

Published by Empress Catherine II
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SINCE 1907

JOURNAL OF MINING INSTITUTE

DIGEST



SUSTAINABLE PRODUCTION MODEL

№ 6 • 2024

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EMPRESS CATHERINE II
ST. PETERSBURG MINING UNIVERSITY

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Abstract

The current issue of the digest is devoted to the International Day of Zero Waste established by the UN Assembly in 2022. This day is celebrated annually of March 30. Unfortunately, the waste sector is a major contributor to environmental pollution, climate change and loss of biodiversity and nature. When we talk about a zero waste approach, we mean responsible production, consumption and disposal of products. This means that resources are recycled or recovered to the greatest extent possible. Thereby it minimizes pollution of air, land and water. Resource-intensive production and transportation methods, careful management of economic and production processes, and the search for optimal solutions can reduce pollution and waste. The zero waste approach promotes rational waste management, minimizes and prevents waste generation, protects the environment, increases human safety, improves human health and well-being.

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Economics of raw materials industries. Goeconomy

The main reason for the appearance of waste is the linear economy: extraction-production-distribution-consumption-waste. The solution is the transition to a circular economy intended to create waste-free production and consumption without depleting natural resources, which are returned to production without ending up in the environment.

Cherepovitsyn A.E., Tretyakov N.A. Development of New System for Assessing the Applicability of Digital Projects in the Oil and Gas Sector. Journal of Mining Institute. 2023. Vol. 262, p. 628-642. EDN: QYBHMC. <https://pmi.spmi.ru/pmi/article/view/15795>



Abstract. Digital transformation is one of the global trends that has covered most sectors of the economy and industry. For oil and gas companies, the introduction of digital technologies has become not just a trend, but one of the factors for ensuring competitiveness and maintaining a stable position in the market in a rapidly changing macro environment. At the same time, despite the positive effects achieved, digital transformation is a complex process from the point of view of implementation and is associated with high technological, financial, and economic risks. The work aims to develop and test a new system for evaluating the applicability of digital projects in the oil and gas sector. The research methodology includes the application of the Gartner curve, methods of expert assessments, and tools for assessing the economic efficiency of investment projects. The developed assessment system is based on a comprehensive accounting of four components: the level of digital maturity of

the company; compliance of the implemented technology with the goals and objectives of the organization; the level of reliability of the implemented technology; the level of innovation of the implemented project. Particular attention is paid to the practical testing of the proposed methodology based on the evaluation of a digital project implemented by a Russian oil and gas company.

Bykova E.N., Khaykin M.M., Shabaeva Y.I., Beloborodova M.D. Development of methodology for economic evaluation of land plots for the extraction and processing of solid minerals. Journal of Mining Institute. 2023. Vol. 259, p. 52-67. DOI: 10.31897/PMI.2023.6



Abstract. The Russian economy has a pronounced resource specialization; in many regions, subsoil use is a backbone or one of the main areas of the economy. In these conditions, the improvement of the methodology for the economic evaluation of lands on which mining enterprises are located is of particular relevance. Based on the existing experience in assessing industrial land, the authors present a developed methodology for determining the cadastral value of land plots where mining enterprises are located, taking into account their industry characteristics and the specifics of production and commercial activities. At the same time, cadastral valuation is considered as a specific form of economic valuation. Particular emphasis is placed on the importance of taking into account the cost factors that have the greatest impact on the formation of the cost of land for the extraction and processing of solid minerals, and the method of assessment depending on the characteristics of the object. To carry out theoretical research, the methods of analysis and synthesis of legal and scientific and technical literature in the field of cadastral and market valuation of land were used in the work. The practical part is based on the application of expert methods, including the method of analysis of hierarchies, system and logical analysis. The method of M.A.Svitelskaya was chosen as

the basis, which presents a combination of modified methods of statistical (regression) modeling and modeling based on specific indicators of cadastral value. The use of this technique in economic practice contributes to increasing the efficiency of cadastral valuation and the objectivity of its results.

Ulanov V.L., Skorobogatko O.N. Impact of EU carbon border adjustment mechanism on the economic efficiency of Russian oil refining. Journal of Mining Institute. 2022. Vol. 257, p. 865-876. DOI: 10.31897/PMI.2022.83



Abstract. The carbon border adjustment mechanism (CBAM) leads not only to the expected environmental changes, but also to the transformation of market environment. The study estimates the losses of the oil refining sector from the introduction of CBAM for the export of oil products from Russia to the countries of the European Union. An approach to assess the impact of CBAM on the cost of oil products has been formed and the mechanisms of its impact on the economy of Russian oil refineries have been identified. The study was carried out on the basis of actual data on the volume of greenhouse gas emissions in accordance with the current rules of the European emissions trading system. Decomposition of assessments of the CBAM impact was carried out into direct and indirect effects, as well as the effect of adaptation. It is shown that with the introduction of the CBAM mechanism, the prices of oil products in the domestic market will be determined not only by the logistical factor, but also by the requirements for environmental friendliness of oil refining. The introduction of CBAM will have a significant impact on the economics of oil refining, including refineries that do not export to the EU. The total impact of CBAM on the economy of Russian oil refineries will be about 250 mln dollars.

Cherepovitsyn A.E., Tsvetkov P.S. Evseeva O.O. Critical analysis of methodological approaches to assessing sustainability of arctic oil and gas projects. Journal of Mining Institute. 2021. Vol. 249, p. 463-479. DOI: 10.31897/PMI.2021.3.15



Abstract. Development of hydrocarbon resources in the Arctic is one of the priority tasks for the economy of the Russian Federation; however, such projects are associated with significant risks for the environment of nearby regions. Large-scale development of hydrocarbon resources in the Arctic should be based on the principles of sustainable development, which imply a balance between socio-economic benefits and environmental risks. The purpose of this study is to analyze the gaps in scientific knowledge on the issues of assessing sustainability of Arctic oil and gas projects (OGPs) and systematize the key problematic elements of such assessments. The analysis was carried out in terms of four key elements that determine the feasibility of implementing Arctic OGP in the context of sustainable development: economic efficiency, social effects, environmental safety and technological availability. The methodology for conducting bibliometric analysis, which included more than 15.227 sources from the Scopus database over the period of 2005-2020, was based on PRISMA recommendations for compiling systematic reviews and meta-analyses. Methodological problems of assessing sustainability of Arctic OGP were mapped and divided into four key sectors: consideration of factors that determine sustainability; sustainability assessment; interpretation of assessment results; sustainability management. This map can serve as a basis for conducting a series of point studies, aimed at eliminating existing methodological shortcomings of the sustainable development concept with respect to Arctic OGP.



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Razmanova S.V., Andrukhova O.V. Oilfield service companies as part of economy digitalization: assessment of the prospects for innovative development. Journal of Mining Institute. 2020. Vol. 244, p. 482-492. DOI: 10.31897/PMI.2020.4.11



Abstract. The digital transformation of the economy as the most important stage of scientific and technological progress and transition to a new technological structure is becoming one of the determining factors in the development and competitiveness of the domestic upstream sector. Prospects for innovative development of oilfield service companies are the key technological areas within the first project of the Hi-Tech Strategy of the German Government until 2020 – “Industry 4.0”. The purpose of this study is to assess the prospects for innovative development of the domestic oilfield service industry in the context of the digitalization of the oil and gas industry. The subject of the research is the process of the formation of key technological lines of “Industry 4.0” and their impact on the domestic oil and gas sector. The research is based on logical-theoretical and empirical analyses. The main factors that determine processes of digital transformation in the oil and gas industry are considered; the results of digitalization processes in the largest foreign and Russian industry companies of the upstream and oilfield services segments are presented. The information base is made up of data from oilfield service and oil and gas producing companies, presented on the official websites of companies in the public domain on the Internet. It has been proven that, unlike the world’s leading companies in oilfield services segment, independent domestic oilfield service companies provide mainly traditional service technologies in a fairly narrow range. The limited scope of functioning and technological capabilities of Russian companies is explained by the lack of necessary investment in development and expansion of business, as well as interest on the part of the state and corporate sectors in the development and replication of domestic technologies and the formation of a full-fledged oilfield services market in Russia.

Yurak V.V., Dushin A.V., Mochalova L.A. Vs sustainable development: scenarios for the future. Journal of Mining Institute. 2020. Vol. 242, p. 242-247. DOI: 10.31897/PMI.2020.2.242



Abstract. Issues of sustainable development began to concern mankind starting from the 20th century, when mass industrialization and the depletion of natural resource potential contributed to the formulation of environmental issues at one of the leading places in scientific discourse. However, what if the goals of sustainable development would not be achieved to 2030? What other way we can identify for humanity to survive? So, the study is about the problems of studying the understanding of the term “sustainable development”, considering the evolution of the formation of the concept of sustainable development and analyzing the modern goals of sustainable development for attainability. From an analysis of domestic and foreign experience, possible scenarios of the development of mankind are identified (such as 1. Creating an environmental framework, 2. Implementation of sustainable nature management practices in the conditions of natural and man-made objects, 3. Implementation of “geoengineering projects”, 4. Construction of autonomous ecosystems, 5. Space exploration in search of a new planet for life, provided that the goals of sustainable development would not be achieved. It has been established that today probability of achieving all the sustainable development goals by 2030 is too small, and the indicated scenarios require, firstly, the development of science and technology, and secondly, a competent assessment of the value of nature and solving the issue of specifying property rights for natural goods.

Nedosekin A.O., Rejshahrit E.I., Kozlovskij A.N. Strategic approach to assessing economic sustainability objects of mineral resources sector of Russia. Journal of Mining Institute. 2019. Vol. 237, p. 354-360. DOI: 10.31897/PMI.2019.3.354



Abstract. The article gives a new definition of economic systems (ES) stability with its distinct strategic content. The main approaches to assessment of sustainability, based on the use of strategic cards, including Balanced Scorecard (BSC), are considered. Synchronous management of effectiveness, risks and chances of the ES exhausts the agenda of managing economic sustainability of ES when it operates in the face of a wide range of challenges. BSC in mineral resources sector (MRS) can be built during the aggregation of BSC by industry and individual enterprises. The use of 4×6 matrix formalism is proposed as the main tool for modeling economic sustainability of the ES.

Grigorev Y.P., Chaikovskaya D.D. Conceptual aspects of declining extraction oilfields valuation methodology under conditions of stable development of national economy. Journal of Mining Institute. 2012. Vol. 195, p. 177-184. <https://pmi.spmi.ru/pmi/article/view/6131>



Abstract. Research of depleted oilfields' valuation is an actual problem under conditions of stable development of national economy. To solve one development of oil producing effectiveness' growth conception is needed. In the given article analysis of oil producing industry by extraction volume and by oil resources increase is done. Main factors of oil producing effectiveness are marked out and also indicators of oil resources provision are suggested. Probable directions of further researches, related to the declining extraction oilfields' valuation are defined.

Markhasina M.V. Strategy modelling of jaking decisions at ecological and economic evaluation of oil project. Journal of Mining Institute. 2009. Vol. 184, p. 156-159. <https://pmi.spmi.ru/pmi/article/view/6849>



Abstract. The supposed methodological approach to the evaluation of oil investment project is based on the principle of correlation of profits and expenses, nature protection expenses included at their early stage. The advantage of this analysis is the possibility of making project analysis of ecological risks based on the method analysis of taking decisions and the analysis of the economical results. The account of the ecological factor of the oil project model of evaluation is based on the developed interaction of the technological, ecological and economic information. Its basis is project documentation, project influence materials, evaluation upon the environment and accountants report.

Cherepovitsyn A.E., Sinkov L.S. Formation of environmental and economic management mechanisms in the oil and gas complex taking into account new global requirements. Journal of Mining Institute. 2009. Vol. 181, p. 206-209. <https://pmi.spmi.ru/pmi/article/view/7074>



Abstract. The main constituents of the environmental and economic management in oil and gas sector are identified. A concept for the environmental strategy of oil and gas companies has been formed, taking into account the use of the mechanisms of the Kyoto Protocol. The possibility of using economic and technological methods to reduce greenhouse gas emissions in the oil and gas sector within the framework of international conventions has been established. Measures to combine environmental and economic effects in the oil and gas industry when using mechanisms to reduce CO₂ emissions are substantiated. The prospects for obtaining economic effects from the implementation of the principles and mechanisms of the Kyoto Protocol have been identified.

Nikolaenkova E.A. Methodology of assessment of scale, depth and radicalism of innovations in production of mining enterprises. Journal of Mining Institute. 2007. Vol. 170(1), p. 205-208. <https://pmi.spmi.ru/pmi/article/view/7820>



Abstract. The evaluation method of innovation of production of mining industry is offered in the work, which is based on the certain indicators. There are: depth, scale and radicality. When introducing this indicators of diversification of production can be substantiatedly determined, for example, the amount of investments which are necessary for realization of reconstruction and modernization of industry. The problem of production connecting the basic factors of technical maintenance of enterprises and the volume of production and geometry interpretation are looked upon in the essay.



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Problems of the sustainable development of the mineral resources complex

In the economy of our country, the mineral resource sector occupies one of the central places, which determines the high importance of the state of the mineral resource base and the dynamics of its development. One of the main goals of sustainable development of the country's economy is balanced consumption and reproduction of mineral raw materials.

Zhdanev O.V. Technological sovereignty of the Russian Federation fuel and energy complex. Journal of Mining Institute. 2022. Vol. 258, p. 1061-1078. DOI: 10.31897/PMI.2022.107



Abstract. The review to achieve technological sovereignty of the Russian fuel and energy complex (FEC) in the ongoing geopolitical situation is presented in the article. The main scope has been to identify the key technology development priorities, restrictions and internal resources to overcome the difficulties utilizing the innovative methodology developed by the author that consists of novel approaches to calculate level of local content, digitalization, business continuity and interactions with military-industrial complex. Some organizational changes have been proposed to intensify the development of hi-tech products for the FEC and related industries, including establishment of the state committee for science and technology and the project office of lead engineers for the critical missing technologies. Two successful examples to utilize the described in the paper methodology is presented: the first domestic hydraulic fracturing fleet and polycrystalline diamond compact cutter bit inserts.

Litvinenko V.S., Tsvetkov P.S., Dvoynikov M.V., Buslaev G.V. Barriers to implementation of hydrogen initiatives in the context of global energy sustainable development. Journal of Mining Institute. 2020. Vol. 244, p. 428-438. DOI: 10.31897/PMI.2020.4.5



Abstract. Modern trends in the global energy market linked to the Sustainable Development Goals often lead to the adoption of political decisions with little basis in fact. Stepping up the development of renewable energy sources is an economically questionable but necessary step in terms of its social and ecological effects. However, subsequent development of hydrogen infrastructure is, at the very least, a dangerous initiative. In connection with mentioned above, an attempt to examine hydrogen by conducting an integral assessment of its characteristics has been made in this article. As a result of the research conducted, the following conclusions concerning the potential of the widespread implementation of hydrogen in the power generation sector have been made: as a chemical element, it harms steel structures, which significantly impedes the selection of suitable materials; its physical and volume characteristics decrease the general efficiency of the energy system compared to similar hydrocarbon solutions; the hydrogen economy does not have the necessary foundation in terms of both physical infrastructure and market regulation mechanisms; the emergence of widely available hydrogen poses a danger for society due to its high combustibility. Following the results of the study, it was concluded that the existing pilot hydrogen projects are positive yet not scalable solutions for the power generation sector due to the lack of available technologies to construct large-scale and geographically distributed infrastructure and adequate international system of industry regulation. Thus, in current conditions, the risks of implementing such projects considerably exceed their potential ecological benefits.



Ochirbat P., Chinzorig B. On enhancement of cooperation between universities for implementation of the program “Sustainable development – 2030”. Journal of Mining Institute. 2018. Vol. 229, p. 27-30. DOI: 10.25515/PMI.2018.1.27



Abstract. The article is focused on one of the pressing issues of our time – the international training of qualified personnel in higher education institutions with the aim of developing a stable economic system of the state, the main elements of which are interrelated stages of economic activity (exploration, prospecting, extraction, processing, and use of mineral resources). The question of the contribution and role of universities of different countries cooperating in the sphere of sustainable development of this sector is considered. The necessity of practical solution of this task for the implementation of UNESCO’s program “Sustainable Development – 2030” is determined. In this relation, the concept of “sustainable development”, its philosophical, scientific-theoretical and cultural aspects are considered, the special significance of the connection between the sustainable development of society and its individual fragments with modern education is emphasized. It is stated that education, in the context of sustainable development, should be anticipating, advancing and open. Given the current trends in higher education, it is possible to mention the work carried out by the Mining Institute of the Mongolian State University of Science and Technology in the direction of international cooperation.

Sergeev I.B., Lapochkina L.V. Sustainable development: theoretical and methodological approaches. Journal of Mining Institute. 2009. Vol. 184, p. 264-269. <https://pmi.spmi.ru/pmi/article/view/6867>



Abstract. In article the essence of an economic category sustainable development is reveals. The points of view on a problem of sustainable development economists of the basic modern scientific schools are considered. In a context of the neoclassic approach the condition of stability of development of Russia is shown.

Alekseev V.V., Kurakina N.I. Complex Approach to the Estimation of the Eco-System State as a Basis for Rational Nature Management. Journal of Mining Institute. 2005. Vol. 165, p. 12-13. <https://pmi.spmi.ru/pmi/article/view/8223>



Abstract. The software environment for the formation of a comprehensive assessment of the ecosystem state is considered, which provides obtaining information of various types, organizing the database and combining heterogeneous data on a single metrological basis, allows the expert-ecologist to form the functional of the ecosystem state assessment taking into account the specifics of the area, the type of production or several industries, the scale of impact on the environment. The modeling system provides pro-forecasting of situation development, the possibility of designing territories, and environmental management.

Pashkevich N.V., Sinkov L.S., Solodkov E.L. Environmental and economic assessment of the environmental impact of mining enterprises. Journal of Mining Institute. 2004. Vol. 159 (2), p. 154-157. <https://pmi.spmi.ru/pmi/article/view/8698>



Abstract. The main methods for assessing the environmental and economic impact of mining enterprises on the environment are considered. The classification of the currently existing methods is given. The disadvantages of the existing typical methods of assessment of environmental damage are analyzed and recommendations on the use of various methods as a combined method are given. An example of assessment of ecological and economic damage of the impact of the Krasny Bor toxic waste landfill is offered. A combined method was used in calculations, which made it possible to determine the annual environmental damage in the amount of 151 million rubles. Based on the calculations it is recommended to implement measures to reduce the impact of the landfill on the environment.

Pashkevich N.V., Pashkevich M.A., Petrova T.A. Environmental and economic assessment of the negative impact of mining and metallurgical waste on air and land. Journal of Mining Institute. 2004. Vol. 158, p. 69-71. <https://pmi.spmi.ru/pmi/article/view/8790>



Abstract. The analysis of technogenic impact of waste of mineral complex on atmospheric air and land was carried out. It was established that the environmental and economic risk of negative impact is determined by the probability of environmental and economic damage.

The probability of damage from land pollution in the zone of impact of technogenic massifs was analyzed. The research work was supported by the American Foundation for Civilian Research and Development.

Responsible production: innovative developments and achievements

Considering that the most important priority in recent years of Russian government policy has been given to import substitution, restructuring business in accordance with the concept of sustainable development that generates profit seems to be a feasible task. Responsible production and consumption is the desire to produce more from fewer resources, that is, to be resource efficient.

Litvinova T.E., Suchkov D.V. Lightweight ash-based concrete production as a promising way of technogenic product utilization (on the example of sewage treatment waste). Journal of Mining Institute. 2023. Vol. 264, p. 906-918. EDN: LMZCWZ. <https://pmi.spmi.ru/pmi/article/view/16020>



Abstract. The study is devoted to the development of a method for the technogenic raw materials utilization. Special attention is paid to the prospect of involving products based on them in the production of new building materials. The results of Russian and foreign studies on the reuse of wastes, such as phosphogypsum, metallurgical slag, waste from municipal and industrial wastewater treatment, etc., in the building materials industry are considered. It has been established that the use of incinerated sewage sludge ash in construction is a promising direction in terms of environmental and economic efficiency. The research confirmed the compliance of the lightweight ash-based concrete components to the regulatory documentation requirements for a number of indicators. As a result of the research, the composition of the raw mixture for the lightweight concrete production with incinerated sewage sludge ash as

a replacement for a part of the cement has been developed. In terms of parameters, the developed concrete corresponds to standard lightweight concrete, marked in accordance with the regulatory documents of the Russian Federation as D1300 (density not less than 1.3 g/cm³), Btb2 (flexural strength not less than 2 MPa), M200/B15 (compressive strength not less than 15 MPa). Lightweight ash-based concrete is suitable for use in construction, repair of roads and improvement of urban areas.

Bolshunov A.V., Vasilev D.A., Dmitriev A.N., Ignatev S.A., Kadochnikov V.G., Krikun N.S., Serbin D.V., Shadrin V.S. Results of complex experimental studies at Vostok station in Antarctica. Journal of Mining Institute. 2023. Vol. 263, p. 724-741. EDN: WQNJET. <https://pmi.spmi.ru/pmi/article/view/16308>



Abstract. Scientific research in the area close to the Russian Antarctic station Vostok has been carried out since its founding on December 16, 1957. The relevance of work to study the region is steadily increasing, which is confirmed by the Strategy for the Development of Activities of the Russian Federation in the Antarctica until 2030. As part of the Strategy implementation, Saint Petersburg Mining University solves the comprehensive study issues of the Vostok station area, including the subglacial Lake Vostok, related to the development of modern technologies and technical means for drilling glaciers and underlying rocks, opening subglacial reservoirs, sampling water and bottom sediments, as well as carrying out comprehensive geological and geophysical research. For the successful implementation of the Strategy, at each stage of the work it is necessary to identify and develop interdisciplinary connections while complying with the requirements for minimizing the impact on the environment. During the season of the 68th Russian Antarctic Expedition, the staff of the Mining University,

along with the current research works, began research of the dynamic interactions between the forces of the Earth, from the deepest depths to the surface glacier. Drilling and research programs have been completed. The drilling program was implemented jointly with colleagues from the Arctic and Antarctic Research Institute at the drilling complex of the 5G well. The research program included: shallow seismic studies, core drilling of snow-firn strata, study of the snow-firn strata petrostructural features, studies of cuttings collection filters effectiveness when drilling snow-firn strata and the process of ice destruction in a reciprocating rotational method, bench testing of an acoustic scanner. As a result of drilling in 5G well at the depth range of 3453.37-3534.43 m, an ice core more than 1 million years old was obtained.



Nepsha F.S., Varnavskiy K.A., Voronin V.A., Zaslavskiy I.S., Liven A.S. Integration of renewable energy at coal mining enterprises: problems and prospects. Journal of Mining Institute. 2023. Vol. 261, p. 455-469. <https://pmi.spmi.ru/pmi/article/view/16215>



Abstract. This article addresses the issue of developing renewable energy in coal mining enterprises in the Russian Federation. The study presents a methodology for assessing the technical and economic efficiency of introducing renewable energy sources based on simulation modeling. An analysis of the potential of solar and wind energy for coal mining regions in Russia is conducted. The authors use a custom software developed by them to simulate the power supply system for various scenarios of renewable energy integration, including solar generation, wind generation, solar generation with energy storage, and wind generation together with solar generation. Based on the example of the Rostov region, a feasibility study of the considered options is presented. Additionally, the research includes a sensitivity analysis of the investment project in the conditions of uncertainty in the development of Russian renewable energy. The research findings indicate that even in market conditions with CO₂ emission quotas and prices at the level of the Sakhalin experiment, renewable energy in coal mining enterprises in Russia remains unattractive and requires additional support.



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Klyuev R.V., Morgoeva A.D., Gavrina O.A., Bosikov I.I., Morgoev I.D. Forecasting planned electricity consumption for the united power system using machine learning. Journal of Mining Institute. 2023. Vol. 261, p. 392-402. EDN: FJGZTV. <https://pmi.spmi.ru/pmi/article/view/16185>



Abstract. The paper presents the results of studies of the predictive models development based on retrospective data on planned electricity consumption in the region with a significant share of enterprises in the mineral resource complex. Since the energy intensity of the industry remains quite high, the task of rationalizing the consumption of electricity is relevant. One of the ways to improve control accuracy when planning energy costs is to forecast electrical loads. Despite the large number of scientific papers on the topic of

electricity consumption forecasting, this problem remains relevant due to the changing requirements of the wholesale electricity and power market to the accuracy of forecasts. Therefore, the purpose of this study is to support management decisions in the process of planning the volume of electricity consumption. To realize this, it is necessary to create a predictive model and determine the prospective power consumption of the power system. For this purpose, the collection and analysis of initial data, their preprocessing, selection of features, creation of models, and their optimization were carried out. The created models are based on historical data on planned power consumption, power system performance (frequency), as well as meteorological data. The research methods were: ensemble methods of machine learning (random forest, gradient boosting algorithms, such as XGBoost and CatBoost) and a long short-term memory recurrent neural network model (LSTM). The models obtained as a result of the conducted studies allow creating short-term forecasts of power consumption with a fairly high precision (for a period from one day to a week). The use of models based on gradient boosting algorithms and neural network models made it possible to obtain a forecast with an error of less than 1 %, which makes it possible to recommend the models described in the paper for use in forecasting the planned electricity power consumption of united power systems.

Skobelev D.O., Cherepovitsyna A.A., Guseva T.V. Carbon capture and storage: net zero contribution and cost estimation approaches. Journal of Mining Institute. 2023. Vol. 259, p. 125-140. DOI: 10.31897/PMI.2023.10



Abstract. Carbon capture, utilization, and storage (CCUS) are a combination of necessary and promising technologies that can help reduce CO₂ emissions, which are not used on a large scale due to the high cost of solutions. This article

aims to review and analyze carbon capture and storage (CCS) projects in terms of their net zero contribution and cost estimates. The study identified a wide range of cost estimation methods that can be applied to CCS projects and revealed such issues as a lack of standardization, limited data, and cost data variability. Still, several common trends were found, including the classification of CCS adopters into low-cost and high-cost industries, cost estimation by CCS step (capture, transportation, storage) and industry (power generation, other sectors), and calculation of relative indices to make comparisons with other decarbonization options. The results of the study can serve as a foundation for developing approaches to estimating the costs of CCS in Russia, which are necessary for planning government support measures and involving businesses in the implementation of these initiatives.



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Sokolov I.V., Antipin Y.G., Rozhkov A.A., Solomein Y.M. Environmental geotechnology for low-grade ore mining with the creation of conditions for the concurrent disposal of mining waste. Journal of Mining Institute. 2023. Vol. 260, p. 289-296. DOI: 10.31897/PMI.2023.21



Abstract. Due to the constantly deteriorating environmental situation in the regions with mining enterprises, the article considers the topical issue of disposing the maximum possible volume of waste from the mining and processing of low-grade ferrous ores through the creation of an effective underground environmental geotechnology. Traditional procedure with descending mining of reserves with a caving system does not allow waste to be disposed of in a gob. The idea is to use geotechnology based on the ascending order of mining the ore body, room excavation, leaving truncated pillars, and staggered arrangement of adjacent rooms in height, which makes it possible to form containers for waste disposal in the form of a cementless backfill. The main characteristics of the proposed procedure are investigated and compared with the traditional procedure of low-grade iron ores mining. It was established that from the point of view of the complete extraction of reserves and the unit costs for the preparatory-development operations, the processes are comparable, while in terms of the mining quality, the proposed option is much more efficient. Evaluation of environmental geotechnology by the criterion of waste disposal, performed according to the proposed methodology, showed that the combination of these technical solutions ensures the placement in the formed gob from 80 to 140 % of all waste generated during the mining and beneficiation of low-grade iron ores.

Chukaeva M.A., Matveeva V.A., Sverchkov I.P. Complex processing of high-carbon ash and slag waste. Journal of Mining Institute. 2022. Vol. 253, p. 97-104. DOI: 10.31897/PMI.2022.5



Abstract. The paper considers a current issue of ash and slag processing for the Polyus Aldan JSC, that has accumulated over 1 million tons of this waste. Following the results of the review of Russian and foreign literature, four promising areas of their use were selected: road construction, building materials, reclamation of disturbed lands, and inert aggregates. To assess the possibility of implementing the selected disposal directions, the samples of ash and slag waste of the enterprise were sampled and analyzed. Fuel characteristics, chemical and mineral composition, as well as physico-chemical and mechanical properties of waste were determined. Taking into account the results of complex laboratory studies and the requirements of regulatory documents, each of the selected areas of using ash and slag waste was evaluated. It was found that their disposal by traditional methods has limitations, mainly related to the high content of unburned fuel residues. The high content of combustible substances and the high specific heat of combustion with a relatively low ash content suggested the possibility of thermal disposal of the studied waste. Based on the literature data, the characteristics of the preparation of organic coal-water suspensions based on the studied ash and slag waste were selected. As a result of a series of experiments on their flaring, the expediency of using the obtained fuel at the enterprise under consideration has been proved. The authors note the possibility of using ash obtained after thermal waste disposal in the road construction industry. The prospects for further research of technologies for the preparation and combustion modes of suspension fuel based on ash and slag waste are determined.

Gusev E.A. Results and prospects of geological mapping of the Arctic shelf of Russia. Journal of Mining Institute. 2022. Vol. 255, p. 290-298. DOI: 10.31897/PMI.2022.50



Abstract. The results of compiling the sets of the State Geological Map at a scale of 1:1,000,000 for the Arctic continental shelf of Russia are analyzed. Results are summed up, and the main problems of geological mapping are outlined. The results of geological and geophysical studies of the Arctic Ocean are of great importance for deciphering the geological evolution. The Arctic shelf is the widest shelf in the world, while the spreading ocean basin is one of the narrowest and is characterized by anomalous structural features. The main problems of geological mapping include identification of the sedimentary cover/folded basement boundary, interpretation of the geodynamic evolution of the shelf and adjacent ocean, determining the rates of sedimentation and stratigraphic subdivision of the sedimentary cover due to a small number of key boreholes. It is promising to further study problem areas with unclear features of geological structure as well as small-scale mapping in areas of industrial development on the Arctic continental shelf.

Zhdaneev O.V., Zaytsev A.V., Prodan T.T. Possibilities for creating Russian high-tech bottomhole assembly. Journal of Mining Institute. 2021. Vol. 252, p. 872-884. DOI: 10.31897/PMI.2021.6.9



Abstract. Development of high-tech well electronic measuring systems is aimed at creating modern equipment: telemetry, well geophysical measurement equipment, the architecture of which is divided into basic (with measurement channels for gamma logging and inductive resistance) and advanced (with radioactive, acoustic, magnetic resonance and thermobarometric measurement channels, including azimuthal methods of investigation). Over-the-bit measurement modules, rotary steerable systems are being developed and channels for transmitting data to the surface are being improved. Vice versa, specialized surface equipment with highly integrated software is being created. Different measurement modules are manufactured by different companies, which creates uncertainties in the possibility of interfacing the manufacturers' measurement modules into a single well measurement system. The article presents an analysis of the readiness of Russian oil service companies to produce well and surface equipment for drilling Russian directional oil and gas wells, meeting modern requirements for accuracy, lifetime and operating conditions. The possibility of creating a fully Russian well high-tech equipment and the required resources, risks and measures to mitigate them when creating a modern well measurement system are considered.

Trushko V.L., Trushko O.V. Integrated development of iron ore deposits based on competitive underground geotechnologies. Journal of Mining Institute. 2021. Vol. 250, p. 569-577. DOI: 10.31897/PMI.2021.4.10



Abstract. The article presents an analytical review of the current state of the iron ore base of the ferrous metallurgy of Russia and the world, identifies the largest iron ore provinces and iron ore producers. The promising directions of development and improvement of the quality of the iron ore base of Russia and the features of the development of new deposits of rich iron ores are identified. Effective technologies for the development of rich iron ores deposits that ensure an increase in production volumes are proposed. The geomechanical justification of rational technological parameters that are easily adapted to changes in mining and geological conditions has been performed. Based on the results of field studies, the use of an elastic-plastic model with the Coulomb – Mohr strength criterion for modeling changes in the stress-strain state of an ore rock mass during mining operations is justified and recommendations for ensuring the stability of mine workings are developed. Effective engineering and technical solutions for the complex development and deep processing of rich iron ores with the production of fractionated sinter ore, which increases the efficiency of metallurgical processes, the production of high-grade iron oxide pigments and iron ore briquettes, which increase the competitiveness of iron ore companies and the full use of the resource potential of deposits, are presented.



*MGS 405 156. Magnetite.
The Kursk Magnetic Anomaly, the Kursk region.*

Abramovich B.N., Bogdanov I.A. Improving the efficiency of autonomous electrical complexes of oil and gas enterprises. Journal of Mining Institute. 2021. Vol. 249, p. 408-416. DOI: 10.31897/PMI.2021.3.10



Abstract. In accordance with the Energy Strategy until 2035, the possibility of increasing the efficiency of energy use of secondary energy resources in the form of associated oil and waste gases has been substantiated by increasing the energy efficiency of the primary energy carrier to 90-95 % by means of cogeneration plants with a binary cycle of electricity generation and trigeneration systems with using the energy of the waste gas to cool the air flow at the inlet of gas turbine plants. The conditions for maintaining the rated power of the main generator with variations in the ambient temperature are shown. An effective topology of electrical complexes in a multi-connected power supply system of oil and gas enterprises according to the reliability condition is presented, which allows increasing the availability factor by 0.6 %, mean time between failures by 33 %, the probability of failure-free operation by 15 % and reducing the mean time of system recovery by 40 %. The article considers the use of parallel active filters to improve the quality of electricity and reduce voltage drops to 0.1 s when used in autonomous electrical complexes of oil and gas enterprises. The possibility of providing uninterrupted power supply when using thyristor systems for automatic reserve input has been proven. A comparative analysis was carried out to assess the effect of parallel active filters and thyristor systems of automatic transfer of reserve on the main indicators of the reliability of power supply systems of oil and gas enterprises.

Belozеров I.P., Gubaydullin M.G. Concept of technology for determining the permeability and porosity properties of terrigenous reservoirs on a digital rock sample model. Journal of Mining Institute. 2020. Vol. 244, p. 402-407. DOI: 10.31897/PMI.2020.4.2



Abstract. The aim of the article is to form the concept of technology for determining the permeability and porosity properties of terrigenous reservoirs using mathematical modeling methods on a digital rock sample model. Digital rock sample modeling is used to assess geological oil reserves. The article presents the concept of digital rock sample modeling technology, which allows carrying out qualitative investigations to determine the permeability and porosity characteristics of the formation, including modeling the pore space and filtration processes. The essence of the concept is that the simulation model of the microstructure for the digital model is formed based on a large number of parameters obtained during lithological and petrographic investigations of thin sections, a study of the sludge and geophysical investigations of wells. The acquired model can be used as a basis for subsequent modeling of filtration processes. Conductivity of single channels of the formed model can be calculated using molecular dynamics methods, models of Boltzmann's lattice equations, and other mathematical models and methods. Based on the results of the study carried out, the application of stochastic packing methods for modeling the structure of the pore space in the digital rock sample model of terrigenous reservoirs is substantiated. In connection with the development of computer and nanotechnologies and their use in the oil and gas industry, solutions that allow obtaining adequate results of digital rock sample models are of high importance and relevance for the production sector. It is especially important to use digital rock sample models in the study of reservoir rocks of shelf fields in the western part of the Russian Arctic, oil shales, rocks represented by loose weakly cemented reservoirs, and others, which are complex for physical experiments.

Volkodaeva M.V., Kiselev A.V. On development of system for environmental monitoring of atmospheric air quality. Journal of Mining Institute. 2017. Vol. 227, p. 589-596. DOI: 10.25515/PMI.2017.5.589



Abstract. The article suggests the directions for development of the system of environmental monitoring of atmospheric air quality in the Russian Federation, namely: an increase in the number of stationary control posts for atmospheric pollution in each specific city; expansion of the list of cities where constant measurements of pollutant concentrations are conducted; expansion of the list of controlled impurities through the introduction of automated air quality monitoring systems, the development of computational methods for monitoring air quality, including not only information on pollution levels in terms of compliance with hygienic standards, but also assessment of pollution levels from the perspective of environmental risk to the health of the population. There is a great sensitivity of plants to the low quality of atmospheric air in comparison with the sensitivity of animals and humans. The air quality standards for vegetation are given. It is proposed to evaluate the quality of atmospheric air not only from the point of view of the impact on human health, but taking into account the impact on vegetation, to include in the program route observations carried out by mobile atmospheric air monitoring laboratories, territories with public green areas, which will increase the information content of atmospheric air monitoring and the state of green spaces. In connection with the increasing noise level in large cities and the lack of a permanent noise monitoring system, it is proposed to equip existing and new monitoring stations with noise level meters to provide reliable information for the development of relevant environmental measures.

Nevskaya M.A. Principles of waste management in the mining industry under the division of property rights to mineral resource. Journal of Mining Institute. 2014. Vol. 208, p. 49-55. <https://pmi.spmi.ru/pmi/article/view/5329>



Abstract. Tendency to accumulation of waste production and processing, reducing the quality of the structure and the deterioration of proven reserves, weak interest in the complex processing of useful minerals determine the need for a number of organizational and legal measures to motivate recycling and waste management. One such measure is the transfer of the waste to the ownership of economic entities. The principles stated in Article – a priority of state interests, accounting system, motivation and incentives aimed at increasing the acceleration process of dealing with waste production and processing, the intensification of the reproduction of mineral resources, the involvement of small mining business.

Veselova Y.A. Organizational and legal issues disposal and recycling of solid household waste. Journal of Mining Institute. 2014. Vol. 208, p. 14-17. <https://pmi.spmi.ru/pmi/article/view/5322>



Abstract. Considered by the regulatory framework in the field of recycling and waste management. Provides statistics on the production and processing of waste. Examined the role of municipalities in waste management. Formulated by the European approach to waste management. The recommendations for improving waste management in Russia.

Barkan M.S., Makhovikov A.B., Kabanov E.I. Modern technology of consumption waste management in the mining agglomeration. Journal of Mining Institute. 2014. Vol. 207, p. 164-167. <https://pmi.spmi.ru/pmi/article/view/5408>



Abstract. Any industrial agglomeration is a territory, not only with a high concentration of industrial facilities, but also with high population density. This, in turn, is an essential prerequisite to problems associated with the large volume of waste consumption. To solve these problems it is necessary not only to improve the technology for processing different kinds of waste, but also to establish a system by their rapid collection and transport.

Barkan M.S., Malyshkin M.M. Comparative analysis of domestic and foreign practice of solid municipal waste. Journal of Mining Institute. 2013. Vol. 203, p. 39-41. <https://pmi.spmi.ru/pmi/article/view/5601>



Abstract. The increase in household waste in St. Petersburg and Leningrad region inevitably leads to environmental degradation, but, unfortunately, the political priorities in the field of waste management are far from perfect and the prevailing non-interference policy leads to economic inefficiency of waste management.

Fedchenko A.A., Iseva L.I. Problems of public-private partnerships in subsoil. Journal of Mining Institute. 2013. Vol. 201, p. 125-130. <https://pmi.spmi.ru/pmi/article/view/5732>



Abstract. The problems of public-private partnership (PPP) in the subsurface are considered. There are identified problems of PPP development in field of subsoil use in different regions of Russia. It is proposed to use the methodological approaches to solving problems identified by the concentration of efforts and resources within the compact areas – mineral centers of economic development (CED).



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Kovshov S.V. Problem of organic wastes and veritechnology as a variant of its solution in the Republic of Mordovia. Journal of Mining Institute. 2009. Vol. 181, p. 217-219. <https://pmi.spmi.ru/pmi/article/view/7077>



Abstract. The article studies waste disposal problem. A special attention is paid to organic waste treatment in the Republic of Mordovia. Verminous technology, which means organic waste processing by earthworms, is offered as one of prospective solutions and a complex system is created to control waste reclamation.

Pashkevich M.A., Movchan I.B., Petrova T.A. Monitoring of technogenic impact of environmentally hazardous facilities of OAO Gazprom. Journal of Mining Institute. 2007. Vol. 172, p. 201-204. <https://pmi.spmi.ru/pmi/article/view/7649>



Abstract. A system of industrial environmental monitoring (EEM) is proposed for Gazprom. As a software and information support of the IEM it is proposed to use the information and measurement system ARCGis, which allows real-time data collection on the state of monitored objects, data processing and analysis, as well as the distribution of monitoring results between different departments of the enterprise. It is established that one of the most rational approaches to the creation of the IEM system is the introduction of a module for interpretation of satellite images taken in different spectral ranges and characterized by high characteristics of spatial resolution.

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JOURNAL OF MINING INSTITUTE

№ 6 • 2024

Editor *S.V. Sinyavina*

Digester *P.V. Kotova*

DTP specialist *S.A. Lysenko*

Photos are submitted by the Mining Museum
and Forpost North-West online media
(photographer *P.V. Dolganov*)

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of Empress Catherine II
Saint Petersburg Mining University
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