



Contents lists available at ScienceDirect

Polar Science

journal homepage: www.elsevier.com/locate/polar

Prospects for the development of the Northern Sea Route after February 2022: An analysis of Russia's policy in the new conditions

Diana Mikhailova, Shinichiro Tabata*

Slavic-Eurasian Research Center, Hokkaido University, Kita 9, Nishi 7, Kita-ku, Sapporo, Japan

ARTICLE INFO

Keywords:

Russian Arctic
Northern Sea Route
Russian policy
Sanctions
Oil and gas

ABSTRACT

This paper aims to evaluate Russian state policy towards the development of the Northern Sea Route with all the political, economic, and financial challenges that followed the war between Russia and Ukraine after February 2022. Much attention has been paid to the new plan of the development of the Northern Sea Route until 2035, adopted by the Government in August 2022 since this is a strategic document serving as a starting point in the analysis of Russia's long-term goals in the Arctic. The analysis shows that the Russian authorities do not want to downgrade the importance and potential of Arctic development, including the Northern Sea Route, although demand for Russian oil and gas is declining except in China and a few other countries, and Russia is having difficulties acquiring essential technologies from developed countries. The Russian Government appears to be more focused on the domestic purpose of the Northern Sea Route, i.e., maintaining the local economy in the Arctic region, including cabotage transportation (shipping between two Russian ports) and northern supply (*severnaya zavoz*).

1. Introduction

In 2022 the sustainable development of the Russian Arctic inevitably faced the consequences of geopolitical upheavals. Expanded Western sanctions that followed the outbreak of hostilities in Ukraine affected various areas, including the Arctic region. Several foreign companies (Equinor, British Petroleum, Total, etc.) left joint Arctic energy projects with Russia or froze its investments (Zhuravel, 2022). The EU sanctions regime banned the supply of technology and equipment to Russia for oil refining and liquefaction of natural gas¹ and imposed an embargo on supplies of Russian oil and refined petroleum products.² These measures could have a critical impact on the Russian economy in the long term, since oil and gas traditionally provide about half of the revenues of the

Russian federal budget.³

In response to sanctions and restrictions Russia intends to take countermeasures. This is stated by the Russian leadership at the highest level: on 13 April 2022, at the Meeting on the development of the Arctic zone, President Putin stressed that despite “various external restrictions and sanctions pressure,” all Arctic projects and plans “should be given special attention to.”⁴ This concerns increasing the supply of energy resources to other, *Non-Western*,⁵ regions of the world, attracting non-Arctic states and associations to cooperation in the Arctic, and developing transport corridors in the East, including the Northern Sea Route (NSR).

To Russia, the NSR is the most important entity in the Arctic. At the domestic level, the NSR plays an important social and economic role as

* Corresponding author.

E-mail addresses: mikhaloveme@gmail.com (D. Mikhailova), shin@slav.hokudai.ac.jp (S. Tabata).

¹ Council Regulation (EU) 2022/576 of 8 April 2022 amending Regulation (EU) No. 833/2014 concerning restrictive measures in view of Russia's actions destabilizing the situation in Ukraine, <https://eur-lex.europa.eu/eli/reg/2022/576/2022-04-08> (accessed 12 September 2023).

² EU sanctions against Russia explained, <https://www.consilium.europa.eu/en/policies/sanctions/restrictive-measures-against-russia-over-ukraine/sanctions-against-russia-explained/> (accessed 12 September 2023).

³ The share of oil and gas revenues in the federal budget in 2022 amounted to 41.6%, <https://minfin.gov.ru/ru/statistics/fedbud/execute/> (accessed 12 September 2023).

⁴ <http://kremlin.ru/events/president/news/68188> (accessed 12 September 2023).

⁵ In this paper, the West means “unfriendly countries” as defined in Government Resolution No. 313 of 9 March 2022, including Australia, Albania, Andorra, UK, EU, Iceland, Canada, Liechtenstein, Micronesia, Monaco, New Zealand, Norway, South Korea, San Marino, North Macedonia, Singapore, USA, Taiwan, Ukraine, Montenegro, Switzerland, and Japan. The Non-West includes all other countries.

<https://doi.org/10.1016/j.polar.2024.101054>

Received 3 October 2023; Received in revised form 1 February 2024; Accepted 13 February 2024

Available online 13 February 2024

1873-9652/© 2024 Elsevier B.V. and NIPR. All rights reserved.

the main route for northern supply (*severnii zavoz*) and serves as the connective tissue between Russia's beleaguered and often neglected Arctic landmass (Meade, 2020). Externally, the NSR allows the transportation of minerals from Arctic hydrocarbon deposits to foreign markets. Despite all existing obstacles, Moscow still intends to turn the NSR into a competitive international shipping corridor between Europe and East Asia.

After Russia faced unprecedented sanctions pressure in response to the aggression against Ukraine in February 2022, the Russian Government was forced to adjust previously made decisions and plans. One of the most important updates was the *Plan of the development of the Northern Sea Route until 2035* (hereinafter the 2022 Plan), adopted by Government Order No. 2115 of 1 August 2022. This Plan represents the extension of those provisions that were previously contained in other government programs (for example, the federal project "Development of the Northern Sea Route" compiled in accordance with the *Comprehensive Plan for the modernization and expansion of the main infrastructure until 2024* adopted by Government Order of 30 September 2018). Researchers agree that the course taken by Russia for a more fundamental development of the NSR and the revision of all implemented and proposed projects seems logical in the current turbulent situation (Medvedeva, 2022; Kotov, 2022). At the same time, others point out the discrepancy between Moscow's ambitious vision and reality related to the possibilities of international shipping along the NSR and the implementation of large energy projects (Solski, 2022).

The development of the NSR and the Russian Arctic zone after February 2022 is discussed in numerous studies. The articles of Medvedeva (2022), Zhuravel (2022), and Kotov (2022) address the current problems of the NSR under conditions of sanctions and restrictions. Smirnov (2023) attempts to analyze the advantages and disadvantages of the 2022 Plan and its potential as an innovative transport project. And yet, there are no studies considering the changes in Russian policy towards the NSR in 2022 and analyzing the 2022 Plan as a direct reflection of these changes.

Thus, this study aims to evaluate the prospects for the development of the NSR with all the political, economic, and financial challenges that followed the events of February 2022.

Although the development of the NSR can be attributed to a broader policy of the development of the Russian Arctic, and we recognize the interdependence between these areas, the article will not provide a comprehensive analysis of Russia's Arctic policy as such. Our intention to take a closer look at the policy regarding the NSR is associated with its growing role in the transport and logistics sector, as the geopolitical crisis and the redirection of supplies to the East have demanded new solutions in these areas.

To achieve the aim of the research, the narrative method will be used to present the main stages and directions of Russia's policy for the development of the NSR before and after February 2022, starting from the 2010s, when a set of key measures for the development of the Arctic zone was adopted. In addition, the discursive method will be used to analyze the public speeches of Russian politicians as one of the forms of articulation of the official view on the NSR (Section 2). An analysis of the general stages of Russia's policy for the development of the NSR in conditions of geopolitical turbulence and the official view on this development is necessary for a better understanding of how the Russian leadership responds to challenges and what measures it is ready to take to deal with them.

To highlight the economic and financial aspects of the matter, much attention will be paid to the 2022 Plan, as a core strategic document that integrates all the key activities for the development of the NSR for the next decade (Section 3). The study of the document is based on a qualitative content analysis and a comparative method, when provisions of the 2022 Plan are being thoroughly examined and compared with the data from other sources (Russian policy documents, publications, and studies related to the topic, etc.). Ultimately, this analysis will allow us to inductively evaluate the prospects for the development of the NSR

and assess their interdependence with external factors.

2. State policy for the development of the NSR

2.1. Background: main stages of policy before February 2022

In recent years, the significance of the NSR and its role in Russia's official agenda have strengthened. Starting with the adoption of a new set of measures for the development of the Arctic zone in the late 2000s, the Russian leadership aimed to create a single transport communication based on the NSR and increase its transit potential (Medvedeva, 2022). *Strategy of the development of the Arctic Zone of the Russian Federation and guarantee of national security until 2020*, adopted by President Decree No. 232 of 8 February 2013, announced plans for the year-round navigation on the NSR, which updated measures to develop its infrastructure, build an icebreaking and rescue fleet, ports, terminals, etc.

In the first half of the 2010s, utilization of the NSR was stimulated by the active development of oil and gas fields in the Arctic and the organization of enterprises for the extraction of hydrocarbons jointly with foreign companies. The drastic reductions of the sea-ice coverage in the Arctic Ocean due to the climate change also expanded the opportunities of the NSR (Gunnarsson and Moe, 2021). It created the prerequisites not only for the wide domestic use of the transport potential of the NSR, but also for the development of international shipping. As Gavrilova (2020) notes, during that period, the image of the NSR was mainly composed of two concepts: the NSR as a *transport corridor* connecting Russia with Europe and the Asia-Pacific region, and the NSR as a *transit route* – an alternative to the Suez Canal. In Russian politics, the idea of "profitability" of the NSR in comparison with southern sea routes was gaining popularity; not only economically, but also strategically. As stated by Dmitriy Rogozin, the Chairman of the State Commission for the Development of the Arctic, at the forum "Arctic: Today and the Future" in 2015, "[t]his is twice the shorter, more accessible, safe route, there are no Somali pirates. ... [T]he creation of a modern nuclear icebreaker fleet allows us to provide ice escort for all container ships" (Gavrilova, 2020). The image of the NSR as a "global" sea route became especially attractive for Moscow, since it meant the restructuring of sea trade routes and the reorientation of Russian goods to new markets, which could have a great impact not only on Russia's economy, but also that of the world's as well.

Studies of Russia's approaches to the legal regulation of the NSR conclude that the period between 2010 and 2014 could be described as an attempt to liberalize the legal regime of navigation on this route. At that time, the Russian authorities realized the need to improve the administrative and regulatory base of the Arctic shipping to attract international transport companies. More flexible conditions for international voyages were introduced with the *Regulations of the Navigation in the water area of the Northern Sea Route*, adopted by Instruction of the Ministry of Transport No. 7 of 17 January 2013. New rules reflected a more market-based approach and allowed Atomflot, the operator of the state-owned nuclear icebreaker fleet, to provide favorable icebreaker tariff rates to shipping companies, which increased the number of transit voyages on the NSR (Gunnarsson and Moe, 2021). By Government Order No. 358 of 15 March 2013, to liberalize the system of administration of the NSR and create greater transparency, a special body was established – the Administration of the Northern Sea Route (NSRA) as part of Rosmorrechflot (Federal Agency of Sea and River Transport) under the Ministry of Transport. It is important to note that while the new regime improved the conditions for commercial operations on the NSR, it did not change Russian views on the international status of the NSR (Moe, 2020).

In 2014, the financial, economic, and political environment changed

significantly, which led to a sharp decrease in international shipping on the NSR and its investment attractiveness with increasing geopolitical tensions (Medvedeva, 2022). In total, 31 transits⁶ (274 thousand tons) were carried in 2014, while a year earlier the number of transits was 71 (1.36 million tons) (Fig. 1). At the same time, the total volume of cargo continued to grow, increasing from 4.0 million tons in 2014 to 20.2 million tons in 2018 (Fig. 2).

After rising geopolitical tensions in 2014, Russia began to develop a more protectionist approach towards the NSR: while maintaining the overall development dynamics, the main attention of regulatory bodies was focused on optimizing management efforts for internal purposes (Solski, 2022). In 2015, the Ministry of Transport proposed restricting the operation of foreign ships on the NSR. Federal Law No. 460 of 29 December 2017 entered into force on 1 February 2018 and initially concerned only *cabotage* voyages (shipping between two Russian ports) and was intended to transfer taxes and other revenues from the transportation to the Russian budget, which was previously remitted to foreign companies. However, since 6 June 2021, Russia has also established a ban on the use of new foreign ships for the transportation of hydrocarbons produced in the Russian Arctic; the exclusive right to these works was given only to vessels *built* on the territory of the Russian Federation (according to Federal Law No. 142 of 26 May 2021). The Russian shipbuilding industry lobbied for the law, in particular the new shipbuilding company “Zvezda” in the Far East. And although foreign ships may still be allowed to such transportation by a special permission of the government (for example, foreign-flagged vessels for the Yamal LNG project), these regulations set the tone for Russia’s increasing control of future shipping on the NSR (Gunnarsson and Moe, 2021).

Moscow’s new vision obviously no longer coincided with the NSR regime that was formed after the adoption of the regulations in 2013, so the government announced that it wanted to reform the management of the NSR (Moe, 2020). Eventually the management of the NSR was divided between the Ministry of Transport and the state nuclear energy corporation Rosatom, the owner of Atomflot. Federal Law No. 525 of 27 December 2018 implied the principle of a “two-key” (*dva klyucha*): some of the functions remained under the jurisdiction of the Ministry’s Rosmorrechflot – regulation of navigation on the NSR, fulfilment of Russia’s international obligations, federal state supervision in the field of transport, etc.; others were transferred to Rosatom – management of the nuclear icebreaker fleet, proposals for the formation of state policy on the NSR, organization of navigation, etc. During the lobbying of the law, Rosatom wanted to take over the key function of issuing permits to sail the NSR, which was assigned to the NSRA. The Ministry of Transport was against the reduction of its powers. Eventually the government supported the model where the Ministry – through the NSRA – is to continue to issue permits, although in coordination with Rosatom (Moe, 2020). Since the functions of Rosatom and the Ministry overlapped in several key areas, the government was to deal with disputes on an individual basis. Experts noted that the law did not fully define the relationship between the structures and did not give clear instructions for resolving contradictions, especially regarding responsibility for hydrography and vessel navigation (Kommersant, 4 December 2018).

One of the most important stages in increasing the efficiency of the NSR as a trade route is making the year-round navigation possible. This implies major changes in management and infrastructure spheres, including improved sea-ice predictions and ice reconnaissance. Given the long distances, well-equipped land-based and offshore emergency stations must be strategically placed along the whole length of the NSR, enabling a timely response to all kinds of ship emergencies. Other necessary infrastructure improvements include the modernization of ports and better navigational infrastructure and hydrography, ice-navigation, and communication systems (Gunnarsson and Moe, 2021).

These infrastructure needs are recognized in Russia, as evidenced by the adoption of Government Order No. 3120 of 21 December 2019 of the *Plan of the development of the infrastructure of the Northern Sea Route until 2035* (hereinafter the 2019 Plan) – the first attempt to establish all the necessary measures (Erokhin et al., 2022).

The 2019 Plan was designed by Rosatom⁷ and provided for measures to develop a cargo base, modernize infrastructure, support domestic shipbuilding, organize hydro-navigation, meteorological, rescue, communication and information systems, etc. The document consisted of 20 pages and included 84 items, almost half of which were to be implemented by 2022. It did not include any financial sources for the planned projects, however, the head of Rosatom Alexey Likhachev estimated the plan at 735 billion rubles, a third of which was to be financed from the state budget, and the rest by the companies-shareholders of the plan (Golubkova and Stolyarov, 2019). Incidentally, Rosatom’s proposals for the plan during its development were criticized by Deputy Prime Minister Yuri Trutnev for being overly focused on icebreakers and not paying enough attention to the infrastructure (Kommersant, 25 July 2019). The 2019 Plan has not undergone any drastic changes since then and remained the most relevant document in the field of the development of the NSR until August 2022.

Nevertheless, even despite the decrease in international activity along the NSR and the adoption of restrictive measures, as well as the absence of an effective administrative system serving international and domestic shipping, Moscow still desires to turn the NSR into a competitive shipping route. The strategic and economic significance of the Northern Sea Route is stressed in the *Fundamentals of the State Policy of the Russian Federation in the Arctic until 2035*, adopted by President Decree No. 164 of 5 March 2020 and the *Strategy of the development of the Arctic zone of the Russian Federation and guarantee of national security until 2035*, adopted by President Decree No. 645 of 26 October 2020, which considers the NSR as a “transport corridor of world importance.”

Thus, over the past 10 years, there has been a progressive development of the policy aimed at expanding the capabilities of the NSR. Despite attempts to create favorable conditions for foreign shipping companies, international activity along the NSR remained volatile after the sharp fall of transit shipping volumes in 2014–2015. At the same time, the overall growth of the cargo volume demonstrated the importance of cabotage for domestic services as well as increasing hydrocarbon exports from the Russian Arctic to foreign countries.

Russia’s growing protectionism over its Arctic resources, embodied in several restrictive initiatives, has also been noticeable. Although fundamental problems remained in the 2010s, ranging from unclear management systems to underdeveloped infrastructure, the analysis shows that the Russian leadership, at least, is taking these challenges into account. At the same time, a dilemma remains in which, on the one hand, the Kremlin wants to develop the NSR as a competitive international route, and on the other hand, maintain full sovereignty over the NSR and support the domestic shipbuilding industry.

2.2. The NSR in the new conditions

Escalation of international relations after 24 February 2022 has influenced the tone of Moscow’s official rhetoric on the Arctic. To understand exactly how the Russian leadership perceived the new geopolitical and economic conditions, it is necessary to take a closer look at the Meeting on the development of the Arctic zone of the Russian Federation, held on 13 April 2022 between President Putin and members of the Government. This meeting was the first state event dedicated to the Arctic development after February 2022.

⁶ In this paper, *transits* mean voyages that crossed both western and eastern NSR boundaries, i.e., Novaya Zemlya and Bering Strait, respectively.

⁷ According to Article 30, Part 5 of Federal Law No. 261 of 8 November 2007 *On sea ports in the Russian Federation and on amendments to certain legislative acts of the Russian Federation*. Part 5 was added by the above-mentioned Federal Law No. 525 of 27 December 2018.

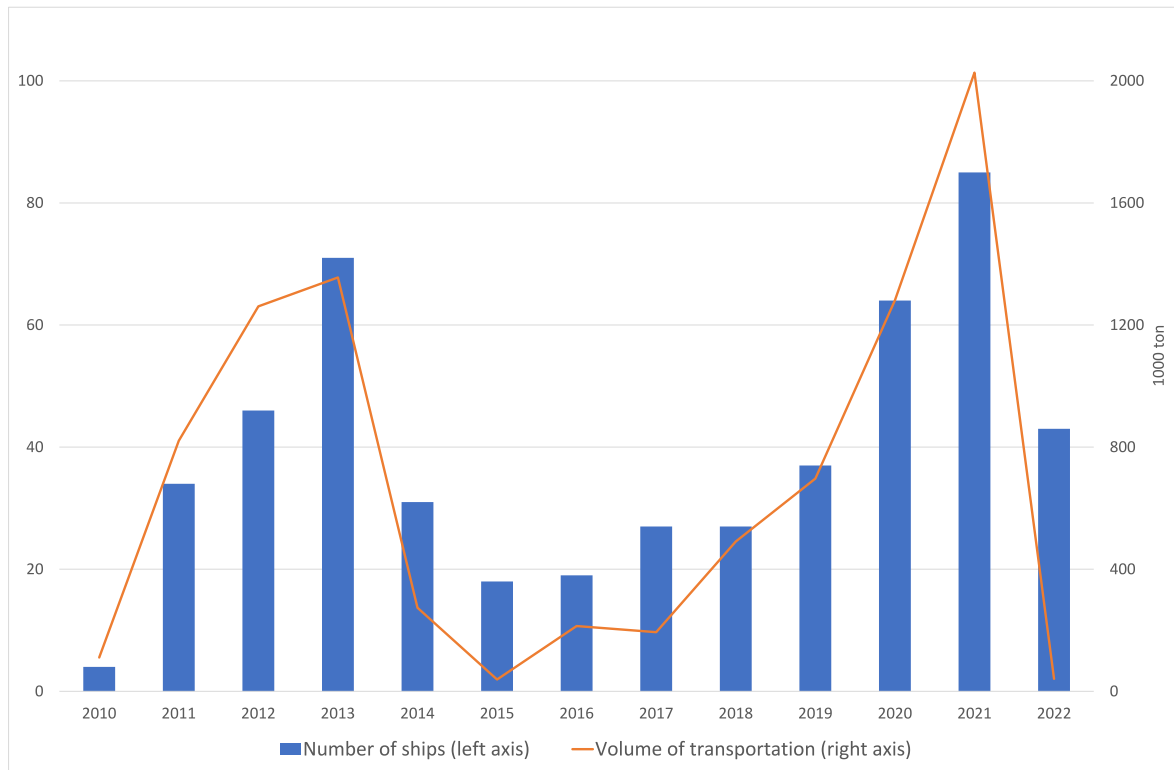


Fig. 1. Development of transits along the NSR, 2010–2022.
Sources: Compiled by the authors from CHNL (2023).

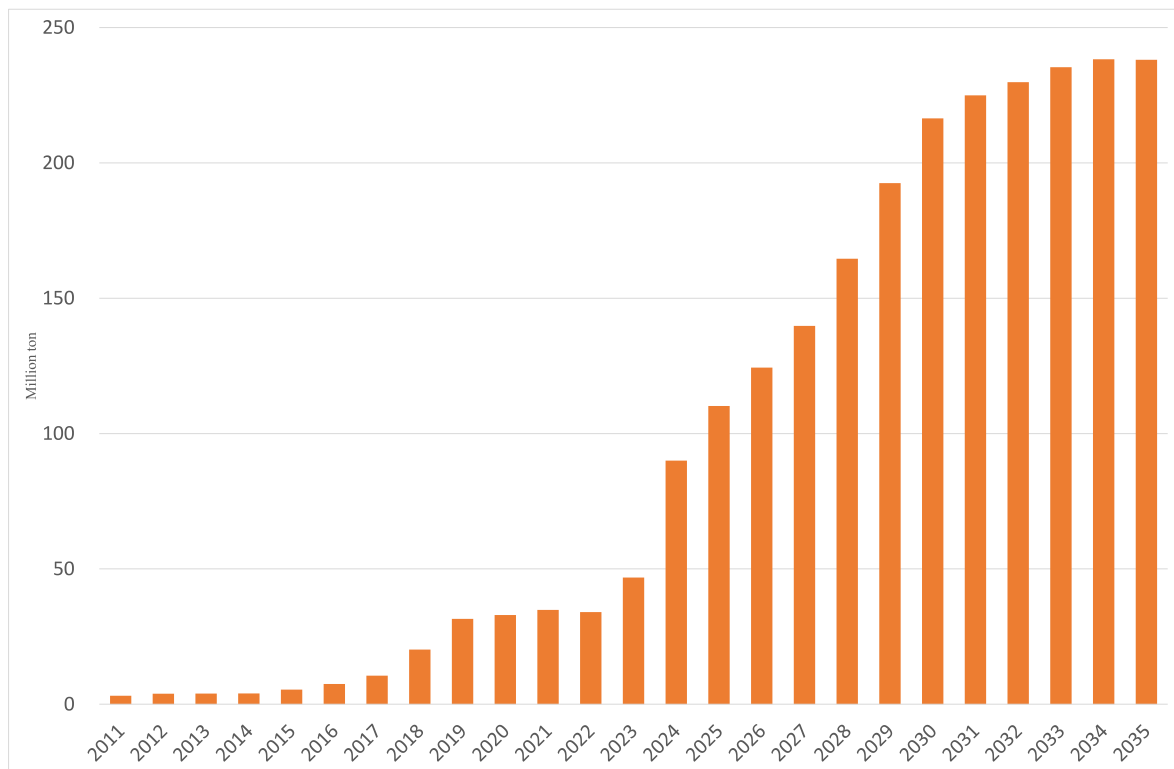


Fig. 2. Volume of cargo transportation along the NSR, 2011–2035
Notes: Data after 2023 are projection by the 2022 Plan.
Sources: Compiled by the authors from Centre for High North Logistics CHNL, 2023 and the 2022 Plan.

Putin placed emphasis on the social sphere: providing residents and social facilities of the Arctic territories with supplies according to the schedule is a primary task, the same applies to the implementation of priority investment projects, he noted. In this regard, Putin instructed the Government to develop a federal law on northern supply and create a single maritime operator for its implementation.

Speaking about the current geopolitical situation, Putin noted: "... [B]ecause of the actions of unfriendly countries, several transport and logistics chains have been disrupted." Though for Russia, "new windows of opportunities" are opening. "... [A]s for Russian oil, gas, coal, we will be able to increase their consumption in the domestic market ... as well as expand the supply of energy resources to other regions of the world ... To solve this problem, we will use all available opportunities, including the development of transport corridors."

Such narratives give a new impetus to the development of the NSR, since the redirection of supplies to the East is currently one of the primary transport tasks for Russia. Following this logic, the NSR would allow Russia to not only relieve the Far Eastern railways, but also to show in practice the advantages of this shortest sea route from Europe to East Asia. In this regard, the President instructed the creation of a new plan for its development until 2035.

The 2022 Plan was adopted by the Government on 1 August 2022 and replaced the previous 2019 Plan. It consists of several new items, indicates the amount of funding (including budgetary and extra-budgetary funds); the content of the document is more extended and detailed (compared to the previous version, the new plan includes more than 150 items), which also demonstrates the Kremlin's awareness of the need to update the models of both initiated and planned projects (Kotov, 2022). Rosatom was again involved in the development of the plan, but this time, according to Vyacheslav Ruksha, Director of the NSR Directorate of the State Corporation Rosatom, proposals from a large number of stakeholders were taken into account, ranging from executive authorities to resource extraction companies. The latter provided their data on the projected production and cargo volumes for the NSR (Rusatom Energo International, 1 August 2022).

Among the priority areas of the 2022 Plan are the development of the cargo base, transport infrastructure, the northern fleet, ensuring the safety of navigation along the NSR, etc. The State Commission for the Development of the Arctic, the Ministry for the Development of the Russian Far East and the Arctic, together with the Coordinating Center under the Government of the Russian Federation, have been appointed as the bodies responsible for the implementation of the plan and its coordination. The Ministry for the Development of the Russian Far East and the Arctic was not previously involved in the development of the NSR (according to the 2019 Plan), but now this body is required to update the Government on the progress. The 2022 Plan's provisions will be discussed more thoroughly in Section 3.

Moving to other significant events related to the NSR, it is worth paying attention to changes in the field of navigation management. As noted by Zamyatina (2022), until 2022, there was some confusion in the use of the NSR, since functions of the icebreaking escort and ice pilots in the NSR water area were not regulated by the legislation. As we discussed earlier, since 2018 Rosatom has "shared" the management of the NSR with the Ministry of Transport, which was not the most efficient model.

On 1 August 2022, by Government Order No. 2019 of 23 July 2022, the Main Directorate of the NSR (*GlavSevmorput*) was created as part of Rosatom, the subject of which is:

- "ensuring the organization of icebreaking escort of ships and escorting ships along the navigation routes in the water area of the Northern Sea Route, as well as the development of navigation routes and the implementation of the placement of ships of the icebreaking fleet in the water area, considering the hydrometeorological, ice and navigational situation in the water area;

- issuance, suspension, renewal and termination of permits for navigation of vessels in the water area, amendments to such permits."⁸

The creation of the Directorate relates to Russia's plans to improve the safety of navigation along the NSR and increase the commercial attractiveness of this route for foreign shipping companies. This is also an indicator of the centralization of powers in Rosatom, since now the control over the navigation of ships in the water area of the NSR has been completely transferred to the corporation. Previously, these functions were assigned to the Administration of the Northern Sea Route (NSRA) as part of the Ministry of Transport. Since the Ministry lost these powers, a "two-key" principle, which had existed since 2018, also disappeared: Rosatom became the sole structure for managing the navigation on the NSR. It is difficult to say how effective this decision is at the moment, but the centralization of powers in one structure should at least increase the coherence of work and reduce the risk of coordination errors.

Interestingly, that on 31 July 2022 a new Russian Maritime Doctrine was also updated by President Decree No. 512. The new document highlights the regional directions of national maritime policy with the Arctic at the top of the list, followed by the Pacific Ocean and the Atlantic (in the previous version of the doctrine, adopted by President Decree No. 1210 of 17 June 2015, the Atlantic direction was the first). The comprehensive development of the NSR in order to transform it into a safe, year-round, and globally competitive national transport communication of the Russian Federation is designated as one of the priority areas of maritime activity in the Arctic (Part 5, paragraph 50). There is also a specification of some tasks, in particular, the creation of a telecommunications infrastructure for the transport complex of the Arctic and the development of the shipbuilding complex of the Far East. These measures, along with the improvement of the navigation management system in the water area of the NSR, the development of icebreaker and rescue fleets, etc., are also contained in the 2022 Plan. Mention of these measures in the Doctrine, which is not part of the set of documents on the development of the Arctic zone, may be an indicator of the growing role of the Arctic direction in general and the NSR in particular among the national interests of Russia.

In 2022, within the framework of the above-mentioned federal project "Development of the Northern Sea Route," subsidized cabotage voyages were carried out along the NSR for the first time. Government Resolution No. 397 of 18 March 2022 provides for the annual allocation of 560 million rubles from the federal budget to subsidize two round voyages between the ports of the North-West and the Far East of Russia. Subsidization of transportation is designed to stimulate the development of the route and show that its active operation is possible and safe (Zamyatina, 2022).

In November 2022, the flag was hoisted on the nuclear icebreaker Ural in St. Petersburg. The construction of icebreakers is one of the priority areas for the development of the NSR: the third and fourth serial nuclear icebreakers Yakutia and Chukotka are to be commissioned in 2024 and 2026, respectively. Moreover, on 2 February 2023, Atomflot signed a contract for the construction of the fifth and sixth serial nuclear icebreakers of project 22220 (Rosatomflot, 3 February 2023). The importance of developing the shipbuilding industry was emphasized by Prime Minister Mishustin during a strategic session on the NSR on 6 June 2023. The strategic session was attended by members of the Government and chairmen of large Russian companies (Rosatom, Novatek, Nor-nickel, Gazprom neft, etc.), some of the stakeholders of the 2022 Plan. Topics on the need to redirect the cargo volumes from West to East and stimulate shipbuilding were once again highlighted during the session, which indicates that the Russian leadership adheres to the directions for the development of the NSR, formed in 2022 (News – The Russian

⁸ GlavSevmorput's website, <https://nsr.rosatom.ru/o-kompanii/predmet-deyatelnosti-i-funktsii-gusmp/> (accessed 10 September 2023).

Government, 6 June 2023).

Regarding the prospects for international shipping on the NSR, it should be noted that in 2022 there was not a single fully international transit via the NSR (Centre for High North Logistics CHNL, 2023). According to Rosatom, the reason was financial risks, the sanctions policy, and the lack of an appropriate fleet from partner companies (Port News, 1 September 2022). Therefore, there was a sharp decline in the volume of cargo transported in transits in 2022 (Fig. 1). But even despite this, the prospects for international shipping along the NSR remain and continue to be actively discussed in the Russian political environment, with high hopes for the participation of Chinese shipping companies (Interfax, 21 March 2023).

The NSR was one of the topical themes of Russia's policy in 2022. In general, the state continues the previously outlined course for the integrated development of the NSR infrastructure. However, the Kremlin's awareness of the need to update major infrastructure plans and projects, together with the growing internal factor in the decision-making process should be taken into consideration. This was manifested primarily in the increased attention of the authorities paid to the law on northern supply, the transfer of powers to Rosatom, a comprehensive update of the NSR development plan, etc. A new ambitious vector is being laid for transforming the NSR into one of the main transport corridors of Russia with a focus on eastern markets and for increasing the cargo volume with the help of energy projects.

3. Prospects for the development of the NSR

3.1. The present situation

The volume of cargo transportation along the NSR was 34.034 tons in 2022, decreasing by 2.3 percent from 34.85 million tons in 2021 (Fig. 2). Out of 34 million tons, LNG and gas condensate was 20.5 million tons, oil and petroleum products – 7.22 million tons, coal – 0.295 million tons, iron – 0.0435 million tons, and general cargo – 4.25 million tons (High North News, 18 January 2023). Among them, transits were only 41 thousand tons, down from 2207 thousand tons in 2021. Even in 2021, transits accounted for only 5.8 percent of the total transportation (Centre for High North Logistics CHNL, 2023).

The fact that the total volume decreased slightly in 2022 indicates that exports of LNG and crude oil from Russia did not decrease in spite of sanctions. In fact, Russia's exports of LNG and crude oil were reported to increase by 7.9 percent and 7.6 percent, respectively (Novak, 2023). Note that 64.6 percent of LNG was produced in Yamal and 35.4 percent in Sakhalin in 2022 and all of LNG was exported.⁹

In 2021, 59.3 percent of crude oil and 82.3 percent of LNG in quantity was exported to the West.¹⁰ Although Russia's oil exports did not decrease in 2021, they are expected to decrease significantly within a couple of years, since the Non-West, including China and India, will not be able to cover all of the decreases in exports to the West. It should be remembered that in May 2022, the EU declared the intention of reducing the fossil fuel dependence from Russia to zero by 2027.¹¹ With respect to exports of LNG, instead of the West, China may receive all exports from Russia if its exports continue at the current level. Note that China's share in Russia's export of LNG was 17.2 percent in 2021.

Thus, it is safe to predict that exports of crude oil and LNG to China in quantity will increase from the present level in the near future. This indicates that the importance of the NSR as an eastward transportation

route of LNG and crude oil will be maintained or enhanced.

3.2. Targets of the 2022 Plan

Table 1 shows the volume of cargo transportation projected by the 2022 Plan. The goal for 2024 was set at 90 million tons, which was higher than the previous goal, i.e., 80 million tons declared by President Decree No. 204 of 7 May 2018. The new goal for 2030 is 216 million tons. This largely exceeds the previous one, i.e., 150 million tons, approved by target indicators of the strategic initiative "Year-round NSR" that was discussed at the meeting of the Council of Strategic Development and National Project on 19 July 2021.¹² It should be noted that in the *Strategy of the development of the Arctic zone of the Russian Federation and guarantee of national security until 2035* adopted in 2020, the target was 90 million tons for 2030 and 130 million tons for 2035.

Clearly, what is behind this ambitious increase in targets is the great expectations of crude oil and LNG projects in the Arctic. Dependence of the NSR development on oil and gas projects has been apparent since 2014 when the increase in transits began to stagnate or decrease. As the following evidence shows, the Russian authorities have maintained this dependence on oil and gas in spite of unprecedented geopolitical tensions in the present world. We doubt the possibility of achieving these targets for two reasons. First, as we saw in the previous section, demand for Russia's oil and gas from the West is expected to decline. Second, Russia will suffer from the embargo on exports of high technology equipment which are essential for the development of new fields and construction of new production facilities and ships. In the following part, we consider the possibility of major projects included in the targets of the 2022 Plan.

First, we want to point out the high degree of dependence on the Vostok Oil project, which is to be implemented in Krasnoyarsk Krai. Transportation volume by this project was to increase from 30 million tons in 2024 to 100 million tons by 2030, accounting for 33.3 percent and 46.2 percent of total cargo transportation of the NSR, respectively. Therefore, it is crucial for the realization of the 2022 Plan that the Vostok Oil project can reach these goals. Yermakov and Yermakova (2021) wrote that this project, if realized to plan, might become a real game-changer for Russia's overall hydrocarbon development in the Arctic and for the expansion of shipments via the NSR in particular. The goal of this project for 2024 presupposes a change of the transportation route of oil produced in operating oil fields including Vankor from the existing pipeline to the NSR. In turn, it presupposes the construction of a new oil exporting terminal "Bukhta Sever" in the Yenisey Gulf, about 40 km southwest of Port Dikson (Par. 2.1.2).¹³ It also requires at least ten Arc7 ice-class tankers (Izhbuldin, 2023). The construction of Bukhta Sever began in July 2022,¹⁴ and the Government issued Order No. 15 of 12 January 2023 to finance this investment as indicated in Par. 2.1.2. Although it may be possible to transfer nearly 30 million tons of oil produced in operating oil fields to this new bay by 2024, the task of constructing oil tankers remains to be solved. The difficulties of this construction were caused by the embargo on exports of high technology equipment to the Zvezda shipbuilding company in Vladivostok where these oil tankers were to be constructed with Korean and US companies (Izhbuldin, 2023; Zamyatina, 2022). In order to overcome this problem, the Government added new paragraph 3.4 to the 2022 Plan by Government Order No. 1103 of 28 April 2023, which instructed the development of domestic parts required for icebreakers, ice-class tankers, and rescue fleet ships (News – The Russian Government, 2 May 2023).

With respect to the target of Vostok Oil for 2030, i.e., 100 million

⁹ Rosstat's website, https://rosstat.gov.ru/enterprise_industrial# (accessed 14 July 2023).

¹⁰ FCS, 2022 and International Trade Centre's website, <https://www.trademap.org/Index.aspx> (accessed 14 July 2023).

¹¹ See REPowerEU plan, https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/repower-eu-affordable-secure-and-sustainable-energy-europe_en (accessed 24 July 2023).

¹² kremlin.ru/d/66217 (accessed 24 July 2023). Out of 150 million tons, 30 million tons were to be transported by transits.

¹³ Par. ## in parentheses shows the paragraph number listed in the 2022 Plan.

¹⁴ News at Rosneft's website, 26 July 2022, <https://www.rosneft.ru/press/news/item/211323/> (accessed 29 June 2023).

Table 1

Projected volume of cargo transportation by the 2022 Plan, in million tons, 2023–2035.

	Shipper	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Novyi Port	Gazprom neft	6.14	5.56	4.71	4.38	4.05	3.73	3.46	3.14	2.86	2.64	2.43	2.25	2.09
Vostok Oil	Rosneft		30.00	35.00	40.00	50.00	65.00	80.00	100.00	100.00	100.00	100.00	100.00	100.00
Yamal LNG	Novatek	20.00	19.70	19.90	19.30	19.40	19.70	20.00	19.50	19.50	19.50	19.50	19.50	19.50
Arctic LNG-1	Novatek					2.30	7.00	13.10	17.90	21.00	21.20	21.60	21.60	21.50
Arctic LNG-2	Novatek	3.60	12.60	14.40	21.20	21.60	21.60	21.50	21.40	21.40	21.40	21.40	21.40	21.40
Obsky LNG	Novatek		0.60	5.10	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20
Norilsk Nickel	Nornickel	0.96	0.96	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Syradasaysky coal deposit	Severnaia zvezda	1.80	3.50	5.30	7.00	7.00	7.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
Baimsky deposit	Baimskaia					0.34	1.13	1.35	1.38	1.26	1.05	1.28	1.24	1.01
Other projects		0.30	0.31	0.31	0.31	0.44	0.78	0.78	0.77	0.77	0.77	0.76	0.76	0.75
Other (supply cargo, "northern supply," transit)		14.02	16.78	24.41	25.92	28.40	32.37	34.07	34.08	39.89	44.99	50.10	53.28	53.58
Total		46.82	90.01	110.21	124.39	139.81	164.59	192.54	216.45	224.96	229.83	235.35	238.31	238.11

Sources: Compiled by the authors from the 2022 Plan.

tons, the development of new oil fields will be necessary. If we take into account the declining demand for Russian oil, it seems unlikely that Rosneft will be able to develop new fields in these areas (Ross, 2023). It should be noted that Rosneft has not changed these targets for 2024 and 2030 since 2021, which means that they have not taken the present geopolitical conditions into consideration.

Second, there are four LNG projects in Table 1. They altogether account for 36.6 percent and 29.6 percent of total cargo transportation of the NSR in 2024 and 2030, respectively. Probably, Yamal LNG will be able to maintain the present level of production and exports until 2035. But the other three projects are new ones, indicating that Novatek has to develop them within a couple of years in order to achieve these targets.

It should be noted that in the long-term development program of LNG production in the Russian Federation, approved by Government Order No. 640 of 16 March 2021, the capacities of these three projects are projected as follows (In million tons. Year of realization in parenthesis):

Arctic LNG-2: 19.8 (2023–2025)

Obsky LNG: 5–6 (possibly after 2024)

Arctic LNG-1: 19.8 (possibly after 2027)

These targets are more or less the same as in Table 1, implying that Novatek also has not taken account of the new geopolitical situation. Concerning Arctic LNG-2, an export terminal "Utrennii" on the Gydan Peninsula (YNAO) started operation in April 2023 (Port News, 24 April 2023). Leonid Mikhelson, Novatek CEO, reportedly confirmed in February 2023 that the first of the project's three trains would be put into operation in late 2023 while the second and the third trains will be launched in 2024 and 2026, respectively (Neftegaz.RU, 6 February 2023). The capacity of the first train is 6.6 million tons. As Sakaguchi (2023) points out, it is doubtful that its second and third trains will be built on schedule since they will require some key equipment not available domestically.

With respect to Obsky LNG, planned to be built near Yamal LNG, it seemed that Novatek postponed this project together with the ammonia and hydrogen production project due to the difficulties of obtaining equipment (Vedomosti, 7 September 2022). Since Arctic LNG-1, planned to be constructed in the southern part of the Gydan Peninsula, may be realized after Arctic LNG-2, until 2030 we can expect the production of only 6.6 million tons of LNG from these three projects: further increases in LNG production are likely to be difficult. If so, the transportation of LNG along the NSR will be approximately 26 million tons in 2030, not the 64 million tons indicated in the 2022 Plan.

Third, the development of the Syradasaiskoye coal deposit, located in the west of the Taymyr Peninsula (north of Krasnoyarsk Krai), has also

not proceeded as planned. Oleg Demchenko, Chairman of the Board Directors of Severnaia Zvezda, which is a subsidiary of Nornickel, admitted that although his company started to supply 100 thousand tons of coal to China in October 2022, there were difficulties in building a new plant due to problems with the procurement of equipment caused by sanctions (Vedomosti, 1 March 2023). This project was to transport 3.5 million tons of coal by 2024 and 12 million tons by 2030.

Fourth, we observe a significant increase in "Other" in Table 1, which includes supply cargo, northern supply, and transits. As for 2022, if we subtract the transportation of oil, gas, and coal from the total volume, we get 6 million tons (See these data in Section 3.1). But in Table 1, "Other" will be 14 million tons in 2023 and 16.78 million tons in 2024. It may include some equipment for resource development. However, we cannot understand why it will be so large.

It is true that in the 2022 Plan, the development of northern supply is emphasized, which is annual state measures to provide the territories of the Far North with basic vital goods (primarily food and oil products) on the eve of the winter season. For example, the development of cabotage transport was noted, including the organization and subsidization of regular cabotage voyages along the NSR from the North-Western ports of Russia to the Far East and back (Par. 1.2). The second example is the development of river transport corridors as a means of ensuring stable northern supply (Par. 2.3). The third example is the construction of ships for northern supply (Par. 3.1.7). In addition, following the request by Putin at the Meeting on the development of the Arctic zone of the Russian Federation in April 2022, Federal Law No. 411 of 4 August 2023 *On northern supply* was adopted, which will be put into effect on 1 April 2024. It should be noted, however, that finances are not identified for Par. 2.3 and 3.1.7. We cannot expect these measures to produce results immediately and boost the transportation of "Other" to such a high level in 2023 and 2024.

Contrary to our evaluations, Aleksei Chekunkov, Minister of Development of the Far East and Arctic, stated at the St. Petersburg international economic forum in June 2023 that Novatek, Vostok Oil, Gazprom neft, Nornickel, Baimskaia, and northern supply will provide the NSR with at least 71 million tons in 2024 and more than 190 million tons in 2030 (Rossiiskaia gazeta, 26 June 2023).

3.3. Financial sources for the 2022 Plan

The 2022 Plan was to be financed by the federal budget and private sources. The total from 2022 to 2035 will amount to 1790 billion rubles (\$29 billion, converted by the official rate at the day of the adoption of this plan). Most of the expenditures are not single-year expenditures, but multi-year expenditures. Assuming that spending is evenly distributed over multiple years, approximately 60% will be spent between 2022 and

2025, and little will be spent after 2031.

It should be noted that not all listed measures have clear funding. In addition, some items include totals but do not include a breakdown of federal and private funds. There are many items where their financial sources are not written. For example, among Par. 1 (Cargo base), only Par. 1.2.1 (Organization of cabotage voyages) has those sources, and among Par. 5 (Management and development of navigation along the NSR) only Par. 5.2.5 (Creation and development of a unified platform for digital services of the NSR) has them. This may come as no surprise, as many of the items are about writing proposals and programs. However, there are some items, such as building a fleet (Par. 3.1.3–3.1.7), where the source of funding is not provided.

In Table 2 summarizing these expenditures, “Off-budget” means private funds. Federal budget and private funds account for 34.6 percent and 22.7 percent of total funding, respectively. The remaining 42.7 percent of the funds (764 billion rubles) have not been identified. Of this, 570 billion rubles is related to railroad (Par. 2.2). Among them is the Northern Latitudinal Railway in YNAO (507 billion rubles. Par. 2.2.1). This cost has the following footnote: “The parameters and sources of financing the construction of the Northern Latitudinal Railway will be clarified when agreeing on the financial model for the implementation of the project.” This project was the most expensive one in the 2022 Plan which accounts for 28.3 percent of total funding. In addition, funding for the construction of the fifth and sixth serial universal nuclear icebreakers (Par. 3.2.6 and 3.2.7) totaling 118 billion rubles is not specified, but funding for the construction of the third and fourth serial universal nuclear icebreakers (Par. 3.2.2 and 3.2.3) and funding for four more icebreakers (220 billion rubles. Par. 3.2.11) are shown.

Railroad, icebreaker, and safety infrastructure are the three largest items of expenditures. Private funding accounts for more than half of the icebreaker fleet, but the construction of fleets and ships (Par. 3.1) does not list the funding sources as noted above. Two-thirds of federal budget resources are earmarked for safety infrastructure, including emergency rescue and Arctic satellites.

Table 2
Financing of projects proposed in the 2022 Plan.

		billion rubles				Share in percent			
		Sum	Federal budget	Off-budget	Un-identified	Sum	Federal budget	Off-budget	Un-identified
1.2.1	Organization of cabotage voyage	7.8	7.8			0.4	1.3		
2	Transportation infrastructure	791.8	79.4	121.6	590.8	44.2	12.8	29.9	77.3
2.1	Port	221.6	79.4	121.6	20.6	12.4	12.8	29.9	2.7
2.1.1	LNG terminal "Utrennii"	40.6	40.6			2.3	6.5		
2.1.5	LNG transshipment complex in Kamchatka	32.0	12.0	20.1		1.8	1.9	4.9	
2.1.16	Coal transshipment in Murmansk	46.5		46.5		2.6		11.4	
2.2	Railroad	570.2			570.2	31.8			74.6
2.2.1	Northern Latitudinal Railway	506.5			506.5	28.3			66.3
3.2	Icebreaker fleet	539.1	119.5	276.8	142.8	30.1	19.3	68.1	18.7
3.2.3	Construction of the 4th serial universal nuclear icebreaker	41.8	6.5	35.3		2.3	1.0	8.7	
3.2.4	Construction of the lead icebreaker	99.1	99.1			5.5	16.0		
3.2.11	Construction of 4 icebreakers	220.0		220.0		12.3		54.1	
4	Safety of navigation along NSR	438.0	409.3	6.8	22.0	24.5	66.0	1.7	2.9
4.1	Creation of the Arctic satellite constellation	150.7	150.7			8.4	24.3		
4.1.1	Space complex of a highly elliptical system	33.4	33.4			1.9	5.4		
4.1.3	Space system in 4 spacecrafts of the Arktika-M type	48.4	48.4			2.7	7.8		
4.1.5	Space system in 2 spacecrafts of the "Kondor-FKA" type	33.3	33.3			1.9	5.4		
4.4	Development of emergency rescue infrastructure	218.2	211.4	6.8		12.2	34.1	1.7	
4.4.2	Construction of 30 rescue fleet vessels	98.2	91.4	6.8		5.5	14.7	1.7	
4.4.3	Maintenance of the rescue fleet	47.7	47.7			2.7	7.7		
5.2.5	Creation and development of a unified platform for digital services	13.7	3.8	1.4	8.5	0.8	0.6	0.4	1.1
	Total	1790.5	619.9	406.6	764.1	100.0	100.0	100.0	100.0

Notes: Many items under 30 billion rubles are omitted.
Sources: Compiled by the authors from the 2022 NSR Plan.

4. Conclusion

After the outbreak of hostilities in Ukraine in February 2022, due to unprecedented sanctions pressure, the Russian Government began to search for new models for the development of existing and planned projects. One of them was the 2022 Plan, which contains measures for the development of the NSR until 2035.

Having compared the provisions of the plan with several external factors, including a ban on the supply of equipment and high technologies for the energy industry, a decrease in demand for Russian oil and gas in the West, and insufficient shipbuilding capacity, we concluded that achieving the ambitious goals of the 2022 Plan is unlikely. Increasing the cargo volume of the NSR largely relies on the implementation of energy projects such as Vostok Oil, Arctic LNG-1 and 2, Obsky LNG, etc. By placing a high stake on these projects, the Russian Arctic remains dependent on the production and export of oil and gas, which, in extremely unfavorable geopolitical conditions for Russia, can increase its economic vulnerability.

At the same time, Russian politicians are optimistic about redirecting energy exports to eastern markets, in particular China and India. In light of this, the NSR, as one of the eastward transportation routes, may begin to play an even greater economic and strategic role for Russia. But since it is impossible to predict the level of production of Russian hydrocarbons and their demand in the coming years, the transformation of the NSR into the key Far Eastern route raises questions. It should also be noted that the year-round navigation along the NSR is only a prospect that will not give instant results and a skyrocketing navigation will not start automatically.

As for the other ambitious idea of creating a competitive international shipping corridor based on the NSR, which was actively discussed during public speeches by Russian politicians and other high-ranking officials, political changes in recent years have increased the contradictions in the Kremlin’s vision. Protectionism, which determines numerous decisions on the NSR, arose before February 2022; sanctions and geopolitical tensions have also accelerated the process of

diversifying goals for the NSR with an emphasis on domestic purposes. The increased attention of the authorities to the law on northern supply, monopolization of powers in Rosatom, subsidization of cabotage transportation, and the resource projects-oriented 2022 Plan indicate that Russia's policies for the NSR are becoming more diverse yet inward-looking.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The author wishes to thank Fujio Ohnishi for comments on earlier drafts. This work was partially supported by the Arctic Challenge for Sustainability II (ArCS II), Program Grant Number JPMXD1420318865.

References

- Erokhin, V., et al., 2022. The Northern Sea Route development: the Russian perspective. In: Ilin, I., Devezas, T., Jahn, C. (Eds.), *Arctic Maritime Logistics: the Potentials and Challenges of the Northern Sea Route*. Springer, pp. 283–303. https://doi.org/10.1007/978-3-030-92291-7_15.
- Federal Customs Service of Russia (FCS), 2022. *Customs Statistics of Foreign Trade of the Russian Federation* (In Russian).
- Gavrilova, K.A., 2020. The Northern Sea Route in Russian official discourse: strategies for determining functions and geographical boundaries. *Sibirskie istoricheskie issledovaniia* (3), 62–75. <https://doi.org/10.17223/2312461X/29/5> (In Russian).
- Golubkova, E., Stolyarov, G., 2019. Rosatom: Northern Sea Route to Cost 735 Bln Roubles. <https://www.marinelink.com/news/rosatom-northern-sea-route-cost-bln-467639>. (Accessed 10 December 2023).
- Gunnarsson, B., Moe, A., 2021. Ten years of international shipping on the Northern Sea Route: trends and challenges. *Arctic Review on Law and Politics* 12, 4–30. <https://doi.org/10.23865/arctic.v12.2614>.
- Izhbuldin, A.K., 2023. Influence of sanctions on oil and gas projects in eastern regions of Russia. *Russia & NIS Business Monthly* 68 (4), 64–79 (In Japanese).
- Kotov, A.V., 2022. Prospects for the development of the key Arctic projects of the Russian Federation under the conditions of sanctions. *Nauchno-analiticheskii vestnik IE RAN* 29 (5), 113–123. <https://doi.org/10.15211/vestnikieran52022113123> (in Russian).
- Meade, J.R., 2020. Russia's New Arctic Policy 2035: Implications for Great Power Tension over the Northern Sea Route. National Intelligence University. https://ni-u.edu/wp/wp-content/uploads/2022/08/NIUShort_07212020_DNI202201735.pdf. (Accessed 10 September 2023).
- Medvedeva, L.M., 2022. The development trajectory of the Northern Sea Route in the changing conditions of the last decades. *Sovremennaiia nauchnaia mysl* (4), 180–187. <https://doi.org/10.24412/2308-264X-2022-4-180-187> (In Russian).
- Moe, A., 2020. A new Russian policy for the Northern Sea Route? State interests, key stakeholders and economic opportunities in changing times. *The Polar Journal* 10 (2), 209–227. <https://doi.org/10.1080/2154896X.2020.1799611>.
- Novak, A., 2023. Russian FEC 2022: Challenges, Results, and Perspectives, 13. *Energeticheskaia politika*. February. <https://energypolicy.ru/rossijskij-tek-2022-vyzyvy-itogi-i-perspektivy/business/2023/12/13/>. (Accessed 9 July 2023) (In Russian).
- Ross, C., 2023. Can stated future export levels at the Vostok oil project be achieved in a time of political adversity? S&P Global, 5 January. <https://www.spglobal.com/commodityinsights/en/ci/research-analysis/can-stated-future-export-levels-at-the-vostok-oil-project-be-achieved-in-a-time-of-political-adversity.html>. (Accessed 29 June 2023).
- Sakaguchi, I., 2023. Current state of each of the Russian oil and gas sectors. *Russia & NIS Business Monthly* 68 (4), 39–63 (In Japanese).
- Smirnov, A.Yu, 2023. Northern Sea Route development plan until 2035 as an instrument of state innovation policy. *Vestnik universiteta* (4), 57–64. <https://doi.org/10.26425/1816-4277-2023-4-57-64> (In Russian).
- Solski, J.J., 2022. The Northern Sea Route at the crossroads: what lies ahead after the war in Ukraine? *The Polar Journal* 12 (2), 401–403. <https://doi.org/10.1080/2154896X.2022.2133389>.
- Yermakov, V., Yermakova, A., 2021. *The Northern Sea Route: A State Priority in Russia's Strategy of Delivering Arctic Hydrocarbons to Global Markets*. The Oxford Institute for Energy Studies.
- Zamyatina, N., 2022. Arctic – 2022. What Do You Remember about the Year. <https://go.arctic.ru/work/arktika-2022-chem-zapomnilya-god/>. (Accessed 10 August 2023) (In Russian).
- Zhuravel, V.P., 2022. The problem of Arctic development under the sanction pressure on Russia. *Nauchno-analiticheskii vestnik IE RAN* 26 (2), 32–40. <https://doi.org/10.15211/vestnikieran220223240> (in Russian).
- Centre for High North Logistics (CHNL), 2023. Shipping traffic at the NSR in 2022. <http://arctic-lio.com/> (Accessed 14 July 2023).