CLIMATE AGENDA AND GLOBAL GEOGRAPHY: THE ROLE OF INTERNATIONAL AGREEMENTS IN COMBATING GLOBAL WARMING

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Abstract

The current climate agenda requires not only political and technological solutions, but also a deep understanding of the geographic factors that influence climate change and adaptation to its impacts. This paper analyzes the role of international climate agreements, such as the Paris Agreement and the Kyoto Protocol, with an emphasis on their geographic significance. It examines regional differences in the impacts of global warming, including the vulnerability of coastal zones, the Arctic, arid regions, and developing countries. Particular attention is paid to how countries' geographic features affect the implementation of international commitments, access to finance and technology, as well as adaptation and sustainable development strategies. The paper demonstrates that effective implementation of climate agreements is impossible without taking into account the spatial context and interregional heterogeneity.

Keywords: climate change, global warming, international agreements, greenhouse gas emissions, sustainable development, climate resilience.

I. Introduction

Over the past few decades, the center of gravity in environmental diplomacy has confidently shifted towards the issue of climate change. The visible effects of climate change are apparent: familiar weather patterns are changing across various parts of the world, glaciers and snow caps are melting, sea levels are rising, and the frequency of extreme weather events is increasing. "This is not surprising," scientists say, "because climate change is a natural cyclical process influenced by numerous natural and geophysical factors. It has been this way for billions of years and will continue to be in the future." However, it is alarming that, according to a fairly widespread opinion within the scientific community, the main cause of climate change, specifically global warming, over the past 50 to 100 years has been the increase in the concentration of greenhouse gases (GHGs) in the atmosphere due to the growing volumes of human economic activity.

At the turn of the 1980s and 1990s, when ecology made a significant breakthrough into mainstream politics, the issue of climate change began to gain increasing international resonance. It was actively embraced by international organizations, and in 1988, the Intergovernmental Panel on

Climate Change (IPCC) was established under the auspices of the UN. The IPCC started to release assessment reports on the state of the planet's climate approximately every four to five years. With each report, experts' conclusions became more confident: the trend of warming on Earth is occurring and has been largely explained by anthropogenic causes over the past century. According to the latest IPCC report in 2007, if current economic development scenarios remain unchanged, the climate could warm by more than 6°C by 2100, and sea levels could rise by nearly 60 cm. The world is threatened with an increase in natural disasters and extreme weather events, shifts in traditional agricultural and fishing zones, loss of biodiversity, and the flooding of entire cities and even countries.

In 1992, the UN Framework Convention on Climate Change (UNFCCC) was signed at the UN Conference on Environment and Development in Rio de Janeiro. In 1997, the Kyoto Protocol to this Convention was adopted in Kyoto, Japan, obligating 39 countries (from the category of industrialized nations and economies in transition) to reduce their GHG emissions by a total of 5.2% during the first commitment period (2008-2012) compared to 1990 levels. The Protocol entered into force in February 2005, thanks to its ratification by Russia.

In the second half of the 2000s, the intensity of discussions surrounding climate change in global politics reached its peak. Authoritative analytical centers recognized climate change as the number one threat to international security, surpassing even the threat of terrorism. In 2007, the UN Security Council devoted a special meeting to climate change for the first time. UN Secretary-General Ban Ki-moon began the practice of holding UN climate summits in the lead-up to the annual sessions of the UN General Assembly starting in 2007. Additionally, the IPCC, along with prominent American environmental politician Al Gore, was awarded the Nobel Peace Prize in 2007.

However, the rise of climate change as a global issue had its downsides. Over the past 20 to 30 years, the discussion surrounding global climate change has become excessively politicized, increasingly moving away from its scientific basis and often falling prey to political interests and speculation. Disagreements persist among scientists regarding, firstly, the extent of the influence of anthropogenic factors on climate change, and secondly, the optimal strategies for humanity to respond to this process. The scientific community has split into "alarmists," who emphasize anthropogenic causes of climate change, and "skeptics," who do not consider these causes to be decisive. Both camps include authoritative scientists with substantial scientific arguments and many reasons to criticize their opponents. Meanwhile, amidst such scientific confrontation, deliberately fueled by the media, politicians face the challenging task of choosing the only correct solution. Are these scientific disagreements not the root cause of the slow progress in international climate negotiations?

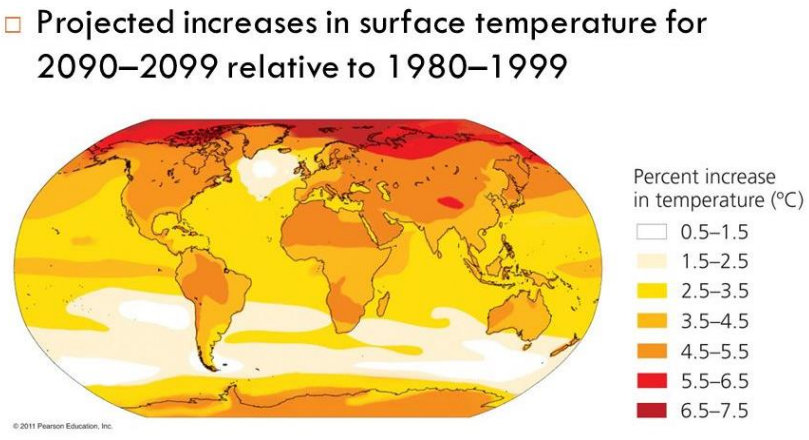

Figure 1. The Earth's climate system

Climate change has become one of the most pressing global challenges of the 21st century (fig.1). Rising temperatures, extreme weather events, sea-level rise, and shifting ecosystems are increasingly threatening human life, natural systems, and global economies (fig.2). The scientific consensus is clear: human activities, particularly the burning of fossil fuels and deforestation, are driving unprecedented levels of greenhouse gas emissions, leading to global warming. This issue, however, transcends national borders, making it impossible for any single country to tackle the problem in isolation. Addressing climate change requires collective action and a coordinated response from the international community.

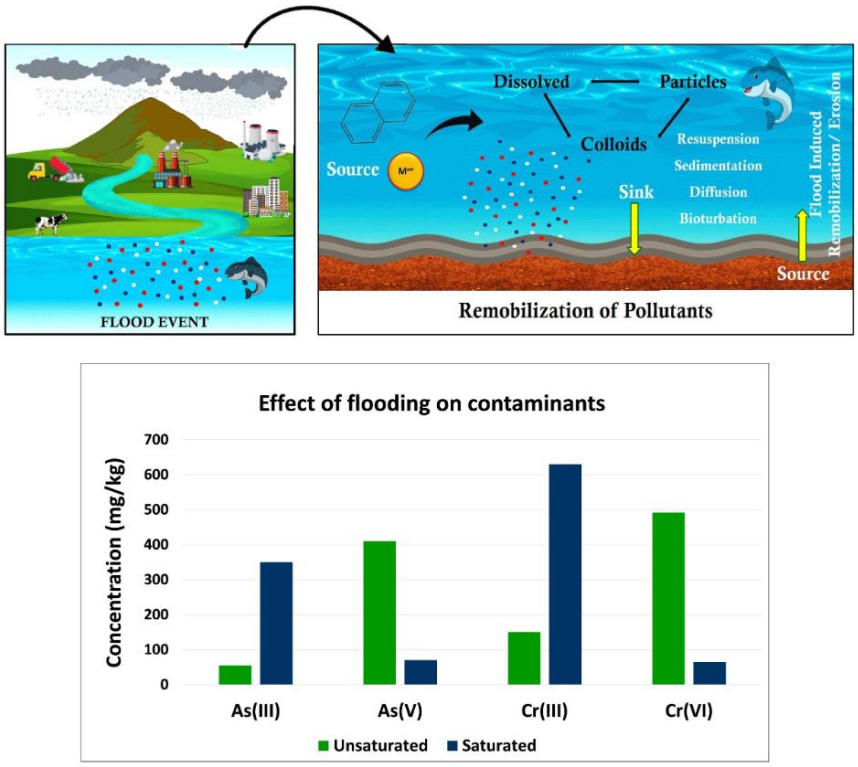

Figure 2. Remobilization of contaminants during extreme flood events. While arsenic is *more mobile* and bioavailable under reduced conditions, chromium beomes *less mobile* and bioavailable.

Climate change significantly exacerbates the severity and frequency of wildfires, leading to a cascade of effects on soil properties and the broader ecosystem. These wildfires alter biological, chemical, and physical aspects of the soil, impacting soil organic matter and its structure, which in turn influences processes like soil erosion and metal transport. Increased temperatures can change the composition of organic matter, with destruction occurring at temperatures between 600°C and 700°C. This degradation of organic matter can further impact soil health and its ability to support vegetation. Climate change-induced erosion increases the transportation and migration of metals within the soil, leading to the loss of metals that are bound to humic materials and facilitating their release into the environment. Research by Frogner-Kockum et al. (2020) highlights how erosion exacerbates this issue. Furthermore, climate change can remobilize legacy metals, such as mercury, altering their release and conversion processes. For instance, mercury can be transformed into methylmercury, a more toxic form that is readily absorbed by organisms. Changes in the redox state of the soil due to flooding can significantly affect the mobility of various metals. Under unsaturated conditions, arsenic (As) exists primarily as the less mobile As(V) species, while chromium (Cr) exists as the more mobile Cr(VI) species. However, flooding can reduce As(V) to the more mobile As(III) and convert Cr(VI) to the less mobile Cr(III). These transformations impact the bioavailability, toxicity, and transport of these elements in soil and aquatic environments, leading to potential

environmental contamination. Additionally, altered rainfall patterns due to climate change can significantly affect net carbon release from the soil. Low rainfall conditions lead to droughts, causing increased release of nitrous oxide (N_2O) from natural soils and inorganic carbon from carbonates and bicarbonates. Moreover, methane (CH_4) and carbon monoxide (CO) can be released from acidic soils (IPCC, 2019). The interplay between climate change, wildfires, and soil dynamics presents a complex web of environmental challenges. Increased wildfire frequency not only alters soil properties but also enhances the mobility and toxicity of metals, contributing to environmental contamination. Changing rainfall patterns further complicate the carbon cycle, highlighting the urgent need for comprehensive strategies to mitigate these impacts and protect soil health and ecosystems.

International agreements play a crucial role in forming a unified approach to combating global warming. These agreements, such as the Kyoto Protocol and the Paris Agreement, provide a framework for countries to set emissions reduction targets, share technology, and cooperate on adaptation strategies. By fostering collaboration among governments, they create a platform for nations to commit to ambitious climate goals, while also addressing the varying capacities and responsibilities of developed and developing countries.

The evolution of these agreements reflects the growing recognition that a global response is needed to limit temperature rise to below 2°C, and ideally 1.5°C, above pre-industrial levels. However, despite these efforts, there remain significant challenges, such as ensuring compliance, financing climate initiatives, and balancing economic development with environmental protection. This introduction sets the stage for an exploration of how international agreements serve as the cornerstone in the fight against global warming, and the challenges they face in driving meaningful change across the globe.

II. Methods

To analyze the role of international agreements in combating global warming, the following methods were used in this paper:

1. Analysis of documents and international agreements:

The main method is a detailed analysis of the texts of key international climate agreements, such as the Kyoto Protocol (1997), the Paris Agreement (2015), and the documents of the United Nations Framework Convention on Climate Change (UNFCCC). These documents are considered in the context of their role in global carbon regulation, reducing greenhouse gas emissions and adapting to climate change. The analysis assesses the legal obligations assumed by the participating countries and the mechanisms for their implementation.

2. Comparative analysis:

To identify differences in approaches to solving climate issues, a comparative analysis of the Kyoto Protocol and the Paris Agreement was used. This analysis examines their principles, mechanisms and results in order to identify changes in the global climate agenda and the impact of these agreements on countries with different levels of economic development.

3. Methods of statistical analysis:

We used data from international organizations such as the Intergovernmental Panel on Climate Change (IPCC) and the World Meteorological Organization (WMO) to analyze the dynamics of greenhouse gas emissions, Earth's temperature, and other climate indicators. These data made it possible to assess the extent to which countries-parties to international agreements are fulfilling their obligations.

4. Qualitative interviews and expert assessments:

We collected opinions from climate policy experts, representatives of international organizations, and non-governmental organizations. Qualitative interviews provided additional

information on the challenges that countries face in fulfilling their climate commitments and on opportunities to improve existing regulatory mechanisms.

5. Content analysis of media and public demand:

We also conducted a content analysis of publications in the global media and social networks reflecting public sentiment and demands for stronger climate action. This method made it possible to study the influence of civil society and the private sector on the formation of climate policy at the international level.

The use of these methods made it possible to conduct a comprehensive analysis of international climate agreements, assess their effectiveness and identify areas for further improvement of global climate policy.

III. Results

The global climate agenda today occupies a central place in the formation of a strategic vision for the future of civilization. It promotes the integration of the efforts of countries to achieve sustainable development goals and the creation of an international institutional framework for the analysis and development of joint solutions. Over the past decades, the climate agenda has become an integral part of global politics, despite the current economic crises and growing contradictions between countries on economic development issues.

One of the reasons for the continued relevance of climate issues is the public demand for action aimed at preventing climate change. Citizens demand that governments take more decisive measures to protect the environment and preserve the planet for future generations. In addition, increasing competition between countries and corporations for leadership in the creation of new "green" infrastructure and technologies stimulates the transition to more sustainable economic models. It is important to note the formation of a new worldview that rejects the old economic principles of making a profit at any cost in favor of the concept of sustainable development.

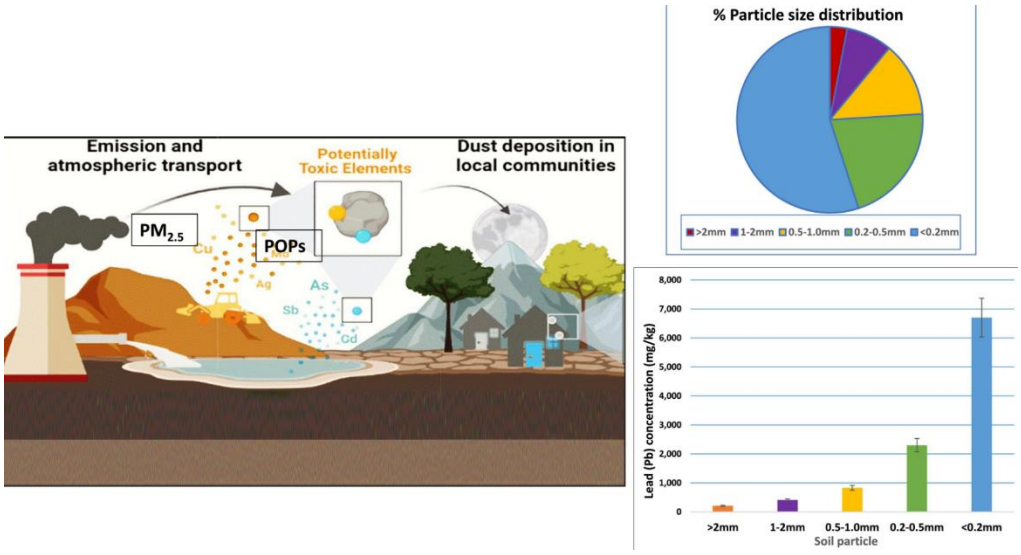

Figure 3. Dust dispersion of contaminants. Wind erosion carries finer particles (<0.2 mm) with enriched concentration of contaminants including lead (Pb), resulting in off-site contamination.

Global climate changes, driven by both natural and anthropogenic factors, significantly impact the transportation and transformation of toxicants. Extreme weather events, such as floods induced by heavy rainfall, facilitate the movement of metals, dioxins, and hydrocarbons from contaminated to non-contaminated areas, exacerbating pollution issues (Lake et al., 2005). Additionally, wind erosion contributes to off-site heavy metal contamination, further spreading pollutants beyond their

original locations (Fig. 3). In response to these challenges, enhancing remediation strategies through green technologies becomes essential, requiring precise steps for remediating contaminated lands. One effective approach is phytoremediation, which utilizes plants to absorb and detoxify contaminants. Elevated atmospheric CO_2 levels can enhance this process by improving plant growth and increasing their capacity for metal detoxification. This not only aids in remediating contaminated soils but also contributes to CO_2 fixation and emission reduction, creating a dual benefit in addressing environmental concerns.

Recognition of climate change as a global threat requires decision-making at the international level. The 2015 Paris Agreement was a milestone in the development of carbon regulation, setting priorities for reducing greenhouse gas emissions, developing technologies for their accumulation and absorption, and implementing adaptation measures. Unlike the Kyoto Protocol, the Paris Agreement transfers the initiative to the level of individual countries and regions, which creates an opportunity for a flexible approach to solving the problem. The world's leading economies have recognized the need to transition to a low-carbon development model based on the use of cleaner and more affordable energy sources.

However, many unresolved issues remain, including the speed and scale of the necessary changes, as well as their consequences for the economy and society. World leaders must not only take into account all aspects of the climate problem, but also coordinate their actions in accordance with scientific data and the international climate agenda. Including climate change issues on the agenda of global summits contributes to progress and allows for harmonizing decisions in areas such as the environment, health and the economy.

This multilateral approach provides an opportunity for a comprehensive solution to the problem of climate change, making international agreements a key tool in the fight against global warming.

The close connection between the issue of climate change and development strategies is critical, particularly regarding traditional energy, which is the primary source of greenhouse gas emissions due to fossil fuel combustion. According to the International Energy Agency (IEA), to maintain atmospheric CO_2 concentrations at a safe level (450 parts per million), countries must undergo a significant environmental and energy revolution. This transformation requires reaching the peak of hydrocarbon use no later than 2020 and transitioning towards predominantly low-emission and renewable energy sources, including natural gas, clean coal, nuclear, hydropower, wind, solar, wave, geothermal, and tidal energy.

Experts argue that a radical increase in energy efficiency is essential to achieving these revolutionary changes. By 2050, it is projected that each dollar of GDP should be produced using only half the energy that was required in 2002. The IEA estimates that by 2030, the share of renewable energy sources and nuclear energy should increase from the current 18% to 33%. Furthermore, from 2007 to 2020, carbon intensity of energy—the average CO_2 emissions per kilowatt-hour of electricity produced—should decrease by 23%, and the carbon intensity of GDP should drop by 37%. By 2020, the proportion of new cars with internal combustion engines should fall from 95% to 40%. Achieving these goals may require up to $430 billion per year in additional investments.

One of the breakthrough solutions in reducing greenhouse gas emissions from hydrocarbon energy is the development of technologies for capturing CO_2 from the atmosphere and storing it underground, known as Carbon Capture and Storage (CCS). However, the commercial implementation of such technologies is still far off, even in technologically advanced Western countries, due to their high costs.

The concept of low-emission development is central to the "New Green Deal" in the global economy, proclaimed by the UN in late 2008. This initiative aims to reorient global economic development towards a new technological base, addressing the dual challenge of reviving economic growth while combating climate change. The promotion of low-carbon energy and enhanced energy

efficiency aligns well with the long-term strategic goals of leading economies worldwide—to reduce reliance on imported fossil fuels while meeting increasing energy demands. As a result, the "green" agenda has become the foundation of anti-crisis strategies in the United States, Europe, and large developing nations, gaining popularity globally. Currently, environmental investments represent a significant portion of the budget plans of countries like the USA, Germany, France, South Korea, and China, with experts estimating that approximately $436 billion has been allocated for these purposes worldwide.

The necessity of stimulating low-emission economic development strategies, especially in developing countries, was also emphasized in the "Copenhagen Accord." This highlights the growing recognition of the need for global cooperation and investment in sustainable development practices to effectively address the challenges posed by climate change.

IV. Discussion

I. Subsection One

Russia has set a goal — transition to a low-carbon development model with the prospect of achieving carbon neutrality by 2060. The consequences of climate change are included in the challenges of the Strategy for Environmental Security of the Russian Federation for the period up to 2025 (Decree of the President of the Russian Federation of 19.04.2017 No. 176), the National Plan for Adaptation of Industries and Regions to Climate Change is being implemented, the Law on Limiting Greenhouse Gas Emissions has been adopted, mandatory carbon reporting for large emitters has been introduced, and conditions have been created for initiating climate projects. Russia declares the need for the most complete consideration of the absorptive capacity of ecosystems. In the low-carbon development strategy of Russia, adopted in 2021, the main emphasis is placed on this mitigation method (mitigation measures): when implementing the target scenario, by 2050 it is expected to reduce GHG emissions by 289 million tons, and increase absorption by 665 million tons of CO2 equivalent compared to the baseline level of 2019, that is, priority is given to absorption measures [4]. Russia's experience in developing national climate legislation and carbon regulation can become the basis for determining environmental and/or climate benchmarks for the EAEU, SCO, and BRICS. The government has adopted basic regulatory documents defining the volumes of greenhouse gas emissions reduction, the methodology for accounting for them, market, financial and legal measures stimulating low-carbon development, and much more. Russia pays great attention to taxonomy issues and is systematically working to create a Unified National System for Monitoring Climate-Active Substances [5]. The development of a national methodology will enhance the status of Russian expertise at the international level, including in negotiations on measures to adapt the economy and population to climate change.

An achievement was the signing of a protocol of intent at the SPIEF between the Federal Accreditation Service and the Global Carbon Council on the recognition of the accreditation of Russian bodies in the validation and verification of greenhouse gas emissions. This opens up new prospects for expanding cooperation with foreign countries in the field of carbon unit trading. For Russia, joint work with the Global Carbon Council is important for the development of common approaches to climate issues as part of friendly multilateral formats.

Thus, Russia today is among the countries capable of determining the vector of development of the climate agenda at the global level, forming an idea of effective ways of transition to a low-carbon economy, and also actively participating in determining the basic development strategies of the world's leading regions, based on scientific data. Russia, occupying a leading position in a number of areas of technological development, is able to offer partner countries environmental or climate

benchmarks with the prospect of their subsequent possible dissemination to the EAEU, SCO, BRICS, etc.

The modern understanding of climate change is associated with a global phenomenon that has manifested itself as a result of the accumulation of greenhouse gases in the atmosphere. The peculiarity of greenhouse gases is that they are evenly distributed in the Earth's atmosphere, i.e. they do not have a local nature of influence. The problem of the greenhouse effect has not only become the subject of scientific discussions on the formation of the climate, but has also attracted wide public interest. The novelty of the climate agenda of the 21st century is associated with the identification of the limits of potential anthropogenic impact on the planet's biosphere, in contrast to the resource limitations in the understanding of R. Malthus in the 17th century [6] or in the report to the Club of Rome in 1972 "The Limits to Growth" [7].

In order to achieve the goals of reducing greenhouse gas emissions, it is important to take into account the positions of different countries and adhere to the principle of common but differentiated responsibility. Climate negotiations, as a rule, take into account the position of the participants in relation to both actions to mitigate the effects of global warming by reducing the anthropogenic impact on the environment by reducing or limiting greenhouse gas emissions, and actions to adapt to the effects of climate change. In the first case, the basis is collective agreements at the level of entities, such as countries or subnational associations, on joint principles and approaches to solving priority problems in the field of climate. The Paris Agreement (2015) points to the importance of adaptation measures, including ensuring direct financing of adaptation activities. In the second case, we are talking about the development of specific actions and events at the level of specific stakeholder groups (regions, enterprises, population and others) to increase their ability to cope with such consequences, reduce their vulnerability to climate risks. In this regard, it is extremely important to show the equal importance of mitigation and adaptation issues.

According to UN forecasts, the main population growth, and therefore sales markets, occurs in developing countries, so the main resources will be “attracted” by these regions. Developing countries in most cases follow the development trajectory of more developed countries (urbanization, industrialization, priority development of personal transport in relation to public transport, etc.).

The expected growth in energy and other resource consumption in developing countries has increased the concerns of developed countries and prompted them to form protective mechanisms, declare the need to restructure the energy system and reduce anthropogenic emissions by abandoning the consumption of fossil fuels. Developed countries have formed a coalition to form a global system of restrictive mechanisms for the use of hydrocarbons, including directive support for renewable technologies, based on a solid ideological foundation and the popularization of climate ideas to form a loyal public opinion. At the level of the OECD (2009) and ASEAN (2010), competing concepts of a "green economy" and "green growth" were presented. The demand for "green" policy in developed countries during this period is largely due to the lack of alternative concepts of economic growth and the conviction of political elites in the correct choice of a method for a rapid transition to a new technological order in order to maintain leading positions in the world economy. More and more economists, based on empirical data on resource use and greenhouse gas emissions, reject the concept of green growth, concluding that green growth is likely to be a mistaken goal and that alternative development strategies should be sought [8]. In addition, accounting for greenhouse gas emissions and absorption in the world does not fully reflect the objective picture; the methods used need to be improved, given that climate data are increasingly used for international comparisons, including as a factor in the competitiveness of producers from different countries [9].

Thus, at the present stage, the climate discourse projects the influence of two basic ideas — ensuring energy security and searching for a new model of intensive development. The EAEU, BRICS and SCO, uniting countries with rapidly developing economies, act as a counterweight to

coalitions of developed countries. The potential for pooling resources and cooperation between participating countries.

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