Special aspects of risk management of the transition to a low-carbon economy

Ekaterina Eliseeva[1*] and *Yuri* Eliseev[2]

[1]Moscow State University of Civil Engineering, Yaroslavl highway, 26, 129337, Moscow, Russia
[2]Nizhny Novgorod State University N. I. Lobachevsky, Gagarin Avenue, 23, 603022, Nizhny Novgorod, Russia

Abstract. The purpose of this work was to assess the opportunities and problems of risk management of the transition to a low-carbon economy in the current development of society. In modern conditions, sanctions against the sale of hydrocarbons, logistics violations, volatility in the oil and gas market, open up wide opportunities for the implementation of the declared "green" economy. But developed countries are faced with a situation where the use of renewable energy sources looks extremely unprofitable, European states are forced to switch to saving electricity, and in some cases governments are bound to return to previously rejected "dirty" technologies – the use of coal and brown coal. To assess the possible risks of the transition to a low-carbon economy, an empirical study was conducted among specialists of Russian and joint enterprises in the energy sector, oil production and refining industries, and the petrochemical complex. The following methods of research were used: comparative, structural and system analysis, sociological research methods (survey, conversation), methods of mathematical statistics. As a result of the conducted research, it was found that the current difficult political situation, the impact of the sanctions on economy, the decline in the standard of living of the population in many developed countries, increasing inflation lead to the fact that previously declared plans to build a "green" economy are exposed to significant risks. In this situation, the Russian Federation, despite the sanction restrictions, has great potential for a successful transition to a low-carbon economy and compliance with the declared international requirements to reduce greenhouse gas emissions. The expert survey made it possible to identify the main risks of Russia's successful transition to a low-carbon economy. The results of the study indicate the need for further research on the risks of transition to a low-carbon economy both globally and nationally.

1 Introduction

For centuries, humanity in previous technological structures used an extensive approach to nature management, which eventually led to serious resource constraints and environmental problems that have a complex impact on the economy and social

* Corresponding author: eliskati2008@mail.ru

development of society, and the interaction between civilization and the biosphere itself has become not only mutual, but critical for either side. In the current situation, the transition of the economy to low-carbon development is associated with the expansion of the share of renewable energy sources (hereinafter referred to as – RES) and the widespread use of energy-saving technologies against the background of a decrease in the use of fossil organic fuels in production and consumption.

At the same time, today the world economy is in many ways not only dependent, but also based on the use of hydrocarbon fuels and derivatives from it, used in energy, various industries, agriculture and transport. According to the International Energy Agency (hereinafter referred to as – IEA), fossil energy sources (oil, gas, coal) account for about 80% of the demand for primary energy resources [1]. This indicates the great dependence of the economy, both developed and developing countries, on hydrocarbon raw materials, and the transition of the world community to a low-carbon economy is a serious challenge for the oil and gas sectors, chemical and oil refining industries.

The result of the transition to the use of RES, narrowly defined, and to a low-carbon economy, in a broad sense, may be a global decline in demand for fossil fuels and an increase in the role of energy-saving technologies. Taking into account the complex environmental consequences of the use of hydrocarbons, many Western countries have declared a transition to "green" energy and a gradual abandonment of the use of fossil fuels. But in the conditions of the sanctional economy, significant volatility of energy prices, political transformations and changes in the geopolitical situation, significant risks of transition to a low-carbon economy arise, and it becomes more difficult to identify threats and specify potential opportunities for socio-economic development of the state in new conditions.

The purpose of this study was to empirically assess the opportunities and problems of risk management of the transition to a low-carbon economy in the current development of society and the challenges of the sanctional economy.

The relevance of the problem under consideration is determined by the existing contradictions between the environmental consequences of the widespread use of fossil fuels, the growth of its prices on the world market, the consequences of the coronavirus pandemic, logistics difficulties under sanction restrictions – on the one hand. On the other hand, there are the high cost of RES, insufficient financing for the development of "green" technologies, social problems against the background of inflation, rising prices, lack of conventional energy sources to ensure the minimum needs of the population, which, first of all, the countries of Western democracy have faced.

2 Literature review

The issues of transition to a low-carbon economy have been in the focus of attention of both Russian and foreign researchers for the past 5 years. This is largely due to the rapidly occurring climatic changes, the rate of which is heterogeneous in different parts of the Earth and often exceeds even the bold predictions of scientists.

Experts of the European Environmental Agency note that risks associated with nonlinear climatic changes are of particular importance in modern conditions. These risks arise at "tipping points" in the history of mankind and are associated with unpredictable events such as "The Black Swan" [2].

With the nonlinear interaction of natural processes occurring in the atmosphere, the world ocean, the cryosphere, the biosphere with anthropogenic influence on land due to economic and social activities, the situation of global warming can dramatically increase. Rapid abrupt climatic change as a result of the nonlinear interaction of various natural and anthropogenic factors that humanity, in fact, will not be able to control, can cause

catastrophic irreversible consequences on Earth, causing active melting in the Arctic, Antarctic ice zones and Greenland, rising sea levels, progressive release of methane from melting permafrost ice, destabilization of hydrates, transition from one type of ecosystem to another. In fact, the COVID-19 pandemic has become such a tipping point in the life of humanity.

During the pandemic, the negative phenomena that caused the crisis in the hydrocarbon raw materials market, which began in the fall of 2018, when oil prices fell sharply due to the glut in the market, were aggravated by a drop in demand for energy carriers. During the coronavirus pandemic and the almost universal introduction of lockdown restrictions, oil and gas companies suffered significant losses due to reduced demand and restrained production of hydrocarbon fuels. However, according to experts [3], even the coronavirus pandemic could not stop climatic change on Earth and the environmental agenda, along with the transition to a low-carbon economy, remained relevant. After a temporary reduction in emissions caused by the economic decline and the shutdown of many industrial plants during the spread of COVID-19 pandemic, today the concentration of greenhouse gases in the earth's atmosphere is again approaching the pre-pandemic level and continues to grow.

F. C. Lott and A. Peter [4] made an attempt to analyse and assess the situation related to the climatic variability of the environment. Scientists used climate modelling according to various scenarios for a number of decades ahead, which allowed us to obtain several dozen different scenarios for the development of the situation. At the same time, various risks were identified and modified. In a similar vein, scientists recognized that they had obtained results with a high degree of uncertainty (an “ensemble” of scenarios), the explanation of which can be found in errors in assessing the initial state of the subject of research, the imperfection of the developed climate models, as well as in the chaotic management of the Earth's atmosphere. The obtained assessment trajectories had a large degree of dispersion, which only confirmed the high degree of uncertainty in the development of future climate scenarios.

To carry out a quantitative assessment of the risks of the greenhouse effect and the possibilities of transition to a low-carbon economy, the probabilities of events that are caused by both natural climate changes occurring on the planet and the intensity and volume of anthropogenic impacts on the environment are considered. At the same time, the bootstrap procedure is used to assess the uncertainties and statistical significance of the obtained calculation results, which makes it possible to assess the risks associated exclusively with climate variability, without taking into account economic and social components [5].

In our opinion, an approach that makes it possible to assess not only the risk of exposure to individual factors or their totality, but also to determine the risk exposure and vulnerability of the object in question based on scenario analysis founded on expert opinions and qualitative assessments of key risk factors seems more appropriate.

S.P. Wendy and G. Lusk [6] propose the concept of inductive risk, which aims to choose between the two most likely scenarios under conditions of uncertainty. In this case, it is possible both to underestimate the risk and to overestimate it, which leads to estimated faulty proportions and errors of conclusions. Decision-making is based on a comparative analysis of the probabilities of potential errors that may occur during the implementation of each of the scenarios. An inductive view of risk helps to avoid the most serious consequences of the changes taking place, for example, in relation to threats to human life and health.

T. Mitrova, A. Khokhlov, Yu. Melnikov et al. [7] note that during the transition to a low-carbon economy, it is necessary to highlight the risks associated with the negative impact of increased global warming, as well as an increase in the frequency and intensity

of dangerous weather events. Underestimating the uncertainties in this case can reduce the efficiency of the country's economy, lead to a decrease or loss of biodiversity, create problems for existing ecosystems, health and life of the population. The risks arising from the transition to a "green" economy also contain uncertainties related to changes in government policy, the introduction of innovative and energy-saving technologies, investor behaviour and the emergence of new business models.

There is no doubt that the transition to a low-carbon economy is impossible without the use of innovative technologies, products and services. But at the same time there are technological risks associated with changes in the production processes of companies, the existing business model and the growth of requirements for investment capital to cover risks. Damage to companies in various industries can also be caused by civil and public activity aimed at reducing investment in carbon-intensive industries [8].

It is also necessary to take into account reputational risks, which are especially significant in an open society, widespread use of the media, the Internet and social networks. An important factor in ensuring the transition to a low-carbon economy is also the behaviour of investors, which, for a successful transformation, should be aimed at meeting the environmental agenda, even if it is costly and unprofitable at a certain stage. It is important to take into account that in the context of global digital transformations, technocratic development and the emergence of new information technologies, an increase in the amount of information available to investors, as well as an increase in the number of non-professional market participants, investors' plans and decisions made by them may be difficult to predict [9].

As noted by P. N. Mikheev [10], new threats (and at the same time potential opportunities) are political, regulatory reforms and legal acts regarding the activities of carbon-intensive industries related to the adoption of regulations governing carbon emissions, the introduction of additional taxes and fees on hydrocarbon emissions, the application of penalties to companies that do not take into account the factor of global warming. A similar example is the European Economic Policy, one of the main priorities of which is to support the transition to a low-carbon economy in all sectors of the economy, investing in green technologies and environmental protection.

There are also regional aspects that are important for the economy of individual states, for example, the Russian Federation. Thus, in the countries of the European Union (hereinafter – EU), several scenarios have been developed for the introduction and application of a cross-border hydrocarbon tax in relation to Russian enterprises. According to the baseline scenario, this tax should be introduced in 2025 and applied to producers engaged in direct greenhouse gas emissions. According to experts, at the same time, the additional burden on Russian manufacturers exporting their products to the EU countries will reach $ 33.3 billion in the USA for the period 2025-2030 [11].

Thus, despite the existing risks and uncertainties, the need to transition to low-carbon development stimulates the processes of economic diversification, the absorption of new less expensive types of production, the development of innovations and more environmentally friendly technologies. It is impossible not to note the social significance of this transition, related to the preservation and safety of the environment, the health and life of the population.

According to the UN, currently the Russian Federation accounts for about 4% of greenhouse gas emissions among developed countries, in terms of greenhouse gas emissions, the country ranks 5th after China, the USA, India and the EU countries, formally being one of the most successful states in terms of reducing greenhouse gas emissions [12]. However, this position in the rating is rather an external indicator that does not accurately characterize the real situation of the transition to a low-carbon economy.

In many ways, this situation is explained by the fact that Russia, having significant reserves of fossil fuels, uses conventional technologies of electric and thermal power, and for a long time did not consider reducing greenhouse gas emissions into the atmosphere as a priority goal of its development. At the same time, Russia also has significant renewable energy use potentials at the level of 4.6 billion tons per year, which is 5 times higher than the current total consumption of fuel and energy resources [13]. This creates significant potential opportunities for the development of renewable energy, but to a certain extent explains stagnancy of the Russian Federation in implementing a low-carbon development path. In addition, like most developing economies, Russia has hidden concerns related to the potential impact of "green" economy strategies on its own economic prospects, on ensuring adequate access to technologies and necessary investments for all countries, etc.

The BRICS countries believe that the transition to a "green" economy should mean a change in consumption and production patterns, primarily in industrialized countries. Along with that, the problems of global standards and certification systems related to the transition to a "green" economy, "green" protectionism and restrictions on market access should also be discussed. However, it should be assumed that there is no other alternative scenario of world development for today.

Currently, a wide range of different tools are offered at the expert level for the transition to a low-carbon economy:

– formation of pricing that would comply with the principles of sustainable environmental development, including the rejection of subsidies and investments in traditional "dirty" production and the introduction of severe penalties for environmental pollution;

– implementation of a public procurement policy that encourages the production of environmentally friendly products and the use of appropriate environmentally friendly production methods;

– reforming the systems of "ecological" taxation, involving a shift in emphasis from the labour tax to pollution taxes;

– growth of public investments in eco-friendly infrastructure (including public transport, renewable energy, construction of energy-efficient buildings) and natural capital to restore, maintain and, where possible, increase the volume of natural capital;

– implementation of targeted state support for research and development related to the creation of environmentally friendly technologies;

– materialization of social strategies designed to ensure coordination between the goals of state development in the social sphere and existing or proposed economic strategies [14].

It is important to note that today many countries of the world already use various tools of the low-carbon economy in their national policies and strategies of socio-economic development. The countries that have started the development of "green" sectors of the national economy include states in various parts of the world: in Southeast Asia (China, Taiwan, South Korea, Japan, Thailand), in South and North America (Brazil, Argentina, Canada, USA), in Europe (EU countries, Belarus), in Asia and Oceania (India, Bangladesh, Malaysia, Australia, New Zealand, Uzbekistan, etc.). In these states, legislative and regulatory frameworks for environmental policy are being developed, indicators of transition to a low-carbon economy are being formed, incentive and reward schemes for companies and manufacturing enterprises are being developed, new educational programs with an environmental agenda are being applied, innovative energy saving technologies are being invested and other tools are being used for a sustainable transition to a low-carbon economy.

Meanwhile, the current political situation in the world, the aggravation of inter-country contradictions, the formation of a multipolar world under sanction restrictions, volatility in

the global energy market lead to the fact that the "green" agenda is no longer the nearest development prospect, but increasingly remote and vague. Political, economic and social risks negate the strategies developed for the transition to a low-carbon economy. And, first of all, this applies to those countries that do not have their own traditional energy resources to a sufficient extent to successfully cope with crisis phenomena, and are largely dependent on supplies from other countries. As a result, the declared "green" policy becomes hostage to economic restrictions, which is most relevant for European countries.

In this situation, Russia, having significant reserves of hydrocarbon raw materials, can afford, unlike many developed economies, in parallel with the reorientation of supplies of fossil raw materials and obtaining increased profit margins due to the increase in the cost of hydrocarbons on the world market in the short and medium term, to actively develop RES in the strategic perspective and reduce hydrocarbon emissions, adhering to international obligations.

3 Methods

The survey method was used as the main one to study the opportunities and problems of risk management of the transition to a low-carbon economy in the situation of the current development of society and the challenges of the sanctional economy, in which 50 respondents participated. The research section included experts from Russian or joint enterprises in the energy sector, oil production and refining industries, the petrochemical complex, officially employed at these firms for at least 5 years and carrying out their activities in positions of at least middle management. The survey was conducted remotely using the Russian social network VKontakte.

For the correctness of the results' presentation of the sociological research, specialists holding senior management positions in companies did not participate in the survey.

The sampling was carried out by a deterministic quota method. The controlled parameters in the course of the study included the following: official employment at a Russian or joint enterprise in the energy sector, the oil and refining industry and the petrochemical complex (at least 5 years), the absence of a senior management position in the company, but the occupied level is not less than middle management.

The field stage of the study was conducted in May-June 2022 by remote survey using a structured questionnaire and the possibility of clarifying certain information from respondents during correspondence (remote conversation). The questionnaire included questions that related to the transition to a low-carbon economy, as well as individual characteristics of respondents, including some personal data (name, age, work experience in the industry/enterprise, position held). The results of the empirical study were processed using mathematical and statistical methods in July 2022.

4 Research results and their discussion

According to the results of the study, it was found that more than half of the respondents (58%) positively assess the possibilities and prospects of Russia's transition to a low-carbon economy over the next 15-20 years (Figure 1).

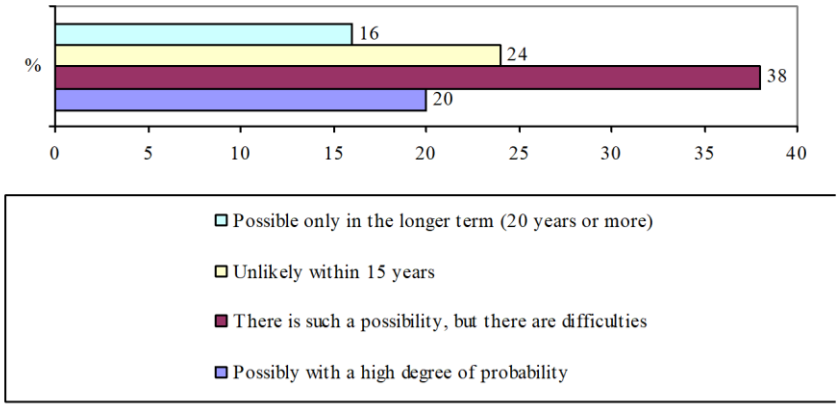

Fig. 1. Answers to the question about the possibilities and prospects of Russia's transition to a low-carbon economy over the next 15-20 years, %.

Respondents pointed to the great potential of innovations related to the use of alternative energy sources, primarily hydrogen fuel. According to experts, the use in Russia of the most popular types of renewable energy in the world (wind turbines and solar panels) has certain limitations due to the cost of implementing these technologies, sanction restrictions (which may have strategic consequences and last for a dozen years), as well as the specifics of the physical and geographical characteristics of the country's regions.

At the same time, respondents' assessment of the possibilities of Western European states for a successful transition to a low-carbon economy in the next 10 years was extremely low:

– more than half of the respondents (34%) indicated that this is unlikely in the specified time period, since developed economies are facing an economic crisis, inflation, a decrease in financing of renewable energy projects and innovative developments;

– 26% of respondents noted that such a transition is possible only in the longer term (20 years or more);

– 18% of respondents indicated that the prospects for Russia's successful transition to a low-carbon economy are much higher than those of Western European countries in the next 20 years (Figure 2).

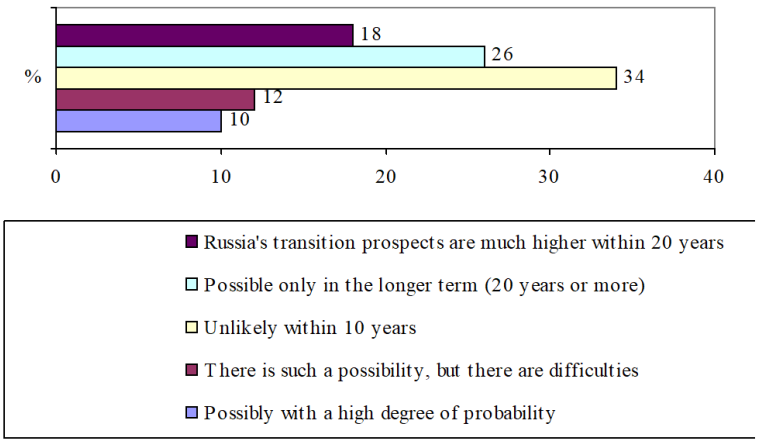

Fig. 2. Answers to the question about the possibilities of Western European states for a successful transition to a low-carbon economy in the next 10 years, %.

To the question about the main risks of the transition to a low-carbon economy on a global scale, the following estimates were obtained (several answers could be chosen):

– insufficient financing of renewable energy projects and development of innovative technologies, freezing of "green" projects (70% of respondents);

– low profitability, complexity and limited implementation, rising cost of renewable energy projects (64% of respondents);

– the political situation and the sanctional economy, the gap in international cooperation in the field of renewable energy (54% of respondents);

– economic crisis, inflation, reorientation to the use of conventional energy sources, changing criteria in the field of ecology, temporary departure from the "green" agenda (48% of respondents) (Figure 3).

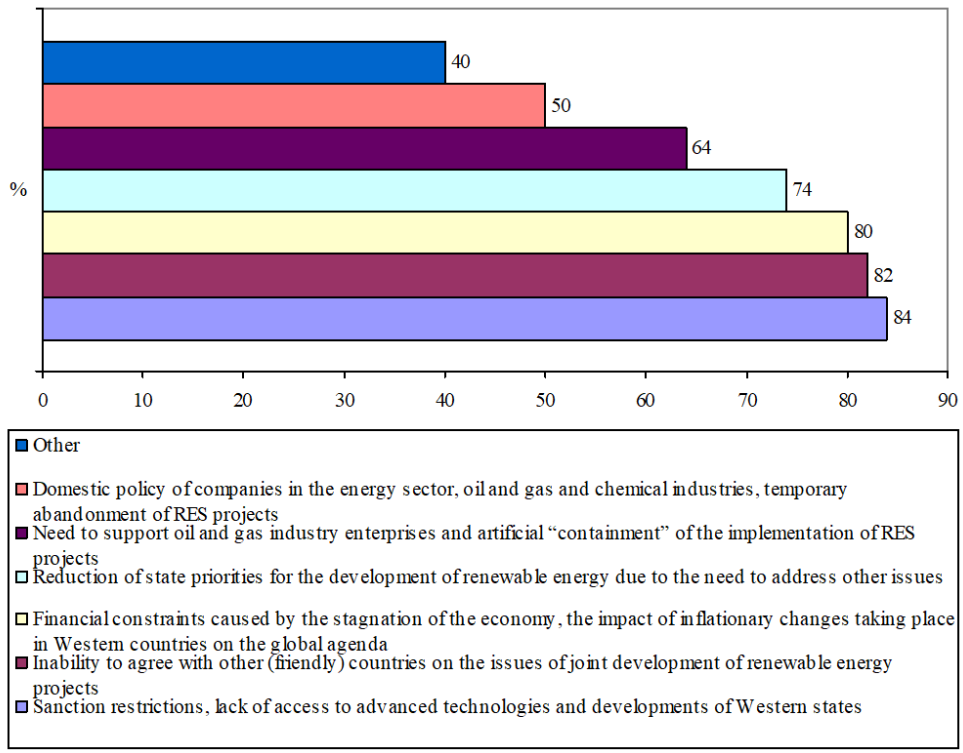

Fig. 3. Answers to the question about the possibilities of Western European states for a successful transition to a low-carbon economy in the next 10 years, %.

Respondents attributed the following to the main risks of Russia's successful transition to a low-carbon economy (it was possible to choose several answers):

– sanction restrictions, lack of access to advanced technologies and developments of Western states (84% of respondents);

– inability to agree with other (friendly) countries on the issues of joint development of renewable energy projects (82% of respondents);

– financial constraints caused by the stagnation of the economy, the impact of inflationary changes taking place in Western countries on the global agenda (80% of respondents);

– reduction of state priorities for the development of renewable energy due to the need to address other issues (for example, assistance in the reconstruction of Ukraine,

implementation of major infrastructure projects, social support of the population, etc.) (74% of respondents);

– the need to support oil and gas industry enterprises and artificial "containment" of the implementation of RES projects (64% of respondents);

– domestic policy of companies in the energy sector, oil and gas and chemical industries, temporary abandonment of RES projects (50% of respondents).

As possible ways to reduce the risks of switching to a low-carbon economy, the respondents identified the following (several answers could be chosen):

– changing the state policy, improving the regulatory framework, creating promising development programs and switching to low-carbon fuel (82% of respondents);

– the use of additional revenues from the increase in the cost of hydrocarbons on the world market for the implementation of renewable energy projects, the allocation of this direction to a priority area of scientific research and practical application (78% of respondents);

– economic (tax) incentives to abandon carbon fuels and switch to RES, increased penalties against companies that violate environmental requirements (68% of respondents);

– expansion of BRICS countries' cooperation in the development of innovative technologies (58% of respondents);

– investment and financial support from government agencies for the transition to hydrogen fuel, the development of the domestic electric vehicle industry, the creation of appropriate supporting urban infrastructure, etc. (42% of respondents);

– active implementation of alternative energy projects (solar, geothermal, tidal, etc.) in regions with significant potential for their development, attracting private business, using PPP (36% of respondents).

According to the results of the analysis of respondents' answers to the questions asked, it should be assumed that today the transition to a low-carbon economy on a global scale has faced serious difficulties, and to a greater extent this applies to Western European countries that previously declared a "green" policy. It should be assumed that Russia has great prospects for the transition to the widespread use of RES, reduction of hydrocarbon emissions, and the implementation of various environmental initiatives. In the current situation, Russia has found itself in a more advantageous position than many developed economies, which is determined not only by significant reserves of hydrocarbon raw materials, rising world prices for fossil fuels, the recovery of demand after overcoming the consequences of the pandemic, but also by great prospects for the use of RES. The risks of a sustainable transition to a low-carbon economy for Russia are mainly related to sanction restrictions, the policy of "cancellation" and the inability to access Western innovative technologies, the possibility of changing the priorities of state development and the need to ensure the required level of social security for the population. In modern conditions, the policy of major players in the oil and gas market can also be adjusted, promising areas of RES development temporarily "frozen".

5 Conclusion

Based on the analysis of the results of the work carried out, the following conclusions can be drawn:

1. Today, the urgency of the transition to a low-carbon economy on a global scale is difficult to overestimate due to climatic change and the increased risk of environmental disasters. As a result of the conducted research, it was found that the current difficult political situation, the impact of the sanctions on economy, the decline in the standard of

population's living in many developed countries, increasing inflation lead to the fact that previously declared plans to build a "green" economy are exposed to significant risks.

In this situation, the Russian Federation, despite the sanction restrictions, has great potential for a successful transition to a low-carbon economy and compliance with the declared international requirements to reduce greenhouse gas emissions. The increase in the cost of hydrocarbon fuel, the additional profits received, the wide potential for the development of RES provides additional opportunities for the transition to alternative energy, the creation of energy-efficient and environmentally friendly industries.

3. A survey conducted among experts of Russian and joint ventures in the energy sector, oil-producing and refining industries, and the petrochemical complex showed that the main risks of Russia's successful transition to a low-carbon economy include the following: sanction restrictions, lack of access to advanced technologies and developments of Western states; inability to negotiate with other (friendly) countries in issues of joint development of RES projects; financial constraints caused by the stagnation of the economy, the impact of inflationary changes taking place in Western countries on the global agenda; reduction of state priorities for the development of RES due to the need to address other issues; the need to support oil and gas industry enterprises and artificial "containment" of the implementation of RES projects; internal policies of companies in the energy sector, oil and gas and chemical industry, temporary abandonment of RES projects (50% of respondents).

4. The respondents identified the following as possible ways to reduce the risks of switching to a low-carbon economy: changing government policy, improving the regulatory framework, creating promising development programs and switching to low-carbon fuels; using additional revenues from increasing the cost of hydrocarbons on the world market for the implementation of RES projects, allocating this area to a priority area of scientific research and practical application; economic (tax) incentives to abandon carbon fuels and switch to RES, increased penalties against companies that violate environmental requirements; expansion of cooperation between the BRICS countries in the development of innovative technologies; investment and financial support from government agencies for the transition to hydrogen fuel, the development of the domestic electric vehicle industry, the creation of appropriate supporting urban infrastructure and active implementation of alternative energy projects (solar, geothermal, tidal, etc.) in regions with significant potential for their development, attracting private business, using PPP.

In the light of the above, we consider it necessary to continue conducting more in-depth and detailed studies on the risks of transition to a low-carbon economy. The purpose of such studies could be to analyse the development of the situation both globally and nationally, identify and quantify possible risks, build predictive scenarios for the development of a "green" economy, taking into account all new challenges and potential opportunities, as well as develop government approaches to stimulating business to increase production energy efficiency, reduce hydrocarbon emissions, implementation of RES projects.

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