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Spatial Aspects of Sustainable Development of Arctic Fuel-Energy Resources in the New World Order: Global Challenges and Solutions

Sergey A. Agarkov¹✉, Dr. Sci. (Econ.), Professor, Chief Researcher

Medea V. Ivanova², Dr. Sci. (Econ.), Associate Professor, Chief Researcher

^{1,2}Luzin Institute for Economic Problems — Subdivision of the Federal Research Center “Kola Science Centre of the Russian Academy of Sciences”, ul. Fersmana, 24a, Apatity, Russia

¹agarkovsa@yandex.ru ✉, ORCID: <https://orcid.org/0000-0002-3417-0265>

²mv.ivanova@ksc.ru, ORCID: <https://orcid.org/0000-0002-6091-8804>

Abstract. The article presents the authors’ vision of the emerging geopolitical factors determining Russia’s position in the global energy infrastructure, which allowed identifying problems and defining priorities and directions of spatial organization of the Arctic system of energy transport communications, expanding the possibilities of involvement of highly liquid energy resources of the Russian Arctic into active economic turnover. The purpose of the study is to analyze the prospects of the economic development of Arctic energy resources in the context of projected changes in the world economic order from the standpoint of ensuring the long-term energy sustainability of the national economy and strengthening Russia’s position in the energy markets of the Asia-Pacific region. The data presented in the study show the vulnerability of the current export-oriented model of the resource-raw materials economy in Russia due to technological and infrastructural limitations of transport logistics. The study substantiates the need to form a new world-system infrastructure for the country’s energy security using the natural resource potential and geo-economic advantages of the Arctic territories. This implies the involvement of highly liquid reserves of fossil energy resources in the Arctic into active economic turnover through the creation of mineral resource centers (MRCs) included in the structure of world economic fuel and energy relations. To achieve this goal, a conceptual model of spatial organization of the Arctic system of energy transport communications is proposed, which combines marine, coastal and land infrastructure facilities into intermodal energy transport corridors (IETC), opening additional opportunities for participation in global, national, interregional value chains and providing a synergetic effect of development of remote Arctic territories.


Keywords: *Arctic zone, resource potential, sustainable development, geo-convergent approach, geo-convergent energy-transport space*

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Introduction

In the current geopolitical environment of uncontrolled economic turbulence, Russia faces a number of major challenges that form systemic national security risks, where, against the backdrop of unprecedented sanctions pressure, our country has lost its leading position as an exporter of hydrocarbon energy resources in European markets. Today, we are forced to state that Russia has lost the European market for oil, oil products and gas, which brought up to one third of federal budget revenues (at the end of 2022, the share of fees from the extraction and sale of oil, coal and gas amounted to about 42%, in 2021 — 36%, in 2020 — 28%)¹. Does this mean that nobody will need the energy resources (oil, gas, coal) produced in Russia? The answer to this question depends on how successful the strategy of energy cooperation with friendly countries that do not support anti-Russian sanctions will be, which fundamentally changes the strategic logic of export-oriented development of the entire energy complex of the country.

Under these conditions, Russia is trying to reorient itself to meet new challenges, transforming the existing structure of commodity flows and changing transport logistics from west to east due to the need to form new export-import channels for participation in global value chains. However, poor diversification, unbalanced spatial organization of the communications system and insufficient development of the transport infrastructure of Russia as a whole, most acutely manifested against the background of the imposed embargoes, create additional risks for the sustainable development of the national economy and require systemic solutions aimed at overcoming existing infrastructure limitations and increasing the spatial connectivity and transport accessibility of territories.

This is especially relevant for the Arctic zone of Russia, which has the world's largest reserves of natural minerals — the main strategic resource base for ensuring the country's economic and energy security in the long term. For the Russian Arctic territories, the geographical and technological accessibility of transport services not only determines the possibilities of socio-economic development, but also is a system-forming factor of integration and unity of the national economic space.

Realization of the potential for economic growth and involvement of the resource base of the Arctic Zone of the Russian Federation in active economic turnover directly depends on the transport accessibility of remote Arctic territories for global and national economic (industrial) centers that generate demand for fuel and energy resources. Therefore, increasing the spatial connectivity and transport accessibility of remote Arctic territories and marine waters is acquiring critical national economic significance both from the standpoint of the country's energy security and for increasing the transit and export potential, including the task of strengthening Russia's position in the energy markets of the Asia-Pacific region. In relation to Arctic subsoil use projects, this means the need to create spatially extended energy transport production chains — intermodal energy transport corridors (IETC) linking mineral resource centers (MRCs) for mining with international and domestic sales markets by a reliable diversified system of transport communications.

¹ "Kommersant" newspaper. URL: <https://www.kommersant.ru/doc/5774268> (accessed 12 August 2023).

The formation of such IETCs should be carried out on the basis of a comprehensive analysis of the current state and problems of developing a unified transport system (UTS) in close interrelation with the general directions of development of the national economy and ensuring the country's energy security in the changing conditions of the global economic order.

Therefore, it is extremely important to analyze the factors and determinants of the spatial organization of a single balanced system of energy transport communications to ensure efficient, reliable and environmentally safe transportation of energy resources extracted in the Arctic to sales markets within the country and for export, which determined the main directions and range of tasks of this study.

In this regard, the authors defined the following research question: "How do the current geopolitical conditions and sanctions affect the prospects for the development of the natural resource potential of the Arctic, and how can the integrated development of the energy transport space increase the multifactor productivity of the extraction and sale of Arctic energy resources?"

The sources devoted to the problems of development of the Russian fuel and energy complex in the context of new geopolitical challenges and sanctions pressure, state and sectoral documents of strategic planning, including methodological approaches to the implementation of sustainable development strategy in the context of new properties and regularities of convergent-network economy, as well as the conditions and ways in which these properties can be used to obtain the expected effects under the influence of global energy trends (energy transition 4.0) were used to answer this question.

The structure of the article includes a review of global energy market trends, as well as an analysis of transport logistics in the context of sanctions and their impact on the Russian freight transport market, and prospects for the development of transport infrastructure.

Literature review, materials and methods

The issues of spatial organization of the economy are the subject of many studies in foreign and domestic literature. A.G. Granberg, S.S. Artobolevskiy, P.A. Minakir, A.I. Tatarkin made a special contribution to the development of this area. Among foreign authors, P. Krugman, B. Hettne, F. Soderbaum, J. Harrison should be noted. The problems of sustainable development of northern regions, spatial organization of Arctic communications are considered in the works of S.A. Agarkov, M.V. Ivanova, S.Yu. Kozmenko, S.Yu. Selin, N.S. Stepanov. The issues of rational nature management, regional features of the development of mineral resources of the Arctic are discussed in the works of V.I. Bogoyavlenskiy, Kontorovich A.E., Masloboev V.A. The impact of international sanctions on hydrocarbon exports is assessed in the works of T. Babin, B. Hilgenshtok, O. Itskhoki, et al. Current problems of transport logistics under sanctions are described in detail in the works of E.A. Kulyagin, I.A. Mamedova, M.V. Tezin, and A.K. Malenkova. World trade and international maritime transport under new geo-economic risks are studied by O.N. Baburina, G.V. Kuznetsova, G.V. Podbiralina, and E.V. Heckert.

The topic of spatial organization of the Russian Arctic economy and its resource potential is reflected in a number of government documents. Thus, the new edition of the “Fundamentals of the state policy of the Russian Federation in the Arctic for the period up to 2035” (Decree of the President of the Russian Federation of 05.03.2020 No. 164) defined the main strategic priorities of the state Arctic policy, including: “...development of the Arctic zone as a strategic resource base; development of the Northern Sea Route as a national transport communication competitive in the world market; creation of conditions for the implementation of large economic projects in the Arctic zone”². The development of the resource potential of the Arctic zone is supposed to be carried out through the formation of mineral resource centers, which are understood as “...a set of deposits under development and planned for development, connected by a common existing and planned infrastructure and having a single point of shipment of extracted raw materials or products of their processing to the federal or regional transport system”³. Besides, the following is set as a strategic objective: “... the formation of a national transport communication system on the basis of the Northern Sea Route competitive on the world market and ensuring year-round shipping throughout the entire water area of the Northern Sea Route”⁴.

Theoretical understanding of the processes of spatial organization of the national economy in the applied context of the tasks of developing the Arctic space and resources leads to the conclusion that transport communications are not only a vital condition for the territorial integrity and unity of the country’s economic space, but also the material basis for the sustainable development of the resource potential of the Arctic zone, since the geographical and technological availability of transport services determines the possibilities for the implementation of economic ties within the country and beyond its borders, ensuring foreign economic relations and the depth of integration into the global economic system. The material basis of the transport network is manifested in the cost characteristics of transport services, which are reflected in the added value chains in the final price of the sale of products (goods) and affect its competitiveness in the sales markets that form the demand for energy resources.

The geographical remoteness of the Arctic Zone of the Russian Federation market from the main centers of international trade and industrial centers of the country necessitates the accelerated development of multi-level transport infrastructure, primarily the Northern Sea Route, in the

² Ukaz Prezidenta RF ot 5.03.2020 № 164 «Ob utverzhdenii Osnov gosudarstvennoy politiki Rossiyskoy federatsii v Arktike na period do 2035 goda» [Decree of the President of the Russian Federation of March 5, 2020 No. 164 "Fundamentals of the state policy of the Russian Federation in the Arctic for the period up to 2035"]. URL: http://www.consultant.ru/document/cons_doc_LAW_347129/ (accessed 01 July 2023).

³ Rasporyazhenie Pravitel'stva RF ot 13.02.2019 N 207-r (red. ot 30.09.2022) «Ob utverzhdenii Strategii prostranstvennogo razvitiya Rossiyskoy Federatsii na period do 2025 goda» [Order of the Government of the Russian Federation of February 13, 2019 No. 207-r (as amended on September 30, 2022) "On approval of the strategy for spatial development of the Russian Federation for the period up to 2025"]. URL: https://www.consultant.ru/document/cons_doc_LAW_318094/ (accessed 24 July 2023).

⁴ Ukaz Prezidenta Rossiyskoy Federatsii ot 26.10.2020 g. № 645 «O Strategii razvitiya Arkticheskoy zony Rossiyskoy Federatsii i obespecheniya natsional'noy bezopasnosti na period do 2035 goda» [Decree of the President of the Russian Federation of October 26, 2020 No. 645 "Strategy for Developing the Russian Arctic Zone and ensuring national security until 2035"]. URL: <http://www.kremlin.ru/acts/bank/45972> (accessed 24 July 2023).

concept of intermodal transport corridors connecting Arctic mineral resource centers (current and prospective) for the extraction (and processing) of fossil hydrocarbons with global and regional sales markets that shape the demand for energy resources.

The task of balanced and interconnected development of the national transport system was reflected in the Transport strategy (Decree of the President of the Russian Federation dated 10.10.2020 No. 645), where, in order to ensure the territorial integrity of the country's economic space, develop foreign economic relations and integrate the national economy into the global economic system, emphasis is placed on: "...strengthening the unified supporting transport network, uniting the most important objects of transport infrastructure for all modes of transport; the principles of the formation of a unified supporting network envisage ensuring transport accessibility to existing and promising mineral resource centers, linking them with the objects of nodal transport infrastructure, providing transport logistics of cargo delivery to industrial centers that generate the demand for mineral resources"⁵. Within the framework of this approach, the Government of the Russian Federation approved the Russian Railways development program until 2025, which includes a comprehensive plan to modernize and expand the traffic (and carrying) capacity of railway lines (more than 8.2 thousand km)⁶.

The review of state and sectoral strategic planning documents, where the main attention was paid to the problem of sustainable development of the Arctic zone, leads us to the reasonable conclusion that the economic development of the resource potential of the AZRF requires the advanced development of the Arctic system of transport communications, primarily within the framework of international transport corridors linking the centers of mineral extraction with the country's and global markets that form the demand for energy resources and other types of strategic raw materials. Since a territorially developed and spatially balanced transport network, uniting the most important objects of transport infrastructure for all types of transport and ensuring the functional unity of the national transport system, creates a supporting frame of the country's economic system, opens up opportunities for participation in the structure of world economic relations, national and global value chains.

However, it should also be emphasized that the goal-setting presented in the documents reflects the principles characteristic of the industrial and market era, but does not take into account the current realities of hypercompetitive, dynamic convergent-network economy [1, Dyatlov

⁵ Rasporyazhenie Pravitel'stva RF ot 27.11.2021 N 3363-r «O Transportnoy strategii Rossiyskoy Federatsii do 2030 goda s prognozom na period do 2035 goda» [Order of the Government of the Russian Federation of November 27, 2021 N 3363-r "On the Transport Strategy of the Russian Federation until 2030 with a forecast for the period until 2035"]. URL: https://www.consultant.ru/document/cons_doc_LAW_402052/ (accessed 26 July 2023).

⁶ Rasporyazhenie Pravitel'stva RF ot 19.03.2019 N 466-r (red. ot 13.10.2022) «Ob utverzhdenii programmy razvitiya OAO "RZhD" do 2025 goda» (s "Dolgosrochnoy programmoy razvitiya Otkrytogo Aktsionernogo Obshchestva "Rossiyskie zheleznnye dorogi" do 2025 goda") [Order of the Government of the Russian Federation of March 19, 2019 No. 466-r (as amended on October 13, 2022) "On approval of the development program of JSC Russian Railways until 2025" (with the "Long-term development program of OJSC Russian Railways until 2025")]. URL: <http://government.ru/docs/36094/> (accessed 25 February 2023).

S.A., p. 10], which are overlaid with geopolitical and technological challenges of the fourth industrial revolution [2, Schwab K.].

Thus, the formation of a new technological mode and decarbonization of the economy is accompanied by a decline in demand for raw materials, as a result of which their share in world trade is reduced (if the peak value of the share of raw materials in world exports was 31.8% (2012), by the end of 2020, it was only 23.3%)⁷. Moreover, the target indicators of long-term development of the national economy, fixed in the state strategic documents, have become significantly out of sync under the influence of sanctions, as evidenced by the analysis of global trends in the energy market (in the period from the end of 2020 to 2022, the highest growth in energy prices over the past 50 years was recorded, which doubled over these two years)⁸, as well as macroeconomic dynamics, characterizing the slowdown in economic growth after a relatively rapid post-Covid recovery in 2021 (Table 1).

Table 1

GDP in constant prices, average growth rate for the period, forecast⁹

	2010-2019	2019	2020	2021	2022	2023 *
	%	%	%	%	%	%
USA	1.7	2.2	-3.5	6.4	1.6	1.7
EU	0.7	1.6	-6.1	4.4	3.3	0.8
South-East Asia	2.9	2.9	-3	2.9	4.7	1.9
India	5	4	-8	12.5	6.8	3.8
China	6.8	5.9	2.3	8.4	3.2	5.0
Russia	2	2.2	-2.7	5.6	-2.2	1.5
World	2.2	2.3	-3.6	6	3.2	2.0
EAEU	2.2	2.4	-2.7	5.4	-1.9	0.8

Under these conditions, when raising the issue of ensuring national interests and energy security of the country, new principles and approaches of goal-setting for competitive development of the national economy, adequate to the time and modern realities of a dynamic, rapidly changing hypercompetitive economy, are required. The Nobel laureate D. North noted: "An attempt to understand economic, political, social changes ... requires the fundamental restructuring of our thinking" [3]. Therefore, the ability to think innovatively and make non-standard and effective decisions aimed at the practical implementation of the unique advantages of our country, is of

⁷ Analiticheskiy doklad EEK «O makroekonomicheskoy situatsii v gosudarstvakh-chlenakh Evraziyskogo ekonomicheskogo soyuza i predlozheniyakh po obespecheniyu ustoychivogo ekonomicheskogo razvitiya» [Analytical report of the EEC "On the macroeconomic situation in the member states of the Eurasian Economic Union and proposals to ensure sustainable economic development"]. Moscow, 2023, 46 p. URL: https://eec.eaeunion.org/upload/medialibrary/b59/Analytical_report_2022.pdf (accessed 18 August 2023).

⁸ Analiticheskiy doklad EEK «O makroekonomicheskoy situatsii v gosudarstvakh-chlenakh Evraziyskogo ekonomicheskogo soyuza i predlozheniyakh po obespecheniyu ustoychivogo ekonomicheskogo razvitiya» [Analytical report of the EEC "On the macroeconomic situation in the member states of the Eurasian Economic Union and proposals to ensure sustainable economic development"]. Moscow, 2023, 46 p. URL: https://eec.eaeunion.org/upload/medialibrary/b59/Analytical_report_2022.pdf (accessed 18 August 2023).

⁹ Source: compiled by the author on the basis of World Bank data.

* Forecast.

particular value today, when the established world economic order is literally collapsing under unprecedented sanction pressure.

In our opinion, goal-setting for competitive development requires a dynamic approach based on the implementation of geostrategic advantages using modern principles, the so-called “end-to-end” solutions (by analogy with “end-to-end” technologies) that are able to radically change the situation in existing markets or contribute to the formation of new ones. We call this a “geo-convergent principle of end-to-end solutions”, which is the basis of the concept of “geo-convergent economic feasibility” of the spatial organization of economic development of the resource potential of the Arctic zone, when it is necessary to use dynamic methods that take into account the geopolitical challenges and principles of functioning of the modern economy, which is “...a global hypercompetitive electronic-networked, socioneuromorphic economic system, which has an integrated, complex organized, distributed, multi-level structural-functional organization ...” [4, Dyatlov S.A.].

According to our opinion, the strategic goal-setting of the spatial development of the Arctic economy, which has huge natural resource potential, should be based on the principle of “geo-convergent economic feasibility” (geo-economic convergent-targeted feasibility), which means a scientifically based determination of the target priorities and directions of the rational spatial organization of the Arctic economic systems in the complementary integrity of the balanced development of the Arctic transport network, taking into account global trends in world development and based on the maximum possible use of geostrategic advantages and natural-resource potential of the territories.

This means the formation of not separate territorially-localized narrowly-specialized extractive industries, but infrastructurally equipped Arctic mineral resource centers (AMRC), included in the system of global and national economic relations, which opens up additional opportunities for participation in fuel and energy chains of added value and provides a multiplicative effect of development of remote Arctic territories [5, Agarkov S.A., Koshkarev M.V.].

This approach involves the formation of a single logistically diversified energy transport system of communications in the Arctic zone, combining the most important transport infrastructure (marine, coastal, land) for all modes of transport into intermodal energy transport corridors (IETC). The conceptual apparatus of this approach is based on the convergent concept of global economic space development [6, Beh A.A.], which is crucial for geostrategic territories, including the Arctic zone, since it allows integration into the structure of world economic relations and opens up additional opportunities for participation in global (and national) value chains. In accordance with this understanding, the essence of the principle of “geo-convergent feasibility” in relation to the spatial organization of the economy is based on the concept of geostrategic territory ¹⁰

¹⁰ Rasporyazhenie Pravitel'stva RF ot 13.02.2019 N 207-r (red. ot 30.09.2022) «Ob utverzhdenii Strategii prostranstvennogo razvitiya Rossiyskoy Federatsii na period do 2025 goda» [Order of the Government of the Russian Federation of February 13, 2019 No. 207-r (as amended on September 30, 2022) "On approval of the strategy for

and is identified with the “geostrategic use of the country’s economic power” [7, Wigell M., Vihma A., p. 606]. The prefix “geo” in this case means not only belonging to the geostrategic territory, but also indicates the goal of long-term development through the perspective of the future based on the maximum use of natural resource potential and geostrategic advantages of the territory.

This intersects with the position of V. Tsymburskiy, who understands geostrategy as “the ability to transform fundamental geopolitical images of the world into the goals and objectives of a specific player, provided with resources and scenarios” [8]. This refers to the ability to actively influence this future using economic methods to achieve strategically important results in ensuring national interests. As K. Weigel and T. Vihma note, “... geoeconomics is engaged in the promotion of geostrategic goals, not in mutually beneficial trade relations between different countries” [9]. This means that development criteria, including national development projects and programs based on geoeconomic (geostrategic) goal-setting, should be applied to geostrategic territories, which include the Arctic zone, using the geo-convergent principle of “end-to-end” solutions that we are developing.

It is also important to emphasize that the development of “end-to-end solutions” is a complex task that requires the participation of many actors from various institutional sectors (government, business, science) with different competencies, powers and capabilities, who, in the process of co-evolutionary interaction, find optimal solutions both at the planning stage and at the stage of practical implementation of goals and objectives.

Thus, from a methodological point of view, the concept of “geo-convergent economic feasibility” that we are developing, which determines the goal-setting of the spatial organization of the economic development of the resource potential of the Arctic zone, is an integrated approach to strategic planning and management aimed at the formation of systemic unity and a new convergent-integrative consistency of the Arctic economic and transport space, which includes co-evolutionary principles for organizing interaction and cooperation of multi-level interested actors (government, business, academic sector) based on a flexible combination of state, market and information-network methods of regulation and coordination.

The economic content of such a convergent-integrated consistency of the Arctic economic and transport space is the unification of the existing and created production capacities of the Arctic fuel and energy complex (AFEC) into a single reproduction complex, included in the structure of world national and interregional economic ties through the system of integrated energy transport corridors (IETC). The functional dominant of such communication systems is the formation of controlled conditions for non-discriminatory access to transport infrastructure and ensuring the possibility of barrier-free interaction between business entities along the entire value chain of extraction, transportation and marketing of Arctic energy resources. At the same time, it is considered that “the organization of integrated logistics allows for optimization of added value chains by re-

spatial development of the Russian Federation for the period up to 2025”]. URL: https://www.consultant.ru/document/cons_doc_LAW_318094/ (accessed 24 July 2023).

ducing the transport component in the cost of goods; according to expert estimates, the optimization of logistics interaction and the use of intermodal technologies leads to a reduction in the prices of transported goods by 13–15%” [10, Dinets D.A., Merkulov A.S., p. 53], since the availability of flexible infrastructure and high intermodality “allow transport corridors to be effective over short and long distances when moving both in the latitudinal (west-east) and meridional (north-south) directions” [10, Dinets D.A., Merkulov A.S., p. 54]. This is especially important in the development of energy resources in remote areas of the Russian Arctic. Such development of the energy transport space of the Arctic is seen as an opportunity to positively influence the value added chains and multifactor productivity in the development of Arctic energy resources.

In order to develop the Northern Sea Route as an international intermodal transport corridor (NSTC), the Government of the Russian Federation has approved the Plan for the development of the Northern Sea Route until 2035¹¹, which includes a set of measures (over 150) aimed at solving infrastructure problems: “... construction of the Utrenniy terminal for storage of liquefied natural gas, the Bukhta Sever oil terminal, the Yenisei coal terminal, construction of coastal and hydraulic structures to supply the Baimskoe field, creation of marine transshipment complexes for liquefied natural gas in the Kamchatka Krai and Murmansk Oblast, a hub port for organizing transit shipments in Vladivostok; there are plans to develop the Murmansk and Arkhangelsk transport hubs, build a transport and logistics hub in the seaport of Korsakov (Sakhalin), bunkering and technical service bases in the ports of Tiksi and Dikson; in order to ensure year-round navigation, it is planned to renew the icebreaker fleet, including the construction of the lead and two serial nuclear-powered icebreakers of Project 10510 LK-120 “Lider”¹² and auxiliary ice-class rescue vessels (46 vessels)”.

It is obvious that the solution of large-scale tasks for the development and modernization of the NSR, including “ensuring year-round navigation (up to 8 months by 2024 and year-round by 2030)”¹³, will become the main driver for attracting foreign carriers to the NSR and its use as an international transit route, including within the framework of the China’s “Polar Silk Road” initiative. The implementation of this project on the basis of mutually beneficial cooperation between both countries, Russia and China, appears to be very promising. Thus, according to B. Heifetz, “the fundamental interests of Russia and China in the development of the Arctic coincide, and the existing differences in positions regarding the priorities of multilateralism or national sovereignty are not acute” [11, Heifetz B.A., p. 69].

¹¹ Rasporyazhenie Pravitel'stva RF ot 1 avgusta 2022 g. N 2115-r «Ob utverzhdenii plana razvitiya Severnogo morskogo puti na period do 2035 g.» [Order of the Government of the Russian Federation of August 1, 2022 No. 2115-r "On approval of the plan for the development of the Northern Sea Route for the period up to 2035"]. URL: <http://government.ru/docs/46171/> (accessed 31 July 2023).

¹² Icebreakers of Russia. Nuclear shipbuilding. URL: [https://www.tadviser.ru/index.php/Статья:Ледоколы_России_\(Атомное_судостроение\)](https://www.tadviser.ru/index.php/Статья:Ледоколы_России_(Атомное_судостроение)) (accessed 14 July 2023).

¹³ Rasporyazhenie Pravitel'stva RF ot 27.11.2021 N 3363-r «O Transportnoy strategii Rossiyskoy Federatsii do 2030 goda s prognozom na period do 2035 goda» [Order of the Government of the Russian Federation of November 27, 2021 No. 3363-r "On the Transport Strategy of the Russian Federation until 2030 with a forecast for the period until 2035"]. URL: https://www.consultant.ru/document/cons_doc_LAW_402052/ (accessed 26 July 2023).

According to the plans of the Government of the Russian Federation, the volume of cargo traffic along the Northern Sea Route will be 80 million tons (by 2024), 150 million tons (2030), 220 million tons (2035). It should be emphasized that these volumes are calculated on the basis of energy resources that are planned to be extracted in the Arctic during the development of new gas, oil and coal deposits, which do not actually exist yet. Therefore, the development of the Northern Sea Route as an international transport corridor is a key condition not only for the life support and development of the Arctic regions (territories), but also from the perspective of national energy security, since it allows for activation of Arctic subsoil use projects. The integrated development of the IETC will make it possible to connect the cargo flow origin points (MRCs) with the facilities of the nodal marine and land transport infrastructure, opening up access to energy resource sales markets. This will provide an opportunity to diversify and combine possible options of transport routes for fossil hydrocarbons extracted in the Arctic, depending on regional economic conditions, price for energy resources and geopolitical situation in the world.

The relevance of the approach we are working out to the development of the Arctic energy transport space on the basis of “geo-convergent economic feasibility” is obvious, since the key factor constraining the development of highly liquid fuel and energy resources of the Arctic is the insufficiently effective spatial organization of the Arctic transport network. The geographical remoteness of the AZRF market from the main centers of international trade and industrial centers of the country necessitates the accelerated development of a multi-level transport infrastructure, primarily the Northern Sea Route. Therefore, the prospective development of fossil fuel energy resources requires the formation of mineral resource centers (MRCs) included in the structure of global economic fuel and energy relations rather than separate territorially localized, highly specialized centers of development. This will open up access to participation in global, national, inter-regional value chains, which will ensure a multiplier effect of the development of remote Arctic territories.

In accordance with this goal-setting system for the development of conceptual approaches to the spatial organization of an integrated system of Arctic communications to ensure the prospective development of Arctic hydrocarbons, it is necessary to understand the main trends in the global energy market.

Analytical framework of the study: geopolitical context

Arctic agenda in the era of global change: global energy market trends

Global demand for hydrocarbons is the main driver of development of the Arctic economy, rich in natural resources, which are estimated by experts at more than 85.1 trillion m³ of combustible natural gas, 17.3 billion tons of oil (including gas condensate), 7162.7 million tons of coal (3.6% of the explored coal reserves in Russia as a whole), as well as other types of minerals (ferrous, non-ferrous, rare, rare earth, noble metals (gold, silver, platinum group metals); apatite ores, diamonds), which are the strategic reserves for the development of the mineral resource base of the Russian Federation. Table 2 presents data on the main types of hydrocarbon (liquid, solid)

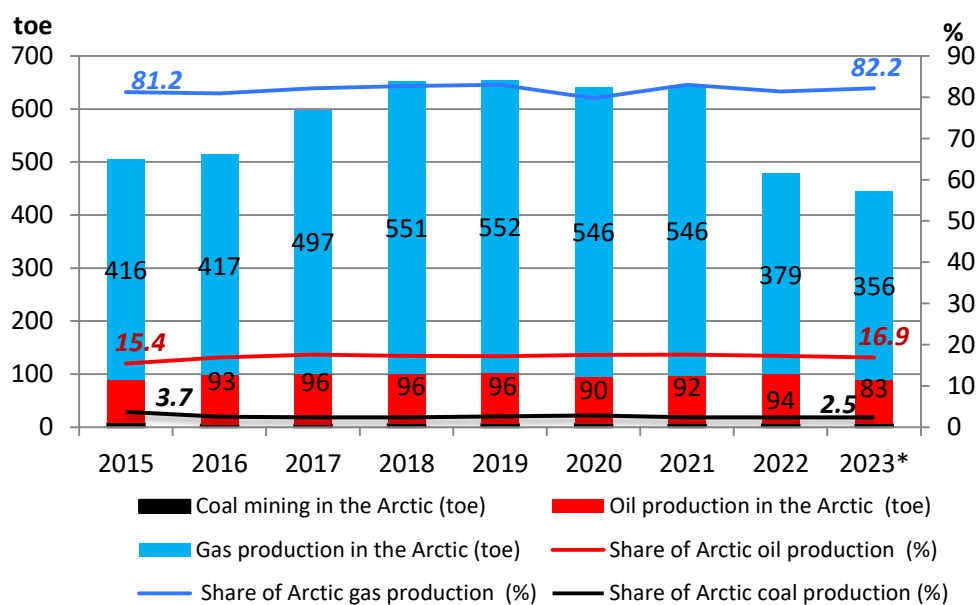
minerals in the Arctic zone of Russia in the specific ratio of reserves and production to the volume of reserves and production of the Russian Federation.

Table 2

Main types of confirmed reserves of hydrocarbon minerals of the Arctic zone of Russia¹⁴

Group and type of mineral	Number of deposits	Units	Reserves (A, B, C ₁)	% of reserves in the RF	Production in 2021	% of production in the RF
Crude oil	282	mln t	3879.5	20.8	69.3	13.2
Combustible gases (free gas)	204	bln m ³	37417.5	76.3	607.5	87.4
Combustible gases (dissolved gas)	264	bln m ³	390.7	25.2	9.2	1.3
Condensate	157	mln t	1352.2	58	20.6	71.4
Coal	45	mln t	7 162.7	3.6	8.1	2.0

Already today, the Arctic zone provides for the production of more than 80% of natural gas and 17% of oil in the Russian Federation¹⁵. Fig. 1 presents data illustrating the dynamics of fossil hydrocarbon production (oil, gas, coal) in the Arctic zone for the period from 2015 to 2022 with a forecast indicator until the end of 2023.

Fig. 1. Extraction of fossil hydrocarbons in the Arctic zone¹⁶.

It is worth noting that the development of Arctic hydrocarbon reserves is not only a high-tech, but also a capital-intensive process that determines the innovative development of a number

¹⁴ Source: compiled by the author on the basis of the Reference on the state and prospects of the use of mineral resource base of the Arctic zone of the Russian Federation as of March 15, 2021. URL: <https://www.rosnedra.gov.ru/data/Fast/Files/202104/45bb8bcc7b844220954744c0149a86f4.pdf> (accessed 16 August 2023).

¹⁵ Ukaz Prezidenta Rossiyskoy Federatsii ot 26.10.2020 g. № 645 «O Strategii razvitiya Arkticheskoy zony Rossiyskoy Federatsii i obespecheniya natsional'noy bezopasnosti na period do 2035 goda» [Decree of the President of the Russian Federation of October 26, 2020 No. 645 "Strategy for Developing the Russian Arctic Zone and ensuring national security until 2035"]. URL: <http://www.kremlin.ru/acts/bank/45972> (accessed 26 June 2023).

¹⁶ Source: compiled by the author based on official statistics and the Analytical Report of the DTS Platforma "Difficult" Oil: Challenges and Prospects. 2018, 68 p. URL: <https://pltf.ru/2019/03/05/trudnaja-neft-vyzovy-i-perspektivy/> (accessed 20 August 2023).

of industries and territories, forming competitiveness clusters in the Arctic zone. Therefore, the plans for the development of the Arctic resource potential should be considered in the context of global trends of world energy markets development.

Global trends in the world energy market

Until recently, Russia positioned itself as an energy superpower, and there were good grounds for this: "... the country provided 10% of the world's primary energy production, 5% of the world's primary energy consumption, and about 20% of the world's hydrocarbon trade. Russian exports accounted for 11% of the global oil and oil product exports, 25% of gas, and 16% of coal" [12, Porfiryev B.N., p. 51]. Today, Russia continues to be an important player in the world market of fossil energy resources, although its position has been greatly undermined by sanctions. According to the Deputy Prime Minister of Russia A. Novak, "... despite pessimistic forecasts, the Russian energy industry copes with the restrictions with dignity and demonstrates stable work, and, in spite of the transformation of global energy markets, continues to develop" [13].

Against the backdrop of sanctions pressure, the price situation on world energy markets for the main groups of fossil hydrocarbons (oil, gas, coal) was characterized by high volatility, and prices reached their maximum by the summer of 2022 (Fig. 1). The growth in prices for Brent crude oil was 118 (+43%) US dollars per barrel (USD/Bbl); for gas — 9.5 (+135%) US dollars per million British thermal units (USD/MMBtu), which corresponds to 340 US dollars per 1 thousand m³¹⁷; for coal — 450 (+150%) US dollars per ton (USD/T) compared to the level of early 2022 (83 USD/Bbl, 4 USD/MMBtu, 180 USD/T, respectively) (Fig. 1).

After the closure of the Russian gas stream, which prompted the EU to switch to LNG, the supply of which overtook pipeline gas for the first time, prices in Europe soared by 160% and reached a record 450 euros per megawatt-hour (euro/MWh), which caused a rush for coal, the annual consumption of which exceeded 8 billion tons, and the price reached 450 USD/T. Fig. 2 shows graphs characterizing the current dynamics of world prices for the main energy resources (oil, gas, coal).

¹⁷ In Russia, gas prices are calculated in US dollars per thousand cubic meters of gas (USD/Tcm), in Europe — in euros per megawatt hour (euro/MWh), in the US and Asia prices are indicated in US dollars per million British thermal units (USD/MMBtu). To convert USD/MMBtu to USD/Tcm, the value in MMBtu must be multiplied by a coefficient of 35.8.

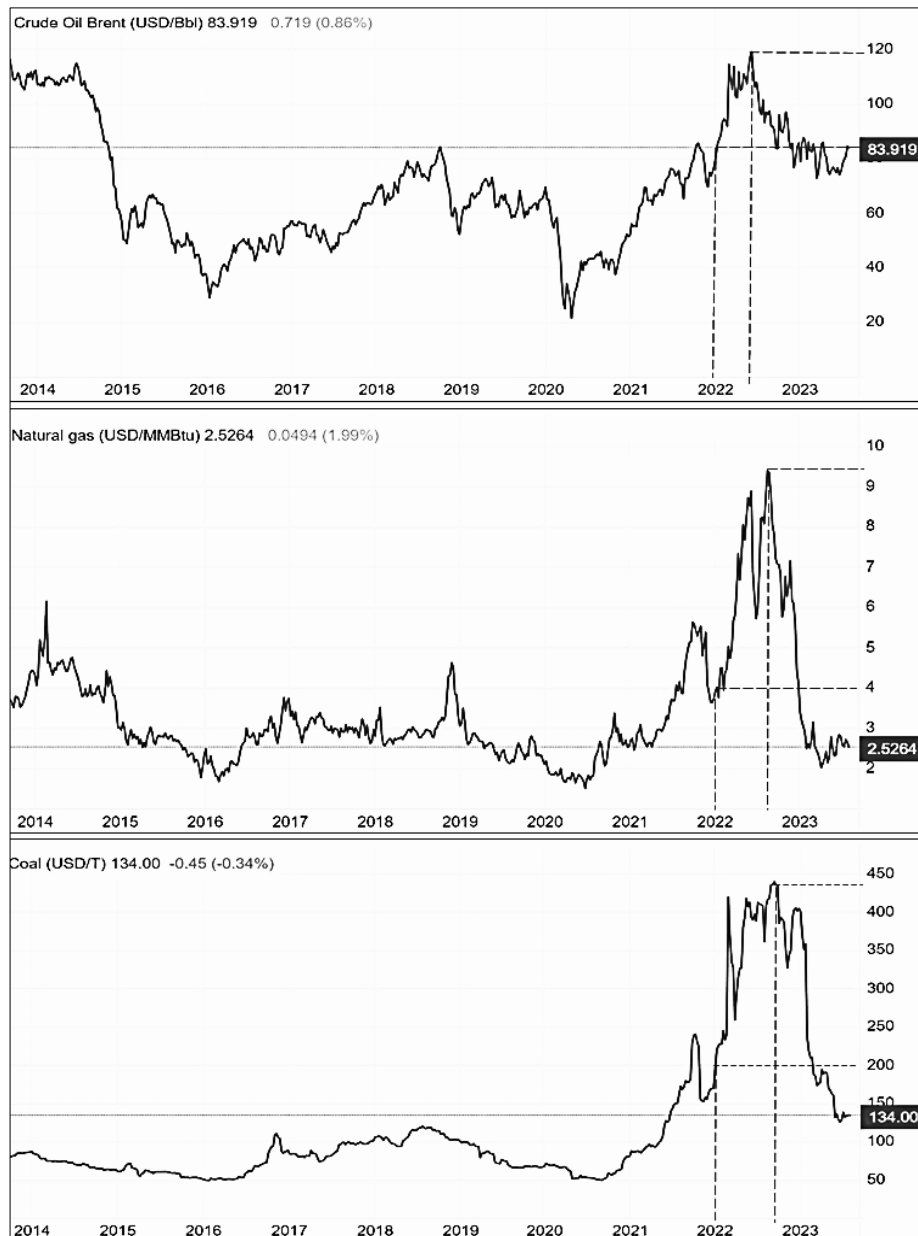


Fig. 2. Dynamics of world prices for the main energy resources (oil, gas, coal) for a ten-year cycle from 2014 to 2023 ¹⁸.

The graphs clearly demonstrate the high volatility and instability of the world energy market. Thus, according to L. Grigoriev, "... today we are witnessing the end of the "rational approach" to the oil industry around the world — geopolitics now rules the energy sector" ¹⁹. However, such a turning point is coming in almost all sectors of the fuel and energy complex. For Russian exporters of fossil energy resources, this will require a profound transformation of transport logistics with a redistribution of commodity flows from the west to the east, where there is great potential for growth in demand for Russian hydrocarbons from Asia-Pacific countries, and primarily — for oil.

¹⁸ Source: Tradingeconomics. URL: <https://ru.tradingeconomics.com> (accessed 15 August 2023).

¹⁹ Mirovoy rynek nefti: novye pravila igry dlya Rossii [Global oil market: New rules of the game for Russia]. *Energeticheskie trendy [Energy Trends]*, 2022, no. 109, 16 p. URL: <https://www.eprussia.ru/market-and-analytics/7543052.htm> (accessed 21 July 2023).

Transport

Due to the geographical peculiarities and the large latitudinal and meridional extent of the territory of Russia, the integrated and balanced development of the transport system is of key importance for ensuring the territorial integrity of the country and regions, for foreign economic relations, and the integration of the national economy into the world economic system. In the current geopolitical conditions, it is extremely important to analyze and assess the impact of the global transformations on the domestic transport industry.

Transport communications are the material basis for economic growth, as evidenced by the close relationship (correlation) of cargo turnover indicators with industrial production and GDP (Fig. 3). The correlation between changes in cargo turnover and changes in industrial production and GDP is 86% and 73%, respectively (Fig. 3). The numerical value of the correlation coefficient indicates the degree and nature of dependence of freight turnover of all transport on the growth of industrial production and the country's GDP.

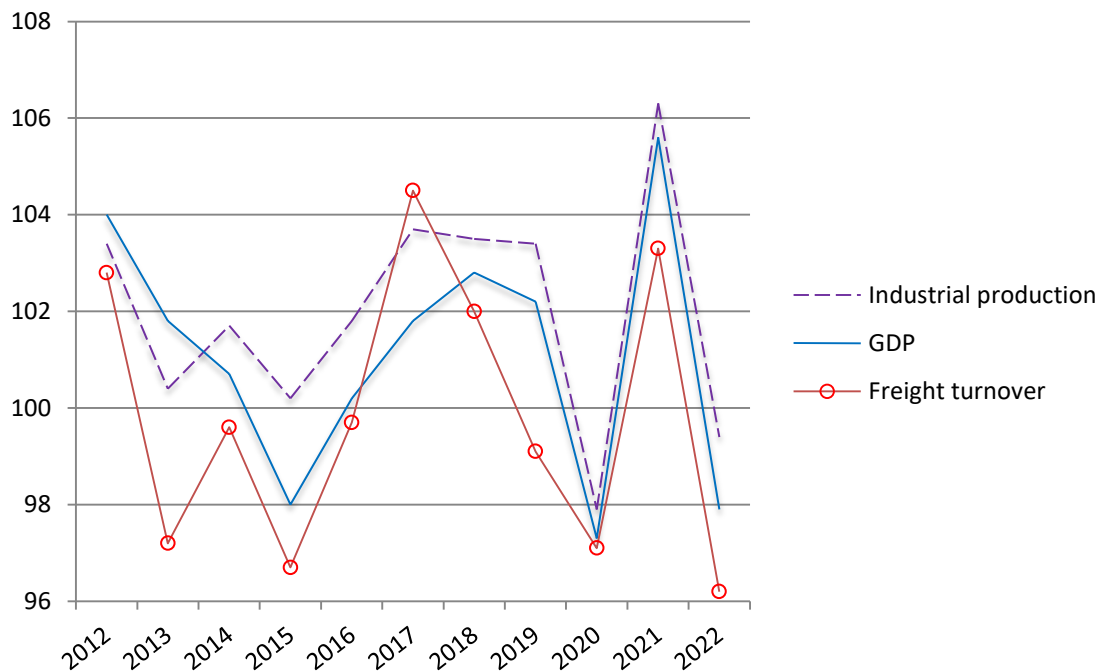


Fig. 3. Dynamics of growth rates of industrial production and freight turnover for all types of transport for the period 2012–2022²⁰.

²⁰ Source: compiled by the authors based on data from Rosstat and the Ministry of Transport of the Russian Federation.

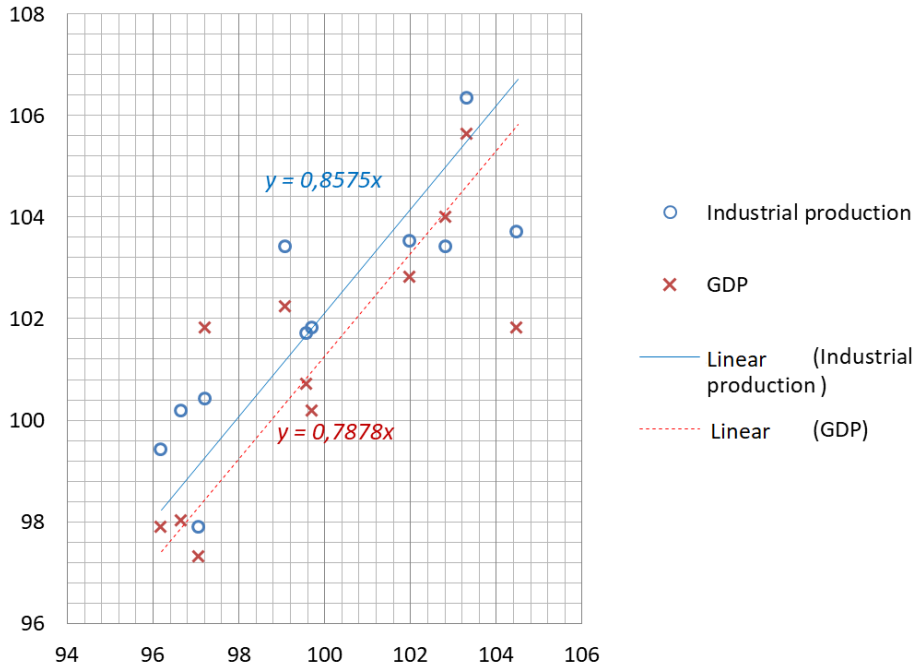


Fig. 4. Correlation between cargo turnover dynamics and industrial production and GDP ²¹.

The sanctions against Russia have become a serious test of sustainability for the entire transport industry. Total Russian cargo turnover by all modes of transport in 2022 decreased by 5% compared to 2021 (see Fig. 3). This is due to a significant decrease in freight traffic in the western direction; at the same time, as it turned out, the Russian transport system was unable to redirect this volume to the east due to a number of infrastructure limitations. The structure of freight transportation and cargo turnover in Russia by all modes of transport for the period 2021–2022 is presented in Table 3.

Table 3

Structure of freight transportation and cargo turnover in Russia by mode of transport, 2021–2022, billion t/km, year ²²

	Cargo turnover			Structure of freight transportation		
	2021	2022	changes, %	2021	2022	changes, %
Railway	2 639.4	2 637.8	-0.1	46.3	47.5	1.19
Vehicular	285.3	290.6	1.9	5.0	5.2	0.23
Maritime	43.9	44.7	1.8	0.8	0.8	0.03
Inland waterway	70.6	64.9	-8.1	1.2	1.2	-0.07
Air	9.2	2.5	-72.8	0.2	0.0	-0.12
Pipeline**	2 653.0	2 514.8	-5.2	46.5	45.3	-1.26
Total	5 701.4	5 555.3	-2.6	100.0	100.0	0.00

Among the main problems, experts mention the limited traffic (and carrying) capacity of rail transport, in particular — the Eastern Polygon of Russian Railways (the Baikal-Amur and Trans-Siberian railway lines) [14, Pekhterev F.S.; 15, Olentsevich V.A., Vlasova E.V.; 16, Kocheshnov A.S., Stoyanova I.A.], lack of rolling stock, poor development of the coastal system of transport com-

²¹ Source: compiled by the authors based on data for the period 2012–2022 (see Fig. 3).

The numerical value of the correlation coefficient indicates the degree and nature of the dependence of freight turnover of all transport on the growth of industrial production and the country’s GDP.

²² Source: compiled by the authors based on data from Rosstat and the Ministry of Transport of the Russian Federation.

munications and port infrastructure [17, Baburina O.N., Kuznetsova G.N. et al.], their low integration into the supporting trunk infrastructure, as well as the presence of numerous “bottlenecks” on transport routes and junctions of particular modes of transport. All this is a major obstacle to the organization of intermodal transport corridors, the development of which is aimed at ensuring effective access of Russian enterprises and organizations to foreign markets [10].

In this context, it is necessary to take into account that the tasks of the Eastern Polygon of Russian Railways (located within the boundaries of four railways — Far Eastern (FERW), East Siberian (ESRW), Trans-Baikal (TBRW) and Krasnoyarsk (KrasRW), the modernization of which has been ongoing since 2013) include the uninterrupted functioning of the main trans-Eurasian transport corridors that ensure cargo transportation from the western regions of Russia and industrial centers of the Urals and Siberia in the direction of the seaports of the Far East and further to the sales markets of the Asia-Pacific region (APR); through the railway crossings of the Far East using the southern sector of the Trans-Siberian Railway and the Zabaikalsk railway station to the industrial centers and seaports of China; routes through Mongolia [15, Olentsevich V.A., Vlasova N.V.]. Besides, the role of the Eastern Polygon is significantly increasing within the framework of the Northern Sea Route development as an inland sea route and an international transport corridor, designed to ensure the economic development of highly liquid hydrocarbon energy reserves, as well as international cargo transit (bulk, liquid, container).

China is very interested in the Northern Sea Route as an international transit route. China’s state transport strategy “One Belt, One Road” envisages a “blue economic corridor” leading to Europe via the Arctic Ocean, called “Polar Silk Road”. It is no secret that China is constantly striving to increase its presence in the Arctic by building up its own scientific, technical, technological and economic potential [18, Kobzeva M.A., p. 972], improving national state Arctic regulation and increasing its international influence in the Arctic. The highest technological level of the PRC is confirmed by the joint Chinese-Norwegian project to build the first Chinese-made deep-water semi-submersible drilling platform, “...which was launched in 2015 in Yantai. The platform is designed for 100 years of operation in the harsh Arctic conditions and is capable of operating at a maximum depth of 8000 m” [18, Kobzeva M.A., p. 972]. This indicates that the Arctic is a strategic priority of China’s foreign economic policy; at the same time, according to B. Kheyfets, “...the existing divergences in Russian-Chinese positions on the priorities of multilateralism or national sovereignty are not acute; a common interest in the development of the Northern Sea Route, which is viewed by China as an important transit route of the “One Belt, One Road” project, makes it possible to seek reasonable compromises and mutually beneficial solutions for both countries” [11, p. 85]. The data presented in Table 4, characterizing cargo transshipment at Russian seaports by basins, clearly demonstrate the growing role of the Northern Sea Route in ensuring the transport logistics of cargo flows.

Table 4

*Transshipment of cargo at Russian seaports by basins, 2021–2022*²³

Marine basins	2021	2022	2022 to 2021
	mln t	mln t	in %
Arctic basin (NSR)	94.2	98.5	4.4
Baltic basin	255.2	245.6	-3.9
Azov-Black Sea basin	258.1	263.6	2.1
Caspian basin	6.8	6.0	-13.9
Far Eastern basin	224.4	227.8	1.5
Total	838.6	841.5	0.3

Thus, the review of literature, strategic documents of state and industry importance, analysis of current trends in the global energy market (including those related to anti-Russian sanctions) allowed to draw a number of important conclusions that formed the basis for the concept of spatial organization of the integrated system of Arctic communications based on the principle of “geo-convergent expediency”.

1. In the context of formation of a new world order, increasing economic turbulence, including due to the aggressive policy of Western countries towards Russia, risks of uncertainty that threaten the economic security of the country have arisen and continue to affect the world energy market.

2. In order to improve international competitiveness, Russia should make maximum use of its geostrategic advantages related to territorial and transit opportunities and natural resource potential.

3. In order to maintain its leading position in the global energy markets, Russia needs a comprehensive solution to two strategically important tasks that have sectoral and regional specifics: firstly, increasing the renewable potential of the fuel and energy complex through technological modernization of existing production capacities and creation of new ones, including the involvement in active economic turnover of new deposits of fossil hydrocarbons of the Arctic zone, capable of meeting the needs of the country and the world for many years to come; secondly, the formation of a unified logistically diversified energy transport infrastructure integrated into the structure of global and regional economic relations.

4. The national transport system in its current state — both as a whole and in a number of key segments of multi-level infrastructure (marine, coastal, land) — is not able to fully and at the required quality level satisfy the growing demand for freight transportation, especially in the eastern direction, where the main demand for Russian fuel and energy resources is currently formed.

The above-mentioned conditions necessitate an analysis of the economic space in the interrelation of factors determining the natural resource potential of territories and the level of development of energy transport infrastructure, providing access to sales markets that shape the demand for fossil energy resources.

²³ Source: compiled by the authors based on data from the Ministry of Transport of the Russian Federation.

Results and discussion

Geographical and technological accessibility of transport services in the Russian Arctic is a critical condition for ensuring its territorial integrity and the unity of the national economic space. A well-developed transport system creates opportunities for the socio-economic development of remote territories, including those of geostrategic importance in terms of mineral reserves, the involvement of which in economic turnover is a strategically important task for ensuring the country's energy security.

Within the framework of our approach to the spatial organization of the Arctic economic space based on the principle of “geo-convergent economic feasibility”, which is understood as the balanced development of the Arctic transport communications system (ATCS) in the complementary integrity of the advanced development of the backbone infrastructure (marine, coastal, continental), allowing to remove the existing restrictions of transport logistics to ensure the possibility of complex-diversified supply of minerals extracted in the Arctic to industrial centers that generate demand for energy resources. This requires the creation of a comprehensive system of intermodal energy transport corridors (IETC), included in the value chains of fuel and energy markets, linking the production process of Arctic hydrocarbon extraction with industrial centers that form the demand for fuel and energy resources.

Fig. 5 presents a conceptualization of the spatial organization of the prospective development of the natural resource potential of the Russian Arctic, illustrating, within the framework of the “geo-convergent economic feasibility” approach we are developing, a system of intermodal energy transport corridors (IETC) integrated into the structure of global and regional economic relations, uniting the most important objects of transport infrastructure for all types of transport to ensure the functional unity of the national transport system.

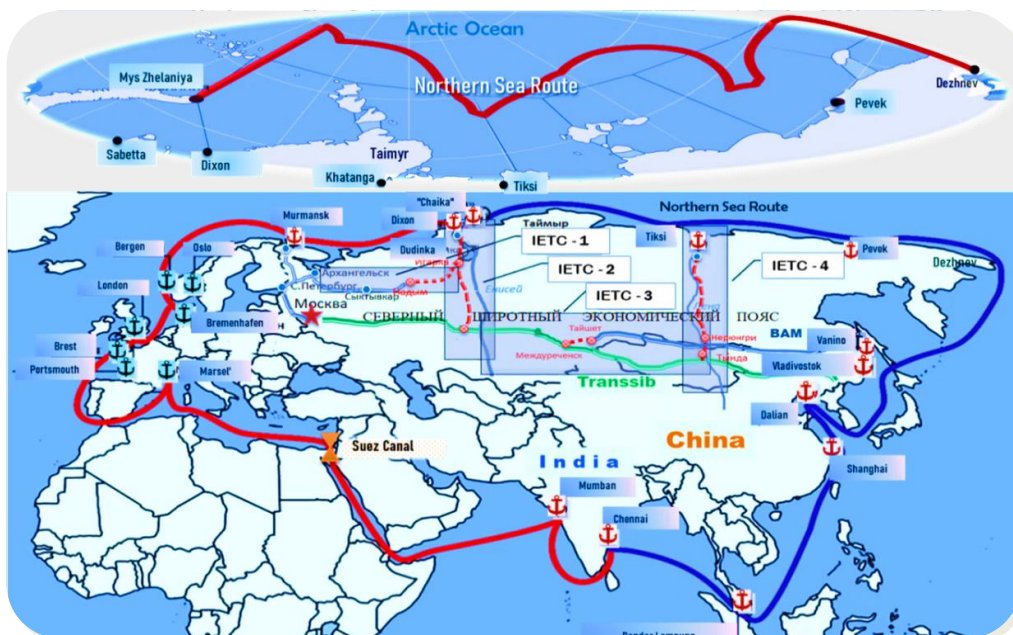


Fig. 5. Conceptualization of the spatial organization of the energy transport space of the Arctic zone²⁴.

²⁴ Source: compiled by the authors based on government and industry strategic documents.

IETC 1 (Northern Latitudinal Route) is an integrated energy transport corridor connecting the Northern Sea Route via the northern ports (Dudinka and Dikson) with the key railway lines linking the Tyumen–Nadym line and the northern latitudinal line starting from Arkhangelsk. IETC 2 (“Yenisei Siberia” project) is an integrated energy transport corridor connecting the Northern Sea Route via the northern ports (Dudinka, Dikson) with the Northern latitudinal economic belt (Transsib, BAM). IETC 3, 4 (“Eastern Polygon” project) are integrated energy transport corridors 3 and 4, which connect the Northern Sea Route via the sea ports of Dikson and Tiksi with BAM and the Trans-Siberian Railway, forming a subarctic bridge with the Northern latitudinal economic belt of Russia.

The approach presented in Fig. 5 develops the concept of international transport corridors “west–east” and “north–south”, the development of which is aimed at ensuring effective access of Russian enterprises and organizations to foreign markets. In this context, the development of the Northern Sea Route as an international transport route is associated with the development of marine and port infrastructure in the Arctic basin, including the construction of modern icebreakers and ice-class transport vessels to ensure year-round navigation and delivery of cargo to markets, which is an important factor in strengthening Russia’s position in the energy markets of the Asia-Pacific region as a guaranteed supplier of energy resources. For these purposes, it is necessary for the Northern Sea Route to be deeply integrated into the country’s transport and logistics system and to connect railway and road highways, as well as Siberian river routes. For full-fledged intermodal (multimodal) servicing of cargo transportation, technical and technological modernization of all major seaports of the Arctic Basin is necessary (Fig. 6).



Fig. 6. Seaports of the Arctic Basin ²⁵.

Such a balanced and territorially connected spatial organization of the Arctic transport network, uniting the most important transport infrastructure facilities for all types of transport

²⁵ Source: compiled by the authors based on Polar Trans data. URL: <https://polartrans.ru/ports-of-the-arctic-basin.html> (accessed 13 August 2023).

and ensuring the functional unity and integrity of a single national transport system integrated through a system of intermodal transport corridors into the global economic space, will provide the opportunity to optimize (and diversify) the supply of Arctic fuel and energy resources to global and regional sales markets that generate demand for energy resources. The availability of flexible infrastructure and high intermodality, allowing the use of several modes of transport to build the most optimal route, will ensure maximum efficiency of transport services in the directions “west–east” and “north–south”. The organization of integrated logistics allows optimizing value chains by reducing the transport component in the cost of the final product [10], which is especially relevant in the struggle for a share in the energy markets of the Asia-Pacific region, where price competition is very high.

We see such geo-convergent organization of the Arctic energy transport space as an opportunity to ensure sustainable development of the resource potential of the Russian Arctic.

Conclusions

1. Arctic fossil hydrocarbons play an important role in ensuring the country’s energy security; their involvement in active economic turnover will contribute to the long-term energy sustainability of the national economy and strengthen Russia’s position in the global energy sector.

2. One of the most significant problems hindering the industrial development of the resource potential of the Arctic zone, where the world’s largest reserves of fossil hydrocarbons are concentrated, is the imbalance in the development and technical and technological backwardness of the Arctic transport system both as a whole and in a number of key infrastructure segments (marine, coastal, land), as well as low integration into the logistics system of global and national economic relations that form value-added chains.

3. The geographical remoteness of the AZRF market from the main centers of international trade and industrial centers of the country necessitates the accelerated development of a multi-level transport infrastructure, primarily the Northern Sea Route, in the concept of intermodal transport corridors connecting the Arctic mineral resource centers (existing and prospective) for the extraction (and processing) of fossil hydrocarbons with global and regional sales markets that form the demand for energy resources.

4. On the basis of the obtained research material and the principle of “geo-convergent economic feasibility” to ensure the sustainable development of the fuel and energy potential of the Arctic zone, developed by the authors, a concept of spatial organization of the Arctic energy transport communications system for efficient, reliable and environmentally safe transport support of the sustainable development of fossil hydrocarbons in the Arctic is proposed.

5. This approach means the formation of not separate territorially localized highly specialized extractive industries, but infrastructure-equipped Arctic mineral resource centers (AMRC), included in the logistics structure of global and national economic ties, which opens up additional

opportunities for participation in fuel and energy value chains and will ensure a synergistic effect in the development of remote Arctic territories.

6. Achievement of the set goal implies the formation of a single logistically diversified energy transport system of communications in the Arctic zone, combining the most important objects of transport infrastructure (sea, coastal, land) for all types of transport into intermodal energy transport corridors (IETC); the availability of flexible infrastructure and high intermodality of the transport network, allowing the use of several types of transport, will optimize logistics of traffic flows in the directions “west–east” and “north–south” [10].

7. The Northern Sea Route, which is the main sea transport route in the Arctic zone, should be deeply integrated into the country’s transport and logistics system to connect seaports, railways and highways, as well as river routes of Siberia into a single logistics network; for full-fledged intermodal (multimodal) servicing of cargo transportation, it is necessary to technically and technologically modernize the main seaports of the Arctic Basin, eliminate infrastructure restrictions in the traffic (and carrying) capacity of rail transport, and build a road transport communication network linking the Arctic territories with economic centers.

8. The proposed approach will accelerate the economic development of the fuel and energy potential of the Arctic, increase the multifactor productivity of the value chains “production — transportation — sales”; it will facilitate the transition from a point (focal) model of economic development of the Arctic resource potential to a geo-convergent one, which will open up additional opportunities for integration into the system of global and national economic ties that form long chains of added value creation; this will also ensure a synergistic effect in the development of remote Arctic territories.

9. The listed synergetic effects of sustainable development of the Arctic fuel and energy resources based on the principle of “geo-convergent economic feasibility” allow asserting that this approach can be included in the theoretical and methodological basis of strategic goal-setting, determining scientifically substantiated target priorities and directions for the rational organization of the Arctic economic system in the complementary integrity of the balanced development of an integrated system of energy transport communications included in the logistics structure of global and national economic ties.

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