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Economic mechanism for promoting the development of technogenic deposits in the Russian Arctic and Far East: institutional conditions and a model for differentiating support measures

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Abstract

Against the background of ongoing reform of preferential regimes in the Arctic Zone of the Russian Federation (AZRF) and the Far Eastern Federal District (FEFD), there is a growing need for institutional solutions that can simultaneously reduce the environmental risks associated with technogenic deposits (anthropogenic mineral accumulations, including secondary mineral resources contained in mine tailings) and maintain the investment attractiveness of projects for their development. The aim of this study is to develop a universal approach to regulating projects for processing technogenic deposits in the AZRF and FEFD macroregions that balances the standardization and differentiation of support measures while accounting for regional differences in the structure of the technogenic legacy and risk profiles. The theoretical framework combines the institutional approach, the concept of government and market failures in environmental regulation, the theory of complementary macroregional development, and the concept of economic incentive instruments. The methodological toolkit includes content analysis and comparison of the regulatory framework governing preferential regimes in the AZRF and FEFD, comparative analysis of the regional distribution of technogenic deposits and the regimes operating in those regions, synthesis of the findings and development of a model for harmonizing the regimes as applied to technogenic deposit development projects, testing of the model using hypothetical examples, and verification by comparison with existing instruments for stimulating the processing of technogenic resources and with the results of previous studies. The study uses statistical data from Rosstat and Rosnedra, as well as information from open scientific and government sources aggregated for the AZRF and FEFD regions. A two-component assessment system is proposed, based on the intersection of an index of project economic feasibility and an integral index of the priority of involving technogenic deposits in order to reduce environmental risk. The resulting matrix makes it possible to rank projects by implementation priority and by the level of government support required. The scientific novelty lies in integrating the structure of the technogenic legacy, environmental risks, and preferential-policy parameters within a single risk-oriented analytical framework; the practical significance lies in the possibility of using this framework to configure a unified preferential regime for the AZRF and FEFD.

Keywords

technogenic deposits; institutional barriers; preferential regimes; regional differentiation; environmental risk; economic incentive mechanism; Arctic; Russian Far East; subsoil use

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Introduction

The global mining industry has entered a transition phase in which mining and mineral-processing waste is increasingly regarded as a resource asset rather than solely as an environmental burden [1-3]. Bibliometric studies record growing interest in integrating circular-economy principles into mining, ranging from tailings valorization to the recovery of critical metals from technogenic accumulations. The geopolitical dimension makes the issue still more acute: competition for critical raw

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materials contained in waste dumps turns mining-waste management into an element of strategic resource policy, while the scale of accumulated legacy continues to outpace the rate at which it is brought into economic use, particularly in Arctic and Far Eastern regions [1, 4-7]. Arctic conditions (permafrost and extreme climate) and the specific features of the Russian Far East (remoteness, low population density, and weak infrastructure) increase both the cost and technological complexity of processing projects of technogenic deposits (TD; anthropogenic mineral accumulations, including secondary mineral resources contained in mine tailings), creating a distinct class of economic and environmental constraints. Against this background, the state has progressively established preferential regimes for these macroregions: an Arctic (the Arctic Zone of the Russian Federation, AZRF) and Far Eastern regimes (territories of advanced development, TAD; the Free Port of Vladivostok, FPV; etc.). Their effectiveness in subsoil use, however, has repeatedly been criticized [8, 9] and the Accounts Chamber of the Russian Federation has pointed to foregone revenues and the absence of a systematic assessment of the fiscal efficiency of tax benefits[1]. At the same time, in 2025-2026 both groups of regimes entered a period of active reform. The Ministry for the Development of the Russian Far East and Arctic developed the concept of a unified preferential regime that would combine TAD, the FPV, and the AZRF within a single legal framework with unified entry conditions and tax parameters[2]. Under these circumstances, the reform both creates risks of less favorable conditions for TD-development projects and opens a window of opportunity for correcting ineffective measures embedded in the current institutional regimes, making the justification of targeted support instruments for TD particularly relevant.

The current academic debate is concentrated around three groups of issues:

• Technogenic deposits as a resource base: classifications of technogenic formations are proposed and their role in the circular economy is substantiated, provided that comprehensive geological, environmental, and economic assessment is performed [10-12]; international studies link TD processing with critical-raw-material policy and environmental remediation, emphasizing the need to assess the stability of residual materials and to conduct long-term monitoring [13-15].

• Environmental risk in the mining sector [6, 16, 17]: probabilistic and scenario-based approaches and methods for assessing environmental and economic damage are used to link pollution levels with monetary estimates of consequences for natural resources and public health. Particular attention is given to geocryological factors in Arctic territories and their influence on contaminant migration and the stability of technogenic facilities [7]. Index-based and GIS approaches to pollution analysis are also developing, but the relationship between risk level and the parameters of preferential regimes remains largely unexplored.

• Institutional and fiscal aspects of subsoil use [18-20]: studies demonstrate the heterogeneous effectiveness of tax incentives and their influence on territorial imbalances and analyze special economic regimes without explicitly linking them to TD. International research compares fiscal instruments and green tax measures, but regional differentiation and the specific features of the technogenic legacy are still considered only to a limited extent [14, 21].

Despite the substantial development of individual components, there is no integrated analytical framework combining the structure of the technogenic legacy, the environmental-risk profile, and preferential-policy parameters while accounting for macroregional differentiation. Existing studies rarely implement a risk-oriented logic for designing preferences: support measures are assessed in terms of their effects on investment and extraction, but not in terms of their capacity to reduce accumulated environmental risks. This leads to the hypothesis that a unified preferential regime for

[1] Report on the Results of the Expert and Analytical Review "Assessment of the Impact of Far Eastern Development Institutions and the Operation of Territories of Advanced Socio-Economic Development and the Free Port of Vladivostok on Achieving the Goals of Accelerated Socio-Economic Development of the Far Eastern Federal District". URL: https://ach.gov.ru/upload/iblock/6f5/ywra3fjrkuqgq4e8k4mvatzst6tkvmz3.pdf?utm_source=chatgpt.com (accessed 10.04.2026).

[2] A Unified Preferential Regime for Businesses to Be Introduced in the Russian Far East and the Arctic. URL: https://www.pnp.ru/economics/na-dalnem-vostoke-i-arktike-vvedut-edinyy-rezhim-preferenciy-dlya-biznesa.html (accessed 10.04.2026).

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processing TD without regional differentiation cannot be sufficiently effective, because asymmetries in the structure of the technogenic legacy and environmental risks across the AZRF and FEFD macroregions require different packages of support measures. The aim of the study is to develop a universal approach to regulating TD-development projects amid reform of the AZRF, TAD, and FPV preferential regimes, ensuring a balance between unification and differentiation of support measures based on regional differences. To achieve this aim, the following tasks are addressed sequentially:

• analyze the mechanisms of existing and reformed preferential regimes as applied to mining projects at TD;

• relate the structure and barriers to TD development across AZRF and FEFD regions to the institutional conditions of support;

• identify regional specificities of the technogenic legacy and environmental profile;

• develop recommendations for harmonizing the regimes for TD-development projects within a unified preferential regime.

Methods

The theoretical foundation of the study is the institutional approach [22]. An additional analytical basis is provided by the concept of government and market failures as applied to environmental regulation, namely a situation in which the regulator creates barriers to entry into the secondary mineral-resource sector rather than incentives for bringing technogenic formations into economic circulation [23]. The theory of complementary macroregional development substantiates the expediency of a unified supraregional approach to the AZRF and FEFD as territories whose institutional deficits are structural rather than local, which calls for coordinated mechanisms of preferential regulation [21]. The concept of economic incentive instruments defines the logic for designing differentiated support measures aimed at adjusting the fiscal, procedural, and coordination parameters of the institutional environment depending on the characteristics of a particular project and the territory in which it is implemented [18-20].

The empirical basis of the study consists of a set of heterogeneous sources grouped into three main blocks:

• Statistical data drawn from Rosstat databases and publications on the socioeconomic conditions of Russian regions; Rosnedra statistics on reclamation of disturbed land; the Water Ranking of Russian regions[3]; data from the National Atlas of Russia[4]; materials from https://statbase.ru/; and information on technogenic deposits in Russian regions collected from open sources. The data were aggregated at two levels: constituent entities included wholly or partly in the AZRF and constituent entities of the FEFD, with a control comparison against the Russian Federation as a whole. The composition of the regions included in the AZRF and FEFD was determined using the legally established list in force in the year of the study. Statistical data used to test the proposed methodological approach refer to 2023, the latest year for which open data were available.

• The regulatory block covers federal laws and subordinate legislation governing subsoil use, waste management, and the fiscal conditions of extraction: the Law of the Russian Federation “On Subsoil”, the Federal Law “On Production and Consumption Waste”, the Federal Law “On Environmental Protection”, the Tax Code of the Russian Federation, and Resolution of the Government of the Russian Federation N 781 of 17 July 2025 “On the Procedure for the Use of Overburden and Host Rocks”. It also includes regulatory acts establishing the current preferential regimes in the AZRF and FEFD, including basic documents defining the boundaries of the AZRF and FEFD, their development policies and strategies, provisions of the Tax Code of the Russian Federation, and subordinate legislation. The regulatory framework for the AZRF and FEFD preferential regimes considered in this study is shown in Fig.1.

[3] Tretyakova E.A., Gotfrid A.V. Water Ranking of Russian regions for 2023: An Analytical Review. Yekaterinburg; Perm, 2025, p. 224.

[4] National Atlas of Russia. URL: https://nationalatlas.ru/ (accessed 10.04.2026).

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	Arctic Zone		Russian Far East			
Regulatory acts	SEZ “Arctic Zone of the Russian Federation”	TAD “Capital of the Arctic” (Murmansk Region) “Capital of the North” (Arkhangelsk Region) “Chukotka” (Chukotka Autonomous Okrug) “Nadvoitsy” and “Kostomuksha” (Republic of Karelia)	TAD Amur Region Kamchatka Krai Chukotka Autonomous Okrug Khabarovsk Krai Primorsky Krai Zabaykalsky Krai Republic of Buryatia Republic of Sakha (Yakutia)	Free Port of Vladivostok (FPV)	KORF (Kuril Islands of the Russian Federation)	Magadan SEZ
Basic acts	Presidential Decree N 296 of 02.05.2014, Presidential Decree N 164 of 05.03.2020, Federal Law N 193-FZ of 13.07.2020, Federal Law N 195-FZ of 13.07.2020	Federal Law N 473-FZ of 29.12.2014	Federal Law N 473-FZ of 29.12.2014	Federal Law N 212-FZ of 13.07.2015	Federal Law N 104-FZ of 31.05.1999 (2016 revision; extended to 2046); Federal Law N 50-FZ of 09.03.2022	Federal Law N 104-FZ of 31.05.1999 (2016 revision; extended to 2046); Federal Law N 147-FZ of 07.06.2025
Tax Code	Art. 284.4; Art. 343.6; Subpara. 5, Para. 1, Art. 342; Art. 336 (Para. 2); Subpara. 12, Para. 1, Para. 2.2, Art. 427; Art. 395 (Para. 1)	Art. 284; Art. 284.4; Art. 342.3; Subpara. 12, Para. 1, Para. 2.2, Art. 427	Art. 284, Art. 284.4; Art. 342.3; Subpara. 12, Para. 1, Para. 2.2, Art. 427	Para. 1.8, Art. 284; selected provisions of Chs 30-31; Part II of the Tax Code; contribution-rate provisions for special regimes	Special provisions in Chs. 25, 28, 30, 31	Art. 286.1
Subordinate legislation	Government Order N 2956-r of 20.10.2021 Orders of the Ministry of the Russian Federation for the Development of the Far East and the Arctic	Government Resolutions: N 656 of 12.05.2020, N 1068 of 09.08.2024, N 876 of 21.08.2015, N 940 of 19.09.2016, N 122 of 12.02.2019	Government Resolutions: N 847 of 27.08.2016, N 875 of 21.08.2015, N 899 of 28.08.2015, N 876 of 21.08.2015, N 630 of 25.06.2015, N 628 of 25.06.2015, N 629 of 25.06.2015, N 878 of 21.08.2015, N 988 of 31.07.2019, N 760 of 14.06.2019, N 877 of 21.08.2015, N 1524 of 28.12.2016	Government Resolutions (2015-2019) extending the Free Port of Vladivostok to FEFD municipalities		
Strategies and development programs	Presidential Decree N 645 of 26.10.2020		Government Order N 2464-r of 24.09.2020			

Fig.1. Regulatory framework of the AZRF and FEFD preferential regimes

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• Scientific publications on reclamation of disturbed land in Arctic and Far Eastern regions [6, 16, 17], management and processing of mining waste [2, 7, 24], and institutional mechanisms providing incentives for bringing technogenic resources into economic use [18-20].

The methodological toolkit of the study comprises four interrelated methods, each of which sequentially generates input data for the next stage of analysis:

• content analysis and comparison of the regulatory framework governing preferential regimes in the AZRF and FEFD. The purpose is to systematize the formal institutional conditions of the preferential regimes and identify their similarities and differences that must be taken into account when the regimes are unified;

• comparative analysis of data on the distribution of technogenic deposits across the AZRF and FEFD regions and the preferential regimes in force in those territories;

• synthesis of the findings and development of a model for harmonizing the regimes as applied to TD-development projects within a unified preferential regime;

• testing the proposed model in the AZRF and FEFD regions using hypothetical case-study analysis [25], and verification of the results by comparison with existing instruments for stimulating the processing of technogenic resources in the AZRF and FEFD regions and with the results of similar previous studies.

Discussion of results

Specific features of applying preferential-regime conditions to technogenic-deposit development projects and differences in the "*entry*" *mechanisms for mining projects*. Several key preferential regimes operate in the FEFD and AZRF, forming the institutional environment for investment-project implementation. The core regimes include territories of advanced development regulated by Federal Law N 473-FZ of 29 December 2014; the regime of state support for entrepreneurial activity in the AZRF established by Federal Law N 193-FZ of 13 July 2020; and the Free Port of Vladivostok regime established by Federal Law N 212-FZ of 13 July 2015. In addition, a special economic zone (SEZ), regulated by Federal Law N 104-FZ of 31 May 1999, operates in Magadan Region and in the South Kuril, Kuril, and North Kuril urban districts of Sakhalin Region. Taken together, these regimes create a legally heterogeneous but in practice overlapping field of tax and administrative incentives, which requires differentiated consideration when analyzing the institutional conditions for projects that bring technogenic deposits into economic circulation (Table 1).

A key feature of TD-development projects is their borderline position between subsoil use and waste management: whether an object is classified as a subsoil plot or as waste determines the application of the mineral extraction tax (MET) and, consequently, the availability of tax preferences. When a TD is entered into the State Balance of Mineral Reserves and developed under a license, MET becomes payable, whereas the processing of technogenic formations not recognized as subsoil-use objects takes place outside the MET regime and is governed by waste-management legislation.

In the AZRF, this distinction is reinforced by the design of the incentives: Subparagraph 8, Paragraph 1, Article 284.4 of the Tax Code of the Russian Federation excludes mineral extraction from eligibility for the reduced corporate income tax (CIT) rate, which requires separate accounting and effectively removes the extraction stage from the scope of eligibility for incentives, fragmenting projects that combine extraction and processing. In TAD and the FPV, there is no universal prohibition on extending benefits to extraction: where extraction is included in the resident agreement and the relevant criteria are met (investment, jobs, separate accounting), reduced CIT rates and other tax and administrative incentives may apply to the combined result of the extraction and processing stages; restrictions are sector- and territory-specific.

At the regime-entry stage, the differences are also substantial. In the AZRF, eligibility for CIT incentives is tied to projects that do not fall within the types of activity specified in Subpara. 8, Para. 1,

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Table 1

Comparison of benefits under the AZRF and FEFD preferential regimes for TD-development projects

Benefit	AZRF	TAD (FEFD)	TAD (AZRF)	FPV	Magadan SEZ	KORF (Kuril Islands of the Russian Federation)	Applicability to TD
Reduced CIT rate	Reduced rate for the regional component of CIT; does not apply to organizations whose principal activity is extraction of solid minerals (Subpara. 8, Para. 1, Art. 284.4 of the Tax Code of the Russian Federation)	Regional component of CIT: ≤ 5 % for the first 5 years and ≥ 10 % for the next 5 years from the first profit	Regional component: 5 % for the first 5 years and 12 % for the next 5 years	0 % for the first 5 years, 18 % for the next 5 years	Abolished from 01.01.2026; investment tax deduction remains available	0 % for 20 years (but not beyond 31.12.2046)	In the AZRF, the benefit is unavailable where the principal activity under OKVED is extraction of solid minerals. In TAD/FPV/SEZ/KORF regimes, there are no direct restrictions by deposit type; applicability depends on the project meeting resident requirements
MET deduction	Applies where the depletion ratio was ≤ 0.001 as of 01.01.2021 or the deposit was not recorded in the State Balance of Mineral Reserves, subject to the other conditions	Not tied to a preferential regime; applies under the general procedure subject to Art. 343.6 of the Tax Code of the Russian Federation					For new or nearly depleted TD, the AZRF deduction is a practical instrument; in the other regimes there is no direct link to the preferential regime
MET reduction coefficient	No special coefficient is established for the AZRF	Reducing coefficients (down to zero) under Arts. 342.1 and 343.2 of the Tax Code for certain new FEFD deposits			Abolished from 01.01.2026	No separate reducing coefficient is provided	For TAD/FPV, MET reduction coefficients may also apply to TD subject to the Tax Code requirements; KORF has no separate special coefficient
Property tax	0 % for 5 years for new resident property, subject to the applicable conditions	0 % for 5 years; thereafter, the rate established by the constituent entity		0 % for the first 5 years; 0.5 % for the next 5 years	Abolished from 01.01.2026	0 % for 20 years	In all regimes, property-tax benefits do not depend on deposit type; the property must be linked to resident activities and meet the criteria for a new asset
Social-insurance contributions	No special reduced rate; partial contribution subsidies may be available under specific programs	7.6 % rate for 10 years			No special reduced rates	7.6 % rate for 20 years	Social-insurance contribution benefits are greatest under the TAD and KORF regimes
Land tax	Benefits are set by regional/municipal regulations; the AZRF does not automatically provide a zero rate	0 % for 5 years for resident land plots; thereafter, regional/municipal rates apply			Abolished from 01.01.2026	0 % for 20 years	Land-tax benefits do not differentiate between technogenic and natural deposits; resident status and designated land use for processing/extraction facilities are decisive
Transport tax	No special benefits within the AZRF	Benefits may be granted by the constituent entity; they are not a core element of the regime				0 % for 20 years	There are no restrictions by deposit type; transport-tax exemption is particularly important for remote TD projects
Free Customs Zone (FCZ) customs benefits	Not provided	An FCZ regime is possible for certain port and industrial TAD	Possible where the required infrastructure exists and the site is included in the FCZ list	FCZ is a core element of the regime	FCZ regime: duty-free import of equipment, technologies, and materials	FCZ regime through extension of the Magadan SEZ regime	The FCZ regime can substantially reduce CAPEX for imported TD-processing equipment; deposit type is immaterial
Infrastructure support	Possible federal and regional co-financing of infrastructure, subsidies, and public-private partnerships (PPP)	Primarily through resident projects and regional TAD development programs	Additional regional measures (ports, roads, power infrastructure)	Targeted infrastructure support and interest-rate subsidies	Dedicated infrastructure support is limited; emphasis is placed on tax and customs benefits	Direct federal infrastructure investment under specific programs	For remote technogenic clusters, infrastructure support is often more important than tax benefits alone and can determine the viability of TD-processing projects
Minimum entry threshold	Approx. 1 million rubles in investment and ≥ 10 jobs (as a general rule under Federal Law N 193-FZ)	Usually ≥ 500,000 rubles and 10 jobs		500,000 rubles ; more flexible job requirements	Investment threshold is set by the agreement and regional regulations	Conditions are less formalized and depend on the agreement	Low entry thresholds in FEFD TAD, FPV, and KORF favor pilot and small TD projects; the AZRF and Magadan SEZ are more sensitive to investment size and formal project status

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Art. 284.4 of the Tax Code of the Russian Federation, which in practice encourages extraction to be structured outside the resident agreement (through projects focused on processing, infrastructure, and geological exploration, GE), thereby creating an institutional gap between obtaining resident status and capturing mining rent. In TAD and the FPV, a project may initially be declared as a mining project; if extraction is included in the agreement and separate accounting is maintained, benefits apply to the entire chain from extraction to processing without splitting the project among several legal entities.

These differences have fundamental implications for the design of TD-development regimes. In the AZRF, the institutional architecture of CIT incentives encourages models in which the profit center is shifted to processing and infrastructure segments covered by the preferential regime, while extraction either takes place outside it or is structured autonomously. By contrast, TAD and FPV regimes allow integrated models in which extraction and processing are implemented within a single legal entity and a single resident agreement. Thus, the choice of preferential-regime jurisdiction for TD-development projects affects not only fiscal parameters but also the structural and organizational configuration of the project: the logic of the AZRF regime is oriented toward territorial development through investment in processing and infrastructure, whereas TAD and FPV regimes permit more direct support for raw-material projects within a broad range of eligible activities.

Distribution and characteristics of technogenic deposits in the AZRF and FEFD regions. The AZRF and FEFD contain some of the world's most significant TD of platinum-group metals, gold, tin, and tungsten. Their formation is a direct consequence of decades of Soviet and post-Soviet mining, which left enormous volumes of off-grade material [1]. A systematization of TD by type, volume, location, and development barriers is presented in Table 2.

Table 2

Technogenic deposits in the AZRF and FEFD regions

TD type	Regions and TD concentration sites	Resource-base characteristics	Development barriers
Tailings of large mines	Murmansk Region, Republic of Karelia, Krasnoyarsk Krai (Taimyr), Zabaykalsky Krai, Primorsky Krai, Kamchatka Krai, Republic of Buryatia	Large long-term tailings facilities (hundreds of millions of tonnes), often containing associated REE and non-ferrous metals	High capital intensity and technological complexity of recovery; mandatory full geological exploration and registration in the State Balance of Mineral Reserves (SBMR)
Previously mined placer deposits containing residual gold	Magadan Region, Republic of Sakha (Yakutia), Khabarovsk Krai, Amur Region, Republic of Buryatia, Chukotka Autonomous Okrug	Large volumes of technogenic sands and waste dumps, with substantial residual gold resources	Mandatory and costly geological exploration for each site; seasonal operations; absence of a consolidated TD cadastre
Waste dumps and tailings of tin-ore and tungsten mining-and-processing plants	Chukotka Autonomous Okrug (Iultinskoye TD), Zabaykalsky Krai, Republic of Buryatia	Concentrated technogenic reserves of tin and tungsten in waste dumps and tailings, often in hard-to-access areas	Lack of infrastructure; high capital intensity and price volatility; need for comprehensive geological exploration
Tailings containing rare and rare-earth metals	Arkhangelsk Region, Republic of Komi, Krasnoyarsk Krai (Norilsk area)	Tailings containing REE, platinum-group metals (PGM), and associated elements; the resources are substantial, but suitable processing technologies remain insufficiently developed. In Arkhangelsk Region, the principal resources are concentrated on the Novaya Zemlya and Franz Josef Land archipelagos	No proven industrial technologies; high processing costs; limited demand; for the Novaya Zemlya and Franz Josef Land archipelagos – critically high transport remoteness and lack of infrastructure; special regime for the use of island territories (border zone, protected-area status); extremely high capital intensity of logistics and site development

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End of Table 2

TD type	Regions and TD concentration sites	Resource-base characteristics	Development barriers
Waste sites generated by oil and gas operations	Nenets Autonomous Okrug, Yamalo-Nenets Autonomous Okrug, Khanty-Mansi Autonomous Okrug – Yugra, Sakhalin Region, Republic of Komi	Large volumes of drilling cuttings and oil-containing waste at fields	No TD status in mining legislation; regulated as waste; processing complexity and remoteness
Small-volume TD	Jewish Autonomous Region, Republic of Karelia, Magadan Region	Small volumes of technogenic accumulations (brucite, graphite, etc.) and limited resource potential	Insufficient scale for capital-intensive projects to pay back; low investment attractiveness

Note. Compiled from a review of state reports on the condition of the mineral-resource base of the Russian Federation[5]. Each region is assigned to the dominant TD type by resource-base volume; regions containing several TD types are listed in more than one row.

The collected TD data made it possible to identify the following principal barriers to TD-development projects:

• regulatory (the requirement to complete the full geological-exploration procedure);
• technological (the absence of a commercially viable technology);
• infrastructural (a complete lack of infrastructure or critically high transport costs);
• legal (the absence of a legal status for oil-field waste as technogenic deposits);
• environmental (none of the preferential regimes includes instruments covering reclamation costs; this barrier is characteristic of historically contaminated sites and lies outside the standard benefits provided under both regimes);
• data/cadastral barrier (the absence of a consolidated TD cadastre containing systematized data on the location, volume, and composition of technogenic objects).

The identified barriers are compared with the AZRF and TAD FEFD preferential regimes in Table 3.

Table 3

Relationship between barriers to technogenic-deposit development and the functional applicability of the AZRF and FEFD preferential regimes

Barrier type	Region	AZRF	TAD/FPV	KORF	Conclusion
Regulatory – geological exploration and registration in the SBMR	All 19 regions	Partly removes the barrier – corresponds to the entry stage, but the CIT incentive for extraction is limited	Largely removes the barrier – benefits extend to the operating phase of a mining project	Partly removes the barrier – project preparation may be financed, but licensing and reserve-balance procedures are not replaced	For TD extraction, TAD/FPV regimes are more effective
Lack of technological and economic viability	Krasnoyarsk Krai	Does not remove	Does not remove	Partly removes – through R&D subsidies, concessional loans, and guarantees	Targeted technological measures are required
Infrastructure remoteness	Nenets Autonomous Okrug, Yamalo-Nenets Autonomous Okrug, Chukotka Autonomous Okrug, Republic of Sakha (Yakutia)	Partly removes – MET deduction for infrastructure facilities is possible	Partly removes – reduces the fiscal burden but does not create a dedicated infrastructure mechanism	Largely removes – through infrastructure co-financing and PPP mechanisms	For this barrier, AZRF instruments can be effectively complemented by TAD/FPV instruments

[5] State reports on the status and use of mineral resources of the Russian Federation.
URL: https://www.mnr.gov.ru/docs/gosudarstvennye_doklady/o_sostoyanii_i_ispolzovanii_mineralno_syrevykh_resursov_rossiyskoy_federatsii/ (accessed 10.04.2026).

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End of Table 3

Barrier type	Region	AZRF	TAD/FPV	KORF	Conclusion
Legal – waste outside the subsoil-use regime	Nenets Autonomous Okrug, Yamalo-Nenets Autonomous Okrug, Khanty-Mansi Autonomous Okrug – Yugra, Sakhalin Region	Does not remove	Does not remove	Does not remove systematically	Requires amendment of mining legislation
Environmental – reclamation and accumulated damage	Republic of Buryatia, Zabaykalsky Krai	Does not remove	Does not remove	Partly removes – through targeted subsidies and environmental programs	Requires dedicated environmental instruments
Cadastral – lack of data and poor exploration	Khabarovsk Krai, Jewish Autonomous Region, Amur Region	Does not remove	Does not remove	Partly removes – through budget-funded geological exploration and inventorying	Requires a budget-funded geological-exploration framework
Capital intensity – R&D and infrastructure simultaneously	Chukotka Autonomous Okrug, Republic of Sakha (Yakutia)	Partly removes – an infrastructure deduction is possible, but the operating stage is not fully covered	Largely removes – CIT and MET incentives apply at the extraction stage	Largely removes – loans, guarantees, and co-financing are possible	Combining regimes is optimal

The analysis of TD distribution, characteristics, and barriers under the existing preferential regimes leads to the systemic conclusion that the institutional logic of the AZRF and FEFD is heterogeneous and, in a number of cases, only weakly aligned with the nature and economics of TD development; this mismatch is particularly evident at the regional level. In the AZRF, the institutional logic of a regime oriented toward infrastructure development and non-extractive activities conflicts with the need for direct support of TD extraction. This is most critical in regions with large and technologically complex technogenic objects – Murmansk Region, Krasnoyarsk Krai, and Arkhangelsk Region – where substantial volumes of tailings containing rare and non-ferrous metals require capital-intensive recovery technologies. An additional constraint is the lack of a developed legal status for oil and gas waste as subsoil-use objects, which makes the preferences effectively inapplicable in the Nenets Autonomous Okrug, Yamalo-Nenets Autonomous Okrug, and Khanty-Mansi Autonomous Okrug – Yugra.

In the FEFD regions, despite the closer fit of the TAD/FPV regime to the economics of TD extraction, a critical institutional mismatch remains because full geological exploration is mandatory and there is no systematic accounting of technogenic objects. This is most acute in Magadan Region, the Republic of Sakha (Yakutia), and Zabaykalsky Krai, which have substantial potential in technogenic placers but face high transaction costs when bringing them into development.

A special position is occupied by regions with dual institutional affiliation – the Chukotka Autonomous Okrug and the Republic of Sakha (Yakutia) – where instruments of both the AZRF and FEFD may potentially be combined. On the one hand, this creates a potentially more flexible support model by combining the AZRF's infrastructure and social benefits with the fiscal incentives of TAD/FPV (including reduced CIT rates and a zero MET rate for a limited period). For example, the Goldarctic LLC project at the Iultinskoye technogenic deposit is being implemented with AZRF resident status, while project support and infrastructure development are provided through the management company of the Chukotka TAD, effectively integrating the mining project into the TAD institutional perimeter. On the other hand, such "dual jurisdiction" does not remove the basic institutional barriers and, in some cases, complicates project structuring by requiring activities and tax regimes to be separated. In Chukotka Autonomous Okrug, this contradiction is intensified by extreme infrastructure remoteness and high project capital intensity, whereas in the Republic of Sakha (Yakutia) it is intensified by the need to combine subsoil-use procedures with TAD regimes while retaining mandatory full geological exploration. Thus, dual jurisdiction expands the set of formally available preferences but does not provide an equivalent reduction in institutional barriers.

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Four types of barriers – environmental, technological, legal (oil and gas), and cadastral – are not removed by any of the regimes and require separate legislative and budgetary solutions that fundamentally differ from tax-preference instruments.

The identified mismatch is not universal but spatially differentiated; it intensifies in regions with the highest concentrations of technogenic resources, difficult natural and climatic conditions, and, where dual affiliation exists, additional institutional complexity of regulation. This points to the need to treat the regional factor as one of the key considerations in designing the new regime of state support for entrepreneurial activity in the AZRF and FEFD macroregions [26], including for TD-development projects.

Development of a model for harmonizing the regimes as applied to TD-development projects within a unified AZRF-FEFD preferential regime. The selection of regional factors correlated with the TD-development problem is based on the results of numerous studies [27, 28]. The specific nature of TD lies in their dual role: they are simultaneously a source of secondary mineral resources and a factor of accumulated environmental damage. Accordingly, the analysis includes indicators reflecting both resource potential and the consequences of long-term anthropogenic impact. Unlike approaches in which factors are used only to assess investment attractiveness, here they serve as a basis for configuring the parameters of preferential regimes – tax, institutional, and infrastructural – depending on the regional conditions under which TD projects are implemented. Three groups of factors are distinguished: natural and climatic, socioeconomic, and environmental-sustainability factors [29-33].

Among natural and climatic factors, precipitation, water availability, and the cryogenic characteristics of the territory are the most important [29, 30]. Precipitation and water availability affect the stability of tailings facilities, contaminant migration, and water-pollution risks, while permafrost affects the choice of pit and tailings-facility types and infrastructure reliability. Approximately 70 % of infrastructure within the Arctic permafrost zone is located in areas with a high potential for degradation of the upper permafrost layer by mid-century [31], while the combination of high precipitation and a frozen foundation intensifies secondary pollution of water bodies through flood runoff from technogenic sites [30]. In the model, these factors are treated as direct arguments for a higher level of support: the higher the risk, the higher the potential level of support.

The socioeconomic group includes gross regional product (GRP), population, and morbidity. Higher GRP reduces the need for large-scale budget support, whereas in economically weaker regions government support becomes critical to project feasibility; this requires inverse normalization of GRP [18, 27, 28]. Population determines labor availability and the scale of potential TD impacts, while elevated morbidity – particularly respiratory diseases and oncological conditions – in regions with a high concentration of mining facilities [32] is interpreted as a signal that projects accompanied by environmental remediation should receive priority incentives.

Environmental-sustainability factors include the scale of accumulated environmental damage, expressed as the area of disturbed land remaining at the end of the reporting year as a result of mineral-deposit development. High values simultaneously reflect the scale of technogenic impact and the TD resource base, indicating both substantial potential for involving technogenic resources and elevated environmental risks. In the model, the effect of this indicator is likewise treated as direct: the larger the area of disturbed land, the higher the potential level of support. Thus, regional factors are regarded not only as constraints on TD-project implementation but also as components of the integral index of the priority of involving TD to reduce environmental risk (IR), reflecting the motivation of the state and society to address the accumulated technogenic legacy as quickly as possible.

At the same time, TD development remains an investment project whose key principle is an adequate return on invested capital [18]. Accordingly, project characteristics themselves must form the second component of the model used to determine the most appropriate support regime. This

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approach is widely represented in the literature [20, 33-36]. Of the studies considered, particular attention is drawn to the work of V.V.Yurak, M.N.Ignatyeva, and O.G.Komarova, which presents an original methodological approach to substantiating an optimal set of instruments for TD development and a model of an economic mechanism stimulating the processing of technogenic mineral formations [20]. The key indicators determining project priority and the package of support measures in that study are environmental effect, commercial (economic) efficiency, and budgetary efficiency. Their combination ranks projects into three main groups: "green" – high-ranked projects recommended for first-priority financing; "yellow" – second-tier projects in terms of priority access to financial resources; and "red" – third-priority projects. Taken together, these indicators constitute the integral economic feasibility of the project (ER).

Combining the model proposed by V.V.Yurak, M.N.Ignatyeva, and O.G.Komarova with the identified regional-priority criterion makes it possible to develop the methodological approach to substantiating the optimal set of instruments for TD development within the task of harmonizing the AZRF and FEFD preferential regimes. The synthetic approach eliminates the key contradiction inherent in applying each block separately. If only the project-ranking matrix is used to obtain resource support without calculating IR, uncertainty remains in the assessment of regional characteristics, because different experts may interpret it differently. If only IR is used without ER, it is unclear to what extent a particular TD requires incentives specifically from an economic perspective. Joint use of both coordinates yields an operational result: a clearly defined set of instruments.

Within this logic, a conceptual model of a two-component project-assessment system is proposed for forming an individualized package of support measures under a unified special regime. The model is based on the intersection of two aggregate indices: project economic feasibility and the integral index of the priority of involving TD to reduce environmental risk. ER aggregates three characteristics of a TD-development project (environmental effect, commercial efficiency, and budgetary efficiency), while IR combines three subindices: natural and climatic conditions (precipitation, share of territory under permafrost, and water availability), environmental stress (area of disturbed land), and territorial-development priority (GRP, population, and morbidity). At the intersection of the ER and IR axes, a support-measure matrix is formed that allows projects to be ranked by implementation priority and the required level of government support. A conceptual diagram of the proposed methodological approach is shown in Fig.2.

The algorithm for implementing the approach includes the following steps:

• collect data for the selected indicators included in each subindex;

• convert the data values to a dimensionless scale (0; 1) using min-max normalization.

Normalization is performed using the complete set of constituent entities of the Russian Federation rather than only the AZRF-FEFD regions. This is essential for comparability because it establishes a common scale, making it possible to assess the AZRF and FEFD regions objectively relative to the nationwide situation; it also creates the empirical basis from which threshold values for classifying IR by level can be determined.

Min-max normalization was selected because its applicability has been demonstrated in studies of territorial environmental indexing and assessment of environmental hazards from mining facilities [37, 38], and because its interpretation is transparent.

The distribution of tax and administrative incentives in the matrix follows the principle "the higher the value, the greater the level of support"; therefore, min-max normalization is not applied in its direct form to every selected indicator. Its inverse form is required for normalizing GRP. The normalized indicators are aggregated into subindices by calculating the arithmetic mean, thereby avoiding the excessive subjectivity that may arise from weighted aggregation. The index approach ensures the comparability of heterogeneous indicators [23].

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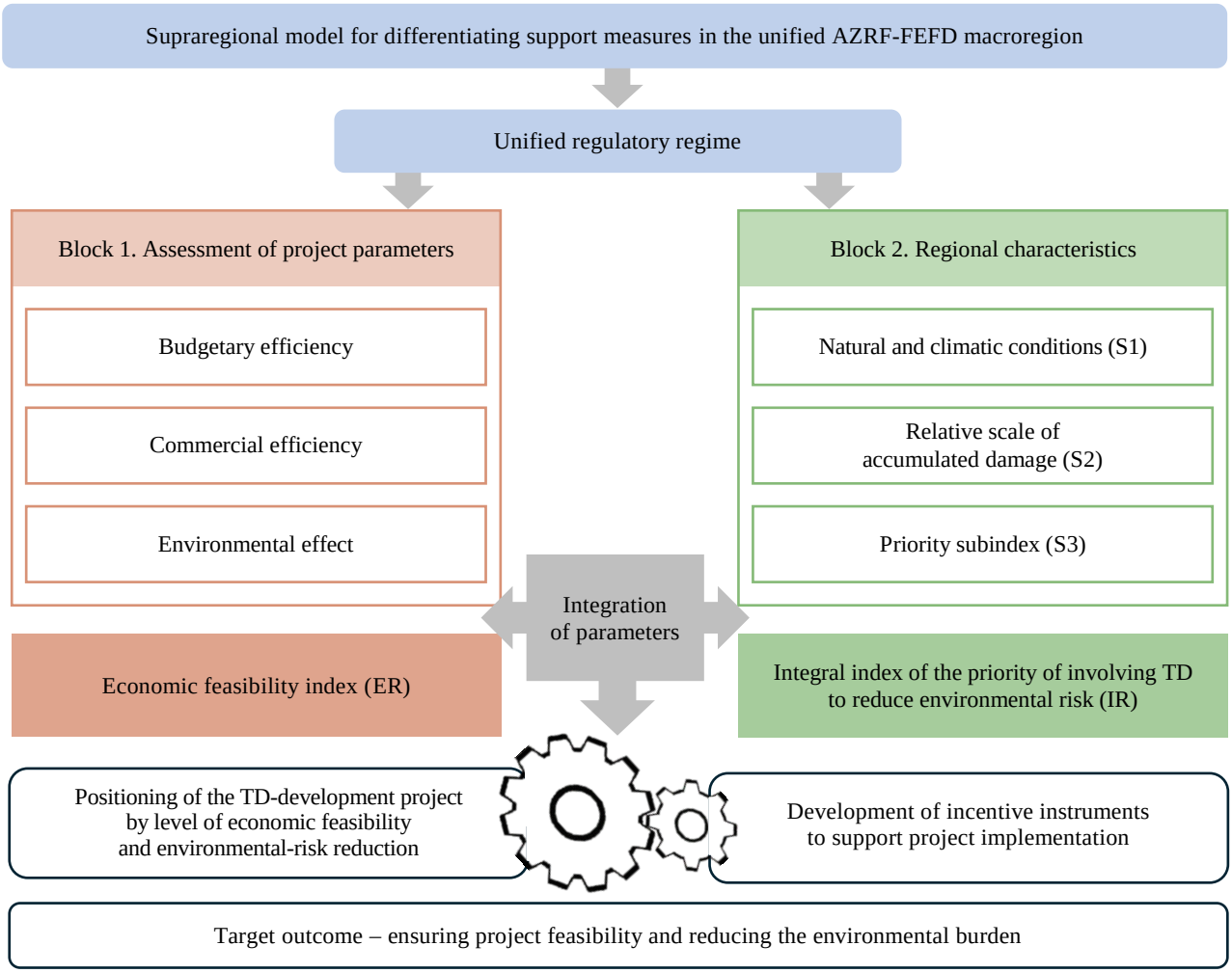


Fig.2. Conceptual diagram of the two-component TD-development project assessment system for forming an individualized package of support measures under a unified special economic regime for the AZRF and FEFD

The composition of the subindices included in the integral index of the priority of involving TD to reduce environmental risk, together with the specific statistical indicators, units of measurement, data sources, normalization direction, and calculation formulas, is presented in Table 4.

Relating the ER and IR indices yields a decision matrix in terms of project priority and the degree of government support required, taking into account the identified specific features of the current AZRF and FEFD preferential regimes. The results of comparing ER and IR as a decision matrix, together with descriptions of the corresponding combinations of index values, are presented in Fig.3.

On the basis of the ER×IR matrix, a unified government-support mechanism is proposed that simultaneously takes into account project economic feasibility and its priority from the standpoint of reducing environmental risks. Unlike the current AZRF and TAD regimes, the proposed approach differentiates support measures not only by the project's economic parameters but also by its environmental significance. As IR increases, the scope of support increases, making it possible to offset the insufficient commercial attractiveness of projects that deliver substantial reductions in environmental risk. For projects with high ER values, support measures are primarily stimulative and are intended to accelerate implementation without providing excessive support.

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Composition and calculation procedure for the subindices of the integral index of the priority of involving TD to reduce environmental risk (IR)

Calculation of the integral IR index	Subindex (arithmetic mean of normalized statistical indicators)	Statistical indicator (unit of measurement)	Data source	Normalization type	Normalization formula	Notation
IR = (S1 + S2 + S3) / 3	Natural and climatic characteristics S1	Mean annual precipitation (mm/year)	statbase.ru	Direct	$x' = (x - x_{min}) / (x_{max} - x_{min})$	x_{min} and x_{max} denote the minimum and maximum values of the indicator across the complete set of constituent entities of the Russian Federation, respectively
		Regional water-availability coefficient	Water Ranking of Russian Regions; State Report "On the State and Protection of the Environment in the Russian Federation"	Direct		
		Permafrost extent (percentage of the constituent entity's total area)	Area estimated from maps of the National Atlas of Russia	Direct		
	Scale of accumulated environmental damage S2	Area of disturbed land at year-end due to mineral-deposit development (ha)	Rosnedra, Form 2-TP (reclamation)	Direct		
	Socioeconomic priority subindex S3	Population (year-end estimate, thousand persons)	Rosstat, socioeconomic indicators by constituent entity of the Russian Federation	Direct		
		Newly diagnosed cases per 1,000 population	Rosstat, socioeconomic indicators by constituent entity of the Russian Federation	Direct		
		GRP per capita (rubles)	Rosstat, socioeconomic indicators by constituent entity of the Russian Federation	Inverse	$x' = (x_{max} - x) / (x_{max} - x_{min})$	

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High IR (above 0.30)	**Environmentally hazardous site, but project with low economic viability** Not a conventional mining project, but a project for eliminating accumulated damage. A special regime is required: budget financing, green funds and environmental-remediation financing mechanisms, exemption from resource taxes, PPP with risk transferred to the state, and simplified procedures under strict environmental KPI control *Recommended support framework: Environmental remediation regime*	**Environmentally important project, but economically unsustainable without support** Ordinary tax benefits are insufficient: zero or reduced MET, concessional financing, infrastructure subsidy, state guarantees, and possibly co-financing of reclamation are needed *Recommended support: TAD/FPV instruments and state participation*	**Environmentally and territorially high-priority project with strong economics** Solution – flagship environmentally oriented development projects. State participation in infrastructure, state guarantees, and concessional financing. A combined package is required: the best elements of AZRF + TAD/FPV, an environmental add-on, reclamation subsidies, and infrastructure priority *Recommended support: combined TAD/FPV and AZRF instruments*
Medium IR (0.15 to 0.30)	**Project with low economic viability, but site posing increasing environmental risks** Solution – selective environmental measures without launching extraction. Local conservation, drainage, and emergency-prevention projects financed from the budget or by existing subsoil users are acceptable, but industrial TD processing is not a priority. If there is potential for technological improvement – R&D and a grant for technology testing; direct state participation is limited to the pre-project stage *Recommended support framework: Environmental remediation preparation regime*	**Typical "yellow" quadrant** The project is economically borderline and simultaneously belongs to objects for which environmental risk can no longer be ignored Solution – a balance of economic and environmental motives. Combined instruments are appropriate: concessional financing, partial reclamation subsidies, and reduced MET in exchange for commitments to reduce environmental damage *Applicable support regimes: TAD and FPV*	**Capital-intensive but sustainable project** Solution – "double dividend": economics plus environment. A long benefit horizon, reduced social-insurance contributions, targeted MET measures, and faster launch are needed *Applicable support regime: AZRF*
Low IR (0 to 0.15)	**Weak project without a pronounced regional priority** Solution – do not develop in the foreseeable future. The state should limit itself to monitoring, site inventorying, and maintaining a minimally safe condition *Preferential regimes and support are not required*	**Borderline market project in a relatively favorable environment** Solution – the project can be implemented as an ordinary investment project, but it should not claim priority under environmentally oriented programs. Government incentives are limited to general regimes (TAD, FPV, etc.) without special "green" justification *Recommended support: TAD/FPV instruments*	**Market project** Economically sustainable project in a relatively favorable region *Recommended support level: minimal government intervention; the standard legal regime and basic infrastructure support are sufficient*
	Low ER (0 to 10 %)	Medium ER (10 to 30 %)	High ER (30 to 100 %)

Green cells – market and near-market projects; yellow cells – projects requiring targeted support;
red cells – projects requiring a special environmental regime or extensive government participation

Fig.3. Decision matrix for TD-development project implementation based on the ER and IR indices

The "High ER – medium IR" quadrant is closest to the logic of the AZRF, where the regime is tightly linked to an investment project and provides substantial CIT and MET incentives, although with restrictions on extraction of solid minerals; the main objective is to improve the economics of capital – intensive Arctic projects. The "Medium ER – medium IR" and, to some extent, "Medium ER – low IR" quadrants correspond to the logic of TAD/FPV, where projects receive a strong fiscal and administrative package (a reduced CIT rate, a reduced MET coefficient, reduced social insurance contributions, one-stop-shop procedures, etc.) but are not environmentally critical.

The "High ER – high IR" and "Medium ER – high IR" quadrants require a combination of AZRF and TAD/FPV instruments. Such projects are both economically significant and environmentally high-priority, so standard benefits should be supplemented by "environmental add-ons" (additional MET deductions, reclamation subsidies, and targeted environmental subsidies), as well as priority access to infrastructure projects and budget co-financing. By contrast, projects in the "High ER – low IR" and "Low ER – low IR" quadrants do not require special support measures: in the former case,

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a standard legal regime and basic infrastructure support are sufficient; in the latter, the state should limit its role to monitoring, inventorying the site, and maintaining a minimally safe condition.

Projects in the "Low ER – high IR" and, partly, "Low ER – medium IR" quadrants require a new type of support because neither the AZRF nor TAD regimes are suited to them: the AZRF is oriented toward investment income, while TAD are oriented toward resident profitability. Two special regimes are proposed for projects with low economic feasibility: the Environmental Remediation Regime for projects with high environmental priority ("Low ER – high IR"), and the Environmental Remediation Preparation Regime for projects with medium environmental priority ("Low ER – medium IR"). The Environmental Remediation Regime covers infrastructure and environmental projects in which the principal performance indicator is a reduction in IR with zero or moderately negative ER. Its instruments include direct budget financing and CAPEX/OPEX subsidies, green bonds and damage-remediation funds, exemption from MET and CIT upon achieving environmental KPI, expanded public-private partnership (PPP) mechanisms, and simplified approvals under strict monitoring. The Environmental Remediation Preparation Regime is designed to reduce risks and prepare the site for reclamation, focusing on budget co-financing of environmental and engineering measures and support tied to environmental KPI.

A unified regime for the Arctic and FEFD can be structured in three layers:

• Basic package (analogous to the minimum package of TAD/FPV + AZRF): reduced CIT rates (0-5 % during the initial period) and social insurance contribution rates; an MET reduction coefficient (down to zero) for TD where the project is implemented under an environmentally significant agreement; and administrative benefits ("land without auction", free customs zone, one-stop-shop regime, accelerated procedures).

• Environmental layer tied to IR and automatically strengthening benefits when a region/project moves into a higher risk zone (additional MET deductions, reclamation subsidies, concessional loans, and IR – reduction KPI determining the depth and duration of benefits).

• Environmental remediation regimes: a separate legal framework for the most hazardous TD, comprising the Environmental Remediation Regime and the Environmental Remediation Preparation Regime, financing through federal programs, the National Wealth Fund, green bonds, and international mechanisms, and integration with the AZRF/TAD framework only in administrative elements while granting full exemption from resource taxes.

Such a regime combines the strengths of the AZRF (long tax horizons and support for capital intensive Arctic projects) and TAD/FPV (minimization of the current tax burden and administrative convenience), while supplementing them with an environmentally differentiated scale of support in which the IR level determines the intensity of incentives for TD development. The proposed two-component ER×IR model specifies the concept of a unified regime for the Russian Far East and Arctic as applied to TD processing projects by adding a formalized index of the priority of involving TD to reduce risk to the economic feasibility criterion. This avoids a "flat" unification of benefits for different project groups under a single legal regime. To verify the proposed model, IR was calculated for the AZRF and FEFD regions (Table 5).

The IR calculations for the AZRF and FEFD regions show that all regions fall into the medium – or high IR categories, for which support regimes differentiated by the scope and intensity of support are required. In addition to the current preferential regimes for these territories, a new Environmental Remediation Regime would be relevant for projects with low ER values and high IR values. To verify the proposed matrix, the method of hypothetical case study analysis is used; the matrix-positioning results are compared with the findings of earlier similar studies by D.S.Nadymov [25] and V.V.Yurak et al. [20], and the matrix recommendations are compared with existing instruments for stimulating TD processing. The Allarechenskoye TD-development project in Murmansk Region, which was used in the studies by D.S.Nadymov [25], and V.V.Yurak et al. [20], was selected as an example (Table 6).

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Table 5

Results of calculating the integral index of the priority of involving TD to reduce environmental risk for the AZRF and FEFD regions

Region	Natural and climatic conditions (S1)	Scale of accumulated environmental damage (S2)	Priority subindex (S3)	IR	IR level
Republic of Karelia	0.24	0.02	0.66	0.31	High
Republic of Komi	0.34	0.08	0.54	0.32	High
Nenets Autonomous Okrug	0.63	0.11	0.27	0.34	High
Arkhangelsk Region (excluding Nenets Autonomous Okrug)	0.19	0.02	0.56	0.25	Medium
Murmansk Region	0.21	0.16	0.46	0.28	Medium
Khanty-Mansi Autonomous Okrug – Yugra	0.29	0.57	0.38	0.41	High
Yamalo-Nenets Autonomous Okrug	0.48	0.17	0.36	0.34	High
Krasnoyarsk Krai	0.40	0.02	0.50	0.31	High
Republic of Buryatia	0.31	0.02	0.44	0.25	Medium
Republic of Sakha (Yakutia)	0.50	0.02	0.51	0.34	High
Zabaykalsky Krai	0.27	0.08	0.46	0.27	Medium
Kamchatka Krai	0.66	0.01	0.44	0.37	High
Primorsky Krai	0.29	0.06	0.50	0.28	Medium
Khabarovsk Krai	0.34	0.02	0.43	0.27	Medium
Amur Region	0.35	0.10	0.47	0.30	High
Magadan Region	0.41	0.10	0.34	0.29	Medium
Sakhalin Region	0.26	0.13	0.33	0.24	Medium
Jewish Autonomous Region	0.62	0.04	0.41	0.36	High
Chukotka Autonomous Okrug	0.40	0.01	0.49	0.30	High

Table 6

Comparison of positioning results for the Allarechenskoye TD – development project using different methodological approaches to selecting a package of support measures

Indicators	Project-positioning results obtained by different researchers		
	D.S.Nadymov [25]	V.V.Yurak et al. [20]	ER×IR matrix (authors' approach)
ER	Medium	Medium	Medium (according to [20, 25])
IR	–	–	0.28 (medium)
Final positioning	"Yellow" project group	"Yellow" project group	Central "yellow" quadrant (medium ER – medium IR) – a zone balancing economic and environmental motives; environmental risk can no longer be ignored but is not critical; the project's economic potential is moderate
Recommended package of support measures	Waiver of the one – off payment. Deduction of geological – exploration costs from MET. Concessional R&D loan	Preferential tax treatment: CIT, MET, and the one – off payment for subsoil use. Deduction of technogenic – deposit exploration and evaluation costs. State guarantees	Combined TAD and FPV instruments – concessional financing, partial reclamation subsidies, and reduced MET in exchange for commitments to reduce environmental damage

The results of positioning the Allarechenskoye TD in the ER×IR matrix, together with comparison against the logic of the current preferential regimes, lead to the following conclusions. All three approaches assign this project to the "yellow" group. With two-dimensional positioning (ER, IR), the Allarechenskoye TD project falls into the central "yellow" quadrant of the matrix, which requires a balance between economic and environmental parameters. The recommended instrument package for this quadrant is based on TAD and FPV regimes, with project-oriented instruments that provide concessional financing, a reduced MET, and subsidies for environmental-protection measures. This corresponds to the Capital of the Arctic TAD operating in Murmansk Region, established in 2020 under the same framework law (Federal Law N 473-FZ) as the TAD of the Russian Far East.

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The existence of the Capital of the Arctic TAD in Murmansk Region makes it possible to eliminate the institutional gap that could arise from the limited applicability of Far Eastern TAD regimes to Arctic regions. Thus, the Allarechenskoye TD-development project has the necessary regulatory instruments for implementation in accordance with the ER×IR matrix recommendations. The key organizational solution remains structuring the project as a resident of the Capital of the Arctic TAD, with the granted benefits explicitly linked to verifiable environmental commitments: reducing the area of disturbed land, lowering pollutant concentrations in water bodies, and eliminating accumulated environmental damage from historical activities. Thus, the study confirms the proposed hypothesis that a unified preferential regime for TD processing without regional differentiation is not sufficiently effective, because asymmetries in the structure of the technogenic legacy and environmental risks in the AZRF and FEFD macroregions require different packages of support measures.

Conclusion

The study consistently demonstrates that the current system of preferential regimes in the Arctic Zone and the Russian Far East was formed primarily to stimulate primary subsoil use and, as a consequence, is only partly applicable to the specific features of TD-development. At the first stage, analysis of the institutional architecture of the AZRF and FEFD regimes revealed a fundamental difference in their underlying logic: the Arctic regime is oriented toward territorial development through investment and infrastructure, which institutionally limits the extension of tax benefits to extraction stages, whereas the Far Eastern regimes permit extraction to be included within the preferential perimeter. This difference predetermines unequal "entry" conditions for TD-development projects and creates alternative implementation trajectories.

At the second stage, comparison of the structure of the technogenic legacy with the parameters of the current regimes revealed a persistent asymmetry: Arctic regions are characterized by a concentration of large environmentally hazardous sites with high remediation costs, whereas Far Eastern regions are dominated by projects that are more flexible in scale and economics, primarily technogenic gold placers. This structural differentiation is not adequately reflected in the parameters of preferential regimes: some environmentally significant but economically challenging projects receive insufficient support, while economically sustainable projects may receive excessive support.

At the third stage, a methodological approach integrating project and territorial decision – making logic was developed and tested to address the identified mismatch. Its key result is the ER×IR matrix, based on the intersection of the project economic feasibility index and an integral index of regional specificity reflecting the priority of involving TD from the standpoint of reducing environmental risks. Application of this instrument formalizes the project-positioning procedure and substantiates a differentiated set of government – support instruments for nine project categories.

The results show that the proposed matrix establishes a risk-oriented logic for designing support measures: when IR is high and project economic efficiency is insufficient, the need for expanded government participation increases, including a combination of tax benefits, infrastructure support, and direct co-financing of environmental measures. Conversely, as economic feasibility rises and environmental priority declines, support should be progressively reduced to the level of basic regimes, thereby minimizing fiscal losses and avoiding distortion of market incentives.

Thus, the study results in an integrated methodological framework enabling a transition from a unified approach to granting benefits toward their selective, parametric configuration based on the combination of project characteristics and the regional environment. The practical significance of the proposed approach lies in its potential use for selecting projects eligible for inclusion in preferential regimes, designing the terms of resident agreements, and developing a prospective model of a unified preferential regime for the AZRF and FEFD.

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