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Transport Infrastructure of the Western and Central Arctic Regions of the Russian Federation: Analysis and Prospects *

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Abstract. For the sustainable development of territories, it is important to pay special attention to transport infrastructure, which directly affects the level of efficiency and competitiveness of the state (region) economy and forms the creation of a rational logistics system. Transport activates the work of the real sector of the economy (economic entities), carries out freight and passenger transportation, and is one of the significant sectors of the national economy, providing employment to the population, tax revenues to the budget system of the Russian Federation, investment attraction and GDP growth. The Arctic zone of the Russian Federation is strategically significant from the perspective of geopolitics and geo-economics in the modern world (12–15% of the country's GDP, 25% of exports). In the article, the object of study is the Western and Central Arctic of the Russian Federation, including six of the eight subjects belonging to the Arctic territories. The methodological framework of the study is based on review and analysis of regulatory documents and scientific literature that determine trends and prospects for improving territories within the development of transport infrastructure. The information base is regional statistical information. The study and assessment of the level of transport infrastructure development of the studied region is carried out. Economic analysis is conducted using statistical methods that allow identifying the main reasons associated with the ineffective operation of transport infrastructure at the meso-level. Tables and figures are used to visualize the research results. This makes it possible to conduct a comparative analysis of territories by the level of transport infrastructure development, to identify leaders and outsiders to substantiate proposals for stimulating key areas, basing on the review of regulatory documents aimed at increasing the efficiency of functioning of this area.
Keywords: *transport, transport infrastructure, indicators, assessment, analysis, problems, prospects, Arctic zone of the Russian Federation*

Introduction

Sustainable development of the state (region) economy is determined by many factors, one of which is the effective improvement of the transport system. Transport infrastructure is becoming the main indicator that allows competing at the level of national and global economies. This is evidenced by the main indicators of the transport industry: the share of gross added value

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in the economy of the Russian Federation is on average 6%, the share of investments in fixed assets is 16.2%, the share of the number of employees is 7.6% [1].

The aim of the research is to study and assess the level of development of transport infrastructure in the regions of the Western and Central Arctic of the Russian Federation.

To achieve this goal, the authors defined the following tasks:

- to consider theoretical and practical aspects of the problem on the basis of a review of literary sources (regulatory legal documents and works of modern researchers);
- to conduct a comparative analysis of the transport infrastructure of the Western and Central Arctic of the Russian Federation and to identify leaders and outsiders;
- to study the prospects for the development of transport infrastructure of the Western and Central Arctic of the Russian Federation.

Let us turn to the object of study. In modern economic conditions, special attention is paid to the Arctic zone of the Russian Federation, which contains eight regions, three of which are fully included in its composition [2]. The population of the territory is 1.8% of the total population of the Russian Federation, the total area of the Arctic territories is 5 million km^2 (29.2% of the total area of the Russian Federation). The macro-region is characterized by difficult climatic conditions for living. The Arctic of the Russian Federation has the lowest population density, the values vary from 0.1 to 4.9 people per 1 km^2 (in Russia as a whole, the density is 8.6 people per 1 km^2) [3], the local nature of territory development and industrial and economic activity, underdeveloped social and transport infrastructure, the economy's focus on hydrocarbon extraction and export of resources to other constituent entities of the Russian Federation and beyond, and dependence on supplies of vital goods. Geographically, the Arctic zone of the Russian Federation is divided into the Western, Central and Eastern Arctic. It should be noted that active economic activity is mainly concentrated in the Western Arctic, including the Murmansk Oblast, the Nenets Autonomous Okrug, partially the Arkhangelsk Oblast, the Republic of Karelia and the Komi Republic.

Interest in the Arctic is noted not only by the Russian Federation, but also by many foreign countries that monitor the region, assessing the natural, economic and business potential of the territory [4].

Dynamic growth of the Arctic territories is impossible without a developed transport infrastructure, which contributes to the effective functioning of the region's economy. For this pur-

[1] Transport of Russia. 2022: Statistical collection. Rosstat. Moscow, 2022, p. 101.
[2] Ukaz Prezidenta RF «O sukhoputnykh territoriyakh Arkticheskoy zony Rossiyskoy Federatsii» ot 02.05.2014 № 296 (red. ot 05.03.2020) [Decree of the President of the Russian Federation "On the land territories of the Arctic zone of the Russian Federation" dated May 02, 2014 No. 296 (as amended on March 05, 2020)]. URL: https://base.garant.ru/70647984/ (accessed 16 January 2022).
[3] Population density of the Russian Federation. URL: http://www.gis.gks.ru/StatGis2015/Viewer/?05285969-ec60-e911-8f04-c52edb349072 (accessed 16 January 2023).
[4] Arctic Climate Change Update 2021: Key Trends and Impacts. Summary for Policy-makers. URL: https://www.amap.no/publications?keywords=&type=9 (accessed 16 January).

pose, the state should carry out systematic work on the development of regulatory documents and their subsequent implementation.

Transport infrastructure in the Arctic zone of the Russian Federation: review of regulatory documents

Considering the importance of the Arctic, a number of documents were developed at the federal level that define the state policy of the Russian Federation for the time period up to 2035[5], the strategic development of the territory[6], and the intensification of economic activity in the Arctic zone[7].

Within the framework of the Strategy for the Development of the Arctic Zone of the Russian Federation, the state program "Socio-economic development of the Arctic zone of the Russian Federation" is being implemented[8]. The document contains information on the assessment of the state of development of the Arctic zone, goals, objectives and measures aimed at solving the identified problems associated with the development of the region. The document sets target indicators for the development of the territory and ensuring national security until 2035. The target value of the indicators is set for the periods up to 2024, up to 2030, up to 2035 by the Decree of the President of the Russian Federation[9].

The target indicator for the development of transport infrastructure in the Arctic zone includes the volume of cargo transportation in the waters of the Northern Sea Route (in 2024 — 80 million tons, in 2030 — 90 million tons, in 2035 — 130 million tons).

Transport infrastructure is a catalyst for the country's efficient economy, which is why the Government of the Russian Federation has developed the following documents: Transport Strate-

[5] Ukaz Prezidenta RF «Ob Osnovakh gosudarstvennoy politiki Rossiyskoy Federatsii v Arktike na period do 2035 goda» ot 05.03.2020 № 164 [Decree of the President of the Russian Federation "On the Fundamentals of the state policy of the Russian Federation in the Arctic for the period up to 2035" dated March 05, 2020 No. 164]. URL: https://www.garant.ru/products/ipo/prime/doc/73606526/ (accessed 16 July 2023).

[6] 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"] (as amended on November 12, 2021)]. URL: https://www.garant.ru/products/ipo/prime/doc/74710556/ (accessed 16 July 2023).

[7] Federal'nyy zakon ot 13.07.2020 № 193-FZ (red. ot 14.07.2022) «O gosudarstvennoy podderzhke predprinimatel'skoy deyatel'nosti v Arkticheskoy zone Rossiyskoy Federatsii» (accessed 18.01.2023) [Federal Law of July 13, 2020 No. 193-FZ (as amended on 14.07.2022) "On state support for entrepreneurship in the Arctic zone of the Russian Federation"] (accessed 18.01.2023)].

[8] Postanovlenie Pravitel'stva RF «Ob utverzhdenii gosudarstvennoy programmy Rossiyskoy Federatsii «Sotsial'no-ekonomicheskoe razvitie Arkticheskoy zony Rossiyskoy Federatsii» ot 30.03.2021 № 484 (red. ot 30.12.2022) [Resolution of the Government of the Russian Federation "On approval of the state program of the Russian Federation "Socio-economic development of the Arctic zone of the Russian Federation" dated March 30, 2021 No. 484 (as amended on December 30, 2022)]. URL: http://www.consultant.ru/document/cons_doc_LAW_381261/ (accessed 16 July 2023).

[9] Ukaz Prezidenta Rossiyskoy Federatsii «O natsional'nykh tselyakh i strategicheskikh zadachakh razvitiya Rossiyskoy Federatsii na period do 2024 goda» ot 7 maya 2018 g. № 204 [Decree of the President of the Russian Federation "On national goals and strategic objectives for the development of the Russian Federation until 2024" dated May 7, 2018 No. 204]. URL: https://base.garant.ru/71937200/ (accessed 18 July 2023).

gy with a forecast horizon up to 2035 [10], State Program for the development of the transport system [11].

The strategy is focused on increasing spatial connectivity, transport accessibility of territories, population maneuverability, growth of freight and passenger traffic, and development of logistics. The document presents the directions of transport infrastructure development in the Arctic zone of the Russian Federation. Particular attention is paid to the Northern Sea Route, which is considered as an alternative route in the directions Asia–Europe and Europe–Asia. The advantages of this route include: reduced route distance (the NSR is about 14 thousand km, the route through the Suez Canal is more than 23 thousand km), reduced cargo delivery time and cargo transportation costs. The average NSR transit time is from 7 to 15 days. The speed of ships is 5–13 knots. The duration of open water navigation is 2–4 months.

It should be noted that for the effective development of the NSR, the Government of the Russian Federation has prepared documents related to the strategy for the development of sea port infrastructure [12], plan for the development of the Northern Sea Route with a forecast horizon until 2035 [13], and issues of providing subsidies for the formation of a digital economic system for this transport route [14].

The strategy for the development of the maritime transport infrastructure of the Russian Federation reflects the specifics of port operations, taking into account the geographical location of sea basins, presents an analysis of the competitiveness of Russian ports, and describes scenarios for their further economic activities.

The NSR development plan focuses on regional aspects of improving the transport infrastructure (ports, railway and river transport corridors, dredging of water areas). Promising Arctic projects in the Western and Central Arctic include the development of the Murmansk port (the only non-freezing port in the Arctic basin), the Sabetta port in the Yamalo-Nenets Autonomous

[10] Rasporyazhenie Pravitel'stva RF ot 27.11.2021 № 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 dated November 27, 2021 No. 3363-r "On the Transport Strategy of the Russian Federation until 2030 with a Forecast for the Period until 2035"] (accessed 21 July 2023).

[11] Postanovlenie Pravitel'stva RF ot 20.12.2017 № 1596 (red. ot 16 yanvarya 2023) «Ob utverzhdenii gosudarstvennoy programmy Rossiyskoy Federatsii «Razvitie transportnoy sistemy» [Resolution of the Government of the Russian Federation dated December 20, 2017 No. 1596 (as amended on January 16, 2023) "On approval of the state program of the Russian Federation "Development of the transport system"] (accessed 21 July 2023).

[12] Strategiya razvitiya morskoy portovoy infrastruktury Rossii do 2030 goda (odobrena Morskoy kollegiey pri Pravitel'stve RF 28.09.2012) [Strategy for the development of sea port infrastructure in Russia until 2030 (approved by the Maritime Board under the Government of the Russian Federation on September 28, 2012)]. URL: https://www.rosmorport.ru/media/File/State-Private_Partnership/strategy_2030.pdf (accessed 29 July 2023).

[13] Rasporyazhenie Pravitel'stva RF ot 01.08.2022 № 2115-r «Ob utverzhdenii Plana razvitiya Severnogo morskogo puti na period do 2035 goda» [Order of the Government of the Russian Federation dated August 01, 2022 No. 2115-r "On approval of the Northern Sea Route Development Plan for the period up to 2035"]. URL: http://static.government.ru/media/files/StA6ySKbBceANLRA6V2sF6wbOKSyxNzw.pdf (accessed 06 July 2023).

[14] Postanovlenie Pravitel'stva RF ot 12 yanvarya 2023 g. № 8 «Ob utverzhdenii Pravil predostavleniya subsidiy iz federal'nogo byudzheta na obespechenie sozdaniya tsifrovoy ekosistemy Severnogo morskogo puti» [Resolution of the Government of the Russian Federation of January 12, 2023 No. 8 "On approval of the Rules for the provision of subsidies from the federal budget to ensure the creation of a digital ecosystem of the Northern Sea Route"]. URL: http://publication.pravo.gov.ru/Document/View/0001202301160013 (accessed 06 July 2023).

Okrug, and the Arkhangelsk port. The Murmansk [15] and Arkhangelsk transport hubs, as well as the creation of a western transport and logistics hub for transshipment of transit container cargoes are expected to be developed comprehensively.

The presented regulatory and legal documents indicate that the transport infrastructure of the Arctic region of the Russian Federation is a significant factor in the development of the economy of the territory and the state as a whole, ensuring growth, stability, and intensity of production and economic activities.

Discussion of the problem of transport infrastructure development in the works of modern researchers

The issue of development of transport infrastructure of the Arctic zone of the Russian Federation is addressed by researchers: Belyaev V.M. [1], Veretennikov N.P. [2], Gurlev I.V. et al. [3], Denisov V.V. [4], Ivanova M.V. [5], Isaev A.G. [6], Kondratov N.A. [7], Kuznetsova M.N. et al. [8, 9], Serova N.A. et al. [10, 11, 12]. The topic is relevant and discussed in the scientific community, is in demand in the practical activities of the executive authorities of the subjects of the regional economy. Transport of the Arctic zone of the Russian Federation is a sphere of interest not only for the state authorities, but also for big business [13, Malov V.A., Tarasova O.V., p. 7].

The works of Kiselenko A.N., Sundukov E.Yu. [14, p. 48], Kuznetsova M.N., Zakoretskaya O.S. [8, p. 147], Shvetsov K.V., Sorokozherdyev K.G., Lebedeva A.S. [15, p. 41], Tsvetkov V.A., Dudin M.N., Yuryeva A.A. [16, p. 681] consider issues of the Arctic region development strategy taking into account major challenges and threats, and assess scenarios for the development of the transport system on the basis of the achievement of target indicators.

Most authors emphasize that for the effective development of the transport infrastructure of the Arctic zone of the Russian Federation, it is necessary to take into account the problems characteristic of this region: low degree of development of the territory, uneven distribution of settlements, production facilities, remoteness of facilities from the main transport highways (large areas and presence of hard-to-reach areas) [17, Shpak A.V., Serova V.A., Biev A.A., p. 32]. The development of the transport industry requires timely modernization of port, railway infrastructure, regional aviation [18, Gorbunov V.P., p. 370; 19, Gruzinov V.M., Zvorykina Yu.V., Ivanov G.V., p. 9; 20, Macheret D.A., p. 80; 21, Pegin N.A, p. 35; 22, Selin V.S., Selin I.V., p. 58; 17, p. 74], application of digital technologies in transport logistics [23, Domnina O.L., Tsverov V.V., Lisin A.A. et al., p. 177].

The main element of the Arctic transport infrastructure is the Northern Sea Route (NSR), which currently determines the trajectory of national economic development. The potential of the NSR is substantiated in the works [24, Zalyvskiy N.P., pp. 40–42; 25, Ivanova M.V., Danilin K.P., Koshkarev M.V., p. 542; 26, Leonov S.N., Zaostrovskikh E.A., p. 9; 27, Selin V.S., p. 20], the prob-

[15] Rasporyazhenie Pravitel'stva Rossiyskoy Federatsii ot 15 dekabrya 2022 g. № 3927-r «Kompleksnoe razvitie Murmanskogo transportnogo uzla» [Order of the Government of the Russian Federation of December 15, 2022 No. 3927-r "Integrated development of the Murmansk transport hub"]. URL: https://npalib.ru/2022/12/15/rasporyazhenie-3927-r-id324998/ (accessed 06 February 2023).

lems and prospects of this waterway are examined in detail in the article [28, Stepanov N.S., p. 98], the analysis of the current state of the transport system is presented in the studies [3, Gurlev I.V., Makosko A.A., Malygin I.G. p. 260; 27, Selin V.S., p. 20]. The port infrastructure plays a special role in the development of this sea corridor [22, Selin V.S., Selin I.V., p. 58; 29, Rakhmangulov A.N., Muravyov D.S., p. 930].

The prospects and demand for this transport direction are confirmed by the constant growth of cargo traffic. The value of the indicator in 2016 was 7.5 million tons, in 2017 — 10.7 million tons, in 2018 — 20.2 million tons, in 2019 — 31.5 million tons, in 2020 — 32.97 million tons, in 2021 — 34.03 million tons. The indicator has increased by 4.5 times over the past 6 years. The key cargoes forming the cargo flow along the Northern Sea Route are liquefied natural gas, oil, oil products, coal, and iron ore.

The NSR runs along the shores of the Western, Central and Eastern Arctic of the Russian Federation. Each of the listed territories has its own peculiarities in the development of the transport system [4, Denisov V.V., Svetlova M.V., p. 40; 26, Leonov S.N., Zaostrovskikh E.A., p. 10].

The territory of the Western Arctic includes old industrial regions (Murmansk Oblast, Arkhangelsk Oblast), which have more developed transport and logistics structure. The Central Arctic (Yamalo-Nenets Autonomous Okrug and part of Krasnoyarsk Krai) is currently receiving significant support from the government through the Seaport Infrastructure Development Strategy [16] and the Northern Sea Route Development Plan [17].

The Eastern Arctic is a remote part of the country with the lowest population density (0.1 to 0.5 people per 1 km^2), extreme climatic conditions, poorly developed economy, and localization of economic activity. The transport infrastructure of the Republic of Sakha (Yakutia) and the Chukotka Autonomous Okrug is characterized mainly by water (sea and river) and air transport. The railway and motorway density coefficients per 1,000 km^2 are the lowest in the Russian Federation (0.3 and 1.3–4.1, respectively) [18]. Since 2013, there has been an intensification of activities to improve the efficiency of transport logistics in the Eastern Arctic. The changes are associated with the change of policy in the field of development of the Arctic territories, which are becoming a catalyst for economic growth.

Let us make a comparative assessment of transport infrastructure in the western and central sections of the Northern Sea Route.

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[16] Strategiya razvitiya morskoy portovoy infrastruktury Rossii do 2030 goda (odobrena Morskoy kollegiey pri Pravitel'stve RF 28.09.2012) [Strategy for the development of sea port infrastructure in Russia until 2030 (approved by the Maritime Board under the Government of the Russian Federation on September 28, 2012)]. URL: https://www.rosmorport.ru/media/File/State-Private_Partnership/strategy_2030.pdf (accessed 29 January 2023).

[17] Rasporyazhenie Pravitel'stva RF ot 01.08.2022 № 2115-r «Ob utverzhdenii Plana razvitiya Severnogo morskogo puti na period do 2035 goda» [Order of the Government of the Russian Federation dated August 01, 2022 No. 2115-r "On approval of the Northern Sea Route Development Plan for the period up to 2035"]. URL: http://static.government.ru/media/files/StA6ySKbBceANLRA6V2sF6wbOKSyxNzw.pdf (accessed 06 February 2023).

[18] Federal State Statistics Service. URL: https://rosstat.gov.ru/search?q=%D0%9F%D0%BB%D0%BE%D1%82%D0%BD%D0%BE%D1%81%D1%82%D1%8C+%D0%B4%D0%BE%D1%80%D0%BE%D0%B3 (accessed 08 February 2023).

Analysis of the transport infrastructure of the Western and Central Arctic of the Russian Federation

Review of literary sources showed that the topic is relevant. Transport infrastructure affects the economic recovery of the region. This structural component is the most significant in the socio-economic development of the territory and influences such indicators as GRP, living standards of the population (average per capita income, employment and unemployment rates), the volume of investment in fixed assets.

The study area is the Western and Central Arctic of the Russian Federation, which includes 6 subjects of the Russian Federation: Murmansk Oblast, Yamalo-Nenets Autonomous Okrug, Arkhangelsk Oblast (including NAO), Republic of Karelia, Komi Republic, Krasnoyarsk Krai. The last four regions partially belong to the Arctic territories.

Table 1 provides a brief description of the regions included in the Western and Central parts of the Arctic zone of the Russian Federation.

Table 1

Characteristics of the regions of the Western and Central Arctic, 2021 [19]

Subject of the Russian Federation	Area of Arctic territories, thousand km^2	Population living in the Arctic territories, thousand people	Average population density, persons per 1 km^2	Share of transport industry in GRP of the region, %
Republic of Karelia	71.4	109.0	3.3	7.5
Komi Republic	127.4	152.0	1.9	6.0
Arkhangelsk Oblast excluding NAO	46.9	585.6	1.9	8.5
NAO	176.0	41.4	0.23	no data
Murmansk Oblast	144.9	724.5	5.0	7.2
Yamalo-Nenets Autonomous Okrug	769.3	552.1	0.7	no data
Krasnoyarsk Krai	1094	237.0	1.2	5.1

The data in Table 1 shows that:

- the Arctic territories of Krasnoyarsk Krai, Yamalo-Nenets Autonomous Okrug, and NAO are less developed. They have the lowest population density of the 6 subjects (1.2 people per 1 km^2, 0.7 people per 1 km^2, and 0.23 people per 1 km^2, respectively). The regions are located on large territories (1,094 thousand km^2, 769.3 thousand km^2, and 176 thousand km^2, respectively);
- the Murmansk Oblast with an area of 144.9 thousand km^2 (5 people per 1 km^2) and the Republic of Karelia with an area of 71.4 thousand km^2 (3.3 people per 1 km^2) can be classified as developed territories;
- the population density in the Komi Republic and the Arkhangelsk Oblast is 1.9 people per 1 km^2;

[19] Source: compiled by the authors based on URL: https://arctic-council-russia.ru/useful/ (accessed 15 June 2023).

- the share of transport in GRP varies from 5.5 to 8.5%. In the Yamalo-Nenets Autonomous Okrug, the value is small (there are no statistical data for the "Transport" sector). NAO is part of the Arkhangelsk Oblast, information is not provided.

Table 2 shows a summary indicator of transport infrastructure development (index) for 2019–2021.

Table 2

Transport infrastructure development index for the regions included in the Western and Central Arctic of the Russian Federation [20]

Subject of the Russian Federation	2019	2020	2021	Minimum additional investment requirement, bln rub.
Republic of Karelia	2.76	2.73	2.75	20.7
Komi Republic	2.99	2.99	2.98	44.5
Arkhangelsk Oblast excluding NAO	2.70	2.52	2.53	29.0
NAO	4.87	4.87	4.88	20.7
Murmansk Oblast	3.24	3.32	3.35	37.3
Yamalo-Nenets Autonomous Okrug	4.30	3.55	4.04	115.0
Krasnoyarsk Krai	3.24	3.23	3.24	143.4
Russian Federation	3.21	3.23	3.24	-
Note: the data are given for the constituent entities of the Russian Federation without singling out the territories included in the Arctic zone of the Russian Federation (no information is available).				

The transport infrastructure development index includes three sub-indices: infrastructure development of roads, railways and air transport. The values in Table 2 indicate the following:

- the dynamics of the indicator is positive, the exceptions are the Arkhangelsk Oblast (the indicator decreases from 2.70 to 2.53), the Komi Republic (the indicator decreases from 2.99 to 2.98), the Republic of Karelia (from 2.76 to 2.75);
- Arkhangelsk Oblast excluding NAO, Komi Republic, Karelia Republic are in the "red zone". The transport infrastructure development index in these regions is below the Russian average (in 2019 — 3.21, in 2020 — 3.23, in 2021 — 3.24);
- the highest values of the transport infrastructure development index are observed in the NAO and Yamalo-Nenets AO. In 2021, this indicator was 4.88 in the NAO, and 4.04 in the Yamalo-Nenets AO. It should be noted that high values of this index do not correlate with the level of transport accessibility in the regions. These are the territories that are hard to access (long travel time, high tariffs, limited modes of transport) and require special attention in the issue of effective formation of transport infrastructure. For this purpose, the port of Sabetta, railway transport corridors, and airports are being actively developed;
- the Yamalo-Nenets Autonomous Okrug is the leading region in terms of additional investment needs (115 billion rubles). The minimum additional need is approximately

[20] Source: compiled by the authors based on URL: https://infraoneresearch.ru/index_id/2019_regions, https://infraoneresearch.ru/index_id/2020_regions, https://infraoneresearch.ru/index_id/2021_regions, https://infraoneresearch.ru/index_id/2021_regions (accessed 15 June 2023).

0.2% of GDP [21]. Krasnoyarsk Krai is not considered, since only 32.8% of the territory belongs to the Arctic zone of the Russian Federation.

The transport infrastructure of the Western and Central Arctic is represented by a network of roads and railways, airports, ports, oil and gas pipelines. The information base for the analysis is statistical information [22, 23, 24].

Table 3 shows the main indicators of road and rail transport in the regions included in the Western and Central Arctic of the Russian Federation.

Table 3

Main indicators of rail and road transport in the regions included in the Western and Central Arctic of the Russian Federation

Indicators	2010	2015	2018	2019	2020	2021	Growth rate, % 2021/2010
Murmansk Oblast							
Operational length of public railway tracks, km	870	870	870	870	870	870	100.0
Length of public roads with hard surface, km	2 697	3 315	3 395	3 414	3 424	3 457	128.2
Cargo turnover of road transport, mln t-km	377	477	391	404	421	387	102.7
Passenger turnover of public bus transport, million passenger-kilometers	758	641	674	671	458	474	62.5
Republic of Karelia							
Operational length of public railway tracks, km	2226	2226	2226	2226	2226	2226	100.0
Length of public roads with hard surface, km	6697	8508	8667	8471	8465	8411	125.6
Cargo turnover of road transport, mln t-km	997	1 119	840	791	772	779	78.1
Passenger turnover of public bus transport, million passenger-kilometers	129	431	382	396	185	211	163.6
Komi Republic							
Operational length of public railway tracks, km	1690	1690	1690	1690	1690	1690	100.0
Length of public roads with hard surface, km	5842	6469	6576	6573	6745	6882	117.8
Cargo turnover of road transport, mln t-km	1415	1214	1138	1089	1195	1503	106.2
Passenger turnover of public bus transport, million passenger-kilometers	756	1 092	566	483	340	383	50.7
Arkhangelsk Oblast excluding NAO							
Operational length of public railway tracks, km	1767	1767	1767	1767	1767	1767	100.0
Length of public roads with hard surface, km	10761	12174	12099	12157	12127	12255	113.9
Cargo turnover of road transport, mln t-km	2827	2925	1436	1976	3024	2610	92.3

[21] FinStroyKonsult. URL: https://infraoneresearch.ru/index_id/2021_regions (accessed 15 June 2023).
[22] Transport of Russia. 2022: Stat. Coll. Rosstat. Moscow, 2022, p. 101.
[23] Regions of Russia. Main characteristics of the subjects of the Russian Federation. 2021: Statistical Collection. Rosstat. Moscow, 2021, 766 p.
[24] Regions of Russia. Socio-economic indicators. 2022: Statistical Collection. Rosstat. Moscow, 2022, 1122 p.

Passenger turnover of public bus transport, million passenger-kilometers	781	817	792	831	514	532	68.1
NAO							
Length of public roads with hard surface, km	200	220	268	281	285	302	151.0
Cargo turnover of road transport, mln t-km	229	49	31	17	28	588	257
Passenger turnover of public bus transport, million passenger-kilometers	8	26	12	15	15	17	213
Yamalo-Nenets Autonomous Okrug							
Operational length of public railway tracks, km	481	481	481	481	481	481	100.0
Length of public roads with hard surface, km	1348	2229	2359	2563	2719	2772	205.6
Cargo turnover of road transport, mln t-km	2122	2144	1346	1208	1179	1067	50.3
Passenger turnover of public bus transport, million passenger-kilometers	646	400	206	215	293	296	45.8
Krasnoyarsk Krai							
Operational length of public railway tracks, km	2067	2067	2078	2078	2078	2078	100.5
Length of public roads with hard surface, km	15089	27526	27526	27665	27452	27561	182.7
Cargo turnover of road transport, mln t-km	2780	3238	3020	3388	3954	4285	154.1
Passenger turnover of public bus transport, million passenger-kilometers	3968	3035	2563	2572	2004	2350	59.2

The data presented in Table 3 indicate the following:

- the operational length of public railway tracks has been stable over the past 10 years;
- the greatest operational length of public railway tracks is observed in the Republic of Karelia (2,226 km) and in Krasnoyarsk Krai (2,078 km). In order to assess the degree of road branching and the level of railway infrastructure development, it is necessary to analyze relative values, for example, the indicator of railway track density (Table 5). This indicator in the Republic of Karelia is equal to 123 km of tracks per 10,000 km^2, in Krasnoyarsk Krai — 9 km of tracks per 10,000 km^2;
- the length of public roads with hard surfaces increased during the period under review. The average growth rate was 142.3%. This is a positive trend in the development of the transport automobile infrastructure. However, the volume of freight turnover of road transport is decreasing in a number of regions (in the Republic of Karelia — by 22.9% compared to 2010, in the Arkhangelsk Oblast excluding NAO — by 7.3% compared to the same period, in the Yamalo-Nenets Autonomous Okrug — by 49.7%), thus, the role of other types of transport in cargo transportation is increasing;
- it should be noted that there are no public railways in NAO. This contributes to the development of motorways: their length has increased by 51%, freight turnover has grown by 157% and passenger turnover — by 113% compared to 2010;

- passenger turnover of public bus transport has tended to decrease over the past 10 years. The exception is the Republic of Karelia (growth of 63.6%), the Nenets Autonomous Okrug (growth of 113%) compared to 2010.

For further assessment of the level of development of road and railway transport infrastructure, various indicators are used: the density of automobile roads and railways, the coefficients of Engel, Goltz, Uspenskiy, Vasilevskiy.

Tables 4 and 5 show the dynamics of road and railway density.

Table 4

Density of public roads of federal, regional, inter-municipal and local significance (km of roads per 1,000 km^2 of territory)

Subject of the Russian Federation	2016	2017	2018	2019	2020	2021
Russian Federation	62	62	63	64	64	65
Republic of Karelia	48	48	48	47	47	47
Komi Republic	16	16	16	16	16	17
Arkhangelsk Oblast, incl.:	21	21	21	21	21	21
– Nenets Autonomous Okrug	1.3	1.4	1.5	1.6	1.6	1.7
– Arkhangelsk Oblast excluding NAO	29	29	29	29	29	30
Murmansk Oblast	23	23	23	24	24	24
Yamalo-Nenets Autonomous Okrug	3.0	3.0	3.1	3.3	3.5	3.6
Krasnoyarsk Krai	11	12	12	12	12	12

Table 5

Density of public railway tracks (kilometers of tracks per 10,000 km^2 of territory)

Subject	2016	2017	2018	2019	2020	2021
Russian Federation	*50*	*51*	*51*	*51*	*51*	*51*
Republic of Karelia	123	123	123	123	123	123
Komi Republic	41	41	41	41	41	41
Arkhangelsk Oblast excluding NAO	30	30	30	30	30	30
NAO	–	–	–	–	–	–
Murmansk Oblast	60	60	60	60	60	60
Yamalo-Nenets Autonomous Okrug	6	6	6	6	6	6
Krasnoyarsk Krai	9	9	9	9	9	9

The figures given in the tables 4 and 5 indicate that:

- the transport infrastructure in terms of road density is below the Russian average: in the Yamalo-Nenets Autonomous Okrug, the gap is 18.0 times, in the Republic of Karelia — 1.38 times. This is explained by the peculiarities of the territorial location of the regions, extreme climatic conditions, and low population density;
- the situation is more favorable in terms of density of public railways: the indicators in the Republic of Karelia and the Murmansk Oblast are higher than in the Russian Federation by 2.46 and 1.2 times, respectively. This indicates that the railway infrastructure is more developed than the road one;
- NAO does not have this indicator.

For a generalized description of transport provision, let us refer to Table 6.

Table 6

Characteristics of transport provision in the Western and Central Arctic of the Russian Federation, 2021 [25]

Subject of the Russian Federation	Engel's coefficient	Goltz's coefficient	Uspenskiy's coefficient
Republic of Karelia	0.049	1.288	0.003
Komi Republic	0.076	2.510	0.006
Arkhangelsk Oblast excluding NAO	0.019	1.440	0.002
NAO	0.003	0.089	0.0002
Murmansk Oblast	0.044	1.634	0.004
Yamalo-Nenets AO	0.005	0.391	0.001
Krasnoyarsk Krai	0.011	0.687	0.002

The calculation results presented in Table 6 show that the Engel's coefficient, which assesses the level of development of the transport infrastructure, has the highest values in the Komi Republic (0.076), in the Republic of Karelia (0.049), in the Murmansk Oblast (0.044), in the Arkhangelsk Oblast excluding NAO (0.019). These territories in the Western Arctic zone of the Russian Federation are characterized by a higher density of roads and railways and population density. Regarding the values of the indicators for the NAO, the Yamalo-Nenets Okrug and the Krasnoyarsk Krai, it should be noted that the transport network is underdeveloped, the development of territories and the industrial and economic activities are focal. The Goltz's and the Uspenskiy's coefficients are modifications of the Engel's coefficient and confirm the conclusions drawn from the values of the Engel's coefficient.

The seaport infrastructure of the Arctic zone of the Russian Federation is of special importance in the transport infrastructure. The ports are located along the NSR coastline.

Table 7 provides characteristics of the ports of the Western and Central Arctic zones of the Russian Federation.

Table 7

Characteristics of the ports of the Western and Central Arctic of the Russian Federation [26]

Subject of the Russian Federation	Number of ports	Settlement	Type of port
Arkhangelsk Oblast excluding NAO	3	Arkhangelsk Onega Mezen	sea port sea port sea port
NAO	3	Naryan-Mar Varandey Amderma	sea port sea port sea port
Murmansk Oblast	2	Murmansk Kandalaksha	sea port sea port
Yamalo-Nenets AO	1	Sabetta	sea port
Krasnoyarsk Krai	3	Khatanga Dixon Dudinka	sea port sea port river port

Sea ports are used to solve the following problems: provision of Arctic settlements and polar stations with necessary resources, transportation of cargoes for economic activities.

The largest number of seaports is located in the Arkhangelsk Oblast (6 ports), including 3 ports in the NAO. Deep-water ports include the Murmansk port and the port of Sabetta. According

[25] Authors' calculations based on Rosstat data.
[26] Source: compiled by the authors.

to the NSR development plan, it is planned to complete the deepening of the Arkhangelsk port by 2035.

Table 8 shows the dynamics of cargo turnover of sea ports of the Western and Central Arctic of the Russian Federation for 3 years, Table 9 shows the structure of cargo turnover dynamics.

Table 8

Dynamics of cargo turnover of the Arctic basin seaports [27]

Port	2020		2021		2022	
	mln t	growth rate 2020/2019, %	mln t	growth rate 2021/2020, %	mln t	growth rate 2022/2021, %
Total	96.0	91.6	94.3	98.2	98.5	104.5
- Murmansk port	56.1	90.7	54.5	97.1	56.3	103.3
- Sabetta	27.8	100.5	27.9	100.4	28.4	101.8
- Varandey	4.9	68.2	4.6	93.9	5.9	128.3
- Arkhangelsk port	3.3	122.4	3.2	97.0	2.3	71.9
- other ports	3.9	44.4	4.1	105.1	5.6	136.6

Table 9

Dynamics of the structure of cargo turnover of the Arctic basin seaports [28]

Port	2020	2021	2022
	sp. gr, %	sp. gr, %	sp. gr, %
Total	100.0	100.0	100.0
- Murmansk port	58.4	57.8	57.2
- Sabetta	29.0	29.6	28.8
- Varandey	5.1	4.9	6.0
- Arkhangelsk port	3.4	3.4	2.3
- other ports	4.1	4.3	5.7

According to the results of tables 8 and 9, it is clear that:

- the highest value of cargo turnover of the Arctic basin seaports over the past 3 years is observed in 2022 (98.5 million tons, growth rate of +4.5%). This is a positive trend for the indicator. The exception is the Arkhangelsk port (decrease in cargo turnover by 28.1% in 2022);
- the lowest value of cargo turnover of the Arctic basin seaports over the past 3 years is observed in 2021 (94.3 million tons, growth rate of 1.8%);
- major seaports in the Western and Central Arctic of the Russian Federation are: Murmansk port, Sabetta port, Varandey port, Arkhangelsk port. The value of cargo turnover by individual ports in 2022 was as follows: Murmansk — 56.3 million tons (57.2%), Sabetta — 28.4 million tons (28.8%), Varandey — 5.9 million tons (6%), Arkhangelsk — 2.3 million tons (2.3%);
- the structure of cargo turnover has been stable for 3 years;
- only Sabetta port shows a constant increase in cargo turnover over 3 years.

Table 10 shows the dynamics of the composition and structure of cargo turnover by type of cargo.

[27] Authors' calculations based on Rosstat data.
[28] Authors' calculations based on Rosstat data.

Table 10

Dynamics of the composition and structure of cargo turnover of Arctic basin seaports by type of cargo [29]

Type of cargo	2020		2021		2022		Growth rate 2021/ 2020, %	Growth rate 2022/ 2021, %
	mln t	sp. gr, %	mln t	sp. gr, %	mln t	sp. gr, %		
Total	96.0	100	94.3	100	98.5	100	98.2	104.5
- dry cargo	30.1	31.4	29.0	30.8	29.4	29.8	96.3	101.4
- liquid cargo	65.9	68.6	65.3	69.2	69.1	70.2	99.0	105.8

The figures in Table 10 indicate the following:

- the structure of cargo turnover by type of transported cargo is stable;
- liquid cargo accounts for the largest share (oil and oil products are key cargoes). In 2020, the share of these cargoes was 68.6%, in 2021 — 69.2%, in 2022 — 70.2%;
- in 2021, dry cargo turnover decreased by 3.7%, liquid cargo — by 1.0%. The decrease compared to the previous period is insignificant;
- in 2022, dry cargo turnover increased by 1.4%, liquid cargo — by 5.8%. This allowed exceeding the indicators of 2020 by 2.6%. The dynamics is positive.

Currently, the ports with railway approaches include the Murmansk port and the Arkhangelsk port. The presence of railways helps to increase the efficiency of logistics.

The development of the transport infrastructure of the macro-region is impossible without increasing accessibility to industrial and social facilities. In the Decree of the President of the Russian Federation [30], among the most important tasks in the field of infrastructure development of the Arctic zone of the Russian Federation, emphasis is placed on the expansion of the network of airports and landing sites for territories that are not connected to the motorway network. It is important to pay attention to the development of airports. According to experts, the Arctic zone of the Russian Federation accounts for 30–40% of domestic air transportation [31].

The state register of airfields and heliports of civil aviation contains 39 airfields located on the territory of the Arctic zone of the Russian Federation (35 airfields with lighting systems, 24 airfields with artificial covering [32]) and 300 landing sites.

Fig. 3 shows the largest airports in the Arctic zone of the Russian Federation. These include: Murmansk Airport, Arkhangelsk Airport, Norilsk Airport, Naryan-Mar Airport, Novy Urengoy Airport. Table 11 shows information about the largest airports in the Western Arctic of the Russian Federation. The airports of Arkhangelsk and Murmansk carry out not only internal but also inter-

[29] Authors' calculations based on Rosstat data.
[30] Ukaz Prezidenta RF ot 5 marta 2020 g. № 164 «Ob Osnovakh 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 "On the Fundamentals of the state policy of the Russian Federation in the Arctic for the period up to 2035"]. URL: https://base.garant.ru/73706526/ (accessed 20 February 2023).
[31] V Arkticheskoy zone aktivnymi tempami vedetsya rekonstruktsiya aeroportov [Airport reconstruction is underway at an active pace in the Arctic zone]. URL: https://www.agaa.ru/news/industry/3186.html (accessed 20 February 2023).
[32] State register of airfields and heliports of civil aviation of the Russian Federation. URL: https://favt.gov.ru/dejatelnost-ajeroporty-i-ajerodromy-reestr-grajdanskih-ajerodromov-rf/ (accessed 20 February 2023).

national flights. The remoteness of the airports from the cities does not exceed 36 km. The shortest distance is 3–7 km.

Table 11

Characteristics of major airports in the Western and Central Arctic of the Russian Federation [33]

Subject of the Russian Federation	Number of airports	Remoteness, km	Passenger traffic, mln people per year	Flights
Arkhangelsk Oblast excluding NAO	Arkhangelsk	6	about 1	internal, international
NAO	Naryan-Mar	3	about 0.2	internal
Murmansk Oblast	Murmansk	24	more than 1	internal, international
Yamalo-Nenets AO	Salekhard Novy Urengoy	7 5	about 0.3 about 0.9	internal internal
Krasnoyarsk Krai	Norilsk	36	about 0.9	internal

Cities are important in ensuring air communication in the Arctic. Table 12 presents information on the share of cities in passenger and cargo turnover at airports in the Western and Central Arctic of the Russian Federation.

Table 12

Share of cities in passenger and cargo turnover of airports [34]

Subject of the Russian Federation	Share of cities in passenger turnover, %	Share of cities in cargo turnover, %
Arkhangelsk Oblast excluding NAO	98	96
NAO	83	91
Komi Republic	94	94
Republic of Karelia	There are no airports in the Arctic zone of the Russian Federation	
Murmansk Oblast	100	100
Yamalo-Nenets AO	73	40
Krasnoyarsk Krai	57	30

Table 12 shows that the largest share of passenger turnover in the Western Arctic of the Russian Federation is in Murmansk Oblast (100%), Arkhangelsk Oblast (98%), Komi Republic (94%). The maximum share of cities in airport cargo turnover is represented in Murmansk Oblast (100%), Arkhangelsk Oblast (96%), Komi Republic (94%), Nenets Autonomous Okrug (91%).

Table 13 presents the volumes of passenger and cargo transportation for 2020–2021.

[33] Key airports of the Arctic zone of the Russian Federation. URL: https://arctic-russia.ru/article/klyuchevye-aeroporty-arkticheskoy-zony-rf/ (accessed 20 February 2023).

[34] Source: compiled by the authors based on the data of the study [“Key settlements of the Russian Arctic: preliminary research materials. Information and Analytical Center of the State Commission for Arctic Development, Institute of Regional Consulting], 2022, 246 p.

Table 13

Dynamics of passenger and cargo transportation volumes at the largest airports in the Western and Central Arctic of the Russian Federation [35]

Airport	2020		2021		Growth rate 2021/2020, %	
	Passengers, thous. people	Cargo, t	Passengers, thous. people	Cargo, t	Passengers, thous. people	Cargo, t
Arkhangelsk	643.5	1818.8	1064.2	1938.5	165.4	106.6
Murmansk	899.8	1656.9	1355.6	1849.0	150.7	111.6
Novy Urengoy	698.9	4400.8	954.7	5175.9	136.6	117.6
Norilsk	431.5	15817.0	604.9	20909.5	140.2	132.2

The results in Table 13 indicate that:

- passenger and cargo traffic volumes increased in 2021 compared to 2020. A significant increase is observed in passenger traffic (47.8% on average), while the average increase in cargo traffic is 16.6%;
- Murmansk airport is the leader in terms of the number of passengers carried (in 2020 — 899.8 thousand people, in 2021 — 1,355.6 thousand people, the growth rate was 150.7%), Arkhangelsk airport is in second place (in 2020 — 643.5 thousand people, in 2021 — 1,064.2 thousand people, the growth rate was 165.4%);
- Norilsk airport focuses on cargo transportation (in 2020 — 15,817.0 tons, in 2021 — 20,909.5 tons, growth rate — 132.2%);
- Novy Urengoy and Norilsk are particularly large air hubs.

These figures confirm the need for a differentiated approach to assessing the spatial development of the Arctic and its transport infrastructure. Currently, cities are key transport and logistics points for the development of natural resources in the Arctic territories, especially in the field of air traffic. This is evident as we move further east in the Arctic zone of the Russian Federation, where there is a low population density, undeveloped network of railway and road transport.

Having outlined the importance of air transportation in the development of the region, it is necessary to ensure timely renewal of the infrastructure. Currently, there is a significant degree of wear and tear of airport infrastructure (runways, airfield equipment) and a lack of resources for the operation and development of airports. This situation does not allow the transport and logistics system of the region to function effectively, since in some areas air transport is the only way to move passengers and cargo.

According to the results of the analysis, it can be stated that the transport infrastructure of the Western and Central Arctic is a significant element in the development of the Arctic zone of the Russian Federation, contributes to the growth of GRP, improves the living conditions of the population, and stimulates the economy of the region.

The transport infrastructure of the territory is represented by a network of roads and railways, airports, and ports. Currently, there is a low level of transport provision. This is explained by

[35] Source: compiled by the authors based on URL: https://favt.gov.ru/dejatelnost-ajeroporty-i-ajerodromy-osnovnie-proizvodstvennie-pokazateli-aeroportov-obyom-perevoz/ (accessed 17 June 2023).

the peculiarities of location, extreme climatic conditions, and low population density. With the increasing importance of the Northern Sea Route, further development of the transport infrastructure of the region is planned (construction of railway lines, port and airport facilities).

Prospects for the development of transport infrastructure in the Western and Central Arctic of the Russian Federation

In order to develop the transport infrastructure of the Arctic of the Russian Federation, it is important to carry out targeted work within the framework of the Strategy for the development of the Arctic Zone of the Russian Federation, the Transport Strategy of the Russian Federation, the Strategy for the development of sea port infrastructure, based on the implementation of the state programs "Socio-economic development of the Arctic zone of the Russian Federation", "Development of the transport system of the Russian Federation", the Plan for the development of the Northern Sea Route for the period up to 2035.

In order to improve transport infrastructure and increase cargo flow along the Northern Sea Route, it is planned to create railway transport corridors. Table 14 provides information on the planned facilities.

Table 14

Creation of railway corridors [36]

Object	Implementation timeframe	Cost, bln rub.
The Northern Latitudinal Railway "Obskaya – Salekhard – Nadym – Pangody – Novy Urengoy – Korotchaevo" and railway lines	2022–2028	506.5
Railway line to the Western transport and logistics hub	2025–2031	26.0
Lavna – Vykhodnoy railway line with a bridge over the Tuloma River	2022–2024	37.7

A large-scale change in the railway infrastructure is expected. It is about the construction of the Northern Latitudinal Railway with a length of 707 kilometers [37]. The project plans to increase the capacity of the railway transport infrastructure to 23.9 million tons of cargo, reduce transport routes from deposits to NSR seaports, and provide socio-economic development of the territories of the Yamalo-Nenets Autonomous Okrug (increased tax revenues and new jobs). The project implementation period is 2022–2028. The project cost is 506.51 million rubles.

The Northern Sea Route development plan for the period up to 2035 considers the possibility of constructing the Northern Latitudinal Passage–2. This will ensure the development of the port of Sabetta and establish a connection between the railway transport infrastructure and the NSR. The deadline for submitting the feasibility study for the project is December 2023.

[36] Rasporyazhenie Pravitel'stva RF ot 01.08.2022 № 2115-r «Ob utverzhdenii Plana razvitiya Severnogo morskogo puti na period do 2035 goda» [Order of the Government of the Russian Federation dated August 01, 2022 No. 2115-r "On approval of the Northern Sea Route development plan for the period up to 2035"]. URL: http://static.government.ru/media/files/StA6ySKbBceANLRA6V2sF6wbOKSyxNzw.pdf (accessed 06 February 2023).
[37] Ibid.

The prospects for the development of the port infrastructure of the Western and Central Arctic of the Russian Federation are presented in Table 15.

Table 15

Characteristics of the ports of the Western and Central Arctic of the Russian Federation [38]

Subject of the Russian Federation	Prospects for port infrastructure development
Arkhangelsk Oblast, including NAO	construction of a marine terminal for shipping lead-zinc concentrate on the Novaya Zemlya archipelago. Cost —1.8 bln rub. (2025–2026)
Murmansk Oblast	- construction of a marine liquefied natural gas transshipment complex, navigation safety facilities. Cost — 20.09 bln rub. (2022–2023); - construction of a bulk cargo terminal (Tuloma terminal). Cost — 22.95 bln rub. (2022–2023); - construction of the Lavna coal transshipment complex as part of the integrated development of the Murmansk transport hub. Cost — 46.45 bln rub. (2022–2024); - reconstruction of facilities of the third cargo area of the Murmansk seaport. Cost — 6.38 bln rub. (2022–2024).
Yamalo-Nenets Autonomous Okrug	construction of the Utrenny liquefied natural gas and gas condensate terminal in the port of Sabetta. Cost — 40.55 bln rub. (2022)
Krasnoyarsk Krai	construction of facilities at the Bukhta Sever terminal for the Vostok Oil project. Cost — 3.72 bln rub. (2023–2024)

For the efficient functioning of the airport infrastructure, the federal project “Development of regional airports and routes” is being implemented, focusing on the reconstruction of airports. The current version of the federal project consists of 3 blocks: reconstruction of 68 facilities at 66 airports, subsidizing air transportation on 175 routes and leasing of aircraft [39]. Note: the document does not provide a list of airports that are planned to be modernized. The cost of the project is 267.5 billion rubles (87.5% of the funds are invested by the state, 12.5% — from extra-budgetary sources).

There are 39 airfields registered in the Arctic, of which 21 airfields are planned to be reconstructed by 2030, including the airfields of Arkhangelsk, Murmansk, Naryan-Mar. At present, the reconstruction of the airfield infrastructure in Norilsk has been fully completed, in 2021 — in Solovki, in 2022 — in Amderma, in 2024 — 10 airfields will be reconstructed [40].

The list of transport infrastructure facilities to be built and reconstructed in the Arctic of the Russian Federation is the key to the creation of a production and logistics system. The commissioning of new facilities will enable the implementation of other investment projects. The

[38] Rasporyazhenie Pravitel'stva RF ot 01.08.2022 № 2115-r «Ob utverzhdenii Plana razvitiya Severnogo morskogo puti na period do 2035 goda» [Order of the Government of the Russian Federation dated August 01, 2022 No. 2115-r "On approval of the Northern Sea Route development plan for the period up to 2035"]. URL: http://static.government.ru/media/files/StA6ySKbBceANLRA6V2sF6wbOKSyxNzw.pdf (accessed 22 February 2023).

[39] Rasporyazhenie Pravitel'stva RF ot 30.09.2018 № 2101-r (red. ot 09.12.2022) «Ob utverzhdenii kompleksnogo plana modernizatsii i rasshireniya magistral'noy infrastruktury na period do 2024 goda» (p.4.7. Razvitie regional'nykh aeroportov i marshrutov) [Order of the Government of the Russian Federation of September 30, 2018 No. 2101-r (as amended on December 09, 2022) "On approval of a comprehensive plan for the modernization and expansion of trunk infrastructure for the period up to 2024" (clause 4.7. Development of regional airports and routes)]. URL: https://mintrans.gov.ru/documents/2/9742 (accessed 17 June 2023).

[40] Arkticheskaya aviatsiya: neobkhodim sistemnyy podkhod [Arctic aviation: a systematic approach is needed]. URL: https://transportrussia.ru/item/5722-arkticheskaya-aviatsiya-neobkhodim-sistemnyj-podkhod.html (accessed 22 February 2023).

Sabetta port, the Northern Latitudinal Railway with an additional railway provide for the expansion of natural gas production on the Yamal and Gydan peninsulas, the growth of cargo traffic along the Northern Sea Route, the construction of icebreakers, and the development of the Murmansk transport hub. The “domino” principle is manifested, creating the basis for sustainable socio-economic development of the Arctic territories.

Conclusion

The state policy of the Russian Federation in the Arctic zone is focused on various areas of activity, in particular on the improvement of transport infrastructure (construction and modernization of sea ports, railways, motorways, airports).

In modern conditions, transport infrastructure becomes an impetus for sustainable development of the subjects of the Russian Federation. It is extremely important to analyze and identify the prospects for the development of the industry, taking into account the existing problems.

The Arctic zone of the Russian Federation is characterized by a low degree of development of territories, localization and remoteness of settlements and industrial facilities from the main highways. To activate the economy of a strategically important region, it is necessary to ensure the long-term development of the transport infrastructure.

The analysis of the transport infrastructure of the Western and Central Arctic of the Russian Federation has shown that the territories in the western part are characterized by a higher density of roads and railways than in the central part of the Arctic zone of the Russian Federation. The values of the indicators (coefficients of Engel, Goltz and Uspenskiy) in the NAO, Yamalo-Nenets Autonomous Okrug and Krasnoyarsk Krai show the underdevelopment of the transport network, the focal nature of territorial development and industrial and economic activity.

The transport infrastructure is below the national average in terms of road density. This is explained by the peculiarities of location of the regions, extreme climatic conditions, and low population density. The situation is more favorable in terms of the density of public railways. This indicates that the railway infrastructure is more developed than the automobile infrastructure. The exception is NAO, where only road, air and water transport are used.

The index of transport infrastructure development in the regions of the Western and Central Arctic of the Russian Federation is below the Russian average. The exception is NAO and Yamalo-Nenets AO. These territories are currently the center of attraction, promising for development in the western and central sections of the Northern Sea Route.

Of particular importance in the transport infrastructure of the Arctic zone of the Russian Federation is the seaport infrastructure located along the coastline of the NSR. The major seaports in the Western and Central Arctic of the Russian Federation are: Murmansk port, Sabetta port, Varandey port, Arkhangelsk port. The largest number of seaports is located in the Western Arctic, in particular in the Arkhangelsk Oblast and the Nenets Autonomous Okrug. The seaports of the

Arctic basin are characterized by a constant increase in cargo turnover due to the construction and modernization of infrastructure facilities.

The development of the transport infrastructure of the macro-region is impossible without increasing accessibility to industrial and social facilities. Therefore, a special role in solving this problem is given to the airport infrastructure. The largest airports of the Arctic of the Russian Federation include Murmansk airport, Arkhangelsk airport, Norilsk airport, Naryan-Mar airport, Novy Urengoy airport, which carry out internal and international transportation. Currently, the focus is on expanding the network of airports and landing sites for areas that are not connected to the road network.

According to the results of the analysis, it can be stated that the transport infrastructure of the Western and Central Arctic is a significant element in the development of the Arctic zone of the Russian Federation, contributes to the growth of GRP, improvement of living conditions of the population, activation of the region's economy.

The results of the study can be used in the process of making managerial decisions in the development of regional transport infrastructure.

References

1. Belyaev V.M., Filippova N.A. Fundamentals of Transport System Organization in Northern Regions. *World of Transport and Transportation*, 2017, vol. 15, no. 1 (68), pp. 162–167.
2. Veretennikov N.P. Formation and Development of Logistics Infrastructure in the Arctic Regions. *Sever i rynok: formirovanie ekonomicheskogo poryadka* [The North and the Market: The Formation of an Economic Order], 2019, no. 1 (63), pp. 89–98. DOI: https://doi.org/1025702/KSC.2220-802X.1.2019.63.89-98
3. Gurlev I.V., Makosko A.A., Malygin I.G. Analysis of the State and Development of the Transport System of the Northern Sea Route. *Arctic: Ecology and Economy*, 2022, vol. 12, no. 2, pp. 258–270. DOI: https://doi.org/10.25283/2223-4594-2022-2-258-270
4. Denisov V.V., Svetlova M. V. Assessment of the Territorial Development of Russia's Regions on the Western Part of the Northern Sea Route. *Proceedings of Voronezh State University. Series: Geography. Geoecology*, 2021, no. 1, pp. 37-44. DOI: https://doi.org/10.17308/geo.2021.1/3254
5. Ivanova M.V. Assessment of Opportunities for the Development of Arctic Communications in the Area of the Northern Sea Route. *Sever i rynok: formirovanie ekonomicheskogo poryadka* [The North and the Market: The Formation of an Economic Order], 2021, no. 2 (72), pp. 35–45. DOI: https://doi.org/10.37614/2220-802X.2.2021.72.003
6. Isaev A.G. Transport Infrastructure and Economic Growth: Spatial Effects. *Spatial Economics*, 2015, no. 3, pp. 57–73. DOI: https://doi.org/10.14530/se.2015.3.057-073
7. Kondratov N.A. Development of Transport Infrastructure in the Arctic Zone of Russia. *Geographical Bulletin*, 2017, no. 4(43), pp. 68–80. DOI: https://doi.org/10.17072/2079-7877-2017-4-68-80
8. Kuznetsova M.N., Zakoretskaya O.S. Development of the Transportation System in Arkhangelsk Region: Problems and Perspectives (Russia, Severodvinsk). *Problems of Modern Economics*, 2017, no. 4 (64), pp. 147–150.
9. Kuznetsova M.N, Zakoretskaya O.S. Transportation Management: Macro- and Micro-Aspects (Russia, Severodvinsk). *Problems of Modern Economics*, 2017, no. 3 (63), pp. 145–149
10. Serova N.A., Serova V.A. Transport Infrastructure of the Russian Arctic: Specifics Features and Development Prospects. *Studies on Russian Economic Development*, 2021, no. 2 (185), pp. 142–151. DOI: https://doi.org/10.47711/0868-6351-185-142-151

11. Serova N.A., Serova V.A. Critical Tendencies of the Transport Infrastructure Development in the Russian Arctic. *Arktika i Sever* [Arctic and North], 2019, no. 36, pp. 42–56. DOI: 10.17238/issn2221-2698.2019.36.42
12. Serova V.A. The Specificity of the Arctic Transport System. *Sever i rynok: formirovanie ekonomicheskogo poryadka* [The North and the Market: The Formation of an Economic Order], 2013, no. 5 (36), pp. 51–56.
13. Malov V.Yu., Tarasova O.V. Transportation Sector as a Sphere of Integrated Interests of the Russian Government and Corporations. *Region: Economics and Sociology*, 2013, no. 3 (79), pp. 3–20.
14. Kiselenko A.N., Sundukov E.Yu. Optimistic and Pessimistic Scenarios for Development of Feeder Network of the Arctic Transport System Based on Achievement of Target Indicators. *World of Transport and Transportation*, 2020, vol. 18, no. 6 (91), pp. 46–62. DOI: https://doi.org/10.30932/1992-3252-2020-18-6-46-62
15. Shvetsov K.V., Sorokozherdyev K.G. Lebedeva A.S. Strategy for Development and Modernization of Transportation and Logistics Routes in the Arctic. *MIR (Modernization. Innovation. Research)*, 2018, vol. 9, no. 1, pp. 40–52. DOI: https://doi.org/10.18184/2079-4665.2018.9.1.40-5
16. Tsvetkov V.A., Dudin M. N., Yuryeva A.A. Strategic Development of the Arctic Region in the Context of Great Challenges and Threats. *Economy of Regions*, 2020, vol. 16, no. 3, pp. 680–695. DOI: https://doi.org/10.17059/ekon.reg.2020-3-1
17. Shpak A.V., Serova V.A., Biev A.A. Modern Challenges of the Transport Infrastructure of the Russian Arctic Regions. *Sever i rynok: formirovanie ekonomicheskogo poryadka* [The North and the Market: The Formation of an Economic Order], 2014, no. 6 (43), pp. 31–35.
18. Gorbunov V.P. Prospects for the Development of Regional Aviation in the Far North and the Tasks of Increasing the Transport Accessibility of the Arctic and the Far East. *Arctic: Ecology and Economy*, 2020, vol. 12, no. 3, pp. 367–375. DOI: https://doi.org/10.25283/2223-4594-2022-3-367-375
19. Gruzinov V.M., Zvorykina Yu.V., Ivanov G.V., Sychev Yu.F., Tarasova O.V., Filin B.N. Arctic Transport Routes on Land, in Water and Air Areas. *Arctic: Ecology and Economy*, 2019, no. 1 (33), pp. 6–20. DOI: https://doi.org/10.25283/2223-4594-2019-1-6-20
20. Macheret D.A. On the Economic Problems of Development of Transport Infrastructure. *World of Transport and Transportation*, 2011, vol. 9, no. 3(36), pp. 76–83.
21. Pegin N.A. National Arctic Transport Line: Problems and Prospects. *Arktika i Sever* [Arctic and North], 2016, no. 23, pp. 32–40. DOI: https://doi.org/10.17238/issn2221-2698.2016.23.32
22. Selin V.S., Selin I.V. Tendencies of Development of the Arctic Sea Ports. *Sever i rynok: formirovanie ekonomicheskogo poryadka* [The North and the Market: The Formation of an Economic Order], 2018, no. 1 (57), pp. 55–66. DOI: https://doi.org/10.25702/KSC.2220-802X-1-2018-57-55-66
23. Domnina O.L., Tsverov V.V., Lisin A.A., Chuvilina O.V. Forecast of Digital Technologies Development in Transport Logistics. *Marine intellectual Technologies*, 2019, no. 4 (36), pp. 173–180.
24. Zalyvskiy N.P. The Northern Sea Route: the Potential of Expectations and the Real Functioning Problems. *Arktika i Sever* [Arctic and North], 2015, no. 20, pp. 37–57. DOI: https://doi.org/10.17238/issn2221-2698.2015.20.37
25. Ivanova M.V., Danilin K.P., Koshkarev M.V. The Northern Sea Route as a Coordination of Interests' Medium for Sustainable Socio-Economic Development of the Arctic. *Arctic: Ecology and Economy*, 2022, vol. 12, no. 4, pp. 538–550. DOI: https://doi.org/10.25283/2223-4594-2022-4-538-550
26. Leonov S.N., Zaostrovskikh E.A. Influence of the Ports of the Northern Sea Route on the Formation of Focal Zones for the Development of the Eastern Arctic. *Arctic: Ecology and Economy*, 2021, vol. 11, no. 1, pp. 6–18. DOI: https://doi.org/10.25283/2223-4594-2021-1-6-18
27. Selin V.S. Factor Analysis of Freight Flows Development along the Northern Sea Route. *Sever i rynok: formirovanie ekonomicheskogo poryadka* [The North and the Market: The Formation of an Economic Order], 2014, no. 6 (43), pp. 19–23.
28. Stepanov N.S. Trajectory of the Northern Sea Route Development: Problems and Prospects. *Russia and the Contemporary World*, 2022, no. 3 (116), pp. 94–116. DOI: https://doi.org/10.31249/rsm/2022.03.06
29. Rakhmangulov A.N., Muravyov D.S. The Development of the Regional Sea Port Infrastructure on the Basis of Dry Port. *Economy of Regions*, 2016, vol. 12, no. 3, pp. 924–936. DOI: https://doi.org/10.17059/2016-3-26

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