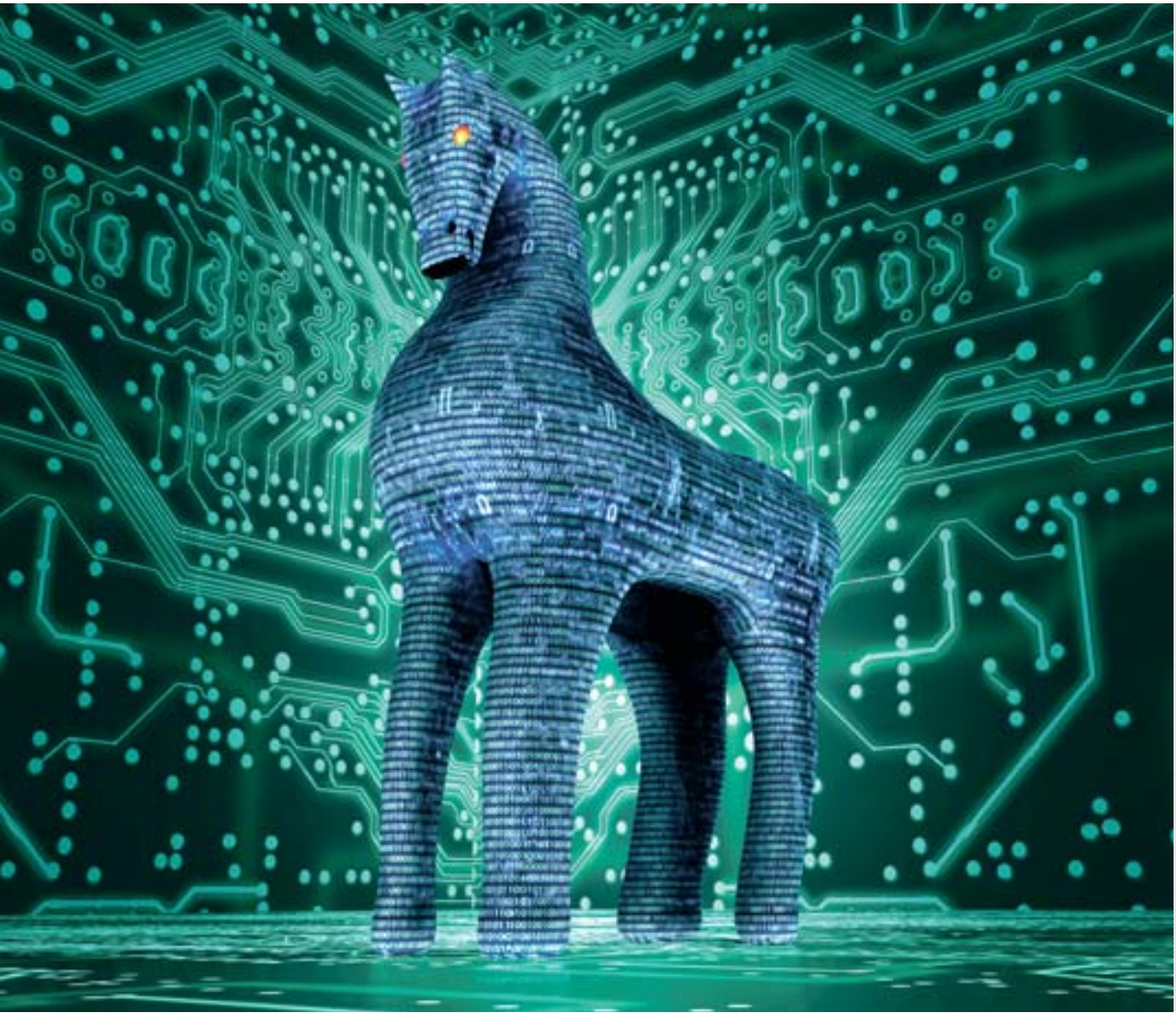

TROJAN HORSE IN CONCEPT SPACE

ULYANA OLKHOVSKAYA
Oil and Gas Vertical

The indicator of state security is several conceptual factors. One of them is the involvement of domestic intellectual businesses in national projects and economic chains. When the process takes place in the format «in spite of» and «through thorns», this is an unconditional plus in favor of domestic entrepreneurship, but questions remain for state regulation.

In August, Leonid Mikhelson spoke harshly about the fourth line of Yamal LNG: «We must admit that our manufacturing plants still have to learn and learn how to make good products. We have claims against all equipment suppliers», – said Leonid Mikhelson. First of all, these claims relate to manufacturers of compressors and turboexpanders. It would seem that we can immediately draw a conclusion that the quality of our hardware leaves much to be desired and mourn the results of import substitution and still unformed technological competencies. But everything is much more complicated. And the conclusions are not so clear cut.

To analyze how things really are with technologies in oil and gas and related fields, you can apply a fairly simple but effective formula. Identify global projects that are being built in the country by our companies and assess the involvement of domestic suppliers and technological solutions in them.

There seems to be a demand. Or still no

Let's take into consideration such projects as Yamal LNG, Novatek, ZabSibNeftekhim, Amur GCC, Sibur, and the gas-chemical project in Ust-Luga of the tandem of Gazprom and RusGazDobycha.

In principle, market experts fully agree with this selection. As for Novatek's projects, they definitely need to be discussed in conjunction with Yamal-LNG, Arktik-LNG 2 and TsSKMS. Domestic producers supplied products worth 600 billion rubles under the Yamal LNG project.

During the construction of TsSKMS facilities, according to Leonid Mikhelson, up to 90% of the scope of work was performed by domestic enterprises. Localization during the construction of gravity-type foundations (GBS) has reached 70%. It is known that more than 400 supplier companies work within the framework of the Arctic LNG-2 project.

The figures are quite impressive and even optimistic. Russian companies participating in a world-class project must, a priori, receive a quality seal on a product certificate. But the question arises – what is wrong with the equipment of the notorious fourth line?

«It's not bad, it's just made the first time. The second time it will be much better»,- says Alexander Gadetskiy, founder of Engineering & Consulting PFA Alexander Gadetskiy.

It is quite possible that the processes, roughly speaking, have not been worked out to automatism, because projects of this level are not done often, or the competitive environment played a role here, because it is known that there is a competition between Novatek and Rosatom for the energy consumer in the Arctic.

And the companies that assembled the fourth line are the «daughters» of the nuclear monopoly. One can only guess what really «went wrong», however, Novatek is going to fix the notorious line, replacing domestic equipment with import. But there are other examples of «inconsistencies» between large construction projects and domestic suppliers.

Here, for example, are the ZapSibNeftekhim and Amur GCC projects. In these plants, the amount of national business is minimal. "In ZapSibNeftekhim, the share of domestic technological equipment is zero, maybe 5%. On «The Amur», the situation is the same, well, maybe about 20%,»-comments Alexander Gadetsky.

To the question «why», he answers that it is connected with the mentality of the top managers of the company. «The reason for non-implementation is not that the manufacturers of domestic equipment are bad, but that the top managers of companies are opposed to Russian equipment,»- Gadetsky sums up. The column equipment at ZapSibNeftekhim and on the Amur was brought in Korea.

«Why?»,- the expert wonders, «after all, for example, at Tobolskneftekhim, the first gas fractionation column for 3 million tons per year was brought via the NSR from Leningrad». Yes, it was in 1984, when the state called the USSR ended. It turns out that in the mid-eighties, two such columns were brought to the Irtysh port, one was installed, and the other was left to lie in the port for a long 25 years. After that, the Sibur company in 2010 took this equipment from the port and erected it at the Tobolsk plant.

The second gas fractionation column, which had lain in extreme conditions for 25 years, began to work properly. It is clear that such a story demonstrates the quality of our hardware. Then the assumption logically arises that if today they prefer the import, then maybe the import is simply cheaper.

«Most likely it is»,- Gadetsky exclaims, -«but we either support our army or we don't. It's the same with the economy». The well-known futurologist and sociologist Sergei Pereslegin also speaks about this. He refers to the significant functions of the state as follows: protection of borders, protection of domestic and foreign markets – in terms of promoting their businesses, standards and regulations, an exploration of space and the ocean, development of own territory, creation of global projects, formation of development institutions. All these parameters create a conceptual space.

So, if national projects, especially those implemented on the state territory, are dominated by imported technologies, then this resembles the model of the same Trojan horse, which was described by the famous poet Homer. And this horse grazes in the so-called conceptual space of the state. Based on this association and the logic of discourse, the question arises of a flexible fiscal policy in relation to buyers of domestic equipment.

Perhaps something is missing in these institutions and the process needs to be stimulated somehow. Is the system of taxes and benefits thought out enough to integrate national business into current projects? Tax segment experts argue that the Russian tax system has a sufficient set of tools for effective tax incentives. This applies even more so to the oil industry, since, among other things, excise subsidies are actively used in it.

«But with respect to import substitution, there is another problem – the lack of agreed goals and understanding of what exactly is subject to state support», – says economist Boris Lucet.

So in June of this year, Minister of Industry and Trade Denis Manturov reported to the President of the Russian Federation on the reformatting of the import substitution program: «We are resuming the import substitution program, we want to switch to a new format. Before that, we put the main emphasis

on the production and import substitution of final products ... We will put the emphasis on the development of our own raw materials, materials and components.» Based on this message, the Government of the Russian Federation should instruct the Ministry of Finance to submit the appropriate follow-ups.

«We can talk about targeted measures, for example, adjusting the investment tax deduction for income tax, or reduced VAT rates when selling equipment or services/works as part of import substitution programs. We can also talk about an integrated approach – a good example here is the so-called tax maneuver in the IT industry. In any case, instructions on tax incentives for import substitution should be included in the overall plan of the Government's work in this direction», – suggests Borys Lutset.

In principle, the initiatives are good. Perhaps targets and tax solutions will be found.

Another interesting example and indicator of how the new format of the import substitution program will be implemented in practice is the gas chemical complex project in Ust-Luga. The Ministry of Finance of the Russian Federation intends to allocate 900 billion rubles from the National Welfare Fund for the implementation of this complex. Anton Siluanov, Minister of Finance of the Russian Federation, said that this money would be used to purchase imported equipment and would not «work» in Russia.

Approximately 10 billion euros will leave the country. This is about 30 percent of the total cost of the project, according to experts. Perhaps this is appropriate. Our sources cautiously assume that there is an expert opinion, where it is established that, nevertheless, without the purchase of certain imported items of equipment, the implementation of this project is impossible today. These are at least pyrolysis ovens and gas carriers for sea transportation. You read related news and find that about 100 local businesses are going to be involved in the construction. According to the idea, Ust-Luga was designed in Soviet times and «sharpened» for the equipment of the national industry.

So, there really are still chances to involve local businesses, especially since they decided to upgrade the import substitution process and turn towards the development of their own products, and, therefore, possibly standards.

«Another question is why should it be funded by the state? Moreover, in the conditions of an excellent price situation in the gas market, the company (Gazprom – ed.) has a good additional financial resource. Considering that the company pays the severance tax on gas in isolation from rising prices, it makes sense to return to the discussion of sources and, if not cancel, then at least reconsider the amount of state funding», – Boris Lutset believes.

Unicorns don't grow here

There are not so many global projects, but the country is big. Therefore, innovative manufacturing and technology companies need to look for markets. Not everyone can «get» into the pool of VIOC suppliers, this is a complicated matter. And not everything is so clear with the «entrance» even on the example of the listed projects.

For example, recently in the Murmansk region, Leonid Mikhelson announced that the fourth line of the Arctic LNG-2 would again be entrusted to domestic producers. «During the construction of the fourth line, domestic equipment will be used, which will be certified»,- Mikhelson said. Our business knows perfectly well what this procedure means.

Ten years ago, the situation unfolded as follows. Domestic technology companies developed and produced superproducts that were competitive in world markets. Usually the scheme was as follows: the intellectual part of the product was developed in Russia, and assembly production or testing sites were organized abroad. The range of technologies is quite wide: instrumentation, chemical and biological development, software.

«It is more difficult and expensive to certify in the Russian Federation, it is easier to make European certification – CE marking, which can be confirmed in Russia»,- businessmen said and opened companies abroad, where they produced products under a foreign brand. «It sells better that way»,- they explained. The world is happy to buy equipment made in Germany and Japan, but not Russian. A device made in Germany and a device made in Russia are two different devices. And not because they are fundamentally different in work, but because made in Germany can cost 15 thousand euros, and made in Russia is much cheaper.

After 10 years with certification in the country, practically nothing has changed.

«We need to develop our own quality standards and certification. Create domestic standards and certify the equipment that we will produce and potentially export. In fact, it is now in the hands of our Western partners, the same American Petroleum Institute API is just dealing with such issues – standards, certificates. And our equipment is not going to be certified, why do they need it? This is competition»,- says Vyacheslav Mishchenko, Director of the Weather and Climate Center for the Fuel and Energy Complex of the Russian State University of Oil and Gas named after I.M. Gubkin.

Yes, in the context of hybrid warfare and deglobalization, which is already being trumpeted from every iron today, our own standards and regulations and the provision of domestic products to the domestic market is considered a logical and reasonable strategy. But while the process slows down.

As far as software is concerned, ten years ago there was an interesting phenomenon.

The software export was not registered under any official parameters. Analysts explained it this way: «Official export-import statistics take into account data based on customs statistics, which mainly implies the physical movement of goods across the border. In the case of software export, the program code is transmitted over the Internet. Our customs is not yet able to physically record such operations.

Unrecorded software exports mean the development of program code on an outsource basis, offshore programming commissioned by foreign (primarily American) customers. We are talking about both writing ready-made IT products and lines of code for individual program modules. As a rule, payment is made to developers directly to personal accounts based on man-hours, lines of code, or by agreement for completed modules».

According to experts, the volume of the IT products export market from Novosibirsk alone (a powerful center for training programmers) in 2012 amounted to more than 100 million dollars a year. Such an assessment of the annual software export from Novosibirsk was based on an assessment of the number of programmers employed in this area and the average monthly income of programmers of outsourcing companies in Novosibirsk, experts specified [2].

But at that time, it was comfortable for IT companies to exist in Russia up to a certain stage, but in order to increase capitalization, it was necessary to «move» abroad because of the need to invest.

After 10 years, experts record a revival in demand for technology and software in the country, but note that scaling a business in their native country is also not an easy task. Becoming a «unicorn» (a start-up company with a market valuation of over $1 billion) is considered virtually fantastic in Russia.

«Today, it is practically impossible for a technologically innovative company to grow into a «unicorn» due to internal investments and the market. To a greater extent, it is precisely because of the small capacity of the Russian market that it will not allow it to become a «ruble unicorn», not to mention the billion dollar bar.

If the idea and technology is relevant and in demand by the consumer, then there is a chance to enter the international market with it and attract venture investors, and even then go to an IPO, but for this, you definitely need to register abroad»,- comments Roman Romanyuk, Chairman of the Board venture fund «Euroventure» (St. Petersburg holding «Euroinvest»).

As an example, the expert talks about the Yakut company inDriver, which created an international service for passenger and freight transportation. It was founded in 2013 in Yakutia, but was able to enter foreign markets and now operates in 35 countries. This fall, the founder of inDriver, Arsen Tomsky, said that the company's valuation was $1.23 billion and that these were investments from world investment funds of the first echelon. He also admitted that it was possible to do this only after his startup and he himself moved to Silicon Valley.

Today, the tax maneuver in the IT industry has activated the segment. This is stated by both officials and the business itself. The first package of measures came into force in 2021. It provides for the establishment for Russian companies of an income tax rate of 3% (in the part to be transferred to the federal budget) and zero – in the part to be transferred to the regional budgets. It also cuts the premium rate from 14% to 7.6%.

Since the adoption of the first package of measures to support the IT industry, the volume of exports of Russian software and services has increased by 13.5% and amounted to more than $5 billion, Deputy Prime Minister Dmitry Chernyshenko said.

«Tax incentives for Russian IT companies have given impetus to the revival of economic activity. The number of accredited domestic IT companies has increased by 3 thousand, at the moment there are almost 15 thousand of them, and the number of software products in the register of domestic software has almost doubled, up to 11 thousand», - the Deputy Prime Minister noted.

In addition, the gross value added of the IT industry grew by almost 20% to RUB 1.2 trillion.

There has been a revival in the IT industry. But the demand for domestic solutions in the domestic market is not particularly growing. «IT solutions are most in demand in those segments in which competition is strongest (trade, banking, transport and logistics, food production). The situation with industry is more complicated, especially where the share of state participation is large»,- notes Valentin Makarov, President of NP RUSSOFT.

It is also worth noting that if the demand for domestic software has appeared, it is not because programmers develop concepts for the level of automatic drilling and production of hydrocarbons on Mars, or calculate optimal bunkering models in the Arctic, but create solutions to optimize business processes.

«Against the backdrop of a slowdown in the fuel and energy complex market, companies associated with the production, processing, and transportation of oil and gas are beginning to optimize their budgets, including the costs associated with the implementation of digital solutions. Today, our large clients, including companies with state participation, purchase software primarily in order to increase the efficiency of their daily business tasks, which will ultimately have a positive impact on the economic performance of the entire company»,- notes Levan Revazishvili, Head of Business Development. sales company MyOffice.

As they say, feel the difference.

Anyway while the business scaling scheme, as well as its integration into global economic chains, is carried out mainly outside the borders of the native fatherland, demand is wider there and investments are not so problematic.

In the current energy transition, when sanctions and trade and political wars are methods of competition, attention to the domestic market and business should be special. Territorial, including energy planning, agreed goals will formulate demand. And a competent fiscal policy, investments, primarily in science and education (in the development and quality of ideas), and a reduction in bureaucratic growths will expand the horizons of supply. And then the Trojan horse will still turn into a unicorn.

https://globalgeography.org/attachments/Asia/United_Arab_Emirates/Pictures/Abu_Dhabi/Masdar_City_18006_-_Masdar_City_Masdar_City.jpg

THE CITY OF THE SUN IN THE STYLE OF CYBERPUNK

IVAN MISHIN
Oil and Gas Vertical

400 years after the publication of «The City of the Sun» by Tommaso Campanella, literally the city of the sun is being built in the UAE. Relying entirely on renewable energy, Masdar City attracts investors from all over the world as the center of the green renaissance of the post-pandemic world economy. What is behind of this extremely ambitious project of a smart city that only a few countries on Earth can afford? Is it an utopia or a reality?

A riddle from the new Jacques Fresco

Probably, the mankind has been dreaming of a perfectly well-maintained urban environment ever since a city was invented. But the first man, who described on paper the concept of a «smart» (in understanding of a Renaissance man) city, was Tommaso Campanella. In 1623 his work «The City of the Sun» was published. The philosopher described an urban environment that fully feature both cultural and social needs of a person. The harmony with the universe (planets and stars) and the development of science and technology were put in the basis of public welfare 400 years before the emergence of the concept of sustainable development. However, Jacques Fresco is still closer to us than Campanella.

Advanced users of the Internet and social networks (in the Russian segment, of course), for sure, have at least once met a meme with a fake riddle from Jacques Fresco. And here's an interesting thing, the paradox of the metamodern era! Laughing at this kind of memes, we do not even notice how we are starting to live more and more in that society, in that world, which is based on the ideas of this old gentleman.

Back in 1975, Jacques Fresco established the Sociocyber-engineering project, which in 1994 evolved into the Venus Project. It was Opus Magnum, the life's work of an American engineer and futurist. Since the Great Depression he had been plotting the idea of this project. Jacques Fresco sought to build a socio-economic system where automation and technology would be integrated into all public spheres to improve living standards. At the same time, reasonable, responsible consumption was put at the forefront to take care of the environment. It meant that the human existence was correlated with the bearing capacity of the Earth. Also an experimental city, which should implemented all these ideas, was planned to build. The Venus Project was to lead all mankind to sustainable development.

In 2017 Jacques Fresco died, having managed to gather a real army of followers around the world. Although they still believe in the Venus Project and invest money in it, the success and future of this enterprise is an open question. Moreover, the project is increasingly reminiscent of the cult of Fresco. Anyway, 10 years before the futurologist's death, Masdar City appears in the Arabian desert near Abu Dhabi, UAE.

In this smart city we can see a realization of all the same ideas, and above all, resource conservation coupled with energy self-sufficiency. The city will be fully provided with electricity from renewable sources. It is hard not to take advantage of the gift of nature, which get the Arabian Peninsula. Of course, we are talking about the sun and the insolation potential. For comparison, the closest star to Earth shines in Moscow for less than 1,700 hours a year, and the average annual insolation is 3.57 kWh per m^2. The duration of solar radiation in Masdar City is 3000-4000 hours per year, but the indicators of insolation on average per year are much more striking! It is approximately 2200 kWh/m^2! Therefore, the Arabian smart city is not just surrounded by fields of solar panels. Even lampposts there look like one solid solar battery. It is symbolic that all the electricity, used during the ceremony of laying the first stone of Masdar City, was generated by solar plants. But, as director of Masdar City Anthony Mallows told in 2016, the stone was virtual... It was laid by touching the screen.

Eastworld

The first renderers of Masdar City, published ten years ago, were striking in their futurism. They demonstrated the houses with solar panels, lying on the roof like tiles, lots of palm trees and neat shrubs a la French park, neon lights and happy people. It was no wonder, because Baron Norman Foster himself was responsible for the design of the city. The utopian picture was

complemented by statements by Anthony Mallows that Masdar City should independently collect rainwater and desalinate seawater, and city buildings had to be equipped with a complete waste recycling system. It was planned to move around the city only on electric self-driving cars. Although it would be more correct to call them railcars because they should ride, according to Mellows, on the magnetic rails. The picture is drawn like from some «Blade Runner», «Total Recall» or «Westworld». But those are dystopias. In Masdar City's project, of course, we can see also the style of cyberpunk, but it's still utopian and with a «twist», brought by an Arab flavor.

Does the stated picture correspond to reality? Here we should start with the fact that $22 billion was required for construction, however, the budget in the end the project amounted to $16 billion. The blame for this fact is the economic crisis, which began in 2008, exactly with the laying of the first stone of Masdar City. The deadlines for the construction of the city began to shift as a result. At first, it was planned to finish in 2015, later in the period 2020-2025, but then a pandemic came. Now the project is expected to be delivered no earlier than 2030.

The project began to be implemented for the state money of the UAE. The reports of the city's management company for the past years contain very modest financial results. The real volume of investments is unknown. But, according to Mellowes, since 2015 Masdar City has started earning itself and also returning money, invested from the state treasury. Moreover, self-sufficiency should be achieved by renting buildings. The International Renewable Energy Agency (IRENA) and the regional branch of Siemens have placed their headquarters in Masdar City, and 900 other firms from multinational companies, including even Lockheed Martin, to local startups have official representative offices in the city. However, in many cases these are not traditional offices, but simply rooms with hot desks, as admitted to The Guardian Chris Wan, the design manager of the Masdar City.

Now Masdar City is a half-empty settlement in the desert. The optimistic statements, given in 2016 by Anthony Mallows, that more than 11.5 thousand high-tech companies will be located here in a few years, did not come true. The same fate befell his words that 50 thousand people will live in Masdar City and the same number will come to work. Approximately 3 thousand people live in the city now. There are no unmanned magnetorail cars either, but you can leave your car in the parking lot at the entrance to the city and rent a scooter. Anyway, Masdar City as a reference model of green life is still a mirage. City managers have abandoned the idea of a city with a zero carbon footprint and energy self-sufficiency. Although Masdar's buildings are really very energy efficient and consume about 50% less electricity and water than conventional buildings in the UAE, the city consumes more than it produces. Therefore, Masdar City is connected to the power grid of Abu Dhabi, which is located nearby, at a distance of 17 km.

Smart Keynesianism

There is practically no information and news about Masdar City after 2016. Does this mean that the project has not achieved success? According to Anastasia Perdereau, Internet of Energy Project Manager SKOLKOVO Energy Center, we see the city being built from scratch, which is always accompanied by a certain

risk. «The success of Masdar will depend on the consistency, regularity and thoughtfulness of measures for its development,» Anastasia Perdereau said.

Obviously, it's all about management. In June 2021, Abdulla Balalaa, who headed the Masdar City project instead of Anthony Mallows, stated that «The UAE leadership has made a longstanding commitment to progressive climate action and recognises the integral part that innovation plays in advancing the global green recovery. Now more than ever, we see the critical importance of the green recovery. It is the only way forward to drive sustainable development, and facilitating innovation in key sectors is a fundamental aspect of this journey, one that we are helping to lead at Masdar City». This statement can mean that the state has not just returned to participating in this project, but has also taken it under its care and control. The figure of Abdulla Balalaa also attracts attention. Prior to joining the Masdar City, he was the Commercial director of Etihad Rail (the national operator of the UAE railways), represented the country's interests in the Railway Committee of the Cooperation Council for the Arab States of the Gulf, and even before that he headed the planning department in the Abu Dhabi City Planning Council. The biography of Mr. Balalaa clearly hints that he is a statesman.

The UAE authorities have made Masdar City the only approved research and development cluster in Abu Dhabi. By the way, this is not the only example when the state is forced to take the development of innopolis under its own control. A similar test site for the development of smart and low-carbon technologies is now being built in South Korea. Korean Songdo, as well as its Arabian counterpart, was predicted to become a technological oasis. It was planned to create, for example, a digital ecosystem for managing the urban environment, which featured the interactions through touch panels on the streets, power plants that generate energy from hard-to-recycle garbage, and much more from the field of science fiction. However, the ambitious project worth $35 billion did not find enough investors and did not particularly attract large global companies. Therefore, the financing fell on the budget of the neighboring city of Incheon, with which Songdo shares a common border.

A few years ago, the South Korean innopolis was inhabited by less than a quarter and presented an eerie sight. There were empty wide streets, on which mannequins stood instead of people. They were installed, apparently, to revive urban views. Now Songdo, which almost turned into a real ghost city, is gradually being populated. So, from 2018 to 2020, the number of res-

idents has more than doubled, amounting to 167 thousand people, however, they occupy only half of the urban housing stock. Anastasia Perdereau noted that life in such a city is more expensive than in the rest, and the question of whether the population is ready to live on an experimental site remains open. «Usually such zones are populated by employees working at the factories and companies located there», Anastasia Perdereau said.

It looks like that often the development of projects of smart cities, as well as relevant technologies, is very difficult without the participation of the state. For example, the volume of the Russian market of technological solutions for a smart city amounted to only 81 billion rubles in 2018. This figure has not changed at the end of 2019. And what about now? «The technologies of smart cities have received an additional impetus for development with the launch of the national program «Digital Economy». Thus, the Ministry of Construction, Housing and Utilities of Russia is implementing the Smart City project within the framework of the national project «Housing and Urban Environment». The standard of the smart city (basic and additional requirements) and standards in the field of data and indicators of the smart cities have been formed by the Federal Technical Regulation and Metrology Agency. In Russia, the project is being implemented in more than 200 cities with a population of 100 thousand people, while successful practices are being scaled. There are a lot of pilot projects all over the country now, and this is a great opportunity to develop new ideas and approaches», Anastasia Perdereau said.

Did the cyberpunk world win?

There is no secret that during the COVID-19 pandemic, the state monitored compliance with quarantine measures by citizens through digital services. This gave rise to a form of Luddism in society. It was not just distrust, but fear of the widespread digitalization of everyday life and spheres of public life. No wonder that such a common expression as «digital concentration camp» appeared. Therefore, not everyone shares an optimistic attitude to the global trend for the transformation of ordinary cities into smart ones. So, according to Dmitry Boikov, head of the DB-ARCH STUDIO architectural bureau, managing all spheres of life will not bring a person to good. «A smart city must be even more terrible than a smart house. Full digital control over all systems of the urban environment and life involuntarily causes allusions to the pages of the totalitarian past of some European states in the 20th century. In addition, the virtual world will drag people and, above all, the younger generation, turning the real world into ruin. Let's rather focus on the environmental friendliness of a city», said Boikov.

However, here's necessary to understand where sustainable urban development will move in the foreseeable future. «The term of «smart city» is an umbrella term and covers a wide range of technological solutions for smart cities. Now the sustainable cities are striving for carbon neutrality and multimodality, security, economic attractiveness and accessibility for their residents, maximum energy and resource efficiency», Anastasia Perdereau said.

According to the expert, these tracks can be implemented in various smart projects in the fields of energy (for example, demand management, deployment of energy management systems at the level of a house, apartment, building), gas and water supply (smart accounting systems, resource efficiency improvement, application of innovative cleaning methods), urban environment (smart systems of urban management, planning and land use), mobility (development of low-carbon personal and public transport, management of transport behavior of citizens), participation of citizens in the life of the city and many others.

«Most of the technologies in the field of resource and energy efficiency are recoupable and relatively easy to calculate. The implementation of smart lighting systems reduces costs by up to 50%, smart buildings technologies reduce resource consumption by 10-30%, smart transport allows you to optimize greenhouse gas emissions, reduce vehicle downtime, save time on trips,» Anastasia Perdereau said. However, she considers that the use of particular technologies depends on government policy and the speed of deployment of innovative technologies. As regards the energy self-sufficiency of smart cities and, in particular, the development of renewable energy, then geographical features play a decisive role here.

Whether we want it or not, but technological progress has already ingrained into our everyday life so much that, probably, we will never be able to erase it. So will you be able to leave the house without taking your smartphone with you? Are you ready, like the Luddites during the Industrial Revolution in England, to bring a sledgehammer over a working laptop or a home PC and smash a technological machine? Without noticing it, many of us have been living in the smart cities for a long time. «There are many examples of the successful smart cities in the world such as Moscow, Copenhagen, Amsterdam, Barcelona, London, Berlin», Anastasia Perdereau said.

Moreover, an ecopolis similar to Masdar City is planned to be built on Sakhalin. The ecopolis has to be finally built in 2030. Earlier it was reported that 150 billion rubles will be spent on the implementation of the project, and on September 15, 2021, at a meeting of the regional investment council, the governor of the Sakhalin Region, Valery Limarenko, announced a preliminary agreement with the DOM.RF about the bank's investment of 50 billion rubles in the infrastructure of the ecopolis. Anastasia Perdereau summarizes that the emergence of such projects is conditioned by the desire of the state and business to develop low-carbon technologies, including their own technological developments and approaches to regulating emissions, stimulating and supporting business on the path to sustainable development.

It turns out that now the countries, which have embarked on a low-carbon path, do not need showcases of a «bright future», but experimental sites for the development and testing of appropriate technologies that will ensure sustainable socio-economic development in the medium or long term. It's like conquering space. Pioneer of the Soviet cosmonautics Sergey Korolev dreamed of Mars and believed that in the foreseeable future people would land on the «red planet». Exactly 60 years have passed since the flight of the first man into space, but we are just getting ready to settle on the moon. It's the same with projects like Masdar City. They are the ones who open the way not just to the rest of the smart cities, but to the smart world. However, this world will not finally come out soon. It will probably have to wait as long as the flight to Mars.