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A Taxonomy of Mineral Resource Projects in the Arctic: A Path to Sustainable Financing?

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Abstract: The development of mineral resources in the Arctic region presents a strategically significant yet challenging endeavor, necessitating a delicate balance between the growing need for resources and pressing climatic and geopolitical concerns. Mineral resource development projects entail high capital intensity and substantial investment risks, with Arctic projects being particularly complex. While sustainable financing mechanisms for projects fostering sustainable development have been largely addressed in many countries through specialized taxonomies, projects within the mineral resource sector require a distinct financing approach. Such a taxonomy should facilitate the establishment of sustainable financing mechanisms for mineral resource projects in the Arctic zone, incentivizing companies to pursue Sustainable Development Goals (SDGs) and mitigate potential social and environmental risks. This article examines the key aspects of sustainable financing for mining-related business projects amidst current trends, substantiating the prerequisites for establishing a taxonomy of Arctic mineral resource projects. Among the most important prerequisites are the contradiction between the SD concept and the development of mineral resources, specific characteristics of Arctic mining projects, and current financing restrictions. An approach to project financing is developed, and an option for classifying Arctic mineral resource projects for the subsequent taxonomy is proposed.

Keywords: sustainable financing; taxonomy; Arctic projects; mineral resources



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1. Introduction

Arctic development issues currently pose significant challenges in political and economic discussions. This challenge is particularly acute concerning the development of the abundant mineral resources in the Arctic region, which represent a strategic reserve in response to growing global needs.

The Arctic zone is often referred to as a treasure trove of natural resources [1]. It harbors the largest reserves of traditional energy resources such as oil, coal, and gas, as well as minerals that underpin emerging technological structures, including nickel, cobalt, zinc, platinum, palladium, diamonds, and rare earth metals [2–4].

Despite the active development of various economic activities in the Arctic, such as transportation, the Northern Sea Route, and shipbuilding, the mining industry remains a cornerstone of economic activity in the Russian Arctic [5].

Given this context, the development of mineral resources in the Arctic zone emerges as a strategically significant task not only for Russia but also for the entire world. However, it is evident that activities related to geological exploration, extraction, and mineral processing entail significant environmental and social risks and cannot be deemed perfectly sustainable within the modern concept of sustainable development. Moreover, recognizing the specificity of these activities and the range of processes involved (exploration, production, processing, and refining), sustainable development cannot be solely equated with the sustainable development of the mineral resources sector. This distinction has been

underscored by the authors of previous studies [6]. Sustainable development in the mineral resources sector is an approach to the strategic development of a territory's mineral resource base that ensures a balance across four key domains over time (geological prospecting and exploration, field development, rational resource use, and national security) in alignment with prevailing global trends [6,7].

Deloitte's "Development Trends 2023" report identified ten new trends directly impacting the global mineral resources sector. These trends include progress in decarbonization processes, a focus on minimizing carbon footprints, an emphasis on environmental, social, and governance (ESG) principles, and ensuring industrial development based on sustainable interaction with nature. Additionally, there is an increasing importance placed on utilizing alternative energy sources and a shift in the key principles of project investment [8].

Despite considerable discourse regarding the abandonment of traditional energy sources [9–11], a complete energy transition appears impractical in the near future. Moreover, a transition to alternative energy sources is impossible without the use of critical materials such as copper, cobalt, nickel, lithium, rare earth metals, and zinc, essential components in wind turbines, electric vehicles, and other modern low-carbon technologies [12,13]. However, their uneven distribution in the earth's crust poses a significant challenge. Research by the U.S. Department of Energy and the European Union indicates that the world may soon confront a shortage of these essential materials required for planned environmental changes.

In addition to climate-related challenges, the mineral resources sector currently faces industry-specific problems, including the following [6]:

- Depletion of traditional mineral reserves;
- Reduction in the share of easily recoverable reserves;
- Complexity and high costs associated with geological exploration;
- Shortages of equipment and technology.

Given these circumstances, the issue of sustainable development of mineral resources becomes increasingly pertinent, considering all constraints. However, it has been noted that resource development alone does not constitute sustainable activity. Thus, the following pressing question emerges: how can projects be incentivized to contribute to the sustainable development of the mineral resource base while aligning with global trends?

Taxonomies for sustainable project financing are already actively employed in global and Russian practices. Companies engaged in the ESG agenda actively seek financing opportunities for their projects [14]. However, the existing instruments primarily focus on funding projects directly contributing to climate-related initiatives, leaving few options for financing sustainable development projects within the mineral resources sector.

The development of mineral resources entails multiple stages, including geological and geophysical exploration, development, resource extraction, processing, and reclamation activities. Each stage requires substantial capital investment. The realization of such projects necessitates collaboration among key stakeholders—the government, regional authorities, and companies—aimed at implementing projects fostering the sustainable development of the mineral resource base.

Recent turbulence in the macro-environment, global supply chain transformations in the mineral resources sector, and geopolitical factors have underscored internal trends, such as an emphasis on import substitution and a focus on ensuring and maintaining energy security. Concurrently, the influence of the ESG agenda has diminished because of restricted access to international financing sources for Russian companies.

The literature on the topic suggests that projects involving mineral resource exploitation may not be sustainable because of significant environmental risks [15,16]. The prevailing climate agenda and low-carbon development trends have prompted several companies and investors to refrain from financing Arctic projects. Institutions such as Britain's Royal Bank of Scotland, Goldman Sachs, Morgan Stanley, Chase, and Wells Fargo, among others, have opted out of financing such endeavors [17].

The development of the Arctic persists despite geopolitical and macroeconomic risks, with its significance heightened because of the need to safeguard and bolster the nation's geo-economic standing. The waning investment activity from foreign funds underscores the need to establish an indigenous system for financing Arctic projects in a sustainable manner. Given these circumstances, addressing this issue necessitates the creation of a financing framework specifically tailored for projects contributing to the sustainable development of the Arctic's mineral resource base.

To address this research problem, the following research questions (RQs) were formulated:

RQ1: What role do Arctic resource projects play in sustainable financing systems?

RQ2: What are the prerequisites for sustainable financing of Arctic projects?

RQ3: How can mineral resource development projects be classified to develop a taxonomy?

To tackle these questions, an extensive literature review was conducted on the existing approaches to sustainable project financing, contemporary taxonomies, and prevailing financing mechanisms for Arctic projects. Subsequently, a research methodology was proposed, encompassing a comprehensive overview of methods and a research algorithm. The outcomes of this study include the identification of prerequisites for establishing a taxonomy for financing projects aimed at the sustainable development of the mineral resource base, the formulation of an approach to project financing, and the proposal of a categorization method for Arctic resource projects, laying the groundwork for subsequent taxonomy development.

2. Literature Review

2.1. Sustainable, Responsible, Green, and ESG Financing: What Is the Difference?

The concept of sustainable finance emerged as a response to global climate, environmental, and social challenges [18–20]. Sustainable finance instruments aim to strike a balance among economic growth, environmental preservation, and societal well-being [18]. Today, various approaches to defining sustainable finance exist, often interchangeably using terms such as “climate finance”, “green finance”, and “responsible finance”. However, distinctions between these terms do exist.

Sustainable, green, and responsible financing forms constitute crucial components of the modern financial system. These financing approaches seek to integrate ESG factors into investment decision-making processes, with the goal of creating and protecting long-term value while considering the interests of all stakeholders—both present and future generations, employees, and communities [21].

Sustainable financing emphasizes the allocation of capital toward activities with minimal negative environmental and societal impacts, promoting economic growth and social well-being in line with sustainability principles. Green financing, a subset of sustainable financing, specifically targets investments in clean energy technologies, renewable energy sources, and other environmentally friendly initiatives, aiming to mitigate greenhouse gas emissions and facilitate the transition to a low-carbon economy. Responsible financing encompasses prioritizing the interests of minority and vulnerable groups, as well as workers, customers, and other stakeholders, addressing issues like labor rights, human rights, and corporate governance [18]. Responsible finance is simply offering financial services in an accountable, transparent, and ethical manner [22].

The absence of unified theoretical and methodological approaches to the concept of sustainable finance contributes to uncertainty in its practical application. Often, the term is conflated with green finance, as well as with responsible and ESG financing.

In international practice, various financing approaches exist, each imposing different requirements on investment targets regarding their compliance with social and environmental standards, implementation scope, goals, and objectives [23].

ESG parameters, along with the non-financial results of a company's or project's activities, form the basis for investment decisions within the realm of responsible financing [24,25]. Sustainable financing focuses on projects that contribute to achieving universally accepted SDGs [26]. Key instruments of sustainable financing include green bonds,

green and social loans, and subsidies aimed at supporting projects meeting high environmental and social standards. Impact and green finance primarily target projects whose implementation yields significant environmental and social outcomes [27].

Responsible investors conduct ESG analyses of all underlying investments, even those considered unethical or unsustainable. Conversely, sustainable investors concentrate solely on companies or industries that contribute to, or stand to benefit from, a more sustainable future. They may focus on specific topics such as renewable energy, electric vehicles, or carbon capture technologies, or they may analyze companies across all industries that align with the transition to a sustainable economy [14,28].

The emergence of sustainable finance and responsible investment, along with the integration of ESG factors, presents both risks and opportunities for financial institutions and investors [29]. Despite the relevance of topics related to the development of sustainable financing mechanisms, these issues are scarcely addressed in the Russian literature.

2.2. Sustainable Investments in the Arctic

The recognition of the Arctic as a strategically vital region with immense potential for global trade has attracted significant foreign investment. However, the high susceptibility of the region to climate change necessitated regulatory measures to govern these investments [30].

The distinctive conditions of the Arctic region demand a specialized approach to investment attraction and allocation. Currently, several investment approaches exist for Arctic development.

According to the Investment Model for the Arctic [31], an era of active investment in the region has commenced, emphasizing the importance of executing investments judiciously. The Arctic Economic Council (AEC), drawing insights from business executives and current realities, identified seven key industry areas for focus as follows: energy, mining, infrastructure, tourism, fishing and aquaculture, investments in human resources, and capacity-building [31]. However, as the Arctic's economic significance grows, so do the risks, including resource utilization concerns, ecological impacts on fragile ecosystems, technical limitations, operational safety, and the welfare of local communities. Yet, addressing these challenges aligns with the principles of sustainable development, which interweave economic, social, and environmental dimensions [32,33].

The Arctic Council has developed Guidelines for Responsible Arctic Investment [34]. The Arctic Investment Protocol is an important step forward and a solid foundation to build upon in the future. It sets a higher standard and allows further advancement of sound practices for sustainable development [35]. According to this document, investors should be guided in their decision-making by the following fundamental principles: (1) ensuring sustainable economic development while generating positive social effects, (2) respecting and involving local communities and indigenous peoples in management decisions, (3) relying on environmental protection and preservation of northern ecosystems, (4) responsible and transparent business conduct, (5) consistency in decisions and actions, and (6) strengthening international cooperation and exchange of knowledge and experience. These principles are encapsulated in the Arctic Investment Protocol [36], with the main emphasis on socially significant projects related to infrastructure development, the creation of social facilities, etc.

Recent Arctic development has encountered numerous financial and investment constraints within the production and industry sphere. While the strategic importance of developing the unique raw material base of northern territories is undeniable, it inevitably sparks discussions regarding environmental consequences and social risks.

In 2017, four of the largest banks—BNP Paribas, World Bank, Crédit Agricole Group, and Axa—publicly announced the suspension of investments in oil and gas projects within Arctic territories. Subsequently, the list of agencies and organizations ceasing participation in Arctic mining projects continued to grow. The financial conglomerate Citigroup specified a list of projects inconsistent with the company's principles, including those related to geo-

logical exploration, production, and marketing of oil and gas in the Arctic zone, alongside coal exploration projects and projects aimed at increasing its production capacity [37].

In a report compiled by Reclaim Finance, it is asserted that not all organizations, banks, and agencies adhere to their stated principles, as some continue to support and sponsor mineral projects in the region [38]. Reclaim Finance's conclusions emphasize the necessity of suspending support for Arctic projects, particularly focusing on all stages of oil and gas projects, with a special emphasis on offshore activities [39].

Thus, an investment paradox emerges in the Arctic context: while the region holds immense attractiveness and significant resource, trade, and industrial potential, there exist challenges and constraints in investing, imposing added responsibility on the investment community.

As noted earlier, business operators display a keen interest in the natural resources of the Arctic [40]. However, resource development necessitates a tailored approach because of the fragility of Arctic ecosystems. For instance, in recent years, the Nordic Investment Bank has increased the size and scale of its investments in the Arctic, reflecting the global attention drawn to the region's resources [41]. Notably, Norway stands out as one of the most responsible participants in Arctic endeavors. Currently, the Nordic Council of Ministers' Arctic Cooperation Program, "A Sustainable Arctic", is open for applications. This program identifies key criteria for decision-making in Arctic project investments, including the project's contribution to a green, competitive, and socially sustainable Nordic Region, as well as the project's clear regional and local impacts.

For Russia, the Arctic represents a promising economic territory with significant economic potential [5]. Legislative acts have been enacted to regulate investment activity in the region, particularly by stimulating investment through the establishment of special zones [42].

Despite global trends, the Arctic remains a crucial resource hub for Russia. The Strategy for the Development of the Mineral Resource Base of the Russian Federation until 2035 underscores the importance of creating conditions for the development of the Arctic's mineral resource base [43]. This necessity arises from the imperative to explore new directions for prospecting, exploration, and development of minerals, driven by the limitations and depletion of traditional mineral reserves.

Access to international capital is important for Arctic projects because of their specific features [44]. As industrial activities in the Arctic intensify, with increased involvement from international players and capital, it becomes imperative to establish rules governing business conduct and investments. These rules should prioritize optimal environmental, social, and governance (ESG) factors or outcomes [45].

2.3. A Taxonomy of Projects: Current Approaches

Project taxonomy functions as a system for categorizing projects based on various criteria, including scale, complexity, timing, and goals. It serves to structure and systematize information about projects, facilitating the selection of the most suitable projects for implementation. Within taxonomy frameworks, projects can be classified according to parameters such as project type, industry, region, implementation period, and budget, enabling the identification of promising areas for investment and business development [46,47].

A sustainable finance taxonomy is a framework of criteria that can serve as a foundation for assessing the ability of a financial asset to support certain sustainability goals and indicate the extent of that support. Its purpose is to provide a powerful impetus to investors and other stakeholders and assist them in their decision-making process by identifying the type of data investors need to assess sustainability [48,49]. The most famous and applicable taxonomies in the domain of sustainable investment projects are Green Bond Principles, Climate Bonds Taxonomy, Green Bond Endorsed Project Catalogue (China), and Taxonomy Technical Report (European Union) [50,51].

The European Taxonomy of Sustainable Finance is a system for categorizing financial assets and investments based on their alignment with sustainable development principles.

Developed by the European Union, the taxonomy includes various categories such as renewable energy, energy efficiency, public transportation, social infrastructure, green buildings, and many others.

The main purpose of the EU taxonomy is to support the sustainable development of the economy and society, to provide investors with benchmarks for investment decisions, and to help regulators and governments prioritize investments and stimulate the development of relevant sectors.

China's Sustainable Projects Taxonomy includes several categories of projects such as clean transportation, sustainable agriculture, and biodiversity conservation, among others. Each category contains a set of criteria and indicators to assess the environmental and social impacts of the project. This taxonomy serves as an important tool for investors to help them make informed decisions about investing in sustainable projects. It also raises awareness of the importance of sustainable development among entrepreneurs and government authorities.

The Singapore–Asia Sustainable Finance Taxonomy (SA-SFT) is a formal classification system established by the Central Bank of Singapore and the ASEAN Financial Regulator to assess and classify financial products, services, and investments from a sustainability perspective. This taxonomy splits all financial products and investments into the following five categories [52]:

- Renewable Energy: investments in projects related to the production of energy from renewable sources such as solar, wind, and hydro.
- Energy Efficiency: investments in technologies and projects aimed at reducing energy consumption and improving energy efficiency.
- Sustainable Agriculture: investments in projects to improve agricultural productivity and sustainability and to conserve natural resources.
- Clean Transportation: investments in low-emission vehicles and infrastructure, such as electric vehicles, charging stations, and public transportation.
- Social Infrastructure: investments in projects in health, education, housing, and other social services.

In Russia, as per the taxonomy developed under the Order of the Government of the Russian Federation No. 1587 of 21 September 2021, investment projects are classified into green and adaptive projects [53]. Projects are classified based on the criteria of the best available technologies (BAT), approved at the industry level [54].

It should be noted that the nature of mineral resource projects as a category, particularly those focused on geological exploration and mining, does not align with the criteria for green projects. Individual projects in mineral processing and metallurgy could potentially attain green project status, but the specific features of their lifecycles usually are not taken into account. Also, existing BAT criteria fail to account for the nuances of operating in Arctic conditions, raising questions about the integration of mineral resource business projects into sustainable financing frameworks and their access to support tools.

In summary, it was found from the literature review that while there are various approaches to financing projects that promote sustainable development, these approaches are not applicable to mineral resource development projects. Additionally, the analysis of sustainable finance taxonomies reveals a research gap concerning taxonomies for sustainable development projects in the mineral resources sector. This study aims to address this gap by developing an approach to financing projects for the sustainable development of the Arctic region's mineral resource base and proposing a taxonomy for project selection.

3. Materials and Methods

This study adopts a theoretical and empirical approach. Methods of analysis, synthesis, systematization, and decomposition of factors are involved. This study uses strategic analysis, planning tools, and scenario methods (Arctic development scenarios under different macroeconomic conditions). This study is based on the principles of the concept of sustainable development and the ESG agenda.

This study involves conducting a content analysis of the scientific literature on sustainable, responsible, green, and other forms of financing to reveal differences and interconnections as well as identify existing approaches to sustainable financing. In addition, an examination of analytical and regulatory documents was undertaken, encompassing both Russian and international sources, focusing on the integration of ESG principles into corporate project activities to track current policies and plans.

The algorithm proposed in this paper is based on the classification of projects by taxonomy. This research studied global examples of sustainable financing taxonomies, the elements of which were adapted to the specifics of Arctic resource potential development projects.

The general research algorithm is illustrated in Figure 1 below.

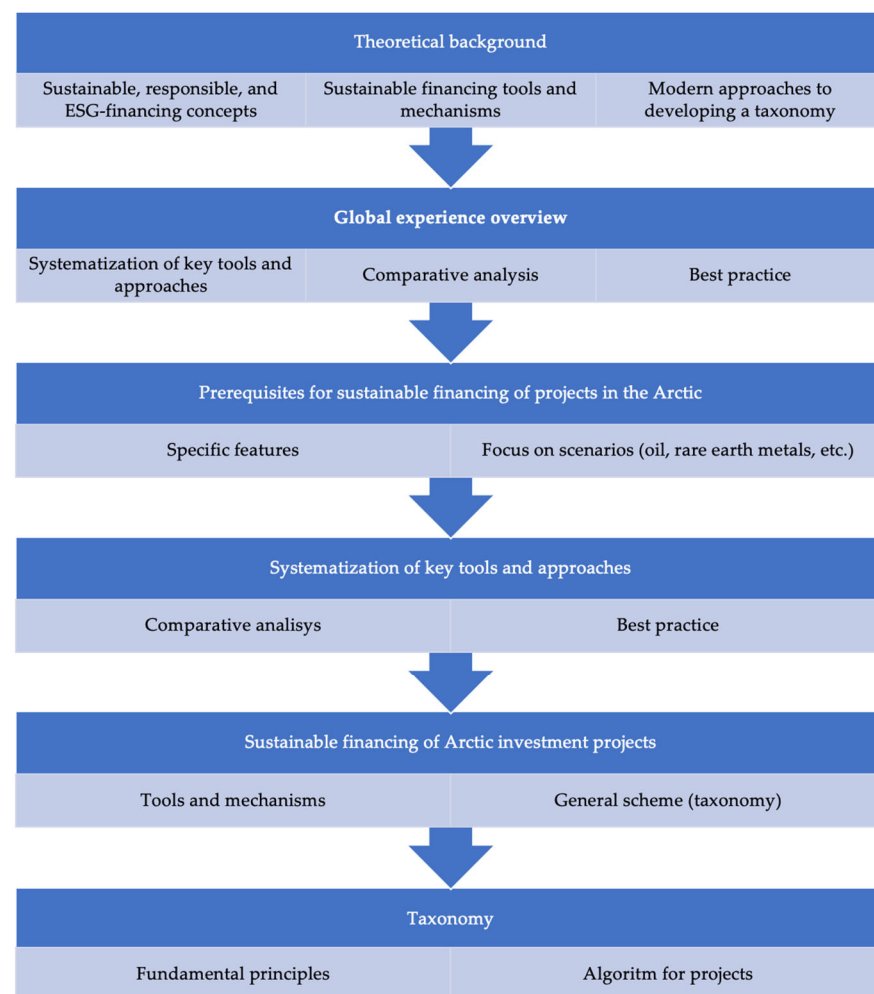


Figure 1. General research algorithm.

4. Results

4.1. Prerequisites for Sustainable Project Financing in the Arctic

As previously discussed, a fundamental contradiction exists between the pursuit of mineral resource development and the principles of sustainable development. This contradiction is underscored by the exclusion of projects aimed at exploring and exploiting mineral resources from existing systems of sustainable financing.

On the one hand, the mineral sector is a key element of the economy, making a significant contribution to GDP and job creation. Also, the extraction and processing of minerals contribute to the development of infrastructure and scientific research in related fields. On the other hand, the development of mineral resources can have a negative impact

on the environment and sustainable development. This can manifest itself in the form of air and water pollution, depletion of natural resources, disruption of ecosystems, and climate change. In addition, the process of mining and processing of minerals can be associated with high rates of injuries and occupational diseases among workers.

Hence, it is necessary to strike a balance between the economic benefits of mineral resource development and the imperative of preserving sustainable development for future generations. The implementation of mineral resource projects must align with global sustainable development goals, such as affordable and clean energy and responsible consumption and production. Furthermore, given the depletion of mineral resources and the growing demand for essential and critical types of minerals, particularly in the Arctic region, the development of sustainable financing mechanisms becomes an urgent imperative.

As mentioned earlier, several key concepts in the domain of sustainable and responsible financing have been designed. The authors have delineated the inter-relationship among these concepts, depicted in Figure 2.

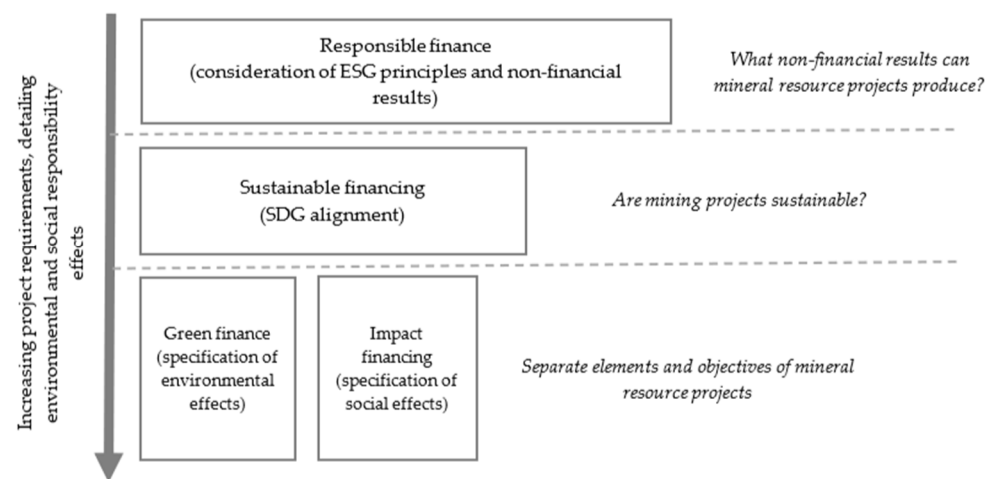


Figure 2. Relationship among the key concepts in the field of financing.

The issues surrounding financing the development of the Arctic are currently among the most pressing concerns, particularly because of the shifting direction and underlying principles guiding investment project support. The unresolved challenges in the area of determining the role and position of projects within the mineral resources sector greatly hinder their integration into sustainable financing frameworks.

A primary challenge entails ensuring the sustainable development of resource potential across all stages, ranging from geological exploration to the creation of high-value-added products. This challenge is underscored by the thesis posited by the Taskforce on Nature-related Financial Disclosures (TNFD), which advocates for a global shift in financial flows from environmentally detrimental outcomes toward environmentally positive outcomes [8].

Despite companies within the mineral resources sector demonstrating a notable commitment to ESG principles and sustainable development, along with evidence of their contributions to achieving SDGs, their prioritization in terms of attracting investments appears to be diminishing, as evidenced by Table 1.

Currently, the decline in investment attractiveness is exerting a particularly acute influence on Arctic projects. Among the most valuable objects in the Arctic for investment are infrastructure development projects (transport, digital, educational), research projects (R&D, innovation, entrepreneurship), and venture projects, as indicated by Oxford Research [56]. Mineral projects, within this framework, are perceived as not contributing significant value to the region's development.

Table 1. ESG rankings of mining companies operating in the Arctic.

Parent Company	Mineral Resource	ESG
Gazprom	natural gas, gas condensate	BBB
Rosneft	oil	BBB
NOVATEK	natural gas	BBB
Gazprom Neft	oil	BBB
Phosagro	apatite, nepheline, gallium, rubidium, cesium	A
Norilsk Nickel	nickel, copper, chromium, selenium, tellurium	A
Rusal	nephelines, rubidium, cesium	BBB
Severstal	iron	A
EuroChem	iron, apatite, zirconium	BB
Highland Gold	gold	CCC
Polymetal	gold	A
Lukoil	oil	A
Alrosa	diamonds	BBB
Karelsky Okatysh	iron	A
Polus	gold	AA

Source: compiled by the authors based on [55].

Drawing from the identified factors and contradictions, the prerequisites for sustainable financing of mineral resource projects in the Arctic were systematized, as outlined in Table 2.

Table 2. Prerequisites for sustainable financing of mineral resource projects in the Arctic.

Key Factors	Main Directions	Sustainable Financing Principles in the Mineral Resources Sector
Contradiction between the concept of sustainable development and the development of mineral resources	Finding a compromise, alignment with sustainable development goals	strengthening international cooperation and exchange of knowledge and experience
Specific characteristics of Arctic mining projects	Adaptation of tools to project specifics	ensuring sustainable economic development;
Lack of mineral resource development projects in existing financing systems	Development of system for such projects	generating positive social effects; respecting and involving local communities and indigenous peoples in management decisions;
Refusal of investment in the Arctic by major agencies	Development of mechanisms, search for new partners	responsible and transparent business conduct; infrastructure development, creation of social facilities
Refusal to cooperate with the Russian Federation		relying on environmental protection, and preservation of northern eco-systems; consistency of decisions and actions.
Prospects for the development of the Arctic zone for business	Adaptation of tools to project specifics	

4.2. Sustainable Financing of Arctic Investment Projects

The Russian Arctic has been and continues to be a promising source of the most sought-after resources. Consequently, the development of mineral resources stands as a key area in the development of the Russian Arctic, essential for ensuring national security, as evidenced by the substantial contribution to Gross Regional Product (GRP) across all Arctic regions (42% in Chukotka Autonomous Okrug, 73% in Yamalo-Nenets Autonomous Okrug, up to 86% in Nenets Autonomous Okrug) [57].

The development priorities outlined in regional strategies revolve around fostering geological exploration efforts, ramping up production of strategically vital resources, and increasing the share of high-value-added products to meet domestic market demands.

Presently, the development of the Arctic's mineral resources is characterized by several discernible trends as follows: 1. uneven dynamics in the financing of geological exploration across different regions, 2. the presence of a large number of mining companies operating at different scales, 3. uneven concentration of mineral reserves, 4. discrepancies between planned and actual regional indicators, 5. declines in production levels (in comparison with set targets) of traditional fossil fuels such as oil, gas, and coal, and 6. an increase in extraction rates (in comparison with set targets) of such critical minerals as copper, nickel, and rare earth elements. The choice of direction for the development of the Arctic resource potential largely depends on the impact of local and global trends. Thus, the actualization of the climate agenda has predetermined the need to shift the focus from traditional resources, such as oil and coal, to critical materials required for the global energy transition. The authors delineated scenarios for Arctic development, tailored to the unique characteristics of mineral resource projects and the prevailing trends (Figure 3). It is important to note that the chosen development scenario significantly influences the criteria, outcomes, and potential impacts of project implementation.

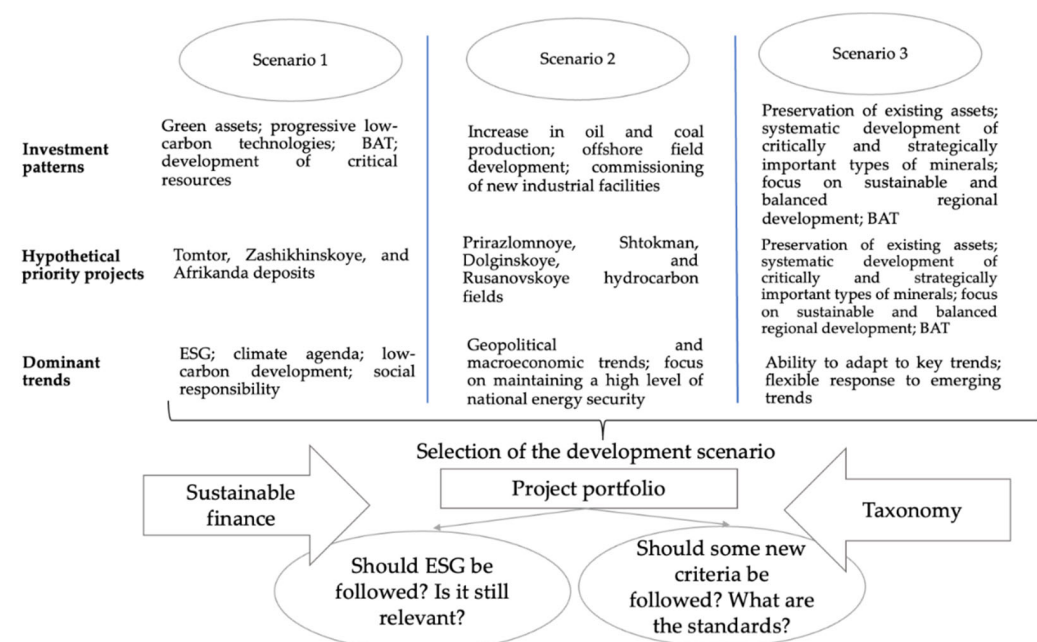


Figure 3. Arctic development scenarios.

Investment projects within the mineral resources sector in the Arctic exhibit distinct specificity, stemming not only from geological, production, and technological factors but also from the following factors [58]:

- Severe natural and climatic conditions, necessitating special operational protocols for industrial facilities;
- Underdeveloped logistics and infrastructure;
- Vulnerability of northern ecosystems;
- The need to take into account the interests of indigenous populations;
- Sanction pressure and investment restrictions, leading to limited access for Russian projects to global sustainable financing instruments;
- Dependency on government support for projects;
- Low investment attractiveness, requiring preliminary exploration and substantial capital expenditures.

These features of the Arctic, coupled with financing challenges and global attention to the region, alongside the conflicting attitudes toward resource extraction, underscore the strategic importance of forming an approach to financing projects for the sustainable development of the mineral resource base. Such an approach must integrate the principles of existing sustainable financing while also accommodating the financing principles for mineral resource development (Figure 4).

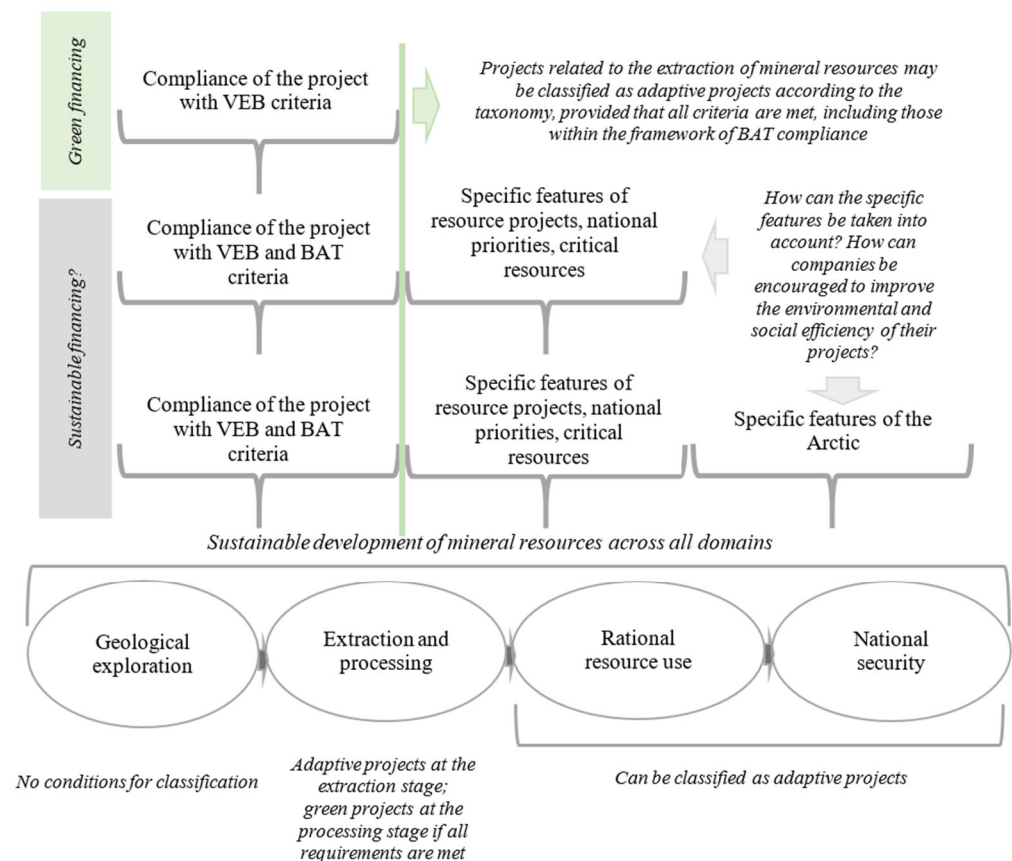


Figure 4. Sustainable financing of mineral resource projects in the Arctic. (VEB—criteria of Russian state corporation “VneshEconBank”).

It can be concluded that the issue of sustainable financing for mineral resource projects, which should be based on the previously described conceptual model of sustainable development (SD) of the Arctic mineral resource base, remains unresolved. The inclusion of mineral resource projects in the system of sustainable financing could serve as a platform for incentivizing companies to conduct their activities in a responsible manner. Additionally, given the conditions of sanction pressure, there is a necessity to focus on the creation and development of a national taxonomy for mineral resource projects. This should take into account both the specifics of such projects and the peculiarities of the Arctic region.

4.3. Taxonomy: An Algorithm and Practical Cases

As previously mentioned, projects aimed at mineral resource development, particularly mining projects, are currently absent from existing taxonomies of sustainable finance. Establishing a system for financing projects geared toward the sustainable development of the mineral resource base would facilitate optimal resource allocation and encourage companies to initiate such projects. Simultaneously, addressing the issue of project selection based on the aforementioned principles can be achieved through the utilization of a taxonomy specifically designed for mineral resource projects.

This taxonomy should be designed based on principles governing the financing of such projects, as well as the impact of the project on the sustainable development of mineral reserves.

Table 3 outlines a taxonomy diagram, encompassing key stages, principles, and criteria for categorizing projects, thereby facilitating the formation of an effective sustainable financing mechanism.

Table 3. Key stages, principles, and criteria for project categorization.

	Filter	Component	Principle	Assessment Criteria	Category
Why?	Filter 1	National interests	strengthening international cooperation and exchange of knowledge and experience	Depends on the country's strategic priorities	Strategic and potential projects
		Contribution to the SDGs	ensuring sustainable economic development	Contribution to the SDGs	
How?	Filter 2	Social responsibility	generating positive social effects; respecting and involving local communities and indigenous peoples in management decisions; responsible and transparent business conduct; infrastructure development, creation of social facilities	Number of jobs; social programs; social infrastructure facilities	Sustainable and unsustainable projects
		Environment	relying on environmental protection and preservation of northern ecosystems	CO ₂ emissions; implementation of environmental technologies; energy efficiency [59]	
		Rational resource use		Integrated use of minerals	
What?	Filter 3	Technology	consistency in decisions and actions	High level of technological development; accounting for the specific characteristics of the Arctic	Implementable, adaptive, and unimplementable projects
		Economy		Potential economic effects; budget efficiency	

The taxonomy of sustainable financing for mineral resource projects in the Arctic constitutes a classification and evaluation system for investment endeavors in this region, grounded upon principles of environmental sustainability, social accountability, and economic viability.

This taxonomy, rooted in the principles of responsible investment articulated previously, is designed to discern and endorse projects within the domain of the mineral resource sector, spanning geological exploration, exploitation, production, and processing. The filter in this taxonomy is the project selection stage. Components combine assessment criteria that are used to make management decisions regarding project categorization.

In accordance with the proposed taxonomy, the initial stage involves assessing national interests and the overall project contribution toward global sustainable development objec-

tives. The delineation of national interests may fluctuate depending on national priorities, such as import substitution policies. Projects at this juncture are classified into strategic and potential ones.

The second stage evaluates facets such as social responsibility, environmental impact, and rational resource use while considering the nuances of resource development, including integrated resource use and waste management. As a result, projects are classified into sustainable and unsustainable ones.

Only projects classified as both strategic and sustainable pass to subsequent selection stages. The final filter categorizes projects as implementable, adaptive projects, which have the potential for medium-term implementation with cost-effective execution, or unimplementable in the short- or medium-term.

The devised algorithm enables project classification, facilitating the effective utilization of sustainable financing mechanisms while accommodating the distinctive requisites of mineral resource projects (Figure 5). Taxonomy algorithms for mineral resource projects in the Arctic need to be implemented by interaction among governments, banks, and investment agencies (such as VEB in Russia for example).

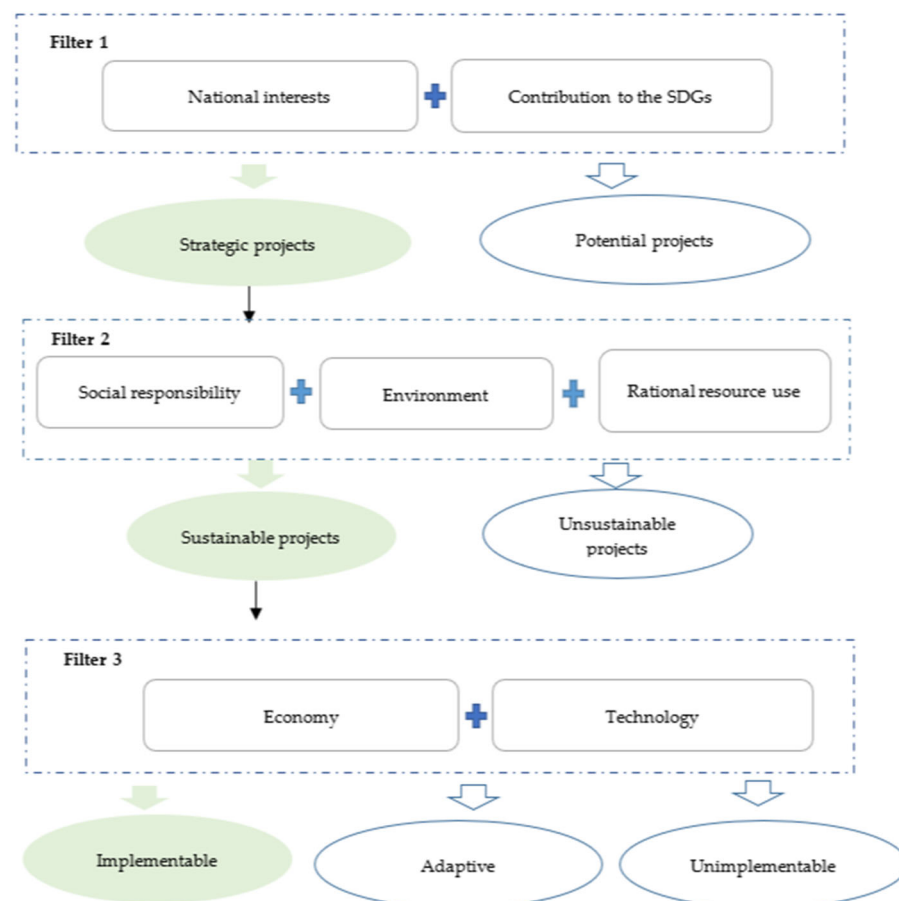


Figure 5. Taxonomy algorithm for mineral resource projects in the Arctic.

5. Discussion and Conclusions

The strategic importance of the Arctic as a source of vital resources, juxtaposed with the influence of global and national trends, underscores the necessity to develop an approach to the sustainable development of the mineral resource base [3,4,6,7,30–32,34,40]. Presently, renouncing resource development is unfeasible, rendering the adoption of sustainable practices imperative.

The exploitation of the resource potential in the Arctic region stands as a cornerstone of the Russian economy and industry. Consequently, contemporary issues pivot not on whether

to exploit the Arctic's mineral wealth but on the methodologies employed, which must align with sustainable development principles while accommodating national priorities.

Sustainable development of mineral resources should be ensured by maintaining a high level of sustainable development of the investment projects implemented in the sphere of geological exploration, mineral extraction, and processing.

Geopolitical instability and sanctions exert substantial influence on industrial development trajectories, necessitating management paradigm shifts and recalibration of corporate objectives. Despite the proliferation and advancement of sustainable financing instruments internationally, methodological quandaries persist regarding project selection and criteria formulation aligning with sustainable development and ESG agendas in Russia. The opacity surrounding government support mechanisms and private investment attraction compounds the issue. Projects are appraised against international benchmarks, resulting in the disjointed integration of Russian companies into ESG ratings. These methodological hurdles preclude the establishment of a unified system for project selection and sustainable financing of mineral resource projects in the Arctic.

Devising approaches to sustainable financing of mineral resource projects in the Arctic is necessary for facilitating a transition to regional sustainable development, considering prevailing market trends and global challenges, including climate change, the energy transition, and growing environmental and social imperatives.

This study has analyzed and systematized approaches to sustainable financing, delved into the theoretical foundations of creating sustainable financing taxonomies, and discussed the nuances of financing mineral resource projects, particularly in the Arctic context. It has underscored the absence of a defined place for mineral resource projects in prevailing taxonomies, necessitating the formulation of an approach to finance projects for sustainable development of the mineral resource base, accounting for numerous prerequisites and constraints [60,61].

It is important to mention that in the context of sustainable finance, issues of financial transparency are relevant. Companies should take a responsible approach to information disclosure and provide timely and reliable data to all stakeholders, including society. The functioning of the sustainable finance mechanism itself largely depends on the degree of financial transparency. Within the framework of this study, the issues of financial transparency were not considered, since an attempt was made to develop the financing mechanism itself. However, in the future, the proposed taxonomy will be tested on the example of specific mineral resource extraction projects, in which the problem of the responsible disclosure of information by mining companies will be considered. In addition, the problem of using conflict materials is currently extremely topical. Reducing the extraction of these materials is one of the important areas. This is now recognized by many companies in the world. Nevertheless, the problem of conflict materials mining has not been considered within the framework of this study. The conditions of the Arctic region and the existing approaches to the development of northern territories differ in many respects from the conditions in the countries that realize their extraction, for example, Congo. Therefore, this paper deals with critical and strategically important types of minerals. However, this topic is interesting and also can be discussed in further research.

Projects geared toward developing the mineral resource base hold the potential to foster the sustainable development of the region. Presently, core principles of sustainability, equity, and environmental stewardship permeate business development endeavors. Locals are welcomed to participate in projects from the earliest stages, not only as members of the workforce but as bearers of unique knowledge about local ecosystems and as future beneficiaries of the fruits of these projects' operations. Such considerations are instrumental to changing the paradigm of "business as usual" and placing the Arctic well on track to become the world's first region to completely transition to sustainable business solutions [62].

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