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Review

Carbon Market for Climate Projects in Russia: An Overview of Nature-Based and Technological Carbon Offsets

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Abstract: Climate projects can become one of the key tools for decarbonization in Russia. They have powerful potential in terms of solving the problems of reducing emissions and increasing the absorption of greenhouse gases, as well as monetization potential for businesses. Despite the geopolitical crisis and sanctions imposed on Russia, certain opportunities for implementing climate projects have remained accessible. This study aims to provide a comprehensive analysis of the current status, including the regulations and approved methodologies, prospects, and challenges for climate projects in the carbon market in Russia. It also offers an overview of international carbon market mechanisms and analyses the advantages and disadvantages of the nature-based and technological solutions of climate projects for carbon sequestration. This, in turn, can facilitate the realization of future strategies for realizing the bigger potential of Russian climate projects in the domestic and international carbon markets. This research also provides up-to-date data on the current situation of the carbon market in Russia.

Keywords: carbon market; carbon credits; carbon balance; greenhouse gas management; Russia

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1. Introduction

In recent years, the issue of climate change has escalated significantly, posing a potential threat to the global economy. To mitigate the adverse effects of climate change, 189 countries have pledged to reduce greenhouse gas emissions (GHGs) as part of their commitment to the Paris Agreement, which was adopted during the 21st session of the Conference of the Parties to the United Nations Framework Convention on Climate Change on 12 December 2015 [1]. The scenarios outlined by the IPCC, aiming to cap the temperature rise at 1.5 °C, highlight the necessity of removing CO_2 from the atmosphere, which is crucial alongside the enactment of emission reduction policies. The International Panel on Climate Change (IPCC) clearly outlines that "the deployment of carbon dioxide removal to counterbalance hard-to-abate residual emissions is unavoidable if net zero CO_2 or GHG emissions are to be achieved". Given the increasing agreement that achieving the set objectives relies on carbon dioxide removal (CDR), different alternatives are being considered. The IPCC defines CDR as "anthropogenic activities removing CO_2 from the atmosphere and durably storing it in geological, terrestrial, or ocean reservoirs, or in products" [2]. These options encompass a spectrum of approaches, including nature-based solutions like forestation, soil carbon sequestration, and wetland restoration, as well as technological innovations such as enhanced weathering, bioenergy with carbon capture and storage, and direct air capture and storage [2].

The Paris Agreement includes market mechanisms for reducing GHG emissions and transferring the results of climate change prevention activities at the international level. Thus, market mechanisms supporting projects to reduce greenhouse gas emissions are actively developing both at the local and global levels. The traditional carbon market is understood as a market in which a special product is traded—carbon units, which, as a

rule, have a denomination equal to 1 ton of CO_2 equivalent [3]. Two types of carbon units can be distinguished. Carbon units confirm the owner's right to emit greenhouse gases into the atmosphere within the limits of the GHG emission quota established by the regulator. Carbon units of this type are usually called emission allowances. The second type of carbon units confirms the reduction in emissions and/or increase in GHG absorption achieved as a result of the implementation of the so-called carbon (climate) projects. Such carbon units are usually called carbon credits, or offsets [3]. This article focuses on climate projects with carbon credits/offsets.

Carbon offsets are mechanisms that allow entities (such as companies or countries) to compensate for their greenhouse gas emissions by investing in projects that reduce or remove an equivalent amount of emissions elsewhere. With ever-increasing needs to reduce GHGs and their carbon footprint, companies are increasingly motivated to purchase carbon offsets. Registered climate projects provide companies and governments with opportunities to offset their emissions by trading carbon credits. The carbon markets have gained prominence. They reached USD 800 billion in 2021, which is more than international trade in grains or oil [4]. The global demand for carbon units is projected to surge more than 25-fold by 2050, potentially reaching hundreds of billions of USD [5]. Currently, the demand for carbon offsets is 127 million tons of CO_2 equivalent, and the supply is 250 million tons. By 2050, demand could be 3.4–5 billion tons, and supply could be 6.8 billion tons.

Russia, a vast nation straddling northern Asia and eastern Europe, is home to some of the world's largest reserves of coal, oil, and gas. Its energy sector plays a pivotal role in global emissions, making it a critical player in the fight against climate change. In 2016, the Russian Federation formally joined the Paris Agreement, aligning itself with international efforts to combat climate change, safeguard the environment, and manage natural resources. However, the geopolitical crisis, sanctions imposed on Russia, and partial economic isolation have influenced Russia's low-carbon development policies and ability to meet climate targets [6]. Nonetheless, certain opportunities for implementing domestic policies and international cooperation have remained accessible. Russia has made progress in recent years developing mechanisms to promote decarbonization in key sectors as well as regulatory frameworks and implementing climate projects aimed at reducing CO_2 emissions.

Russia, as one of the world's largest energy exporters and a significant emitter of greenhouse gases, has been exploring various approaches to offset its carbon footprint. Climate projects can become one of the key tools for decarbonization in Russia. They have a powerful potential in terms of solving problems of reducing emissions and increasing the absorption of greenhouse gases, as well as monetization opportunities for businesses. Given the above-stated aspects, this study aims to provide a comprehensive analysis of the current status, including the regulations and approved methodologies, prospects, and challenges for climate projects in the carbon market in Russia. It also offers an overview of the types of climate projects for carbon sequestration and analyses their advantages and disadvantages. This, in turn, can facilitate the realization of future strategies for realizing the bigger potential of Russian climate projects in the domestic and international carbon markets. This study also provides up-to-date data on the current situation of the carbon market in Russia.

The rest of the paper is structured as follows. The Section 2 provides an overview of the market development mechanisms for carbon credits in the world. Section 3 provides a comprehensive analysis of the carbon market in Russia, including the legislative framework and methodologies for the implementation of climate projects in Russia. Section 4 presents the current implementation status of climate projects in Russia. The Section 5 provides concluding remarks.

2. Market Development for Carbon Credits in the World

2.1. Carbon Market Mechanisms and Their Implementation

The carbon market and the practice of implementing climate projects emerged in 1992 following the signing of the United Nations Framework Convention on Climate Change [7]. After the expiration of the Kyoto Protocol period, emission reduction trading was carried out within national jurisdictions, as well as within private carbon unit issuance programs.

Two types of carbon markets can be highlighted—compliance/mandatory and voluntary. In compliance carbon markets, regulated entities (e.g., industrial companies, organizations) have mandatory obligations to reduce their GHG emissions and thus can use carbon credits to reach their legally binding climate targets at lower costs than direct GHG emission reduction [8–10]. Voluntary climate markets are those markets where regulated entities can voluntarily offset their emissions by buying carbon credits [9]. The World Bank's experts identify three primary categories of carbon emission mechanisms:

Independent mechanisms (standards) that operate independently of specific climate agreements or protocols and are administered by private, non-affiliated organizations. Their role is to validate, verify, and generate carbon credits for commercialization that are internationally recognized. Importantly, such standards have been essential in providing detailed guidance in developing and quantifying carbon projects. Examples include the Verified Carbon Standard (VCS), Climate Action Reserve (CAR), and Gold Standard.

The certifier organization VERRA, which administrates the VCS, is the largest international, project-based voluntary mechanism for carbon mitigation and removals. It was founded in 2005 by a consortium including the International Emissions Trading Association, the World Economic Forum, and the World Business Council. Established in 2003 by the World Wildlife Fund and other international non-governmental organizations, Gold Standard, the second largest global independent offset mechanism, certifies and provides a mechanism for predominantly voluntary offsetting.

International mechanisms: These mechanisms align with international climate agreements and are typically overseen by international organizations. Running since 2004, the Clean Development Mechanism (CDM) is a prominent example, established under the Kyoto Protocol. The CDM promotes carbon removal while promoting social, environmental, economic, and sustainable development in developing countries while generating certified emission reductions [11]. Another example is the Joint Implementation (JI) that was in place between 2000 and 2012, under which industrialized countries could earn emission reduction units from removal projects in another industrialized country to meet part of the Kyoto Protocol commitments and their emission reduction targets.

National mechanisms (regional, national, and subnational): Developed and implemented at the country or regional level, these mechanisms are regulated by the corresponding jurisdiction's legislation. The European Union (EU) climate policy divides emission sources into three sectors: the EU Emissions Trading System (EU ETS), the Effort Sharing Decision (ESD), and the Land Use, Land Use Change and Forestry (LULUCF) [9]. The EU ETS, which has been in operation since 2005, is a frontrunner and a reference for other jurisdictions [10]. It comprises power and heat generation, energy-intensive industries, and commercial aviation. The ESD covers almost all other sectors excluded from the EU ETS, including road transport, heating and cooling of buildings, small industries, and emissions from agricultural practices [9]. The LULUCF covers GHG emissions from land use, land use change and forestry.

The "Label Bas-Carbone" is the first voluntary carbon market control system in France, which further contributes to climate change mitigation [12]. It certifies projects that cover farming and forestry activities to reduce emissions and increase removals. Private actors or public entities can voluntarily offset their GHG emissions by financially supporting environmental services (low-carbon activities) in France. The Spanish certification scheme Registro de Huella de Carbono provides a three-tier label to private companies such as calculating a company's carbon footprint, reducing a company's emissions, and compensating a company's emissions by buying certificates from the registry. Another example is the

German MoonFutures, which was introduced as the first voluntary carbon credits scheme to incentivize projects to reduce GHG emissions that arise from peatland rewetting [13]. Puro.earth is a voluntary, commercial carbon removal marketplace based in Finland [14]. This is a Finnish enterprise financed by the energy company Fortum and offers businesses and organizations to reduce emissions by purchasing carbon dioxide removal certificates.

The Foundation for Climate Protection and Carbon Offset KliK [15] established in Switzerland fulfills its legal obligations to offset part of the CO_2 emissions from fossil fuel vehicles. It supports carbon offset projects related to energy efficiency or the use of renewable energy in households, electric mobility, the use of renewable energy in industry, and methane reduction in agriculture. However, it does not support forestry projects or apply in the field of fossil fuel extraction. In the UK, the Woodland Carbon Code was initiated in July 2011 to create carbon sequestration forest projects [16]. The Code sets out how to plant and manage woodlands, and how to reliably measure, verify, and manage the resulting carbon sequestration. As a reward, landowners receive emission credits, which can then be sold to companies/individuals to offset their emissions.

In 2013–2014, China started establishing seven subnational ETS pilots that varied in sectoral coverage, emission caps, offset ratios, and carbon prices [10,17–21]. In 2021, China started a national ETS in which carbon offset protocols allow eligible projects to register and earn Chinese Certified Emissions Reduction (CCER) credits, which absorb the legacy of Certified Emission Reduction (CER) credits under CDM, where China was the largest producer of CER credits [10,22]. Based on California's Global Warming Act in 2006, the United States has a compliant carbon market system, "Cap-and-trade program", which sets a declining cap on major greenhouse gas emitters throughout California, creating an economic incentive for investments in cleaner, more efficient technologies [23]. The program covers emissions from power, industrial, building, and transportation sectors that account for approximately 80 percent of the state's GHG emissions.

Australia has a voluntary program called the Carbon Farming Initiative [24]. Under this mechanism, the Emissions Reduction Fund issues Australian Carbon Credit Units to businesses, community organizations, local councils, individuals, and others that successfully implement an emissions reduction project. The New Zealand Emissions Trading Scheme was created to enable New Zealand to meet its obligations under the UNFCCC and the Kyoto Protocol [25]. Under this scheme, businesses are compensated for sequestering carbon. All sectors of the economy must report their annual greenhouse gas emissions to the government. These sectors include forestry, agriculture, waste, synthetic gases, industrial processes (including iron and steel producers), liquid fossil fuels (including gasoline and diesel suppliers), and stationary energy (such as power generation and industrial heating). Australia and New Zealand are unique cases since they set no limitation on the number of offset credits that can be used by industrial entities, as well as they concern industrial carbon emission reduction and forest carbon offsets as identical [10].

2.2. Types of Climate Projects for Carbon Offsetting

Carbon removal solutions are activities that transfer carbon from the atmosphere to storage within a non-atmospheric carbon pool and contribute toward decreasing atmospheric carbon dioxide levels [26]. They can be divided into two large groups: nature-based solutions (NBS) and technological solutions (TS).

2.2.1. Nature-Based Solutions for Carbon Sequestration

According to the World Conservation Congress of the International Union for Conservation of Nature, nature-based solutions are "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits" [27]. The primary objectives of such projects include ecosystem restoration, climate change adaptation, and the mitigation of its impacts.

Ecosystem protection solutions are NBS projects that preserve or enhance specific natural resources within existing natural ecosystems or poorly managed ecosystems [28]. Examples include safeguarding forests from logging and degradation due to fires or the unsustainable extraction of non-timber resources. Blue carbon refers to the carbon sequestration that occurs in coastal waters due to marine algae and mangrove ecosystems. These ecosystems play a crucial role in capturing and storing carbon dioxide from the atmosphere. Additionally, efforts are directed toward maintaining and improving natural wetlands and marshlands. The majority of wetlands are perceived as long-term carbon absorbers. Furthermore, they exhibit substantial carbon reserves per unit area in comparison to other ecosystems. This phenomenon is primarily attributed to the lack of free oxygen in the soil, leading to decreased decomposition rates, which allows a significant portion of the CO_2 absorbed by the ecosystems to remain sequestered in the soil. However, wetlands also emit methane. Due to the elevated warming potential of methane relative to CO_2, some restored wetlands may require up to a century to achieve a balance between CO_2 absorption and methane release, thus transitioning into net greenhouse gas absorbers. This concern, along with uncertainties regarding the overall impact of wetlands on climate and the criteria for measurement, may explain why wetlands are often overlooked in a significant portion of the CDR literature [2].

Sustainable ecosystem management involves enhancing land resource management to increase carbon sequestration without altering the current primary land use. This refers to the increase in soil organic carbon levels, which can be achieved by introducing carbon inputs into the soil, such as litter, residues, roots, or manure, or by decreasing carbon losses through soil respiration. Implementing alterations to agricultural techniques, such as minimizing or eliminating tillage, adopting crop rotation, allowing crop residues to decompose, or applying compost or manure, enhances this carbon reservoir, which has the potential to absorb 2–5 Gt CO_2 annually [2]. The principal drawbacks of this CDR method are saturation and reversibility, although a notable advantage is its immediate large-scale applicability. Biochar is a carbon-rich form of charcoal produced by heating biomass, such as agricultural residues, without oxygen. When incorporated into the soil, it has the ability to capture carbon. The advantages of biochar include its positive impact on soil quality, nutrient levels, and water cycles, as well as its ability to reduce the release of non-CO_2 GHG from soils [2]. Additionally, its stability in the soil allows for the long-term storage of carbon dioxide for centuries under suitable conditions. However, potential drawbacks include effects on plant defenses and changes in albedo (i.e., a surface's ability to reflect or absorb solar radiation). Since biochar has not yet been widely applied, there are significant uncertainties regarding the estimates and anticipated side effects (ibid).

Ecosystem restoration solutions involve modifying the current land use model. Examples of ecosystem restoration solutions include afforestation for establishing forests on previously non-forested lands and reforestation, which aims to protect forests from logging, degradation due to deforestation, fires, and unsustainable extraction of non-timber resources as well as restore forests on lands that were forested within the past 50 years. These efforts contribute to a more effective utilization of natural and protected ecosystems. Some concerns emerge regarding the impact of forestation on albedo, since it tends to decrease albedo thereby raising surface temperatures [2]. Other limitations include the saturation of carbon sinks in mature forests and forests' susceptibility to disruptions. As a result, ongoing forest management is necessary even after forestation efforts. However, a positive aspect of this approach is that it is readily accessible for widespread implementation.

2.2.2. Technological Solutions for Carbon Sequestration

The UN categorizes carbon sequestration technologies into specialized carbon capture technologies—fossil fuel technologies with carbon capture and storage (CCS) and carbon capture utilization and storage (CCUS); direct air carbon capture and sequestration (DACCS); and bioenergy carbon capture and storage (BECCS) [28].

CCS and CCUS technologies are needed to decarbonize hard-to-reach sectors and remove CO_2 from the atmosphere. The carbon capture process involves capturing CO_2 emissions produced from various industrial sources before they are released into the atmosphere. The captured CO_2 can be utilized for various purposes instead of being stored underground. Carbon utilization involves converting CO_2 into valuable products such as synthetic fuels, chemicals, building materials, or even carbon-neutral products like biochar. Once CO_2 is captured, it is transported to a suitable storage site and injected deep underground into geological formations such as depleted oil and gas reservoirs, saline aquifers, or unmineable coal seams. The CO_2 is stored securely underground, preventing its release into the atmosphere and reducing the overall carbon footprint of industrial processes. The main disadvantage of CCS and CCUS technologies is that they have high costs and energy-intensive equipment. Overall, CCS and CCUS technologies play a crucial role in achieving carbon neutrality and limiting global warming by capturing and storing or utilizing CO_2 emissions that would otherwise contribute to climate change [28].

BECCS is the combination of energy generation from biomass with CCS. The CO_2 stream from industrial and energy-related sources at bioenergy facilities is captured, conditioned, compressed, and transported to a storage location for long-term isolation from the atmosphere. BECCS allows power plants to produce negative emissions: biomass absorbs CO_2 as it grows, and when the biomass is burned, the CCS prevents CO_2 from escaping into the atmosphere. Land competition presents a significant challenge, potentially affecting food prices and security. Other drawbacks of bioenergy production include GHG emissions resulting from land-use changes, negative impacts on biodiversity, alterations in albedo, increased water usage, and the application of fertilizers, which can affect water quality and contribute to non-CO_2 GHG emissions [2].

DACCS is a relatively new technology for removing carbon dioxide from the atmosphere. Direct air capture comprises various technologies aimed at extracting CO_2 from the ambient air. Most of these technologies employ large fans to draw atmospheric air into a contactor device, where CO_2 molecules are separated via contact with a liquid or solid sorbent, resulting in a concentrated CO_2 stream. The sorbent is then reused in the process, while the cleaned air is released back into the atmosphere. The resultant CO_2 stream can be either used or stored into geological formations for permanent storage. However, utilizing CO_2 does not yield negative emissions, thus the primary focus is on storage. The relatively high costs because of substantial capital investments, energy requirements, and carbon transport and storage constrain the DACCS's widespread adoption [2].

Technological solutions have their merits. They are considered more controllable, and storing captured carbon underground can lead to long-term removal from the atmosphere. However, these solutions also face challenges. For instance, BECCS, if deployed at scale, may require vast land areas and offer limited social or environmental benefits beyond carbon storage. Similarly, DACCS demands substantial electricity, materials, and energy, potentially falling short of expectations for absorbing gigatons of CO_2 from the air.

3. Development of Carbon Market in Russia

3.1. Legislative Framework for Climate Projects in Russia

The primary mechanism of Russia's climate policy—balancing the interests of the authorities, society, and business—involves climate projects and the establishment of a voluntary carbon market as a pricing tool. One of the key objectives for the Russian delegation at COP 26 in Glasgow was to agree on the terms for implementation, verification, and accounting that made progress towards this direction [6]. To decarbonize its economy, Russia introduced a carbon regulation system as part of the Strategy for the Socio-Economic Development of the Russian Federation with Low Greenhouse Gas Emissions until 2050, adopted in 2021 [29]. This strategy aims to increase GHG absorption from 535 to 1200 million tons of CO_{2e} by 2050 and achieve carbon neutrality by 2060. Compliance and voluntary carbon markets have been established at the levels of production value chains (carbon footprint), enterprises (scopes 1, 2, and 3), and regions (regional carbon budgets).

In March 2022, Kontur JSC was designated by government decision as the operator of the register of carbon units. On 1 September 2022, a register of carbon units was launched in Russia, and in the same month, the carbon market was launched [30]. Several laws and regulations have already been adopted that regulate the market of carbon units in Russia (see Table 1). In Russia, the market for carbon units was launched in connection with the introduction of sustainable development projects (climate projects) as one of the main instruments of the country's climate policy. A taxonomy has been developed, according to which certain types of projects in the sectors of waste management, energy, construction, industry, transport, water supply, sanitation, and agriculture, as well as natural landscapes, rivers, reservoirs, and biodiversity, are considered "green" [31]. The result of the climate project is the accrual of carbon units. Carbon units are accounted for within a single register and can either be credited to the enterprise implementing the climate project as a reduction in its total emissions or sold by it on the exchange.

Table 1. Main legislative documents that regulate the carbon market in Russia.

Regulation	Description
Federal Law of 2 July 2021 No. 296-FZ "On Limiting Greenhouse Gas Emissions" [32]	Approves the principles of limiting GHG emissions; provides for the maintenance of state accounting of GHG emissions and the creation of an appropriate register, principles for the circulation and offset of carbon units; introduces the obligation of "regulated organizations" to submit annual reports on GHG emissions; establishes basic concepts such as "absorption of greenhouse gases", "climate project", "carbon unit", "carbon footprint", "verification of the results of the implementation of a climate project", etc.
Resolution of the Government of the Russian Federation of 21 September 2021 No. 1587. [33]	Approves the criteria for sustainable development projects and the requirements for the verification system for these projects
Order of the Government of the Russian Federation of 29 October 2021 No. 3052-r. [34]	Approves the strategy for the socio-economic development of the Russian Federation with low greenhouse gas emissions until 2050.
Resolution of the Government of the Russian Federation of 1 March 2022 No. 367-r [35]	Determines the authorized legal entity to perform the functions of the carbon units registry operator
Resolution of the Government of the Russian Federation of 14 March 2022 No. 355 [36]	Sets criteria for classifying legal entities and individual entrepreneurs as regulated organizations
Resolution of the Government of the Russian Federation of 24 March 2022 No. 449. [37]	Approves the rules for assessing the achievement of greenhouse gas emission reduction targets.
Resolution of the Government of the Russian Federation of 24 March 2022 No. 455. [38]	Approves the rules for the verification of carbon units.
Resolution of the Government of the Russian Federation of 30 March 2022 No. 518. [39]	Approves the procedure for determining the fee for the services of the operator of the registry of carbon units.
Resolution of the Government of the Russian Federation of 20 April 2022 No. 707. [40]	Approves forms, rules for submitting and verifying reports on greenhouse gas emissions, as well as rules for creating and maintaining a register of greenhouse gas emissions.
Resolution of the Government of the Russian Federation of 30 April 2022 No. 790. [41]	Approves the rules for creating and maintaining a register of carbon units, as well as conducting transactions with carbon units in this register.
Federal Law No. 34-FZ of 6 March 2022 "On Conducting an Experiment to Limit Greenhouse Gas Emissions in Certain Subjects of the Russian Federation" [42]	Stimulates the implementation of technologies to reduce GHG emissions and increase their absorption, the formation of an independent verification system, as well as the creation of a system for the circulation of carbon units and quota fulfillment units; defines accounting methods and tools for regulating emissions and absorption of greenhouse gases.
Resolution of the Government of the Russian Federation of 20 May 2022 No. 905. [43]	Approves the forms of a standard agreement for the provision by the operator of services for conducting operations in the register of carbon units.
Order of the Ministry of Economic Development of the Russian Federation dated 11 May 2022, No. 248. [44]	Approves the criteria, procedure, and forms of reporting on the implementation of climate projects.

Federal Law No. 34-FZ "On Conducting an Experiment to Limit Greenhouse Gas Emissions in Certain Subjects of the Russian Federation," adopted on 6 March 2022, defines accounting methods and tools for regulating emissions and the absorption of greenhouse gases that will be used as part of the experiment (see Figure 1). It also sets the objectives to stimulate the implementation of technologies to reduce GHG emissions and increase their absorption, the formation of an independent verification system, and the creation of a system for the circulation of carbon units and quota fulfillment units.

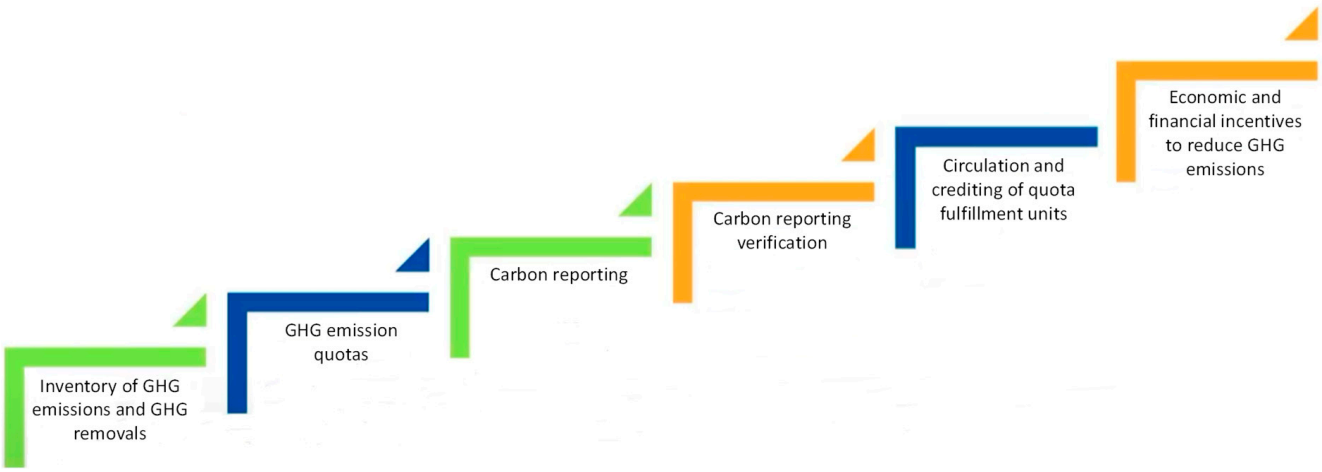

Figure 1. Accounting methods and tools under Federal Law No. 34.

The carbon market is voluntary in Russia. At the same time, in one of the regions—the Sakhalin region—participation in such a market has become mandatory in the context of an experiment to achieve carbon neutrality by the end of 2025 (this goal, according to estimates by the developers of the region's climate program, will be achieved ahead of schedule).

A climate project must be registered on the Carbon Unit Registry before its implementation. Participants in the carbon market can release and transact carbon credits only after their climate projects have been validated and verified. The subject of verification is the confirmation of information on the reduction (prevention) of GHG emissions or an increase in their absorption as a result of the project implementation. The criterion for classifying projects as climate change is compliance with the requirements of the Russian legislation, including the national standardization system in the field of limiting GHG emissions. The Russian carbon market uses generally accepted verification methodologies and tools, which aim to be synchronized with international methods and standards. Carbon units are priced following the dynamics of the market, i.e., their value is determined by the market participants based on supply and demand.

With the current version of law 296-FZ, it is possible to allow foreign companies only to open accounts, receive statements, and accept carbon units. Foreign companies will be able to carry out orders for the transfer of carbon units and the offset of carbon units only through intermediaries—through persons who have an account and enhanced qualified electronic signatures on the State Services portal. Recently, Kontur JSC, the operator of the Russian Register of Carbon Units, sent its proposals for the admission of foreign entities to the carbon market in terms of their access to registry services through international systems [45].

3.1.1. Carbon Polygon Initiative to Expand Climate Projects

In February 2021, the Ministry of Science and Higher Education of the Russian Federation launched a pilot project to establish carbon polygons within various regions of Russia [46]. These carbon polygons serve as testing grounds for developing technologies to monitor carbon balance. Carbon polygons consist of one or several land parcels with representative topography, vegetation structure, and soil cover specific to the given

territory. They are designed for scientific research, capacity-building, and infrastructure development related to monitoring climate-active gas balances in natural ecosystems. As of the report's release, Russia has 12 active carbon polygons covering a total area exceeding 27,000 hectares.

Carbon polygons serve as research platforms where measurement methods are explored, while carbon farms represent practical applications of these methods to achieve highly efficient CO_2 sequestration within terrestrial ecosystems. Their primary purpose is to evaluate carbon stocks in ecosystems and verify offset rates. These polygons focus on methodological advancements and pedological organization. By quantifying specific numerical data, such as carbon sequestration rates, carbon polygons contribute to the validation of emission reductions or absorption. At this stage, carbon polygons primarily serve research and educational functions. They are envisioned as monetizable climate projects. These farms would effectively sequester CO_2 while simultaneously supporting sustainable agricultural practices. The transition from research-oriented polygons to operational farms holds promise for addressing climate change and promoting economic viability.

3.1.2. Regional Experiment: Sakhalin Region

The first Russian region under this experiment of Federal Law No. 34-FZ is the Sakhalin region. Sakhalin serves as a prototype for an internal carbon market. The experiment in Sakhalin will test various carbon regulation measures and assess their effectiveness for potential expansion across the country [6]. The experiment started on 1 September 2022 and will last until 1 December 2028. During the implementation of the experiment, the region must achieve carbon neutrality no later than 31 December 2025. The experiment sets targets for reducing GHG emissions and increasing their absorption and emission quotas, and it provides for the creation of infrastructure to support climate projects and the circulation of carbon units. A fee is charged for exceeding the quota, and if the quota is not exhausted, the company can issue carbon units of the remainder for their subsequent sale.

The primary strategies for reducing greenhouse gas emissions include gasification and the development of renewable energy sources. Measures such as complete gasification, abandonment of coal generation, transformation of transport to eco-fuel and electric traction to increase energy efficiency and energy saving are being carried out [47]. The Sakhalin regional government aims to increase the proportion of gas-powered and electric vehicles to 50% of the total transport share by 2025 [6]. To achieve this, a comprehensive package of incentives, including various subsidies, elimination of the transport tax, compensation, and procurement, is provided. In addition, the Sakhalin region is also testing a mechanism for quotas for GHG emissions. Emission limits are established for each regulated organization in the Sakhalin region, with an annual volume of GHG emissions of at least 20 thousand tons of CO_2-eq. The experiment also includes developing hydrogen energy and implementing carbon capture and storage technologies. Other measures are also being implemented in the forestry sector, agriculture, and the field of municipal solid waste management. The experiment aims to reduce methane emissions in the waste sector through separate waste collection and the establishment of a waste recycling infrastructure.

By 2025, the goals are to achieve 100% technical gasification of the Sakhalin region, convert 145 coal-fired boiler houses to gas, and gasify 37,237 households, 157 enterprises, and 66 municipal entities connected to natural gas [6]. Citizens will receive compensation payments, and legal entities performing gasification work for residential buildings under agreements with citizens will receive subsidies. Currently, less than 1% of energy in the Sakhalin region comes from renewable sources and the aim is to increase this share to 15% by 2026 [6,48].

Therefore, the Sakhalin experiment represents quite an ambitious project in Russia's decarbonization policy. However, changes in external and internal economic conditions have delayed the project's start, extended the timeframe for achieving its goals, and shifted the focus to forestry and other climate projects [6]. Nonetheless, this experiment is crucial as a starting point for practically implementing the tools outlined in the Low-Carbon

Development Strategy until 2050 (including data collection and informed future decision-making by testing emission control mechanisms and pricing), identifying their limitations and opportunities (ibid). According to the Law, the experiment can also be carried out on other Russian territories, which will be included by introducing amendments to the Law. Several regions have already shown interest in participating in such pilot projects, including the Kaliningrad region and the Khanty-Mansiysk Autonomous Okrug [28].

3.2. Methodologies for the Implementation of Climate Projects in Russia

The implementation of climate projects in Russia is provided by Federal Law No. 296-FZ "On Limiting Greenhouse Gas Emissions". Article 5 calls for the approval of documents by the national standardization system to limit GHG emissions by implementing climate projects and determining the carbon footprint. The current GOST framework allows climate project implementers to choose their methodologies independently, using any international standard or developing their own following the requirements of the Ministry of Economic Development of the Russian Federation [6]. To address this issue, Gazprombank and the Institute of Global Climate and Ecology, named after Academician Israel, signed an agreement in February 2022. Under this agreement, the Institute's experts create methodologies for implementing climate projects, enhancing the quality and competitiveness of Russian carbon units. The agreement covers 18 methodologies tailored to the needs of potential climate project implementers registered in the Russian carbon unit registry and the specific characteristics of each project area [49].

Currently, the Federal Agency for Technical Regulation and Metrology (Rosstandard) has approved the following six methodologies for implementing carbon offsetting projects in Russia [50]:

1. Methodology for carbon offsetting projects for the extraction of gas from oil fields, which would otherwise be flared or released into the atmosphere with its utilization for energy generation (PNST 899-2023) [51];
2. Methodology for carbon offsetting projects for reducing greenhouse gas emissions by using associated petroleum gas from oil wells as a feedstock instead of flaring (or dispersing) (PNST 900-2023) [52];
3. Methodology for carbon offsetting projects for estimating organic carbon reserves in soil on arable lands (PNST 901-2023) [53];
4. Methodology for carbon offsetting projects for conversion of industrial plants from coal/petroleum fuel to gaseous fuels (PNST 902-2023) [54];
5. Methodology for carbon offsetting projects for transition to energy-efficient technologies and/or low-carbon fuels for buildings (small-scale projects) (PNST 903-2023) [55];
6. Methodology for carbon offsetting projects for transition to energy-efficient technologies and/or low-carbon fuels in new and existing buildings (PNST 904-2023) [56].

This complex of national standards is called the "System of Standards for the Implementation of Climate Projects" and is based on the principles and methodological basis developed under the Clean Development Mechanism. Similarly to CDM, the standards specify the scope, its applicability, requirements for baseline and timeline, additionality requirements, requirements for the monitoring plan, project scenarios, estimation of emissions from leaks from project activities, minimization of the risk of volatility, methods for preventing double counting, recommendations for changing and/or maintaining the baseline in case of extension credit period and project activities, etc. [57]. As stated in each of these standards, this complex of national standards assists state and private companies, industrial enterprises, as well as regulatory authorities in fulfilling their obligations to reduce GHG emissions within projects implemented following Federal Law No. 296-FZ "On Limiting Greenhouse Gas Emissions", ensures the quality of carbon units issued within the Russian system for the implementation of climate projects, standardization of the structure and terminology of implemented climate projects, increases transparency in the implementation process of climate projects, and helps to achieve Sustainable Development Goals both at the national and corporate levels [51].

The Russian Register of Carbon Units provides recommendatory methodologies for climate projects (registry website: https://carbonreg.ru/ru/ (accessed 14 June 2024)). They are not binding documents but rather guidelines for performers. Thus, each performer has the opportunity to develop his methodology and use it. The Register of Carbon Units does not accept or approve methods. It provides a platform to inform people that they exist and can be used. Currently, there are 11 accepted methodologies of climate projects, and 3 methodologies are under public discussion. The accepted methodologies are the following [50]:

1. Guidelines for demonstration of the additionality of the project activity;
2. Leak detection and repair in gas production, processing, transmission, storage, and distribution systems and in refinery facilities;
3. Reforestation;
4. Improved forest management, including forest fire protection;
5. Improved forest management, including reduced impact logging;
6. Recovery and utilization of gas from oil fields that would otherwise be flared or vented;
7. The technology of used lubricating oil regeneration;
8. Grid connection of isolated electricity systems;
9. Rewetting of drained temperate peatlands;
10. New cogeneration project activities supplying electricity and heat to multiple customers;
11. Electricity and heat generation from biomass.

The methodologies under public discussion are the (1) energetic utilization of solid municipal waste (including production of refuse-derived fuel, RDF); (2) anaerobic digestion of organic waste, and (3) incineration and energy utilization of landfill gas.

In addition, Russia has common standards related to greenhouse gas statements. This is a family of GOST R ISO 14064 standards (three parts) [58–60]. There is also a standard for the methodological support of climate projects—GOST R ISO 14080-2018 [61].

One of the most important principles that must be observed when implementing climate projects is the principle of additionality, which means that the reduction (prevention, absorption) of emissions would not have occurred if this project had not been implemented. Under the order of the Ministry of Economic Development of the Russian Federation no. 248 of 11 May 2022, the definition of additionality is formulated as follows: "reduction (prevention) of greenhouse gas emissions and/or increase in their absorption during the project implementation period is not the result of the influence of factors not related to project activities; project activities are carried out in addition to activities aimed at fulfilling the mandatory requirements stipulated by the legislation of the Russian Federation, in force as of the beginning of the project implementation" [62]. However, according to international carbon standards, the concept of additionality is interpreted more broadly. Another important criterion for climate projects is the baseline level: the level of net greenhouse gas emissions expected without the project's additional activities. The emission reductions and/or increased absorption resulting from the project represent the difference between this baseline and the actual net GHG emissions (measured in tons of CO_2-eq.). Once these values are verified by an independent greenhouse gas validator and verification body, and necessary allocations are made for emission reduction units, including provisions for leakage and volatility risks, they correspond to the issued carbon credits [62]. Importantly, the credit period has not yet been defined in regulatory documents.

4. Current Implementation Status of Climate Projects in Russia

Russia has a significant potential for implementing both nature-based and technological climate projects. Estimates suggest that in the coming years, their collective output could range from 1.5 to 10 million carbon units [6,49]. As of March 2024, twenty climate projects have been registered in the register of carbon units and have been validated following Russian legislation. Until recent times, only a brief summary of registered climate projects had been published on the registry website, which receives some criticism for not being

transparent. However, from 1 June 2024, the new changes to the Decree of the Government of the Russian Federation, dated 30 April 2022, N 790, came into force, aimed at increasing the transparency of the carbon units market. Now, the Registry of Carbon Units will publish project documentation of the climate project, a report on its implementation, as well as a verifier's report. Project information will be updated once a month, not once a quarter.

On 26 September 2022, the first transactions with carbon units issued as part of this climate project were carried out on the National Commodity Exchange [63]. Current registered climate projects include initiatives in low-carbon energy, resource conservation, sustainable agricultural practices, reforestation efforts, etc., which will be analyzed more in detail in Sections 4.1 and 4.2.

4.1. Registered Climate Projects Based on Technological Solutions

Table 2 presents an overview of currently registered climate projects based on technological solutions. These projects, undertaken by different organizations, highlight the ongoing efforts to transition towards more sustainable and efficient practices in energy production, chemical manufacturing, and resource extraction.

Table 2. Examples of registered climate projects based on technological solutions.

	Number of Carbon Units	**Climate Project Implementation Period**	**Type of Economic Activity**
Increasing energy efficiency in the production of thermal energy (Rusal Ural)	800,152	08.06.2023–31.12.2036	Production of steam and hot water (thermal energy) by boiler houses.
Increasing energy efficiency in the preparation of raw water (Rusal Ural)	198,559	01.01.2025–31.12.2034	Production of steam and hot water (thermal energy) by boiler houses.
Construction of gas pipeline (PAO Tatneft)	18,657	20.08.2021–02.06.2034	The extraction of oil and natural gas (associated gas)
Substitution of power generated from coal- and oil-fired power plants (AO Polyus Krasnoyarsk)	4,122,439	01.05.2018–30.04.2028	Electricity transmission and technological connection to distribution networks.
Reconstruction of the cryogenic facility for deep processing of dry stripped gas (PAO Tatneft)	1,963,434	01.01.2021–31.12.2034	Production of industrial gases
Increasing the installed electrical capacity through the construction of a new renewable energy production facility (PAO EL5-Energo)	915,335	01.05.2021–30.04.2031	Production of electricity obtained from renewable energy sources
Use of waste lube oil generation technology (AO Delfin Group)	6,187,316	01.03.2024–28.02.2039	Hazardous waste treatment and disposal
Construction of gas pipeline (PAO Tatneft)	27,773	02.08.2021–17.08.2031	The extraction of oil and natural gas (associated gas)
Construction of gas pipeline (PAO Tatneft)	30,000	13.09.2021–31.12.2031	The extraction of oil and natural gas (associated gas)
Expansion of gas collection system from the PAO Tatneft facilities (PAO Tatneft)	93,220	01.02.2022–31.03.2034	The extraction of oil and natural gas (associated gas)
Construction of gas pipeline (PAO Tatneft)	23,750	01.01.2022–31.12.2031	The extraction of oil and natural gas (associated gas)
Increasing efficiency in the production of olefins (OOO SIBUR-Kstovo)	1,381,798	15.12.2019–14.12.2029	Production of chemical organic basic substances
Reconstruction of the booster pump station (PAO Tatneft)	2070	01.06.2021–31.10.2032	The extraction of oil and natural gas (associated gas)

Table 2. *Cont.*

	Number of Carbon Units	Climate Project Implementation Period	Type of Economic Activity
Energy efficiency re-equipment (PAO Nizhnekamskneftekhim)	5,647,684	01.11.2022–31.10.2032	Production of chemical organic basic substances
Energy efficiency measures in the production of monomers (OOO Tomskneftekhim)	95,634	26.01.2022–25.01.2032	Production of chemical organic basic substances
Increasing energy efficiency in the production of ethylene oxide and glycols (AO Sibur-Neftekhim)	47,759	01.11.2023–31.12.2032	Production of chemical organic basic substances
Modernization of the energetic block of the state district power plant (AO Inter RAO—Electric Power Plants)	81,042	29.05.2019–31.12.2024	Production of electricity
Prevention of GHG (methane) emissions using mobile compressor stations (OOO Gazprom MKS)	49,928,002	01.10.2019–31.12.2029	Transportation of gas and its processed products through pipelines
Re-engineering the production of dioctyl terephthalate (DOTP) (AO Sibur-Khimprom)	14,333	04.05.2022–31.03.2026	Production of chemical organic basic substances
Construction of the factory-wide flare system of the gas processing plant (PAO Tatneft)	51,172	01.01.2021–31.12.2030	Petroleum products production
Connection of the pipeline to the gas pipeline (PAO Tatneft)	4640	01.01.2021–31.12.2030	Petroleum products production
Replacement of coal-fired boilers with gas (PAO Rushydro)	381,820	01.01.2022–31.12.2027	Production of electricity obtained from renewable energy sources
Introduction of an electrical power generating facility based on solar energy (OOO DalEnergoInvest)	1832	01.01.2022–31.12.2031	Production of electricity

Several climate projects involve the construction and expansion of gas pipelines by PAO Tatneft, a Russian oil and gas company, which claims to achieve carbon neutrality by 2050. They aim to reduce the flaring of associated gas, a significant source of methane emissions, to enhance the extraction and transportation of oil and natural gas. The projects span from 2021 to 2034 and indicate a substantial commitment to improving the infrastructure for natural gas collection and transportation, thereby reducing environmental impact and increasing efficiency.

Some projects focus on enhancing energy efficiency and reducing emissions in the chemical industry. For instance, SIBUR has the largest portfolio of projects for reducing CO_2 emissions among Russian businesses. The total expected effect of reducing greenhouse gas emissions during the implementation of projects until 2032 is more than 6 million tons of CO_2-eq [64]. The climate project at Nizhnekamskneftekhim involves the use of by-products from the enterprise's production cycle at its own combined cycle plant to generate electricity. This reduces natural gas consumption and significantly reduces greenhouse gas emissions. The climate project implemented at Sibur-Neftekhim provides for the reduction of GHG emissions by increasing energy efficiency in the production of ethylene oxide and glycols. As part of the project, gas coolers were installed at the production site. The equipment made it possible to obtain additional steam necessary for the production of ethylene oxide and glycols by utilizing thermal energy from the production process, thereby reducing the consumption of natural gas in the boiler room. In the climate project of Tomskneftekhim, superheated steam generated in the production of monomers is sent to a turbogenerator before further use in the production chain. This makes it possible to provide polyethylene

production with its own energy, replacing grid electricity obtained by burning fossil fuels. These climate projects complied with the GOST R ISO 14064-3-2019 standard [60].

The climate project on the replacement of coal-fired boilers with gas, implemented by PAO Rushydro, has increased the efficiency of the power station and reduced electricity and heat costs [65]. With gasification at the station, a large-scale reconstruction of the boiler units was carried out, which made it possible to significantly extend their service life and increase reliability. The equivalent carbon footprint reduction is over 70,000 tons of $CO_{2,}$ and as a result, 71,983 carbon units were issued by the Carbon Units Register and credited to RusHydro. Projects like the modernization of the energetic block of the state district power plant (AO Inter RAO—Electric Power Plants) and the introduction of renewable energy sources (PAO Rushydro and OOO DalEnergoInvest) highlight the energy sector's pivot towards sustainability by upgrading existing power plants and incorporating renewable energy sources.

These projects, while diverse in their objectives and sectors, collectively contribute to the overarching goals of reducing GHG emissions, improving energy efficiency, and transitioning towards more sustainable industrial practices. They reflect the increasing recognition of the need to address climate change and environmental sustainability within the context of economic development and energy security.

Russia has significant carbon storage potential, and thus carbon capture, utilization and storage technologies can be seen as a promising technological solution for climate projects in Russia. Large Russian petrochemical companies like Rosneft, Tatneft, Gazprom Neft, and Novatek are announcing plans to use CCUS [6]. For example, Rosneft aims to prevent emissions of 20 million tons of CO_2-equivalent greenhouse gases by 2035 and anticipates launching a pilot CCUS project in 2028. Tatneft plans to achieve carbon neutrality by 2050 through the implementation of CCUS projects. Gazprom Neft is investing approximately RUB 30 billion in a carbon capture and storage project in the Orenburg region and has partnered with the Sakhalin regional government to advance sustainable development and climate projects on the island [6]. Novatek and Severstal are collaborating on a pilot project to produce "blue" hydrogen from natural gas using carbon dioxide capture and storage technologies (ibid).

4.2. Registered Climate Projects Based on Nature-Based Solutions

Table 3 presents an overview of currently registered climate projects based on nature-based solutions. These projects demonstrate diverse approaches to addressing climate change and promoting environmental sustainability within different economic sectors. From agricultural soil carbon sequestration to forest fire prevention and CO_2 capture and utilization, each initiative plays a crucial role in mitigating GHG emissions, enhancing carbon sinks, and fostering resilience to climate change impacts.

Table 3. Examples of registered climate project based on nature-based solutions.

	Number of Carbon Units	Climate Project Implementation Period	Type of Economic Activity
Changes in the reserves of organic carbon in the soil on arable land (OOO Helio-Pax-Agro)	56,635	01.01.2018–31.12.2022	Agriculture.
Forest climate project. Aviation fire protection of a forest area (JSC Rusal Krasnoyarsk Aluminum Plant)	5,152,843	19.07.2019–19.10.2033	Forestry and other forestry activities.
Increase of GHG absorption on the forestry territory (OOO VCL)	1,515,282	01.09.2023–01.09.2102	Forestry and other forestry activities.
Construction of the 4 t/h liquefied CO_2 plant (AO "NAK "AZOT")	583,995	01.09.2022–31.08.2042	Production of fertilizers and nitrogen compounds.

The project implemented by OOO Helio-Pax-Agro focuses on implementing practices to enhance the organic carbon reserves in soil on arable land. By adopting sustainable agricultural practices such as reduced tillage, cover cropping, and organic soil amendments, OOO Helio-Pax-Agro aims to increase soil carbon sequestration. This not only helps mitigate climate change by removing carbon dioxide from the atmosphere but also improves soil health, water retention, and agricultural productivity. The enterprise of the mineral and chemical company EuroChem NAK Azot registered a climate project for the construction of a plant for the production of liquefied carbon dioxide with a capacity of 4 tons per hour. To produce liquefied carbon dioxide, CO_2 from ammonia production will be captured and utilized.

The forest climate project managed by JSC Rusal Krasnoyarsk Aluminum Plant is the first voluntary project in Russia for the aviation protection of forests from fires [66]. It includes personnel training (hiring, training, medical support), monitoring the development of small aviation, and preventing and extinguishing forest fires. The area where the project is being implemented is one of the most dangerous in terms of fire in the Krasnoyarsk Territory. Another example of a forest project implemented by OOO VCL aims to enhance GHG absorption in forestry territory to increase forest carbon sinks to offset anthropogenic carbon emissions and combat climate change over the long term.

Russian companies have also participated in the international carbon markets. For instance, JSC Lesozavod-25 and OJSC Arkhangelsk Pulp and Paper Mill have, through projects involving the combustion of wood waste to generate energy for their own use, verified and sold over 800,000 voluntary emission reduction units valued at approximately EUR 1.5 million [6,67]. Additionally, two more Russian projects are listed in the VCS registry of the Verra company: the Terneyles company's project for the conservation of intact forests and the Core Carbon Group's project aimed at reducing methane leaks in low-pressure gas distribution networks in the Tomsk region [6]. However, transferring carbon units to foreign registries was not permitted [6,67]. All carbon units issued in the registry can only circulate within that registry and cannot be transferred to the owner's account in a foreign registry, which presents an additional obstacle for companies aiming to participate in international carbon markets.

Given Russia's significant potential for absorbing emissions, forest climate projects could substantially contribute to achieving carbon neutrality. However, they can be seen as the most complex type of climate solutions since their implementation involves several risks and limitations. The main risks include carbon leakage, natural risks such as the death of forest stands due to fires, diseases, and other causes, as well as the potential termination of project funding [68]. Forest climate projects are long term and often require additional investments in irrigation and forest protection. Furthermore, such projects are not economically viable for areas smaller than 10,000 hectares, and the yield of carbon units can vary significantly based on the forest's structure [69]. Even with the effective implementation of forest climate projects, some estimates indicate that two-thirds of emission reductions will still need to be achieved through industrial technologies [6,70].

4.3. Future Prospects for Russia's Climate Projects Development

The carbon market mechanisms play a crucial role in global efforts to combat climate change, incentivizing emission reductions while fostering sustainable practices. The question of which carbon emission mechanism is better lacks a straightforward answer, as each mechanism possesses its own advantages and limitations. The choice of mechanism depends on specific circumstances and priorities. It is crucial to consider factors such as international recognition, flexibility, degree of control, adaptability to conditions, and financial accessibility. Some countries may favor a combined approach, incorporating various mechanisms based on project specifics and objectives.

Implementing climate projects and developing a voluntary carbon market can become one of the primary tools for Russia to achieve its climate goals and enhance its future ambition. Several factors support the potential for the creation and development of the

carbon market in Russia. Physical climate risks in the country remain and pose a threat to some aspects of national security. Their minimization requires a combination of a set of measures to mitigate climate change and adapt to it. The goal of reducing GHG emissions under the Paris Agreement remains relevant for Russia. Currently, climate projects based on technological solutions are prevailing in the Russian Register of Carbon Units. This can be explained by the late adoption of methodologies and insufficient knowledge base for nature-based solutions. However, with improving the legislative and methodological basis, including by implementing the carbon polygons experiment as well as overall widespread interest, we can expect that climate projects based on nature-based solutions will gain more attention and popularity.

Notably, companies in Russia primarily seek to reduce their greenhouse gas emissions to meet corporate decarbonization goals, rather than to monetize the results of climate projects. This focus highlights the importance of prioritizing internal emissions reductions and achieving corporate decarbonization targets, often through the offsetting of absorbed greenhouse gas emissions within organizational boundaries. The key drivers for the growth of carbon markets are corporate strategies and the desire of enterprises to realize their climate commitments and goals. The implementation of sustainable development projects is becoming economically attractive for private businesses due to the opportunity to reduce the energy and resource intensity of production and at the same time obtain carbon units available for sale or other purposes. This is also relevant due to the need to access investment and debt capital in foreign markets, since a low carbon footprint of assets and compliance with ESG standards are becoming increasingly important conditions.

Regarding international cooperation and recognition, the geopolitical crisis of 2022 that led to the expanding sanctions and the partial isolation of the Russian economy has shifted Russian foreign policy and economic development in a more non-Western direction. Russia is actively developing international cooperation in terms of climate change inside the BRICS cooperation (i.e., an intergovernmental organization comprising Brazil, Russia, India, China, South Africa, Iran, Egypt, Ethiopia, and the United Arab Emirates) and the Eurasian Economic Union (EAEU). BRICS countries and EAEU partners are now seen as primary collaborators for climate initiatives.

Nearly all BRICS and EAEU partners face threats due to climate change and thus consider climate projects and the voluntary carbon market as crucial tools for decarbonization [6]. However, both partners and Russia itself encounter challenges in gaining international recognition for the verification and validation standards of carbon credits. Therefore, there is an ongoing discussion in terms of establishing unified approaches and standards within an expanded BRICS and EAEU framework that could lead to the recognition of partner countries' units and the creation of a common carbon market. Russia's active participation in all forms of cooperation on climate issues can help prevent further isolation and ensure participation in decision-making and discussions on critical aspects of the climate change agenda.

5. Conclusions

Reducing the carbon footprint is increasingly relevant in today's global economy, particularly for exporting companies aiming to enhance competitiveness. In the carbon markets, companies that reduce emissions can sell their carbon units to other entities unable to curtail their own emissions independently. High-quality climate projects and transparency in implementation processes are the main conditions for their competitiveness in the carbon market. Therefore, principles of climate project quality have gradually been developed. Such principles include project additionality, precise and reliable methods for accounting for emissions reduction and absorption increase, the absence of double counting, and the permanence of achieved emissions reductions.

Discussions surrounding achieving net-zero emissions prompt a re-examination of the role of nature-based and technological projects in meeting decarbonization goals. Considering corporations' desire to decarbonize their business processes, technological climate

projects, including carbon capture, use, and storage technologies, are actively developing. At the same time, nature-based solutions are often more cost-effective compared to technological solutions for carbon mitigation and adaptation, especially in certain contexts. Nature-based projects can provide additional benefits such as sustainable livelihoods, improved water quality, and recreational opportunities, contributing to local economic development. Technological solutions should still complement, but not replace, nature-based ones (unlike technology, ecosystem restoration and agroforestry can help conserve biodiversity, improve soil fertility, and improve water quality). Technological solutions cannot compensate for the loss of forests and ecosystems and should not discourage investment in nature-based solutions. At the same time, technological solutions for CO_2 capture are attractive because they are considered more controllable, and storing captured carbon underground can lead to long-term removal from the atmosphere. Therefore, it is expected that the use of both technology- and nature-based solutions will be seen as complementary in the journey towards achieving net-zero emissions.

Despite the continued relevance of the climate change agenda for both business and government, several barriers and uncertainties hinder the progress of climate projects and their subsequent monetization in Russia. The carbon market in Russia is still in its initial stage. The need to clarify the regulatory, legal, and methodological framework of climate projects, as well as the lack of governmental support, still poses challenges. It is essential to continue enhancing and systematizing the validation and verification of climate projects to fully align them with international standards. Furthermore, a lack of expertise and knowledge in implementing climate projects and their monetization exacerbates these challenges. It is crucial to inform companies about the benefits and limitations of climate projects, as well as their actual costs. Uncertainty surrounding the demand for climate projects adds another layer of complexity, as the potential size of the Russian market and the economic viability of Russian climate projects in international carbon markets remain unclear. Addressing these barriers requires international cooperation and the recognition of the Russian verification system and methodologies used, thereby fostering a shared understanding and acceptance of accounting for greenhouse gas emissions and trading carbon units. Russia can gain significant benefits from entering the global carbon markets if it has absorbed the relevant lessons from other countries' experiences in building institutional capacity and establishing a legal framework for developing climate projects [4]. The most possible international cooperation on climate issues is currently seen under BRICS and EAEU partnerships. Implementing climate projects can help mitigate the negative impacts of climate change on the Russian economy, enhance cooperation with key partners, and prevent Russia from becoming completely isolated and excluded from global climate regulation.

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