



Research article

International cooperation on climate research and green technologies in the face of sanctions: The case of Russia

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Abstract: The purpose of this study was to develop the theoretical model for the regime of anti-Russian sanctions against the climate R&D sector, as well as the related green finance sector. Achieving this purpose was carried out on the basis of using the system of the following methods. 1) A method of discursive analysis was applied to texts and statements that occur in scientific articles, analytical reviews and notes in electronic media and discussion pages on the Internet. 2) Meta-analysis was applied to both original works and to primary materials of an empirical nature containing statistical data, which are sometimes of a variable nature. 3) The methodology of stochastic factor analysis served as the basis for considering sanctions as factors that probabilistically determine various changes in Russian science and technology policies and science legislation. 4) The use of the foresight method was aimed at identifying options for the medium- and long-term development of Russia's participation in international cooperation in the field of climate R&D while under sanctions. According to the developed model, the regime of scientific sanctions against Russia is aimed at breaking cooperation with Russian participation at the level of programs and projects. The institutionalization of scientific ruptures has several aspects, such as the freezing of personal contacts, the suspension of funding, as well as the supply of equipment and the provision of services for its maintenance. The peculiarity of scientific sanctions against Russia lies in the unprecedented combination of the national and global scales of their consequences. The study concludes that, due to Russia's significant contribution to climate change, the consequences of scientific, economic and financial sanctions have a negative cumulative effect on the implementation of the global climate agenda. This means the emergence of problems in reducing greenhouse gas emissions due to the

partial abandonment of previously formulated climate goals. The model proposed in this study reveals Russia's response to sanction challenges, which means that Russia continues to follow the trend in the development of climate science and improve the institution of green finance.

Keywords: climate agenda; climate R&D; international cooperation in science; international climate projects; Russia; anti-Russian sanctions; green finance; climate policy

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1. Introduction

One of the most significant challenges facing modern humanity is climate change. Solving the problem of climate change adaptation and mitigation requires extensive international cooperation. This is reflected in the agreed upon sustainable development goal (SDG) to “[t]ake urgent action to combat climate change and its impacts” (SDG No. 13)¹. This goal, like other SDGs, involves such means of achievement as financial mechanisms, capacity building and trade development, as envisaged in SDG No. 17. It should be emphasized that important issues on the global climate cooperation agenda include not only the use of flexible green finance tools, but also the intensification of international cooperation in the field of science, technology and innovation (STI). The fact is that, as it was noted once in the Special Report of Working Group III of the International Panel on Climate Change on the “methodological and technical aspects of technology transfer”, the increased use of scientific knowledge and innovative technologies for adaptation to climate change and the mitigation of its consequences can constitute an important component of an effective solution of the problem caused by this phenomenon².

However, as follows from the new documents of the Intergovernmental Panel on Climate Change, the intensity of international cooperation and interconnectedness in the climate sphere is far from the level that is necessary to mitigate the effects of climate change³. It seems that such a conclusion is quite relevant in relation to international cooperation in STI. The difficulties that arise are caused by differences in the scientific and technological potential of the parties, a lack of funding and shortcomings in scientific diplomacy. This may also include various organizational, legal and communication barriers, and no doubt the lack of scientific diplomacy. In turn, the events of the last year, namely, imposing massive sanctions against Russia, make it possible to be convinced of the

¹ Transforming our world: The 2030 Agenda for Sustainable Development // A/70/1 of September 18, 2015. Available from: <http://www.un.org/ru/documents/ods.asp?m=A/70/1>

² Management of technological change. Explanatory Summary of the Special Report of the IPCC Working Group on Methodological and Technical Aspects of Technology Transfer. Geneva, 2001, p. 3. Available from: <https://archive.ipcc.ch/pdf/special-reports/spm/srtp-en.pdf>

³ IPCC. Climate change 2021: The physical science basis. Contribution of Working Group I to the sixth assessment report of the Intergovernmental Panel on Climate Change. Masson-Delmotte V. et al. (eds). Available from: https://report.ipcc.ch/ar6/wg1/IPCC_AR6_WGI_FullReport.pdf

existence of another barrier, such as scientific and technological sanctions in the climate sphere. It must be understood that sanctions in the field of science and technology mean the termination of international cooperation, an integral part of which is the termination of funding for joint programs and projects in STI. Moreover, scientific sanctions (i.e., the termination of cooperation in the field of R&D) and technological sanctions (i.e., the termination of technology transfer) are closely related to financial sanctions, affecting, among other things, green finance. All of this makes it difficult to get the planned joint scientific and technology results, which is so necessary for the practical response to climate change. In addition to this, there is a slowdown in national technological modernization that is in line with green transformation.

The relevance of the topic of the given article lies in the fact that the case of sanctions against Russia is unprecedented. This applies not only to the number of anti-Russian sanctions, but also to the nature of their consequences. In general terms, the novelty of the situation is reflected in some generalizations formulated by representatives of the expert community. As Davydova (2023) notes, under the sanctions, Russia's problems with access to green technologies and international financing will only grow. Moreover, Moscow should not rely too much on new partners, as they are more interested in obtaining Russian natural resources at a discount than in high-tech cooperation in green development. It must be acknowledged this conclusion is rather categorical. In particular, according to the research company "Refinitiv", about 70% of Asian companies are implementing climate initiatives to one degree or another. This is complemented by increased attention to other areas of the environment, society and good governance (ESG) agenda⁴.

Thus, the consequence of the sanctions is the emergence of difficulties in the implementation of Russian plans for a green transition, which is largely carried out in line with the national climate policy and with the fulfillment of international obligations under the Paris Climate Agreement. However, there are also broader implications, namely, a slowdown in the process of achieving SDGs at the national level. The prospects for such a slowdown are also related to the fact that, for the transition to sustainable development, it is important to use the results of scientific research and technological developments. In turn, anti-Russian economic and financial sanctions are often associated with scientific and technological sanctions that hinder the development of the Russian climate R&D sector.

Therefore, it would not be a mistake to say that the implementation of Russia's green transition plans in the context of the sustainable development strategy, including the achievement of the goals of the Russian climate policy, is negatively affected by sanctions affecting the field of green and climate R&D.

Meanwhile, the uniqueness of the case of Russia lies not only in the seriousness of the consequences of sanctions for its national development, but also in their consequences for the whole world. It is known that sanctions cause damage not only to the country against which they are introduced, but also to the country that imposes them. The specificity of the current crisis in international relations is that sanctions also impact global goals and benefits. This is obvious enough.

The core of global goals is SDGs, and the preservation of the planet's climate in its current state is a global public good. It is quite reasonable to believe that economic sanctions against Russia

⁴ Refinitiv. Financial Data Catalogue. Available from: <https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiZt8f-7YL3AhXNiIsKHY3sCR8QFnoECB0QAQ&url=https%3A%2F%2Fwww.refinitiv.com%2Fen&usq=AOvVaw3ynU2FKYPm9YTS8VIBAnG>

indirectly threaten serious global climate consequences. According to I. Sechin (June 18, 2022)⁵, chief executive officer of the Russian national corporation “Rosneft”, anti-Russian sanctions have effectively ended the global green transition. At the same time, the residual “green rhetoric” conflicts with real practice, which is now aimed at finding any source of hydrocarbons at any cost, instead of Russian ones⁶. In this situation, for example, the prospects of the European Green Deal are called into question. Nevertheless, green growth around the world will continue in one way or another, but it will be inconsistent and uneven.

In addition, the achievements of climate science and the achieved level of its institutionalization should also be attributed to the global public good. In this regard, anti-Russian sanctions harm both global SDGs and global climate science, as well as related technological developments, since Russia makes a significant contribution to their generation and use. Indirectly, the decline of Russia’s scientific and technological potential may accelerate adverse climate change and weaken the ability to adapt to it and mitigate its consequences on a global scale.

In this regard, the purpose of this article was to form a model of anti-Russian scientific and technological sanctions, as well as to determine their consequences both for Russia and for the implementation of the global climate agenda.

2. Literature review

The subject matter of the article is at the intersection of several problematic issues.

First, this is the negative impact of such a category of sanctions (i.e., scientific sanctions) on the development of climate science and green technologies in Russia, as well as on curtailing of the involvement of the Russian climate R&D sector in international relations.

Second, this is the impact of economic sanctions on Russia’s climate policy and, ultimately, on the global climate agenda and the climate of the planet.

Third, this is the negative impact of sanctions on the development of green finance in Russia. The fact is that green finance determines the success of the R&D sector and allows the launch of green projects, which contribute to the fight against climate change. However, the further successful development of the green finance sector in Russia is overshadowed by serious problems in the face of sanctions. This has consequences not only for the growth of climate problems in Russia, but also on a global scale.

According to the author’s approach, in the current scientific literature, a comprehensive understanding of the relationship of these problematic issues, taking into account the specific position of Russia, has not yet been developed. However, there are prerequisites for such an understanding.

⁵ The head of “Rosneft” said that the sanctions against Russia ended the “green transition” in the world (June 18, 2022). Available from: <https://newprospect.ru/news/aktualno-segodnya/glava-rosnefti-zayavil-chto-sanktsii-v-otnoshenii-rossii-pokonchili-s-zelenym-perekhodom-v-mire/>

⁶ The head of “Rosneft” said that the sanctions against Russia ended the “green transition” in the world (June 18, 2022). Available from: <https://newprospect.ru/news/aktualno-segodnya/glava-rosnefti-zayavil-chto-sanktsii-v-otnoshenii-rossii-pokonchili-s-zelenym-perekhodom-v-mire/>

2.1. Modern theory of scientific sanctions: Significant results

The foundations of the theory of scientific sanctions have been formed in the academic community relatively recently. Experts in the field of scientific sanctions justify that scientific sanctions are purposefully aimed at creating barriers to the development of science and technology in sanctioned countries. In general, scientific sanctions against some states are a phenomenon that is quite widespread in the practice of international scientific and scientific-technological cooperation. There are similarities with this type of sanction against some states, including their varieties and patterns in the manifestation of their consequences, as well as in the response of affected states to these sanctions.

The largest body of research is devoted to sanctions against science in Iran. Special articles have analyzed in detail the typology of sanctions and their implications for Iranian science and the participation of Iranian scientists in international cooperation (Butler, 2019; Zarghami, 2013; Kokabisaghi et al., 2019; Tarikhi, 2020; Ghoddousi, 2017). The foreign literature also contains works in which there is a detailed analysis of scientific sanctions against other countries; for example, those against Sudan (Bezuidenhout et al., 2019). The author of this article identified the types of sanctions that have been applied against the Sudanese scientific sector, as well as the problems of access of Sudanese scientists to the international research community. Similarly, scientific sanctions against Iraq have resulted in the limited access of Iraqi scientists to medical literature, an inability to publish in Western journals and an inability to participate in scientific meetings (Sansom, 2004). These scientific works not only represent an analysis of a kind of primary “field material”, but they also contain some explications of patterns in relation to scientific sanctions, their types and consequences. All of this means the formation of prerequisites for the development of the theory of international scientific sanctions.

Kokabisaghi et al. (2019) have concluded that “academic boycotts violate the freedom of researchers and hinder progress. The free exchange of ideas regardless of creed is essential to optimize global scientific progress”. This is a very important conclusion, which shows that the issue of scientific sanctions is closely related to the paradigm of open science and the problem of implementing academic freedoms as an “engine” of the progress of science and education. In addition, in the specialized literature, questions about the effectiveness of sanctions and the response of the scientific community are raised. This approach is quite appropriate, since it is known that the effectiveness of sanctions, along with their selectivity and their consequences, is one of the key elements of the theory of economic and political sanctions, with which scientific sanctions not only intersect, but also have a similar content structure. In particular, it is recognized that modern science is vulnerable to political sanctions. The World Medical Association describes academic sanctions or boycotts as “discriminatory restrictions on academic, professional, and scientific freedoms that deprive or exclude physicians and others from educational, cultural, and scientific gatherings and other opportunities to share information and knowledge” (Mousavi et al., 2015).

In a more detailed form, elements of the theory of scientific sanctions are presented in the above-mentioned work devoted to the study of scientific sanctions against Sudanese scientists (Bezuidenhout et al., 2019). It explicitly acknowledges that academic systems of research and education are often overlooked areas that are affected by sanctions that are not only financial, economic and political, but also scientific. Here, the question is raised about the non-selectivity of the actions of economic sanctions in the area of influence of which science often falls. The advantage

of this work is that it provides a comparative analysis of the economic and scientific sanctions that were imposed on Sudan, Iraq, Iran, Serbia and South Africa.

One of the few general works is a small article of Esmaeili and Ataie-Ashtiani (2021). It contains quite critical remarks regarding economic sanctions and their impact on science in terms of upholding the principles of academic freedom and freedom of scientific research. Moreover, a remark is made regarding the fact that these freedoms under the conditions of sanctions must be defended based on national and international law.

In addition, we should highlight a special article on scientific boycotts, which traces the historical stages of the complications of international cooperation in connection with sanctions against certain countries (Gordin, 2022). However, this author does not address the current situation of the anti-Russian scientific sanctions regime.

Due to the fact that science includes a variety of activities, institutions and policies, the question arises about the system of aspects that are affected by sanctions. In a systematic form, they are given in the article by Mansouri (2018). The originality of this work lies in the fact that aspects of such impact are considered on the example of an active response to sanctions by the science and technology policy of Iran. As a consequence, increasing national funding for science, encouraging the development of a science and technology policy, mobilizing knowledge production and, where possible, activating international cooperation, took place in practice.

Intermediate conclusion. Currently, there are no scientific works of a general and special nature that would analyze the impact of scientific sanctions themselves on the development of research and technological developments in the climate area.

2.2. *Scientific sanctions against Russia as a subject matter of the current scientific research*

The sanctions regime against Russian science is one of the concrete reflections of international scientific sanctions. Due to its transience, the ongoing processes of the academic “boycott” to Russia in 2022–2023 have not yet been comprehensively understood in Russia or by the foreign scientific and expert community. There are statements, empirical descriptions of ongoing processes and forecasts. However, the theoretical picture of anti-Russian scientific sanctions aimed at slowing down the development of Russian science and its inclusion in world science is at the stage of formation.

The list of a few purely theoretical works concerning the current regime of anti-Russian sanctions in the field of science includes the work of Placket (2022). It raises two main questions. The first is about how Russian science will develop in the context of a reduction in the scale of Russia’s participation in international scientific cooperation in connection with measures to suspend such cooperation by Western countries for an indefinite period. Second is the question of whether the West should stop its scientific exchanges with Russia. In general, the situation of uncertainty regarding the preservation or non-preservation of cooperation, as well as the duration of its suspension, was emphasized. Another work touches upon the problems of scientific relations between Russia and foreign countries that have not imposed sanctions against Russia (Mallapaty et al., 2022). These are, first of all, China, India and Brazil. However, this article does not answer the question of to what extent these areas can compensate for the damage to Russian and world science

as a result of the suspension of Russian cooperation with states that have introduced economic and, along with them, also scientific sanctions.

The significant amount of analytical materials in which sprouts of theoretical understanding of the anti-Russian sanctions regime in relation to the R&D sector are visible, although they suffer from presenting as an overview. Noteworthy is a special report on the changing circumstances in which Russian science will have to exist and develop (Delards et al., 2022). Despite the fact that, in this report, a lot of attention is paid to ways to support Ukrainian science, a significant place is given to the concept of the validity of anti-Russian scientific sanctions. Decisions to sever ties with Russian scientists and institutions are based on the desire to influence the Russian government. However, it is pointed out that individual scientists have to bear responsibility for the actions of the government. This raises the issue of the validity of turning individual scientists into the target of sanctions. This question is answered by Koonin (2022). He believes that, if the sanctions are seen as retaliation, which is highly doubtful, then, indeed, individual scientists can become a target. However, as we can see, the theory of retribution does not work in the case of anti-Russian scientific sanctions, unlike, for example, political sanctions.

With returning to the report prepared by Delards et al. (2022), it must be noted that Koonin (2022) also raises important conceptual issues, such as the need to protect academic communication with Russian scientists, the prioritization of horizontal sanctions that allow maintaining of the moral and practical distinctions between the actions of the government and individuals. Thus, restrictive measures should be applied on a case-by-case basis, cover the affected scientific teams and should not become an ultimatum.

A significant amount of review materials, in which generalizations of a conceptual nature occur, is devoted to the problem of anti-Russian sanctions. Such materials posted on news pages and in electronic media on the Internet began to appear at the end of 2014, when the first signs of anti-Russian scientific sanctions made themselves known. At the same time, one can see the introduction of the term “blockade” into circulation, which was used as part of the phrase “international scientific blockade” of Russian science. In scientific journals, a number of barriers were identified for the participation of Russian scientists in international cooperation and for the development of Russian science, which fall under the category of “scientific sanctions”. However, the intensity of these difficulties was still not as fundamental as it has been since the end of February 2022. In this regard, modern reviews widely use the terms “tsunami of sanctions”, as well as “cascade of sanctions”. All of this reflects a truly unprecedented situation that is of concern not only to Russians, but also to the Western academic community. As a result, a significant amount of materials appeared on the Internet that were devoted to the problems of Russian participation in international scientific cooperation. They pay special attention to the search for an answer to the question of what future awaits foreign scientific collaborations in Russia.

Thus, a subject area of research has emerged that analyzes the state of international cooperation, as complicated by sanctions. There is an initiative to hold a broad discussion about possible actions in this domain, marked by conflicts and political tensions. In 2023, there was a continuation of the discussion. New trends include concretization of the study of scientific sanctions and their results in relation to various fields of science and international cooperation. And, climate science is no exception. Unfortunately, the given studies, in which the author of this article will refer to in the

course of his research, are of an empirical nature and are not supplemented by a view of the sanctions barriers from the Russian point of view.

Intermediate conclusion. There is a formation of a circle of studies in which scientific sanctions against Russia are analyzed. However, there are no special works devoted to the impact of sanctions on Russian climate R&D and on the prospects for Russia's involvement in the relevant global climate R&D chains.

2.3. Environmental impacts of economic sanctions and sanctions as an element of the climate regime: Controversial issues

In recent decades, the theory of economic sanctions has been developed, including from the point of view of considering them as an alternative to war and an instrument of indiscriminate action, etc. (Bergeijk, 2021; Early, 2020; Habibzadeh, 2018; Davis and Engerman, 2003; Chan and Drury, 2000). Criteria for the degree of their effectiveness have been developed (Jones and Portela, 2020; Hayes, 1997), including the theory of the effectiveness of targeted sanctions (Giumelli, 2016; Eriksson, 2009) and their classification into negative or positive ones (Caruso, 2021; Newnham, 2002). At the same time, it has been found that economic sanctions affect certain areas, such as culture (Dricoll, 2010), education (Hwami, 2021), distribution of national wealth (Afesorghor and Mahadevan, 2016) and human rights (Peksen, 2009).

But, perhaps the most important for our study is the relatively new direction of studying the impact of economic sanctions on the environment and climate. These works show that it is rather limiting to reduce the discussion of the results of sanctions only to their political and economic consequences and not to take into account emerging environmental risks, including risks in relation to the human right to a healthy environment. A number of studies have shown that economic sanctions have a negative impact on the environment in the affected state (Madani, 2021; Fu et al., 2020; Fotourehchi, 2020; Jowkar et al., 2016; Lewis and Madani, 2016; Madani and Hakim, 2016; Portela, 2016; Soroosh and Madani, 2014; Carucci, 2000). In these and other works, researchers and experts show that, in order to avoid the deterioration of the economic situation, states under sanctions adhere to survival strategies that involve accelerated environmental degradation. Of course, economic sanctions are far from the only cause of environmental problems in the countries that are subject to sanctions. But, there is no doubt that sanctions are a noticeable catalyst for environmental degradation.

In the list of studies on the environmental impacts of sanctions, the work of Madani (2020) stands out. In this article, the author takes the first step in creating a theoretical framework for examining the environmental impacts of sanctions by developing a general causal model that explains how economic sanctions can affect the environment.

Since climate protection issues are currently present in the discourse of environmental protection, a completely new circle of research has appeared, in which sanctions are considered from the perspective of their transformation into an element of global, regional and national climate regimes. Unlike the usual economic sanctions applied to certain countries and indirectly determining negative environmental consequences, climate sanctions, on the contrary, are designed to protect the environment. Thus, they should help to curb climate-damaging behavior such as illegal logging, dirty manufacturing and corruption. It should be emphasized that a model of climate sanctions as a means of protecting the

planet's climate is in the process of formation (Cirone and Urpelainen, 2013). Hagen and Schneider (2021) believe that trade sanctions can become an effective climate policy tool only after a sufficiently large climate coalition is formed (Hagen and Schneider, 2021; Nordhaus, 2015). In addition, they believe that the responsibility of future policymakers and academia is to expand research on the interdependence between war, sanctions and the environment to help develop policies that are more in line with sustainable development and the goals of the Paris Climate Agreement.

What has prompted the desire to develop a climate sanctions model? According to Okonkwo (2017), the Paris Climate Agreement provides for the control of climate change, but this is one area that is difficult to control. The absence of binding targets and, as a result, the absence of possibility to use sanctions, makes it difficult to implement this treaty. However, there is a reserved approach to climate sanctions as a tool to influence countries that do not perform their international climate obligations (Grimalda et al., 2022).

Indeed, in the face of economic and scientific sanctions, Russia, for example, faces the challenge of realizing its national climate policy goals. Accordingly, the hypothetical imposition of climate sanctions would look quite absurd. As with other sanctioned states, the prohibitive and destructive nature of sanctions can lead to suffocating consequences. In the situation of the Ukrainian crisis, which showed a high degree of attachment of the modern world to fossil fuels, the scale of the climate club is not so large that climate sanctions have a legitimate character.

At present, a targeted model of climate sanctions looks more acceptable. Proponents of this type of model suggest the application of climate sanctions against corporations, not countries. According to Slack (2021), green sanctions, within this model, can quickly change the way global finance looks at climate change. However, the application of this model to sanctioned state enterprises also raises a lot of legitimate issues. This can be justified by the fact that the imposing climate sanctions not only against states, but also their enterprises, which are already objects of economic sanctions, can cause their economic collapse as a whole.

The approach expressed by Bub (2020) seems to be quite balanced. He believes that the introduction of a climate sanctions regime is quite promising. But, nevertheless, the climate crisis is a challenge that should be addressed primarily, not by the imposition of sanctions, but through international cooperation; particularly, the transition to a sustainable world must be carried out within the framework of a political world order based on multilateral agreements, community and cooperation.

Intermediate conclusion. In the list of scientific works, the authors of which investigate the negative impact of economic sanctions on the environment of the affected state, there are no special works that are devoted to understanding the case of Russia. However, the problem of the impact of economic and financial sanctions on Russian climate policy, as will be shown below, is nevertheless formulated by the expert community.

2.4. Green finance market in Russia as a focus of scientific research

The global financial markets are dominated by a green agenda. Governments encourage investment in sustainable and environmentally friendly companies and projects. As a result, businesses that harm the environment are at a competitive disadvantage. This model relies on so-called green financial instruments. Russia has not absolved itself from these processes. At the same time, each country is looking for its own

way to form a mechanism for financial support of innovations and investments in the field of green modernization. The purpose of the latter is to implement structural shifts toward environmentally sustainable production and consumption in accordance with global goals and national development priorities. As a result, there has been an increase in publications on the development of green finance in Russia (Dudin et al., 2022; Vasilyeva and Bakrunov, 2022; Belousov, 2022; Bobylev, 2021; Zimina and Finogenova, 2021). In general, the list of scientific studies on the development of green finance tools in Russia is huge. However, these studies are carried out in a narrowly specialized manner, i.e., their results are not in the broader context of the triad “sanctions on the Russian sector of climate R&D—global climate agenda—green finance”.

2.5. The contribution of the article to the solution of the scientific problem posed

This study was carried out by taking into account the above-analyzed scientific achievements and the results formulated by other authors. However, this study not only contributes to the solution of scientific problems related to sanctions, but it also constructs a new subject research area at the system level. It models the multi-component anti-Russian sanctions regime in the climate R&D sector as a subject matter of special scientific study.

In the course of studying this regime, undertaken by the author of the given article within the framework of the original author’s model, scientific results should be assessed as scientific achievements and, moreover, as a contribution to the area of research on international sanctions. The contributions are as follows:

- for the first time in the scientific literature, the regime of anti-Russian scientific and technological sanctions in the field of climate research has been studied. This contributes to the theory of scientific sanctions, as well as to the direction of research focused on the relationship between economic sanctions and the environment;

- the nature and instruments of the international regime of scientific sanctions in the climate sphere are disclosed;

- the regime of scientific anti-Russian sanctions is considered in the broadest context of the importance of science and technology, as well as of green financing in the process of transition to sustainable development and the achievement of the goals at the national and global levels;

- the author of the article shows, through the example of Russia, that not only economic, but also scientific sanctions, have a negative impact on the environment and climate;

- anti-Russian scientific, and with them, economic and financial sanctions, are considered as a disruptive factor that not only causes failures in the implementation of the national climate policy in its scientific, economic and financial aspects, but they also act as a factor in its adjustment;

- a concept was formulated according to which anti-Russian scientific sanction, as well as related technological, economic and financial sanctions, have an unprecedented resonance not only in the area of global climate science, but also in relation to the planet’s climate.

3. Materials and methods

3.1. Research program

As noted in the introductory part of this article, as well as at the beginning of Section 2: Literature Review, the subject matter of the article is complex. It means that achieving the purpose of the article involves conducting multi-vector research, both theoretical and empirical.

In the first case, this is a systematic understanding of anti-Russian scientific and technological sanctions in the climate area as a significant obstacle to international cooperation in the field of climate STI, including Russia's fulfillment of obligations under the Paris Climate Agreement, as well as the implementation of national climate plans to reduce anthropogenic greenhouse gas emissions.

In the second case, this is an analysis of the negative impact of such a category of sanctions (i.e., scientific and other related sanctions) on the development of Russian climate science, international scientific cooperation with Russia's participation in the climate area, as well as on the development of the green technologies and green finance sector in Russia. A special subject matter of attention is the mutual intersection of Russian climate policy and Russian policy in the field of science and technology, both at the level of the national and international dimensions in the context of sanctions.

The author of the article intends to show that anti-Russian sanctions in the regarded area not only lead to the disruption of research planned by Russian and foreign scientists, but also to problems in the implementation of the global climate agenda. Equally important is the analysis of the financial support of the green projects in Russia before and after the imposition of large-scale sanctions against it. Additionally, the research program for the presented article involved a rigorous study of Russian climate policy measures aimed at supporting both the R&D sector and the green finance sector, which are tools of the green transition, as well as an idea that which Russia does not intend to refuse.

The scientific program for the article is very rich and diverse. This is predetermined by the fact that scientific sanctions, as well as technological sanctions, are at the intersection of science, economics, law and politics. Consideration in the presented article of all of these aspects, which converged in a unique way in the case of Russia, predetermines the novelty, originality and scientific significance of the article.

3.1.1. Research hypothesis

The implementation of the planned program was aimed at testing the research hypothesis. This hypothesis involves the emergence in 2020–2023 of an unprecedented international anti-Russian regime in the field of climate R&D, which as it seems to the author of this study, includes financial sanctions and has a negative impact not only on Russian climate science and climate policy, but also on the global climate agenda as a whole, which is known to be a reflection of the global sustainable development strategy.

3.1.2. Theoretical model design

This study formulated a theoretical model of the regime of anti-Russian sanctions that specifically affect the climate R&D sector.

According to this model, a climate sanctions regime has a combined character. Its target components are similar to those of any other sanctions regimes. The difference lies in the subject area of targeted sanctions. In the case under consideration, the subject of sanctions is the Russian climate R&D sector, as well as its involvement in international cooperation. According to the proposed model, this means the suspension of funding for programs and projects, while the supply of equipment and the provision of services for its maintenance are stopped. In both cases, this leads to curtailment of scientific research.

It would seem that these points repeat, in general terms, the scientific sanctions against any other countries. However, the model of scientific sanctions against Russia differs in the terms of the combination of the national and global scales of their consequences. Thus, this sanctions regime is far from safe, not only for the scientific and technological potential of Russia, but also for the entire global climate science.

Another aspect of the model analyzed is that the regime of anti-Russian scientific and climate sanctions has nothing to do with the regime of climate sanctions proper, since the latter has not even been developed at the multilateral international level. But, there is close contact with the economic and financial sanctions imposed against Russia, which negatively affect the environment and the implementation of government climate policy. Due to Russia's significant contribution to climate change, the consequences of scientific, economic and financial sanctions have a cumulative effect on the global climate and the global climate agenda. This means that there are problems with the implementation of plans to reduce greenhouse gas emissions due to the partial abandonment of previously formulated climate goals.

And, finally, the model proposed in this study reveals Russia's response to sanction challenges. In particular, there is a search for innovative ways to reduce the negative impacts both on the environment and in the area of science and technology. The model reflects the patterns according to which sanctions, in the case of Russia, that affect various aspects of the climate sphere (scientific, financial, political) do not have the devastating consequences for which they were designed.

3.2. Theoretical background

3.2.1. General theoretical vision

Initially, it should be noted that the combination, within the framework of the presented study, of the analysis of differentiated sanctions in the areas of both scientific research and technological developments should be justified by the connectedness of scientific research and technological developments within the framework of a single sector. In addition, the research subsector, together with the technological developments subsector, act as links in a single innovation system aimed at reconfiguring society and the economy in the direction of an effective response to climate change. The knowledge gained in the course of scientific research has not only theoretical significance, but it also has practical value. On the one hand, measures to support and stimulate scientific research are in demand. On the other hand, favorable conditions are needed for their use as part of technological developments, as well as for the basis for the formation and implementation of socioeconomic measures. One of these measures is the dynamic development of a multi-level system of green finance.

An essential type of green finance is climate finance, which is understood as “financing of investment projects aimed at preventing or mitigating climate change, as well as adapting to the consequences of climate change” (Yakovlev and Kabir, 2019). From our point of view, an important component of these projects is the usage of climate technologies. However, financial support for the R&D sector is not a less important area of climate finance. In the face of international competition for green and, respectively, for climate finance, any problems in international relations, for example, caused by sanctions in the field of R&D and finance, hinder the development of national scientific and technological capacity and slowdown the ability of the target countries to solve the climate problems.

3.2.2. Theoretical aspect of international cooperation in the area of climate STI: Aims and regulation

Achieving an understanding of the forms and consequences of sanctions that weaken the scientific and technological potential of Russia in the area of climate and lead to the freezing of its participation in international scientific and technological cooperation requires a theoretical understanding of the broad picture of modern international cooperation in the area of climate STI.

The framework for managing global scientific and technological progress as a way to solve problems that arise in various sectors related to the transition to sustainable development is set by international climate law. One of the directions for realizing the purpose of international law in this area is the effective functioning of the international legal regime for the widest international innovation, scientific and technical cooperation (Shugurov, 2018a). This cooperation is a sphere of the implementation of the obligations of states enshrined in the United Nations (UN) Framework Convention on Climate Change (Article 4), its Kyoto Protocol (Article 10) and the Paris Climate Agreement (Article 10). These obligations mean the implementation and improvement of scientific and technological interaction, such as the exchange of knowledge and data, as well as technology transfer. The private sector is involved in the fulfillment of these obligations.

At the same time, it can be seen that, following the Kyoto Protocol, which uses the term “innovative environmentally friendly technologies” (paragraph 9 (iv) of Article 2), in the Paris Agreement, it is quite noticeable that the recognition of the importance of scientific and technological means is the significance of relevant innovations in general. So, paragraph 5 of Article 10 of the Paris Agreement explicitly stipulates that “accelerating, encouraging and enabling innovation are essential to an effective, long-term global response to climate change and to the promotion of economic growth and sustainable development.” This clarification is a reflection of the fact that modern scientific and technological cooperation between states has acquired the features of innovative cooperation. Indeed, without these innovative technological changes, it is in fact difficult to imagine a long-term socioeconomic development strategy characterized by low greenhouse gas emissions, which is often associated with a low-carbon development strategy. Moreover, collaboration on climate STI can have a positive impact on achievement of SDG No. 13, other SDGs and their related targets. This is not only the goal of eradicating poverty, but also of ensuring food security and eradicating hunger.

For this reason, international innovation, scientific and technological cooperation in the context of other areas (finance, trade, investment, etc.) provides for a scientific basis for climate policy at the international, regional and national levels. Here, it is important to clearly formulate the initial ideas about what is happening with the climate, what are the causes of its changes leading to negative

consequences and what needs to be done to prevent or mitigate them and reduce the level of vulnerability. In addition, without the use of scientific knowledge, it is hardly possible to formulate strategies and measures to prevent the threat of global climate change. In other words, climate policy at the national, regional and global levels seeks to be scientifically based. But, at the same time, this kind of climate policy (Galiana and Green, 2010) is combined with the scientific validity of climate law proper at the national and international levels (Ghaleigh, 2016).

Scientific and technological cooperation in the climate area, provided for by the global climate agenda, is carried out in various organizational forms, ranging from modern research to technology transfer (Maembe, 2012; Hedger, 2012; Brewer, 2008). As Russian authors note, “in the face of global threats and challenges, the world scientific community is everywhere engaged in climate change forecasting, developing more and more new models. Each model has its advantages and disadvantages, but they all prove that climate change is global in nature, and the solution to this problem requires a global approach to solving the problem and international cooperation” (Moon and Popeta, 2022). Global scientific and information cooperation is an indispensable factor in achieving the completeness of scientific knowledge. Thus, in the report on climate features in the territory of the Russian Federation for 2021, in the Chapter “Air temperature” an example is given that data on surface air temperature were obtained thanks to the operation of a network of 702 meteorological stations, of which 577 stations were located in the territory of Russia, and others were located in the territory of foreign countries⁷. This demonstrates the importance of international networking in the data acquisition process.

The institutional framework for multilateral cooperation in the area of climate STI forms is, first, the Clean Development Mechanism (Haite, 2012; DeConnick et al., 2008), and, second, the Technological Mechanism of the UN Framework Convention on Climate Change (Shugurov, 2018b).

The success of cooperation assumes sufficient funding the climate R&D. Therefore, the financial support provided by the Global Environment Facility for the implementation of projects involving the development, transfer and use of climate technologies is in high demand (Shugurov, 2019a). A significant role in financing various projects with a technological component is played by the Green Climate Fund (Shugurov, 2019b). Fulfillment of international legal obligations in the field of climate STI and their financial support contributes to the fulfillment of the tasks reflected in the 2030 Agenda for sustainable development and of the provisions of international climate agreements. However, obstacles called sanctions may arise that hinder the fulfillment of these obligations.

3.2.3. Scientific and technological sanctions in the climate sphere as barriers to international cooperation: Theoretical exposition

Scientific sanctions as a tool to influence a particular state with the aim of changing its policy, as well as forcing it to fulfill obligations related to other areas of international cooperation, including the area of security, have become a widespread practice of international relations targeted at Iran, Iraq, Sudan, etc. The scale of sanctions has prompted researchers to create the foundations of the theory of international scientific sanctions (Gordin, 2022; Esmaili and Ataie-Ashtiani, 2021; Mansouri, 2018).

⁷ Report on climate features in the territory of the Russian Federation for 2021. Moscow: Rosgidromet, 2022, Available from: <https://www.meteorf.gov.ru/images/news/20220324/4/Doklad.pdf>

From the author's point of view, a number of scientific sanctions, which constitute a restriction or even a rupture and termination of relations within the framework of various forms of cooperation (joint research and development, data and information exchange, training of specialists, etc.), most directly negatively affects the fulfillment of international obligations in the field of STI. The unilateral refusal of states, as well as individual scientific institutions, to fulfill previously assumed obligations forms the content of scientific sanctions and leads to non-fulfillment of obligations by targeted state.

In the usual practice of interstate cooperation, the refusal of one state to fulfill its obligations is quite acceptable as a form of reaction to the unfair performance by another state of its obligations under a treaty. But, the fact of the matter is that, in the case of scientific sanctions, they deal with a kind of punishment for behavior that does not belong to the R&D sector. This can be seen as a spillover of economic and political sanctions into the sphere of STI. And, that is no longer the case when sanctions act as a possible way out of the impasse that has arisen in scientific and technological cooperation. By the way, sanctions, as they are, are not a tool that can be used to solve the problems of international cooperation in the field of STI.

But, as is the case with political and economic sanctions, they also have a negative impact on the actors that impose them. In addition to this, in the case of sanctions in the area of climate STI, the situation of a negative nature becomes global. The overall result is a reduction in the global scientific and technological capacity that is necessary to combat climate change, mitigate its effects and adapt to them. At the same time, the importance of promoting transnational cooperation and actions in the field of climate research is being updated, even under the conditions of the sanctions regime.

In terms of the consequences for the sanctioned state, there is a risk that it will face difficulties in fulfilling its obligations to reduce emissions and transition to a low-carbon path of development in the form of a green economy. And, here comes the next trap. Members of the "climate club" reasonably believe that, if countries do not comply with the provisions of the climate agreements, then they should be punished in the form of increased tariffs from the countries that are members of this club (Nordhaus, 2015). Of course, these sanctions have no basis in the provisions of the Paris Agreement due to the fact that it is not a formal climate club. But, the imposition of sanctions is quite acceptable within the limits of those climate provisions that experts show are included in trade agreements (Berger et al., 2017).

But, let us not hide the fact that climate science sanctions are quite complex. They not only include a direct rupture of scientific and technological ties, but they also hinder the implementation of national policies that aim to achieve climate neutrality. At the same time, a flurry of negative effects of scientific and economic sanctions, undermining the climate viability of the state against which they were directed, creates a will to resist negative circumstances. In this case, this can be expressed in the activation of scientific, technological and economic policies, as well as in the improvement of climate finance tools. Note that only the complex nature of the implemented measures can create an effect.

In other words, the source of financing is being reduced, which can also be classified as green finance. This can be justified by the fact that green finance is intended to ensure a green transition, while the R&D sector contributes directly to ensuring this transition. All of this is closely related to the financing of green projects involving the use of green technologies.

3.3. Methodology background

The presented study was carried out on a methodological basis, which included general scientific methods of analysis, synthesis, abstraction and generalization. The author used the historical method for the process of analyzing the dynamics of anti-Russian sanctions that affected climate R&D. The study also relies on the comparative method that was used in the analysis of statistical indicators.

The author of this article relied on the method of discursive analysis, focusing on texts and statements that appear in scientific articles, analytical reviews and notes in electronic media and discussion pages on the Internet. If the questionnaire method is aimed at clarifying the opinions and positions of foreign and domestic scientists and researchers, then the discursive analysis method allows one to determine the thinking styles implemented in the assessment of the current flurry of anti-Russian scientific and economic sanctions associated with them. Thus, it will contribute to the identification of ways of rational and mental reflection of ongoing events, as well as to the degree of influence of the emotional background on it.

Due to the large flow of information related to scientific sanctions and characterized by a lack of consistency, the method of meta-analysis is relevant for the formation of a holistic picture of ongoing events. It is a way of reviewing and evaluating literature and information that allows for the testing of research hypotheses. This method addresses both the original works and primary materials of an empirical nature containing statistical data, which sometimes have a variable nature. With regard to the subject area of interest to us, this method can become the basis for testing various hypotheses regarding the measures of legal response to sanctions by the affected state.

The technique of stochastic factor analysis may well become one of the new methods used in the subject area of research under consideration. In this case, sanctions will be considered as factors that determine, in a probabilistic way, various changes in Russian science and technology policy and science legislation. In general, the use of this method forms the basis not only for describing the processes of changes in the legal regulation of science, but also for making forecasts as the basis for taking certain practical measures of a legislative, organizational and legal nature.

Using the foresight method as a way to identify options for the medium- and long-term development of Russia's participation in international cooperation under sanctions results in a systematic analysis of available expert assessments in relation to alternative scenarios. These assessments have been systematized and classified, as well as used as the basis not only for theoretical constructions, but also for conceptual models of appropriate measures to overcome and mitigate the consequences of international anti-Russian sanctions in the field of science. Using this method allows one to see the whole picture, as well as to evaluate the best scenarios, which depend on the practical measures taken. Moreover, foresight involves the coverage of assessments of experts from various fields of activity and those who are directly interested in solving the problems discussed in this article.

The system-synergetic approach and its characteristic conceptual apparatus have a high level of heuristic value. Its use makes it possible to develop a new qualitative understanding of the processes of isolation, self-isolation and autarky in the field of science, including the processes caused by sanctions.

In the course of the study, the entropy approach, which arose within the framework of the system-synergetic approach, was used. It is a model for describing the accumulation of uncertainties in the system and allows one to establish the patterns of the onset of entropy equilibrium and justify the

occurrence of instabilities and catastrophes. The use of the entropy approach in the implementation of the presented study is determined by the fact that sanctions in relation to the participation of Russian scientists in international scientific cooperation are characterized by institutional gaps at the level of scientific centers, programs and projects, when interaction is suspended for an indefinite period. From this arises psychological and organizational frustration. However, if, in relation to economic sanctions there is an opinion that they have reached their quantitative and qualitative limit, then, in relation to scientific sanctions, such a conclusion is problematic. In addition, it is very promising to use this approach to analyze the general state of Russia's participation in international scientific cooperation, some areas of which are affected by sanctions, while others are not.

The present study is based on game theory. As is known, this theory performs the function of a method for studying optimal strategies in games, understood as a process in which two or more parties participate, fighting for the realization of their interests. In essence, from the point of view of game theory, sanctions are not only coercive measures, but they are also means that are designed to force the other side to play according to other rules that are beneficial to the rule-defining side.

3.4. Used data for empirical analysis

In preparing the study, the author used a variety of official data, including statistics relating to the following:

- (1) Russia's climate policy.
- (2) Russian state scientific and technological policy in the area of climate research and climate technologies.
- (3) Development of Russia's international cooperation in the field of climate R&D.
- (4) Examples of targeted sanctions against international programs and projects in the area of climate R&D with the participation of Russia.
- (5) Assessments by the foreign scientific community of the negative impact of anti-Russian sanctions on the progress of global climate science.
- (6) Impact of sanctions on the state of Russian green finance and on the prospects for the development of its climate technology sector.
- (7) Response measures of the Russian government, the Russian academic community and businesses regarding the need for further implementation of climate policy in the context of sanctions and the development of the climate R&D sector.

4. Empirical analysis and its results

4.1. Russian policy in the field of climate scientific research and technologies: Qualitative and quantitative analysis

For a long time, Russia has remained in the eyes of the world as a community hostage to the image of a conservative supplier of fossil fuels, which, for many years, was skeptical about the topic of climate change. An additional argument was that the country is neither a recipient nor a mandatory donor of funds for climate programs. However, in recent years, the topic of climate in Russia has

gained considerable popularity. This is reflected in the transition to proactive actions aimed at supporting the competitiveness of the national economy in the context of climate policy⁸. The national climate policy followed in the wake of the global agenda and is in line with the fulfillment of obligations under international climate treaties. In Russia, it is recognized that “the main trend in the development of climate regulation is the desire to achieve “carbon neutrality”—a state where anthropogenic greenhouse gas emissions are leveled by their absorption. At the same time, international regulation only sets a general vector: specific measures are determined at the national level and depend on the political will of states”⁹.

In a relatively short time, Russian climate policy, including the political will of the state, has become the subject of a wide range of scientific research studies. In these studies, its results are defined in a generalizing form. Problematic issues are noted. One of them is its correlation with the tasks of socioeconomic development of the country. The researchers emphasize that “Russia’s climate policy is formed in a complex environment, which is characterized by a multi-vector discussion covering a wide range of problematic issues. Nevertheless, the main problem of the discussion is the assessment of the impact of climate policy measures taken in accordance with international decisions on the growth of the national economy. It is the recognition of threats to the growth of the national economy as a result of the implementation of climate policy that acts as the main deterrent to its formation, as well as the lack of nationally formulated priorities of national climate policy that allow achieving socio-economic goals of sustainable development, and not contradicting them” (Yakovlev et al., 2020).

Other authors emphasize that an effective climate policy is in the process of formation in Russia. So, Veselova (2021) points out that “despite the adopted national documents the existing and institutional framework, it is too early to talk about the implementation of a full-fledged policy of Russia in the field of climate change. Our country is still at the initial stage of the formation and development of climate policy”.

In turn, Koshkina (2020) identifies factors that hinder the implementation of an effective climate policy. She notes that “the current state policy is based mainly on the voluntary participation of large companies in the implementation of measures and projects to combat climate change, which oppose the establishment of strict restrictions and the use of market regulatory mechanisms. It follows from this that the success of climate policy remains in question. To date, climate policy is not effective, since the proper

⁸ Russia’s Climate Agenda: Responding to International Challenges. The report was prepared by the CSR Foundation together with the Analytical Center of the Fuel and Energy Complex REA of the Ministry of Energy of Russia and the Situation Center LLC (January 2021), pp. 8–9. Available from:

https://www.dipacademy.ru/documents/2267/2021_1_%D0%94%D0%BE%D0%BA%D0%BB%D0%B0%D0%B4_%D0%9A%D0%BB%D0%B8%D0%BC%D0%B0%D1%82_%D0%A6%D0%A1%D0%A0_%D0%90%D0%A6_%D0%A0%D0%AD%D0%90_%D0%A1%D0%A6.pdf

⁹ Regulation in the field of climate change: world practice and prospects. Moscow: Center for International and Comparative Legal Studies, 2021, p. 11. Available from: https://iclr.ru/storage/publication_pdf/%D0%A6%D0%9C%D0%A1%D0%9F%D0%98_%D0%98%D0%B7%D0%BC%D0%B5%D0%BD%D0%B5%D0%BD%D0%B8%D0%B5%20%D0%BA%D0%BB%D0%B8%D0%BC%D0%B0%D1%82%D0%B0_1649167910.pdf

level of reduction in greenhouse gas emissions, the carbon intensity of the economy, as well as the share of fossil fuels in energy production has not yet been achieved”.

The scientific and expert community has reached an understanding that climate policy should facilitate the transition to a model of economic development that ensures the strengthening of Russia’s competitive potential based on the functioning of high-tech sectors of the national economy and that is within the framework of industrial modernization. In the context of the internationalization of the climate vector of national development, the climate policy tools being developed, e.g., legislative mechanisms and technical standards, should reflect the content of the global environmental agenda, but, of course, in relation to the needs of national development.

In the context of the subject matter of our article, focus on the scientific aspect of the state climate policy is needed. Like all other areas of government policy, Russia’s climate policy is knowledge-intensive, i.e., it is based on a solid foundation of scientific knowledge and information that is necessary for decision-making and for the implementation of effective measures. As noted in reports by Roshydromet (Federal Service for Hydrometeorology and Environmental Monitoring) (2005) that were prepared during the formation of Russian climate policy based on the unity of its national and international dimensions, “Russia, having entered the XXI century, fully feels the need to find solutions to such issues as obtaining objective and unbiased assessments of the nature of climate change in its territory, including assessing the role of anthropogenic factors in current and upcoming climate changes, scientific justification of steps in connection with the Kyoto Protocol, both for the period of its validity and for the longer term, assessment of the impact of the changing climate on economic sectors and the social sphere and the development of specific solutions for their adaptation. Solutions are also needed to coordinate efforts within the country in order to achieve breakthrough results in the field of climate research and the use of climate information and eliminate the backlog from a number of foreign countries”.

This conclusion means recognition of the need not only for organizational, legal and human resources, but also for scientific support of Russia’s national climate policy. The mentioned aspect of this policy simultaneously becomes part of the governmental policy in STI and equally assumes organizational, legal and personnel support of climate STI. In the report by Roshydromet (2005), it was noted that the main task of scientific support is to obtain and provide the interested national agencies with reliable and objective scientific information for decision-making. The priority scientific tasks are as follows:

- (1) Development and maintenance of climate monitoring systems in the territory of Russia, including climate-shaping factors and climate change indicators.
- (2) Research and assessment of possible future changes in the global and regional climate, as well as their consequences.
- (3) Research and evaluation of the cost of measures to adapt to climate change, measures to mitigate the anthropogenic impact on the climate and the economic effect of the implementation of these measures.
- (4) Development of criteria and parameters (threshold values) of Russia’s climate security.
- (5) Independent (international) examination of the results of scientific research in the area of climate research and related fields.

- (6) Development of mechanisms that encourage closer scientific cooperation between organizations of Roshydromet, the Russian Academy of Sciences and other institutions on the implementation of targeted scientific programs in the field of climate research.

As follows from these directions, the field of climate research extends from the study of physical processes up to the analysis of the socioeconomic consequences of climate change.

The scientific factor and, moreover, the scientific and technological direction of the national climate policy, are reflected in the Climate Doctrine of the Russian Federation¹⁰. The main tasks listed in paragraph 18 of this document include strengthening and developing the information and scientific basis of climate policy. This implies strengthening the scientific, technical and technological potential of the Russian Federation, which will ensure the maximum completeness and reliability of information about the state of the climate system, impacts on the climate from society, current and future climate changes and their possible consequences. Of course, such a direction as participation in the initiatives of the international community in solving issues related to problem of climate change also includes participation in international scientific and technological cooperation.

In full compliance with the marked provisions of the Climate Doctrine, the Comprehensive Plan for the Implementation of the Climate Doctrine¹¹ specifies its provisions concerning the development of scientific and technological potential. Provisions of the paragraph 1 of the Section I “Strengthening and development of information, scientific, socio-economic and personnel policy in the field of climate” of this plan provides information to forecast threats to national security as related to climate change, an assessment of the risks and benefits for the economy of the country and its territory, and the ability to adapt to climate change. Further, as for international cooperation, in paragraph 27 of the Section IV “International cooperation in the field of climate change” the participation of the Russian Federation in the various activities of the Intergovernmental Panel on Climate Change, established by the World Meteorological Organization and the UN Environment Programme, is scheduled.

The Comprehensive Plan for Scientific Research of Weather and Climate¹² defines national priorities for scientific research on weather and climate, taking into account national and international experience in organizing climate science. In fact, the key element is the provision that research in the area of weather and climate change is intended to serve as scientific support for the decision-making process.

¹⁰ Climate Doctrine of the Russian Federation (Decree of the President of the Russian Federation No. 861-rp of 17.12.2009). Available from:

http://www.consultant.ru/document/cons_doc_LAW_94992/586f138029052bbd32631ec35d82d4a25e46d841/

¹¹ The Comprehensive Plan for the Implementation of the Climate Doctrine of the Russian Federation for the period up to 2020 (Decree of the Government of the Russian Federation No. 730-r dated 25.04.2011) (revision dated 31.01.2017). Available from:

http://www.consultant.ru/document/cons_doc_LAW_113534/01d9eda41b3c1208217fd6d6cba6706690594c28/

¹² Comprehensive Plan for Scientific Research of Weather and Climate (until 2020). Available from: <https://cc.voeikovmgo.ru/ru/dokumenty/kompleksnyj-plan-nauchnykh-issledovaniy-pogody-i-klimata>

This approach is in line with the spirit and decisions of the Third World Climate Conference (2009)¹³. The most important outcome of the conference was the creation of the Global Framework for Climate Services (GFCS). The concept of this framework is to present the possibility of effective management of the risks and opportunities arising from climate variability and change. This is especially true for those countries which are most vulnerable to dangerous climatic phenomena¹⁴. The Russian Comprehensive Plan for Scientific Research of Weather and Climate was provided for the creation of the Russian segment of the GFCS.

The Comprehensive Plan is based on the recommendations and priorities of national scientific research formulated in the first assessment report of Roshydromet on climate change and its consequences in the territory of the Russian Federation (2008), as well as in the decisions of the All-Russian Meteorological Congress (hereafter MC-VI, 2009)¹⁵. An essential feature of the Comprehensive Plan is the multidimensional integration of national weather and climate studies recommended by MC-VI next solutions:

- (1) Integration of fundamental and applied research.
- (2) Integration of scientific research and educational process.
- (3) Integration of national research into international programs.

The Comprehensive Plan is focused on the development of a system of interdepartmental consortia that allows the scientific community and consumers to consolidate in order to solve major scientific problems. In addition to solving scientific problems, the Comprehensive Plan is designed to do the following:

- (1) Optimize expenditures of the federal budget and other sources.
- (2) Concentrate the potential of Russian climate science on solving priority tasks and obtaining practical results aimed at ensuring the national interests of the Russian Federation.
- (3) Minimize duplication and give synergy to national research on the weather and climate and in related fields.
- (4) Contribute to building the potential of Russian climate science.

As noted in the MC-VI decisions, weather and climate studies relevant to Russia, in general, are in line with the tasks facing the entire world. Therefore, Russian research should be focused on integration into international research programs. Such programs include the World Climate Research Program and its projects, the International Geosphere and Biosphere Program, the World Weather Research Program and its projects, the Atmosphere and Environment Research Program, international projects under the auspices of the Scientific Committee on Antarctic Research, the Atmospheric Sciences Commission of the World Meteorological Organization, etc.

¹³ Report of the World Climate Conference-3 “Improved climate information for a better future” (Geneva, Switzerland August 31—September 4, 2009). Available from: https://library.wmo.int/doc_num.php?explnum_id=3070

¹⁴ Implementation plan for the global framework for climate services (GFCS) (World Meteorological Organization, 2014). Available from: https://gfcs.wmo.int/sites/default/files/implementation-plan//GFCS-IMPLEMENTATION-PLAN-14211_ru.pdf.

¹⁵ Decision of the VI All-Russian Meteorological Congress (October 14–16, 2009, St. Petersburg). Available from: http://voeikovmgo.ru/download/events/VI_sezd.pdf

International cooperation implies positioning and integration of Russian climate science into international programs of climate and related research (item 2), taking into account the national interests of the Russian Federation and using all possible advantages of international cooperation; the organization and financing of internships of the most gifted young scientists and specialists, graduate students and undergraduates in the world's leading scientific centers (in combination with strengthening motivations for returning to domestic research institutes); and the active participation of Russian scientists in the working and steering of groups of international projects in the organizing committees of international scientific conferences, schools and seminars for the preparation of international assessment reports on climate change and other specialized international reports on climate and related issues.

The Comprehensive Plan creates the basis for scientific support of the implementation of the Climate Doctrine of the Russian Federation.

The expected results of the studies included in the Comprehensive Plan will ensure the formation and compliance at the global level of the scientific basis of the Russian Federation's climate policy, including the following:

- (1) Assessment of the past and current states of the climate system.
- (2) Assessment of factors influencing anthropogenic activities on the climate.
- (3) Forecast of future climate changes and their impacts on the quality of life of the population of the Russian Federation and other regions of the earth.
- (4) Assessment of the degree of protection and vulnerability of ecosystems, economy, population, state institutions and infrastructure of the state in relation to climate change and existing opportunities for adaptation to them.
- (5) Assessment of the possibilities of the mitigation of anthropogenic impact on the climate.
- (6) Two types of research and development results are envisaged as part of the implementation of the Comprehensive Plan.
- (7) Increment of knowledge and new (or improved) technologies that are used in science to improve knowledge.
- (8) Products for practical use (not only in economic sectors, but also in the political sphere, in the field of defense, etc.). If we turn to the National Action Plan¹⁶, then the tasks of planning measures of adaptation of the Russian Federation to climate change include scientific support for the process of development and adoption by state authorities and economic entities of decisions aimed at improving the level of security (protection of vital interests of the individual, society and the state) from the perspective of the effects of climate change on the population and economy, including natural hazards and natural emergencies.

The federal scientific and technical program in the field of environmental development of the Russian Federation and climate change for 2021–2030 is aimed at improving the efficiency of

¹⁶ The National Action Plan of the first stage of adaptation to climate change for the period up to 2022 (Approved by the Decree of the Government of the Russian Federation dated December 25, 2019 No. 3183-r). Available from: <http://static.government.ru/media/files/OTrFMr1Z1sORh5NIx4gLUsdgGHyWIAqy.pdf>

scientific and technical activities in the field of environmental development of the Russian Federation and climate change¹⁷. Directions of the program implementation are as follows:

- (1) Monitoring and forecasting of the state of the environment and climate; mitigation of the anthropogenic impact on the environment and climate.
- (2) Adaptation of ecological systems, population and economic sectors to climate change.

One of the planned directions of the program includes the use of high-tech technologies by the program's technological partners and other organizations, the effectiveness of which is confirmed by the results obtained under the program. This program involves the implementation of a number of directions of the Strategy of Scientific and Technological Development of the Russian Federation (2016)¹⁸. As such, the strategy provides for the directions of technological development of the Russian Federation, namely, obtaining scientific and technological results that are the basis of innovative development and are capable of ensuring the global competitiveness of the Russian Federation in foreign markets and responding to major challenges.

Based on these strategic guidelines, the program in the field of environmental development of the Russian Federation and climate change for 2021–2030 assumes the elimination of the backlog of the Russian Federation from the leading countries of the world in the area of high-tech scientific research concerning the environment and climate change. The need to eliminate such a backlog is dictated by the following reasons. First, the lack of evidence-based data in these areas of research does not allow the Russian Federation to properly manage environmental and climate risks and minimize them. Second, this disadvantage does not allow us to actively and effectively defend national socioeconomic interests at the international level.

Therefore, as the developers of the program expect, its implementation will ensure the following:

- (1) world-class achievement in terms of high-tech technologies for monitoring and forecasting the state of the environment and climate, including natural hazards, based on modern observation systems and physical and mathematical modeling.
- (2) use of the high adaptive potential of the Russian Federation; improvement the effectiveness of climate change adaptation measures for various ecological systems, social groups, economic sectors and regions of the Russian Federation; and development and implementation of low-carbon, environmentally friendly technologies in various sectors of the economy of the Russian Federation.
- (3) scientific justification of effective measures to protect Russian producers from foreign restrictive measures introduced under the pretext of environmental and climate safety.

It does not follow from what has been said that Russia has no significant achievements in climate science. Significant results are not only systematized in the program, but also in paragraph 1 of the Section VIII of the Eighth National Communication of the Russian Federation to the

¹⁷ Decree of the Government of the Russian Federation of February 8, 2022 No. 133 “On approval of the Federal scientific and technical program in the field of environmental development of the Russian Federation and climate change for 2021–2030”. Available from: <http://static.government.ru/media/files/Ekv7TcPAJBv4n3oUn6ofUdAR5cu5W1PM.pdf>

¹⁸ Decree of the President of the Russian Federation of December 1, 2016 No. 642 “On the Strategy of scientific and technological development of the Russian Federation” (edition of March 3, 2021). Available from: http://www.consultant.ru/document/cons_doc_LAW_207967/

Conference of the Parties of the UN Framework Convention on Climate Change (hereafter COP)¹⁹. In 2021, the Ministry of Science and Higher Education of Russia, together with leading scientific institutes and universities, carried out work to determine the content of upcoming scientific research. As a result of this work, four blocks of research have been identified:

- (1) The solution of the task of preparing technologies to obtain and interpret climate data.
- (2) The development of a system for monitoring and accounting for data on greenhouse gas flows and the carbon cycle in terrestrial ecosystems.
- (3) The development of a monitoring system for key areas of the world's oceans, coastal zones and seas of Russia, including observations of the ocean-atmosphere system and climate modeling.
- (4) Development of economic and mathematical models for evaluating measures planned and implemented in relation to the national economy.

Among other things, the topics of Russian climate projects included the study and subsequent restoration of peatlands, as well as the research and restoration of soils. The development of economic and mathematical models for evaluating measures planned and implemented in relation to the national economy is very promising²⁰. At the moment, work on monitoring greenhouse gases is being carried out within the framework of the pilot project of the Ministry of Education and Science of Russia on the creation of carbon polygons²¹. Researchers are working at eight already open landfills, and nine more are scheduled to be launched this year.

A separate area is the equipping of research institutes with devices, which is very necessary for the implementation of scientific and technical programs. Recall that, within the framework of the national project "Science and Universities"²², the task of updating the instrumentation base of leading scientific organizations is being solved. By the end of the 2019–2024 period, about 90 billion rubles will have been allocated from the federal budget for its solution. In 2022, about 12 billion rubles were allocated for the purchase of high-tech equipment, of which 2.5 billion rubles was spent only on the purchase of domestic devices.

Thus, it is easy to see that Russian researchers depend on imported devices, and the share of domestic instrument-making products is insignificant²³. In 2021, within the framework of the national project "Science and Universities"²⁴, modern equipment was purchased at the Pushchino

¹⁹ The Eighth National Communication of the Russian Federation submitted in accordance with Articles 4 and 12 of the United Nations Framework Convention on Climate Change and Article 7 of the Kyoto Protocol. Moscow, 2022, pp. 204–215. Available from: https://unfccc.int/sites/default/files/resource/NC-8_BR-5_rus.pdf

²⁰ In Russia, scientific research in the field of climate will be conducted in 4 main directions (February 8, 2022). Available from: <https://minobrnauki.gov.ru/press-center/news/novosti-ministerstva/46885/>

²¹ The Ministry of Education and Science of Russia will launch a program for the development of carbon polygons (December 11, 2022). Available from: <https://minobrnauki.gov.ru/press-center/news/novosti-ministerstva/26691/>

²² Passport of the national project "Science and Universities" (2018–2024). Available from: <https://minobrnauki.gov.ru/upload/2021/09/%D0%9D%D0%B8%D0%A3.PDF>

²³ Climate control: What research in the field of climate is carried out by scientists of Russian scientific institutes (February 17, 2022). Available from: <https://minobrnauki.gov.ru/press-center/news/science-i-education/47149/>

²⁴ Passport of the national project "Science and Universities" (2018–2024). Available from: <https://minobrnauki.gov.ru/upload/2021/09/%D0%9D%D0%B8%D0%A3.PDF>

Scientific Center for Biological Research of the Russian Academy of Sciences to determine the contents of carbon and nitrogen in soils, plants and aquatic environments, which will allow for the collection of high-quality analytical data:

X-ray fluorescence spectrometer S6 JAGUAR for the analysis of the contents of elements ranging from nitrogen to uranium (Bruker, Germany)	CHNS-analyzer Vario EL Cube (Elementar GmbH, Germany)	Analyzer “TOPAZ NC” of domestic production for the determination of total nitrogen and carbon in samples of drinking, natural and wastewater (LLC “nformanalyti-ka” Russia)
18.65 million rubles	14.03 million rubles	1 million rubles

From the information provided, the dominance of German equipment is obvious. Taking into account the regime of international sanctions, there are moments of risk for those conducting Russian climatological research.

This conclusion is confirmed by the information that the federal budget for the period of 2019–2024 provides for the allocation of about 90 billion rubles to solve the problem of the development of the instrumental base. In 2022, 12 billion rubles were allocated to organizations for the purchase of high-tech equipment. Of this amount, only 2.5 billion rubles were spent on the purchase of domestic devices²⁵. The above statics indirectly indicate an insignificant list of high-tech domestic devices, with the help of which high-quality climate research should be carried out.

4.2. *The impact of sanctions on Russia’s participation in international scientific cooperation in the field of climate research: Event analysis*

4.2.1. Participation of Russia in international cooperation in the field of climate research: Forms and directions

In order to understand the extent to which the sanctions have had a negative impact on the Russian climate R&D sector and in what forms this negative impact is exerted, it is necessary to generalize and systematize the achieved level of Russia’s involvement in international cooperation.

The development of Russian climatological research is aimed at overcoming the backlog at the world level. The most important means of solving this problem is international cooperation. Russia’s participation in international projects is guided by and proceeds from the development of the scientific and technological complex of the Russian Federation, which makes it possible to attract the best international experts, as well as to localize a large research infrastructure. At the same time, Russia’s international scientific and technical cooperation is focused on ensuring the country’s leadership in setting the global research agenda for the climate²⁶.

²⁵ In Russia, scientific research in the field of climate will be conducted in 4 main directions (February 8, 2023). Available from: <https://minobrnauki.gov.ru/press-center/news/novosti-ministerstva/46885/>

²⁶ Eighth National Communication of the Russian Federation, submitted in accordance with Articles 4 and 12 of the United Nations Framework Convention on Climate Change and Article 7 of the Kyoto Protocol. Moscow, 2022, pp. 215–218. Available from: https://unfccc.int/sites/default/files/resource/NC-8_BR-5_rus.pdf

In 2018–2021, the Russian Federation continued to contribute to the implementation of targeted projects in the field of environmental and climate protection through the organizations of the UN system. The main cooperation in this area was carried out under the UN Development Programmed and the UN Environment Programmed.

The total amount of contributions to project activities during this period amounted to USD 15.4 million; please refer to Table 1 for more details.

Table 1. Project activities.

Year	Value
2018	USD 2 948 957
2019	USD 5 362 243
2021	USD 7 039 200

The Russian researchers participate in major international projects and climate research programs through international structures, such as World Meteorological Organization, United Nations Educational, Scientific and Cultural Organization, Framework Convention on Climate, the International Council of Scientific Unions and other organizations.

In 2015, the project was completed to create the European-Russian Center for Cooperation in the field of environmental and climate research in the Arctic and Subarctic “EuRuCAS” (Seventh Framework Program of the European Union, 2012–2015)²⁷. The project was supported by the joint Norwegian-Russian Nansen International Center for Ecology and Remote Sensing in St. Petersburg, with additional partners from Germany, Sweden, France, Austria, Finland and the UK.

For the period of 2014–2020. Russia and the European Union supported 13 joint projects in the field of climate and ecology research under the Russian Federal Target Program “Research and development in priority areas of development of the scientific and technological complex of Russia for 2014–2020” and the European Union Framework Program “Horizon 2020”. The budget funding amounted to 246 million rubles. Off-budgetary funding was more than 602 million rubles²⁸.

Despite the sanctions being imposed since 2014, Russian–European scientific cooperation continued until the end of 2022 and seemed to be rather promising. This was evidenced by the webinar “Priorities of the EU and Russia in the field of climate change research and related innovations” (September 16, 2020)²⁹. The event was attended by the special representative of the Ministry of Education and Science of Russia and focused on issues of scientific, scientific-technical and scientific-educational policy, issues of interaction with the Russian Academy of Sciences, as well as issues of

²⁷ European-Russian Center for Cooperation in the Arctic and Sub-Arctic Arctic environmental and climate research (Grant agreement ID: 295068) (1 May 2012 – 31 October 2015). Available from: <https://cordis.europa.eu/project/id/295068>]

²⁸ Russia and the EU presented projects in the field of climate change research (September 16, 2020). Available from: <https://www.minobrnauki.gov.ru/press-center/news/ nauka-i-obrazovanie/25286/>

²⁹ Priorities of the EU and Russia in the field of climate change research and related innovations. Opportunities for cooperation within the Horizon 2020 program (September 16, 2020). Available from: https://aebrus.ru/ru/news/eu_russia_climate_change_research_and_innovation_priorities/

international scientific and technological cooperation. During the event initiated by the European partners, experts from Russia and the European Union presented research and innovation priorities in the area of studying climate change. The webinar participants were unanimous in their opinion: climate change is a complex interdisciplinary challenge that covers the foundations of sustainable development not only in the Russian Federation, but also in the European Union.

4.2.2. Suspension of Russia's participation in international climate research programs and projects

The strengthening and expansion of the sanctions against Russia not only leads to serious damage to Russian climatology, but also to the country's participation in international cooperation. In most cases, the damage done to Russian climatology is the result of the curtailment of international relations. This has a direct negative impact on the national scientific and technological potential, which, ultimately, will affect the implementation of a national low-carbon development strategy. If we turn to history, during the Cold War, climate scientists were able to promote global science in the field of climate research within the framework of the environmental agreement between the USA and the USSR in 1972. Article 3 of this agreement provides for the joint development and implementation of programs and projects in the field of fundamental and applied sciences³⁰. A feature of the current situation is that, not only governments, but also scientific organizations have joined in the imposition of sanctions against Russian research institutions.

Disconnection from international programs and projects has serious consequences. For example, the European Union suspended Russia's participation in its flagship research program "Horizon Europe". Accordingly, the implementation of projects approved by the Ministry of Science and Higher Education and "Horizon Europe" projects³¹ has been terminated. There are two frozen projects. The first is the "Polar Regions in the Earth System (PolarRES)" project³². The overall goal of the PolarRES project is to expand the study of key local-regional physical and chemical process interactions in the atmosphere, ocean and ice in the Arctic and Antarctica, as well as the reactions of these regions and their impact on projected changes in world gyres and their consequences for society and the environment. To study the impact of projected changes in world gyres on the climate of the Arctic and Antarctica, the project was planned to conduct a thorough analysis of the climate of both polar regions using the latest regional climate models of unprecedented accuracy. The Nansen International Center for Environment and Remote Sensing, founded in 1992 in St. Petersburg as a non-profit joint venture, and in 2001 reorganized into a scientific foundation, is engaged in the study

³⁰ Agreement between the Union of Soviet Socialist Republics and the United States of America on cooperation in areas of environmental protection (1972). Available from: <https://docs.cntd.ru/document/1901895>

³¹ List of Horizon 2020 projects, whose Russian participants received support from the Ministry of Science and Higher Education of the Russian Federation as part of the 2021 competition. Available from: https://www.eas.europa.eu/sites/default/files/list_of_projects_supported_by_mshe_eng.pdf

³² Horizon Europe. Project "Polar Regions in the Earth System" (Grant agreement ID 101003590, 1 September 2021–31 August 2025) (8,133,841.25/ EU contribution 7,996,321.25). Available from: <https://cordis.europa.eu/project/id/1010035900>

of climate change in the Arctic, including measurements of sea, ice and surface air temperatures, as well as satellite remote sensing of the atmosphere, ocean, sea and ice and a number of other topics.

Another climate project, the implementation of which became impossible as a result of sanctions, is the CRiceS project “Climate relevant interactions and feedbacks: The key role of sea ice and snow in the polar and global climate system”³³. The CRiceS project recognizes that sea ice is an integral but volatile part of the earth’s system. The polar climate system as a whole affects the lives of people and their livelihoods around the world. In order to plan and adapt to polar and global climate change, CRiceS aims to conduct a large-scale analysis of the causes and consequences of polar transformations. The project was designed to increase understanding of the extent to which rapid sea ice loss is linked to physical and chemical changes in the polar oceans and atmosphere. The members of the consortium intend to quantify the governing chemical, biogeochemical and physical processes/interactions in the coupled ocean-ice/snow-atmosphere system through a comprehensive analysis of new ground-based and satellite observations.

The Russian partner of the project is the Institute of Computational Mathematics and Mathematical Geophysics of the Siberian branch of the Russian Academy of Sciences. It is a well-known leader in the development of numerical methods for solving direct and inverse problems of mathematical physics, numerical statistical modeling (Monte Carlo methods), geophysics, atmospheric, oceanic and environmental physics, chemistry and electrophysics. The institute has developed algorithms and programs used to solve important problems of natural resource management, explore oil and gas fields, forecast natural and man-made disasters and assess their consequences, conduct atmospheric sounding from space and develop effective supercomputer equipment for medicine, the nanoindustry and information security.

In addition to the Horizon Europe Program, cooperation with Russian scientists and scientific organizations was suspended by the national research councils of several European countries. Note that this is the position of some scientific institutions that create difficulties in the development of Russian climatological research. Particularly affected are those areas of research that depend on the supply of foreign equipment from, for example, the Max Planck Institute.

The dependence of the Russian climate research sector on foreign equipment is quite obvious and is not hidden by anyone. This leads to limitations in the effectiveness of the Russian government’s financial support for climate research. In early February 2023, the Russian government announced plans to invest 5.9 billion rubles (about USD 92 million) in climate research and decarbonization, as well as to create Russia’s own carbon tracking system. The basic link of the system is the research station on Samoylov Island (northeast of Siberia)³⁴. Numerous studies of processes occurring in permafrost in the Arctic region of Siberia are carried out at this station in the area of climatology, geomorphology and hydrobiology. The main users of the station are joint expeditions of the Institute of Polar and Marine Research, the Alfred Wegener Institute Helmholtz

³³ Horizon Europe. Project “Climate relevant interactions and feedbacks: the key role of sea ice and snow in the polar and global climate system” (1 September 2021–21 August 2025) (8 507 794.35/ EU contribution 7 999 266.25). Available from: <https://cordis.europa.eu/project/id/101003826>

³⁴ Research Station Samoylov Island. Available from: <https://www.awi.de/en/science/geosciences/permafrost-research/stations/samoylov.html>

Center for Polar and Marine Research (Germany), the Arctic and Antarctic Research Institute in St. Petersburg and the Melnikov Permafrost Institute in Yakutsk, which have been held annually since 1999. But, due to the shortage of foreign equipment, the prospects for the project are rather vague.

Over a long period of time, Russian and German scientists have been measuring atmospheric CO₂ changes using the Zotino Tall Tower Observation Facility (ZOTTO)³⁵ in the southwestern part of Siberia in Krasnoyarsk. The result of ZOTTO's work was the conclusion that Siberian forests absorb only one-sixth of Europe's industrial emissions. This statement has pragmatic implications, as some countries can buy emission credits from others. Germany provided financing for the construction and purchase of instruments. However, the continued operation of the station has been called into question due to the lack of maintenance by Germany. Similar maintenance and equipment supply issues have called into question a series of international projects in the Arctic that are particularly important for understanding climate change.

The above examples show the suspension of international cooperation activities in the form of problems with the supply of equipment and the provision of technical services, not only in relation to purely national projects, but also for projects with international participation. It should be noted that the cessation of maintenance of long-term measuring systems, which are of key importance for climate modeling, reduces the possibility of building such models, which, in the future, will lead to negative results in the practical implementation of national development programs.

Similarly, the suspension affects other forms of cooperation, such as the exchange of information and data. In this regard, climate scientists in Russia are deprived of access to the Climate Data Store³⁶, which provides a single point of access to a wide range of climate data on past, present and future climates, including satellite observations, in situ measurements, climate model projections and seasonal data. In addition, a manifestation of the sanctions regime in the field of international scientific cooperation was the termination of access to supercomputers based in other countries. Adding to all of this, the exit of technology companies such as Intel has led to a deterioration in computing power at the national level. Therefore, the actions of Western partners aimed at disconnecting Russia from satellites and the exchange of climate data may lead to the impossibility of accurate weather forecasting because it requires relevant data from all over the world.

The same logic manifested in scientific sanctions exists in economic sanctions, namely, the manifestation of negative consequences for the party that imposed these sanctions. Restraining, for various reasons, the national development of scientific research, as well as the curtailment of international collaborations, damages both the scientific research of foreign scientists and the global climate research industry. In the latter case, there is a disruption in the functioning of scientific networks that have been built over the years.

³⁵ ZOTTO. Available from: <http://forest.akadem.ru/State/MID.html>

³⁶ Climate Data Store. Available from: <https://cds.climate.copernicus.eu/>

4.2.3. Climate scientific cooperation in the Arctic and sanctions: Negative trends in the national and global contexts

The logic of discontinuities noted above can be traced in the field of scientific cooperation in relation to the study of climate change in the Arctic. Research in the field of climate change and related topics within the framework of the Arctic Council are characterized by great significance. The states that are members of the Arctic Council contribute to the development of the Arctic territories and the observation of climate change in this region, complementing each other within the framework of joint scientific projects. Looking back at the events of 2014, the Arctic Council has found ways to maintain ties with Russia. In this case, non-profit organizations with representative offices in Russia continued to maintain close ties with the scientific community. Russia, the USA, Canada and Iceland, at the initiative of the Pew Charitable Trusts³⁷, met in Shanghai in 2015 to discuss the agreement to prevent unregulated fishing on the high seas in the central Arctic Ocean³⁸.

This agreement is one of the aspects of the achieved scientific and diplomatic progress on environmental issues and the conservation of natural bioresources. A key element of the agreement is to conduct a study on the volume of fish stocks as a basis for launching future fisheries. Moreover, in 2017, the agreement on enhancing international Arctic scientific cooperation³⁹ was signed, which became the legal basis for multilateral scientific and technical cooperation. In 2021, Russia also actively cooperated with foreign countries on a number of Arctic projects on climate change and ecology.

One of them, the project “The role of cyclonic activity and moisture transfer in the dynamics of the Arctic climate”, was implemented by the Institute of Oceanology of the Russian Academy of Sciences together with Stockholm University. The relevance of the research within the framework of the specified project lies in the development of new diagnostic approaches to the analysis of moisture transfer to the Arctic, which is of critical importance for the formation of local climate anomalies in this region. The project assumes the conditions under which cases of abnormally strong moisture transfer occurs in the current climate and includes an assessment of such conditions for the future climate.

Among the priority areas of cooperation during the Russian chairmanship of the Arctic Council were climate change and the ecology of the Arctic, as well as scientific cooperation⁴⁰. During its chairmanship, Russia declared the desire to further strengthen cooperation in the Arctic, to consolidate the Arctic states around agreed upon long-term goals and to search for joint solutions to common problems. With regard to scientific cooperation, Russia strived to increase the efficiency of scientific activity and the practical applicability of its results. To this end, the need to optimize the use of scientific infrastructure and promote the use of new technologies and best practices in the implementation of joint projects was planned. The focus was on the formation of a mechanism to

³⁷ Pew Charitable Trusts. Available from: <https://www.pewtrusts.org/en>

³⁸ Agreement to Prevent Unregulated High Seas Fisheries the Central Arctic Ocean (October 3, 2018). Available from: <https://www.mofa.go.jp/files/000449233.pdf>

³⁹ Agreement on Enhancing International Arctic Scientific Cooperation (11 May 2017). Available from: <https://oaarchive.arctic-council.org/handle/11374/1916>

⁴⁰ Russia’s Chairmanship Priorities for the Arctic Council 2021–2023 (2021–05). Available from: <https://oaarchive.arctic-council.org/handle/11374/2646>

support multilateral research initiatives (the ArcticNet project) in order to strengthen scientific and technological cooperation in various fields. The ArcticNet project⁴¹ aims to fund a balanced research portfolio that spans the various disciplines and levels of climate change impact—from communities to the global context. Its partners are the Intergovernmental Oceanographic Commission of UNESCO (IOC), the federal agency responsible for the protection of the country's waters and the management of Canada's fisheries and ocean resources (Fisheries and Oceans Canada).

Other scientific priorities that Russia has indicated are the expansion of cooperation in the process formation and analysis of world and national ecological databases of large data arrays, the use of remote data methods for deciphering local processes in the Arctic and the FLUXNET global observation network for exchange atmospheric and biospheric flows.

According to the Comprehensive Program of the Russian Federation's Chairmanship of the Arctic Council in 2021–2023, its aspirations are aimed at further strengthening cooperation in the Arctic, consolidating the Arctic states around agreed long-term goals and finding joint solutions to common problems⁴².

Besides, the chairmanship program provided for the development of international scientific cooperation in the Arctic in the form of joint research programs, scientific forums and other events in the field of scientific activities (Section X "International scientific cooperation in the Arctic"). In November 2021, the Ministry of Education and Science of the Russian Federation held a meeting of senior officials for the coordination of scientific research in the Arctic⁴³.

The meeting discussed issues of priorities for scientific research in the Arctic, held joint scientific competitions for research projects of the countries of the Arctic Council, created the coordinating committee for scientific activities in the Arctic to oversee joint research and expeditions, strengthened international Arctic scientific cooperation and created a common international research database of the countries of the Arctic Council. Following the meeting, the Russian Ministry of Education and Science supported the initiative to hold the Fifth International Polar Year in 2032–2033.

But, today, it is quite clear that, given the situation in the Arctic Council, events planned for subsequent years, such as the International Research-to-Practice Conference Universe of the Polar Bear (2023) and the International Research-to-Practice Conference Euro Arctic (2023), will not be held.

The expert community recognizes that understanding climate change is largely related to the joint exchange of information and science with Russian scientists in the context of the Arctic

⁴¹ ArcticNet Core Research Program (2022–24) Available from: <https://oceandecade.org/ru/news/arcticnet-core-research-program-2022-24/>

⁴² Programme of The Russian Federation's 2021 to 2023 Chairmanship of the Arctic Council. Available from: <https://oaarchive.arctic-council.org/handle/11374/2645>

⁴³ Meeting of Senior Officials for the Coordination of Scientific Research in the Arctic (18 November 2021). Available from: <http://mniop.ru/vstrecha-starshih-dolznostnyih-lits-po-koordinatsii-nauchnyih-issledovaniy-v-arktike.html>

Council⁴⁴. In addition, it is noted that the suspension of projects involving Russian researchers for an indefinite period plunged Arctic science into chaos⁴⁵.

This can be justified by the fact that more than half of the coastline of the Arctic belongs to Russia, and the information collected by stations in Siberia and buoys in the Arctic Ocean provides irreplaceable data on climate change. After processing, an empirical basis arises, which makes it possible to form models of ongoing natural processes. And, without global science, it is impossible to solve global problems, such as climate change, including the conservation of biodiversity. Climate change itself has not taken time out due to events in Ukraine. But, we must not forget that climate research is complemented by research on the mineral resources of the Arctic, which are of value for the economic development of the Arctic states. However, this aspect of cooperation is traced not to the solution of global problems, but to competition for the resources that are necessary for the green transition⁴⁶.

Now, the channels of international communication have been blocked, which makes it impossible to implement the obligations stipulated in the Agreement on Scientific and Technical Cooperation in the Arctic. Seven of the eight Arctic states have announced the suspension of their participation in all meetings of the Arctic Council and its subsidiary bodies. This has led to the curtailment of international scientific cooperation involving Russia, ranging from studies of polar bears and whales to research in commercial fishing, permafrost melting, sea ice retreat, peatland ecology and forest fires. The curtailment of cooperation with the participation of Russia also takes place through the International Arctic Scientific Committee, the working groups of which include Russian representatives. The suspension of the activities of the Arctic Council is of concern to Asian states. Commentators predict that scientific cooperation between polar countries and Asian states such as Singapore, India and Japan will be frozen⁴⁷. As a consequence, the suspension of full-scale cooperation could seriously undermine the aspirations of Asian states to improve their perceptions of change, making it difficult to implement programs aimed at solving environmental problems.

The course of events directly influenced the implementation of a series of project initiatives. One of them is the Snezhinka International Arctic Station⁴⁸. The project was initiated by Russia at the end of 2019 and was unanimously supported by the members of the Arctic Council on June 8, 2020 at the session of the Working Group on Sustainable Development. This is a unique,

⁴⁴ War in Ukraine has implications for Arctic co-operation, climate change research (February 25, 2022). Available from: <https://www.cbc.ca/news/canada/north/ukraine-war-implications-for-arctic-1.6363856>

⁴⁵ Russian and Western scientists no longer collaborate in the Arctic. That is bad, not least for climate research. Available from: <https://www.economist.com/science-and-technology/russian-and-western-scientists-no-longer-collaborate-in-the-arctic/21809236>

⁴⁶ Keating J. Is an Arctic ‘Cold War’ coming? How climate change and the war in Ukraine are driving tensions. Melting ice and geopolitics are making for a dangerous mix at the “top of the world.” (February 9, 2023). Available from: <https://www.grid.news/story/360/2023/02/09/is-an-arctic-cold-war-coming-how-climate-change-and-the-war-in-ukraine-are-driving-tensions/>

⁴⁷ Siow M. Will Russia sanctions freeze Asia’s climate change research on the Arctic? (27 April 2022). Available from: https://www.scmp.com/week-asia/politics/article/3175554/will-russia-sanctions-freeze-asias-climate-change-research?module=perpetual_scroll_0&pgtype=article&campaign=3175554

⁴⁸ Snezhinka International Arctic Station. Available from: <https://arctic-mipt.com/>

autonomous, scientific and educational complex operating on the basis of hydrogen energy and renewable energy sources at the suggestion of the Moscow Institute of Physics and Technology. The aim is testing and demonstration by Russian and international partners of nature-saving life-support technologies, as well as smart-home settlement systems, robotics, telecommunications, medicine, biotechnology, new materials and artificial intelligence solutions. It was planned that the project will involve joint research on the problems of ecology, climate change, environmental pollution and the oceans. In the situation of sanctions, foreign financing of the construction of the station became impossible. Therefore, all costs were borne by Russia. Despite the difficult geopolitical situation in the world, the construction of the Snezhinka International Arctic Station will begin in 2023⁴⁹, because the study of the Arctic climate and the environment remains an important strategic task for Russia. Test operation of the station will begin in 2024.

The curtailment of international cooperation with the participation of Russia is taking place at a very critical moment, which is dangerous for the Arctic. This is expressed in environmental risks associated with the loss of sea ice, pollution and shipping⁵⁰. This should also include the issue of permafrost thawing, which has an impact on climate change. Two-thirds of the territory of Russia is covered with permafrost, which contains a huge amount of organic material. Its melting and decomposition is accompanied by emissions of greenhouse gases, in the form of methane and carbon dioxide, into the atmosphere. But, the damage done to Russian research finds its continuation in the damage to the scientific research of other states of the Arctic Council. It is determined by the fact that Russia's jurisdiction covers most of the Arctic Ocean, which contains almost half of the Arctic resources.

One of the main obstacles to adaptation to climate change in the Arctic region is "limited information and uncertainties in scientific models of climate change and its future consequences, insufficient consideration of the local context, rich traditional experience and knowledge about the impact of climate change on the lives of northerners. All this creates barriers to decision-making and the choice of successful options for responding to Arctic challenges" (Nikitina, 2019). Therefore, the termination of scientific cooperation with Russia creates problems for the development of measures and the implementation of projects for the adaptation of the region as a whole. This hinders the adaptation of the Russian Arctic region. For example, today, a national strategy for the development of the Russian Arctic until 2035 and a bill to provide a system of preferences for investors in the Arctic zone are being developed. But, as experts note, under the sanctions, "taking into account the best foreign practices and their adaptation to the specifics of the Russian Arctic regions and national plans for the development of the Arctic zone, on the one hand, and the mutual exchange of innovative assessments and results of scientific research on climate variability in the polar regions, accumulated worldwide well-known Russian scientific school of climatology, on the other hand, will help strengthen international cooperation in the field of adaptation and risk management in the Arctic" (Nikitina, 2019).

Similar problems are observed in Finland. In a report prepared on behalf of the government of Finland (Koivurova et al., 2022), the idea is expressed that the implementation of the main

⁴⁹ The Arctic project "Snezhinka" is being implemented in any case (June 15, 2022). Available from: <https://ria.ru/20220615/arktika-1795372600.html?in=t>

⁵⁰ Struzik E. The Ukraine war is affecting vital Arctic research (February 17, 2023). Available from: <https://thebulletin.org/2023/02/the-ukraine-war-is-affecting-vital-arctic-research/>

provisions of the Finnish Arctic Policy Strategy, revised just a year and a half ago, will experience difficulties due to recent events. The document proceeds from the fact that sustainable development in the region depends on international and regional cooperation. In turn, possible steps by Russia to weaken activities in the field of sustainable development, such as in the field of climate research, may slow the pace of transition to sustainable development in the Arctic region as a whole, since the state of the environment and climate knows no national boundaries.

The report acknowledges that, for decades, Russia and its research organizations have played a significant role in Arctic research (Koivurova et al., 2022). Since Russia owns almost half of the Arctic region, the termination of research cooperation with Russia leads to significant gaps in Arctic research. In particular, many Finnish research projects in the Arctic involve field work in Russia. But, in the current situation, they have to be interrupted or redirected. For example, the University of the Arctic has received funding from the Finnish Ministry of Foreign Affairs in order to refocus its activities. The interruption of scientific cooperation with Russia hinders important research aimed at understanding environmental and climate change. “Finland must be able to maintain an understanding of Russia’s Arctic regions in the new circumstances. Up-to-date information is especially important for ensuring climate resilience and sustainable development in the Arctic. Therefore, practical relations with Russia should not undermine the security of Finland, and cooperation should not create harmful dependencies” (Koivurova et al., 2022). Thus, Finland still needs information about the Russian Arctic regions and is interested in scientific cooperation with Russia, and this will require special political efforts, including determining the conditions and terms under which it will be possible to restore contact with Russia that is related to the Arctic questions.

In addition to the suspension of cooperation between states, there is a curtailment of cooperation in the area of interaction with international organizations. This concerns Russia’s cooperation with the World Wildlife Fund, which has been operating in Russia since the early 1980s. A notable project funded by the foundation was the creation of the Great Arctic Reserve⁵¹, which is the largest natural reserve in Eurasia. Over the past decades, the foundation has supported over 1,000 field research projects. The result has been the protection of over 200,000 square miles of unique land in the Arctic and subarctic regions. However, in recent times, the Fund’s activity has begun to cause a wary attitude in Russia. Moreover, the government of Chukotka stopped working with the World Wildlife Fund⁵².

A significant climate project is the peatland restoration project. Russia has vast areas of peatlands that have been degraded as a result of mining, agriculture, oil and gas exploitation and intense permafrost thawing. Fires were another reason for their degradation. In total, peatlands account for 5% of greenhouse gas emissions in the country. Peatland degradation especially intensified after the 2010 fires. The German government has funded projects to restore the

⁵¹ Big Arctic Reserve. Available from: <https://wikiway.com/russia/bolshoy-arkticheskiy-zapovednik/>

⁵² The Government of Chukotka terminated the agreement with the World Wildlife Fund (November 11, 2022). Available from: https://prochukotku.ru/news/obshchestvo/onf_pravitelstvo_chukotki_rastorglo_soglashenie_s_vsemirnym_fondom_diko_y_prirody/

hydrological regime that allows Russian peat bogs and marshes to remain wet, leading to the retention of their carbon. The Succow Foundation has now suspended the project indefinitely⁵³.

As we have already indicated above, foreign scientists recognize the importance of continuing cooperation with Russia. Notably, Senior Fellow at the Wilson Center in Washington, D.C. and former diplomat Evan Bloom, who contributed to the creation of the Arctic Council, admits that “[t]he break in cooperation is necessary because of the [Ukraine] crisis, but progress on pan-Arctic issues cannot be without participation of Russia”⁵⁴. Unlike European partners, the USA’s Arctic Research Consortium, which also includes representatives from Russia and European countries, took a more sustained position and did not make loud statements, but simply suspended the membership of its Russian partner. Despite the significant complication of Russian–American relations, the USA has expressed its intention to continue to cooperate with Russia in the field of environmental protection⁵⁵. The greatest concern of the USA is caused by a consequence of climate change such as the reduction of the Alaskan-Chukotka populations of bears and sea lions. Obtaining reliable scientific results included in the USA’s list of endangered species is impossible without Russian participation.

4.3. New trajectories of the Russian climate policy in the context of sanctions and the agenda for the development of the green technology sector: Results and discussion

Under the impact of economic sanctions and the erection of trade barriers against Russia as a response to the Russian-Ukrainian armed conflict, there are risks in the consistent implementation of Russia’s climate policy. Thus, there is a fairly noticeable trend toward legislation with a negative ecological impact and the abolition or weakening of various environmental norms and requirements, including a reduction in the number of inspections⁵⁶. These trends are emerging in the context in which businesses find themselves interested in relaxing environmental laws to help them adapt to the negative results of sanctions. On the one hand, targeted sanctions imply increased pressure on the fossil fuel industry in Russia⁵⁷. But on the other hand, targeted sanctions hinder Russia’s transition to green technologies, which are at the heart of the modernization of its energy sector. This slowdown has a negative effect, given the low level of technological re-equipment of Russian technologies in terms of responding to climate challenges.

⁵³ Michael Succow Foundation For the protection of Nature. Peatland restoration in Russia. Phase III for fire and climate change prevention mitigation (duration 07.2020–12.2023). Available from: <https://www.succow-stiftung.de/en/peatlands-climate/moorrestauration-in-russland>

⁵⁴ Struzik E. The Ukraine war is affecting vital Arctic research (February 17, 2023). Available from: <https://thebulletin.org/2023/02/the-ukraine-war-is-affecting-vital-arctic-research/>

⁵⁵ The USA wants to cooperate with Russia in the Arctic (August 15, 2022). Available from: https://octagon.media/istorii/ssha_xotyat_sotrudnichat_s_rossiej_v_arktike.html

⁵⁶ Simonov E. Environmental lawlessness during wartime (June 29, 2022). Available from: <https://uwecworkgroup.info/environmental-lawlessness-during-wartime/>

⁵⁷ Carrington D., Taylor M. Revealed: The “carbon bombs” set to trigger catastrophic climate breakdown // The Guardian (21 May 2022). Available from: <https://www.theguardian.com/environment/ng-interactive/2022/may/11/fossil-fuel-carbon-bombs-climate-breakdown-oil-gas>

According to Russian experts, “when comparing the tools and practices used by foreign and Russian oil and gas companies, it was found that Russian oil and gas companies are not engaged in the development of technologies for capturing and storing carbon and generating energy from hydrogen. Methane emission management as a special type of management exists only for Gazprom, while for foreign companies methane management is an integral part of sustainable development management” (Lyubarskaya et al., 2019).

In a situation where the green transition is costly and complicated by sanctions, some political circles have taken the initiative to withdraw from the Paris Climate Agreement⁵⁸. However, this scenario is not supported at the government level. And, nevertheless, at a time when the European Union and the USA are beginning to abandon the previously proclaimed ambitious climate agenda, the Russian expert community is raising the question of “to what extent our laws and other legal norms correspond to current political realities. You need to understand: sanctions are easily introduced, but they are difficult to cancel, and in our case, most likely, they will not be canceled at all, so the problems that we have now are for a long time ... So it’s time to take inventory of the current norms” (Roginko, 2022).

These trends in Russian climate policy do not mean a rejection of technological modernization and a rejection of the corresponding obligations of international climate agreements. This thesis can be substantiated by the fact that governmental agencies, companies, think tanks and other institutions that have been actively developing and implementing green strategies in recent years proceed from the continued relevance of the climate change agenda. This is manifested in the continuation of the course toward the development of renewable energy⁵⁹.

In addition to said, the process of enacting laws related to climate and carbon emissions is ongoing. In 2021, the law “On limiting greenhouse gas emissions” was adopted⁶⁰, which creates the basis for the implementation of climate projects in Russia, namely, measures to reduce emissions and increase the absorption of greenhouse gases. It also encourages large companies to report emissions. The law provides for the adoption of emission reduction targets for the economy as a whole and for individual industries in particular; it also establishes a system for attracting private investment for sustainable (including green) development projects.

Further, the strategy for the socioeconomic development of the Russian Federation with low greenhouse gas emissions until 2050 was adopted⁶¹. The organizational framework for its achievement will be the implementation plan for the low-carbon development strategy of Russia, which is being developed by the Ministry of Energy. In 2022, Russia introduced a greenhouse gas

⁵⁸ Sergey Mironov: Russia must withdraw from the Paris climate agreement after Western sanctions (April 20, 2022). Available from: <https://spravedlivoru/12016310>

⁵⁹ Will Russian business maintain its course towards decarbonization? (March 29, 2022). Available from: <https://rawi.ru/2022/03/sohranit-li-biznes-v-rossii-kurs-na-dekarbonizaciyu/>

⁶⁰ Federal Law “On Limiting Greenhouse Gas Emissions” dated July 2, 2021 N 296-FZ (last edition). Available from: http://www.consultant.ru/document/cons_doc_LAW_388992/

⁶¹ Decree of the Government of the Russian Federation of October 29, 2021 N 3052-r “On approval of the strategy for the socio-economic development of the Russian Federation with low greenhouse gas emissions until 2050” Available from: <http://static.government.ru/media/files/ADKkCzp3fWO32e2yA0BhtIpyzWfHaiUa.pdf>

reporting system for large emitters. Quite noticeable was the initiative to launch pilot projects on carbon trading in the Sakhalin region, aimed at achieving carbon neutrality by 2025⁶².

However, not everything is so simple. According to the forecast of the Institute for Economic Forecasting of the Russian Academy of Sciences, Russian potential to reduce greenhouse gas emissions by 2050 could almost halve in a year, mainly due to technological limitations. The restrictions imposed on Russia have created conditions where some of the measures to decarbonize the economy cannot be implemented. Therefore, CO₂ emissions will decrease by 2050 to 1.119 billion tons instead of the 630 million tons of CO₂ planned by the strategic documents. As a comparison, the author of this study must point out that net emissions in 2019 amounted to 1.5 billion tons of CO₂, taking into account the absorptive capacity of forests. Of course, if no measures are taken, then, if the current pace of economic development is maintained, the volume of emissions may even increase by 2050 and reach up to 2 billion tons of CO₂.

The Russian goal for 2030 looks unambitious, i.e., to reduce emissions by 30% from 1990 levels, including absorption by forests and other ecosystems (this goal has already been achieved, as, due to forests, emissions have almost halved). But, by 2060, Russia is going to achieve carbon neutrality, which is already comparable to the plans of other major emitters, i.e., the USA and the European Union (2050), China (2060) and India (2070). The implementation of this target scenario will require investments in reducing greenhouse gas emissions of about 1% of the gross domestic product (GDP) annually in 2022–2030, and up to 1.5–2% of GDP in 2031–2050. In this case, net emissions will be reduced to 630 million tons, which is 60% of the 2019 level and 80% of the 1990 level. However, the question legitimately arises of how exactly this will be achieved.

It is obvious that the intention to reduce emissions largely by increasing the absorption capacity of forests already raises many questions from Russian and international experts. Russia has been raising the topic of its forests and their global role in absorbing emissions for several years. Russian scientists and politicians are talking about the need to adopt a new forestry methodology that would increase the level of absorption and thus better take into account the role of Russia in this matter. But, forests alone are not enough here.

The imposition of sanctions will require a revision of plans to reduce emissions, since decarbonization largely depends on imported equipment and technologies, including those from unfriendly countries, the supply of which to Russia is limited. Hence, the implementation plan of the low-carbon development strategy will be subject to adjustment by taking into account sanctions and new realities. Of course, it does not follow at all that this will insurmountably prevent Russia from achieving carbon neutrality by 2060. But, it is quite possible that this will happen objectively as a result of the economic downturn, which will automatically lead to a reduction in greenhouse gas emissions. In some ways, this will be reminiscent of a repeat of the 1990s, when a sharp decline in industrial production led to a reduction in emissions of more than 30%, which even exceeded the country's commitments under the Kyoto Protocol. However, it is hardly reasonable to consider the resuscitation of such a scenario as genuine decarbonization.

⁶² The State Duma adopted in the third reading the law on the experiment with CO₂ on Sakhalin (February, 16 2022). Available from: <https://www.interfax.ru/russia/822453>

The decarbonization of the economy implies a qualitative expansion of the use of green technologies and the influx of green investments. Russian companies have experience in using a wide range of most existing technologies that contribute to low greenhouse gas emissions. These are technologies for capturing, utilizing and storing carbon, as well as technologies for switching to the use of energy derived from low-carbon sources, including the atom and hydrogen. Thanks to the use of the latest technologies, companies not only reduce emissions, but also increase the economic efficiency of their production⁶³.

However, under the sanctions, barriers have emerged both in access to green technologies and in international funding for green projects. All this encourages a wide range of politicians, businessmen and scientists to start an active discussion on alternatives to foreign technologies and sources of financing in order to continue the green transition⁶⁴. As a result, the continuation of the desire of Russian enterprises to meet international standards generates new initiatives.

Under the conditions of sanctions, there are restrictions on the possibilities of importing foreign technologies. Dependence on imported equipment and technologies required for decarbonization is as follows:

Oil sector: 55%

Coal industry: 45%

Electric power industry: 31%

Difficulties in access to imported technologies, as one of the aspects of sanctions pressure, are a factor in the achievability of the Russian strategic goal by 2050. This does not mean that it is necessary to revise the low-carbon development strategy, as measures to reduce greenhouse gas emissions are implemented at the corporate level. In general, additional mechanisms of economic support for decarbonization measures are in demand, including support for the R&D sector and technological modernization.

The current isolation from technology flows could lead to a projected increase in emissions. But, on the other hand, the shortage of components will lead to the shutdown of a number of enterprises. Therefore, net emissions may decrease. So, some leveling will happen. However, this should not lead to complacency or provoke technological dependency. Limiting Russia's access to low-carbon technologies is detrimental to not only achieving Russian climate goals, but also global climate goals. This can be seen as a starting point for arguments to ease sanctions pressure. However, the wait-and-see attitude, even if supported by active measures of diplomatic persuasion, cannot but be supplemented by the intensification of scientific, technological and economic policies.

The decline in the flow of foreign technology has coincided with a reduction in sources of foreign investment and a freeze in the implementation of international programs, which complicates plans to modernize traditional industries. In particular, the rather dynamically emerging Russian

⁶³ Ministry of Economic Development of the Russian Federation. Overview of Russian practices in the field of low-carbon development and adaptation to climate change, pp. 9–21, 26–30. Available from: https://www.economy.gov.ru/material/file/f400e099af84821321639151851e72c0/obzor_rossiyskih_praktik_v_sfere_nizkouglerodnogo_razvitiya_i_adaptacii_k_izmeneniyam_klimata.pdf

⁶⁴ Polkanov V. Russian business does not turn off the green path (May 4, 2022). Available from: https://www.ng.ru/economics/2022-05-04/100_155304052022.html

renewable energy sector was faced with the fact that international investors (i.e., Vestas, Fortum and ENEL) left. At the same time, it should be taken into account that high rates and indicators of decarbonization imply an increase in investments. In particular, in order to achieve carbon neutrality by 2050, Russia will need a total investment in decarbonization in the amount of 458 trillion rubles for 28 years. In general, decarbonization involves a variety of options for reducing emissions. The most optimal is the one that will lead to the least losses in terms of economic growth.

The activation of the climate agenda contributes to the implementation in Russia of measures that encourage investors to invest in green initiatives that have a beneficial effect on the environment.

In recent years, the principles of sustainable financing based on the impact of investments on the ESG have grown in popularity in Russia. As follows from the report of the InfraGreen expert-analytical platform “Infrastructure and Finance for Sustainable Development” on the Russian ESG transformation, a real ESG breakthrough was made in Russia in the development of this sector of the economy in 2018–2021⁶⁵. This means that the basic structure of regulations has been created, i.e., that regulations, standards and taxonomies have been created. According to calculations, climate projects in Russia can reduce annual greenhouse gas emissions by 500–900 million tons of CO₂ equivalent. The potential of the Russian green projects market is USD 300 billion by 2030.

Some companies have started manufacturing products in accordance with ESG standards. Others have begun to express interest in the ESG transformation. The first Russian specialized consulting agencies and the ESG Alliance appeared on the market. The Bank of Russia has created regulations for companies based on international ESG reporting standards.

An important Russian achievement was the creation of a mechanism for raising funds, namely, green bonds to support and develop environmentally significant projects of Russian companies.

Through the mechanism of green bonds in Russia, projects are now being financed in the field of energy, real estate, waste management, engineering, as well as in the financial and transport sectors. The first issue of green bonds was placed in December 2018 on the Moscow Exchange (Table 2).

Table 2. Issuance of green bonds in Russia.

Year	Value
2018	1.1 billion rubles
2019	12.2 billion rubles
2020	10.5 billion rubles
2021	16.3 billion rubles

The Russian green bond market is showing steady growth. In 2022, the volume of placement of new ESG bonds on the Russian market exceeded 80 billion rubles⁶⁶. This is 36% below the record level of 2021, but higher than in 2020. In 2022, the Russian ESG finance market managed to avoid a

⁶⁵ ESG and green finance in Russia: It's too early to put an end to it. The Infragreen platform published a report with information on the developments over the past three years (March 29, 2022). Available from: https://www.vedomosti.ru/ecology/green_finance/articles/2022/03/29/915686-esg-i-zelenie-finansi-rossii-krest-stavit-rano

⁶⁶ Kalmatsky M (2023) Russian business began to invest more in social projects. Available from: <https://rg.ru/2023/01/24/rossijskij-biznes-stal-bolshe-vkladyvatsia-v-socialnye-proekty.html>.

serious fall due to the general normalization of the situation in the financial markets in the second half of the year, the entry into the market of several large issuers with state participation, as well as the implementation of previously postponed plans for the placement of ESG bonds. In the medium term, with a high degree of probability, 2021 remained a record year in terms of the volume of placements (126.5 billion rubles), i.e., when the market situation developed on a wave of interest in various ESG instruments and the green finance agenda in general, and also reflected certain expectations regarding regulatory incentives.

The ESG bond sector, created to finance social and environmental projects, has been actively developing and, in four years, has grown into four independent segments of green, social bonds, sustainability bonds and national and adaptation projects. A separate category of sustainable financing instruments is social bonds. In 2020–2021, six issuers in Russia carried out nine issues of social bonds, the total volume of which amounted to 83 billion rubles. The funds were used to implement projects in education, culture, healthcare and the construction and reconstruction of infrastructure facilities for housing and municipal services.

For three years, 33 green, social and other targeted bonds were issued for sustainable development by Russian issuers for 418 billion rubles. The total volume of Russian issuers by the end of December 2021 amounted to 192.6 billion rubles. In Russia, the first five rating agencies have appeared that have the right to verify green bonds and conduct an external evaluation of projects.

Another way to finance projects aimed at implementing the sustainable development goals is through ESG loans. From July 1, 2021 to July 1, 2022, the volume of the portfolio of such loans, according to the rating agency, tripled and amounted to about 1.2 trillion rubles. At the same time, systemically important credit institutions accounted for 91% of the portfolio of green and social loans, compared with 96% a year earlier. This indicates the development of ESG lending in medium-sized and small-scale banks, which means an increase in competition in this area.

An important stage in the development of the Russian market of green finance instruments was the approval in 2021 of the national taxonomy of criteria for sustainable projects, including green development, as well as the requirements for their verification system. The criteria for sustainable (including green) development projects in the Russian Federation, as well as the requirements for the verification system for sustainable (including green) development projects in the Russian Federation, were approved by Decree of the Government of the Russian Federation of September 21, 2021 No. 1587⁶⁷. The purpose of the criteria was to develop investment activities and attract off-budget funds to projects aimed at implementing the national development goals of the Russian Federation in the field of green finance and sustainable development. The criteria included criteria for green projects (taxonomy of green projects) and criteria for adaptation projects (taxonomy of adaptation projects).

⁶⁷ Decree of the Government of the Russian Federation dated September 21, 2021 No. 1587 “On approval of the criteria for sustainable (including green) development projects in the Russian Federation and requirements for the verification system for sustainable (including green) development projects in the Russian Federation”. Available from: <https://veb.ru/files/?file=594c9cda7303e6820f23a83804fa633a.pdf>

The very definition of green and adaptation projects has been established by the goals and main directions of sustainable (including green) development of the Russian Federation⁶⁸.

As a result of the sanctions, there has been a decrease in the availability of the green finance required for ESG projects. This is due to the following reasons:

- (1) the departure of Western investors who supported the business, which declared its commitment to sustainable development standards;
- (2) withdrawal from Russia of reputable consulting firms such as McKinsey, Boston Consulting Group (BCG), Accenture, Deloitte, KPMG and PwC;
- (3) imposition of sanctions on Vnesheconombank of Russia⁶⁹.

The inclusion of this bank in the sanctions list largely blocks its ability to promote the ESG financing market. Recall that, in 2020, the Russian government designated Vnesheconombank of the Russian Federation as a methodological center for sustainable financial instruments. According to the order of the government of Russia, such a step was necessary for the implementation of the Agenda for Sustainable Development. The main development of Vnesheconombank of the Russian Federation in this direction was the taxonomy of green projects, approved in September 2021. It helps investors determine whether an asset meets international ESG criteria.

Be that as it may, the implementation of the green transition in the context of the climate agenda only when relying on national financial and technological capabilities is very difficult. In this context, the complication of Russian companies' access to green finance, which entails a slowdown in the green transition, will affect not only the achievement of Russian climate goals, but also global climate goals. This should be justified by the fact that Russia accounts for one-seventh of the world's land, and global warming on its territory is developing twice as fast as the average on the planet. Solving the problem of climate change without Russia is impossible, as the country is in the top five major emitters of greenhouse gases, which, together, are responsible for 58% of global emissions.

Therefore, due to the biospheric and ecological interconnectedness, these local processes will sooner or later begin to influence global indicators. State borders are not able to stop this process, and sanctions will only lead to an aggravation of the planetary situation. It is necessary to fully agree with the position according to which "sanctions and voluntary freezing by contractors of work not only with Russian regulators, but also with companies that have adopted a green agenda and invested in their own transformation, are pushing them out of global climate activity"⁷⁰. Therefore, pushing Russian companies out will have the opposite effect.

Thus, the presence of a certain technological potential and green financing instruments, with all of the existing sanction-related difficulties, allows one to state that the Russian economy is quite efficient in terms of greenhouse gas emissions. So, in the field of electricity, the country is second only to the European Union in terms of emissions, but, compared to China, the USA and other

⁶⁸ Decree of the Government of the Russian Federation dated July 14, 2021 No. 1912-r "Goals and main directions of sustainable (including green) development Russian Federation. Available from: <https://veb.ru/files/?file=a1801766df8b0402740561a5ef800d53.pdf>

⁶⁹ VEB.RF // <https://вэб/рф/en>

⁷⁰ Sapozhkov O., Galiyeva D. The climate has no fatherland. The freezing of Russian green projects and resources will delay the fight against global warming (November 15, 2022). Available from: <https://www.kommersant.ru/doc/5667381>

countries, it looks very good. In the sphere of metallurgy and the production of ammonia and aluminum, Russia is also far from the first place in terms of pollution.

Table 3. Emissions.

Country	Value
Russia	328 grammes per ton
European Union	269 grammes per ton
USA	405 grammes per ton
China	613 grammes per ton
India	709 grammes per ton

Source of data: CO₂ emissions in the process of generating 1 kilowatt-hour of electricity: [RAS experts assessed the impact of sanctions on Russia's plans for decarbonization (05/26/2022) // <https://www.vedomosti.ru/economics/articles/2022/11/22/951444-otsenili-vliyanie-sanktsii-na-plani-po-dekarbonizatsii> <https://www.vedomosti.ru/economics/articles/2022/11/22/951444-otsenili-vliyanie-sanktsii-na-plani-po-dekarbonizatsii>].

The above statistics (Table 3) show one of the starting points for the diplomatic efforts undertaken by representatives of the Russian business community within the framework of the international climate regime. Until recently, Russia was not very active on the platforms of international climate negotiations, but, in recent years, there has been an increase in activity, which is largely due to the need to respond to sanctions restrictions. The fact is that sanctions and voluntary freezing by contractors of work not only with Russian regulators, but also with companies that have adopted a green agenda and invested in their own green transformation, are pushing them out of global climate activity. Therefore, the Russian climate-oriented business seeks to convince the world community that curtailing cooperation with Russia is a mistake that threatens not only individual markets, but also the overall goal of achieving climate neutrality.

In other words, without the greening of the Russian industry, global plans to stop global warming are difficult to implement. Thus, the Russian representatives have been raising the issue of withdrawing green areas of cooperation from sanctions for several years now. There is a variety of projects, the implementation of which is possible with the support of the Global Environmental Facility. However, the corresponding applications from Russia have remained in limbo since 2014. The climate projects of Russian companies, which could be supported by international funds and banks, are very promising. Within the framework of the COP 27, the business community urged to not boycott green projects in Russia, because it could negatively affect the work of Russian companies⁷¹.

Several arguments are given. The first is that domestic carbon regulation should be considered as an integral part of global, and, in particular, European regulation. Sanctions also complicate access to green finance, which will affect global climate problems. Striking Russian climate projects out of the global context leads to a noticeable decrease in their overall productivity and a loss of climate profitability. In turn, a certain number of them may not be implemented at all due to sanctions restrictions. Responsible Russian businesses are still hoping to convince the world community that

⁷¹ Sanctions and a boycott of green projects will make it difficult to fight climate change, Russian businessmen said UN Conferences (November 15, 2022). Available from: <https://www.asi.org.ru/news/2022/11/15/rossijskaya-delegacziya-na-konferenczii-oon-po-klimatu-zayavila-cto-bojkot-zelenyh-proektov-v-rossii-zatrudnyat-borbu-s-izmeneniem-klimata/>

the exclusion policy is a mistake that threatens not only individual markets, but also the overall goal of achieving climate neutrality. Without the greening of Russian industry and its resources, plans to stop global warming is difficult.

Representatives of business stressed that Russia is of interest to the world as a source of gas, which is important in the transition to more environmentally friendly energy sources, as well as metals necessary for the development of renewable energy. For example, copper is a basic component of smart grids and in the production of electric vehicles, solar panels and wind and hydropower generators. In the case of sanctions ignoring Russian climate projects, not only will their productivity decrease, but it will lead to the use of dirtier technologies by Russian enterprises, with all the ensuing consequences. In addition to this, Russian non-governmental organizations (NGOs) sent an appeal to the COP 27 Conference⁷². In it they called for the following:

- (1) Set ambitious targets for reducing greenhouse gas emissions for 2030–2035, giving priority to low-carbon development measures (using renewable energy sources and increasing energy efficiency).

Expected practical result: advancing the global climate agenda.

- (2) Recognize as unsuitable for solving the climate problem technologies that operate on the basis of fossil fuels, nuclear technologies, large river dam hydropower, the incineration of municipal solid waste and hydrogen fuel produced on the basis of nuclear energy and fossil fuels.

Expected practical result: moving toward a more ambitious technology agenda.

- (3) Ensure the participation of representatives of civil society and vulnerable social groups in decision-making during the COP 27.

Expected practical result: moving toward a democratic and inclusive global climate regime.

5. Directions for further research analysis

The general pattern of the sanctions regimes is that the affected states take measures aimed at solving the problems of national development in the context of sanctions. In each historical case, the design of these measures is specific. The implementation of this scenario can be perfectly illustrated by the case of Russia. This is a process that is unfolding before our eyes. The set of measures attracts attention, while the results of their implementation will declare themselves in the future. It follows that there is a promising space for further research within the subject matter of the presented article.

So, the sanctions regime has created a specific situation for the implementation of Russia's climate policy, which has a complex and multifaceted character. The R&D sector was also affected, as sanctions have had an impact both on its functioning in and integration into international cooperation. In turn, the continued development of the climate research sector and related green technologies has become the subject of a new round of Russian climate policy, as well as state policy in the field of science and technology in the context of sanctions. The proactive measures being taken are aimed at preventing Russia from lagging behind in the climate sphere.

⁷² Russian NGOs sent an appeal to the participating countries of the UN Climate Change Conference 2022 (July 7, 2022). Available from: <https://www.asi.org.ru/news/2022/11/07/nko-prizyvayut-sokrashhat-vybrosy-panikovyh-gazov-i-adaptirovatsya-k-izmeneniyu-klimata/>

The key initiative is to establish six research centers in the form of consortia to study climate change on a wide range of observations, from permafrost to desertification⁷³. Another initiative is the creation in Russia of the Unified Monitoring System for Climatically Active Substances. It is planned to allocate 9.1 billion rubles for its financing until 2024, and monitoring will involve dozens of scientific institutions across the country. In the relevant order of the government, the creation of the unified system is considered as an innovative project of national importance⁷⁴. The network will create favorable conditions for the fulfillment of Russia's international obligation to maintain the national inventory of anthropogenic emissions from sources and removal and greenhouse gas sinks. The implementation of the innovative project under consideration should have a decisive impact on preventing the negative impact of climate change on the Russian economy and the quality of life of citizens.

The main source of financial support of the climate R&D sector is the funds reserved for the implementation of the federal project "Low-carbon development policy"⁷⁵, which is as an integral part of the state program "Economic Development and Innovative Economy". Its project passport provides for the improvement of the National System for Monitoring Emissions and Removal of Greenhouse Gases, including conducting the necessary studies (9.29 billion rubles). An additional source is the funds provided for the implementation of the federal scientific and technical program in the field of environmental development of the Russian Federation and climate change for 2021–2030. The result of the network functioning will be the creation of a physical and mathematical model of the earth, the monitoring of various climatic processes and the development of scenarios for the decarbonization of economic sectors. The data obtained will be used to adjust the activities of the implementation plan of the low-carbon development strategy until 2050. And, finally, verified information is considered as the basis for the formation and further promotion of Russian approaches in the world.

Despite the negative impact of sanctions, Russia intends to intensify scientific climate research in the main areas that should solve the problem of preparing technologies for data collection and interpreting climate data⁷⁶. These include the following:

- (1) Development of a system for monitoring and recording data on greenhouse gas flows and the carbon cycle in terrestrial ecosystems.

Target result: reasonable forecasts of future ecosystem changes.

- (2) Development of a monitoring system for key areas of the world oceans, coastal zones and seas of Russia, including observations at the ocean-atmosphere boundary and climate modeling.

Target result: formation of a climate change model.

⁷³ Russia will create six research centers for climate change research (September 28, 2022). Available from: https://nauka.tass.ru/nauka/15896167?utm_source=google.com&utm_medium=organic&utm_campaign=google.com&utm_referrer=google.com

⁷⁴ Decree of the Government of the Russian Federation of October 29, 2022 No. 3240-r "On approval of the most important innovative project of national importance" "climate active substances" and an action plan ("road map") for the implementation of the first stage (2022–2024). Available from: <https://www.garant.ru/products/ipo/prime/doc/405491263/>.

⁷⁵ Passport of the federal project low-carbon development policy (2022–2030). Available from: <https://www.profiz.ru/upl/Low-carbon%2C%20passport%20pdf?ysclid=l82ve97nze599897040>

⁷⁶ In Russia, scientific research in the field of climate will be conducted in 4 main areas (February 8, 2023). Available from: <https://minobrnauki.gov.ru/press-center/news/novosti-ministerstva/46885/>

- (3) Development of economic and mathematical models for assessing measures planned and implemented in relation to the national economy.

Target result: adaptation of the economy to climate change.

It is quite clear that the condition for the implementation of these areas is the proper level of equipment of research institutes with modern scientific instruments and equipment. Therefore, the provision of domestic instrumentation products is of key importance. But, here, the problem is not in the amount of funds allocated for this, but in the absence of highly developed production.

Accordingly, the task arises to develop the instrument-making industry with the attraction of the necessary amounts of financial resources and investments. In our opinion, in addition to budgetary funds, funds should be raised through green financing instruments. In the current conditions, green finance instruments should not only contribute to the implementation of green projects with a high-tech component, but they should also support technological developments in relation to the development of the instrument base. This can be justified by the fact that the Federal scientific and technical program in the field of environmental development of the Russian Federation and climate change for 2021–2030 in conjunction with the national project “Science and Universities” cannot solve the problem of providing instruments for the climatological branch of science.

The problem of adaptation to climate change and mitigation of their consequences is not solved by conducting scientific research, but by implementing relevant projects in various sectors of the economy based on the use of the best technologies. Russia is faced with the task of improving the organizational, legal and personnel conditions to stimulate the development of domestic technologies. And, of course, the focus should be on using them to provide technological developments and climate projects with reliable and effective green financing instruments from national sources from foreign countries that did not impose sanctions against Russia.

Currently, the Russian government is actively developing tools to support the green finance market. In particular, a system of affordable financial incentives is being considered for both investors and issuers of green and social bonds. For example, in 2021, the Program for Concessional Financing of Green Projects and Initiatives in the field of sustainable development was launched and started to work. This made it possible to create economic incentives for the transition to advanced environmental standards. Under the sanctions, the green financing program has been expanded. According to the Decree of the Government of the Russian Federation of March 11, 2023 N 373⁷⁷, the list of areas of green initiatives has been expanded, the concessional financing for which can be attracted through special bonds or loans.

Projects related to the construction of energy-efficient housing, the clearing and restoration of water bodies, the creation and modernization of infrastructure for direct capture of greenhouse gases from the environment, as well as the capture and disposal of landfill gas with subsequent energy recovery, will be eligible for concessional financing. For projects in the energy sector, directions have been added for the modernization and repair of infrastructure for transporting hydrogen, as well as for the production of batteries, their disposal and reuse. Projects that use the technology of electric heat pumps will be able to

⁷⁷ Decree of the Government of the Russian Federation of March 11, 2023 No. 373. Available from: http://www.consultant.ru/document/cons_doc_LAW_441987/92d969e26a4326c5d02fa79b8f9cf4994ee5633b/

receive concessional financing. This technology allows the heat accumulated in the ground and water bodies to be converted into thermal energy for heating the building.

Russia does not seek to abandon green finance against the backdrop of sanctions. Moreover, the Russian expert community is focused on the approach whereby sanctions do not apply to green investment, which affects the interests of future generations.

6. Conclusions

The climate crisis is a challenge that affects all states to one degree or another. The solution of the climate problem is possible only through broad international cooperation. In other words, the transition to a sustainable world and the achievement of sustainable development goals presupposes agreement and cooperation. Unfortunately, the life of the international community is marred by sanctions that divide the members of the international community and bring disharmony. In some cases, sanctions are well justified. But, in other cases, even if this seems quite reasonable to some states, sanctions become negative factors that complicate the solution of global problems, such as climate change. Russia, in this case, is very indicative and, moreover, instructive.

The study found that one of the goals of anti-Russian sanctions is to slowdown the development of Russian climatological R&D and its involvement in international relations.

As the study showed, the consequences of targeted scientific sanctions present in the form of the suspension of research cooperation at the level of joint research and scientific activities, as well as in the form of stopping the supply of scientific equipment and freezing external funding, which not only slows down the development of climate research in Russia, but also that in other countries. In addition to this, global climate science as a whole suffers.

In addition, difficulties in the technological modernization of the Russian economy in line with green transformations should be added here due to the lack of inflow of foreign green finance and green investments. All of this ultimately causes difficulties in the development of a climate-oriented economy at the national level, as well as in the implementation of international obligations under the climate regime. Moreover, plans for the transition to sustainable development and the achievement of its goals at the national level can be attributed to serious consequences.

Moreover, the failure to fully implement plans for the transition to sustainable development and the achievement of its goals at the national level can be attributed to the serious consequences of scientific and related economic and financial sanctions. Taken together, and given that Russia is a major emitter of greenhouse gases, there are risks to the goals of the global climate agenda. They will not be reached in a timely manner. In this case, the global consequences will be the most depressing.

In general, this study not only contributed to the solution of scientific problems related to the understanding of sanctions, but also formed a new subject research field at the system level. Such was the multicomponent regime of anti-Russian sanctions in the climate R&D sector, which involves various instruments of pressure on Russia. The anti-Russian science and technology sanctions regime operates in the broad context of the importance of science and technology, as well as green finance, for the process of transition to sustainable development and the achievement of its goals at the national and global levels. The case of Russia demonstrates that economic and scientific sanctions can have a negative impact on the environment and climate. At the same time, anti-Russian scientific

sanctions, and, with them, economic and financial sanctions, play the role of disruptive factors that not only cause failures in the implementation of the national climate policy in its scientific, economic and financial aspects, but also act as a factor in its adjustment and stimulate the search for national innovative measures to respond to emerging difficulties.

Anti-Russian scientific, as well as technological, economic and financial sanctions associated with it, have an unprecedented resonance not only with respect to global climate science, but also to the climate of the planet. For this reason, climate cooperation should remain one of the few areas where a positive development of relations between Russia and Western countries is still possible. The experience of interaction between the USA and China is indicative here, which, in recent years, have managed to reach many climate agreements, despite severe contradictions in other areas. As for the case of Russia, the interests of solving the global problem of conservation of climate change and efforts to transition to sustainable development and renewable energy, reduce greenhouse gas emissions and finance the adaptation of civilization to the changes that have already occurred require the withdrawal of cooperation tools beyond any political restrictions. This means that the most promising issues for cooperation should remain cooperation in the field of scientific research (including monitoring of emissions and removals), the reduction of methane emissions, adaptation to climate change, including in the Arctic, the development of renewable and hydrogen energy programs and energy efficiency.

The model of anti-Russian sanctions in the area of climate R&D formulated in this study, as well as the closely related green finance sector, is not only explanatory, but can also have a practical application, i.e., policy implications. In particular, based on this model, recommendations can be developed on the formation of a targeted policy for the development of the Russian climate R&D sector and the green finance sector under sanctions. The proposed model can become a guideline for eliminating practical uncertainties regarding the extent of the consequences of sanctions for Russian climate R&D and their involvement in international cooperation, as well as the consequences for foreign contractors. The results of the study can become a guideline for harmonizing the approaches and actions of various policy actors in the area of science, technology and green finance. In other words, the practical significance of the study stems from the fact that the developed model of anti-Russian sanctions on climate R&D includes the development of a model of Russian policy under these conditions. A special segment on this development, namely, the development and implementation of government policy on international cooperation in the form of scientific diplomacy, requires further research efforts. And, finally, due to the fact that the formulated model includes an analysis of the negative consequences of anti-Russian scientific sanctions on world climate science and the state of the climate, the presented model can become a starting point for discussion within the global climate regime on the appropriateness of applying anti-Russian sanctions and how they are affecting the climate.

Use of AI tools declaration

The author declares that he has not used the Artificial Intelligence (AI) tools in the creation of this article.

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Conflict of interest

The author declares no conflict of interest.

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