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The Arctic is Warming: Green Transition, Critical Minerals and Energy Sources, New Maritime Routes and Geopolitical Competition

Artik Isınıyor: Yeşil Dönüşüm, Kritik Mineraller ve Enerji kaynakları, Yeni Deniz Rotaları ve Jeopolitik Rekabet

Cemal Kakışım[1]

Abstract

Climate change is facilitating access to the mineral, mineral and fossil energy resources of the Arctic, while also rendering alternative sea routes increasingly viable. The Arctic is becoming a pivotal supply centre for the global green energy transition, particularly given its abundance of rare earth elements, critical mineral reserves and renewable energy potential, including wind and solar. Geographic change in the Arctic offers new opportunities for green transformation, energy, maritime transport and scientific research. Critical minerals and rare earth elements, which are essential for the green energy transition, renewable energy infrastructure and electrification of transport, reinforce the interest of China, the US and the EU in the Arctic. In this context, the region, like the Middle East, is turning into a new energy-focused geopolitical competition area. The aim of this study is to analyse the impact of the geographical change in the Arctic on the natural wealth of the region and to address the importance of the Arctic in the global green energy transition and green economy initiative. In this context, the international geopolitical competition and cooperation situation in the Arctic will be evaluated.

Keywords: Arctic, *Climate Change, Green Transition, Critical Minerals, Energy Geopolitics.*

Öz

Küresel ısınmaya bağlı iklim değişikliği, Kuzey Kutbunun (Arktik) maden, mineral ve fosil enerji kaynaklarına erişimi mümkün kılmakta ve alternatif deniz rotalarını giderek daha fazla kullanılabilir hale getirmektedir. Arktik, özellikle nadir toprak elementleri, kritik mineral rezervleri, rüzgar ve güneş gibi yenilenebilir enerji potansiyeli ile küresel yeşil enerji dönüşümü bakımından bir arz merkezine dönüşmektedir. Arktik'teki coğrafi değişim yeşil dönüşüm, enerji, deniz ulaştırma ve bilimsel araştırmalar bakımında yeni fırsatlar sunmaktadır. Yeşil enerji dönüşümü, yenilenebilir enerji altyapısı ve ulaşımda elektrifikasyon bakımından oldukça elzem olan kritik mineraller ve nadir toprak elementleri, Çin, ABD ve AB'nin Arktik'e olan ilgisini perçinlemektedir. Bu bağlamda bölge, Ortadoğu gibi giderek yeni bir jeopolitik rekabet alanına dönüşmektedir. Çalışmanın amacı, Arktik'teki coğrafi değişikliğin bölgenin doğal zenginlikleri üzerindeki etkisini incelemek ve Arktik'in küresel yeşil enerji dönüşümü ve yeşil ekonomi girişimi özelinde önemini ele almaktır. Bu bağlamda Arktik'te uluslararası jeopolitik rekabet ve işbirliği değerlendirilecektir.

Anahtar Kelimeler: *Arktik Bölge, Iklim Değişikliği, Yeşil Dönüşüm, Kritik Mineraller, Enerji Jeopolitiği.*
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Introduction

The world is experiencing global climate change, mainly due to an increase in average temperature (IPCC, 2022). This change produces various externalities, such as sea level rise, melting of glaciers, loss of biodiversity, floods, droughts, and forest fires, which cause the ecosystem to be out of balance. The melting of glaciers is one of the most significant impacts. Therefore, the Arctic Region (North Pole) is the geography where the effects of climate change are felt the most. Compared to other regions, the temperature increase occurs twice as much in the Arctic (Chételat et al., 2022).

Due to the increasing global temperature, glaciers that have existed in the Arctic for centuries are losing mass and melting faster every year (IPCC, 2022). The melting of Arctic glaciers is more than just a problem that will lead to sea level rise. It offers the opportunity to create new maritime trade routes and to unearth energy and mineral resources that have remained untouched until today. Offering new opportunities as well as threats in this respect, ice melting makes Arctic ports, which are closed for most of the year, and Arctic Sea routes, which are opened by ice-breaking ships with high operating costs, more accessible. The melting is expected to enable the extraction of fossil resources such as natural gas and oil, estimated to be billions of barrels, from the Arctic Ocean floor in the future (USGS, 2008 and King, 2020). It is also expected to enable the exploration and development of Arctic mineral fields containing critical minerals and rare earth elements, which are essential for the production of defense industry products and green technology products (Dmitrieva & Solovyova, 2023).

New opportunities arising from climate change in the Arctic are shaping regional geopolitics. Just like the geopolitical problems caused by fossil fuels in the 20th century, especially in the Middle East, the possibility of a similar situation in the Arctic is increasing day by day. The Arctic's renewable energy resource potential and mineral reserves such as cobalt, nikel, and rare earth elements are becoming even more important, especially in an atmosphere where the green transformation initiative is accelerating on a global scale within the scope of the Kyoto Protocol, the Paris Agreement, and European Green Deal (the EGD). In this respect, it is an undeniable fact that geographical changes will shape Arctic geopolitics and diplomacy. The fact that geographical changes make the Arctic's economic and natural resource potential more and more accessible every day increases the interest of dominant actors such as Russia, the US and China in the region. It encourages the EU, which leads the green transformation efforts on a global scale, to utilize the renewable energy potential and natural wealth of the region.

The qualitative method, which is a widely used research approach in the field of social sciences, was selected as the research method for this study. The study was designed according to the case study method, which is a specific design for conducting qualitative research. The aim of the study is to examine the effects of geographical change in the Arctic on the region's maritime transport, international trade, energy resources, and mineral potential, and to address the importance of the Arctic in the global green energy transition and green economy initiative. Related literature was reviewed during the study and the gap in the literature was observed. It was found that the critical mineral potential of the Arctic as well as the role of the Arctic Region in the green energy transition is not sufficiently emphasised in the literature. In this context, firstly, the impact of climate change on the Arctic is emphasised by using quantitative and qualitative data with a case study. The green economy and green energy transformation on a global scale are explained, and the new infrastructure requirements required by this transformation are analyzed. Finally, the international competition environment in the Arctic, led by China, the USA, and Russia, is analyzed.

1. Climate Change and Global Warming Cause Arctic Glaciers to Melt

According to regular reports from the National Aeronautics and Space Administration's Global Change Research Programme, the global climate is changing more rapidly than natural changes have occurred throughout history (NASA, 2022). This change is evident from consistent trends in global average temperature, sea level rise, upper ocean heat content, and sea and land-based ice melt. These changes are the most fundamental evidence yet that the planet is warming more and more (Cheng et al., 2023).

The Intergovernmental Panel on Climate Change (IPCC) of the United Nations (UN) provides the most comprehensive and qualified research reports. According to IPCC, it is stated that irreversible changes have occurred in the global climate for centuries, the imbalance in temperatures will continue for a maximum of 30 years and the environmental impacts due to climate change will continue in the future (IPCC, 2022).

The Arctic, in particular, is experiencing dramatic changes due to the global temperature increase. The Arctic climate is changing rapidly and its atmosphere, ocean and land area are warming at an unprecedented rate. These are accompanied by various environmental changes observed in land and marine ecosystems, hydrosphere and cryosphere (Budikova, 2009). Since 1979, Greenland and northeastern Canada have experienced the most significant annual mean surface and tropospheric warming in the Arctic (Ding et al., 2014). On a global scale, the highest temperatures in the last decade were experienced in the Arctic and the highest anomaly in the last decade was measured as +1.26°C in Finland. In the report of the World Meteorological Organisation, it is also stated that an unprecedented loss of glaciers and ice sheets occurred in the period between 2011-2020. Ice loss in Antarctica and Greenland was 38 % higher between 2011 and 2020 compared to the 2001-2010 period. In the same period, the glacier mass loss in Greenland was 251 Gigatonnes (Gt) per year on average. The highest loss was experienced in 2019 with 444 Gt. According to the report, old ice, which is defined as ice that has remained unmelted for at least four years, accounted for 33 % of the total ice cover of the Arctic Ocean in March 1985, while this rate decreased to less than 10 % by 2010 and dramatically to 4.4 % in March 2020 (WMO, 2023). In other words, this decline shows that the mass of glaciers that can survive in the Arctic in the summer season has also decreased considerably.

With the melting in the summer season, the surface area of the ice mass, which was measured as 15.65 million km² between 1981-2010, decreased by 6% to 14.78 million km² in the 2011-2020 period. The Arctic Ocean has lost 2/3 of its glacier cover in the last sixty years. A 70% of the current ice mass consists of seasonal glaciers that form within a year and melt within the same year (Öztürk & Gürsoy, 2022).

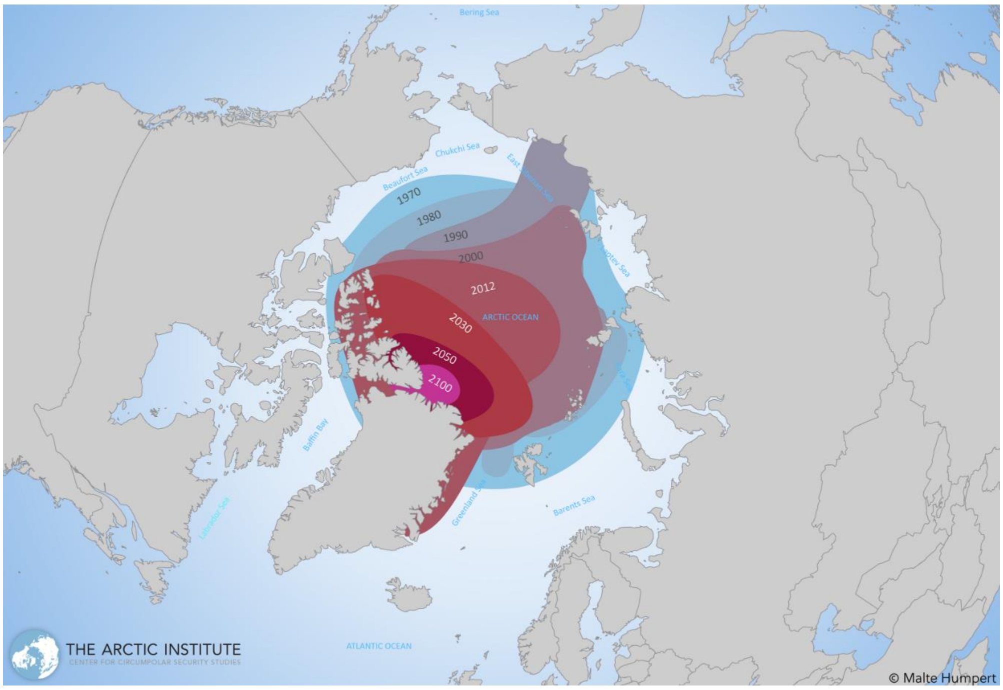

Figure 1: Arctic Summer Ice Extent 1970-2100

Source: The Arctic Institute & Humpert, 2016

Future projections indicate that melting of glaciers will continue at an accelerated pace. Predicted average temperature increases for 2050 and 2100 differ significantly, with estimates ranging from 1.4 to 5.8 °C by 2100 (Chatterjee & Tandon, 2020). The National Ice Centre (USNIC) reports that average temperatures in the Arctic could increase by 4 to 5 °C by 2050 (USNIC, 2024). According to forecasts, it is stated that the Arctic Ocean will not have an ice mass in the summer season in the very near future. In the winter season, it is stated that the ice mass will be thinner and much more fragile, making icebreakers unnecessary. It is stated that in approximately 2100, the Arctic Ocean will turn into a completely ice-free water mass even in the winter season (Öztürk & Gürsoy, 2022). Fig. 1, prepared by Malte Humpert of the Arctic Institute, shows the summer ice loss in the last 50 years. Fig. 1 also shows the predicted summer ice loss in 2050 and 2100.

It is understood from the projections that the Arctic Ocean will be completely opened to maritime transport, and the region will turn into a suitable economic area for the exploration of its natural riches. In this context, before evaluating the potential of the Arctic, it would be useful to discuss the Green Economy Model and Green Energy Transition, which make the opportunities offered by the region even more meaningful.

2. Green Energy and Green Economy Transformation: New Energy Infrastructure and New Economy Requirements

Beyond climate change, global warming leads to the development of a new production infrastructure and economic understanding that will radically change the world economy. The UN played an active role in this process. The entry into force of the Kyoto Protocol in 2005, which imposed responsibilities on developed countries in the fight against climate change, and finally the determination of Sustainable Development Goals and the signing of the Paris Agreement in 2015 basically aimed to combat global warming, protect the environment, prevent climate change, and develop a sustainable development model for countries (Kakışım, 2023). In this context, in order to reduce carbon emissions, which are the main cause of climate change, UN members were asked to take urgent action to combat climate change in order to build a low-carbon economy where fossil fuels are abandoned and to ensure that global warming is below 2°C. They were requested to create a clean, environmentally friendly and cost-effective national energy profile (Church & Crawford, 2020).

In the EU, the EGD came into force in 2019, which will transform the world economy on environment and climate, furthering the efforts of the UN. The main objective of the EGD is to transform the EU into a fair and prosperous society with a modern, dynamic economy and resource-efficient. The EGD has established three criteria with the objective of achieving zero greenhouse gas emissions by 2050, ensuring a resource-independent economic growth model and guaranteeing that no individual or region is left behind (European Commission, 2020). In this context, the EU has set important targets to support the fight against climate change and increase the use of renewable energy sources: Reducing greenhouse gas emissions by 30% by 2030 and making the EU Climate Neutral by 2050, increasing the share of renewable energy sources in the EU's energy mix to 40% by 2030 and reducing energy consumption by 36%, reducing greenhouse gas emissions from transport vehicles by 55% by 2030 and producing new vehicles with zero emissions by 2035 (European Commission, 2020).

Within the scope of the EGD, it is also aimed to establish a new economic structure, also defined as the Green Economy Model, which will reshape the world economy. In order to transition to a green economy model, it is planned to develop a carbon pricing mechanism to reduce greenhouse gas emissions from production and transport. In this context, two types of market instruments, namely Carbon Border Adjustment Mechanism (BCARM) and Emissions Trading System (ETS), have been developed. The main objective of both instruments is to develop a production and transport infrastructure that will completely eliminate greenhouse gas emissions. The ETS ensures that products imported in accordance with the green criteria are excluded from the BCARM. Therefore, the ETS promotes the use of renewable energy on the one hand and taxes the carbon footprint of products entering the EU economic area on the other.

The rapid increase in carbon emissions from maritime transport has led to steps to limit these emissions. Within the scope of the initial greenhouse gas strategy of the International Maritime Organization (IMO), it is aimed to reduce greenhouse gas emissions per shipment by at least 40% by 2030 and 70% by 2050 on average across international shipping (Morante, 2022). The target of reducing emissions in maritime transport is also envisaged in the EGD. By including maritime transport in the ETS, it is aimed to reduce GHG emissions from ships by 2% by 2025, 14.5% by 2035 and 80% by 2050 compared to 2020 levels. This reduction is especially valid for ships with a gross tonnage of over 5,000, which account for 90% of greenhouse gas emissions in maritime transport (EU Monitor, 2023). In addition, as of 2024, all intra-European routes and 50 per cent of extra-European routes operated by ships of 5,000 gross tonnes or more calling at EU ports are subject to the ETS. As of 2027, it was decided to include the ships of countries outside the EU in the scope of the ETS (Tunahan et al., 2023). The decisions taken within the scope of IMO and ETS make it obligatory for commercial ships, especially container ships, carrying goods to the EU to choose closer routes to reach EU ports and to use cleaner energy sources for energy.

The UN and EU-led initiative to combat climate change and create an economic model suitable for green transition has led to a rapid change in the global energy consumption profile. According to British Petroleum's 2024 report, based on global consumption, the fastest growing sources among primary energy sources are renewable energy sources including wind, solar, bioenergy and geothermal. According to the report, the share of renewable energy in primary energy is expected to increase from just over 10 % in 2022 to over 25 % in 2050. In the UN and EU's net zero greenhouse gas emission scenario, it is projected to be 50 % (British Petroleum, 2024). China is the leading country where the increase in renewable energy capacity will be realised the most. China alone is expected to account for 40 % of the expansion in global renewable capacity by 2024, followed by the EU with 27 member states, the USA and India (IEA, 2019). Similar to the transformation in energy, electrification is also expected to expand in transport. According to future scenarios, the global number of electric vehicles, excluding two- and three-wheelers, is estimated to reach 245 million in 2030, more than thirty times its current level (IEA, 2020).

Green energy technologies and electric vehicles required by the energy transition have a very different energy infrastructure. In solar and wind power plants and electric vehicles, energy is stored in batteries using lithium minerals. Cobalt and lithium minerals are the basic components used in the storage of energy produced by renewable energy sources and in the production of batteries that can be characterized as the fuel of electric vehicles and devices (Johansson, 2013). Furthermore, rare earth elements and critical minerals such as neodymium in wind turbines, tellerium, ruthenium and indium in solar panel cells, graphite, niobium, vanadium in electric vehicles are needed (Johansson, 2013). Considering the net zero greenhouse gas target, the International Energy Agency estimates that demand for graphite is expected to quadruple and demand for cobalt, nickel, and rare earths to double by 2040. The most dramatic increase for critical minerals is estimated to be in lithium demand with an eight-fold increase (IEA, 2024).

In addition to a powerful country like China, a significant part of the critical mineral reserves is hosted by countries such as Chile, Argentina, Bolivia, and the Democratic Republic of Congo, which are economically and politically fragile, corrupt and have a highly unstable political structure. China differs from other fragile states as a supplier country. China has a dominant position in rare earth reserves, production, and exports. In 2019, it alone accounted for 60% of global rare earth element production. In addition, 50-70% of lithium and cobalt and 90% of rare earth elements are processed alone (IEA, 2024).

China's dominance of critical minerals confronts the giants of the world economy, which are rivaling each other in renewable energy investments and electric vehicle production (Kakışım, 2021). China's control over the production of critical minerals disturbs developed countries, especially the US and the EU, which are in the process of rapid energy transition. In particular, China's taking various measures to limit the export of critical minerals and completely stopping exports to countries such as Japan under the pretext of diplomatic tensions makes countries that need these minerals, especially the US, the EU, Japan, and South Korea, uneasy in terms of mineral supply security. It drives them to search for alternative mining sites and supply sources. In order to eliminate China's dominance in the supply chain of critical minerals, the US, EU, Japan, and Australia are establishing cooperation and partnerships for the development of potential mining sites in different parts of the world.

3. Opportunities and Challenges in the Wake of Changing Geography in the Arctic

3.1. The Future of Arctic Shipping

The Arctic is an ocean located in the north of North America, Europe, and Asia that has been completely covered by glaciers for centuries. The Arctic Ocean, which covers an area of approximately 14 million km2 and is quite shallow compared to other oceans, has an average depth of 987 m, and its deepest point is 5502 m (Britannica, 2024). It is surrounded by Russia, Norway, Canada, the USA, and Greenland, an island politically connected to Denmark, located in the north of three continents. Despite the absence of direct coastlines, Iceland, Finland, and Sweden are also classified as Arctic countries due to their proximity to the North Pole (World Economic Forum, 2015).

Due to the spherical structure of the earth, distances shorten as one travels from the Equator, the widest point of the planet, towards the north or south. While a ship travelling from London to Yokahama has to travel approximately 21,000 km through the Strait of Gibraltar, the Mediterranean, the Suez Canal, the Red Sea, the Gulf of Aden, the Indian Ocean, the Strait of Malacca and the South China Sea, this distance is reduced to 14,000 km through the Arctic and shortened by 7,000 km (Yılmaz & Çiftçi, 2014).

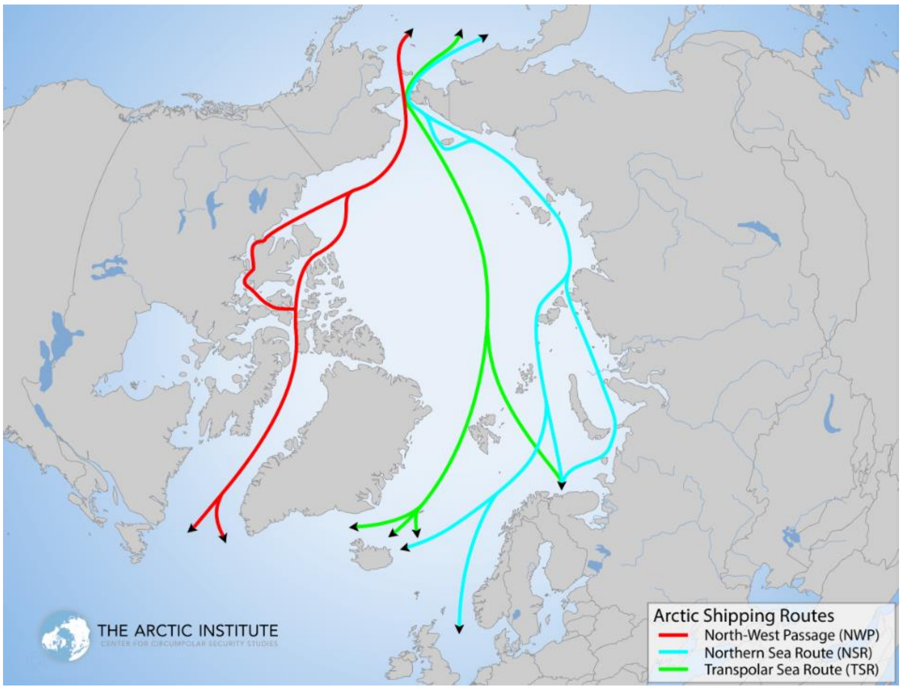

Figure 2: Arctic Shipping Routes

Source: The Arctic Institute & Humpert, 2016

In the Arctic, there are two main sea routes that were used in the past, which are covered with glaciers, especially during the winter months, and are difficult to pass, guided by icebreaker ships: The Northern Sea Route and the North West Sea Route. Sea ice in the Arctic Ocean usually melts severely in June or July and begins to freeze again as of October. Ships passing through the Northern Sea Route sail without the need for icebreakers during the summer months, but from autumn onwards they sail with the help of icebreakers (Scott, 2024).

As can be seen on Fig. 2., the Northern Sea Route, which runs along the coasts of North Asia and Northern Europe (Blue Line), forms a route that makes maritime transport between East and Southeast Asian countries such as Indonesia, South Korea, Japan and China and European countries very practical through the Bering Strait passage. The North West Route, which runs along the coasts of Alaska and Canada, shortens the maritime transport between the USA, Canada, Europe and Asian countries considerably compared to traditional routes.

Ship traffic through the Bering Sea and Strait, which is located on the route of the Northern and North West Sea Routes, increased by 250% between 2008 and 2015. This increase is largely due to the Yamal LNG project developed jointly by Russia and China to extract natural gas from the Arctic (Boylan, 2021). Natural gas produced from Russia's reserves in the Arctic is liquefied and transported to China via this route.

With the impact of climate change and melting of glaciers, the Transpolar Sea Route (Green Line) is offered as a new alternative to these two routes. The Transpolar Sea Route, which does not have to follow the coastline, is a route that will result in reduced transportation costs and time compared to the other two routes. While the Northern Sea Route reduces the journey between Europe and East Asia from 30 days to 18 days via the Suez Canal, the Transpolar Sea Route shortens this journey by 1 to 5 days (Bennett et al., 2020). Considering the predictions that the Arctic will be ice-free in summer from 2050 onwards, it is highly likely that the TAranspolar Sea Route will be heavily used by commercial vessels in the future.

Arctic Sea routes cause less carbon emissions in transportation with shorter cruising distances compared to alternative routes. To exemplify this concept, the distance (6800 miles) of the journey from Narvik, Norway to Qingdao, China via the Northern Sea Route by a Panama type ship with a carrying capacity of 68,000 tonnes and a daily fuel consumption of 36.7 tonnes is reduced by 42% and 55%, respectively, compared to the traditional route via the Suez Canal (11800 miles) and the Cape of Good Hope (15075 miles). Furthermore, the reduction in fuel consumption via the Northern Sea Route has the additional benefit of lowering carbon emissions. Compared to the Cape of Good Hope route, the Northern Sea Route results in approximately 1645 tonnes less carbon emissions, while in comparison to the Suez Canal route, the reduction is approximately 2701 tonnes (Liu et al., 2023).

It is important for the future of the maritime industry that Arctic routes offer a route that reduces carbon emissions. The shipping sector accounts for approximately 2.8 % of all global carbon emissions by 2022 (Morante, 2022). Emissions from shipping have increased by more than 90 % since 1990. Between 2012 and 2023, emissions from international shipping increased by an average of 15% to 706 $mtco_2$ (million tonnes of carbon dioxide equivalent). Considering the global shipping industry as a country, this level of carbon emissions makes it the world's seventh largest emitter of carbon dioxide (Statista, 2024).

Arctic Sea routes are not only economical and green, but also offer ships a safe and uninterrupted navigation compared to traditional routes. In this context, the recent risks faced by the maritime trade between East Asia and Europe through the Suez Canal are noteworthy. The tension between Israel and Iran in the Middle East has been increasing for many years. Iran's transformation of this tension into a proxy war against Israel through the Houthis, who are effective in Yemen, seriously jeopardises the security of one of the most intensive routes of international maritime trade, which reaches the Mediterranean Sea via the Bab el-Mendeb Strait, the Red Sea and the Suez Canal (Mediterranean - Asia - Australia Maritime Trade Route). In addition to seizing merchant ships entering the Bab al-Mandeb Strait, the Houthis have carried out missile and drone attacks on ships, causing the sinking of some merchant ships and the death of their crews (France24, 2023). These attacks escalated especially with the Israeli attacks on Gaza in October 2023. Maritime enterprises, which could not ensure the safety of navigation due to the attacks, turned to the Cape of Good Hope as an alternative route and tried to reach Europe by travelling around the African continent. The preference for this route caused ships to spend more fuel and time and led to a decline in the volume of maritime traffic and trade through the Suez Canal.

3.2. Fossil Fuel Potential of the Arctic

Discussions on the energy and mineral potential of the Arctic and international public interest in the region have increased with the publication of the findings of a study conducted by the United States Geological Survey in 2008. According to the report, 32.1 % of the world's undiscovered oil resources and 12.3 % of its discovered resources are located in the Arctic (Moe, 2023). The Arctic's total undiscovered conventional gas and oil resources are estimated to consist of approximately 1,669 trillion cubic feet of natural gas, 44 billion barrels of natural gas liquids and 90 billion barrels of oil (USGS, 2008). It is estimated that more than 87 % of Arctic oil and natural gas resources (approximately 360 billion barrels of oil equivalent) are located in 7 regions in the Arctic basin: West Siberia Basin, East Barents Basin, Arctic Alaska Basin, West Greenland-East Canada Basin, America Basin, Yenisei-Khatanga Basin and East Greenland Rift Basin (King, 2020).

Table 1: Artic Petroleum and Natural Gas Reserves Privince

Petroleum Province	Crude Oil (billion barrels)	Natural Gas (trillion cubic feet)	Natural Gas Liquids (billion barrels)	Total (oil equivalent in billions of barrels)
West Siberian Basin	3.66	651.50	20.33	132.57
Arctic Alaska	29.96	221.40	5.90	72.77
East Barents Basin	7.41	317.56	1.42	61.76
East Greenland Rift Basin	8.90	86.18	8.12	31.39
Yenisey-Khatanga Basin	5.58	99.96	2.68	24.92
Amerasian Basin	9.72	56.89	0.54	19.75
West Greenland-East Canada	7.27	51.82	1.15	17.06

Source: (King, 2020).

According to the USGS report, approximately 84% of oil and natural gas resources are located in offshore areas outside of onshore areas (USGS, 2008). The existence of energy resources in the seabed and ocean floor will intensify the discussions among the countries bordering the region regarding the delimitation of continental shelves and the delineation of exclusive economic zones.

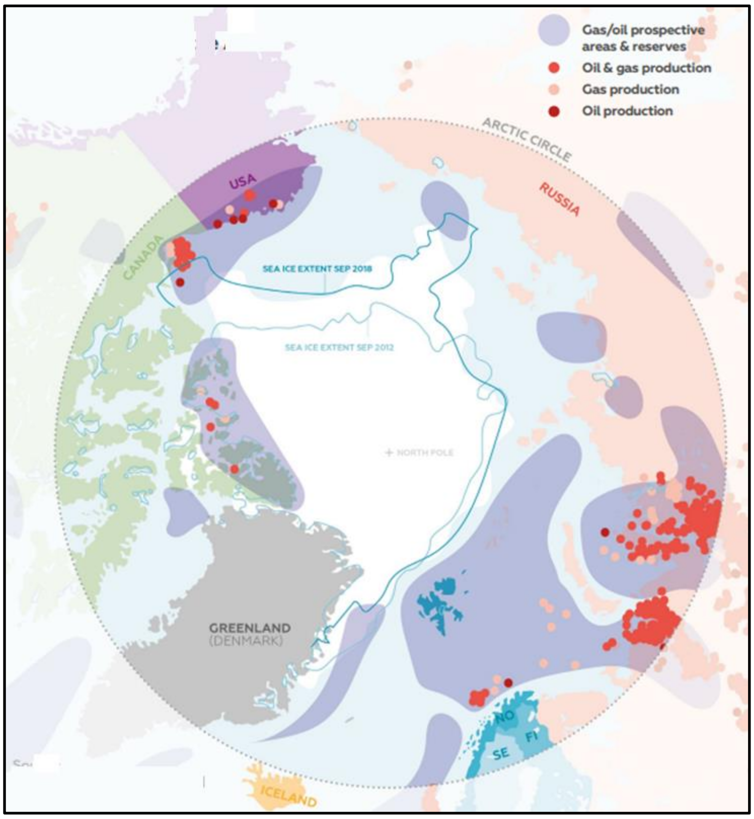

Figure 3: Resources and Sea Ice Extent in the Arctic

Kaynak: Geiger, 2022

Fig. 3 shows the potential hydrocarbon reserves located in onshore and offshore areas on the Arctic coasts as well as the fields where oil and natural gas production is currently carried out. Among the coastal countries, Russia realises production in most of these fields. It continues its exploration activities in order to convert its potential fields into production. The most important of these discoveries is the Vostok Oil Project developed by Russia's national energy company Rosneft. The oil production to be obtained through the project is expected to gradually reach 100 billion tonnes by 2030. In addition, Rosneft announced in 2022 that it had reached an oil reserve of 82 million tonnes in the Pechora Sea, which opens to the Arctic Ocean (Geiger, 2022). Russia also continues its efforts to develop alternative transport corridors to transport Arctic energy resources to world energy markets. Rosneft is building an Arctic oil terminal in the port of Bukhta Sever, which will be used for oil transport as part of the Vostok Oil Project, which aims to facilitate the development of the Northern Sea Route. Rosneft aims to gradually increase its exports to 100 million tonnes per year by 2030 through the port of Bukhta Sever, which is expected to become Russia's largest oil terminal by 2030 (Enerdata, 2022).

Considering the location of the reserves, it seems to be a more realistic scenario for Russia to LNG and export them to East Asian countries outside Europe via alternative routes. Russia's attempt to turn energy exports into a weapon for EU countries by cutting off the flow of natural gas during the Ukraine-Russia war (Reuters, 2022). has perpetuated the perception in the West that Russia is not a reliable supplier of natural gas. It has led EU countries to search for alternative supplier countries. Therefore, the Northern Sea Route is seen as the most suitable transport route for the export of natural gas that Russia, which is at risk of losing the European market, is likely to put into operation in the Arctic.

3.3. Critical Mineral Potential of the Arctic

Fossil energy investments have been questioned more in the new conjuncture where efforts for green transition and transition to a green economy have gained momentum. Practices such as the BCARM and ETS are rapidly moving industrialised countries away from fossil fuels and towards renewable energy sources. Therefore, the demand for critical minerals and the search for supply sources are increasing in countries investing in green transition. In this context, the mineral reserve potential of the Arctic has become more important than its oil and natural gas potential.

The Arctic holds a mineral resource of a size that can support global critical mineral security (Dmitrieva & Solovyova, 2023). According to geological surveys, rare earth oxides in the Arctic are estimated to be 126.76 million metric tonnes (mmt), with 72.26 mmt in Arctic Russia, 41.69 mmt in Greenland, and 14.31 mmt in Arctic Canada (Mered, 2019). Approximately 27.7 million tonnes of rare earth element trioxides are located in territories of the Russian Komi Republic, the Republic of Sakha (Yakutia), and the Irkutsk Region: Platinum and Palladium (94.6%), Cobalt (75%), Nickel (70.5%), Tin (50.2%), Gold (11.7%), and Silver (11.2%) (Dmitrieva & Solovyova, 2023).

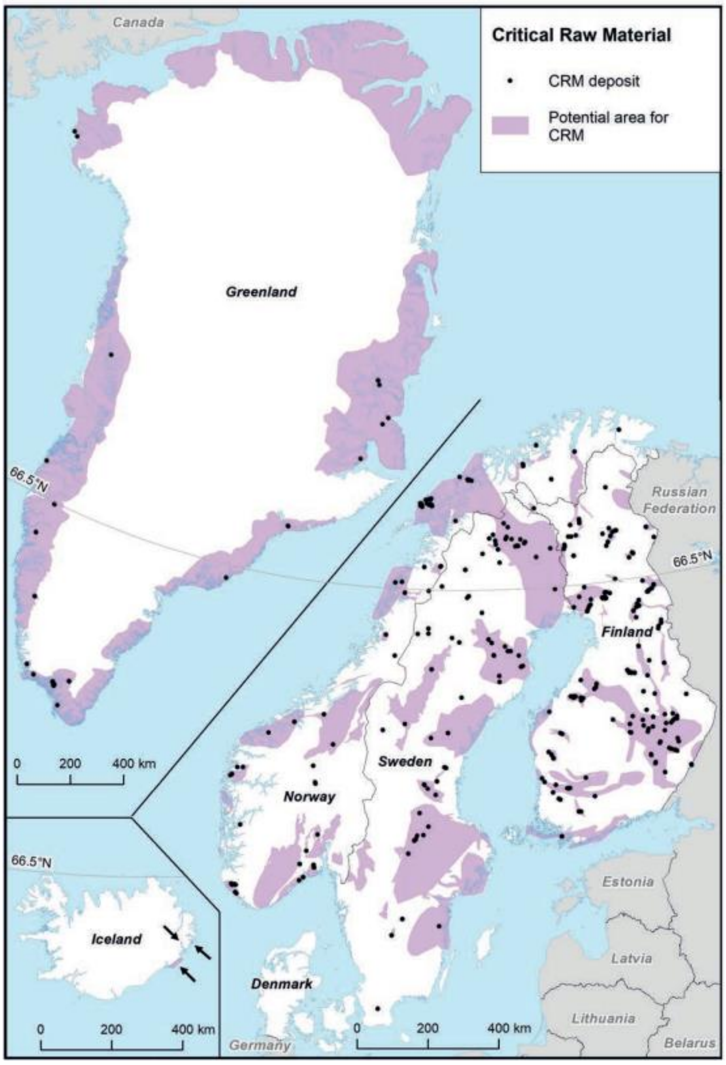

Figure 4: Known or Potential Critical Mineral Reserve Areas in Arctic Countries

Kaynak: Eilu et al., 2021

Apart from Russia, Greenland, Norway, Finland, Sweden and Iceland also have critical mineral reserves in the Arctic. These countries have a potential similar to the leading global mineral-rich countries such as Canada, USA, Australia, South Africa and Brazil (Eilu et al., 2021). Fig. 4 shows the critical mineral fields and potential reserves in these countries. Finland is the only European country that currently produces cobalt on a significant scale. Large reserves of lithium and vanadium, a critical metal for storage systems such as lithium batteries for storing renewable energy, are located in Finland, Greenland, Sweden and Norway. Norway has reserves of graphite and titanium, and also produces them. Niobium and tantalum are located in variable quantities in Greenland and Fennoscandia (Eilu et al., 2021).

Focusing on the mineral potential of the Arctic, Norway announced in 2023 that it had discovered a significant amount of metals and minerals ranging from copper to rare earth elements as a result of its exploration activities. It is estimated that the discovered field contains approximately 24 million tonnes of magnesium, 3.1 million tonnes of cobalt and 1.7 million tonnes of cerium, one of the rare earth elements. In addition, other rare earth metals such as neodymium, yttrium and dysprosium are expected to be found among the magnesium reserves (Adomaitis, 2023). Following this important discovery, Norway rapidly started to work on the extraction of mineral resources from the seabed. In June 2024, Norway initiated the first licensing process involving 386 fields for the development of seabed mineral resources within its exclusive economic zone in the Arctic. After the licensing process takes place in 2025, the first exploration work is expected to start in 2030 (Mining Technology, 2024). Despite the investments, Norway's experience, especially in processing rare earth elements and converting them into by-products, is quite limited. The similar situation is also valid for other countries in the region (Eilu et al., 2021). Nevertheless, if the mines can be exploited, Norway's dependence on China for imports of critical minerals used in the production of wind turbines, solar panels and electric vehicle batteries will decrease. In addition, Norway will become a new supplier country in terms of critical mineral supply for EU countries after natural gas. These mineral resources are among the strategically needed minerals included in the critical mineral list of the EU.

The USA is another country with critical mineral potential in the Arctic. The offshore floor of Alaska, which the USA acquired from Russia in 1867, which has turned into a natural wealth over time and made the USA a part of the Arctic, contains areas favourable for mineral formation. Although gold, lead, sand, gravel, silver and zinc are mostly produced in Alaska today, the focus is on the production of offshore hard minerals with a higher economic and strategic value in the future. Alaska's non-fossil fuel mineral economy ranks sixth in the United States (Kraska, 2024). In this context, melting ice cover not only makes Alaska more favourable for the extraction of critical minerals. It also transforms Alaska into a potential source of supply that will reduce US critical mineral import dependence on China. It encourages the US to become a more active player in the Arctic.

The minerals hidden in the floor of the Arctic Ocean have triggered demands for the extension of the continental shelf and exclusive economic zone among the countries in the region. Denmark, Norway and Canada applied to the Commission on the Limits of the Continental Shelf under the United Nations Convention on the Law of the Sea to extend the continental shelf beyond the 200 nautical mile limit. Canada submitted to the Commission the scientific evidence necessary to determine the Arctic continental shelf 1.2 million km^2, Greenland (Denmark) 895,000 km^2 and Norway 235,000 km^2. Moreover, Russia's request to expand its Arctic continental shelf by 1.7 million km^2 was accepted by the Commission in 2023 (Kraska, 2024). Similar attempts are expected to come from other Arctic countries. In this case, it is expected that increasing claims will lead to overlapping claims and international tensions among the Arctic countries.

3.4. Renewable Energy Potential of the Arctic

The Arctic is rich in renewable energy resources. Due to its geographical location, the region's renewable energy production potential is more than twice the global average, and Arctic resources are easier to convert into production than other continents (Liu et al. 2023). Therefore, it is no coincidence that the top three countries (European Environment Agency, 2024) that meet their basic energy consumption from renewable energy are Sweden, Finland and Denmark, which have Arctic coasts.

The region's wind energy potential is richer compared to other renewable energy sources. Wind is effective in the entire region, including land and sea areas. Wind speed is measured as 11 metres per second (m/s) in Greenland and North Iceland, 10 m/s in the Norwegian Sea, 9 m/s in the Bering Strait region, 8 m/s in Russia's Nova Zembla and Kara Sea (Mered, 2019). According to the World Energy Council, the annual theoretical energy production and technical usable capacity of Arctic wind energy account for 18.5 per cent and 17.2 per cent of the world capacity, respectively (Liu et al. 2023).

Apart from wind, the region's most powerful renewable resources are hydroelectric, geothermal and solar energy. In particular, the melting of the glacier mass increases the hydroelectricity generation capacity of the region. The hydroelectricity generation potential, 80 GW (gigawatt) in 2013, increased to 510 GW in 2021 with the effect of melting (Liu et al. 2023). Iceland and Norway aim to produce green hydrogen from excess hydropower capacity. In this context, the energy companies of Japan, Switzerland and Norway are working together to develop green hydrogen solutions based on hydroelectricity and wind energy called Hyper Project. With the realisation of the Hyper Project, it is planned to establish an international green hydrogen supply chain by 2030 and to transport the green hydrogen produced from Finnmarkt in the northern region of Norway to Japan via the Arctic Sea routes (Mered, 2019).

Geothermal resources, having an asymmetric distribution throughout the region, are mostly concentrated in Western Alaska, Western Canada and Iceland. More than a hundred hot springs and wells have been discovered in Alaska (Liu et al. 2023). In Iceland, geothermal energy is widely used in heating, greenhouse agriculture and aquaculture, and geothermal energy meets 25 % of the national electrical energy consumption. Russia's geothermal energy potential is 10-15 times higher than its fossil fuel reserves. Furthermore, the region is more efficient in terms of solar energy potential due to more efficient operation of solar panels at low temperatures (Liu et al. 2023).

Due to its renewable energy potential, the Arctic has become an area of investment opportunities in the global green energy and economic transformation process. The region has the potential to provide electrical energy to Ultra High Voltage Cable Technology and the Global Energy Connectivity Project developed by China, which allows electricity sharing between continents. Described as the ''energy's intercontinental ballistic missile'', the UHV technology and China's Global Energy Interconnection Project are planned to enable low-cost transport of electric power over long distances from Laos in Asia to Brazil in South America and from China to Central African countries (Huang, 2020). ‘‘Arctic energy hubs” giant wind farms connecting continental grids from East to West constitute an important supply source of the Global Energy Connectivity developed by the State Grid Corporation of China. It is stated by experts that Arctic's renewable energy potential can provide 600 TWh (terawatt hours) of wind energy per year to the Global Energy Interconnection (Mered, 2019).

4. International Competition and Cooperation in the Arctic

The Arctic Council was established in 1996 to ensure effective governance on Arctic issues such as biodiversity, science, climate, ocean, pollution and indigenous peoples. The Council is composed of the countries bordering the Arctic, namely the USA, Canada, Russia, Iceland, Sweden, Norway, Denmark and Finland. The Council has thirteen observing countries from Europe, East and South Asia, including Germany, France, China, Japan, South Korea and India, countries with no geographical connection to the Arctic (Arctic Council, 2023). Additionally, Türkiye and the EU, representing twenty-seven member states, have also applied to become observer members. Considering the membership structure, it is observed that countries far away from the region strive to be a part of scientific studies in the region. In the literature, ‘Arctic Exceptionalism’ is defined as the Arctic Council countries acting independently of political dynamics, and taking stability, harmony and peace in the Arctic as a basis (Käpylä & Mikkola, 2015). In this context, the effort is being made to make the Arctic a region, where scientific diplomacy is prominent and scientific cooperation is demonstrated, away from diplomatic tensions and conflicts.

China, an observer member of the Council, is the country showing the most interest in the Arctic with its ambitious goals (Bertelsen & Gallucci, 2016). Despite the distance of thousands of kilometres, China, defining itself as a ‘Near Arctic Country’, defined its Arctic policy and goals with the White Paper published in 2018 (PRC, 2018). In the White Paper, as part of China's foreign policy strategy, the Arctic Silk Road is developed as an important tool that can bring China to its goals in the Arctic. The Arctic Silk Road, a complement to China's 21st century Belt and Road Initiative, is based on the development of infrastructure such as Arctic maritime routes and ports from Japan to the Netherlands through the Bering Strait (Biagioni, 2023). Energy and mineral policy is another issue emphasized in the White Paper. It is aimed to develop oil, natural gas and mineral resources with an environmentalist and cooperative approach, respecting the sovereignty rights of the regional countries in order to legally and rationally exploit Arctic natural resources. It also aims to work together with the Arctic countries by sharing personnel, knowledge and experience in order to transform the region's rich renewable energy resource potential such as wind and geothermal into production and to strengthen clean energy cooperation (PRC, 2018).

These goals become more meaningful considering China's energy profile. China, a country dependent on imports of fossil energy resources, imports more than 70 % of its oil consumption and more than 40 % of its natural gas consumption. Therefore, the Arctic, with its rich fossil fuel reserves, is an important resource to ensure China's energy supply security (Biagioni, 2023). China's critical mineral dominance is also an important factor in terms of energy and mining policy. The Arctic's proven reserves of rare earth elements represent a potential to sustain China's global dominance in the processing and export of critical minerals. Separating elements from rare earth oxides, refining them into metals, and turning the resulting alloys into permanent magnets for green energy technologies and defence industry products requires considerable technical experience and know-how (Levin & Skelton, 2010). China is one of the rare countries that have proven their expertise in this field with years of experience. In this context, China is a potential partner for Arctic countries needing to transform critical minerals into raw materials but lacking technical competence. The most concrete cooperation in the region for critical minerals has been between China and Greenland. An agreement was reached to develop the minerals in Kuannersuit, the world's second largest rare earth oxide deposit, by companies with China as a partner (Jacobsen et al., 2024).

China's mining activities in the Arctic have led to an escalation of regional rivalry. Chinese involvement in the Kuannersuit Project has caused discomfort, especially in the USA. In 2019, the US took action to avoid losing the competitive advantage by signing a memorandum of understanding with Greenland to help develop the region's natural wealth (Kakışım, 2021). Due to the discomfort with China's influence in the region, US President Donald Trump offered to buy Greenland from Denmark (The Guardian, 2019). Trump, who was re-elected President in January 2025, has argued even more fervently for the need to take control of Greenland for the sake of US national security and freedom. Furthermore, while Trump has expressed his intention to purchase Greenland, he has made it clear that he wishes to capitalise on the region's natural resources and the advantages that new waterways will bring. Moreover, he asserts that his primary objective is to prevent China and Russia from filling the vacuum in the region. Diplomatic circles also frequently discuss the risk of China's exploitation of the Arctic's natural resources. In an article for the New York Times, Thomas Pickering, a former senior US diplomat, argued that China's ambitions to reach the Arctic via Greenland and

Iceland threaten US interests. This approach is seen as a 21st century geopolitical reflection of the jousting between the US, which is militarily dominant in Greenland, and China, focused on expanding its resource empire (Dialogue Earth, 2013).

Except for energy and mineral resources, there are areas of cooperation between China and the United States on other Arctic issues. Despite the global economic rivalry between the two dominant actors and political tensions over issues such as the South China Sea and Taiwan, both countries have been able to prioritise cooperation on Arctic scientific issues. US scientists utilise Chinese icebreakers for their scientific activities in polar research. They organise the Sino-US Arctic Social Science Conferences on topics such as climate change, safe Arctic shipping and sustainable resource development (Pan & Hungtington, 2024).

The Central Arctic Ocean Fisheries Agreement is another example of international cooperation. Despite some differences of opinion regarding the Arctic, the signatories, particularly the USA and China, have been able to find common ground on matters related to fisheries, research and monitoring activities (Dyck, 2024). A similar international cooperation could be developed for the establishment of a governance mechanism for the Transpolar Maritime Route shipping activities. The transformation of this route into a safe and functioning one would benefit not only the Arctic countries but also the East Asian countries that have intensive trade relations with Northern European countries, especially China. In particular, the fact that maritime trade through the Suez Canal has become riskier due to tensions and attacks in the Middle East may reinforce cooperation in the development of Arctic Sea routes.

One of the most challenging areas in the region is cooperation in the extraction of energy resources and critical minerals in the Arctic. Russia has the longest coastline and thus the largest exclusive economic zone in the Arctic, and its energy and mineral policy is largely based on the export of energy resources. Moreover, it aims to export not only oil and natural gas but also nickel, copper and rare earth elements. While Russia's energy power shapes its geopolitics, its income from energy exports constitutes a significant portion of its national income (Silantiev & Nurgalieva, 2023). Nevertheless, when it comes to its national interests, Russia is realistic enough to launch a comprehensive attack against Ukraine at the expense of losing its energy market in Europe. Arctic mineral resources are turning into an alternative source of income for Russia in terms of a global energy profile in which the use of fossil fuels is decreasing and the demand for minerals is increasing. In this respect, it is highly probable that Russia may take initiatives that may violate its sovereign rights to develop Arctic energy and mineral resources and undermine the cooperation efforts that the countries in the region may develop among themselves or with third countries. The Russian flag, which Russia planted on the floor of the Arctic Ocean in 2007, is more than a symbolic gesture; it reflects its geopolitics towards the Arctic and the importance it attaches to undersea natural riches.

Russia's invasion of Ukraine in 2022 in violation of international law led to a weakening of its relations with the Arctic Council and its member states. Due to the Russian-Ukrainian War, the Arctic Council's activities were suspended in March 2022 by the decision of seven of the eight member states. Seven member states are looking for a way to resume polar studies without Russia's involvement (Dyck, 2024). Russia, on the other hand, has determined its attitude towards the Arctic Council by threatening to be withdrawn from the Council (High North News, 2024). Considering the political developments, Russia's expansionist policy, implemented again in recent years, is one of the most obvious indicators that Arctic Exceptionalism is coming to an end.

China is the most important non-regional country for Russia to develop cooperation in the Arctic. A significant sign in this respect is the successful completion of the Yamal LNG Project for the development of Arctic natural gas resources. China's national oil company and the financial support of the Silk Road Fund played a vital role in the realization of the project. In the face of Western sanctions imposed after the invasion of Ukraine and the attempts to exclude Russia from the European energy market, Russia has turned to China as an alternative market. China found the opportunity to purchase Russian natural gas under favourable conditions. Russia's rapprochement with China by shifting away from the West supports energy demand security and diversifies the market of consumer countries. It also provides China with security of supply through a cheap and uninterrupted energy flow. In this context, energy relations between Russia and China are likely to develop towards the development of Russia's critical mineral reserves in the Arctic and the utilisation of its renewable energy resource potential. China's desire to realise the Global Energy Connectivity Project and its experience and superiority in the processing of critical minerals provide Russia with the opportunity to develop its natural wealth without relying on the West. Thus, its mineral resources will turn into an alternative income for Russia, which sustains its economy with the income from fossil fuel imports.

Conclusion and Evaluation

Climate change is expected to change the physical geography of the Arctic, enabling access to the region's proven critical mineral and mineral resources in the very near future. It would enable the uninterrupted use of Arctic Sea routes, which are economically and environmentally more favorable than existing routes. In this respect, the Arctic is turning into a geography of opportunity, facilitating the transition to green energy and economy. The Arctic transport routes, offering cost, time and fuel advantages, would facilitate the adaptation of Asian countries, currently exporting to EU countries using traditional routes, to the EGD and provide them with a competitive advantage. In this context, the development of Arctic Sea routes in terms of international maritime trade is a potential area of cooperation. It is because the opening of the Arctic to uninterrupted ship traffic in the near future with the melting would positively affect international trade and support mutual commercial interests.

The Arctic's critical mineral and mineral resources, such as rare earth elements, are more attractive than its oil and natural gas potential. While the global shift away from fossil fuels is accelerating, demand for critical minerals, crucial for new energy technologies, is increasing. Ensuring the security of critical mineral supply is becoming an even more important issue than the security of oil and natural gas supply. Therefore, the attention of Arctic countries and non-regional countries such as China, which is trying to establish influence in the region, is directed towards the mineral fields in land and sea areas. The development of mineral deposits may be one of the issues escalating international tensions in the Arctic in the future.

The US and EU's dependence on critical minerals reaching dimensions threatening energy security (Shiquan & Deyi, 2023) could pose risks that could lead to the end of Arctic Exceptionalism. Russia's efforts to be pushed out of the Arctic Council draw attention as one of the developments accelerating this process. It is unlikely that Arctic countries will experience the instability that oil and natural gas wealth has brought to Middle Eastern countries, given their developed economies and democracies. However, the region's natural wealth and its geographic change have the potential to increase tensions between the US, China, and Russia and cause a crisis in the Arctic. The re-emergence of the long-standing US desire to acquire Greenland, a possibility that has been further exacerbated by Trump's re-election, will further escalate tensions in the region. Despite the rejection of this offer by the Greenlandic population, the expansion of the United States' military activities in the region through NATO can be seen as a geopolitical response to China and Russia. In particular, the recent evolution of the diplomatic and economic rapprochement between Russia and China towards a strategic partnership and the further expansion of bilateral cooperation in energy and mining in the Arctic could push the US to take more stringent measures, such as increasing its military presence in the region.

Regarding energy geopolitics, Russia could follow quite aggressive policies. Especially in terms of offshore mineral and energy resources, the delimitation of Arctic maritime boundaries may turn into a diplomatic and political crisis. In this context, it is not possible to develop energy and mineral fields among the Arctic countries and turn them into a common wealth. The energy and mineral dependence of the Arctic countries constitutes an obstacle to cooperation in this field. At this point, China can open a new path with its ambitious goals. It might be possible for Russia or the Nordic countries to cooperate with China, a non-regional actor, to develop mineral resources outside the disputed regions. Energy cooperation might also be achieved in projects that support green transformation, such as China's Global Energy Connectivity. This is because green projects would support the emission reduction targets of countries as targeted by the Paris Agreement and the EGD.

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