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GEOECONOMIC AND GEOPOLITICAL CHALLENGES OF ENERGY TRANSITION. IMPLICATIONS FOR WORLD ECONOMY

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Abstract. The article deals with geoeconomic and geopolitical challenges for the further development of the world economy in the conditions of the energy transition designated by a number of countries of the world. The authors carried out a detailed analysis of the trends in the development of "green" energy in the period before and during the COVID-19 pandemic, identified the main directions of changes in the state energy policy of developed and developing countries. It is established that the accelerated and forced transition to renewable energy sources had a negative impact on the dynamics of economic development of a number of countries of the world. The authors make the assumption that the non-alternative and accelerated transition to "green" energy, actively promoted by developed countries (EU, USA and other OECD countries), together with a sharp decline in investment in traditional hydrocarbon energy sources, can lead to the formation of significant imbalances in the global economy, loss of predictability of the development of global and regional energy and energy markets. In addition, the authors pay special attention to the role of rare earth metals in the energy transition, whose markets are characterized by high monopolization in favor of China. Together with the global economic crisis, which was caused by the consequences of the COVID-19 pandemic, the trends of the accelerated energy transition have significantly worsened the stability of the energy systems of many countries of the world. Taking into account these factors, the authors have analyzed the strategic consequences for states engaged in intensive decarbonization of their national economies and the fuel and energy complex. At the same time, the authors noted that the EU's long-term plans to increase the share of hydrogen energy in the energy balance open up new prospects for the Russian Federation, which has extensive opportunities for the production and export of hydrogen. The importance of the development of domestic technologies in the field of hydrogen energy was noted. In addition, taking into account the development trends of the energy transition, the importance of the development of the rare earth industry in the Russian Federation to reduce the impact of imports of rare earth elements from China was noted.

Keywords: world economy, global energy crisis, geo-economics, geopolitics, USA, EU, China, Russia, COVID-19, rare earth metals.

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ГЕОЭКОНОМИЧЕСКИЕ И ГЕОПОЛИТИЧЕСКИЕ ВЫЗОВЫ ЭНЕРГЕТИЧЕСКОГО ПЕРЕХОДА. ПОСЛЕДСТВИЯ ДЛЯ МИРОВОЙ ЭКОНОМИКИ

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Аннотация. Рассматриваются геоэкономические и геополитические вызовы для дальнейшего развития мировой экономики в условиях обозначенного рядом государств мира энергетического перехода. Авторами выполнен подробный анализ тенденций развития "зеленой" энергетики в период до начала и в течение пандемии COVID-19, определены основные направления изменений государственной энергетической политики развитых и развивающихся государств. Установлено, что ускоренный и принудительный переход на возобновляемые источники энергии оказал негативное влияние на динамику экономического развития ряда государств мира. Авторами высказано допущение, что активно продвигаемый развитыми государствами (страны ЕС, США и другие страны ОЭСР) безальтернативный и ускоренный переход на "зеленую" энергетику в совокупности с резким снижением объемов инвестирования в традиционные углеводородные источники энергии может привести к формированию существенных дисбалансов в мировой экономике, потере предсказуемости развития мировых и региональных рынков энергии и энергоносителей. Особое внимание уделено роли в энергетическом переходе редкоземельных металлов, рынки которых характеризуются высокой монополизацией в пользу Китая. В совокупности с мировым экономическим кризисом, который был вызван последствиями пандемии COVID-19, тенденции ускоренного энергетического перехода в значительной степени ухудшили стабильность энергосистем многих стран мира. С учетом этих факторов выполнен анализ стратегических последствий для государств, осуществляющих интенсивную декарбонизацию своих национальных экономик и топливно-энергетического комплекса. Отмечено, что планы ЕС по увеличению доли водородной энергии в энергобалансе открывают новые перспективы для Российской Федерации, обладающей широкими возможностями по производству и экспорту водорода. Подчеркнута важность развития отечественных технологий в области водородной энергетики. Учитывая тенденции развития энергетического перехода, отмечена необходимость развития редкоземельной индустрии в РФ для снижения влияния импортных поставок редкоземельных элементов из Китая.

Ключевые слова: мировая экономика, мировой энергетический кризис, геоэкономика, геополитика, США, ЕС, Китай, Россия, COVID-19, редкоземельные металлы.

INTRODUCTION

One of the key global trends in the modern world economy is the transition from traditional fossil energy sources to renewable energy sources (RES). This is a complex and controversial process that will result in a radical change in the nature of the relationship between man and nature, and the formation of an entirely new model of economic growth will lead to changes in the world economy and geopolitics. In terms of the sustainable development paradigm, meeting human needs must be done without negatively impacting the environment and without harming future generations and social stability[1]. This will require significant changes in the economic, corporate, and socio-political structures of society. The COVID-19 pandemic appears to accelerate significantly the fourth energy transition.

[1] The current energy transition is the fourth, with renewables already accounting for about 90% of the world's generating capacity growth today. The first was the transition from wood (biomass) energy to coal, which in the 19th century triggered industrial development based on steam engines. The second energy transition, from coal to oil and oil products, took place in the 20th century with the invention of the internal combustion engine. The third energy transition is seen as the abandonment of petroleum products for power generation in favor of natural gas.

TURNAROUND

As a result of the COVID-19 pandemic, the world economy has experienced one of the biggest structural crises in recent history. The year 2022 is expected to see an intensive recovery of world trade, which will occur in parallel with the continued restructuring of world markets, including the energy ones. In 2020–2022, in most countries of the world, the decrease in GDP and the crisis trends were overcome mainly by an increase in liquidity through the issuing of national and world currencies. The cyclical nature of the crisis, caused by the emergence of new strains of the coronavirus, has had a detrimental effect on the stability of the global financial system, leading to accelerated inflation and a global rise in prices for goods and services. In addition, the crisis processes have significantly increased tensions in global politics and geo-economics.

The major centers of economic and political power, which include the US and some EU and OECD countries, on the one hand, and Russia, China, and a number of other Eurasian states, on the other hand, are in conflict with each other in the geo-economic and geopolitical fields and this has a serious impact on all the processes taking place. The authors hereof believe that the crisis in supply chains, rising global inflation,

the high degree of dependence of states on dollar emission, as well as a significant imbalance of supply and demand for goods, will persist in the near term.

The observed processes demonstrate the weakening of both military power and geopolitical influence of the Western powers compared to the Russian Federation and their economic superiority over the new world economic leader – China. The Eurasian continent, where the countries with the highest rates of economic development are concentrated, is steadily strengthening its role in the world economy.

Western countries are making every possible effort to maintain their leadership. However, according to a number of experts [source 1], their mission to control global economic development has failed. A period of global turmoil is coming, which will be underpinned by the rivalry between the leading states for technological leadership and investment, resources, and capital [1]. The US, which was the world's largest economy until the mid-2010s, sees China's economic ambitions as a threat to its own development and makes every effort to slow down its economic growth. At the same time, in the period from 2020–2021, it has become clear that the macroeconomic resilience of China, Russia, and many other countries in Eurasia and Southeast Asia has proved to be much higher than countries that are considered to be developed.

The key issue for the world economy today is not the development of productive capacity or human capital but the rising prices for existing assets, including through the US stock market bubbles, which, following their collapse in 2008 and further recovery, are driving up real estate prices to a significant extent. Thus, the paradigm shift in global development since the beginning of the 21st century, as well as the strong development of innovative technologies and the subsequent growth of intangible assets, have made the nominal GDP of powers with these assets higher compared to actual GDP.

According to a *McKinsey* report published in November 2021, the global balance, as well as the net worth of assets in the world, has almost quadrupled since the beginning of the 21st century. For example, world assets have reached 1,540 trillion USD in 2020, up from 440 trillion USD in 2000. Moreover, their net worth has risen from 160 trillion USD to 510 trillion USD [source 2]. However, the authors hereof believe that the trends may change in the coming years, causing a change in the rules of the game, forming a new geopolitical world order, and leading to the global transformation of all the key areas of the world economy.

According to a number of experts, the ongoing climate change, as well as the problems of depletion of traditional energy resources are deliberately exaggerated [source 3]. Human activity cannot globally change the ecology of the planet, although it can cause significant damage. Traditional energy sources, which are still the main sources in the world energy balance, will retain their importance, and only in the rather distant future, their share in the world energy balance may decrease.

According to other experts, the energy transition is vital for the further development of human civilization, as it will reduce the negative impact on the natural environment. It is stressed that using RES, harmful emissions (first of all, carbon dioxide and other greenhouse gases) are much lower than when using natural gas or coal for energy production.

Both groups of experts agree that the following disadvantages of renewable energy must be addressed for a successful energy transition:

1. Solution of the land use problem. Replacement of 10% of traditional energy sources in the global energy mix with renewables would require using about 15% of the Earth's land mass (excluding Antarctica). Taking away agricultural land in favor of RES installation will exacerbate food shortages and consequent hunger, especially in the regions of Africa and the Middle East.

2. A reduction in direct and indirect harm to ecosystems from the use of RES. The manufacture of RES power generation equipment, installation of the plants, and their lifecycle operation, like any industrial activity, cannot be considered an environmentally neutral activity. However, its harmful impact is not assessed in full and for unclear reasons; it is excluded from assessments of the environmental consequences of RES use [2].

3. RES power generation equipment includes a number of toxic and hazardous elements and processes. For example, the minerals and metal alloys used in solar energy contain lead. The storage of energy generated from RES requires, among other things, the use of electrolytes, which are aggressive chemical compounds. Thus, although RES appear at first glance to be environmentally and technically safe, the processes for their production and use are complex, costly, and toxic. As a result, there has been a major push to reduce the cost of producing energy from RES. It is expected to improve its safety by switching to more affordable and non-toxic chemical elements, making water the main by-product.

4. One of the key issues for plants generating energy from RES is the instability of their operation, which is due to many factors, mainly weather. The widespread use of RES within existing grid systems, given their balancing requirements, is extremely difficult. At the same time, current technologies do not make it possible to fully ensure efficient storage of energy generated from RES, balancing its production and consumption, which significantly hampers the development of the industry.

THE IMPOSITION OF "GREEN" STANDARDS

In the authors' view, the imposition of green projects and credits on states by the US and Western European countries is a tool to stifle development in the rest of the world, with a negative impact on traditional industries. The accelerated transition to renewable energy under the "sustainable development" paradigm does not promise a real reduction in negative environmental impacts, being primarily a strategy of the leading powers to maintain their leading economic and technological positions in the world.

The aggressively promoted transition to green energy and the reduction or complete withdrawal of funding for conventional energy projects, coupled with the COVID-19 crisis, have led to a deterioration in the stability of the energy systems of many nations, particularly in Europe. In fact, this has led to a global energy crisis in the second half of 2021.

Thus, if the US and developed EU plans to decarbonize their economies are achieved, one will witness a new, even deeper global energy crisis, which will not only hit key sectors of the global economy, but will also cause socio-political conflicts.

Further imposition of the energy transition without taking into account the economic and social particularities of particular countries and regions of the world will exacerbate the struggle for the resources that are required to produce energy from RES. This in turn will cause a global environmental crisis due to the high degree of pollution in the production of the equipment in question.

According to the *Bloomberg* study, rapid and chaotic changes in the global energy sector may have a negative impact on the success of key European banks [source 4]. A rapid shift to RES would cause an accelerated depreciation of assets associated with coal, oil, gas, and other conventional energy sources. An alternative to such an unfavorable scenario, in the authors' opinion, is not a total transition to RES, but partial preservation of traditional power generation capacities, their transfer to more environmentally friendly fuel (primarily natural gas), as well as the development of a peaceful atom.

ENERGY TRANSITION IN THE EU

At the end of 2019, the European Commission announced a comprehensive EU strategy called the Green Course. Its key objective is to achieve climate neutrality in all countries participating in this strategy by the middle of the 21st century [source 5].

According to forecasts, by 2030, the reduction of carbon dioxide emissions in the atmosphere is expected to exceed 55% in relation to 1990, and the share of renewable sources in the energy balance of countries participating in the strategy will increase up to 40% (including that the RES share in energy production should reach about 2/3). However, by 2030, energy consumption is also expected to decrease by almost 40% (including coal by more than 70%, oil by 30%, and natural gas by 25%) compared to 2015.

The European Union has been actively developing the mechanisms to implement its strategy, mainly by forcing other states to participate. In addition to the impressive €1 trillion investments for the period of 2020–2030 [source 6], initiatives are also being developed to reduce the scale of energy supplies from Russia to EU countries.

The European Commission is pinning its main hopes on cross-border carbon regulation [source 7], under which suppliers of certain products to the EU have to pay a fee for the harmful environmental emissions associated with their production. It is assumed that states using a carbon regulation similar to the EU will be exempt from these payments. It is not yet known exactly how this mechanism will work; only speculative options are being discussed.

Thus, the EU is trying to establish payment for harmful emissions from imports from countries with little or no regulation of emissions. The European Commission has already developed the relevant directives, which are expected to come into force in 2022. The implementation of the EC "green" initiatives will weaken the financing of gas projects and the production of cars with combustion engines in Europe. The states supplying the EU with gas and oil products (Russia, OPEC countries, etc.) may suffer from this [3].

According to the *Boston Consulting Group* (BCG), the losses of Russian exporters after the introduction of this instrument will amount to 3 billion USD to 5 billion USD. European experts estimate the losses

of Russian exporters to be lower – from 1.14 billion USD to 1.37 billion USD [source 8].

According to the draft EU Methane Strategy, the main goal is to reduce methane emissions in the EU by 2030 by a third compared to 1990. In this connection, it becomes especially important for Russian oil and gas companies to commit themselves to maintaining and providing transparent reporting, as well as ensuring independent monitoring of methane emissions along the entire oil and gas supply chain to the EU, from production to transportation. In 2020, the EU Hydrogen Strategy was adopted with the main objective of stimulating green hydrogen production, which should reduce the share of hydrocarbons in the EU energy mix.

In this context, it is relevant to note that the Russian Federation has the necessary technology and resources to develop hydrogen energy. In order to strengthen its position in the global energy market, in 2021 the Concept of hydrogen energy development in the Russian Federation until 2024 was adopted [source 9]. According to the Concept, revenues of the Russian Federation from hydrogen export may be from 23.5 billion USD to 100 billion USD annually with supplies ranging from 8 million to 33 million tons. In December 2020, the management of Gazprom PJSC proposed that the German side explore the possibility of hydrogen supplies from the Russian Federation and a reverse supply to the Russian Federation of carbon dioxide, which would then be used or buried.

CHANGE IN CHINA'S POSITION

As a result of strong economic growth, the GDP of China grew by 8.1% in 2021, exceeding the initial target of 6% set by the country's authorities. At the same time, China remains one of the few countries in the world (and the only major economy) to have maintained positive economic growth in 2020 despite the crisis. Moreover, the Chinese economy experienced a gradual slowdown between 2010 and 2020. This trend is linked to the transformation of the country's economic model, which aims to shift from an aggressive expansion of exports to meeting domestic demand while gradually saturating the domestic market and, consequently, reducing the growth rate of consumer spending and lending. China's industrial production dynamics between 2011 and 2019 were similar to those of GDP.

China has become the world's largest producer of industrial and agricultural products in the last decade (Table). The PRC is a world leader in the production of not only traditional goods but also advanced knowledge-intensive products: computers, electronics, gadgets, and RES equipment. This can be explained not only by China's considerable industrial success but also by the fact that the country has the largest reserves of rare earth metals (REMs) – 35.4% of the global total – used in the production of innovative products (see Fig.). China accounts for 52.3% of the global production of these materials. Importantly, China exports REMs not as raw materials, but as finished products.

Table. Production of major industrial and agricultural products by the world's leading countries

		China	USA	India	Russia	Germany
Electricity	Ranking place	1	2	3	4	7
	Share, %	38.42	23.41	8.16	5.84	3.31
Petroleum, including gas condensate	Ranking place	3	1	7	2	14
	Share, %	10.29	40.35	2.13	27.89	0.10
Natural gas	Ranking place	3	1	8	2	13
	Share, %	7.64	42.53	1.43	30.63	0.25
Coal	Ranking place	1	3	2	5	6
	Share, %	57.80	9.61	11.62	5.98	2.54
Cast iron	Ranking place	1	7	3	4	6
	Share, %	70.67	1.95	6.48	4.54	2.23
Steel	Ranking place	1	4	2	5	6
	Share, %	65.44	5.77	7.32	4.85	2.60
Iron	Ranking place	3	7	4	5	10
	Share, %	11.76	2.34	11.34	4.87	0.06
Cars	Ranking place	1	4	3	9	2
	Share, %	18.15	24.50	18.78	3.45	4.15
Cotton fabrics	Ranking place	1	16	17	3	4
	Share, %	74.97	0.01	0.01	1.55	0.69

Окончание таблицы

		China	USA	India	Russia	Germany
Wheat	Ranking place	1	4	2	3	7
	Share, %	23.26	9.10	18.04	14.96	4.02
Potatoes	Ranking place	1	5	2	4	6
	Share, %	34.81	7.27	19.03	7.43	4.02
Fruit, berries, citrus fruits and grapes	Ranking place	1	4	2	9	14
	Share, %	50.88	5.74	21.24	0.88	0.50
Vegetables and gourds	Ranking place	1	3	2	4	13
	Share, %	68.58	3.50	15.39	1.81	0.40
Livestock and poultry for slaughter	Ranking place	1	2	5	4	6
	Share, %	34.34	21.53	3.67	5.05	3.57
Milk	Ranking place	3	2	1	6	5
	Share, %	6.47	17.63	33.39	5.74	5.89
Eggs	Ranking place	1	2	3	5	11
	Share, %	57.57	9.82	9.13	3.91	1.09
Vegetable oils	Ranking place	1	2	4	5	7
	Share, %	27.68	16.13	9.92	8.23	4.58
Salt	Ranking place	1	14	16	7	2
	Share, %	74.98	0.01	0.01	0.78	16.83

Source: [ист. 10, p. 644, 646-647].

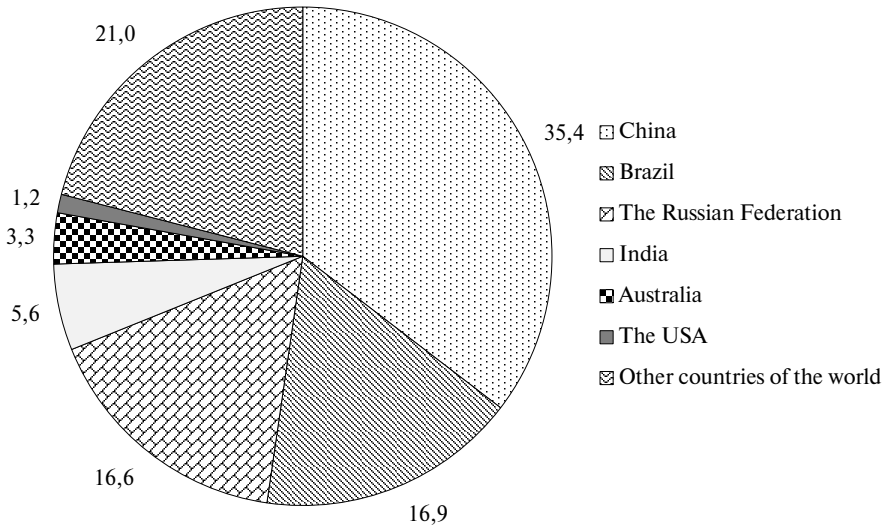

Fig. World reserves of rare earth metals, 2020, %

Source: [11].

In addition to China, REM producers are the USA, India, and Russia; however, the indicators of their resources and current smelting are not even close to those of China. There are also deposits of REMs, for example, in African states. South Africa alone ranks sixth in the world in terms of its reserves. At the same time, China has long been actively developing its economic presence on the African continent, where it is crowding out other countries. Most of the deposits are under the control of Chinese companies. Moreover, China controls 65 ports on the continent through which raw materials are exported.

The main directions of China's energy policy for the long term are set out in the documents "The Strategy for Revolutionary Changes in the Production and Consumption of Energy Resources for the Period 2016–2030" and the "Forecast of the Development of the World Energy and the Energy Sector of China for the Period up to 2050". Individual sets of measures aimed at achieving the goals of sustainable development and combating climate change are also

provided for by the First National Plan of the PRC in the field of combating climate change.

The result of the formation of a modern energy system in China and the transition to a "green" economy should be the achievement of carbon neutrality announced by the Chinese government by 2060. With a high probability, in addition to the price dynamics for traditional energy resources, in the medium term, the contours of the global economy and energy will also be formed by prices for increasingly scarce rare earth raw materials for the production of solar cells, electronics, and other RES components, which will strengthen China's position in the global economy [4]. For most Western countries, this is likely to be a factor holding back the energy transition.

ROLE OF RUSSIA

According to some estimates [source 12], as a result of the energy transition, the fall in export revenues of the Russian Federation could be about 180 billion USD by 2035 and 190 billion USD by 2050. In the case of a successful energy transition in the world, the volume of oil and gas condensate production in the Russian Federation could be reduced by more than 70%, natural gas by more than 50, and steam coal by 90% [source 13].

The system of use of hydrocarbon resources used in Russia since the 1990s was based on principles different from those of developed countries. It lacked competition and non-interference of the state. The main idea was to extract oil and gas rent.

In the scientific literature, both domestic and foreign experts often discuss the theory of the "resource curse". However, to this day, it remains unknown why it does not affect a number of states that have large centers of hydrocarbon production and belong to the category of the most developed. Examples are the USA, Canada, and Australia. They account for about 1/3 of the world volume of hydrocarbon production [source 11]; however, for some reason, it is believed that the "resource curse" does not affect them.

Experts believe that it is all about rent – the basis of oil and gas industry activity. In the authors' opinion, taking into account the experience of some countries, in the Russian Federation, it is reasonable to form such a model of management of the oil and gas sector, in which a high level of competition will be observed, as well as the concentration of oil and gas rent in the hands of the state.

According to forecasts of energy transnational corporations, research agencies and institutes, the share of hydrocarbons in the world energy balance until the middle of the 21st century will remain significant, though it will be gradually replaced by renewable sources of energy [source 14]. In this connection, the fact of transformation of the oil and gas sector of the country into the innovative sector of the economy, whose powerful contribution will allow providing development and progress of the state, becomes important.

In Russia, according to strategic documents in the energy sphere, in the medium term, it is expected to increase the production of oil, gas, and coal. In the long term, stabilization and some reduction of oil production are possible, while natural gas and coal production (to ensure export supplies) are likely to grow.

In fulfillment of the commitments undertaken by Russia under the Paris climate agreements, in October 2021, the Strategy of socio-economic development of the Russian Federation with low greenhouse gas emissions until 2050 (hereinafter – the Strategy) was approved, which will be the basis for the development of state policy measures in the Russian Federation to limit greenhouse gas emissions. According to the Strategy, the key target is to reduce greenhouse gas emissions by 2050 to 70% of the 1990 level. Two scenarios of development of the Russian economy to counteract climate change – inertial and target (intensive) were developed within the Strategy.

For sustainable development, the Strategy envisages the implementation of a target scenario that provides for new measures to decarbonize the Russian economy (application of new technologies, development of hydrogen energy, steam and gas generation, growth of the post-industrial economy, and reduction of energy intensity).

Under this scenario, Russian government policy measures in various sectors aimed at reducing greenhouse gas emissions are seen as additional incentives for technological development. Such measures will include carbon pricing, introduction of a system of quotas for greenhouse gas emissions, "green" (climate) projects, certificates of energy origin, etc. The scenario takes into account the mutual linkage between the goals of the international climate agenda to reduce greenhouse gas emissions and Russia's economic capabilities and fulfillment of long-term socio-economic development goals.

The basis for RES development is REMs. According to BP's data for 2020, Russia accounts for about 16.6% of global reserves, but its share in global production is still less than 1%. To meet its domestic

needs, it has to import them from China, while a significant share of the country's mined rare-earth metals is exported [source 11].

The high dependence on imported REM purchases is a direct threat to the national security of the Russian Federation. The government has set a goal of bringing Russia to the second place in the world in mining rare-earth metals by 2030, with a share of more than 10%. It is planned to considerably reduce REM imports in 2021–2025 and then to fully cover the country's needs by domestic mining. The first step to solve this problem should be the reduction of REM extraction tax in Russia by 3.2 p.p. to 4.8% from January 2020 and the introduction of privileges for mining and processing companies.

The Russian government has plans to develop Russia's largest REM deposits, Tomtorskoye (Yakutia) and Zashikhinskoye (Trans-Baikal Territory), in order to achieve these goals. It is expected that commercial production of REM at the Tomtorskoye deposit will begin in 2025. An enterprise for sorting REM, which will be extracted from mineral fertilizer waste, will be launched in the Moscow Region.

It is planned to build a hydrometallurgical plant in the Trans-Baikal Territory with a design capacity of 160 thousand tons of processing annually. It will produce the following types of products:

– ferroniobium used in metallurgy;

– concentrate of superheavy REMs used in innovative industries, electronics, and nuclear industry;

– praseodymium and neodymium, which are needed to create ultra-high-power magnets.

The authors believe that the steps taken by the Russian government to develop the rare-earth industry will ensure the establishment of Russia as one of the key players not only in the relevant segment of the world market but also in the global energy industry.

RESULTS

The imposition and forcing of the energy transition by the leading Western countries are due to their desire not to lose their leading position in the global economy. Considering the above trends, the authors believe that the greatest stability and development prospects in the long term will be preserved not only by those countries which have secured their technological leadership but also by those which have resources to produce "green" energy equipment and nuclear technologies. In this case, the key factor of long-term strategic success is parallel support for the development of new renewable energy technologies on par with the traditional sectors of the fuel and energy complex.

As for the EU, the lack of a raw material base of REMs in the forced "green transition" will only weaken the economy of the Union's states, as well as strengthen the position of competitors from Asia. The consequences of the energy transition will be enhanced to a greater extent by the countries with a significant raw material base of rare-earth elements and hydrocarbon resources, as well as developed technologies, such as China, the USA, and Russia. In this regard, the authors hereof believe that countries that have decided to make the transition to green energy should carefully calculate all geo-economic and geopolitical opportunities and risks of the energy transition.

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