On the Rostrum of the RAS Presidium

Strategies for Socioeconomic Development with Low Greenhouse Gas Emissions: Scenarios and Realities for Russia

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Received December 28, 2021; revised January 10, 2022; accepted January 20, 2022

Abstract—This article is a supplemented and updated version of the report at the meeting of the Presidium of the Russian Academy of Sciences with the participation of the leadership of the Russian Ministry of Economic Development on September 21, 2021. The authors analyze the main opportunities and risks of implementing the Strategy for the Socioeconomic Development of the Russian Federation with Low Greenhouse Gas Emissions until 2050.1 The key role of the global climate agenda, determined by the leading countries of the world, primarily the European Union, in shaping the institutional environment that influences decision making in the field of national economic policy, is emphasized. It is argued that there is no automatic positive relationship between the race for so-called carbon neutrality of the economy by 2050, prescribed by the global climate agenda, and the achievement of the sustainable development goals set by the United Nations. Principles and approaches to reduce the risks of decarbonization of the economy are formulated. These provide for the integration of a set of measures to reduce net greenhouse gas emissions with those to adapt communities and economic systems to climate change, and harmonize the measures above with the national goals of long-term sustainable development. Estimates of the economic effects of implementation of various scenarios of the decarbonization of the national economy and the associated risks of the global energy transition for Russia are introduced.

Keywords: climate policy, climate change adaptation, energy transition, economic dynamics, greenhouse gases

DOI: 10.1134/S1019331622030030

With the adoption in 1992 of the United Nations Framework Convention on Climate Change (UNFCCC),2 the climate agenda and issues of climate regulation have come to the fore and have gradually taken a firm place among the priorities of global politics in general and international economic relations in particular. Moreover, in recent years, the economic vector of global climate policy has practically become its dominant feature. This is confirmed by a significant increase in the number of economic entities (from corporations to states) that have adopted strategies for socioeconomic development with low greenhouse gas emissions (hereinafter referred to as strategies). On the eve of the 26th Conference of the parties to the UNFCCC in Glasgow (November 2021), the number of such strategies in the world at the national level alone reached 40 (including the Russian one), not counting the EU regional strategy and hundreds of their corporate counterparts.3 At the same time, the small share of countries that have adopted strategies (about 20%) in the total number of states that signed the Paris Climate Agreement in 2015 is noteworthy,4 in accordance with the requirements of which all participating countries are to have such strategies.

1 Adopted by Decree of the Government of the Russian Federation no. 3052-r on October 29, 2021. http://static.government.ru/media/files/ADKkkCzp3WO32e2Ya0B8tIpyzWFHaiUa.pdf
2 United Nations Framework Convention on Climate Change (adopted May 9, 1992). https://www.un.org/ru/documents/decl_conv/conventions/climate_framework_conv.shtml
3 By the end of 2021, the number of strategies reached 47. More countries (142) adopted or qualitatively updated in 2020–2021 their obligations on the contributions of national economies to the reduction of anthropogenic emissions of greenhouse gases [1].
4 Paris Climate Agreement (adopted December 12, 2015). https://unfccc.int/files/meetings/paris_nov_2015/application/pdf/paris_agreement_russian_.pdf
SCIENTIFIC BASE FOR DEVELOPMENT AND KEY HYPOTHESES OF THE STRATEGIES

Almost all strategies are founded on the modern knowledge base on climate and climate change, which in the global scientific community is represented in a consolidated form by a series of capital assessment reports of the Intergovernmental Panel on Climate Change (IPCC), including the latest, IPCC VI Assessment Report, the first volume of which was published at the end of 2021 [2]. Without going into a discussion on the physical foundations of climate change presented in these reports, which are the subject of professional discussion of specialists in the field of natural sciences, we emphasize that methodological and forecasting approaches, including climate change scenarios, based on the conceptual and institutional framework of the UNFCCC and the Paris Agreement, as well as the empirical data of these reports, serve as a common ground on which various states, primarily their economic authorities, build their actions in the field of climate policy, including the formation of national strategies.

Note the recently intensified orientation of the strategies mentioned towards a low-carbon economy and the achievement of carbon neutrality by the mid-21st century. Back in August 2021, 15 out of 30 national strategies registered with the UNFCCC secretariat contained such a target setting; but already in November 2021, by the beginning of the FCCC Conference of the parties in Glasgow, the total number of national strategies reached 40, of which 78% were carbon neutral. In December 2021, these figures were 47% and more than 90%, respectively (calculated according to [3]).

Forming their strategies, states proceed not only from the above-mentioned general physical and methodological basis of climate change but also from a number of hypotheses used in the construction of low-carbon development scenarios. One of these hypotheses assumes the preservation of relative stability or low volatility of international economic relations and the world economic situation in the forecast period. At the same time, given the long-term nature of the strategies (30 years or more), there is every reason to expect various external shocks (of a political and geopolitical, social, environmental, and economic nature), which can significantly delay the achievement of the goals stated in them.

Another hypothesis provides for an unequivocally positive relationship between the implementation of a set of measures to reduce greenhouse gas emissions with other (nonclimate) sustainable development goals. In fact, the situation is much more complicated. Thus, according to the global models developed by the same IPCC, as well as authoritative experts from the United States, Norway, and China, even a shutdown of the world economy and a drop in anthropogenic greenhouse gas emissions to zero will not ensure immediate stabilization of the climate, significant changes in which and large-scale natural disasters associated with which will continue for at least 15–20 years [4, 5]. In addition, it should be taken into account that there are not only strong interconnections between the goals of sustainable development but also certain contradictions. For example, an accelerated (drastic) reduction in emissions of the main greenhouse gas CO2 as part of the implementation of the strategy in a number of countries, primarily developing ones, may conflict with the goals of eradicating poverty, and improving health, and providing access to energy for all. Therefore, in order to overcome contradictions and conflicts of interest, it is necessary to choose priorities that provide a balance (and in some cases a kind of “exchange”) between solving the problems of reducing climate risks, on the one hand, and environmental and socioeconomic risks, on the other. As an illustration, let us take the 2020 situation, when global production decreased by 3.5% due to the coronavirus crisis. This was followed by a decrease in greenhouse gas emissions by 5.4% (including from the combustion of fossil fuels by 5.6%) [6], and at the same time, aerosol emissions decreased, which, in turn, led to an increase in atmospheric transparency and an increase in surface air temperature (warming) [2, p. 40]. Thus, the effect turned out to be opposite to that expected by the IPCC experts.

Another case of conflict between the solution of environmental and climate problems is the reduction of the threat to human health in large industrial centers from emissions of harmful and dangerous pollutants into the air. An illustrative example is the Russian Noril’sk, where the protection of the population from the negative impact of the accumulated volume of sulfur involves the use of recycling technologies, accompanied by additional CO2 emissions. For residents of such areas and regions, obviously, the priority is to solve acute current medical and environmental problems, while the global goal is to minimize emissions of climate-active CO2. To cope with these contradictions, it will help to have an integrated approach that includes organizational and industrial—technological solutions that simultaneously reduce environmental threats to human health and greenhouse gas emissions in a way that maximizes the reduction of the overall

At the level of individual regions and countries, the IPCC reports are supplemented and specified in the relevant assessment reports, for example, in Russia—Roshydromet Assessment Reports on Climate Change and Its Consequences in the Russian Federation (the latest, third report, is being prepared for publication in the current year 2022, the previous two were published in 2008 and 2014, respectively).

At the same time, according to the data of the World Meteorological Organization, the concentration of CO2 reached 413.2 ppm, and that of methane and nitric oxide, 1889 and 333 ppm, respectively, exceeding the average values for the last decade [6].
risk to human well-being and long-term sustainable socioeconomic development.

**IMPERATIVES AND KEY ELEMENTS OF EFFECTIVE IMPLEMENTATION OF THE STRATEGIES**

When developing and implementing a strategy, several requirements are expected to be met, which are a necessary condition for its effectiveness and, at the same time, act as key elements of its implementation. It is necessary to make maximum use of win—win (in terms of investments) technological and innovative solutions and the best available technologies (BATs) on the domestic market to reduce emissions (including greenhouse gas capture and utilization) and carbon sequestration (primarily by natural ecosystems, especially forests). In the BAT structure, it is necessary to highlight the low-carbon technologies of nuclear power plants, as well as the nuclear-industrial complex as a whole as a source of the latest scientific and technological developments (for example, membrane filters and production of “green” hydrogen), which allow solving environmental and climate problems.

The next requirement and at the same time a component of an effective strategy is the integration of actions to decarbonize the economy with measures to adapt it to climate change, which, according to model calculations (including experts from the Organization for Economic Cooperation and Development [7]), provides the best economic and climate effect. The importance of adaptation as a strategic direction of climate policy, equivalent to reducing man-made net greenhouse gas emissions, is emphasized in the UNFCCC, the Paris Agreement, and the Glasgow Climate Pact [8]. It is natural that most foreign strategies and nationally determined contributions (NDCs)⁷ to the implementation of the Paris Agreement, as their analysis shows, contain a special section on adaptation. Nevertheless, both abroad and in Russia, adaptation is still the stepdaughter of climate policy, receiving only a tenth of the cost of decarbonizing the economy and, accordingly, needing a multiple increase in funding. This implies the need for increased funding for the entire climate agenda, the scope of which will increasingly shift towards adaptation measures, primarily planning and preparedness measures for natural and climatic emergencies in order to reduce the risk and scale of losses and damage.

Two more requirements concern an effective strategy in Russia. First, there is its integration with the country’s environmental policy, including the national project “Ecology,” as well as with actions within a set of strategic initiatives of the government (“Technological Breakthrough” program⁸) aimed at reducing emissions of pollutants harmful and hazardous to human health, including industrial and municipal waste, and the sustainable reproduction of natural resources, and the protection of ecosystems, including forests, as well as the conservation of biodiversity.

Second, there is the integration of the strategy and the climate agenda as a whole into the strategy of long-term sustainable socioeconomic development of the country, focused on national interests and the achievement of national development goals, the integral of which is to improve the quality of life of citizens. This implies correct prioritization in the strategic planning process. This refers primarily to the goals and risks of sustainable development of the country. According to our estimates, both in the world and in Russia, the scale of human losses and economic damage from environmental pollution with hazardous and harmful substances is ten times (according to various sources, from 40 to 200) and almost an order of magnitude (9–10 times), respectively (calculated according to [6, 9, pp. 8–9; 10, p. 11; 11], exceed those from hydrometeorological disasters, which are associated with an increase in the intensity of climate change due to emissions of CO₂, which is harmless to human health but climatically active. This, of course, does not mean that measures to counteract the disasters mentioned are unimportant and can be shelved. We are talking about understanding the real orders of numbers and the “price” of the climate issue in a number of other goals and objectives of sustainable development and the correct setting of strategic priorities based on such an integral risk assessment. The same, if not to a greater extent, applies to other sustainable development goals related to ensuring affordable energy for all and dynamic inclusive economic growth, with which climate protection must also be harmonized.

In reality, however, most strategies are focused on achieving carbon neutrality, which is due to their conceptual reliance on the paradigm of the so-called low-carbon development, actively promoted by certain political and business circles in the West, primarily the EU, and a part of the expert and analytical community associated with them. The essence of this paradigm is as follows:

- the undeniable priority of the climate change problem and its solution (which is defined as climate stabilization—not exceeding the threshold of 1.5°C by 2100 compared to the preindustrial era) over other sustainable development goals;
- these changes themselves are the result of purely anthropogenic factors;

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⁷ Nationally Determined Contributions (to the Paris Agreement); NDC is the term used in the official text of the Paris Climate Agreement.

⁸ http://government.ru/news/43480/
• a strategic solution to the problem is a radical reduction (to zero by 2050) of anthropogenic net emissions of greenhouse gases, primarily CO₂.

As can be seen, this is far from the integrated approach described above and the correct prioritization of sustainable development goals. Just as far from it and from the Paris Agreement is the active desire of individual countries to dictate to specific states and the world community models of the structural and technological transformation of their energy and economy as a whole without taking into account national specifics. In relation to Russia, this is expressed, in particular, in the underestimation of the role of nuclear energy in the decarbonization of the economy, despite the carbon-free generation of nuclear power plants and the fact that most experts, including the “green ones,” consider an effective energy transition (implying a change in the structure of the energy balance towards a significant reduction in the share of fossil fuels and increasing the share of environmentally friendly energy sources) difficult or completely unattainable without increasing the contribution of nuclear power plants.

In this regard, attention is drawn to the cliché actively used, including in official documents,9 “adaptation of the Russian economy to the global energy transition.” Its use seems to be highly debatable and creates confusion with the concept of adaptation of the population and the economy to climate change. The latter concept is not only etymologically and meaningfully correct, given that adaptation is adaptation, but also legitimate, being enshrined in international legal documents—the UNFCCC (1992), the Paris Climate Agreement (2015), and the Glasgow Climate Pact (2021). Considering the role of Russia in the global energy sector (which until recently was characterized as an energy guarantor), the modern structure of electricity generation, which many countries can envy,10 as well as the potential of our country in the field of new technologies and the production of low-carbon energy sources (nuclear and hydrogen), it is difficult to agree that in the foreseeable future, Russia’s strategy for the global energy transition should be limited to adapting its economy and energy to the changes taking place in the world.

It seems that Russia takes and should continue to take (and defend) an active position as one of the key players in the global energy market, based on its strengths and national interests listed above, avoiding those imposed from outside as part of the notorious “race to zero.”11 Recipes for structural and technological restructuring of the energy sector and the economy as a whole. The issues of changing the domestic energy system must be approached carefully, as required by the national interests of the country,12 not forgetting that the price of energy has a direct impact on the sustainability, including financial, of the entire economy.

According to the estimates of a number of authoritative expert groups, the transformation of the global energy balance within the framework of the energy transition will cost approximately 3–4% of world GDP [12–14]. The implementation of an aggressive decarbonization scenario with a rapid phaseout of fossil fuels and the achievement of carbon neutrality by the global economy in 2050 could lead to energy costs exceeding 10% of GDP in most of the world’s major economies. Given the forward-looking cost structure for these countries, this increase in energy prices will be a key constraint on sustainable economic growth and, consequently, achieving carbon neutrality by 2050, despite the possible significant reduction in the cost of the existing technologies and those devised in the future. It is no coincidence that a third of the strategies adopted in the world either do not set the goal of achieving carbon neutrality at all or significantly postpone the timing of its possible achievement (2060 and later).

ESTIMATES OF THE ECONOMIC EFFECTS OF IMPLEMENTING THE STRATEGY FOR RUSSIA

Russia, as one of the largest economies in the world, which is also dependent on the export of hydrocarbons, cannot but consider the global climate agenda as a source of risks and, at the same time, opportunities for sustainable long-term development. In this regard, the national strategy should link the solution of two key tasks in the framework of the decarbonization of the economy: to ensure Russia’s contribution to the achievement of global climate protection goals and the structural and technological transformation and modernization of the national economy for dynamic and sustainable socioeconomic development in the long term, focused on improving the level and quality of life of the population.

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9 See, for example, “On Decisions Based on the Results of the Strategic Session ‘Russia’s Adaptation to the Global Energy Transition.” http://government.ru/orders/selection/401/43295/. Cited September 20, 2021.

10 In Russia, almost 38% of generation is provided by carbon-free hydroelectric power plants and nuclear power plants, as well as renewable energy sources. About half more is accounted for by natural gas, the environmental cleanliness of which significantly exceeds coal, which remains one of the basic sources or the foundation of the energy of the world’s leading economies, including the United States, China, and India: respectively, 20, 57, and 75% of the contribution to electricity generation (for comparison, 15% in Russia, and 13% in the EU).

11 A term adopted by the expert community that reflects the desire of countries to achieve carbon neutrality as soon as possible.

12 Energy Security Doctrine of the Russian Federation, approved by Decree of the President of the Russian Federation of May 13, 2019, no. 216. http://www.kremlin.ru/acts/bank/44252. National Security Strategy of the Russian Federation, approved by the Decree of the President of the Russian Federation of July 2, 2021, no. 400. http://www.kremlin.ru/acts/bank/47046
The mission of economic science in relation to the implementation of the strategy in Russia is to develop scenarios and model calculations that take into account and evaluate, on the one hand, the impact of shifts in the structure of technologies used on the parameters of net greenhouse gas emissions and, on the other hand, the effects of the use of these technologies on the economic dynamics. Here it must be kept in mind that the introduction and use of each technology is characterized by a certain capital intensity, and this affects the cost structure and, further, the system of intersectoral interactions in the economy. The forecasting methodology based on input–output tables, developed at the RAS Institute of Economic Forecasting, makes it possible to solve this complex problem by assessing the impact of the implementation of specific scenarios (including a set of actions and technologies for reducing net greenhouse gas emissions) on the balance of production, incomes, and prices. In addition, this methodology makes it possible to show how the final results of economic development in the medium and long term correspond to the priorities of the goals set.

When formulating strategy scenarios, the forecast of the development of the situation in the global economy is of fundamental importance. According to model calculations, a change in the world economic situation over a 30-year period (2021–2050) will seriously affect the development of the Russian economy and will become a much more significant factor in the effectiveness and efficiency of implementing the strategy than production and technological shifts within the domestic economy under all scenarios. The situation is not the most favorable, but it should be taken into account when developing (adjusting) scenarios and implementing the strategy.

In the coming decades, the process of changing national economic and energy policies towards decarbonization will have a significant impact on global energy demand. The changes include requirements to increase the share of low-carbon energy sources; fuel efficiency targets; targets for the use of alternative transport technologies; reduction of greenhouse gas emissions and the level of carbon intensity of individual sectors of the economy; and new environmental standards, which, as a rule, are reflected in the strategies and national contributions declared by the governments of the countries of the world to the implementation of the Paris Climate Agreement. Their implementation by 2050, according to experts and our calculations, will reduce global CO2 emissions caused by the energy consumption of hydrocarbons by more than ten billion tons compared to the scenario of maintaining the existing economic policy.

Such a massive reduction in emissions implies a significant contraction in global demand for hydrocarbons. The biggest restrictions will affect coal consumption. The peak of demand for it will most likely be passed before 2030, but for Russia at least until 2035 there will be a window of opportunity to maintain and even increase the volume of revenue from foreign coal trade. This is due to the continued favorable situation for the export of Russian high-calorific coal to the markets of Southeast Asia, where large capacities of coal-fired thermal power plants have been introduced in recent years and a stable demand for thermal coal will be provided over the next 15 to 20 years. Demand for Russian coal will also be supported by a decline in high-quality coal production in Indonesia and Australia, as well as the price competitiveness of Russian raw materials. At the same time, the export of Russian coal to the West will begin to decline in the short term. As a result of the above trends, Russian coal exports are expected to reach 235 million tons by 2035.

As for oil and gas, the main factor affecting the global demand for “black gold” will be the transfer of vehicles to electric traction. According to our estimates, the share of electric cars in the structure of the global passenger auto fleet may increase from the current 1 to 15% by 2035. Under these conditions, global demand for Russian oil and oil products by 2035 may reach about 425 million tons of oil equivalent. Due to the very low carbon content of natural gas, the demand for it will decrease slightly. With an average annual growth rate of the world economy of 2.7% in 2022–2035, the volume of Russian natural gas exports by 2035 may reach up to 440 bcm. Thus, in the next 15 years, the demand for Russian hydrocarbons in the world market will remain at the current level even with the most stringent options for international climate policy measures. This makes it possible to build constructive scenarios for the development of Russia based on the economic potential of the energy sector, including through the use of income from the export of its products for the structural and technological modernization of the Russian economy.

Another important feature of the Russian strategy is that, unlike developed countries, our country has the opportunity to use a wide range of decarbonization technologies, the choice of which should be based on an assessment of their economic efficiency. Under these conditions, one of the main parameters of the strategy scenarios is the level of additional investment required to use the technologies mentioned. The mechanism for choosing the optimal scenario for the decarbonization of the economy is shown in Fig. 1.

The base scenario of the strategy assumes the need for additional investment of 1.1% of GDP per year until 2050 in the decarbonization process against the backdrop of economic growth at an average annual
It is planned to use the most affordable ways to reduce net greenhouse gas emissions, including technologies with moderate carbon intensity. Such solutions include changes in the structure of electricity generation (with a gradual increase in the share of low-carbon sources), the development of electric smelters in metallurgy, energy efficiency in the housing and communal sector, etc. The fundamental problem of such a scenario is that the decarbonization measures envisaged by it do not ensure a reduction of net greenhouse gas emissions in the amount necessary to achieve carbon neutrality by 2060, or the fulfillment of Russia’s obligations under the Paris Agreement and the Glasgow Climate Pact, which is unacceptable.

On the contrary, the intensive scenario assumes a significant reduction in net greenhouse gas emissions (to 260 million tons of CO₂ equivalent by 2050) due to a significant increase in the share of electricity generation based on renewable sources, an increase in the share of electric cars in the total car fleet, and the introduction of CO₂ capture and recycling technologies and the industrial use of hydrogen. The large-scale introduction of low-carbon technologies requires large investments: in the scenario under consideration, the level of additional investment reaches 3% of GDP on average over 2021—2050, which is a significant burden on the economy. Thus, an increase in economic growth rates up to 3% per year in the medium term implies an increase in the share of investment in fixed capital in GDP up to 25%. A further increase in the load will have a negative impact on consumer demand and on the standard of living of the population as a whole, primarily through price increases associated with the need to recoup additional investments. Therefore, the average annual GDP growth rate in 2021—2050 in the intensive scenario decreases to 2.6%, i.e., below the forecasted global indicator for the same period, which significantly worsens the competitiveness of the domestic economy and increases the risks for sustainable economic development.

Under these conditions, the target scenario (see Fig. 1) is effective, providing an acceptable balance between sustainable economic growth and a reduction in anthropogenic pressure on the climate by choosing the optimal technology structure. According to our estimates based on the intersectoral model of the Russian economy, such a scenario provides for a significant (up to 660 million tons of CO₂ equivalent by 2050) reduction in net greenhouse gas emissions while ensuring average annual GDP growth rates at the level of 3% in 2021—2050. This is achieved by a set of solutions, primarily technological ones, implemented within the framework of two strategic areas of decarbonization of the economy: reducing greenhouse gas emissions (in particular, their capture and utilization), primarily in cities and industrial centers of the country, and the absorption of CO₂ accumulated in the atmosphere by ecosystems, mostly forests.

The reduction of greenhouse gas emissions is achieved through measures of structural and technological modernization of the economy, including increasing the energy efficiency and reducing carbon intensity. The main requirements for the technologies underlying these measures are their localization in Russia, which will reduce the dependence on technological imports, as well as their moderate capital intensity, which implies the use of existing technologies (subject to their improvement).

Within the scenario under consideration, the structural and technological factor can help reduce greenhouse gas emissions in the amount of approximately 1.2 billion tons of CO₂-equivalent (approximately 40%
of the 1990 emission level) in 2021–2050. Among the sectors of the economy in which this factor can provide the greatest reduction in greenhouse gas emissions, three stand out.

First of all, energy and housing/communal services. The reduction of emissions here in the years 2021–2050 can equal 267 million tons of CO₂-equivalent due, first, to a change in the structure of electricity generation towards a gradual decrease in the share of electricity produced from coal and an increase in the share of generation based on renewable sources and nuclear power plants—from 1 and 19% in 2021 up to 10 and 25% by 2050, respectively, and, second, to a reduction in the energy intensity of the public utilities sector due to housing renovation and energy-efficient repairs of multi-apartment residential buildings (for more details, see [15]). The choice of decision priorities is due to the territorial and production specifics. Thus, in Moscow, where the quality of generating capacities is high, it is advisable to concentrate the main efforts on the housing and communal services sector, but, for example, in Rostov oblast, the reduction of greenhouse gas emissions is most effectively achieved by modernizing the generating capacities in the energy sector.

Two other effective sectors include, first, transport (including pipelines) with approximately the same amount of emission reduction (265 million tons of CO₂-equivalent). This is achieved mainly with the help of technological solutions that significantly reduce uncontrolled emissions from pipelines and, to a lesser extent, by switching a significant part of transport (primarily automobiles) to electric traction. Second, we have waste management or handling: with the potential to reduce greenhouse gas emissions over the same period of about 105 million tons of CO₂ equivalent.

Due to the maximum transfer of technological processes to electricity, chemical and metallurgical production and the production of other nonmetallic mineral products are also expected to reduce greenhouse gas emissions, but only by 33 million tons of CO₂ equivalent.

The implementation of the above decarbonization measures will require investments in the amount of 1.8% of GDP on average per year for 2021–2050. At the same time, the average annual GDP growth rate will remain at the level of 3%, because a higher investment rate compared to the base case will make it possible to balance the increase in prices that compensate for the costs of decarbonization with an increase in the efficiency of the economy and an increase in the income of economic agents.

Another key direction of the strategy implementation mentioned above—the absorption of CO₂ accumulated in the atmosphere by ecosystems (forests)—is not inferior to the structural and technological factor in terms of the potential for decarbonization of the economy. According to the latest estimates of authoritative experts [16], as of 2014, the biomass of only managed forests provided the absorption and storage of 354 billion tons of carbon or almost 1.3 billion tons of CO₂ equivalent, which is 46% higher than the national inventory of greenhouse gas emissions. According to other estimates, the total absorption potential of all major terrestrial ecosystems (forests, soils, wetlands) is 2.5 billion tons of CO₂ equivalent, which exceeds the current gross anthropogenic greenhouse gas emissions. Taking into account the special significance and complexity of assessing the absorbing potential of Russian forests and its effective implementation, which is the subject of a special analysis (see [18] for more details), we restrict ourselves to two fundamental comments.

First, for the potential of forests and other ecosystems to sequester and store carbon to be realized and its contribution to be recognized by the international community, massive efforts are required, in particular investments in the conservation of ecosystems, primarily forests and wetlands, which annually lose over 10 million hectares from forest and peat fires and suffer from the consequences of global warming, especially in the northern regions of the country, where such rates are high. Moreover, a qualitatively different forest policy and an effective policy in sustainable nature management are needed. It is necessary to form large scientific projects that should be interdisciplinary. The significance of the course of the strategy under consideration (often referred to as forest—climatic, although this is too narrow) is such that the Russian scientific community has a real opportunity to provide tangible support to the economy and to make a significant contribution to mitigating climate risks of development.

Second, the great potential for absorbing greenhouse gases not only does not decrease in significance, but, on the contrary, implies an active policy of decarbonization of the economy, the absence or inefficiency of which in the foreseeable future may lead to a slowdown in economic dynamics and failure by our country to fulfill its international obligations. This is unacceptable for Russia as a climatically and politically responsible state, as well as from the point of view of providing vital conditions for sustainable socio-economic development and the growth in the level and quality of the life of people.

14According to other estimates, the potential of carbon absorption and storage by forests is twice as high and reaches 2.5 billion tons of CO₂ equivalent [17].
15Speech by Russian President V.V. Putin at the climate summit of more than 40 heads of state, initiated by the US President on April 22–23, 2021. http://kremlin.ru/events/president/news/65425/videos
The strategy for the socioeconomic development of the Russian Federation with low greenhouse gas emissions until 2050 is designed to make a significant contribution to ensuring sustainable growth and modernizing the domestic economy and, most importantly, improving the quality of life. To accomplish this, it is necessary to take into account the dynamics of not only net greenhouse gas emissions but also macroeconomic indicators, to analyze and adjust the scale and processes of structural and technological shifts, enhancing the contribution of science to these shifts, and also to assess the changing role of Russia in the global economy. Excessive emphasis on the decarbonization of the economy in isolation from the tasks of adapting the population and economic systems to climate change, not to mention underestimating or ignoring other priority sustainable development goals for Russia’s national interests, carries significant risks. It is necessary to link a set of measures in the field of low-carbon development with climate change adaptation measures and with the country’s environmental policy. Finally, they need to be integrated into a long-term strategy for Russia’s sustainable socioeconomic development.

The choice and implementation of an effective scenario for the decarbonization of the economy should proceed from the priority of maintaining the dynamics of economic growth at an acceptable level, which is fixed in the national strategy adopted by the Government of the country. This means that, despite possible external pressure and sometimes attempts to dictate directly in the field of structural and technological policy, Russia needs to make the most of the available technological potential to minimize the economic risks of the decarbonization policy. As the above calculations and estimates show, there is such a possibility. Its implementation puts forward a large number of interdisciplinary tasks, the solution of which requires close cooperation of scientists and specialists in the natural sciences and sociohumanitarian fields of knowledge, including economics [19], producers, and industry and regional consumers of climate information, decision makers at all levels of government, non-profit organizations, and the media.

ACKNOWLEDGMENTS

This article was prepared within the framework of a grant provided in the form of a subsidy for conducting large scientific projects in priority areas of scientific and technological development within the subprogram “Basic Scientific Research for Long-Term Development and Ensuring the Competitiveness of Society and the State” of the state program of the Russian Federation “Scientific and Technological Development of the Russian Federation,” the project “Socioeconomic Development of Asian Russia Based on the Synergy of Transport Accessibility, Systemic Knowledge of the Natural Resource Potential, and the Expanding Space of Interregional Interactions.” Agreement with the Ministry of Science and Higher Education of the Russian Federation no. 075-15-2020-804 (internal grant no. 13.1902.21.0016).

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

REFERENCES

1. 2021 WHO Health and Climate Change Global Survey Report (World Health Organization, Geneva, 2021).
2. “IPCC, 2021: Summary for policymakers,” in Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (Cambridge Univ. Press, 2021).
3. Communication of long-term strategies. https://unfccc.int/process/the-paris-agreement/long-term-strategies. Cited December 31, 2021.
4. B. H. Samset, J. S. Fuglestvedt, and M. T. Lunelayed, “Delayed emergence of a global temperature response after emission mitigation,” Nat. Commun., No. 11, 3261 (2020).
5. “Emissions slashed today will be felt only in the middle of the century,” Economist, July 11 (2020). https://www.economist.com/science-and-technology/2020/07/11/emissions-slashed-today-wont-slow-warming-until-mid-century
6. State of the Global Climate 2021: Provisional Report (World Meteorological Organization, Geneva, 2021). https://library.wmo.int/doc_num.php?explnum_id=10859
7. The Economic Consequences of Climate Change (OECD, Paris, 2015). https://doi.org/10.1787/9789264235410-en
8. Glasgow Climate Pact: Decision -/CP.26. https://unfccc.int/documents/310475. Cited November 13, 2021.
9. Closing the climate protection gap—Scoping policy and data gaps. https://ec.europa.eu/regional_policy/en/publications/publications/communications/2021/closing-the-climate-protection-gap-scoping-policy-and-data-gaps
10. State of Global Air 2018: Special Report (Health Effects Institute, Boston, 2018).
11. The Sustainable Development Goals Report 2019 (United Nations, New York, 2019).
12. Energy transition outlook 2021: A global and regional forecast to 2050: Executive summary. https://download.dnv.com/eto-2021-download
13. World Energy Outlook 2021. Bloomberg New Energy Finance (2021).
14. Net Zero by 2050: A Roadmap for the Global Energy Sector: Special Report (International Energy Agency, Paris, 2021).
15. I. E. Minyaev and A. N. Milyutin, “Residential energy efficiency as a driver of economic growth and carbon-intensity reduction in the Russian Federation.” Round-
table discussion “Socio-Economic Impact Assessment: Apartment Building Renovations & Energy-Efficiency Increases in Russia’s Urban Housing Stock.” World Bank, Moscow, October 5, 2021. https://www.worldbank.org/en/events/2021/10/05/socio-economic-effects-of-capital-repairs-of-multi-family-apartment-buildings-in-russia

16. D. Schepaschenko, E. Moltchanova, S. Fedorov, et al., “Russian forest sequesters substantially more carbon than previously reported,” Scientific Reports, No. 11, 12825 (2021).

17. A. N. Filipchuk and N. V. Malysheva, “The assessment of the feasibility of using the state forest inventory data to implement the national commitments under the Paris Agreement,” IOP Conf. Ser.: Earth Environ. Sci., No. 1, 012026 (2020).

18. E. A. Vaganov, B. N. Porfiriev, A. A. Shirov, et al., “Assessment of the contribution of Russian forests to climate change mitigation,” Ekon. Reg., No. 4, 1096–1109 (2021).

19. V. I. Danilov-Danil’yan, V. M. Kattsov, and B. N. Porfiriev, “The problem of climate change: The field of convergence and interaction between natural sciences and the sociohumanities,” Herald Russ. Acad. Sci. 90 (5), 577–587 (2020).

Translated by B. Alekseev