UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE

ASSESSMENT OF ENERGY AND MINERAL RESOURCE ENDOWMENTS IN CENTRAL ASIA

APPLICATION OF THE UNITED NATIONS FRAMEWORK CLASSIFICATION FOR RESOURCES

Synthesis Report

prepared under the UNECE project ECE-E298
"Improving national capacities of Central Asian countries to harmonize and implement internationally applicable system of classification and sustainable management of energy and mineral resources"

compiled by H. Tulsidas (United Nations Economic Commission for Europe)

based on the Assessment Reports and Case Studies developed in the framework of the project implementation by Institute of Hydrogeology and Environmental Geoscience (M. Absametov and D. Chensizbayev) and G. Freiman (Kazakhstan), A. Rogalsky and A. Shorukov (Kyrgyzstan), R. Bakhtdavlatov and S. Pirnazarov (Tajikistan), and A. Kholikov and J. Movlanov (Uzbekistan)

Geneva, 2020

Cut-off date: 30 October 2020

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ACKNOWLEDGEMENTS

This Synthesis Report is prepared in the framework of implementation of the project "Improving national capacities of Central Asian countries to harmonize and implement internationally applicable system of classification and sustainable management of energy and mineral resources". The project was coordinated by the Sustainable Energy Division of the United Nations Economic Commission for Europe (UNECE).

Whereas information on Turkmenistan was collected from the available published reports, main authors of the Assessment Reports and Case Studies developed in the frames of the project implementation that serve as the basis for this Synthesis Report, are the following organizations and experts:

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ACRONYMS AND ABBREVIATIONS

CIS	-	Commonwealth of Independent States
CO_2	-	carbon dioxide
CRIRSCO	-	Committee for Mineral Reserves International Reporting Standards
FEZ	-	free economic zone
GDP	-	gross domestic product
GKZ	-	State Reserves Committee
HPP	-	hydropower plant
IRR	-	internal rate of return
ISL	-	in-situ leaching (production method)
JORC	-	Australian Accounting Standards for Exploration Results, Mineral Resources and Ore Reserves
MPC	-	maximum permissible norms
NGO	-	maximum permissible concentration
NPV	-	net present value
PRMS	-	Petroleum Resources Management System
SCR	-	State Commission on Mineral Reserves
SDG	-	Sustainable Development Goals
SPE	-	Society of Petroleum Engineers
SRM	-	sustainable resource management
UNECE	-	United Nations Economic Commission for Europe
UNFC	-	United Nations Framework Classification for Resources
UNRMS	-	United Nations Resource Management System

EXECUTIVE SUMMARY

A major imperative of the governments of resource-rich countries is to decide how, and how fast, to develop their natural resources, how to share the revenues between companies and the state, and how to use the state's revenues. Achieving an optimal rate of use of natural resources is important to the sustainable development of each country. A good understanding of a country's resource base is vital for defining the optimal pathway for its development. To put natural resources to the benefit of a country and the society requires a carefully laid out road map. Otherwise, issues like the so-called "Dutch disease" will make a large part of the economy uncompetitive and mismanaged to make a strong contribution to sustainable development. Social and environmental impacts that accompany resource production, value-addition and use are also often detrimental to the economic progress of a country if not managed well. A good social and environmental plan requires proper understanding of the challenges and opportunities the natural resource endowments might offer. Figuring out the correct social and environmental management is also an integral part of sustainable natural resource use.

The Central Asian region, consisting of Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan, is exceptionally rich in energy and mineral resources, which are managed using a system derived from the former Soviet Union classification system. The region benefitted from the commodities boom during the first decade of the 2000s. However, because of the growth in exports over the past decade, the region remains vulnerable to economic shocks, as relatively high dependence on exports of raw materials, a distinct circle of trading partners and a limited manufacturing capacity make the economy of these countries somewhat exposed to fluctuations in commodity prices.

The United Nations Framework Classification for Resources (UNFC), developed and maintained by UNECE, offers a frame for classification and management of natural resources in line with the aspirations of sustainable development goals (SDGs). The system is being expanded as the United Nations Resource Management System to provide a more robust framework for the sustainable and integrated management of natural resources. The adoption and use of UNFC are expected to enable better management of natural resources with full considerations for social and environmental impacts.

With this as the background, Russian Federation funded the project "Improving national capacities of Central Asian countries to harmonize and implement internationally applicable system of classification and sustainable management of energy and mineral resources", which was implemented in the course of 2017–2019 (and was further extended by the donor through 2020 to implement additional activities). This project – targeted towards government policy-making organs such as the relevant ministries and institutions like the national geological surveys and universities – was expected to enable better management of natural resources and had the following objectives: (1) to improve national capacities to develop a national system for classification and sustainable management of all energy and mineral resources based on the United Nations Framework Classification for Resources (UNFC), and; (2) to improve knowledge and skill of national stakeholders to apply UNFC for energy and mineral resource projects.

This report is a synthesis of a series of reports on natural resource endowments developed under this project for Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan, including assessments of national energy and mineral resources and case studies on how UNFC could be applied to selected energy and mineral projects to provide structured information that can drive its optimum development. Various national consultants generated the reports. Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan actively participated in the project. For the sake of completion, some information on Turkmenistan available in published reports are also included here.

This project demonstrated that the application of UNFC as a bridging system could be useful in improving the classification and management of resources and thus attract finances for its progressive development. Optimum national roadmaps could be implemented that could make the resource sector resilient and less vulnerable to commodity market shocks. Moreover, the close consideration of social and environmental aspects will ensure long-term benefits such as value addition, diversification and early adoption of innovative technologies. Thus, the application of UNFC can support the groundwork in making natural resource sector challenges into opportunities.

As an outcome of this project, Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan are pursuing ways to adopt UNFC in the national environments, and the results of these initiatives will shortly become apparent.

INTRODUCTION

The project "Improving national capacities of Central Asian countries to harmonize and implement internationally applicable system of classification and sustainable management of energy and mineral resources " was funded by the Russian Federation and was implemented in 2017–2019 (further extended by the donor through 2020 to implement additional activities). The project had the active participation of Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan. Inputs related to T urkmenistan were collected from open sources.

The project was targeted towards government policy-making organs such as the relevant ministries and institutions like the national geological surveys and universities, and was aimed i.a. at enabling better management of natural resources through achievement of the following objectives:

1. To improve national capacities to develop a national system for classification and sustainable management of all energy and mineral resources based on the United Nations Framework Classification for Resources (UNFC), and;
2. To improve knowledge and skill of national stakeholders to apply UNFC for energy and mineral resource projects.

UNECE has developed UNFC for the sustainable management of national energy and mineral resource endowments. UNFC is an international best practice that provides the most efficient tool for resource management by identifying interrelations among the social, economic, technological and physical aspects of a resource base. Central Asian countries are well endowed with natural resources such as petroleum and minerals, as well as uranium and have significant growth potential for renewable energies. The adoption and use of UNFC are expected to enable better management of natural resources with full considerations for social and environmental impacts.

UNITED NATIONS FRAMEWORK CLASSIFICATION FOR RESOURCES

UNFC provides countries, companies, financial institutions and other stakeholders a futuristic tool for sustainable development of energy and mineral resource endowments.[1] UNFC applies to energy resources including oil and gas; renewable energy; nuclear fuel resources; mineral resources; injection projects for the geological storage of carbon dioxide (CO_2); and the anthropogenic resources (such as secondary resources recycled from residues and wastes). The emerging challenges in these sectors are the sustainable, environmental-friendly, carbon-neutral and efficient development, production of energy and raw materials required for a growing population. Innovations in production, consumption and transportation are fundamentally challenging how energy and material sectors function today. As a unique tool for harmonizing policy framework, government oversight, industry business process and efficient capital allocation, UNFC is capable managing the natural resources required for the present and future needs of the society and realizing the objectives on the Sustainable Development Goals (SDG).

UNFC, in its core principles, encompasses the holistic management of socio-economical, technological and uncertainty aspects of energy and mineral projects. The project maturity and resource progression model of UNFC can de-risk projects from costly failures and thus protect the investments. UNFC integrates social and environmental considerations and technology readiness required to bring clean and affordable energy resource projects into the market. UNFC aims to provide clear and consistent specifications, guidelines and best practices for all energy and mineral sectors, which are of particular importance for the management of expanding demand of bioenergy, geothermal energy, solar energy, wind energy and hydropower resources. To help the application of UNFC uniformly worldwide, guidelines on requirements for the competency of the personnel are included in the system. UNFC provides case studies and implementation examples, not only to improve the consistencies in the usage but also to enhance the system through innovative applications.

Benefits of using UNFC include:

- Structured framework of principles, rules and guidelines;
- Alignment to major international and national classification systems;
- Simplicity without sacrificing complete necessary flexibility;
- Leveraged global communications;
- Numerical and language-independent coding scheme.

[1] Updated in 2019 to improve its applicability to all resources. However, this report uses the UNFC-2009 in the case studies. There are no substantial differences between the two versions other than some changes in the terminology. The numerical code, which is the key component of UNFC remains unchanged as well as the basic definitions. Therefore, these case studies remain valid and relatable to the current version of UNFC.

The UNFC classification is based on a generic, principle-based system, in which quantities are classified on the basis of the three fundamental criteria; environmental-socio-economic viability (E), technical feasibility (F), and degree of knowledge (G), using a numerical and language independent coding scheme. Combinations of these criteria create a three-dimensional system (Figure 1).

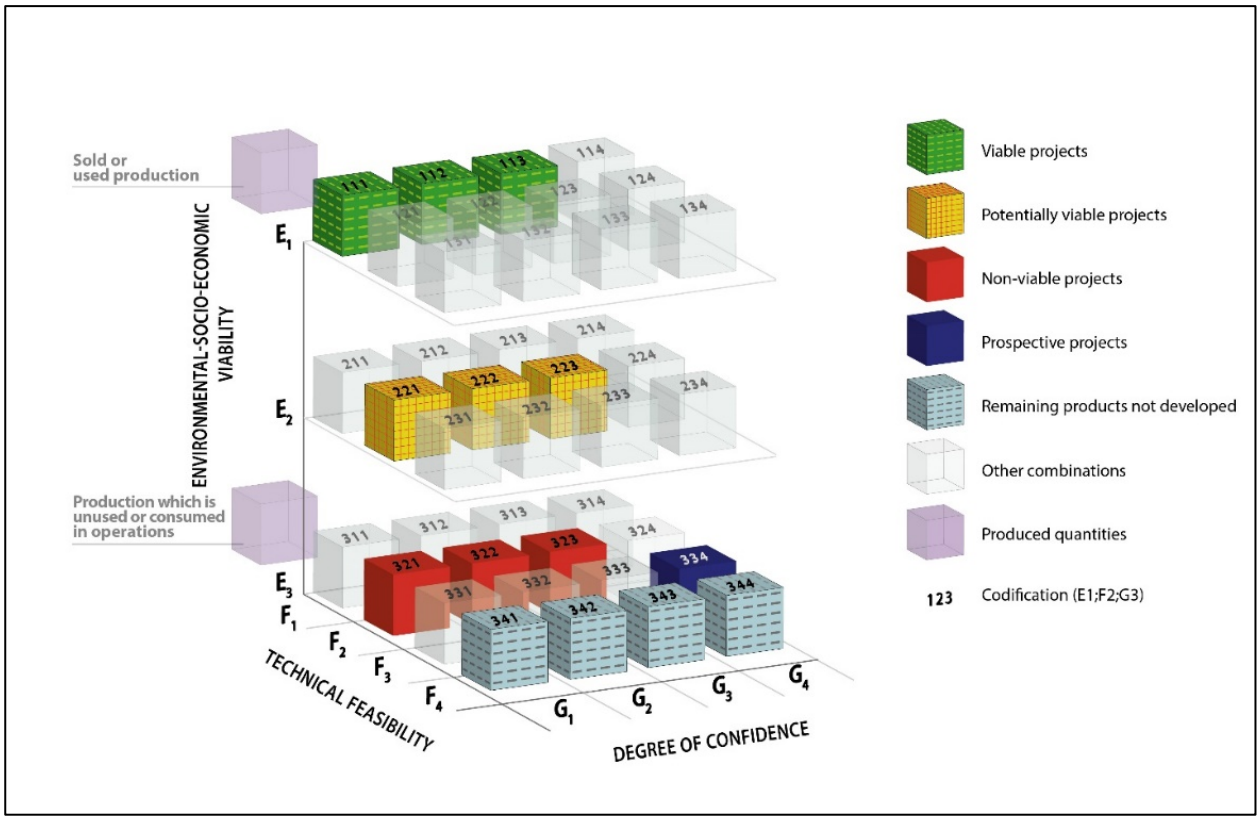

Figure 1. United Nations Framework Classification for Resources

Considering the scope and interconnectedness of sustainable resource management (SRM), UNFC is now being expanded as the United Nations Resource Management System (UNRMS). UNFC will remain at the core as the classification framework, while UNRMS will provide a tool kit for the systemic development of a project through time, whether comprising a single resource or combinations of different resources, to ensure its capacity to contribute to sustainable development within the "people, planet, prosperity" remit of the 2030 Agenda for Sustainable Development.

UNRMS, through a systems approach to SRM, seeks to enable tighter integration of the policies, especially the sustainable development programme of a country or a company to the project level implementation. Such an integration, if realized, will bring out an essential transformation in the resource management landscape, with emergent patterns such as:

- Resource centring, the life-cycle management of resources
- Value centring, the discovery of economic resources and targeting social and environmental returns
- Service or customer centring, breaking away from the commodity paradigm
- Security of supply and criticality, examining the strategic needs.

Each of the above is contributory to a transition in resource management from a linear to a circular economy, where all resources whether primary or secondary are retained to the fullest extent possible within the system boundaries resulting in a waste reduction to the point of eventual "zero waste".

While economic gains and operating profits matter, these need not be the prime drivers of a new resource management model. Profits should follow good social and environmental outcomes. This is not a radical view; many businesses have been built on similar foundations for a century or more.

Based on the first principles thinking, i.e., collapsing the problem into its fundamental principles and creating new knowledge-based solutions, some of the core approaches in resource management can be easily identified (Box).[2]

Box: Fundamental principles of SRM

1. **Responsibility to the planet**
   The primary responsibility of SRM shall be continued well-being of planet, its inhabitants, and environment.
2. **Integrated, indivisible management of resources**
   SRM shall be undertaken within the framework of public, public-private and civil society partnerships, in an integrated and indivisible manner consistent with its social, environmental and economic viability.
3. **Systems view**
   SRM shall integrate a systems view at all stages.
4. **Social license to operate**
   SRM shall ensure obtaining and keeping the social license to operate.
5. **Full life cycle view**
   Resources shall be managed with a life cycle view encompassing resource discovery to production, final use, reuse, and recycling.
6. **Service orientation**
   Resources shall be produced primarily as a service to society.
7. **Comprehensive resource recovery**
   SRM shall facilitate and support the knowledge-base and systems for comprehensive recovery of value at all stages of operation.
8. **Circularity**
   SRM shall facilitate and support the knowledge-base and systems for responsible design, use, reuse and recycling.
9. **Zero waste**
   SRM shall facilitate and support the knowledge-base and systems that promote the target of eliminating all wastes as reasonably achievable.
10. **Zero harm**
    SRM shall facilitate and support the knowledge-base and systems that pursue continual improvement in health and safety performance with the ultimate goal of zero harm as reasonably achievable.
11. **Hybridization**
    SRM shall facilitate and support the knowledge-base and systems that promote the uptake of hybrid technologies and diversification in production and use.
12. **Continuous strengthening of core competencies and capabilities**
    SRM shall ensure continuous strengthening of core competencies and capabilities that are required for cross-disciplinary research, development, demonstration, deployment and operations.

Although the crucial roles of resource efficiency, circularity and waste minimization are well studied and reported, UNRMS through a comprehensive set of tools supports the implementation of these objectives.

[2] UNECE Expert Group on Resource Management. (2020). *ECE/ENERGY/GE.3/2020/4 – United Nations Resource Management System Concept Note: Objectives, requirements, outline and way forward.* Available at: https://www.unece.org/fileadmin/DAM/energy/se/pdfs/egrm/egrm11_apr2020/ECE_ENERGY_GE.3_2020_4.pdf

NATURAL RESOURCES OF CENTRAL ASIA: CHALLENGES AND OPPORTUNITIES

Central Asia is a region rich in natural resources, including oil and gas, and the momentum of Asia's economic development is already generating massive pressures for the exploration and exploitation of new sources of energy. Kazakhstan, Turkmenistan, and Uzbekistan already export oil and natural gas. Because natural gas is more evenly spread throughout the region, it may hold even greater potential than oil. Natural gas is found throughout Central Asia; it is used to supply electrical power and as local fuel for cooking and heating. Kyrgyzstan and Tajikistan hold significant hydropower resources for electricity export. Central Asia is rich in a variety of mineral deposits. Arsenic, bauxite, boron, bismuth, copper, chromium, iron, lead, manganese, mercury, salt, silver, titanium, tungsten, uranium, and zinc are just a few of the minerals found in significant quantity. In addition, countries of the region hold some of the world's largest shares of some of these minerals— chromium, gold, and uranium among them. Kazakhstan with 15% and Uzbekistan with 2% of uranium reserves are second and eighth, respectively, among world leaders and hold great potential. Central Asia's coal production and investments are on the upswing.

Hydropower has been a key component of Central Asia's energy use for more than a half-century. The region's water-energy nexus, however, is a complicated one. The energy needs of the upstream Kyrgyzstan and Tajikistan and the irrigation needs of downstream Kazakhstan and Uzbekistan have to be balanced. Most of Central Asia consists of wide-open expanses and corridors through which winds highly favourable for energy production are available. Water has long been the fundamental concern of in Central Asia. Few parts of the region are naturally water endowed, and it is unevenly distributed geographically. This scarcity has caused people to adapt in both positive and negative ways. Vast power projects and irrigation schemes have diverted most of the water flow, transforming terrain, ecology, and even climate. On the one hand, powerful electrical grids and rich agricultural areas have helped the region flourish; on the other, water, air, land, and biodiversity have been degraded.

Central Asian countries face severe effects of climate change, including an increasing number of droughts and floods, melting glaciers, changes in the frequency and amount of precipitation, the Aral Sea crisis. Mining operations can also significantly affect the environment. Damage depends mostly on topographical conditions, means of extraction, and soil characteristics. Mineral extraction can unsettle long-established environmental balances within the earth and on its surface. Improper processing and transport of minerals and poor storage and disposal of mineral waste add to the damage. Problems of safe storage of waste are exacerbated in Kyrgyzstan and Tajikistan by natural disasters, such as landslides and earthquakes, which are common occurrences. To ensure sustainable development and mitigate effects of climate change, Central Asia would benefit from focusing on energy efficiency and clean energy, for example, through retrofits for greenhouse gas mitigation, elimination of gas flaring, and development of renewable energy sources. Cleanup of and reduction in pollution from hydrocarbon and mineral extraction are further outstanding needs.

KAZAKHSTAN

A review of energy and mineral resources of the Republic of Kazakhstan is presented here, which shows their role in the economy of the country, as well as the role of the state for resource management, based on the current legislation in the area of development of natural resources and environment protection.

The assessment describes counteracting measures of the state against the global economic crisis events. It also points out the existing classification systems of mineral resources of the country. Statistics on energy production and the development of mineral resources and social and ecological aspects are also considered. It provides data on the development of non-traditional renewable energy resources and the results of scientific research in this area, as well as information about the training system for technical and scientific staff and about the state of energy and natural resource management system of the country.

The classification of the State Reserves Committee (GKZ) of the Republic of Kazakhstan (RK) establishes uniform requirements for reserves and resources of oil, natural hydrocarbon gas (free gas, gas cap gas and gas dissolved in oil) and condensate, their state accounting according to the degree of knowledge and development.

The GKZ RK classification also establishes requirements for forecasted resources and reserves of solid minerals. In addition, by the adoption of Kazakhstan as the tenth member of Committee for Mineral Reserves International Reporting Standards (CRIRSCO) in 2016, and the new Code of the Republic of Kazakhstan "On Subsoil and Subsoil Use", enacted in 2018, the Kazakhstan Code of Public Reporting on the Results of Exploration, Mineral Resources and Mineral Reserves (KAZRC Code), developed in accordance with the CRIRSCO template, received the right of official application in the Republic.

The current classification reflects the results of a phased geological study of the subsoil. A phased study of the subsoil is carried out by the implementation of relevant projects. Each project has goals, deadlines, quality requirements and

certain risk levels. Similar principles for a phased study of subsurface resources and project management are laid in UNFC.

For the UNFC Case Study, one solid mineral deposit ("N" deposit) located in the East Kazakhstan region and one hydrocarbon deposit ("X" deposit) located in the Kyzylorda region were taken. The example of the currently operating pyrite-polymetallic deposit "N" in the East Kazakhstan region, the socio-economic importance of the mining enterprise, which has been operating profitably for a long time and is city-forming for the region, is shown. The company has developed an optimal socio-economic model for production from the field, which is aimed at ensuring the longest possible period of profitable production. In accordance with UNFC, the estimated reserves of pyrite-polymetallic ores as of 01.01.2019. can be classified as E1, F1,2, G1,2.

The example of the "X" project, the stages of geological study of the subsoil and development of the hydrocarbon field are shown, and the results are linked to the classification according to UNFC along three main axes – E, F, G. The scope of work of the Exploration Projects made it possible to identify a prospective structure for oil and gas exploration and to discover the "X" field. The results of the exploration stage are classified according to UNFC in three axes as E3.2; F2.2; G3. The implementation of the exploration phase projects confirmed the industrial significance of the field and reserves are classified according to UNFC as E2; F2.1; G3. The start of industrial development of the field allowed for additional research on newly drilled wells, to deepen the knowledge of oil deposits. According to UNFC, oil reserves as of 02.01.2019 can be classified as E1.1, E2; F1.1, F1.2; G1 + 2.

The study confirms the comparability of the classification of the GKZ of the Republic of Kazakhstan and UNFC. Unlike other classifications, UNFC takes into account the economic and social viability of projects, market conditions and uncertainties.

Given that in the modern world, the number of many resource companies operating in different countries is growing, the need for a unified classification system is obvious. UNFC is a principles-based classification system, which can serve as the basis for global communication in the field of energy and minerals.

KYRGYZSTAN

During the Soviet period, the mining industry of Kyrgyzstan was one of the leading sectors of the economy. Five mining and metallurgical combines, tens coal mines, tens oil and gas fields and enterprises for mining of building and chemical raw materials successfully operated during this period. Kyrgyzstan was the large supplier of mineral raw materials for the Soviet Union and world market. By the end of the 1980s, up to 100% of antimony, up to 64% of mercury, up to 80% of rare earth commodity, up to 25% of monocrystalline silicon and up to 15% of the uranium produced in USSR were produced in Kyrgyzstan. In some years the coal mining achieved 4.5 million t, oil was produced at the volume of 490,000 tons, and natural gas - 350 million m^3.

Now the mining industry is a priority direction in the economic development of the republic. It makes up to 10% of global domestic production. Exploration and development of mineral resources are taking on special economic and political significance. The major sectors of the mining industry are gold, antimony, mercury, tin, coal, oil, gas and construction materials. Fresh, mineral and thermal waters are produced for local use. There are possibilities for mining of tungsten, platinum, iron, titanium, vanadium, aluminium, copper, strontium, molybdenum, beryllium, tantalum, silver, bismuth, arsenic, cobalt, some traced elements, coloured stones, graphite deposits and a lot of non-metallic minerals.

Kyrgyzstan is characterized by a very complicated geological structure. There are many types of sedimentary, magmatic and metamorphic rocks which have been formed in different geodynamic conditions. The basement of Pre-Mesozoic age and crustose of Mesozoic-Cenozoic age are distinctly stood apart in the structure of the Kyrgyz Tien Shan.

The investigation of mineral deposits occurrences starts with geophysical work, which helps to understand the Earth's crust and structure at the large depth. Kyrgyzstan has great potential for many types of mineral resources. More than 10,000 different deposits and occurrences of ore, non-ore, energy and non-metallic minerals have been discovered during the intensive geological investigations since the establishment of the Kyrgyz Geological Department in 1938.

This report includes UNFC Case Study on the two national schemes and its relationship with UNFC - the "Classification of deposits reserves and prognostic resources of solid minerals of Kyrgyzstan", "Classification of deposits reserves, oil and combustible gases perspective and prognostic resources".

Two projects were selected for the Case Study: (1) a complex gold, silver and copper deposit (deposit No.1), and; (2) a multi-pool deposit of oil and gas with a wide stratigraphic range of oil and gas production. In order to maintain confidentiality, the names of deposits were not disclosed.

According to this study, the complex deposit No.1 was classified according to UNFC as E1.1 F1.3 G3, that is, the mining and marketing of minerals are profitable under current market conditions and realistic predictions of future market conditions. Mineral resources are classified as quantities with a low-reliability rating. Currently, detailed studies have been completed in deposit No.1, which were targeted to demonstrate the expediency of mining by implementing a specific development project or mining operations.

The main resources of oil and gas project No.2 have been assigned a code E2. F2.1.G3 on UNFC; in addition, there are additional quantities of oil and gas in the stratum that have been assigned the code E3.3. F4. G3.

The Case Study demonstrates that the adoption of the UNFC in Kyrgyzstan will lead to improvement of the investment climate, which would make it possible to advance towards the achievement of SDG 7 and 9. In addition, an increase in investment flows will directly affect the social status of the people, which will advance the achievement of SDG 1, 2 and 8. The environmental aspect is unlikely to change as a result of the implementation of the UNFC; however, attracting investment in renewable energy can facilitate achievement of SDG 11 and 13.

Based on the results of the study, certain conclusions were drawn on the existing classifications used in Kyrgyzstan, as well as on the advantages and problems of using the UNFC in Kyrgyzstan, which is discussed in more detail in the conclusions. The implementation of the UNFC system should be consistent. The complete abandonment of the existing system of the National Classification of Energy and Mineral Reserves and Resources and the transition to UNFC will take time because this requires reanalysis of all geological and technical-economic materials left over from the times of the Former Soviet Union.

An assessment by the UNFC system of the country's major energy and mineral objects will help attract larger bona fide investments in the development of the country's economy. It is worth noting that when applying the UNFC in Kyrgyzstan, certain classes should be distinguished according to the assessment of environmental and social impacts because when implementing projects in Kyrgyzstan, there could be challenges with solving these problems.

A renewable energy project has not been studied due to the lack of national classification of reserves and prognostic resources for renewable energy in Kyrgyzstan, but the study provides a brief summary of perspectivity for its use, as well as the possibility of introducing UNFC in this field. It is considered that it is necessary to carry out an assessment, namely, of the competitive objects, as well as renewable energy projects of Kyrgyzstan according to the UNFC system. Competitive projects will give a clearer and more realistic picture of the resource and save time for future investors and the government of Kyrgyzstan. It will allow assessing the risks and economic efficiency of investing. Moreover, renewable energy projects on the territory of Kyrgyzstan require urgent investment.

As renewable energy resources in Kyrgyzstan are poorly studied, the start of the UNFC implementation in Kyrgyzstan should begin from this sector, as currently there are no classifications in this field. The implementation will be simpler, and by using this example, experience in working with the UNFC would be gained, which will be useful in the future.

Based on the results of this Case Study, it was concluded that the application of the UNFC system in Kyrgyzstan would give positive dynamics in the development of the country's mining sector. Nevertheless, as stated above, it takes time for a full transition to the UNFC system. The issue of adaptation and successful implementation of the UNFC in Kyrgyzstan requires optimally close interaction between the state and the subsoil user and the corresponding geopolitical, economic and technological platform.

TAJIKISTAN

Intensively changing geopolitical, geo-economic and technological picture of the modern world sets the backdrop for Tajikistan for progressing towards sustainable economic development and measures to ensure national security. The foreign policy objectives of the country are aimed at creating favourable external conditions for development, strengthening the foundations of statehood, protecting the rights and freedoms, interests and dignity of citizens, and strengthening the position of the state in the international arena.

In turn, there is an urge to see that the internal policies are aimed at reducing the vulnerability of the country's economy to potential external threats, finding and developing effective mechanisms and domestic sources of sustainable economic development, ensuring stable economic growth, productive employment, sustainable access to energy resources and a favourable business environment. The economic potential of the country is considered as the material basis of national security. In this regard, the rational use of human and natural capital, as well as strengthening the institutional development potential in the direction of increasing efficiency, diversification and competitiveness of the national economy, will determine the industrial development of the future and ensure the transition from the agrarian-industrial to the industrial-agrarian economy.

The basis of the sustainable, industrial and innovative development of the country will be natural capital. Huge hydropower potential, clean water, favourable land and climate, flora, considerable labour resources, and rich mineral resources create opportunities for the development of export-oriented and import-substituting industries, creating modern sectors of the mining and manufacturing industries, non-ferrous and ferrous metallurgy, environmentally clean agro-industrial complex. The rich historical and cultural heritage of Tajikistan, its unique nature with pristine lakes, rare animals and plants, as well as high mountains are important conditions for the development of tourism and increasing the contribution of this industry to the country's GDP.

Natural resources, including minerals, oil, natural gas, ore and non-metallic raw materials, and other similar non-renewable resources, are the basis of modern industrial production. The value of mineral resources of Tajikistan that used to be determined in a planned economy, however, does not meet the requirements of modern markets: the prices of raw materials fluctuate greatly, and the value of mineral resource determined today will no longer be acceptable tomorrow. In addition, there are no unified agreed approaches to the economic assessment of mineral resources at the stage of preliminary selection of investment projects, and this is one of the problems of attracting strategic investors to the mining industry.

Since currently the economic assessment of mineral resources is carried out separately (geologists determine the volume of mineral resources (often approximate), and economists determine the value of these resources for decades (only at existing rates, tax base, etc.), then; as a result, an insufficient economic valuation of mineral resources – the expected value of the net present value that can be obtained as a result of the development of deposits of estimated mineral resources – is carried out.

Field missions to the deposits located in the former republics of the USSR prove the positive fact that even in the current challenging economic conditions, the owners and operators of the deposits still carry out exploration work, investing significant amounts of money. Yet typically, this process is led by “active managers” who do not have a geological education. Being subordinates, geologists conduct exploration according to their experience and the requirements of state bodies. Often geologists act within tight budget constraints, tacking between the requirements of owners and government agencies (although there are exceptions).

Owners need to get information on where the resources are and put them on the balance sheet as quickly as possible in order to accelerate the start of field development. However, at a certain stage, when subsoil users want to get a loan or attract foreign investment, a problem arises that the conducted geological exploration works do not meet the requirements of international reporting systems (for example, Australian JORC-2012 or Canadian NI43- 101 [1, 2]). The consequence of that is that the available materials have almost no value to attract funding. To overcome this challenge, it might be recommended to observe the requirements of international codes for exploration (which require a minimum increase in costs), which allow obtaining a high-quality document, acceptable by all parties for consideration.

But most importantly, it is advisable to invite a specialist from an independent audit company both at the stages of exploration and when assessing resources/reserves, to ultimately develop a report on the quality of exploration work in the summer when exploration is in progress, which will objectively reflect and indicate possible errors that are not too late to fix. As this is not requested by the state bodies, the latter accept what is written in the exploration reports, without questioning any data.

The main requirement for evaluating mineral resources, when assessing them according to international standards, is the quality of geological exploration and analytics. Of course, large mining companies have entire departments, dozens of experienced specialists in the field of block modelling work, who are constantly developing and improving their skills. Yet currently, the “Quality Assurance Quality Control of assay data” - “Quality Assurance and Quality Control of Analytical Research” are particularly poorly set up in small and medium-sized companies. The history allows to recall the case of Busang deposit in Indonesia, where omissions in analytics escalated into ‘Twentieth Century Scam’, after which the Western codes of exploration appeared when the losses of investors amounted more than 100 million US dollars, and confidence in the Toronto Stock Exchange itself was undermined. Nowadays, it has very detailed requirements set out in the current NI43-101 Code.

The problems of classification of resources and standardization of their various types have always been very relevant. After all, the “correct”, i.e. the classification that is most understandable to the investor allows companies to attract funds at more favourable conditions, which therefore reduces the cost of production and allows to increase profitability. In Tajikistan, the system of classification and inventory accounting developed in the USSR is still in use. This system is now official, and it is it that is used by the State Commission for Reserves. At the same time, the approval of resources according to international standards, is becoming more widespread. Given that in the modern world, the number of many resource companies operating in different countries is growing, the need for a unified classification system is obvious. In view of this, this is a compelling reason for the country to assess the applicability of UNFC to national energy and mineral resources.

TURKMENISTAN[3]

Turkmenistan is bordered by Kazakhstan to the northwest, Uzbekistan to the north and east, Afghanistan to the southeast, Iran to the south and southwest and the Caspian Sea to the west. Over 80% of the country is covered by the Karakum Desert. The Karakum Desert in Turkmenistan is one of the driest deserts in the world; some places have an average annual precipitation of only 12 mm. The centre of the country is dominated by the Turan Depression and the Karakum Desert. The Kopet Dag Range, along the southwestern border, reaches 2,912 m at Kuh-e Rizeh (Mount Rizeh). The Great Balkan Range in the west of the country (Balkan Province) and the Köýtendag Range on the southeastern border with Uzbekistan (Lebap Province) are the only other significant elevations.

Turkmenistan is one of the fastest-growing economies in the world. Turkmenistan's most economically important mineral deposits were bromine-iodine brine, natural gas, and petroleum. Turkmenistan's major gas deposits were discovered in its central and eastern areas in the 1940s and '50s, and in the 1980s the republic became the second-largest producer of gas in the Soviet Union. During the Soviet era, gas was exported mainly to other Soviet republics, as Turkmenistan steadily increased delivery from about 9.2 million m^3 in 1940 to about 234 million m^3 in 1960 and about 51 billion m^3 in 1975. This export was centrally controlled, and most of the export revenue was absorbed into the Soviet central budget. This changed in 1991 when Turkmenistan gained independence and established full control over gas export and export revenues.

Turkmenistan's current and future economy is arguably highly dependent on crude petroleum and natural gas exports; therefore, the country is actively searching for new routes to export natural gas. Turkmenistan continued to focus on the development of the nonhydrocarbon mineral sector. Some signs of the emphasis on the nonhydrocarbon sector are Turkmenistan's investment in chemical and construction material plants, modernization of the existing iodine and bromine plants, and the construction of a potash-processing plant. The industry will benefit from the use of UNFC in resource assessments.

UZBEKISTAN

The geological industry of the Republic of Uzbekistan is designed to ensure the mineral and raw material security of the country, the realization of its geopolitical interests in the region and on the world stage.

The nature of the geological industry is inextricably linked with the basic industries of the Republic, dealing with:

1. mining, primary processing, transportation and sale of mineral raw materials;
2. use of mineral raw materials for the production of consumer goods and products, including export-oriented.

The geological industry is the basic component of the dynamically developing economy of the country. Various sectors of the national economy and scientific and technological progress are putting forward to the geological prospecting all the new demands for the types of mineral raw materials and products of its redistribution.

The main tasks facing the geological industry are:

- ensuring a high-quality implementation of comprehensive studies on the regional scale, conducting on a systematic basis state geological surveys, and timely updating of cartographic data for creating standard maps;
- high-quality forecasting of exploration work, ensuring an increase in the efficiency of prospecting, evaluation and exploration of deposits such as metallic mineral resources, non-metallic minerals (including noble, non-ferrous metals and uranium), ferrous and rare metals, rare earth elements, unconventional (non-traditional) types of minerals, and hydrocarbon raw materials;
- assessment and forecast of the state of the subsoil in the territories subject to hazardous geological processes and phenomena;
- the introduction of modern advanced technology and technology in the industry;
- scientific appraisal of the priority areas of the industry (research, thematic, developmental works, technological studies of ores of solid minerals), based on normative documents and developed techniques that provide the basic requirements of modern geology to the study of mineral resources;
- implementation on a systematic basis of training and retraining of personnel for the geological industry using the best practices, as well as making proposals for further training in higher and secondary educational institutions of the Republic;
- introduction of modern methods and mechanisms for organizing and conducting work on the geological study of the subsoil, their financing and monitoring.

[3] An assessment based on open data sources.

In general, geological studies, being in the initial chain of identification and development of raw materials, are inextricably linked with the activities of the industries engaged in the extraction, processing and production of mineral raw materials with the further organization of high value-added industries based on them.

The end-users of mineral raw materials are energy producers, fuel and raw materials resources, the metallurgical and chemical industries, the construction industry, the agro-industrial complex and many other basic sectors of the economy.

In Uzbekistan, geological exploration works for solid minerals (gold, uranium, coal and other non-metallic minerals) are carried out in accordance with the Methodological Instructions for geological exploration according to the stages, 1999 and the Tentative classification of reserves and deposits and forecast resources of solid minerals, 1994.

In general, a comparison of UNFC and the Uzbek classification shows, in general, the similarity of proposed approaches to the categorization of resources based on the above three main characteristics. For each category of resources allocated in UNFC, there is a corresponding analogue of the Uzbek classification.

In recent years, the country has been actively striving for the attraction of foreign investments in all sectors. Application of the UNFC system certainly serves for the efficient attraction of investments, conducting of international research in the field of energy and minerals, carrying out analysis in the field of resource management, industrial process planning and efficient allocation of capital.

For the Case Study for the UNFC application to energy and mineral resources in Uzbekistan, two objects were selected – the Tebinbulak titanomagnetite ore deposit and the Tsentralny coal site.

The Tebinbulak iron ore deposit is located in the north-western part of the Republic in the Sultanuvays Mountains. Administratively, it is located in the Karauzyak district of the Republic of Karakalpakstan, in 12 km north-east of the Karatau village. The nearest major settlements are the towns: Nukus (70 km to the north-west), Turtkul (90 km), Beruniy (60 km south-east). The Nukus-Uchkuduk highway runs in 3 km north of the deposit, the Nukus-Turtkul-Bukhara asphalted highway is 5 km to the west, and the Nukus-Karatak-Turtkul-Gazachak railway spur is in 5-7 km in the same direction. The Karauzyak nearest railway station with a large petroleum depot on its territory is located in 7 km to south-south-west from the centre of the field. The source of electric power in the area is the Takhiatash State District Power Plant. In 5 km from the field, there is the Takhiatash-Karatau-Turtkul high-voltage transmission line. The BukharaCenter gas pipeline passes on the port side of the Amu Darya, and the Gazli-Nukus gas pipeline passes very close to the field. Along the Nukus-Turtkul highway, the Tyuya-Muyun-Nukus water conduit operates, providing water to nearby settlements.

Currently, the final stage of appraisal works is underway at the deposit. Reserves (commercial products) in the projected contour of the quarry of the Tebinbulak deposit are calculated by B + C1 category – 1695.8 million t with an average grade of 19.2% Fe_2O_3, at a cutoff grade 15%. In general, the Tebinbulak field qualifies as E1.2 F1 G1, i.e. the project is commercial.

The Tsentralny coal site is located in the southern part of the Republic in the Baysuntau Mountains. Administratively, it belongs to the Baysun district of the Surkhandarya region of the Republic of Uzbekistan. The climate of the region is continental with extended hot, dry summer (up to + 40º) and short but cold winter (up to -20º) with heavy rainfall. The relief of the area is high-mountain, strongly dissected with absolute marks of 1750-3240 m. The site is located in 80 km north-west of the Shurchi nearest railway station and is connected to the Baysun city by an asphalt road 6 km in length. The power supply is possible to be produced from an electric substation of 6/0.4 kV (Gossets) from the Central Asian energy ring. Commercial coal-bearing capacity is associated with the middle Jurassic deposits. Currently, at the field reserves by B+C1 categories are calculated at 6986.0 thousand t and 5707.0 thousand t at C2 category. The Tsentralny deposit is sufficiently studied and is considered to be promising for the construction of an exploration and production enterprise. The deposit can be assigned the E1.1. F1.2. G2 code of UNFC, and at the same time it can be classified as a “commercial project”.

NATURAL RESOURCE MANAGEMENT IN KAZAKHSTAN

The Republic of Kazakhstan is located almost in the middle of the Eurasian continent. Kazakhstan shares borders with the Russian Federation in the north, north-west and north-east, with China in the south-east, with Uzbekistan in the south-west, and with the Kyrgyz Republic in the south. The area of the country within its present borders is 2,794.9 thousand km^2. By its administrative-territorial structure, Kazakhstan is divided into 14 regions and three cities of national significance. The cities of national significance are Nur-Sultan, the capital of the country, Almaty and Shymkent, which have a population of over 1,000,000 people. As of the beginning of 2019, the population of Kazakhstan was 18.7 million people.

Kazakhstan is a land of complex and various terrains: about 10% of its territory are high mountains, the rest of the territory are lowlands, plains, plateaus and highlands. The terrain of south-west, north and central regions is mainly flat with small altitudes up to 200-300 m above sea level. There are mountains in the south-east of the Republic. Their peaks are 5-6 thousand m above sea level. The highest point of Kazakhstan is located in Tian Shan mountain system, it is Khan Tengri peak (its height is 6995 m). Inland basins (Caspian Sea, Aral Sea, Lake Balkhash), deep depressions and dry basins are common in the terrain of Kazakhstan.

The climate of Kazakhstan is arid, except the south-east and east mountain regions. The average temperature in January is from -18°C in the north and east of the country to -3°C in the southernmost part. The average temperature in July is from +19°C in the north to +28°C, +30° C in the south. The continental character of the climate of Kazakhstan increases from the west to the east and from the south to the north. The average January temperature in the flat part of the territory is -17°C in the north and -1°C in the south. The average July temperature is +19°C in the north and +30°C in the south. The average annual temperature is about 8°C in the north and +14°C in the southernmost part. Winter is long and cold in the north. In some years the temperature can go below -52°C, but there can be also thaw periods, when the temperature goes up to + 5°C. The highest temperature is not more than +41°C in the north and +49°C in the south.

The territory of Kazakhstan is located in four climatic zones, such as forest-steppe, steppe, semi desert, and desert. Flat lands with the highest moisture content of the north part of the country belong to the foreststeppe zone. The shortest season is spring, which lasts 1.5 month, summer lasts 3 months, and winter lasts from October to April. A big territory in the north of the country is located in the steppe zone. There are strong winds in this area.

The geographical position of Kazakhstan determines significant differences of climate conditions between north and south regions, and central, west and east regions as well. This heterogeneity is more noticeable in winter, when the territory of Kazakhstan is under the influence of the western extension of the Siberian anticyclone. In summer, thermal depression is formed in the territory of Kazakhstan, because of warming of the underlying surface. In the mid-seasons south cyclones pass through the territory of Kazakhstan, and they determine the weather changeability.

The high-pressure axis stays along the 50^{th} parallel above the territory of Kazakhstan most time of the year. This high-pressure belt is often formed due to the merging of the western extension of the Siberian anticyclone with the eastern extension of the Azores anticyclone. Therefore, anticyclonic weather is very common in Kazakhstan, except northernmost and south regions. The annual quantity of precipitation in the flat territory is 350 mm in the north and 100 mm in the south. There are minimum quantities of precipitation (100-125 mm) in Aral Kyzyl Kum and near Lake Balkhash. The annual quantity of precipitation in the mountain regions of Tian Shan is within the wide range from 400 to 900 mm, depending on the altitude above sea level and slope exposure. The annual quantity of precipitation is up to 1000 mm on the western slopes of Altay, while the eastern slopes are still dry. The annual quantity of precipitation goes up in the altitudes of 1800-2000 m above sea level, and it goes down slowly as the altitude exceeds this level.

ROLE OF ENERGY AND MINERALS PRODUCTION IN NATIONAL ECONOMY

Kazakhstan is very rich in mineral resources. Oil, coal, various ore and non-metallic deposits are the priceless treasure of the republic. Some of these mineral resources make Kazakhstan famous in the world. They include chrome iron ore deposits, polymetallic deposits, copper, tungsten, molybdenum and uranium ores. Kazakhstan takes the first place in the world on developed reserves of zinc, tungsten and barytes, the second place on copper and fluorite reserves, the third place on manganese reserves, the forth place on molybdenum reserves, and it is among top ten countries with the largest gold reserves.

The country possesses 10% of the world reserves of iron ore and 25% of the world uranium reserves. Kazakhstan ranks the 13th position in the list of countries with the developed oil reserves. The mining sector provides over 30% of GDP and constitutes over 60% of industrial production. The oil sector is the most important segment of the country's economy. The share of the oil sector comprises almost 25% of the general structure of GDP. Revenues of the oil sector

provide a half of all fiscal revenues of the country. Almost 70% of all export of the country in value terms is export of oil and gas condensate, a significant share of the tax on extraction of mineral resources (85%).

One of the most important resources of Kazakhstan is groundwater. 2905 groundwater deposits and groundwater sites for different purposes have been developed in Kazakhstan. Total operational reserves of groundwater are: 42,765.16 thousand m^3/day (15.60 thousand m^3/year), or about 24% of forecast resources with mineralization up to 10 g/l – 176,105 thousand m^3/day (64.28 thousand m^3/year), and 38% of forecast resources with mineralization up to 1 g/l – 110,789 thousand m^3/day (40.44 thousand m^3/year). The reserves of fresh water are 36,892.60 thousand m^3/day (13.19 thousand m^3/year), or 86% of the total volume.

GOVERNMENT POLICIES AND PROGRAMMES IN ENERGY AND MINERAL RESOURCES

According to the Constitution, adopted by the national referendum on August 30, 1995, the Republic of Kazakhstan is a unitary, democratic, secular, legal and social state with a presidential form of government. It has three independent branches of power, that is, executive, legislative and judicial. The highest values of the government are the individual, his rights and freedom.

The President of the Republic of Kazakhstan is the head of the state, its highest-ranking official; he determines the main objectives of domestic and foreign policy of the state and represents Kazakhstan at home and abroad. The President of the Republic of Kazakhstan is a symbol and guarantor of the unity of the people and the state's power, the inviolability of the Constitution and the rights and freedoms of the individual and the citizen. The President of the Republic of Kazakhstan ensures coordinated operation of all branches of the state power and their responsibility to the people. The President is elected for a 5-year term, he must be at least 40 years old, must have lived in Kazakhstan for at least 10 years, must be fluent in the official language (Kazakh).

The Government holds executive power in the Republic of Kazakhstan. The Government heads the system of executive bodies and supervises their activity. The Government is a collegiate body, and it is responsible to the President for all its activities. In some cases, prescribed by the Constitution, the Government is responsible to the Majilis of the Parliament and the Parliament. The Members of the Government report to the houses of the Parliament in the case, prescribed by subparagraph 6 of article 57 of the Constitution. The Government is formed by the President of the Republic of Kazakhstan, as prescribed by the Constitution.

The bicameral Parliament holds the legislative power. The Parliament of the Republic of Kazakhstan is the highest representative body of the Republic, which performs legislative functions. The Parliament is constituted of two houses, that is, the Senate and the Majilis, working on a regular basis. The Senate is composed of deputies, as prescribed by the Constitution. Two deputies are sent from each region, each city of national significance and the capital of the Republic of Kazakhstan. Fifteen Senate deputies are appointed by the President of the Republic in order to ensure that all societal interests and groups are adequately represented.

The Majilis consists of 107 deputies. They are elected as prescribed by the Constitution. A deputy of the Parliament cannot be a member of both houses at the same time.

Deputies of the Senate are elected for a six-year term. Deputies of the Majilis are elected for a 5-year term.

The legislative power is actually controlled by the President. The Government reports to the President, not to the Parliament (see legislative acts, regulating the relations in the area of energy and natural resources, below).

The Constitutional Court and the system of local courts hold judicial power. Justice in the Republic of Kazakhstan is administered only by the court. Judicial power is exercised through civil, criminal and other forms of legal proceedings, established by law. In some cases, prescribed by law, criminal proceedings are conducted with the participation of jurors. The courts of the Republic are the Supreme Court of the Republic, local and other courts of the Republic, established by law. The judicial system of the Republic is established by the Constitution of the Republic and the constitutional law. It is prohibited to establish any special and emergency courts under any name. Judicial power is exercised on behalf of the Republic of Kazakhstan; and its purpose is protection of rights, freedoms and legitimate interests of citizens and organizations, enforcement of the Constitution, laws, other normative legal acts, international treaties of the Republic. Judicial power extends to all cases and disputes arising on the basis of the Constitution, laws, other regulatory legal acts, international treaties of the Republic. Decisions, sentences and other rulings of courts are binding throughout the territory of the Republic [3].

The Government of the Republic of Kazakhstan develops and determines the main directions of the state policy on electrical energy and mineral resources.

The Ministry of Energy of the Republic of Kazakhstan conducts the management in the area of electrical energy.

The Committee on Atomic and Energy Supervision and Control of the Ministry of Energy of the Republic of Kazakhstan carries out supervision and control in the area of electrical energy.

The Committee on Regulation of Natural Monopolies, Protection of Competition of the Ministry of National Economy of the Republic of Kazakhstan is a state body that conducts management of competition protection, restricts monopoly activities on certain markets, controls and regulates the activities, related to the state monopoly, in accordance with the legislation of the Republic of Kazakhstan. The Committee also provides cross-sector coordination, regulation and control of the activities of natural monopolies on the regulated markets, to the extent permitted by the legislation of the Republic of Kazakhstan. It also controls and regulates the activities of energy-producing and energy-supplying organizations in accordance with the Law of the Republic of Kazakhstan "On Electrical Energy". Other special executive, permitting and controlling functions are also performed by the Committee.

The National Welfare Fund Samruk-Kazyna JSC conducts the management of revenues. The National Welfare Fund Samruk-Kazyna JSC is a state holding company, which owns and manages national companies in different sectors of the economy, including electrical energy, telecommunication, transport and national institutes of development. The National Welfare Fund Samruk-Kazyna JSC was established to increase the competitive ability and stability of the national economy, as well as to prevent possible negative influence of global markets on the economic growth in the country.

The main purpose of the activities of the Fund is to conduct the management of blocks of shares (shares of participation), which it owns on the right of ownership, of national institutes of development, national companies and other legal entities, in order to maximize their long-term value and to increase their competitive ability in global markets. The Fund owns the following portfolio companies:

- AirAstana JSC, (51% of shares);
- Real Estate Fund Samruk-Kazyna JSC was established on March 6, 2009. The sole shareholder of the Real Estate Fund is Samruk-Kazyna JSC. The Real Estate Fund is an operator of an anti-crisis programme NurlyZher.
- Samruk-Energo JSC is the biggest multi-industry energy holding company, successfully integrated in the international balance of energy, which creates value for its shareholders. It is aimed at formation of a high-performance system of energy supply, which will ensure stable development of all industries of Kazakhstan. The sole shareholder of Samruk-Energo JSC is the National Welfare Fund Samruk-Kazyna JSC.
- KEGOC JSC, Kazakhstan Electricity Grid Operating Company Joint-Stock Company, is a subsidiary company of Samruk-Kazyna JSC. It was established on September 28, 1996, by the decision No.1188 of the Government of the Republic of Kazakhstan "On some measures of reconstruction of the energy system management of the Republic of Kazakhstan".
- United Chemical Company LLP (100% of shares).
- National Company KazMunayGaz JSC is a Kazakhstani operator of exploration, production, processing and transportation of hydrocarbons, representing the interests of the state in the oil and gas industry of Kazakhstan (90% of shares). The group of companies of National Company KazMunayGas JSC, founded in 2002, includes more than 190 organizations.
- National Mining Company Tau-Ken Samruk JSC is the national mining company. 100% of shares of NMC Tau-Ken Samruk JSC are owned by the National Welfare Fund Samruk-Kazyna JSC.
- National Atomic Company Kazatomprom JSC is the national operator of the Republic of Kazakhstan for import and export of uranium, rare metals, nuclear fuel for nuclear power plants. Since 2009, Kazakhstan has been the world leader in natural uranium mining. The assets of the national atomic company include the whole complex of enterprises, involved in the chain of production of final products, that is, from exploration, uranium mining, production of nuclear fuel cycle to science, social security and training of staff. National Welfare Fund Samruk-Kazyna JSC owns 85.08% of shares.
- Kazakhtelecom JSC is the largest telecommunications company in Kazakhstan, and it has the status of a national telecommunications operator.
- Kazpost JSC is the postal operator of the Republic of Kazakhstan. It represents the Postal Administration of Kazakhstan in the Universal Postal Union, and it is one of the basic elements of the national infrastructure. The sole shareholder is the National Welfare Fund Samruk-Kazyna JSC.
- NC KTZ JSC, National Company Kazakhstan Temirzholy, is a national transport and logistics holding company, which provides infrastructure for growth of national economy and development of transport and logistics system of Kazakhstan. The sole shareholder of NC KTZ JSC is the National Welfare Fund Samruk-Kazyna JSC.

The described structure is presented in Figure 2.

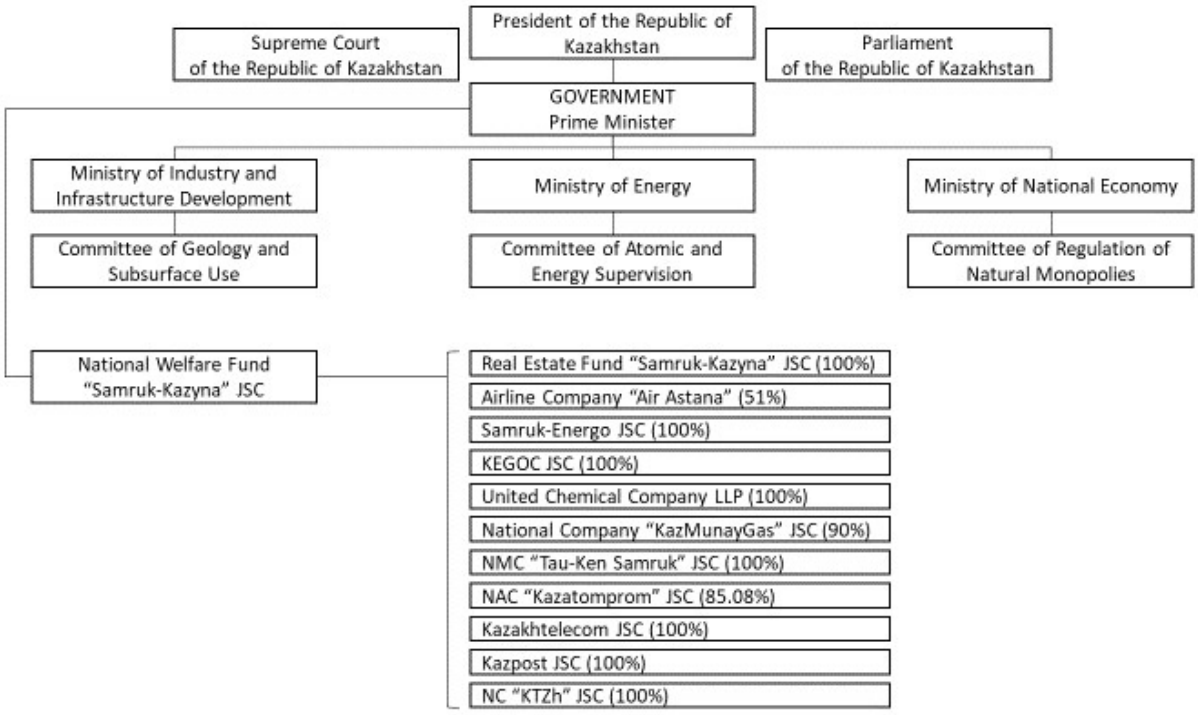

Figure 2. Structure of the state hierarchy, including regulation of subsoil use

Legal basis for development of energy and mineral resources is determined by the legislation of the Republic of Kazakhstan. Main legislative acts, regulating the relations in the area of energy and natural resources are:

1. The Code of the Republic of Kazakhstan on Subsurface and Subsurface Use (with amendments and additions dated May 24, 2018). The aim of the Code is to ensure the sustainable development of the mineral resources base of the Republic of Kazakhstan for the economic growth of the state and the welfare of the society. The tasks of the Code are:
   (a) protection of the state ownership of the subsurface;
   (b) implementation of the state policy and regulation of relations in the field of subsurface use;
   (c) protection of interests of the state, citizens of the Republic of Kazakhstan and the rights of subsurface users;
   (d) ensuring the growth of the mineral resource base of the Republic of Kazakhstan;
   (e) establishing the grounds, conditions and procedure for the emergence, implementation, modification and termination of rights of subsurface use;
   (f) provision of the legal framework for the sustainable development of subsurface use;
   (g) creating the conditions for attracting investments for the geological study of the subsurface and subsurface use;
   (h) strengthening the rule of law in the field of subsurface use.

   Legal regulation of relations in the field of subsurface use is based on the following principles: rational management of the state fund of subsurface resources; ensuring environmental safety when using subsurface; availability of information in the field of subsurface use; payment for subsurface use; conscientiousness of subsurface users; stability of conditions of subsurface use.

2. The Ecological Code of the Republic of Kazakhstan (with amendments and additions dated April 11, 2019). regulates the protection, restoration and preservation of the environment, the use and restoration of natural resources in economic and other activities related to the use of natural resources and the impact on the environment within the territory of the Republic of Kazakhstan. The main tasks of the Ecological Code are:
   (a) ensuring the sustainable development of the Republic of Kazakhstan; 2) ensuring the environmental security;
   (b) ensuring the ecosystem approach to regulation of ecological relations;
   (c) state regulation in the field of environmental protection and state management in the field of the use of natural resources;
   (d) ensuring implementation of compulsory measures to prevent pollution of the environment and any harm to it;

(e) ensuring responsibility for violation of the environmental legislation of the Republic of Kazakhstan;
(f) ensuring compulsory compensation for damage caused to the environment;
(g) ensuring a fee-paying and permissive procedure for the environmental impact;
(h) ensuring the use of the best environmentally friendly and resource-saving technologies when using natural resources and impacting the environment;
(i) cooperation, coordination and publicity of the activities of state bodies on the environmental protection;
(j) encouraging natural resource users to prevent, reduce and eliminate environmental pollution, to reduce waste, etc.

3. The Land Code of the Republic of Kazakhstan (with amendments and additions dated April 3, 2019). The tasks of the Land Code are: establishing the grounds, conditions and limits for the emergence, modification and termination of the right of ownership to a land plot and of the land use right; establishing the procedure for exercising the rights and obligations of land owners and land users; regulation of land relations in order to ensure the rational use and protection of land, the recovery of soil fertility, the preservation and improvement of the environment; creating conditions for the equitable development of all forms of farming; the protection of land rights of individuals and legal entities and the state; the creation and development of the real estate market; strengthening the rule of law in the field of land relations.
4. The Water Code of the Republic of Kazakhstan (with amendments and additions dated April 19, 2018). The tasks of the Water Code of the Republic of Kazakhstan are: the achievement and maintenance of the environmentally safe and economically optimal water use and protection of water resources, water supply and water disposal in order to maintain and improve the living conditions of the population and the environment.
5. The Concept for the Development of the Fuel and Energy Complex of the Republic of Kazakhstan until 2030, approved by the Government of the Republic of Kazakhstan in order to develop the fuel and energy complex and improve the efficiency of use of energy resources. The main tasks of the FEC are:
   (a) modernization and construction of new assets for generation and transmission of electrical energy and heat, oil processing;
   (b) development of domestic energy and fuel markets, the consistent liberalization and development of competition;
   (c) intensification of exploration by attracting investment;
   (d) modernization of industry and transport, the implementation of modern technologies in order to improve the efficiency of energy sources and to reduce the negative impact on the environment;
   (e) development of technologies and infrastructure for alternative types of energy sources: renewable energy sources (RES), nuclear energy, processing of oil-associated gas, gas transportation, coal; chemical production;
   (f) promoting the integration of the Republic of Kazakhstan into international associations; creating a common energy market within the Common Economic Space.
6. The Concept for Development of the Geological Industry of the Republic of Kazakhstan until 2030, aimed at development of the geological industry. The main tasks of the geological industry are:
   (a) improvement of the state system of program-target planning and conducting geological exploration works; the consideration of possibility to finance early and, accordingly, riskier regional and prospecting stages of exploration of solid minerals, hydrocarbons and groundwater by the state;
   (b) improvement of the legal framework and the technical regulatory framework in order to increase investment attractiveness for implementation of innovative technologies for the geological study of the subsurface and reproduction of the mineral resource base, for the development of the equal competition environment;
   (c) development of public-private partnership mechanisms by attracting the world's leading exploration, mining and oil-producing companies to participate in the implementation of projects on the state geological study of the subsurface;
   (d) development of infrastructure in the field of development and implementation of innovative technologies in the geological industry;
   (e) providing manpower for the geological industry.

CLASSIFICATION AND MANAGEMENT FRAMEWORK FOR ENERGY AND MINERAL RESOURCES

Currently, Kazakhstan is taking an important step, which is motivated by the current situation and global economy, that is, transition from classifications of the State Commission on Mineral Reserves (SCR) to international systems, such as CRIRSCO (Committee for Mineral Reserves International Reporting Standards) for solid minerals, and SPE-PRMS (Society of Petroleum Engineers-Petroleum Resources Management System) for raw hydrocarbon reserves [4].

SCR was founded in 1927 in order to create a unified metering system of developed reserves and to ensure an objective assessment of mineral reserves at the country level.

According to the classification of SCR, reserves and resources are divided into five main classes and marked with symbols A, B, C_1, C_2 and P_1, P_2 and P_3, depending on the level of reliability of geological survey data [5,6,7].

The SCR classification has been improved many times, but at the present moment it remains incomprehensible for international specialists, and it is not accepted by stock markets, which is an obstacle to attracting foreign investments.

The legal basis for start of works in this direction is the 74th step of the Nation's plan – 100 specific steps", which involves increasing of transparency and predictability of subsurface resources management by implementation of CRIRSCO, an international system of reporting standards for mineral reserves [8].

MINERALS

In 2015, thanks to the 74th step of the "Nation's plan – 100 specific steps", the Public Association "Professional association of independent experts of subsurface PONEN" and Association of Legal Entities KAZRC were established. They developed Kazakhstani Code of public reporting on the results of geological surveys, on mineral resources and mineral reserves KAZRC [9]; and in 2016 Kazakhstan became the CRIRSCO 10th member. As of today, the following countries and/or regions (names of reporting codes) are members of CRIRSCO: Canada (CIM), Australia and New Zealand (JORC), the European Union (PERC), the USA (SME), the RSA (SAMREC), Russia (NAEN), Chili (IMEC), Mongolia (MPIGM), Brazil (CBRR), Kazakhstan (KAZRC), Turkey (UMREK), Columbia (CCRR), Indonesia (KCMI) [10].

Since June 28, 2011 any submission of reports should be done in accordance with the Kazakhstani Code of Public Reporting KAZRC. This requirement is stipulated by the Code of the Republic of Kazakhstan named "On Subsurface and Subsurface Use" [11].

As for the SCR system, it will be effective in the transition period, which will last up to January 1, 2024 [11].

Classification of resources and reserves by CRIRSCO pattern (including KAZRC Code) is illustrated in Figure 3; estimated interrelation between resources and reserves of solid minerals, according to the standards of CRIRSCO and SCR, is shown in Table 1 [12].

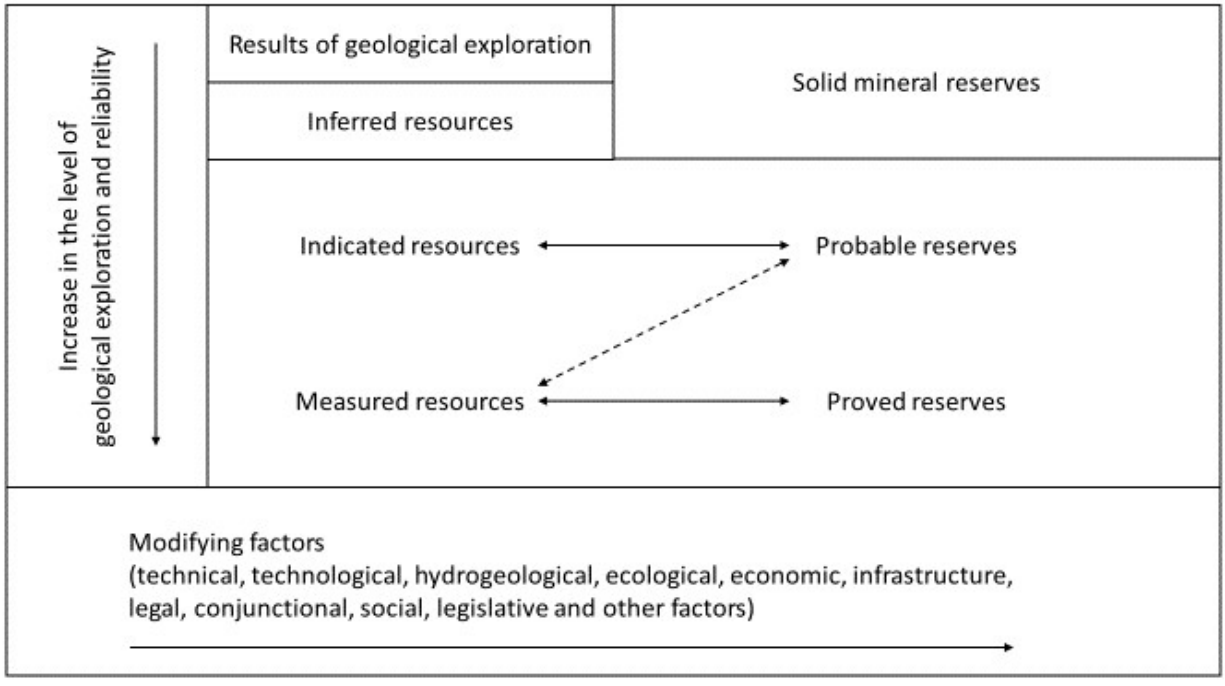

Figure 3. Classification of resources and reserves by CRIRSCO pattern (including KAZRC Code)

Table 1 – Estimated interrelation between resources and reserves of solid minerals, according to the standards of CRIRSCO and SCR

Mineral resources CRIRSCO	Resources and reserves SCR	Mineral reserves CRIRSCO	Operational reserves SCR
Inferred	P1 forecast resources		
Indicated	C2 reserves of all deposits of all complexity groups and C1 reserves of deposits of the third group	Probable	Operational reserves of inferred deposits
Measured	C1 reserves of deposits of all complexity groups and A and B reserves of deposits of the first and the second groups	Proven	Operational reserves of developed deposits

RAW HYDROCARBONS

The use of SPE-PRMS system is not stipulated by the law, however, on the official website of the Committee on Geology and Subsurface Use of the Ministry of Industry and Infrastructure Development of the Republic of Kazakhstan [4] there is information about the transition to the international system of reporting standards SPE-PRMS for raw hydrocarbons, which is recommended by consultants of Lloyd's Register and Adam Smith International group of companies.

It was preceded by work of the abovementioned consultants, funded by the European Bank of Development and Reconstruction, on harmonization of Kazakhstani regulations in subsurface use, preparation of geological survey reporting, assessment of mineral resources and reserves in line with international reporting standards.

Alongside with transition, it is planned to implement the Central Commission on hydrocarbon reserves on January 1, 2024 [11].

GROUNDWATER

The classification system of groundwater has not been changed. The possible reason is that there is no unified system of classification of groundwater reserves.

The existing United Nations Framework Classification (UNFC) includes only geothermal resources [13].

UNFC was developed under the authority of the UN European Economic Commission, and its common aim is to develop an international classification system for energy and mineral resources, reporting and management standards. Although at first UNFC was developed for mineral and oil and gas sectors, renewable energy has also been included in the classification; and the classification has become more widely used recently.

The foundations of UNFC are the fossil energy and mineral reserves and resources of 2009 (UNFC 2009) [17] are three fundamental criteria:

- Economic and social viability of the project (E);
- Status and validity of a field development project (F);
- Geological exploration (G).

A comparison of the classification of the Republic of Kazakhstan and UNFC-2009 is given in Table 2.

Table 2 – Comparison of the classification of the Republic of Kazakhstan and UNFC-2009

	Kazakhstan category system	UNFC-2009 categories	UNFC-2009 class
Reserv	A, B, C1	E1, F1, G1, G2, G3	Commercial projects
	C1, C2	E2, F2, G1, G2, G3	Potentially commercial projects
Resour	C2, C3	E3, F3, G1, G2, G3	Non-profit projects
	P1, P2, P3	E3, F3, G4	Exploration projects

As of today, some European countries, Australia, New Zealand, the Russian Federation and the Philippines conduct assessment of geothermal energy resources, using UNFC.

SCR classification is used in the Republic of Kazakhstan (similar to the Russian Federation); the commission on groundwater reserves has been named as the State Commission on Subsurface Examination (SCSE), since the Code came into force in 2018 [11].

Moreover, since the Code of the Republic of Kazakhstan "On Subsurface and Subsurface Use" came into force, the period of examination has been shortened significantly (by 40%) [14, 15]; registration procedures of production document have been simplified, the period of registration has been shortened [11, 16].

Taking the above mentioned into consideration, one can state that significant changes of the legislation have been implemented in order to attract foreign investments and to reinforce the mineral resources base; and the advanced Australian model was taken as a basis.

ENERGY AND MINERAL RESOURCE ENDOWMENTS

Kazakhstan is very rich in mineral resources; it joins the group of world leaders for the diversity of mineral resources (Table 3).

Table 3 – Mineral resources of the Republic of Kazakhstan

Natural resource	Number of deposits	Reserves	World ranking
Gold, thousand t	349	2.3	15
Silver, thousand t	195	49	2
Copper, million t	124	40	3
Lead, million t	93	15.5	3
Zinc, million t	90	32	4
Iron, million t	63	20	8
Chromium, million t	17	355	1
Manganese, million t	42	677	3
Molybdenum	51	1.1	4
Uranium, thousand t	56	903	2
Oil, billion tons	249	4.6	12
Gas, trillion m^3	252	1.7	19

According to the US Geological Survey, the share of mineral resources of Kazakhstan in the world mineral complex in percentage is as follows: chromium - 48%, lead - 13.84%, uranium - 12%, zinc - 11%, molybdenum - 9 %, silver - 5.7%, copper - 4.3%, gold - 2% and iron - 1.5%.

ANNUAL PRODUCTION, TRADE, REVIEW OF CURRENT STATUS AND OUTLOOK

OIL

The volume of oil production in Kazakhstan is going up in recent years, due to the development of Kashagan deposit. In 2017, 86.2 million t were produced [17]. According to recent reports, oil production in the Republic will be 90.3 million t in 2018 or 4.7% more than in 2017 (according to the message of Kanat Bozumbayev, the Minister of Energy, on the press-conference held on December 26, 2018) [18]. Oil production under three big projects will be 53.9 million t, including 13.2 million t in Kashagan (120% to the plan of 2018), 28.6 million t in Tengiz (103.3% to the plan of 2018), 12.1 million t in Karachaganak (100.8% to the plan 2018).

Oil export will be 71.5 million t or 102.4% by 2017. The volume of oil processing will be 16.1 million t; it will increase by 8% by 2017. The dynamics of oil production in the Republic of Kazakhstan is shown in Figure 4.

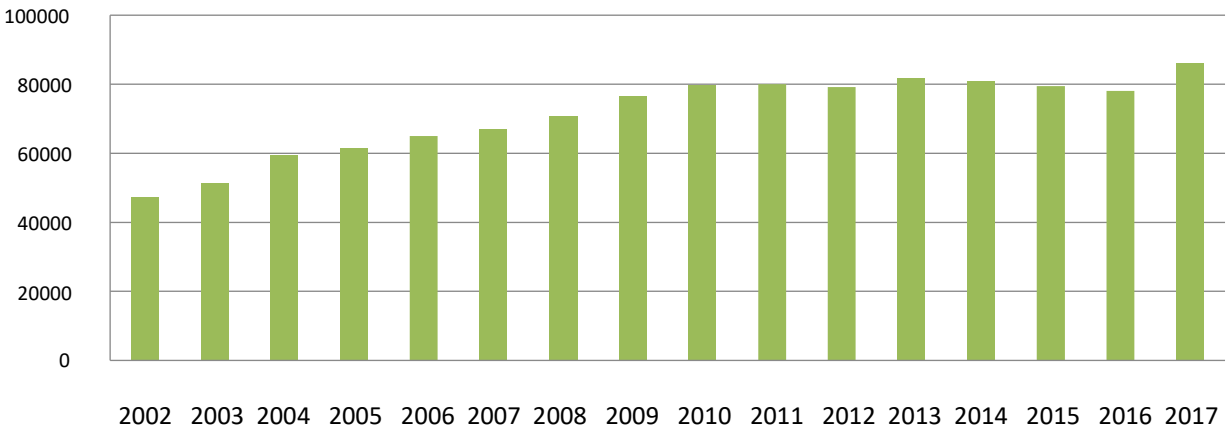

Figure 4. Dynamics of oil production, including gas condensate, in Kazakhstan, thousand t

GAS

Currently, Kazakhstan takes the 22nd place in the world and the 3rd place in the Commonwealth of Independent States (CIS) after Russia and Turkmenistan in the list of countries with proven reserves of "blue fuel". Gas reserves are estimated at 3.9 trillion m^3, including 2.6 trillion m^3 of associated gas and 1.3 trillion m^3 of natural non-associated gas. 52,921.1 million m^3 of gas were produced in 2017 [17] (Figure 5). In 2018, 54.8 billion m^3 of gas were produced; it is 3.6% more than in 2017. About 30% of gas is used inside the country, 30% of gas is exported. The remaining gas is injected into the formation to maintain formation pressure, in order to increase extraction of liquid hydrocarbons, and it is also used by subsurface users for their own process needs [18].

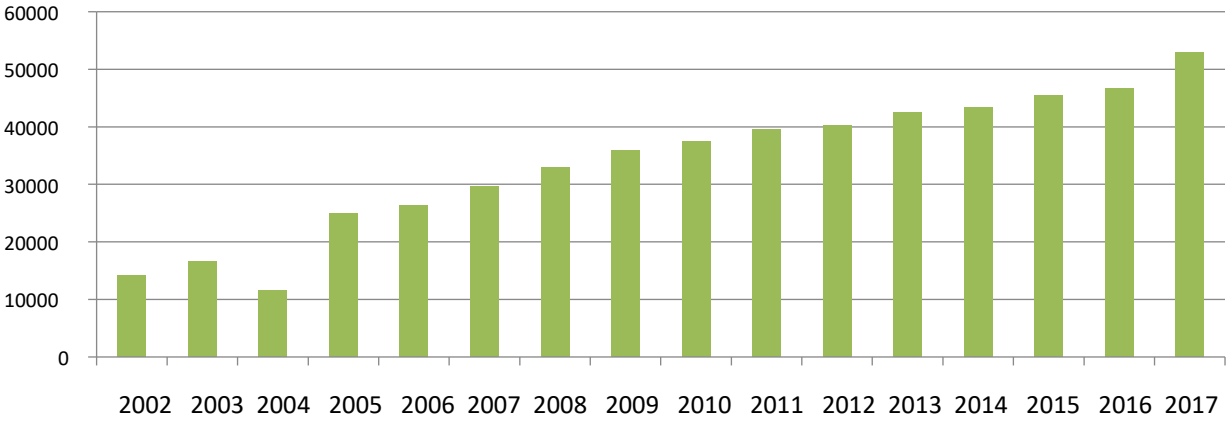

Figure 5. Dynamics of gas production in Kazakhstan, million m^3

COAL

According to the Report of Samruk-Energo JSC of 2017, the main part of the mined coal is used by the electrical power industry of the Republic of Kazakhstan (51%), and 31% of coal is exported. The rest volume is used for public utility needs of people and in the industrial enterprises (13% and 5% correspondingly). Bogatyr Komir is one of the biggest companies in the world in open-pit coal mining; its balance reserves are 2.75 billion tons. Production capacity of the company is 42 million t/year of coal, including 32 million t in Bogatyr coal deposit, 10 million t in Severniy coal deposit [19]. The dynamics of coal mining in the Republic of Kazakhstan is shown in Figure 6 [17].

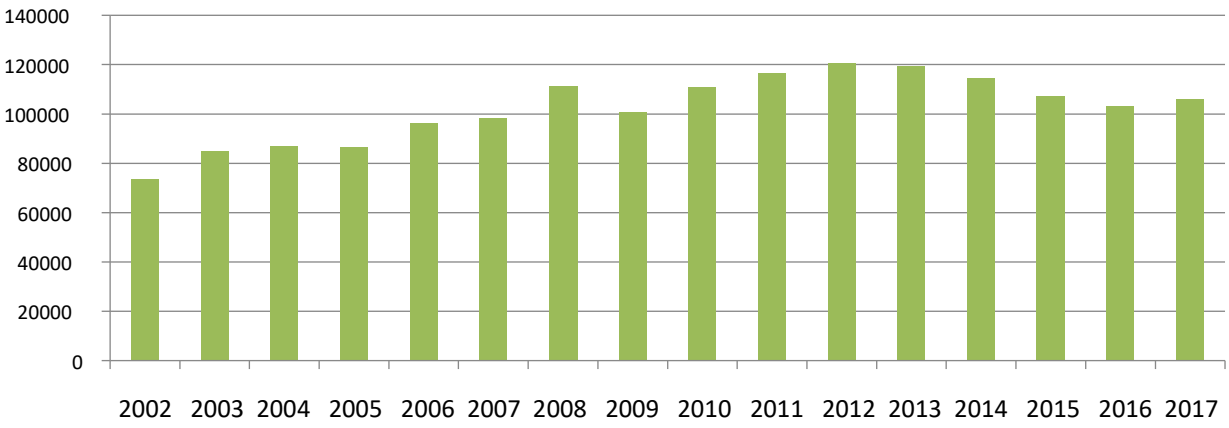

Figure 6. Dynamics of coal mining, thousand t

URANIUM

Kazakhstan takes the first place in the world on uranium production, and the second place after Australia on the developed uranium reserves. In 2017, Kazakhstan produced 39.3% of world uranium, Canada was the second (22% of world uranium production), Australia was the third (9.9%). Top three countries have provided 71.2% of world uranium.

According to the data of the World Nuclear Association, in 2017, five big world companies, producing uranium provided 65% of world production. The biggest company among them is NAC Kazatomprom JSC, which provided 21% of world uranium production.

Kazatomprom, together with its subsidiaries, dependent and joint organizations are developing 26 deposits in the Republic of Kazakhstan, which are consolidated into 13 mining assets (Figure 7). The main method of uranium production is in-situ leaching (ISL), which was used for the first time in 1960s. In 2017, this method provided 50% of world uranium production. The ISL method, compared to traditional methods, ensures a lower cost of production and has a less negative impact on the environment.

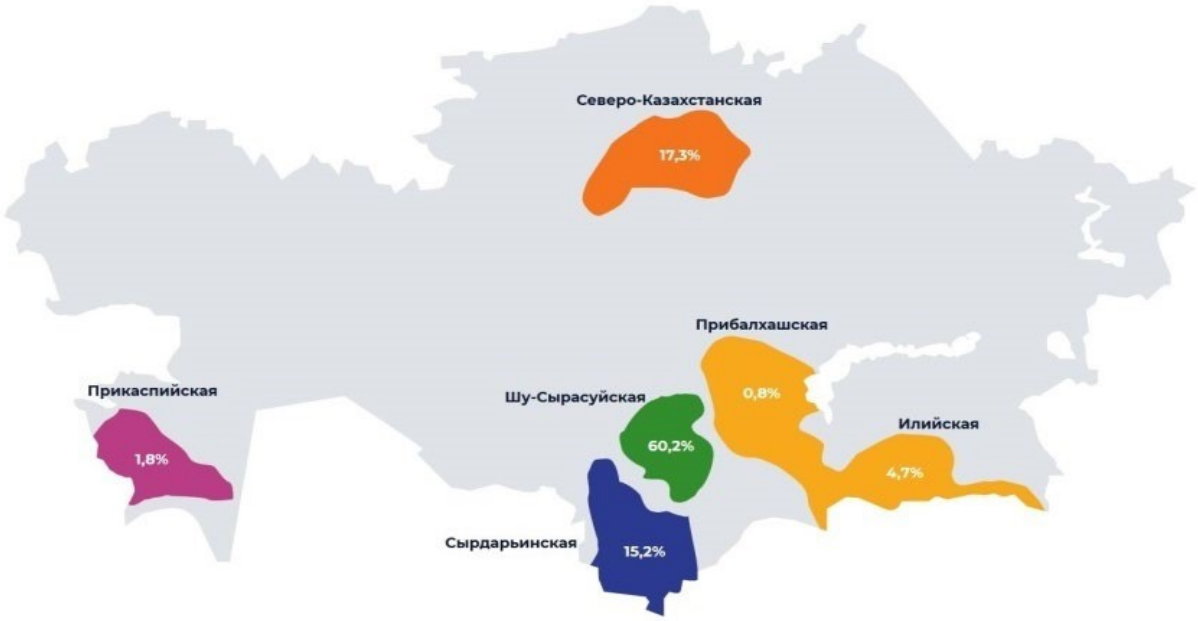

Figure 7. Uranium production regions in Kazakhstan

Kazatomprom has a unique competitive position, thanks to favorable geological conditions of the Republic of Kazakhstan, which are very suitable for ISL. 100% of uranium is produced using the ISL method. Kazatomprom is an absolute leader in uranium production, using the ISL method (~20% of world uranium production in 2017), and it is considerably superior to its main competitors (Figure 8). All processes of uranium production are automated and continuously monitored; technical equipment of the deposits fully complies with the international safety and

environment requirements, such as OHSAS 18001 and ISO 14001 [20]. It is planned to increase annual production of uranium from 21.705 thousand t in 2017 up to expected 22.750-22.800 thousand t in 2019 [21].

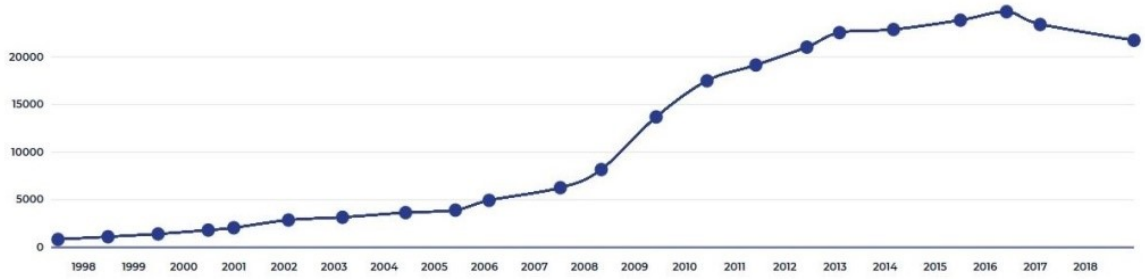

Figure 8. Dynamics of uranium production in Kazakhstan

OTHER MINERAL RESOURCES

Dynamics of iron ore, copper ore and aluminum ore (bauxite) mining are presented in Figures 9, 10 and 11, respectively.

Figure 9. Dynamics of iron ore mining, thousand t

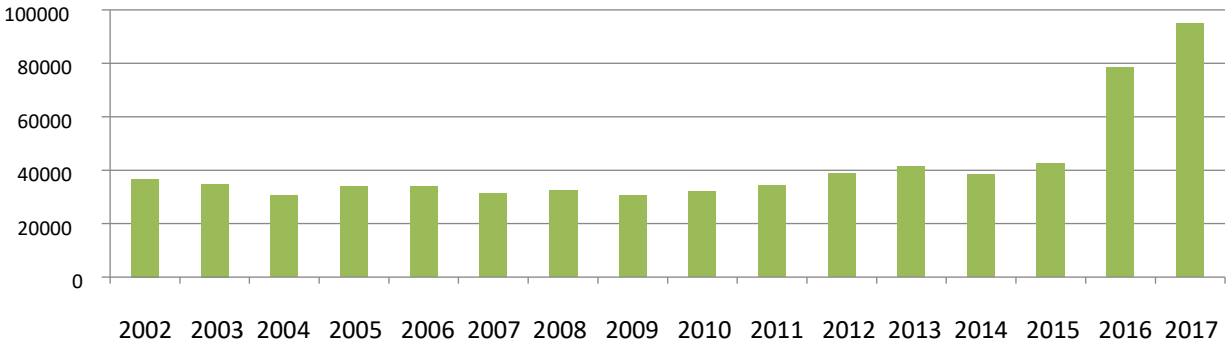

Figure 10. Dynamics of copper ore mining, thousand t

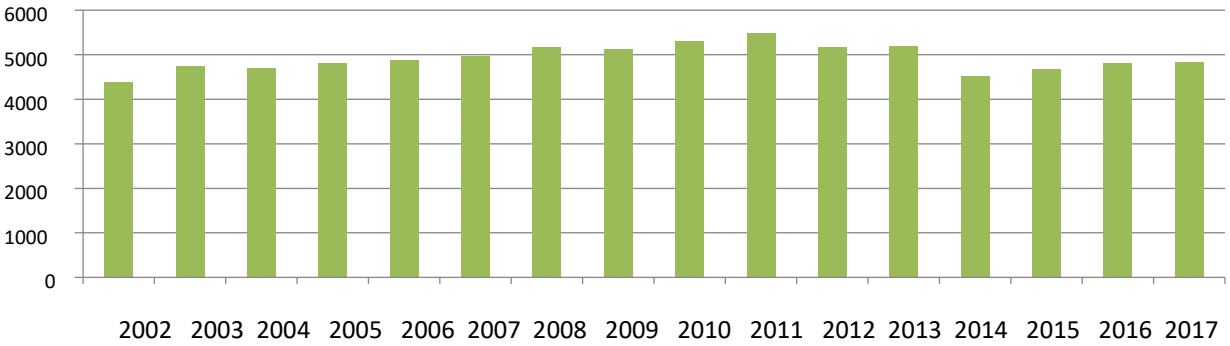

Figure 11. Dynamics of aluminium ore mining (bauxite), thousand t

ENERGY PRODUCTION

Gross installed capacity of all power plants of Kazakhstan is 18 992.7 MW of electrical energy. Production is divided by the type of a power plant as follows:

- TPP (thermal power plants) — 87.7 %;
- CPP (condensing power plants) — 48.9 %;
- CHPP (combined heat and power plants) — 36.6 %;
- GTPP (gas-turbine power plants) — 2.3 %;
- HEPP (hydroelectric power plants) — 12.3 %.

About 70% of electrical energy of Kazakhstan is produced by coal burning, 10.6% by gas flaring, and 4.9 % by oil burning; 14.5% of electrical energy is produced from hydropower and renewable energy resources.

THERMAL POWER

The main volume of electrical energy is produced at 37 thermal power plants, which work on coal from Ekibastuz, Maykuben, Torgay and Karaganda coal basins. The largest hydroelectric power plant in Kazakhstan is Ekibastuz GRES-1. It has 8 power generating units, their installed capacity is 500 MW each; available capacity of the plant is 3500 MW. Aksu (Yermakov) GRES produces the biggest volume of electrical energy.

NUCLEAR POWER

The only nuclear power station of Kazakhstan was located in Aktau and worked from 1973 to 1999. It had a fast neutron reactor with the capacity of 350 MW. Currently, atomic energy is not used in Kazakhstan, although uranium reserves are estimated at 900 thousand t (according to the IAEA records). Major deposits are in the south of Kazakhstan (South Kazakhstan region and Kyzylorda region), in the west in Mangystau and in the north.

At the moment the government is considering construction of a new nuclear power station. Several nuclear research reactors are used in the country.

HYDROELECTRIC POWER

Kazakhstan is rich in water resources. Gross capacity of all water resources of the country is 170 billion kW/year. Main rivers are the Irtysh, the Ili and the Syrdarya. Economically efficient water resources are mainly in the east (the Altai Mountains) and in the south of the country. The biggest HEPP are Bukhtarminskaya, Shulbinskaya, Ust-Kamenogorskaya (on the Irtysh river) and Kapchagayskaya (on the Ili river). They provide 10% of the country's electricity.

They plan to increase the use of water resources for electrical energy production in the medium term. In December 2011, Moinakskaya HEPP (300 MW) was commissioned; Bulakskaya HEPP (80 MW), Kerbulakskaya HEPP (50 MW) and several small hydroelectric power plants are being designed.

NON-TRADITIONAL RENEWABLE ENERGY RESOURCES

Renewable energy resources bring no more than 0.2% of total amount of electrical energy.

Installed capacity of renewable energy resources in the first half-year period of 2018 is 427.5 MW. The capacity of small hydroelectric stations is 198.2 MW, wind farms capacity is 121.45 MW, solar plants capacity is 107.56 MW, bioelectric plants capacity is 3 thousand kW.

Kazakhstan is the first country in Central Asia, which created institutional conditions for transition to "green economy". The Ecological Code was adopted in 2007, the Law on supporting the use of renewable energy resources was adopted in 2009 and the Concept on transition towards "green economy" was adopted in 2013. Kazakhstan is actively cooperating with international financial institutes in development of infrastructure for renewable energy resources.[4]

The national energy industry is being modernized in the country. As of today, there are 50 enterprises, which use renewable energy resources with gross capacity 295.7 MW [22].

[4] 10 June – 10 September 2017, EXPO-2017, an International Specialized Exhibition under the egis of the International Exhibition Bureau was held in Astana. The topic of the exhibition was "Energy of Future". 115 states and 22 international organizations participated in EXPO-2017.

In December 2011, the first wind farm Korday WF (first part) was commissioned in Zhambyl region. Its capacity is 1500 kW. In December 2014, 9 wind turbines were built, and it increased the capacity up to 9 MW (Figure 12).

Although a possible annual duration of solar energy use is 2200-3000 hours/year, and the estimated capacity is 1300-1800 kW/m^2, solar energy is still not widely used in Kazakhstan.

Figure 12. Wind farm in Korday, 2015

In 2010, KazPV project was started in Kazakhstan. Its main aim is to create a complete vertically-integrated production of photovoltaic modules, using Kazakhstani silicon. KazSilicon produces silicon in Ushtobe (Almaty region). The raw material is processed by KazakhstanSolarSilicon in Ust-Kamenogorsk, and finally silicon cells are produced. Photovoltaic modules are assembled by AstanaSolar in Astana.

At the end of 2012, the first part of solar plant Otar was commissioned in Korday district of Zhambyl region. Its capacity is 504 kW, the designed capacity is 7 MW.

SOCIAL AND ECOLOGICAL ASPECTS OF ENERGY AND MINERAL RESOURCES PRODUCTION

The Kazakhstan National Fund (hereinafter the National Fund) was established in 2000 in order to ensure stable social and economic development of the country and to decrease the external influence. The National Fund accumulates direct taxes from the oil and gas sector that constitute 74% of all revenues of the state budget. The National Fund fully accumulates the share of the Republic of Kazakhstan under the Agreements on production sharing, it also almost fully accumulates rent export tax (96%), bonuses (88%), incomes from natural resource users against the compensation claims to oil sector organizations (90%), excess profit tax (96%).

Within the framework of the "Global energy-ecological strategy" and following the decisions of the UN Conference RIO+20, Kazakhstani scientists have developed a draft of the Concept of sustainable energy strategy of future Kazakhstan till 2050. The main parameters of the concept are presented in Table 15 [24].

Table 15 Main and external target parameters of the "Strategy of sustainable energy of future Kazakhstan till 2050" in 2050

Main parameters	
Electrical energy consumption	300±5 billion kW/hour
Capacity of major energy funds	55±5 GW
Share of renewable energy resources, including hydropower	More than 51%
C02 emission per capita	Not more than 3.9 t/person/year
Volume of oil reservation for future generations	2 billion tons of forecast reserves, extracted with the use of existing and forecast technologies
Total capital investment	300 billion US dollars, in 2012 prices
Duration of the sufficient energy flow for implementation of 10-year development plans for Kazakhstan and its regions	Next 10 years after adoption of each 10-year plan
Tariff increase due to sustainable energy	No more than by 21 US dollars per month in relation to population, in 2012 prices
External parameters	
Growth of a gross domestic product per capita	5.3 times
Energy consumption ratio of a unit of a gross domestic product in 2050 to the corresponding unit in 2012	0.5
Population growth	Up to 25 million people

TECHNICAL EFFICIENCY AND INNOVATIONS

Kazakhstan places great importance on improvement of efficiency and implementation of innovations of Kazakhstani scientists and engineers. In 2017 an international exhibition EXPO-2017 was held in Astana, where successful Kazakhstani innovative projects in production, construction, housing and public utilities and transport were presented. Here are some of them:

- Multi-level and multi-row rotary type wind farm;
- Hybrid wind and solar plant “The Great Steppe Energy KazZhelKuat-VRTB” for electrical energy production;
- Innovative accumulators for renewable energy, electric cars and electronics;
- Innovative technology of electrical energy production from gas cleaning, air cleaning in the premises and waste utilization;
- Stand-alone hybrid plant with solar emission concentration;
- Construction of an energy-saving melting reactor for non-waste processing of technogenic waste;
- Development of a self-regulating generator drive of a wind turbine;
- Development of a silicon solar battery with planar concentrate.

A legislative framework has been created in the Republic of Kazakhstan for the development of a network of technology parks (so-called “technoparks”) on the basis of the Strategy for Industrial-Innovative Development of the Republic of Kazakhstan for 2003-2015 approved in 2003 by the Decree of the President of the Republic of Kazakhstan. The main objective of technology parks is to identify, disclose, develop the innovation capacity of the country and its regions, as well as to satisfy the demands of the economy for innovative products. Now there are national and regional technoparks in the Republic of Kazakhstan.

National technoparks contribute to the creation of new industries in the republic that will ensure the future competitiveness of the Kazakhstani economy. A distinctive feature of national technoparks is that the regime of free economic zones (FEZ) with preferential taxation is focused on the industry sectors. Regional technoparks provide a gradual increase of the technological level of the economy and create conditions for small and medium science-intensive and technological businesses. Regional industrial enterprises, scientific organizations and higher educational institutions are systemic components of regional technoparks. The tasks of technoparks are as follows:

- development of business plans and marketing research;
- management of projects and search for financing sources;
- material and technical support of the project preparation (provision of premises, telecommunication services, provision of access to laboratory equipment);
- accounting, legal and translation support of the project;
- assistance in testing, patenting, certification, creating a prototype;
- provision of consulting services.

Some Kazakhstani technoparks include the so-called business incubators, i.e. buildings or several buildings where, for a limited time (2-5 years), newly created small enterprises rent their premises. The main objective of the business incubator is to “grow up” high-tech companies from the earliest stages, from the moment of inception of an idea.

There are the following technoparks in Kazakhstan:

1. Technopark “Algorithm” LLP, Uralsk. The areas of activities include mechanical engineering for the oil and gas industry, instrument engineering, petrochemistry, environmental technologies.
2. Almaty Regional Technopark is aimed at the development of construction technologies, the production of construction materials; the development of the chemical industry, metallurgy, and mechanical engineering.
3. Technopark KazNTU named after K.I. Satpayev, Almaty (www.tpntu.kz). It is created to ensure the dynamic development of science-intensive technologies, the implementation of scientific, technical and technological innovations in the industry, the commercialization of the results of research and development.
4. East Kazakhstan Regional Technopark Altai LLP, Ust-Kamenogorsk. The area of its activity is production and processing of non-ferrous metals, information technologies, mechanical engineering, environmental technologies, production of new materials, etc.

The innovation infrastructure of the Republic of Kazakhstan has a number of privileges. For example, in the FEZ PIT of Alatau the corporate tax is reduced by 50%; the participants are fully exempt from land and property taxes; the turnover on sales of services is exempt from VAT; the participants are exempt from customs payment for imported goods; concessional financing by development institutions is provided.

DATA AND KNOWLEDGE MANAGEMENT

The Committee of Statistics, National Center for State Scientific and Technical Expertise JSC, the Republican Geological Fund were established in Kazakhstan to ensure the data and knowledge management.

The Committee of Statistics is an authorized body which develops and implements the state policy on statistics. It also develops and implements the statistics improvement programmes in the Republic of Kazakhstan. The Committee of Statistics is a part of the Ministry of National Economy of the Republic of Kazakhstan.

In accordance with the current legislation and the tasks entrusted, the Committee performs the following duties:

1. develops and implements the state policy on state statistics;
2. ensures the accumulation, maintenance and updating of information statistical databases on the socioeconomic situation of the republic and its regions;
3. carries out international cooperation within its competence and concludes the agreements in the framework of cooperation;
4. performs other duties stipulated by this Law, other Laws of the Republic of Kazakhstan, Acts of the President of the Republic of Kazakhstan and the Government of the Republic of Kazakhstan.

The Committee of Statistics collects operational data about: healthcare, investment, culture, population, education, crimes, communications, energy and commodity markets, enterprise finance, national accounts, gender statistics, indicators of the state programme on industrial-innovative development, domestic trade, science and innovations, environmental protection, industry, construction, transport, tourism, prices and tariffs, etc.

The Republican Center for Geological Information Kazgeoinform Limited Liability Partnership (RCGI) was established by Resolution No. 376 dated June 25, 2018 of the Government of the Republic of Kazakhstan under the Committee of Geology and Subsurface Use of the Ministry of Industry and Infrastructure Development in order to carry out the collection of geological information.

The duties of the RCGI include: the collection of geological information fully owned, owned and used by the state; storage, summarization and systematization of the information; providing it to the interested persons as a National Operator for collecting, storing, processing and providing the geological information.

The National Center for State Scientific and Technical Expertise was established by Decree No. 831 dated July 19, 2011 of the Government of the Republic of Kazakhstan. The Center deals with the creation of state resources for scientific and technical expertise in the country's scientific sphere, including the information on the scientific potential in general. It collects, processes, and analyzes documents, including PhD and Master thesis defended in the republic, reports on research and development activities, scientific and technical programmes, deposit research papers, publications of Kazakhstani scientists; over 10 thousand documents are processed every year. It provides access to the domestic and international information resources for corporate and individual subscribers, including the state administration bodies of the republic; it also provides the whole range of associated information services.

There is a vocational education and training system for all sectors of the national economy of Kazakhstan. The intermediate vocational education system includes colleges and vocational schools. In 2018, 769 of these schools worked well; 489.8 thousand students were studying there. A higher education system includes 124 higher education institutions, mainly universities. In 2018, 524.5 thousand students were studying there [18]. Specialists for fuel and energy and mining industries are trained in 23 largest universities of Kazakhstan.

The European Qualification System is adopted in the education system of Kazakhstan, which includes a bachelor's degree program, a master's degree programme and a PhD programme of postgraduate education.

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UNFC CASE STUDY

APPLICATION OF UNFC TO MINERAL DEPOSIT "N"

As an example of the possible use of the UNFC for assessing a solid mineral deposit, the exploited pyrite-polymetallic ore deposit "N", which is located in the territory of the East Kazakhstan region of the Republic of Kazakhstan, was selected (see Figures 13 and 14). The deposit is a typical representative of pyrite type ore objects, widely known in the world and in Kazakhstan. The practical value of the ores of deposits of this type are five useful components – copper, lead, zinc, gold and silver. Ores of the deposit are represented by both continuous (predominantly) and disseminated varieties. Most of the ore substance (especially in solid ores) is pyrite.

Figure 13. Map of the territory of the Republic of Kazakhstan, location of research objects

Like many other ore objects in Kazakhstan, the “N” field was discovered more than 100 years ago, and was subsequently explored in stages, with a gradual increase in the detail of exploration work, which was carried out in parallel with exploitation, first by a quarry, and later by an underground method.

During the discovery of the deposit, ore bodies came to the surface and were partially (to a small extent) mined by ancient miners. In the wake of such developments, the “N” field was discovered. At the first stage (1950-s), the exploration of the upper horizons of the field was carried out by digging ditches, deep pits with cuts and wells of great depth (up to 100 m). The upper part of the ore bodies was composed of oxidized ores, which spread from the surface to a depth of 30 m, which were replaced with depth by sulfide ores. The next stage of exploration – deeper horizons of the field (mid-1960-s) was carried out in parallel with mining operations. Exploration was carried out by drilling wells to a depth of 300-500 m.

Figure 14. Map of the “N” field region

The “N” field is medium in scale. According to the latest recalculation of reserves of 2018, taking into account the movement of reserves (production and additional exploration), as of 01 January 2019, the reserves of the field are as follows:

- ore: 5672.0 thousand t;
- copper: 141.8 thousand t, with an average grade of 2.5%;
- lead: 62.4 thousand t, with an average grade of 1.1%;
- zinc: 238.2 thousand t, with an average grade of 4.2%;
- gold: 5104 kg, with an average grade of 0.9 g/t;
- silver: 158.8 tons, with an average grade of 28.0 g/t.

NATIONAL CLASSIFICATION SYSTEM FOR MINERAL RESOURCES

Classification of reserves of deposits and forecast resources of solid minerals of the Republic of Kazakhstan (classification of GKZ RK, and classification by the KAZRC code) is considered.

DESCRIPTION AND DETAILS OF THE NATIONAL CLASSIFICATION AND MANAGEMENT SYSTEM

Predicted resources of solid minerals according to their degree of geological knowledge are divided into categories P3, P2, P1. Each of these categories clearly indicates the degree of reliability of the calculated values.

Reserves of solid minerals according to their degree of knowledge are divided into two groups:

1. pre-estimated reserves of category C2;
2. confirmed (explored) reserves of categories C1, B, A.

The principles for applying the classification of forecast resources and solid mineral reserves are given in Figure 15.

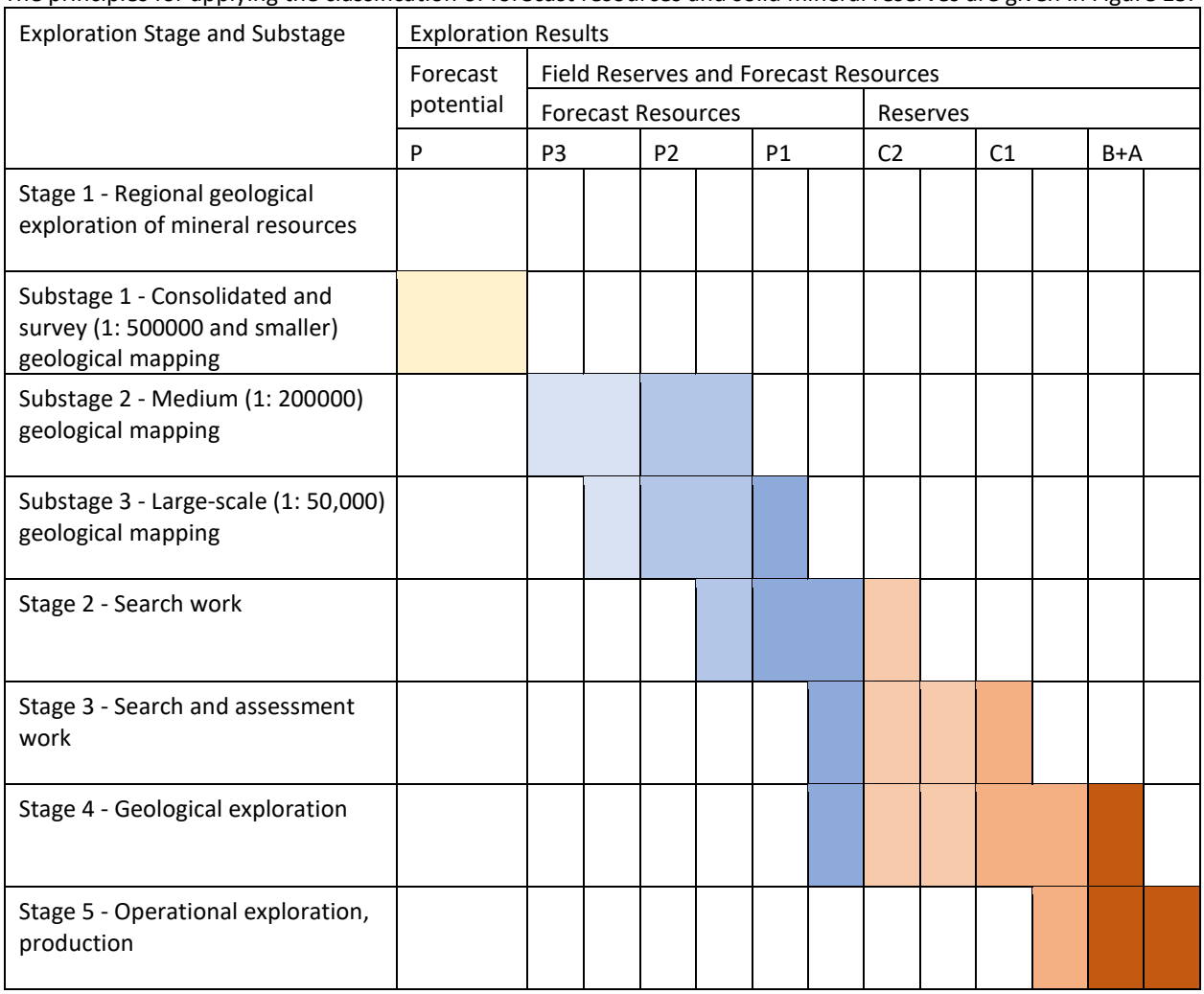

Figure 15. Application of classification of reserves and forecast resources according to the GKZ RK standard

Reserves of categories A, B, C1 belong to industrial reserves, category C2 to previously explored. Reserves of categories A, B, C1, C2 are classified as reserves – economically viable for production. In addition, off-balance reserves are also distinguished, which are currently unprofitable for mining by the contents of useful components, or by the conditions

of occurrence, or by technological properties, but may be of practical interest in the future. Both reserves and forecast resources, their definitions and application are fully consistent with the classification in force in the former USSR.

In 2016, Kazakhstan became the 10th member of CRIRSCO. With the introduction of the new Code "On Subsoil and Subsoil Use", the practical implementation of the KAZRC Code, which fully complies with the CRIRSCO template began (Figure 16).

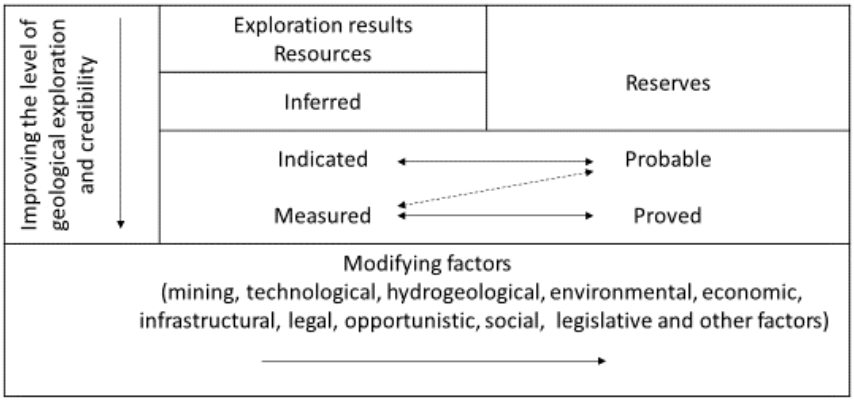

Figure 16. Categorization of resources and reserves as per the CRIRSCO template (including the KAZRC Code)

In accordance with the KAZRC Code, since 2019, subsoil users began to submit reports of Competent persons on assessment of resources and reserves of deposits to GKZ.

COMPARISON OF THE GKZ RK CLASSIFICATION FOR SOLID MINERALS WITH UNFC

A comparison of the classification of reserves and forecast resources of solid minerals of the Republic of Kazakhstan (in the absence of a bridging document with UNFC) can be represented as follows (Figure 28).

Table 4 – Estimated ratio of UNFC and GKZ RK classification (solid minerals)

UNFC Classes defined by categories and sub-categories							GKZ reserves and forecasted categories
Total commodity initially in place	Extracted	Sales Production					
		Non-sales Production					
	Class		Sub-class	Categories			
				E	F	G	
	Known deposit	Commercial project	On Production	1	1.1	1,2,3	A, B, C1
			Approved for development	1	1.2	1,2,3	B, C1, C2
			Justified for development	1	1.3	1,2,3	C1, C2
		Potential commercial project	Development pending	2	2.1.	1,2,3	C1, C2
			Development on hold	2	2.2	1,2,3	C1, C2, P1
		Non-commercial projects	Development unclarified	3.2	2.3	1,2,3	C2, P1
			Development not viable	3.3	2.3	1,2,3	P1, P2
		Additional quantities in place		3.3	4	1,2,3	P2, P3
	Potential deposit	Exploration projects	[No sub-classes defined]	3.2	3	4	P3
		Additional quantities in place		3.3	4	4	P

The main difference between the UNFC and the GKZ RK classifications is the absence of the E axis factors in the latter. The GKZ RK classification (as a two-dimensional system) focuses only on the degree of geological exploration of deposits and the feasibility of projects.

When evaluating deposits according to the GKZ RK classification, the main emphasis is on the significance of the project for investors, often the socio-economic and environmental component is simply ignored. When planning the development of the mineral resource base of Kazakhstan, state bodies do not take into account, to the necessary

extent, the needs of the population, the creation of new jobs in the raw materials sector of the economy, and the ecological state of the regions. The lack of necessary attention to the socio-economic and environmental aspects of projects is determined by the fact that too little attention is paid to the requirements of GKZ RK standards.

The approximate ratio between the UNFC and the GKZ RK classification shown in Fig.5 can be used as the basis for a binding document between the two classifications. However, the GKZ RK classification will remain a conceptually two-dimensional model of an outdated approach to the planning and development of the mineral resource sector of the economy of Kazakhstan.

Since the classification of mineral resources and mineral reserves according to the KAZRC Code is fully consistent with the CRIRSCO template, which has a bridging document with UNFC, the classification is compared using a bridge document dated 5 January 2015 (Figures 17, 18, 19). It should be noted that with significant progress in using the classification according to the KAZRC Code, this system is also significantly inferior in accounting for the maximum number of factors, compared with the UNFC. Also, the classification by the KAZRC Code is inferior to the GKZ RK classification in view of the absence of different ranks in the estimates of forecast resources.

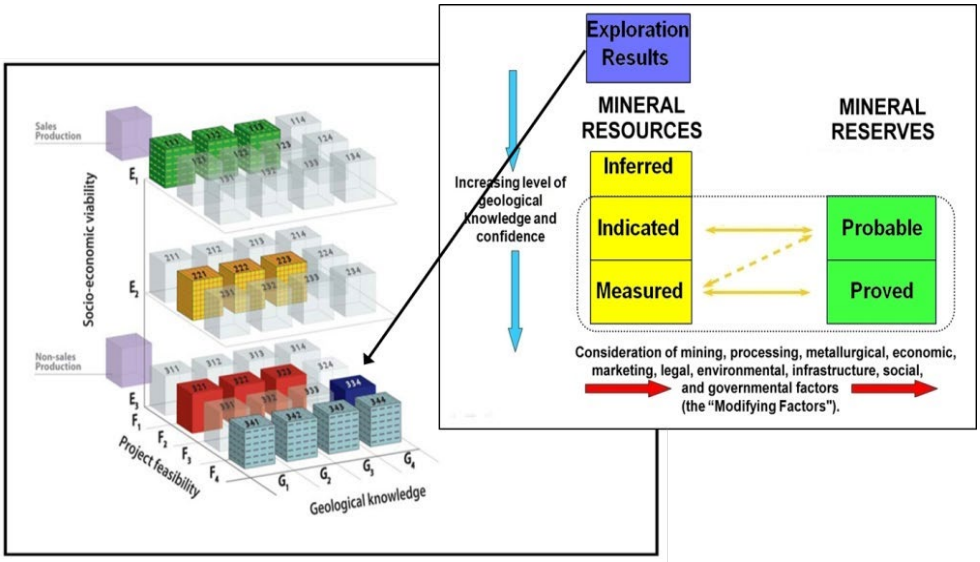

Figure 17. Exploration projects

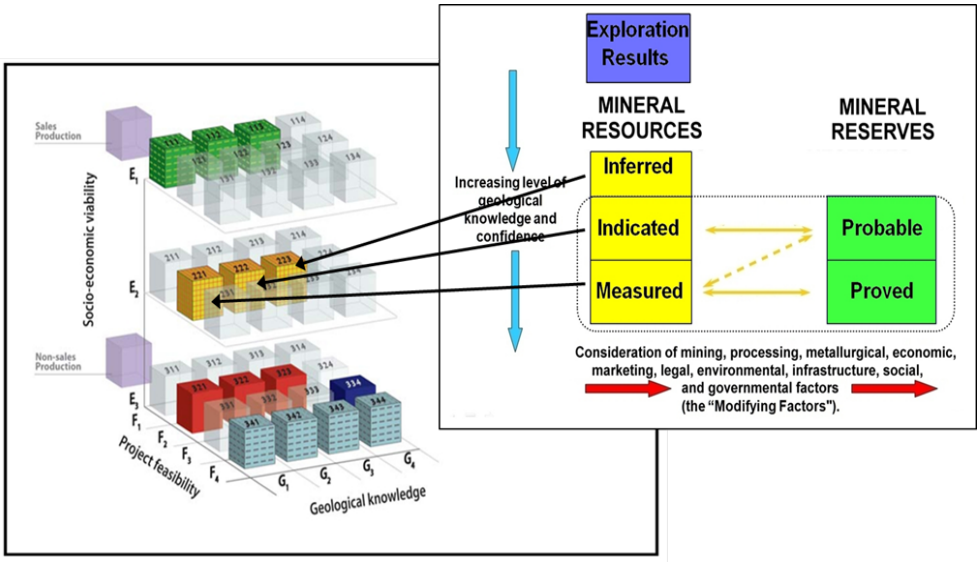

Figure 18. Potentially commercial projects

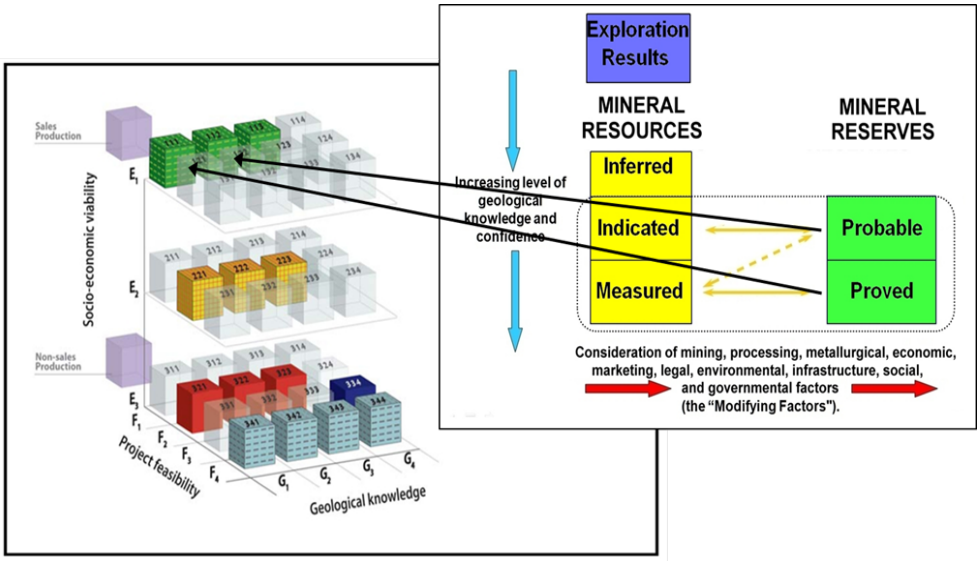

Figure 19. Commercial projects

BACKGROUND INFORMATION ON THE "N" FIELD PROJECT

PREVIOUS WORK

The "N" field has been explored over a long period. In the area of the deposit, geological studies of various details were carried out, starting in 1949. For more than 20 years, more and more detailed exploration work has been consistently carried out, which has provided an increase in the reliability of reserves estimates. The main projects and stages of exploration are given below.

1. Search project. Exploration work at the field was carried out 1949-1952 and included groundbased geophysical exploration using magnetic prospecting and electrical exploration, as well as the drilling of individual wells on a rare network (200x400 m through) – the category of forecast resources according to the GKZ classification; according to UNFC – categories E3.3, F3, G4.
2. Search and evaluation project. On the basis of obtaining positive results in 1953-1954, exploratory and appraisal work was carried out by drilling wells on a 100x200 m network, as a result of which a large part of the ore deposit was discovered – a category of reserves according to GKZ C2 classification, as well as forecast resources P1; according to UNFC – categories E.2, F2.3, G2,3.
3. Preliminary Intelligence Project. In 1955-1960, preliminary exploration was carried out by drilling wells through a 100x100 m network and tunneling at a horizon of + 625 m with reserves estimated for categories C2 and C1; according to UNFC – categories E2, F2.1, G2.
4. Detailed intelligence project. In 1962-1966, a detailed exploration was carried out by drilling wells on a 50x50 m network, as a result of which, based on the development of a feasibility study, balance reserves for categories B, C1 and C2 were calculated; according to UNFC – categories E1.2, F1.3, G1,2.
5. In total, during the exploration of the field, 227 wells were drilled with a total volume of 99 thousand m, 2380 m of underground mine works were completed, core samples of 15.3 thousand and furrow samples of 3.8 thousand were taken.
6. Large volumes of exploration work carried out at the field provided a high degree of reliability of reserves. In 1968, pilot development of pilot block No. 1 was started.
7. Development project. Based on the results of pilot production in 1972, a project for developing the field was developed, and in 1976 the field began commercial operation. Two mine shafts were passed, and horizontal openings were opened after 60 m. With a total ore reserves of 9.5 million t, the design capacity of the mine for ore production of 200,000 t/year was envisaged. Ore processing is carried out at the beneficiation plant, which was built at the deposit in 1980.

Reserves categories according to GKZ – B, C1, C2; according to UNFC – E1, F1.2, G1,2.

Ore mining and processing has been carried out since 1976 with a break in 1993-2000, during the post-Soviet crisis. Since 2001, the field has been continuously operated. A total of 3.9 million t of ore was mined during the period of the field's operation.

CURRENT STATUS OF THE PROJECT, AND OUTLOOK

The current actual Mining Project was approved in 2007. For socio-economic reasons, the mine's ore production and processing capacity is 200 thousand t/year.

Mining at the deposit is accompanied by operational exploration, which allows to detail ore bodies with the transfer of their reserves to higher categories. From category C1, reserves are transferred to category B. The density of the operational intelligence network is 12.5 x 12.5 m. Such an exploration network makes it possible to ensure the most efficient ore mining. Currently, reserves categories according to GKZ are B, C1; according to UNFC categories – E1, F1, G1,2.

The mine and concentration plant are regularly upgraded with equipment upgrades, process improvements and cost optimization in order to increase the efficiency of the enterprise.

SOCIO-ECONOMIC AND SOCIO-ENVIRONMENTAL ASPECTS OF THE PROJECT

ECONOMIC ASPECTS

The company is a subsoil user engaged in the exploitation of the "N" deposit with ore processing at its own processing plant. The company produces several sulfide concentrates: copper, lead and zinc, which it sells to metallurgical plants.

Due to the fact that the enterprise is operating and city-forming, economic efficiency assessments were carried out in three variants of the mine's ore productivity: 200 thousand t (option 1), 300 thousand t (option 2), and 400 thousand t (option 3). The ore processing plant's capabilities allow doubling the mine's productivity. To solve this problem, a financial and economic model was calculated, which provides for the following key indicators: income (sale of concentrates); costing; production profit; income tax; net profit; capital expenditures; accumulated cash flow (net present value (NPV) at a discount rate of 10%); internal rate of return (IRR); life of the enterprise. Comparison of technical and economic indicators of 3 development options are presented in Table 5 (thousand US dollars):

Table 5 – Comparison of technical and economic indicators of 3 development options

Indicator	Option 1	Option 2	Option 3
Income	362,8	544,2	725,6
Production costs	198,4	297,6	396,9
Production profit	164,4	248,4	328,7
Income tax, 20%	32,9	49,7	65,7
Net profit	131,5	198,7	263,0
Capex	21,5	30,1	40,8
NPV (10%)	4,9	11,2	21,5
IRR	11,6	24,3	39,6
Life of the enterprise, by year	2047	2037	2033

Despite the higher result indicators for the second and third options, given the social significance of the project, the company-subsoil user prefers the first option – the longest possible existence of the enterprise.

SOCIAL ASPECTS

The company-subsoil user is one of the city-forming enterprises in its area. The number of employees of the enterprise (2017-2019) and the wage fund are presented in Table 6.

Table 6 – The number of employees of the enterprise (2017-2019) and the wage fund

Indicator	Unit	2017	2018	2019
Number of employees	Persons	470	481	493
Payroll	US dollars	3,615,240	4,155,840	4,295,016
Average salary	US dollars	641	720	726

As of 2019, the average salary at the enterprise is 1.6 times higher than the average salary in Kazakhstan (453 US dollars). Under the terms of the Subsurface Use Contract, the enterprise annually pays the amounts for the social development of the district as presented in Table 7.

Table 7 – Social payments of the enterprise

Indicator	Unit	2017	2018	2019
Specialist training	US dollars	35,838	41,197	48,944
Social development of the area	US dollars	1,635,405	1,879,488	2,232,921

The average annual budget of the region in which the company-subsoil user is operating over the past three years has amounted to about 15.5 million US dollars. Based on this amount, the company's payments for the social development of the district constitute a significant share of the revenue part of the district. With the total population of the region 44.3 thousand people (about 10 thousand families), more than 400 families are provided with jobs at the "N" field.

ENVIRONMENTAL ASPECTS

An Environmental Impact Assessment has been carried out in the "N" Ore Mining Project. In accordance with current regulations, emissions of harmful substances into the environment are calculated annually, and payments for these emissions are coordinated. The mining project provides for measures aimed at reducing emissions of harmful substances and the overall negative impact on the environment.

To prevent negative impact, careful compliance with environmental measures is necessary. In this regard, the project provided for technologies and technical solutions that minimize the negative impact on the environment, including:

- reduction of pollutant emissions into the atmosphere;
- reduction of emissions into surface and underground waters;
- reduction of soil pollution;
- reduce the impact on flora and fauna;
- reduce environmental impact in emergency situations;
- measures to improve the safety of mining;
- measures to control emissions during periods of particularly adverse weather conditions;
- reclamation of land disturbed by mining.

The measures envisaged by the project ensure minimization of the harmful environmental impact, provided that all design decisions are carefully observed.

FIELD PROJECTS STATUS AND FEASIBILITY

TECHNOLOGICAL FEASIBILITY ASPECTS

Exploration projects at the “N” field have been fully implemented. The ore bodies of the deposit are fully explored. In this regard, further exploration work at the field is impractical. At the production stage, operational exploration is carried out as a result of which the reserves of the field are refined at individual sites to prepare them for production.

Reserves of the “N” field as of 2019 are:

- ore: 5672.0 thousand t;
- copper: 141.8 thousand t, with an average grade of 2.5%;
- lead: 62.4 thousand t, with an average grade of 1.1%;
- zinc: 238.2 thousand t, with an average grade of 4.2%;
- gold: 5104 kg, with an average grade of 0.9 g/t;
- silver: 158.8 tons, with an average grade of 28.0 g/t.

Over the years, the results of drilling wells by mining were verified at the field. The certification work demonstrated the consistency of the data that was obtained from the wells with the results of testing the mine works. In different years, during the operation, work was carried out to compare the exploration results with the operational data, as a result of which it was shown that in all cases the calculated ore reserves practically coincide, and, in some cases, according to the mining results, the reserves increase.

The results of many years of cost-effective mining of ores of the “N” deposit indicate the economic efficiency of the project, and design decisions suggest that the operation of this facility can be successfully continued for almost another 30 years. This fact has important socio-economic significance for the population of the region.

DETAILED STUDIES CONDUCTED

Over the past 10 years, work on technological mapping of ores and technological research is regularly carried out at the “N” deposit, in order to increase the extraction performance of useful components. Thanks to these studies, from 2017 to 2019 extraction of useful components in concentrates increased, including:

- copper to copper concentrate – from 76.3 to 81.3%;
- lead to lead concentrate – from 62.6 to 68.4%;
- zinc to zinc concentrate – from 81.7 to 83.9%.

The increase in the extraction of useful components ensured an increase in the volume of marketable products and income from its sale by 6.2%.

LEVEL OF KNOWLEDGE / CONFIDENCE IN ESTIMATES

GEOLOGICAL AND TECHNICAL ASPECTS

The geological features of the deposit and ore bodies have been studied in detail thanks to consistent multi-stage geological exploration, including production exploration. Geophysical studies in wells confirmed the correctness of

the coordination of ore bodies, which was confirmed by the results of operation. The features of the geological structure of the “N” field are illustrated on the geological map and geological section (Figures 20, 21).

The field was discovered by two shafts at nine horizons. The ore has been mined for over 30 years. Ore processing is carried out at our own processing plant with the production of conditioned concentrates of copper, lead and zinc. The sale of concentrates is carried out at the metallurgical plants of the Kazzink LLP holding.

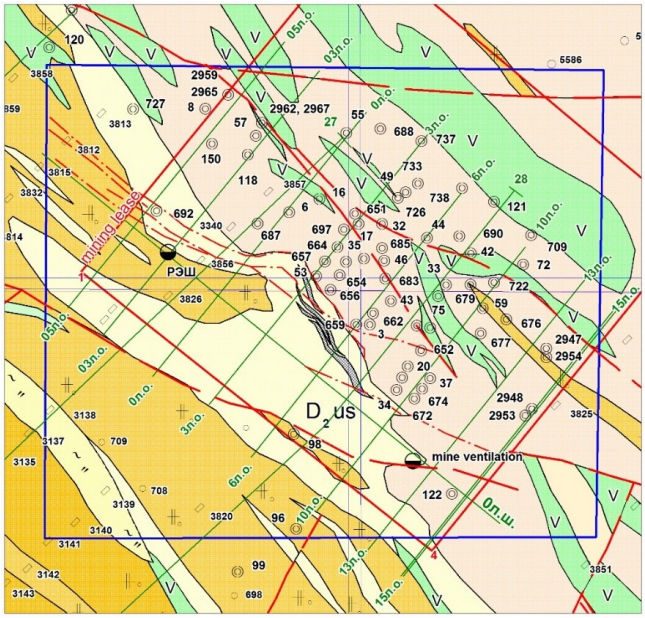

Figure 20. Geological map of the field “N”

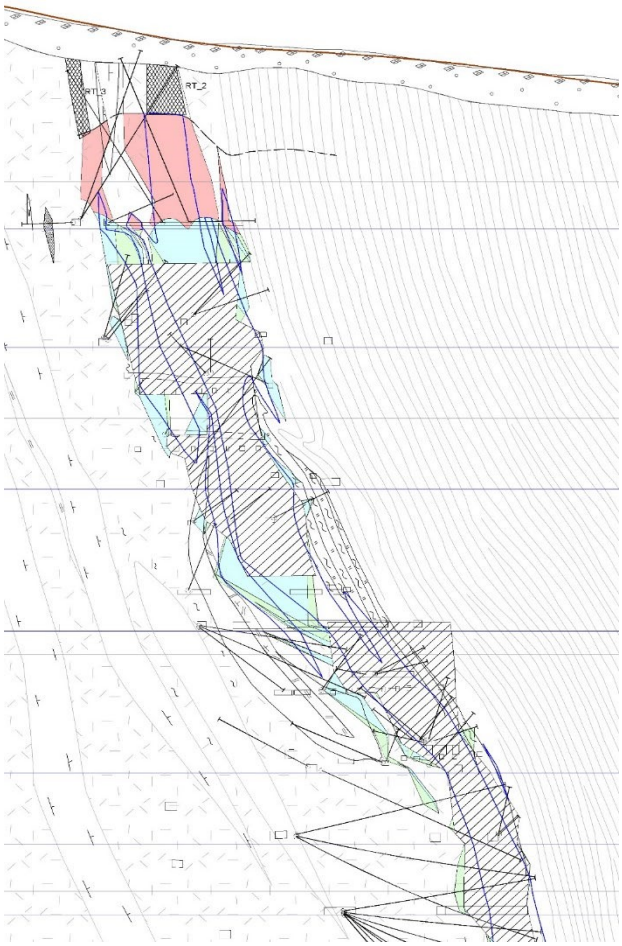

Figure 21. Geological section along line 3 (the shaded areas are the worked-out space, pink and blue are the remaining ores of various types, and underground wells are shown in short straight lines)

ESTIMATES OF QUANTITY AND VOLUME

The latest revaluation of the “N” field reserves was carried out in 2018. All data processing, including replenishment of the database, contouring of ore bodies, construction of wireframe and block models, interpolation of metal contents into a block model, replenishment of mining (mining chambers), was carried out using the Micromine tools.

To clarify the patterns (capacity analysis, distribution of contents, etc.), statistical studies were conducted on a database of testing wells and mine workings. Histograms of the distribution of contents for all samples for five metals (copper, lead, zinc, gold, silver) were constructed and correlation relationships between the metals were determined.

When contouring ore bodies, the following principles were observed:

- The contour of ore bodies is built according to the maximum possible tracking between sections and the choice of the best option for its coordination in sections and plans in accordance with the morphology of ore bodies, as well as taking into account the available materials of the predecessors;
- The contouring of ore bodies along strike and dip was carried out using the rules of interpolation and limited extrapolation;
- Interpolation of data on the rise and fall of ore bodies was carried out in most cases at a distance of 15-20 m to 40 m, occasionally more than 50 m. Mutual linking of ore intersections at lower horizons was carried out at distances from 40-50 m to 70-75 m.
- The contouring between ore and barren workings was carried out taking into account the density of the exploration network by half the distance between the workings.

Because the ores of the deposit are complex, the conversion factors of metals into conditional copper were calculated, which were: for lead gold 0.3, for zinc 0.45, for gold 0.6, for silver 0.01.

Variographic studies were carried out on the basis of a 1 m long file of composites. Since the ore bodies of the deposit have the same elemental composition, morphology, and due to the fact that according to the results of the study of histograms of individual populations of elements, no elements are distinguished, the same parameters of the anisotropy ellipsoid are used in the calculation of reserves for comparing exploration and exploitation data (Figure 22).

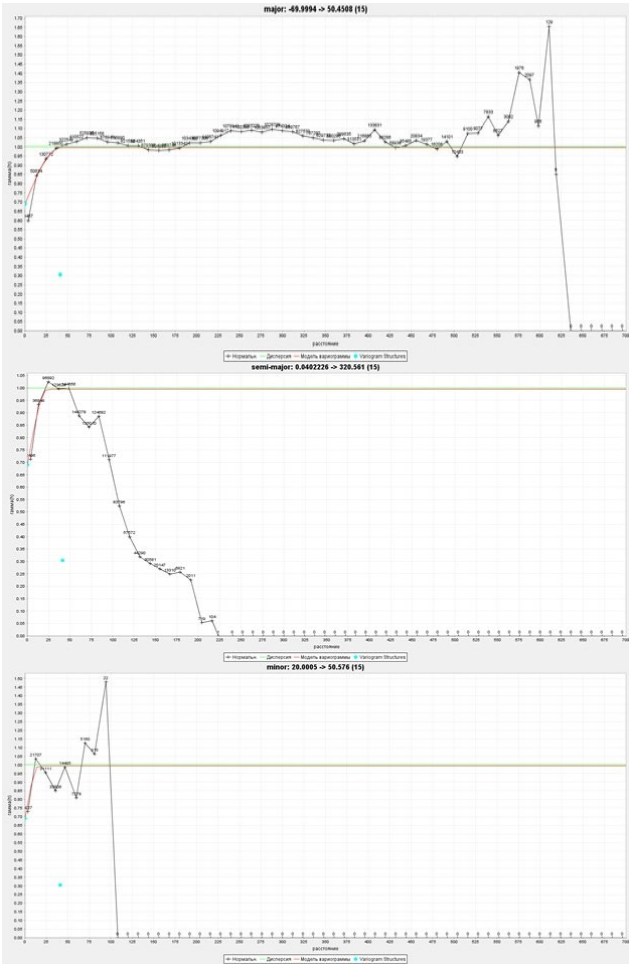

Figure 22. Variograms on the example of studies of the distribution of copper in ores of “N” deposit

The contents were interpolated into the block model by ordinary kriging separately for each side and each ore body. After interpolation, each block was assigned a volume weight depending on the metal content. In addition, conventional metal was calculated (Figures 23, 24). To assess the quality of content interpolation, verification was carried out in two ways:

1. Visual certification. Correspondence of the tracks of composites, wireframe model of the ore body and the block model of geological reserves.
2. Statistical verification.

The certification results showed the reliability of the performed estimates of resources and reserves of the “N” field.

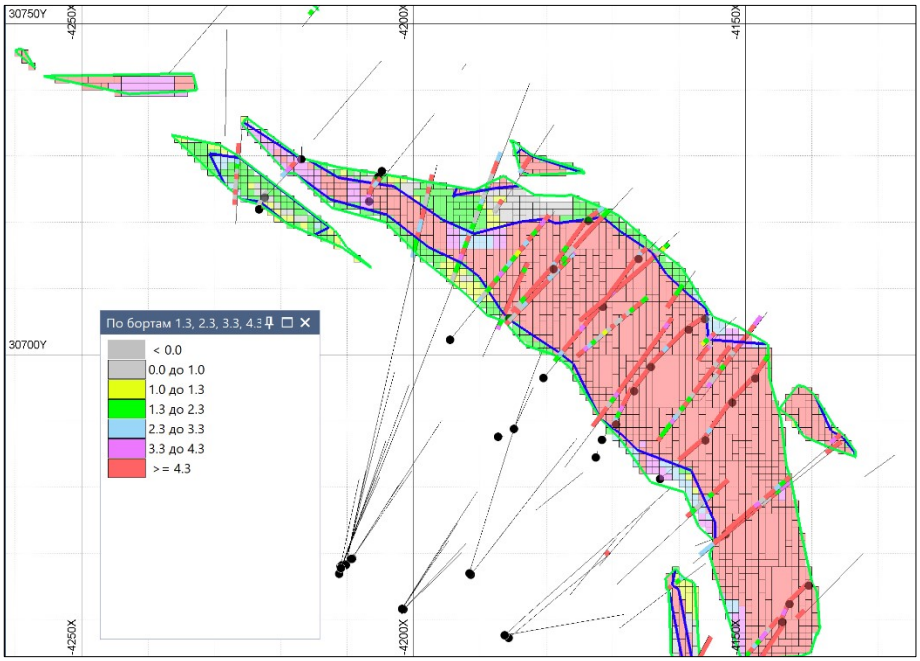

Figure 23. Visual verification of the block model on the horizon 6 +630, ± 6.25m

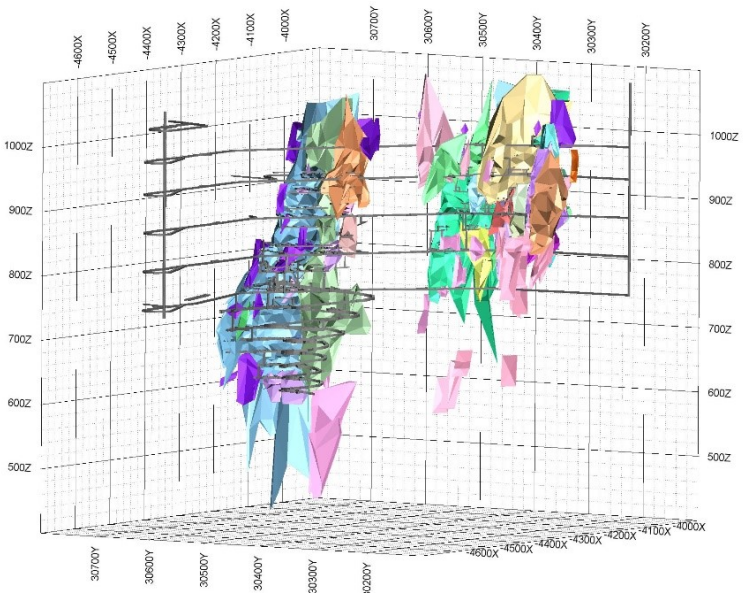

Figure 24. General view of the wireframe model of ore bodies of the “N” deposit Different colors show sections of ore bodies with different cutoff grade.

The optimum cutoff grade of reference copper for estimating reserves is assumed to be 2.0% (with a mine production and ore processing capacity of 200 thousand t/year) based on a comparison of the technical and economic indicators of various stock options calculated at the cutoff grade of reference copper 1.6, 2.0, 2.4 and 2.8%.

CLASSIFICATION OF THE "N" FIELD PROJECT USING UNFC

REVIEW OF SOCIO-ECONOMIC INFORMATION INCLUDING SOCIAL AND ENVIRONMENTAL (E-AXIS)

The pyrite-polymetallic ore deposit "N" has been operating profitably for more than 30 years. The subsoil user company is a city-forming enterprise that provides work for almost 500 workers and specialists. In general, the work of the enterprise is important for the socio-economic development of the region. The company's management deliberately chose the option of annual ore production and processing capacity of the enterprise (200 thousand t), which ensures the maximum life of the enterprise (28 years). A significant part of the district's budget is formed by the enterprise in the form of taxes.

Therefore, the socio-economic feasibility of ore mining, production of concentrates and their marketing can be classified according to UNFC-2009 by category E1.

REVIEW OF PROJECT FEASIBILITY INFORMATION (F-AXIS)

The high quality of ores of the "N" deposit, the compactness of the ore bodies, the high degree of their exploration, continuous field exploration at the deposit, and the stable sale of products (concentrates) ensure a stable economic position of the enterprise with satisfactory IRR performance of 11.6% and average annual profit for the entire period of development of 4.7 million US dollars. Some of the reserves of the deep horizons of the field (about 20%) that have not yet been discovered by underground mining are characterized only by preliminary technical and economic assessments.

Therefore, the feasibility study of ore mining, production of concentrates and their marketing can be classified according to UNFC-2009 in category F1.2.

REVIEW OF GEOLOGICAL KNOWLEDGE / CONFIDENCE IN ESTIMATES (G-AXIS)

The latest assessment of the field's reserves (as of 01.01.2019), made by 3D modeling using Micromine, while ensuring proper quality control of testing and analytical work, confirmed by studies comparing exploration and production data, provide a high degree of confidence in the estimates.

At the same time, on the deep horizons of the deposit, where production exploration has not yet been carried out, some of the reserves have been studied with a lower degree of detail than on those horizons where ore is mined. This part of the reserves is characterized by less confidence in valuations.

Therefore, the degree of geological exploration and confidence in reserves estimates of the "N" field can be classified according to UNFC-2009 into F1.2 categories.

CLASSIFICATION OF THE PROJECT USING UNFC SCHEME

Based on the above review of the "N" project on the axes of the UNFC-2009 classification, stocks of pyrite-polymetallic ores as of 01.01.2019 can be classified as E1, F1,2, G1,2.

CASE STUDY II: APPLICATION OF UNFC TO OIL AND GAS DEPOSIT "X"

Administratively, the "X" field is located in the Kyzylorda region of the Republic of Kazakhstan. Geographically, the field is located in the southwestern part of the Torgai Trough (Figure 25). Details are presented in Figures 26 and 27.

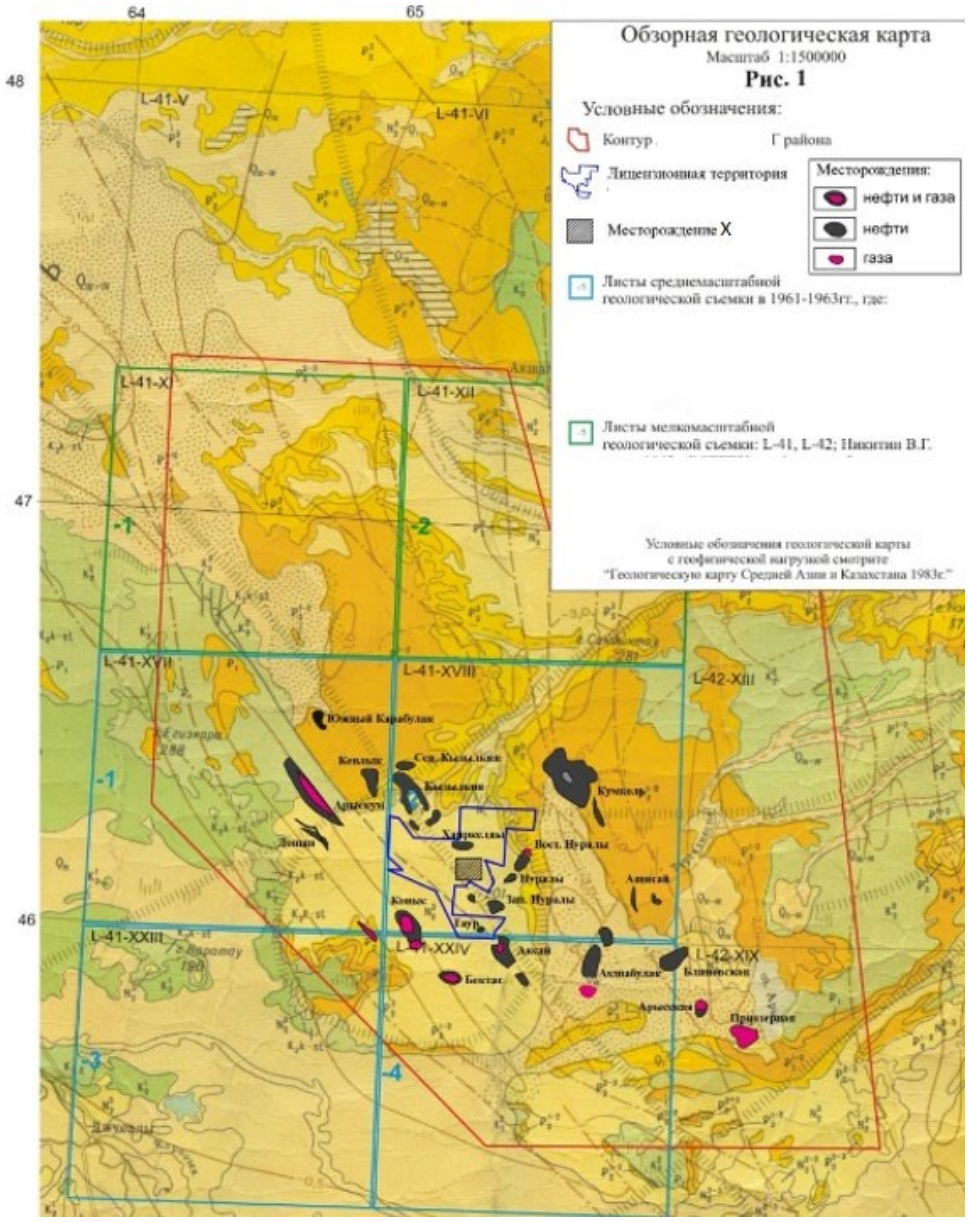

Figure 25. Regional map, "X" field

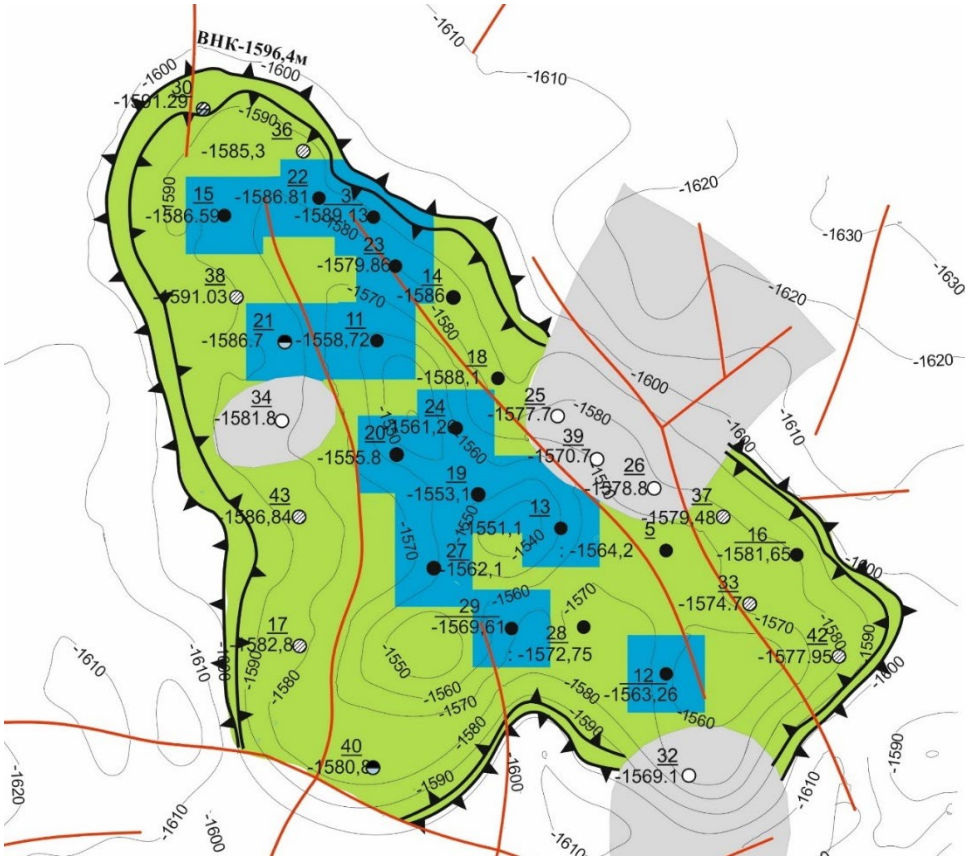

Figure 26. Structural map on the roof of the collector of the productive horizon M-II-1 (I object of development)

Figure 27. Structural map for the collective productive horizon U-0-3 (II development object)

Proceeding from the regional nomenclature of productive horizons at the "X" field, oil deposits were revealed in the lower neocomial deposits K1nc1 (horizons: M-II-1; M-II-2; M-II-3) and in the upper Jurassic J3 (horizons U-0-1, U-0-2, U-0-3, U-0-4, U-I).

In 2019, the report "Recalculation of oil reserves at "X" field as of 02.01.2019" was prepared. Initial geological and recoverable oil reserves are approved according to the GKZ RK classification in the following quantities and categories:

- B: 929 thousand t of geological, including recoverable – 346 thousand t;
- C1: 2064 thousand t of geological, including recoverable – 741 thousand t;
- C2: 316 thousand t of geological, including recoverable – 92 thousand t.

As of 2 January 2019, total oil production at the "X" field amounted to 315 thousand t.

For "X" field, as of 02.01.2019, the remaining recoverable oil reserves calculated according to the GKZ RK classification are as follows:

- B+C1 categories: 2678 thousand t;
- C2 category: 92 thousand t.

In terms of recoverable oil reserves, according to the GKZ RK classification, "X" field belongs to the category of small fields with reserves of up to 3 million t.

NATIONAL CLASSIFICATION SYSTEM FOR RESERVES OF FIELDS, PROSPECTIVE AND FORECAST OIL

RESOURCES AND NATURAL HYDROCARBON GAS

Classification of reserves of fields, prospective and forecast oil resources and natural hydrocarbon gas of the Republic of Kazakhstan (GKZ RK classification) is considered.

DESCRIPTION AND DETAILS OF THE NATIONAL CLASSIFICATION AND MANAGEMENT SYSTEM

The GKZ RK classification establishes uniform requirements for the classification of reserves and resources of oil, natural hydrocarbon gas (free gas, gas caps and gas dissolved in oil) and condensate, their state accounting in the bowels by the degree of study and development. Basic concepts of reserves categories and resource categories are used in the GKZ RK classification.

Oil, gas and condensate resources are divided into prospective (category C3) and forecast (categories D0, D1 and D2) according to their degree of substantiation and timeliness.

The resources are predictable:

- Category D2 – predicted resources of lithology-stratigraphic complexes, estimated within large regional structures, the industrial oil and gas bearing capacity of which has not been proved yet.
- Category D1 – Projected resources of lithology-stratigraphic complexes, estimated within large regional structures with proven industrial oil and gas bearing capacity.
- Category D0 – Estimate of inferred resources at identified local sites within the region with D1 resources and used to plan geophysical surveys to identify and prepare structures for exploratory drilling.
- Resources are promising:
- Category C3 – prospective resources estimated on structures and areas prepared for deep exploratory drilling within the oil and gas bearing area. Prospective resources are used when planning prospecting works.

Stock categories (reserves of oil, gas, condensate and associated components are divided into proven categories A, B, C1 and preliminary estimated (undiscovered) categories C2. Proven reserves include those under development (categories A and B) and those explored (category C1)):

- Category A – reserves are calculated on the basis of the deposit (or part of it) drilled in accordance with the approved field development project and serve as a basis for optimizing the system and process of oil, gas and condensate reserves development.
- Category B – reserves are calculated on the basis of the deposit (or its part) drilled in accordance with the approved technological scheme of field development and serve as the basis for the development project.

- Category C1 – reserves of a deposit (its part), the oil and gas content of which is determined on the basis of commercial oil, gas and condensate inflows received in wells and positive results of geological and geophysical studies in untested wells.5
- Category C2 – reserves of the deposit (its part), the presence of which is justified by the data of geological and geophysical studies.6

COMPARISON OF THE GKZ RK CLASSIFICATION FOR OIL AND GAS RESOURCES WITH UNFC

The classification of field reserves, prospective and inferred oil and natural gas resources reflects the results of a step-by-step geological study of the subsoil.

The subsoil study stages are carried out through the implementation of relevant projects. Each project has objectives, timelines, quality requirements and specific risk levels

The presented scheme (Figure 28) highlights 4 main stages of subsoil studies, while each stage of the subsoil study has a specific resource and reserve estimate by category: regional, a search stage, exploratory, and industrial development.

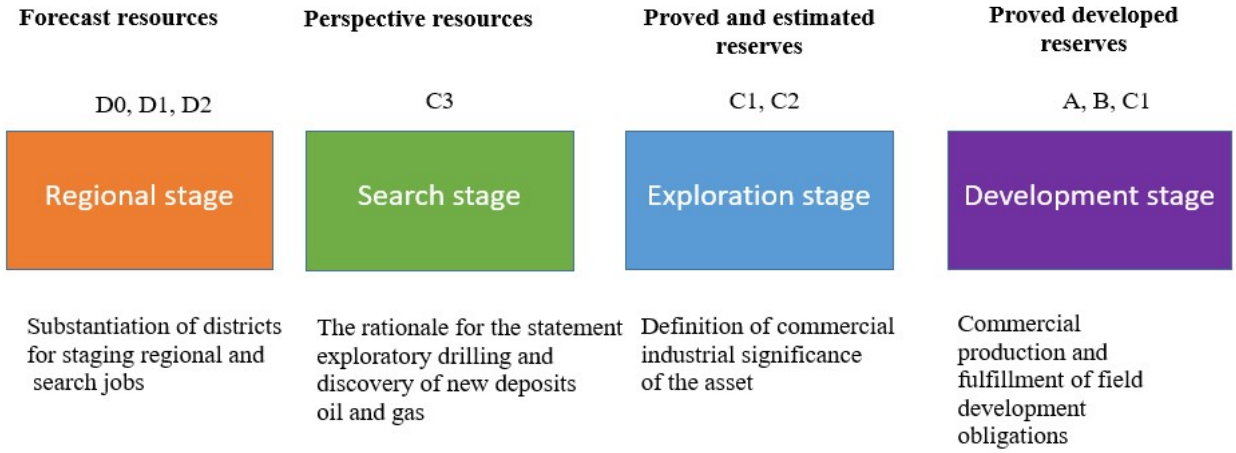

Figure 28. The phased study of asset based on project management

Similar principles of step-by-step subsoil study and project management are laid down in the UNFC. For example, from the G4 category, where only estimated quantities of a potential field are determined through the G3 category, where the quantities are already discovered, but determined with a low degree of certainty and through the G2 category, where the quantities are determined with a medium degree of certainty reach the G1 category, where the quantities at the known field are determined with a high degree of certainty. At the same time, with a certain degree of conditionality it is possible to compare the categories of geological study under the UNFC with the GKZ RK classification so, for example, G4 is comparable with the category of resources D0, C3, category G3 – with the estimated category of reserves C2, category G2 – with the categories of reserves C1 and C2, category G1 – with the categories of reserves A, B.

It is also tentatively possible to compare the criteria of the status and feasibility of the field development project under the UNFC with the stage-by-stage subsoil study projects in Kazakhstan. F4 category under the UNFC is comparable to regional stage projects, F3 category under the UNFC is comparable to exploration stage projects, F2 category under the UNFC is comparable to exploration stage projects, F1 category under the UNFC is comparable to the projects of the field development stage.

The study of a specific field under the G1 category and the economic feasibility of production and sales under the E1 category under the UNFC is achieved by phased implementation of projects from F4 to F1 category.

[5] Category C1 reserves are calculated on the basis of the results of geological exploration and production drilling and should be studied to the extent that they provide the initial data for the development of the technological scheme of the field. Category C1 reserves can be allocated to new areas based on drilling and testing of single wells, provided that commercial oil and gas inflows are received.

[6] Category C2 reserves are calculated in unexplored parts of the deposit adjacent to areas with higher categories of reserves. Category C2 reserves are used to determine the prospects for the field, to plan exploration work or geological and field studies and, in part, to design the development of a deposit.

BACKGROUND INFORMATION ON THE "X" FIELD PROJECT

PREVIOUS WORK

In 2009, field seismic works were carried out in the Contract area with a total area of 90 km2 of 3D seismic data.

Since 2011, exploration work has been carried out on the basis of the "Prospecting Works Project". In 2011, additional 3D seismic work was carried out in Area X with an area of 175 km2, and the materials obtained were interpreted and structural maps of the main reflective horizons were constructed. Additionally, the processing of 2009 seismic data was reworked. In 2012, wells 3 and 5 were drilled in accordance with the exploration project.

Field "X" was discovered in 2012 by obtaining oil inflow in well 3 during testing of the interval 1885-1891 m (horizon – U-I). The oil flow rate was 26.5 m^3/day at a 7 mm connection.

In 2013, based on the results of the work performed, the "Operational calculation of oil reserves and dissolved gas reserves at the "X" field" as of 15.05.2013 was performed. In 2013, the "Trial Operation Project of "X" Field" was drawn up.

In 2014, the "Calculation of oil reserves, dissolved gas and associated components of "X" field" as of 01.07.2014 was performed. Inventories are calculated in the following quantities and categories:

- 742 thousand t of geological, including 279 thousand t extracted,
- S1, 2249 thousand t geological, including 808 thousand t extracted.
- C2, 315 thousand t geological, including 89 thousand t recoverable.

In 2014, the "Technological Scheme for Development of the "X" Field" was drawn up, providing for the drilling of 19 production wells from 2015 to 2018. In 2016, the "Author's supervision over the implementation of the technological scheme of "X" field development" was performed. In 2017, based on the results of production drilling, the company increased and clarified the reserves of oil dissolved in oil, gas and associated components of the "X" field as of 05.01.2017.

CURRENT STATUS OF THE PROJECT, AND OUTLOOK

In 2018, the "Analysis of "X" field development" was performed with specified development indicators until 2021.

As of 02.01.2019, 28 wells were drilled in total at the "X" field, of which 22 wells were drilled in the operating well stock, 5 wells were inactive, and 1 well was under development (under injection). Wellbores of the operating fund work in fountain and mechanized ways. Flowing wells at the field 2 are operated by mechanized method with 20 wells, including 15 wells with sucker rod pumps, 4 wells with electric submersible pumps and 1 well operated by means of a compressor gaslift.

SOCIO-ECONOMIC AND SOCIO-ENVIRONMENTAL ASPECTS OF THE PROJECT

ECONOMIC ASPECTS

As part of this assessment, the economic efficiency of the proposed 3 development options was conducted not only to assess the economic performance of the contractor as an investor, but also the share of the Republic of Kazakhstan in the form of taxes and contributions to staff training and social development.

This project has created an economic model that takes into account the following points: gross revenue (oil sales); accounting for all refundable and non-refundable mandatory payments; tax; the subsoil user's cash flow; cash flow of the Republic of Kazakhstan.

To make a decision on the efficiency of economic indicators of development options, integral indicators such as cash flow, NPV with a discount rate of 10% were calculated. These figures were calculated on the basis of net cash flows. Comparison of technical and economic indicators of 3 options of development is given in Table 8.

Table 8 – Economic indicators of field development (thousand US dollars)

Indicator	Option 1	Option 2	Option 3
Net sales revenue	165,100	264,644	253,872
Capital expenditures	0	3,416	20,581
Operating expenses	34,304	59,391	53,452
Taxes and payments to the budget	64,146	103,476	98,391
Income tax	11,407	17,749	14,366
Excess profits tax	0	0	0
Accumulated cash flow	55,244	80,612	67,082
Contractor's NPV (10%)	35,084	48,824	41,454
Revenue of the Republic of Kazakhstan	75,553	121,224	112,757
Life of the enterprise, by year	2038	2040	2035

As can be seen, the implementation of the project under the recommended option 2 will bring the Republic of Kazakhstan about 121.2 million US dollars. The Advisory Committee recommends that the General Assembly approve the establishment of an additional amount of 100,000 US dollars in budgetary revenue in the form of taxes and contractual obligations.

SOCIAL ASPECTS

To understand the significance of the above figure, it can be compared with the data of the Civil Budget of the city of Kyzylorda (hereinafter referred to as the Budget) for 2017-2019 on social projects (Figure 29).

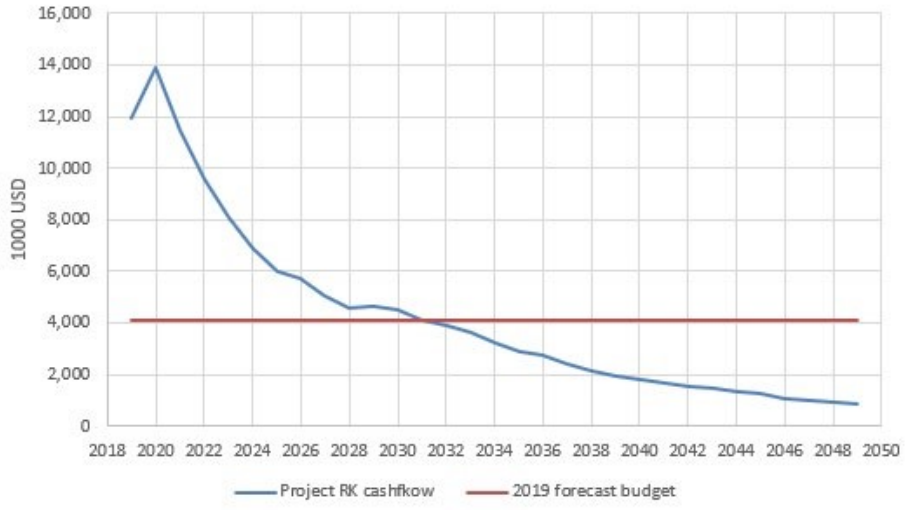

Figure 29. Comparison of the Republic's cash flow from social needs

In general, according to the Budget, for 2019, the projected allocations for the social sphere of the city of Kyzylorda should be about 1.58 billion tenge or approximately 4.1 million US dollars. If to result on years of receipt of the Republic of Kazakhstan from the present project and to compare these receipts with the sum (4.1 million US dollars) allocated for 2019 only on social sphere it is visible that only from realization of the present project the Republic of Kazakhstan can "close" requirements on social sphere of the city of Kyzylorda till 2031.

On the subsoil-user level, the company "X" is engaged in the search, exploration, development of oil and gas fields and oil production, with the further sale of commercial oil in the domestic and foreign raw material markets. Company "X" is not a city-forming enterprise.

The number of employees starting from 2017 is presented in Table 9.

Table 9 – Payroll fund

Indicator	Unit	2017	2018	2019
Employees	people	209	232	233
Payroll	thousand US dollars	2,236	2,851	2,863
Average salary per employee	US dollars	891	1024	1023

As can be seen, as a whole, "X" employs 233 people as of 2019, with an average salary of 1,000 US dollars, which is on average 3 times higher than the average salary in the area. In general, over the past 4 years, social commitments have been total as shown in Table 10 below.

Table 10 – Social obligations of "X" Company

Indicator	Unit	2016	2017	2018	2019 plan
Training of specialists	thousand US dollars	22,167	132,331	112,183	174,384
Social development of the region	thousand US dollars	2,248,472	1,123,034	1,597,255	497,261

ENVIRONMENTAL ASPECTS

As part of the development of the Technological Scheme for field development, a preliminary environmental impact assessment was developed.

The area of the planned activity is confined to the sensitive zone of anthropogenic impact in which minor changes as a result of economic activity may cause undesirable changes in individual components of the environment. In order to prevent negative impact on the environmental components it is necessary to carefully observe environmental protection measures.

In this regard, the project included technologies and technical solutions that would have had the least impact on the environment. The main components of the environment affected are the air basin, water areas, subsoil, flora and fauna of the area, and the social environment (Figure 30).

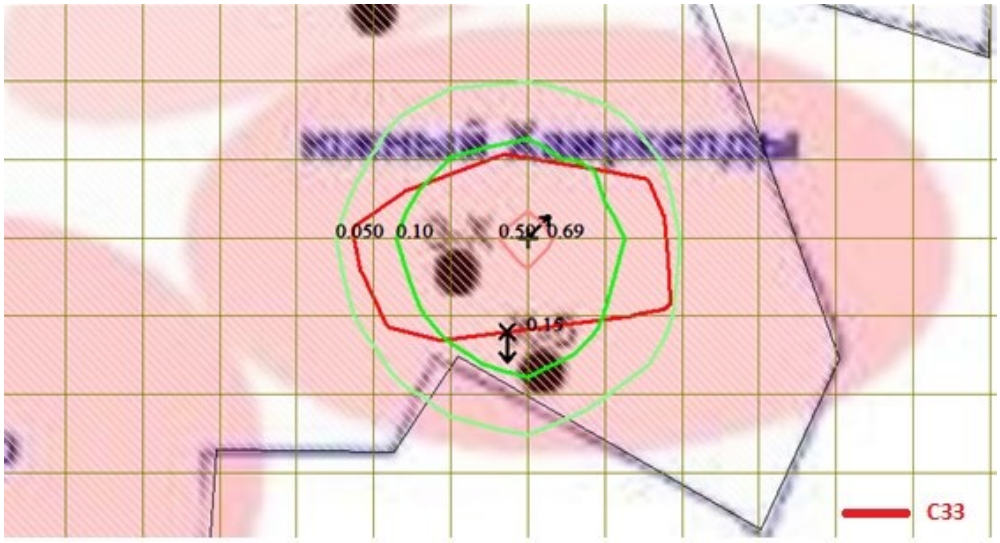

Figure 30. Calculation of the dispersion of the concentration of pollutants in the field

On the basis of the analysis of the current situation, the adopted design decisions and their predicted consequences the maps of calculation of dispersion of pollutants in the surface layer of the atmosphere were additionally modeled. Emissions of pollutants do not exceed maximum permissible concentrations (MPCs) (Table 11). Thus, the analysis of the component and integral impact on the environment allows us to conclude that the implementation of the project, subject to compliance with the design technological solutions will not have a significant negative impact on the environment. At the same time, the implementation of the project will have a significant positive impact on the socio-economic sphere and will lead to an improvement in the standard of living of a significant group of people. The planned implementation of the project is desirable from the socio-economic point of view and is possible without consequences from the point of view of the environmental situation development.

Table 11 – MPC table for "X" field project

Code	MPC maximum once, mg/ m^3	MPC maximum per day, mg/m^3	Safe exposure level, mg/ m^3	Hazard Class	Substances taking into account cleaning, g/s	MPC maximum once, mg/ m^3
0123	Iron (II, III) oxides (diGeleSo trioxide, Iron oxide) /Iron equivalent/ (274)		0.04		3	0.02
0143	Manganese and its compounds /in terms of manganese (IV) oxide/ (327)	0.01	0.001		2	0.002
0304	Nitrogen (II) oxide (Nitrogen oxide) (6)	0.4	0.06		3	0.4
0328	Carbon (Soot, Black Carbon) (583)	0.15	0.05		3	0.35
0330	Sulphur dioxide (sulphur dioxide, sulphur dioxide, sulphur dioxide (IV) oxide) (516)	0.5	0.05		3	0.50
0337	Carbon oxide (Carbon monoxide, Carbon monoxide) (584)	5	3		4	4.76
0410	Methane (727*)			50		0.17
0415	Mixture of hydrocarbons limit C1C5 (1502*)			50		0.004
0416	Mixture of hydrocarbons limit C6C10 (1503*)			30		0.0004
0602	Benzene (64)	0.3	0.1		2	0.00001
0616	Dimethylbenzene (mixture of o-, m-, pisomers) (203)	0.2			3	0.000001
0621	Methylbenzene (349)	0.6			3	0.000002
0703	Benz/a/pyrene (3,4Benzpiren) (54)		0.000001		1	0.00001
1325	Formaldehyde (Methanal) (609)	0.05	0.01		2	0.04
2754	Alkanes C12-19 /C/ (Hydrocarbons limit C12-C19 (C); RPK-265P solvent) (10)	1			4	1.00
2902	Weighted particles (116)	0.5	0.15		3	0.02
2907	Inorganic dust containing silicon dioxide in %: more than 70 (Dynas) (493)	0.15	0.05		3	0.13

FIELD PROJECTS STATUS AND FEASIBILITY

TECHNOLOGICAL FEASIBILITY ASPECTS

The technical project of 2009 for field seismic works in 3D modification (90 km2) is related to prospecting projects to identify promising structures for oil and gas exploration. Based on the results of the seismic survey, promising structures for oil and gas exploration were identified, but area "X" was not covered by these studies.

DETAILED STUDIES CONDUCTED

Additional 3D seismic work was carried out under the prospecting project, covering an area of 175 km2. The obtained materials made it possible to identify and preliminarily delineate promising hydrocarbon deposits, to construct

structural maps of the reference reflective horizons and to determine the points of location of exploration wells to confirm the identified prospective structures.

Exploration wells 3 and 5 were drilled in 2012 under the above exploration project. Geophysical surveys were carried out in the wells drilled, and oil-saturated thicknesses, porosity and oilsaturated reservoirs were determined for each productive horizon. The properties of oil have been studied. The work on this project was carried out at the search stage.

On the basis of operational reserves calculation, the “Project of trial operation of “X” field” was drawn up, which provides for drilling of 7 new wells, including 4 production and 3 exploration wells. The total number of wells during the trial operation reached 9.

Based on the results of the trial operation of field “X”, the following tasks were solved:

- parameters of oil-saturated reservoirs in new wells were determined, and oil properties in formation and surface conditions were studied;
- the operating modes of productive deposits were studied, and the elastic energy potentials of the formation system were assessed;
- productive characteristics of deposits were studied according to the data of long-term well operation at different modes;
- the productivity of producing wells and the optimal underbalance on productive formations were specified;
- assessment of problems related to well operation and oil production.

In 2014, the “Calculation of oil reserves, dissolved gas and associated components of “X” field” as of 01.07.2014 was performed. The “Trial Production Project for “X” Field” is part of the exploration phase. In 2014, based on the results of reserves calculation, the “Technological scheme of “X” field development” was drawn up. Further, in 2016, the “Author’s supervision over the implementation of the technological scheme of “X” field development” was performed.

During the implementation of the technological scheme for the development of the “X” field, 19 producing wells were drilled, and the field development and preparation of oil quality for sales and distribution began. In 2017, based on the new data on 19 wells drilled and geological and field studies conducted, a report was prepared on “Growth and clarification of oil reserves, dissolved in oil gas and associated components of “X” field” as of 05.01.2017. The implementation of the Technological Scheme for the development of the “X” field belongs to the commercial development stage.

In 2018, the “Analysis of the development of “X” field” was completed, according to which the field is currently being developed.

In 2019, based on the results of the implementation of the recommendations of the project “Analysis of the development of “X” field”, the “Recalculation of oil reserves of field “X” as of 02.01.2019” was carried out, in which there was a change in the categories of reserves as a result of a more detailed study of the field. The project “Analysis of the development of “X” field” is a part of the Technological scheme of development, and also refers to the stage of commercial development.

LEVEL OF KNOWLEDGE / CONFIDENCE IN ESTIMATES

GEOLOGICAL AND TECHNICAL ASPECTS

As a result of the interpretation of MOGT 3D seismic data, both structural and non-structural objects have been identified in the contract area, and the provisions of tectonic disturbances and the contours of the foundations' protrusions have been clarified. Structural maps of all productive horizons were constructed based on the results of interpretation of seismic surveys and taking into account wells drilled at the “X” field.

A total of 28 wells were drilled at field “X”, where a full range of geophysical studies were carried out. Productive horizons were identified by correlation of well sections. All wells have oilsaturated thicknesses, porosity and oil-saturated coefficients. Water-oil contacts (WOC) in all oil reservoirs have been justified.

In total, 284.8 m of core sinking was achieved at the field, with a total linear flow of 260.2 m or 91.36% of sinking. A total of 166 core samples from nine wells were selected and analyzed along the section. Out of this amount, 150 samples of them were studied within the limits of productive deposits. The number of conditioned samples is 124.

Based on the results of petrophysical core studies, the following dependencies for chalk and Jurassic deposits were constructed:

- dependence of the porosity parameter on the porosity coefficient;
- saturation parameter dependence on water saturation coefficient;
- determination of the limit value of the porosity coefficient;
- dependence of permeability coefficient on porosity coefficient;
- dependence of volume density on porosity coefficient;
- dependence of permeability coefficient on volume clayiness;
- dependence of porosity coefficient on volume clayiness;
- dependence of permeability coefficient on the total content of clayey and carbonate cement;
- dependence of porosity coefficient on the total content of clayey and carbonate cement;
- histogram of distribution of granulometric fractions.

All wells within the B and C1 categories are in operation. All of them have measured formation and bottom-hole pressures, studied different modes of operation. At field "X", the properties of oil in reservoir conditions were studied by 26 studies of deep samples from 14 wells. Properties of degassed oil are determined by 29 samples from 14 wells.

The component composition of oil in all productive horizons is highly paraffinic, low-tar and lowsulfur. The density of formation oil changes 701 -720g/ m^3, gas content 98-123 m^3/t, volume factor 1,244-1,31 d.unit, viscosity 0,66-0,8 mPa*s.

ESTIMATES OF QUANTITY AND VOLUME, AND CONFIDENCE IN GRADES

The boundaries of productivity areas for each horizon are:

- the contours of the adopted provisions of WOC. SOCs were adopted based on well testing data consistent with the results of the GIS interpretation;
- boundaries;
- correlation;
- petrophysics.

Logs parameters were determined in Interactive Petrophysics software package. The selection of collectors was carried out at a qualitative level and linked by reasonable boundary values. Productivity areas, reservoir volumes, pore volumes and saturated reservoir volumes within the limits of the accepted productivity circuits and categories were determined in a 3D model in the Petrel software according to the existing guidelines for calculating reserves (Figures 31, 32).

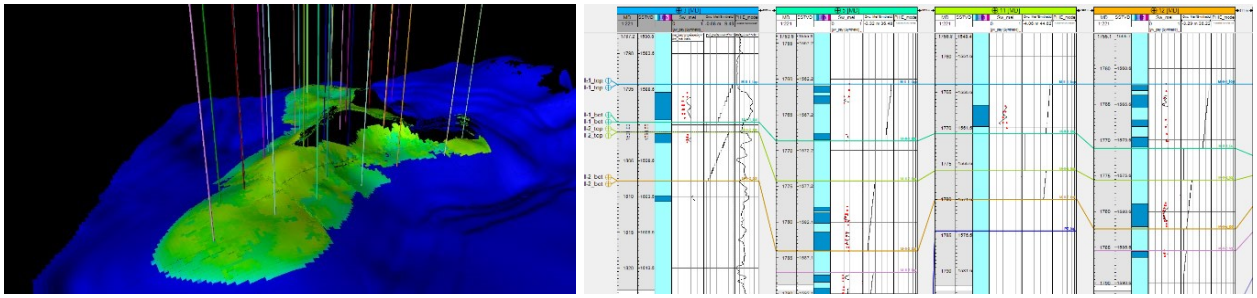

Figure 31. Model grid (left) and cross section of well section (right)

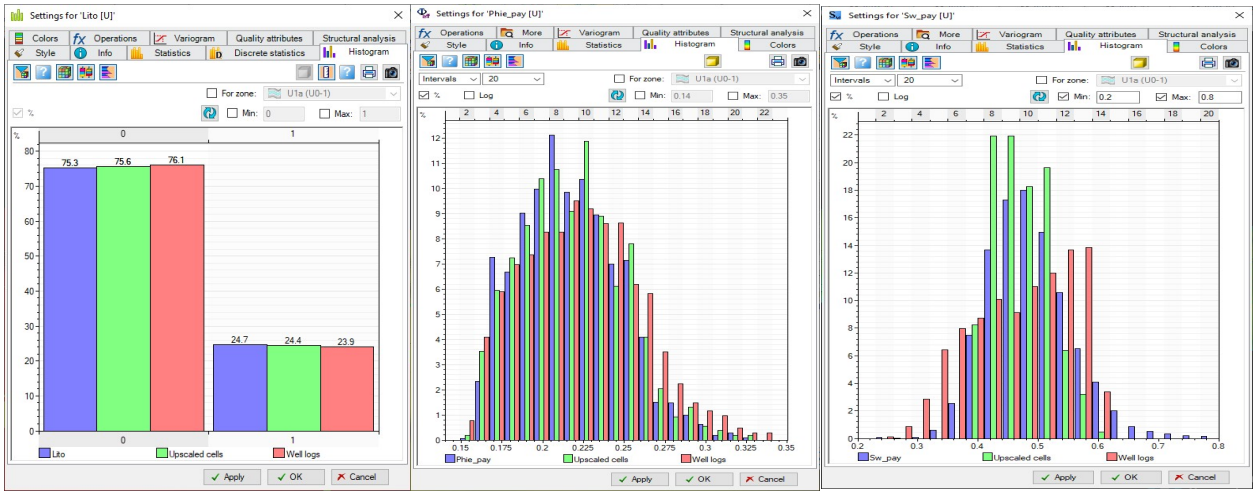

Figure 32. Comparison of input parameter distributions (fraction of collector, porosity, water saturation) based on modeling results and initial data

On the basis of laboratory studies of oil samples, a fluid model was constructed from which, according to field conditions of separation, oil density, conversion factor and gas content were determined. The main oil properties of the field based on the modeling results are shown in Figure 33.

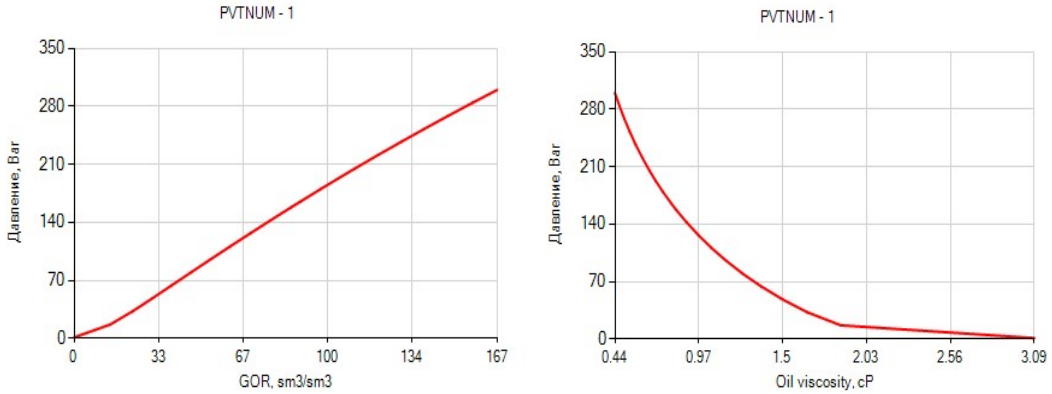

Figure 33. Dependence of gas content and viscosity of formation oil on pressure

According to the results of SCAL, the phase permeability curves were constructed, and the water displacement coefficient of oil was derived (Figure 32).

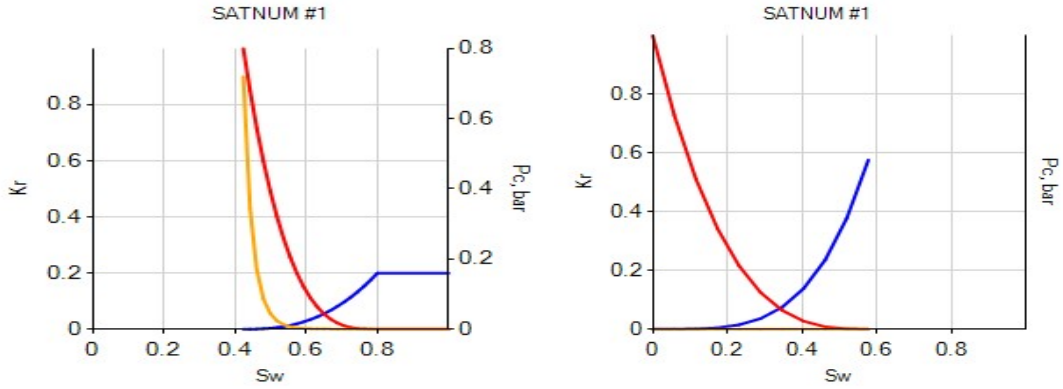

Figure 34. Phase permeability of oil-water by the result of modelling

Based on the results of interpretation of the total volume of geological and field data, two hydrodynamic models for each development object were built in the t-Navigator software package. Table 12 shows the main parameters of the models, illustrated in Figures 35 and 36.

Table 12 – Model parameters

Indicator	Object 1	Object 2
Measuring system	METRIC	METRIC
Griddle type	Single	Single
Free phases in the model	GAS&OIL&WATER	GAS&OIL&WATER
The water horizon	Aqufer	Aqufer
Start date of calculation	1.01.2012	1.01.2012
Platform	tNavigator	tNavigator
Dimension, I	202	202
Dimension, J.	250	250
Dimension, K	17	48
Number of active cells	198 610	415 635
Number of equilibrium regions	4	6
Number of filtration regions	3	5
Number of PVT regions	4	6
Number of reported regions	7	6

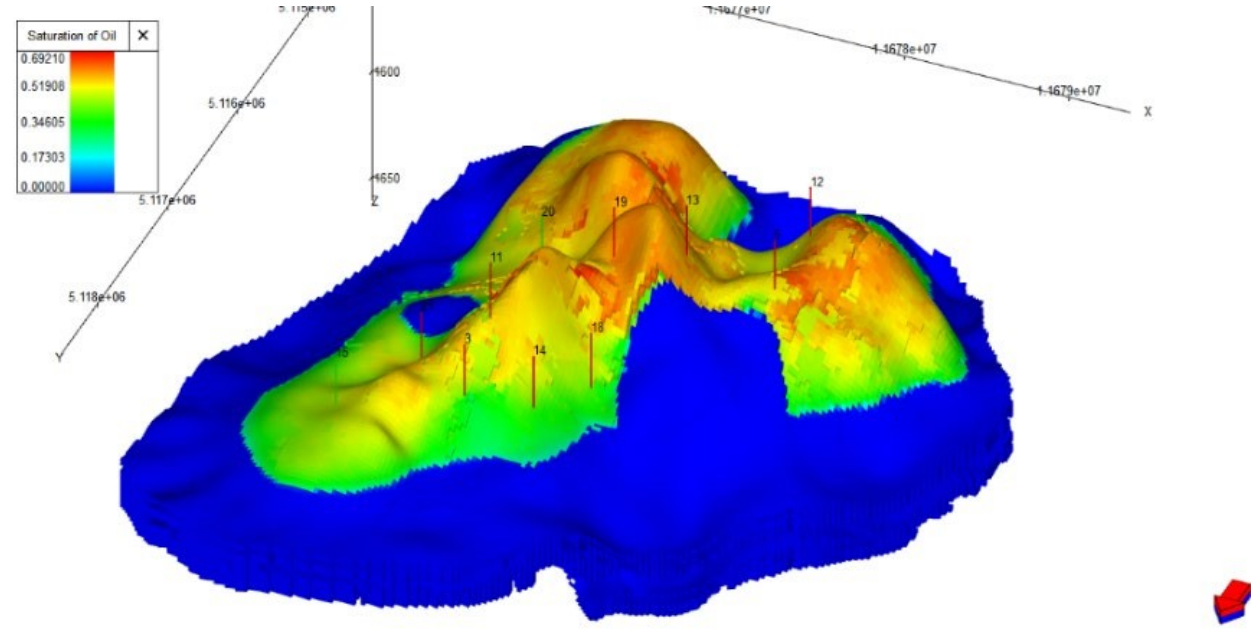

Figure 35. Dynamic grid model of Object 1

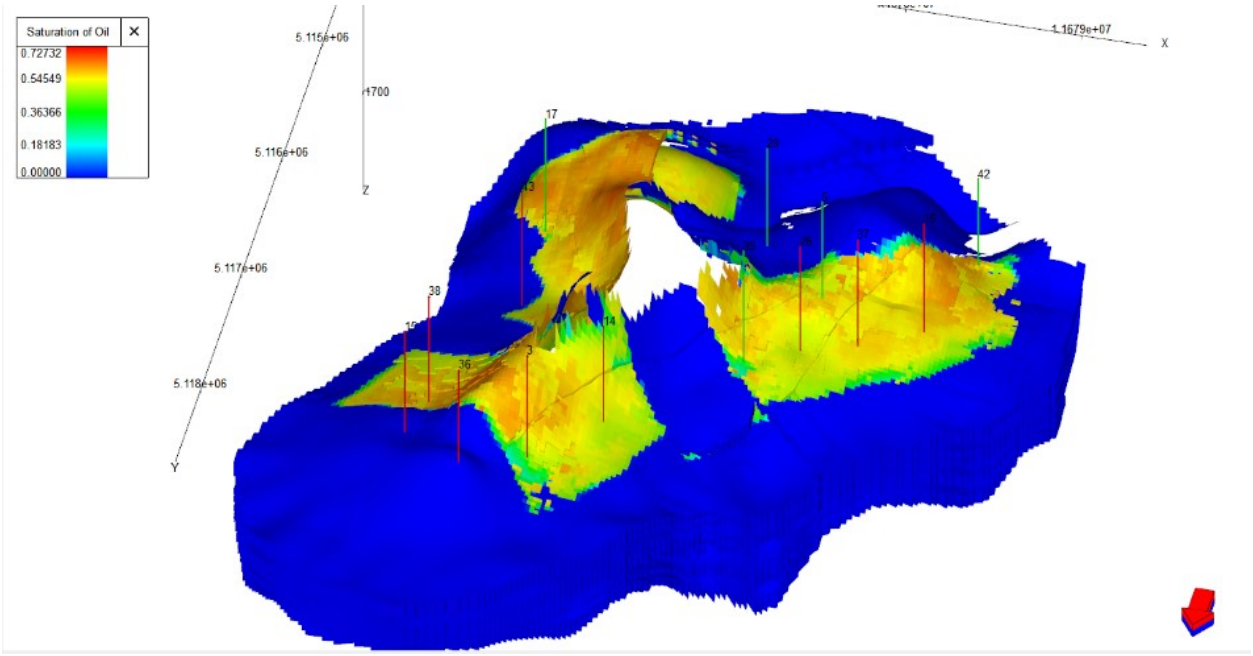

Figure 36. Dynamic grid model of Object 2

Adaptation was carried out for each horizon both at the development site and at the wells. Adaptations for oil sampling in general at the facility are shown in Figures 37-42 and 43. It should be noted that the constant pressure in Regions 5 and 6 is a category of C2 reserves that needs to be further explored before commercial development.

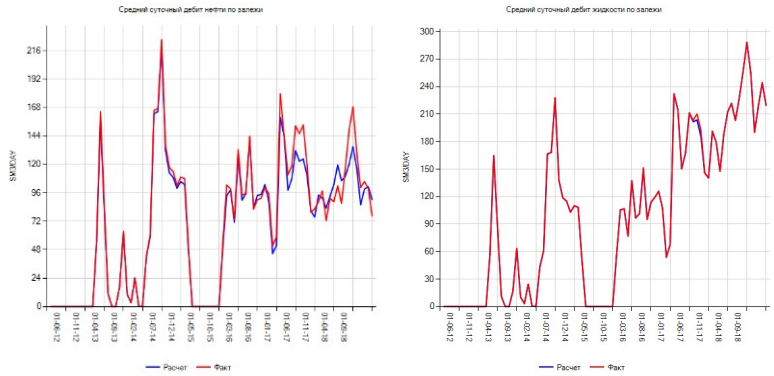

Figure 37. Adaptation of oil and liquid rates by Object 1

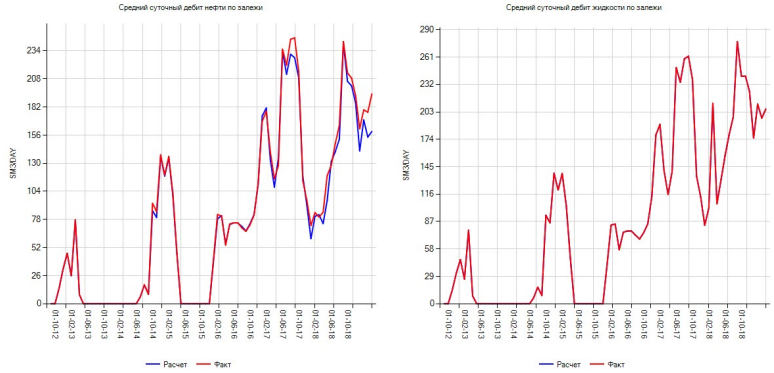

Figure 38. Adaptation of oil and liquid rates by Object 2

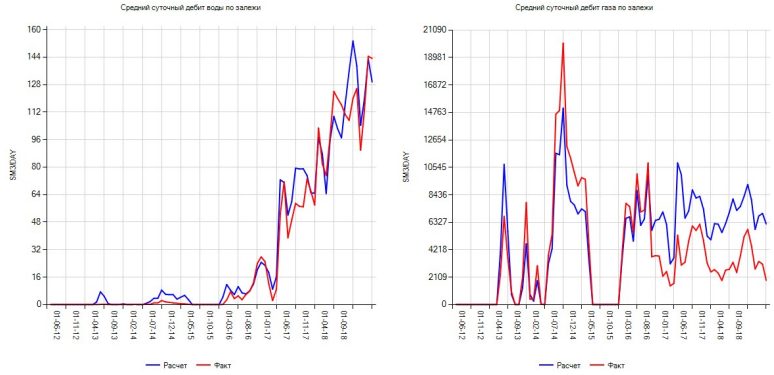

Figure 39. Adaptation of water rates and GOR of Object 1

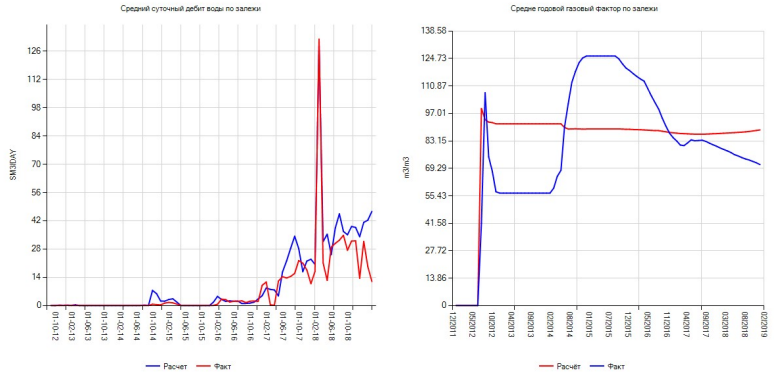

Figure 40. Adaptation of water rates and GOR of Object 2

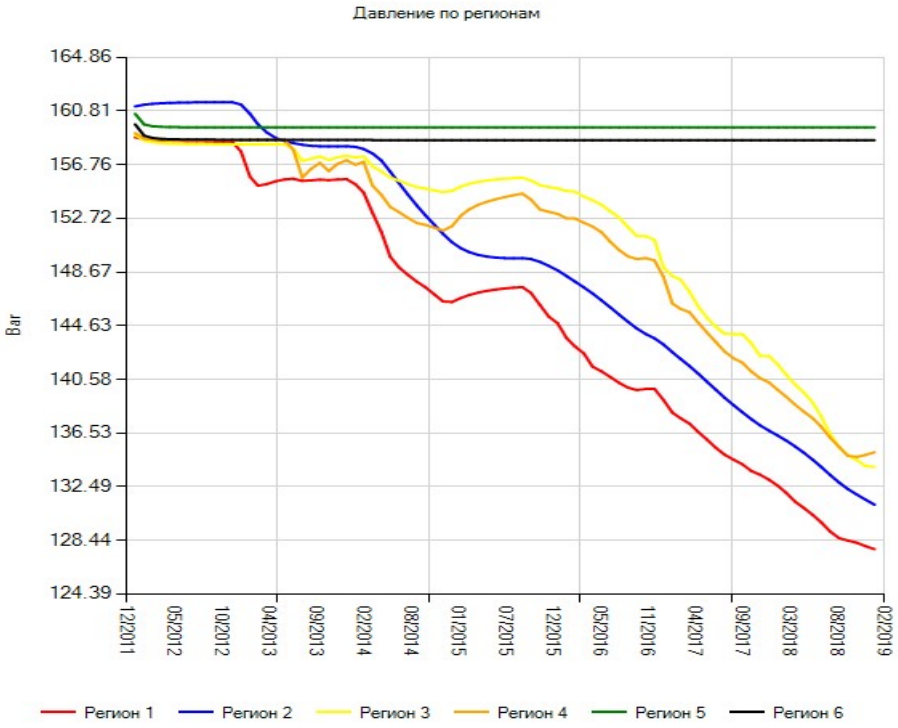

Figure 41. The reservoir pressure dynamics along the horizons of Object 1

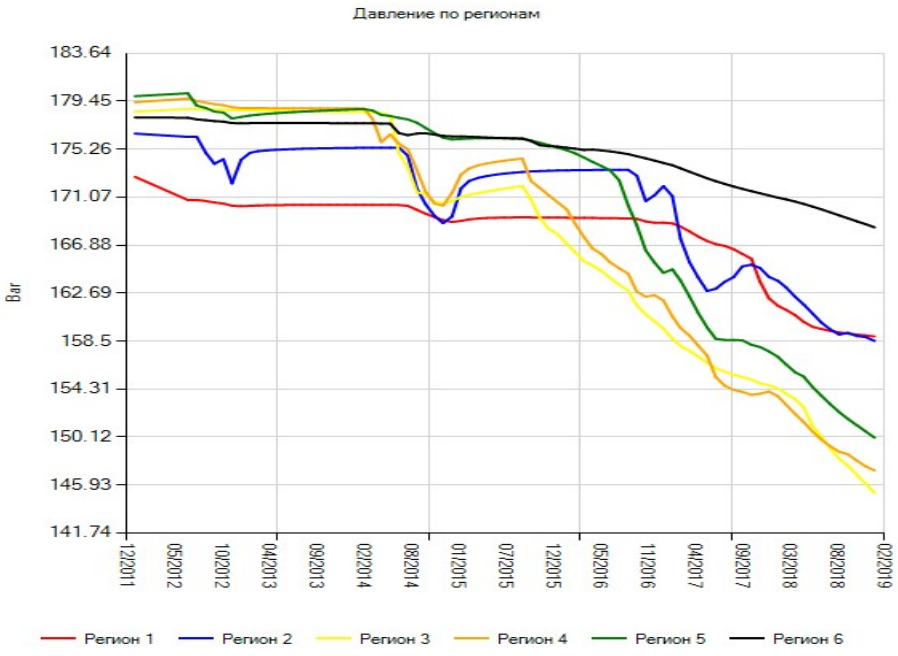

Figure 42. The reservoir pressure dynamics along the horizons of Object 2

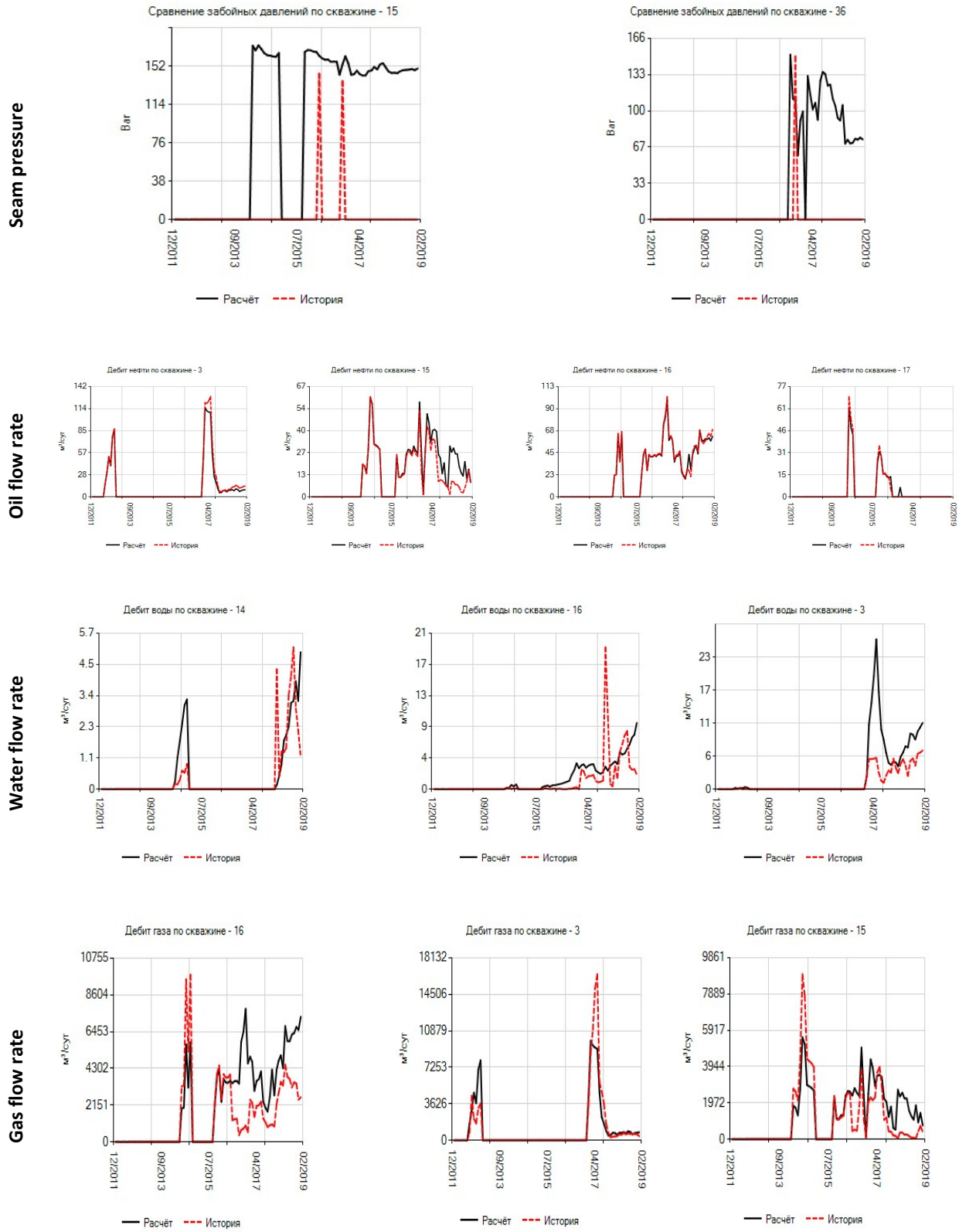

Figure 43. Seam pressure and oil, water and gas flow rates of wells

In general, the obtained model satisfactorily reproduces the historical data on fluid sampling and reservoir pressure dynamics not only for the objects of development in general, but also for wells.

On the basis of the obtained adaptation of calculations for the period of history, 3 variants of further development were calculated and the most efficient project from the point of view of economy was chosen. The following Table 13 summarizes the main technical and economic indicators of field development options.

Table 13. Technical and economic indicators of field development

Technological indicators	Option 1	Option 2	Option 3
Accumulated oil production since the beginning of development, thousand t	816	1,111	1,106
Crude oil recovery factor (CEP), %.	27.3	37.1	37.0
Oil gas production since the beginning of development, million m^3	106	134	137
Dissolved gas recovery factor (DGR), %.			
Accumulated water injection, thousand t	8,994	28,943	20,003
Accumulated compensation of withdrawals, %	45	65	78
Drilling of production wells, total	0	4	24
Transfers of wells between facilities, total	0	7	6
Integral economic indicators.	Option 1	Option 2	Option 3
Last profitable year	2038	2040	2035
Net sales revenue, thousand US dollars	165,100	264,644	253,872
Capital expenditures, thousand US dollars	0	3,416	20,581
Operating expenses, thousand US dollars	34,304	59,391	53,452
Taxes and payments to the budget, thousand US dollars	64,146	103,476	98,391
Income tax, thousand US dollars	11,407	17,749	14,366
Excess profits tax, thousand US dollars	0	0	0
Accumulated cash flow, thousand US dollars	55,244	80,612	67,082
Contractor's NPO (10%), thousand US dollars	35,084	48,824	41,454
NRR, %.	n/a	n/a	n/a
Payback period, year	2019	2019	2019

In terms of technical and economic evaluation, Option 2 is the most advantageous option for both the Contractor and the Republic.

According to the indicators of Option 2 of the development and as of the date of 02.01.2019 studies, the oil reserves of field X are approved in the following quantities and categories:

- B - 929 thousand t of geological, including recoverable 346 thousand t;
- C1 - 2064 thousand t of geological, including recoverable 741 thousand t; - B+C1 - 2993 thousand t are geological, including 1,087 thousand t recoverable; - C2 - 315 thousand t of geological, including 92 thousand t extracted.

CLASSIFICATION OF THE "X" FIELD PROJECT USING UNFC

REVIEW OF SOCIO-ECONOMIC INFORMATION INCLUDING SOCIAL AND ENVIRONMENTAL (E-AXIS)

The results of the prospecting phase of the 3D Modification Field Seismic Design (90 km2) and the Adjacent Exploration Project have not been able to determine the economic viability of oil extraction due to lack of information.

Therefore, the economic feasibility of oil production and sales at the exploration stage can be classified under the UNFC-2009 subcategory E3.2.

Aims, objectives and scope of work performed under the Trial Field Development Project are given in Section 4, paragraph 4.3 of this report. The results of the trial operation of field "X" allowed us to assume profitable production and sales of oil in the foreseeable future.

The economic viability of oil production and sales under the Trial Operation Project can be classified under UNFC-2009 under category E.2.

Commercial production of oil at field "X" is carried out on the basis of 2 projects "Technological scheme of "X" field development" and "Analysis of field "X" development". The scope of work performed, and the results obtained are presented in sections of this report.

As of 02.01.2019, the economic feasibility of oil production and sales during the period of commercial development can be classified under the UNFC-2009 into categories and subcategories E1.1 and E2.

REVIEW OF PROJECT FEASIBILITY INFORMATION (F-AXIS)

The works carried out in 2009-2010 under the Technical design for field seismic surveys in 3D modification (90 km^2) at the search stage under the UNFC-2009 in terms of project feasibility (F-axis) belong to the F3 category. In order to confirm the presence of a deposit (or deposits) on the identified prospective structures it was necessary to conduct additional research and prospecting and exploration work.

As noted, the Exploration Project has resulted in the discovery of the "X" field. Additional 3D seismic work (175 km2) has been carried out, exploration wells 3 and 5 have been drilled, and the first oil spouting flow has been obtained. Following the implementation of the Prospecting Works Project, the field has not been further explored and additional studies were required to justify commercial production and therefore, under the UNFC-2009, the feasibility of the project (F-axis) corresponds to the F2.2 subcategory.

The Trial Production Project of "X" Field was completed in 2013-2014. Field "X" was at the exploration stage in terms of its degree of exploration. The purpose of the Trial Operation was to evaluate the discovered oil deposits, prepare them for commercial development and further exploration of promising areas. The tasks set out in the Trial Operation Project have been implemented. The necessary amount of information was obtained, which allowed to conduct the first reserves calculation with a feasibility study of oil recovery coefficients (FS EOR). Calculations of the Feasibility Study of the IEP have confirmed the necessity of drawing up the Technological scheme of development and implementation of the project in the foreseeable future.

Based on the above, according to the UNFC-2009 classification, the feasibility of the project (Faxis) corresponds to subcategory F2.1.

As of 02.01.2019, the majority of the field area was drilled by production wells, and commercial oil production was in progress in accordance with the approved project documents (industrial development stages are described above). In view of the above, the feasibility of the UNFC-2009 project should be classified under subcategories F1.1 and F1.2.

REVIEW OF GEOLOGICAL KNOWLEDGE / CONFIDENCE IN ESTIMATES (G-AXIS)

The 3D (90 km2) field seismic surveys in 2009 revealed promising structures. The estimation of the resources of the structures as potential deposits was based on indirect data. Such data, which is largely similar to that of the region, is characterized by a significant range of uncertainty and risk of non-confirmation. Therefore, according to UNFC-2009, geological exploration and confidence in estimates (G-axis) corresponds to G4 category.

Additional 3D seismic work and drilling of wells under the 2011 Prospecting Project resulted in the discovery of field X. Types and volumes of work are provided in the report.

In 2013, oil reserves in industrial category C1 amounted to 1272 thousand t of geological and 383 thousand t of recoverable oil and estimated category C2 reserves of 3870 thousand t of geological and 1161 thousand t of recoverable oil.

The operational calculation of reserves performed without a feasibility study of the oil recovery factor allows to classify the geological study and confidence in the estimates as G3 under the UNFC-2009, as the recoverable quantities are estimated with a low degree of reliability.

The purpose of the trial operation is to clarify the initial geological and field data for calculating reserves and drawing up the Technological Development Scheme. Tasks solved during trial operation are presented above. The reserves estimation report based on the results of trial operation became the basis for drawing up the Technological scheme of "X" field development.

In 2014, oil reserves in industrial category C1 amounted to 3460 thousand t of geological and 1257 thousand t of recoverable oil and in appraisal category C2 – 1508 thousand t of geological and 404 thousand t of recoverable oil.

The results of the Trial Operation Project allow to classify the geological study and confidence in the estimates under the UNFC-2009 as G2.

Commencement of commercial development of the field made it possible to conduct additional research on newly drilled wells and to deepen the study of oil deposits. The scope of work on the Technological Scheme of development is described earlier in the report.

In 2019, recalculation of oil reserves at X field as of 02.01.2019 was performed, where reserves and categories were clarified. As of 02.01.2019, oil reserves at the "X" field were, by category:

- B+C1 – 2993 thousand t of geological, including recoverable – 1087 thousand t;
- C2 – 316 thousand t of geological, including recoverable – 92 thousand t.

As of 02.01.2019, the geological exploration and confidence in the estimates under the UNFC2009 at field "X" can be attributed to the G1+2 categories.

CLASSIFICATION OF THE PROJECT USING UNFC SCHEME

Based on the above review of project, against the three axes of the UNFC-2009 oil reserves at "X" field (as of 02.01.2019) can be classified as follows: E1.1, E2, F1.1, F1.2, G1+2.

The oil reserves of industrial categories B+C1 correspond to the categories and subcategories E1.1, F1.1, G1 according to UNFC-2009. Oil reserves of the estimated categories C2 correspond to the categories and subcategories E2, F1.2, G2 according to UNFC-2009.

ALIGNMENT TO SUSTAINABLE DEVELOPMENT GOALS IMPLEMENTATION

NATIONAL APPROACHES

The Sustainable Development Goals (SDGs) fully coincide with the priorities and objectives of Kazakhstan. For Kazakhstan, the implementation of the SDG methodology and indicators provides the opportunity for systematic adaptation of strategic planning and monitoring to world standards, taking into account the harmony of Kazakhstan's policy documents, primarily the "Strategy-2050" and the resulting industry programmes, to global development goals.

The mission of international experts from UNDP in order to quickly comprehensively assess

Kazakhstan's readiness for the implementation and monitoring of the SDGs, held in November 2016, revealed a rather high degree of inclusion of the SDG targets in national and sectoral plans - 61% of the SDG targets are already covered by national strategic documents.

Kazakhstan is part of the High-level Group for Partnership, Coordination and Capacity-building for the provision of statistics for the 2030 Agenda for Sustainable Development, composed of Member States, including regional and international UN agencies, as observers.

The first national technical meeting on SDG statistics was held in Kazakhstan with the participation of representatives of all government bodies, NGOs, research organizations, various trade unions and associations, national companies, UN agencies and international experts in various sectors. The main goal of the meeting was to assess the readiness of the national statistical system to produce global indicators for monitoring the SDGs, as well as to identify additional national indicators that would be relevant for Kazakhstan. A specially created interdepartmental Working Group on the implementation of indicators for monitoring the SDGs is developing a system of indicators that includes both global and national indicators, taking into account the priorities of Kazakhstan.

In general, the systematic implementation of the SDGs in Kazakhstan will undoubtedly give a positive multiplier effect, in particular: facilitating the process of becoming one of the 30 most competitive states in the world by achieving the indicators of the Organization for Economic Cooperation and Development (OECD) through the implementation of the SDGs, and; giving an additional impetus to processes such as enhancing human potential, attracting foreign technologies and experience, advanced training in the field of processing large data arrays (Big Data). Implementation of SDGs is becoming one of the factors of investment attractiveness for large international corporations, for which the model of socially responsible business and its relevance to the SDGs is an important component of their image.

INDUSTRY APPROACHES

The economy of Kazakhstan is heavily dependent on mining activities. Attracting private investment in subsoil use is one of the priority tasks in the extractive industries. The objective of economic growth can be solved by sustainable

development programmes. For example, Kazakhstan's subsoil users working in the fields of solid minerals, oil and gas pay to the oblast budget, in addition to tax payments, also targeted payments for arranging infrastructure, building and repairing schools and preschool institutions.

During the development of new oil and gas fields in the Kyzylorda region of Kazakhstan, thousands of new jobs were created. Many residents of the region working in oil and gas fields received special technical education at the expense of subsoil users. Subsurface user companies are constantly involved in projects that provide social support to the population.

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NATURAL RESOURCE MANAGEMENT IN KYRGYZSTAN

Kyrgyzstan is a landlocked, mountainous, lower-middle-income country with an economy dominated by minerals extraction, agriculture, and reliance on remittances from citizens working abroad (Figure 44). Cotton, wool, and meat are the main agricultural products, although only cotton is exported in any quantity. Other exports include gold, mercury, uranium, natural gas, and - in some years - electricity. The country has sought to attract foreign investment to expand its export base, including the construction of hydroelectric dams, but a difficult investment climate and an ongoing legal battle with a Canadian firm over the joint ownership structure of the nation's largest gold mine deter potential investors. Remittances from Kyrgyz migrant workers, predominantly in Russia and Kazakhstan, are equivalent to more than one-quarter of Kyrgyzstan's GDP.

Figure 44. Map of the Kyrgyz Republic

Following independence, Kyrgyzstan rapidly implemented market reforms, such as improving the regulatory system and instituting land reform. In 1998, Kyrgyzstan was the first Commonwealth of Independent States country to be accepted into the World Trade Organization. The government has privatized much of its own shares in public enterprises. Despite these reforms, the country suffered a severe drop in production in the early 1990s and has again faced slow growth in recent years as the global financial crisis, and declining oil prices have dampened economies across Central Asia. The Kyrgyz government remains dependent on foreign donor support to finance its annual budget deficit of approximately 3 to 5% of GDP.

Kyrgyz leaders expect the country's August 2015 accession to the Eurasian Economic Union (EAEU) will bolster trade and investment, but slowing economies in Russia and China and low commodity prices continue to hamper economic growth. Large-scale trade and investment pledged by Kyrgyz leaders have been slow to develop. Many Kyrgyz entrepreneurs and politicians complain that non-tariff measures imposed by other EAEU member states are hurting certain sectors of the Kyrgyz economy, such as meat and dairy production, in which they have a comparative advantage. Since acceding to the EAEU, Kyrgyzstan has continued harmonizing its laws and regulations to meet EAEU standards, though many local entrepreneurs believe this process as disjointed and incomplete. Kyrgyzstan's economic development continues to be hampered by corruption, lack of administrative transparency, lack of diversity in domestic industries, and difficulty attracting foreign aid and investment.

The Kyrgyz Republic is administratively divided into seven regions and two republic cities. The further subdivision is 40 areas and 12 regional cities. The lowest unit is 453 ail aymaks and 17 district cities. Fourteen settlements of different types have arisen near the mines.

Electricity is the most reliable infrastructure in Kyrgyzstan. In the country, there are 18 hydro-electro stations and two thermal ones. Kyrgyzstan is incorporated in an integrated power grid with Kazakhstan, Uzbekistan, Turkmenistan, Tajikistan. The republic exports 2.5 billiard kW of electric power.

The total length of railways in Kyrgyzstan is 422 km and consists of the route Osh - Kok-Yangak, the route Balykchi - Bishkek - Lugovoe (Kazakhstan). These routes connect with Russia through Kazakhstan and Uzbekistan. The civil-engineering project of the railway to China through the Torugart pass is being designed. Because of the mountain relief, the largest part of cargo carriage inside the country is realised by trucks. The total extent of roads is 18600 km. The part of roads of strategic significance (Bishkek - Osh) is modernised under international standards. Four civil-engineering designs of international highways are developed: Bishkek - Kazakhstan - China - Karachi, Bishkek – Uzbekistan - Turkmenistan - Iran (Bander Abbas), Bishkek - Kazakhstan - Ural and Osh - Khorog - Irkeshtam.

ROLE OF ENERGY AND MINERALS PRODUCTION IN NATIONAL ECONOMY

Kyrgyzstan has a long history of mining. There were 27 coal mines at the beginning of the 1900s in the south of the republic, which supplied the whole of Central Asia with coal. Besides coal, lead, silver, mercury and antimony were being mined.

The exploration for oil and gas was begun in the Kyrgyz part of Fergana valley since 1900. By 1913 the crude oil production reached 3000 tons. The oil fields and coal deposits were being developed predominantly with the participation of German, French, Belgian, English and American investors. About one thousand workers were taken up at coal mines and crude oil production. Approximately 50% of gross production and 60% of working places of all industry of Kyrgyzstan belonged to foreign enterprises.

During World War II, ten mining combinates were active in the territory of Kyrgyzstan. They developed lead, silver, antimony, zinc, mercury, gold, tungsten and arsenic. In the post-war time, four uranium mines were added to them, the commercial production of rare-earth metals, molybdenum, rhenium, gold, fluorspar has begun later.

Six lead-zinc, two tungsten, four uranium, four mercury, one rare-earth, two antimony and about ten coal deposits have been developed over the last 50 years on the territory of Kyrgyzstan. In the late 1980s, the enterprises of Kyrgyzstan were producing up to 100% of antimony, up to 64% of mercury, up to 30% of rare-earths, and up to 20% of the uranium in the USSR.

At the Soviet time, more than 50 thousand workers were occupied in the mining sector of Kyrgyzstan. At the current moment, the total number of workers in the mining industry is estimated to less 10,000.

To the moment of the USSR desintegration, in the republic were five mining-metallurgical plants: Makmal Gold-Mining Combinate, Kadamzhai Antimony Combinate, Khaidarkan Mercury Combinate, Kara-Balta Uranium Combinate and Aktuz Rare-Earth Mine. The Kadamzhai plant and Kara-Balta plant processed the tolling ore-sources. Aktuz and Khaidarkan, having difficulties in sale of products already at the Soviet time, had the budgetary subsidies and were in a high-gravity financial position under market conditions.

After the USSR, the mining sector of Kyrgyzstan, like other industries, has gone through a crisis. The changes in the forms of managing under the market conditions, losses of economic relations, absence of the niche in the world market were the reason for this crisis. Nevertheless, gold mining has been developed successfully.

All the products of the mining sector are being exported. The overall dynamics of the mining industry with the exception of gold is sharply declining after 1990 cause of subsequent destruction of economic relations between republics of the former USSR. The main resources mined at present on the territory of the republic are gold, antimony, mercury, tin, tungsten, which are being exported to China, Commonwealth of Independent State (CIS) countries and Europe. Hydrocarbon raw materials (oil, gas, coal), the construction raw materials and water resources are mainly consumed inside the country.

Coal mining, crude oil production and gas recovery cover 40% of the needs of the republic in energy. The import of fuel and energy resources is 30 % of the total import of the republic. For the last 30 years in the republic three big and five small refineries have been put into operation with total petroleum refining output up to 800,000 tons annually.

During the 1940s-1960s, there were seven coal mines and five open coal pits with annual output up to 3,5 million t in total. During the 1970s there were ten coal mines and two coal open pits. The maximal output was 3,7 million t, while in Kyrgyzstan the demand for coal is three million t. The republic held the fourth place on reserves up to 1,3 milliard tons and coal mining in the USSR, after Russia, Ukraine and Kazakhstan. Kyrgyzstan has limited resources of mineral oil and gas. The coal is the basic combustible.

The outlooks of deposits were sharply increased after the adoption of a decision about the building of the Kyrgyz part of the transcontinental railway Europe - China going near the Uzgen coal basin, and railway Balykchi – Kara-Keche – Djalal-Abad, connecting the south and the north of Kyrgyzstan. A number of Russian, Turkish, German and other companies are interested in hereinafter study and industrial development of coal deposits in Kyrgyzstan.

In the Fergana valley about ten million t of crude oil, 7,5 billion м3 of gas has been produced in total. More than 40% of mineral oil and 60% of recoverable gas reserves have been worked out.

By 1958 the crude oil production grew up to 490 thousand, and gas – up to 380 million m^3 annually. But since 1991 there was a decline in an output till 80 thousand t of mineral oil and 30 million м3 of gas in 2014, from 2014 till 2018 oil production increased till 200 thousand t/year of mineral oil. Production of gas remains the same. Domestic oil and gas production covers only 10% of the needs of the country.

The gas line connecting Kyrgyzstan through Kazakhstan with gas fields of Uzbekistan is used for deliveries of imported natural gas.

Since the 1980s the mining of nonmetallic minerals for production of construction materials was rather successfully developed, completely supplying the construction industry in the country. Now the industry of construction materials is presented by the operations producing cement, slates, asbestos-cement, brick, glass, porcelain, asphalt-concrete, ceramics, gypsum, facing stones, etc. Cement, bricks, basaltic casting, facing stones are supplied to neighbouring countries.

GOVERNMENT POLICIES AND PROGRAMMES IN ENERGY AND MINERAL RESOURCES

Kyrgyzstan has gained independence in 1991 as a result of the disintegration of the USSR and has accepted the parliament republican form of government that was proved on the few referendums. The Constitution of the Kyrgyz Republic proclaims the following principles: The Kyrgyz Republic is a sovereign, unitary, democratic republic constructed on the basis of the lawful secular state. The citizens of the Kyrgyz Republic elect the President, deputies of the Jogorku Kenesh (Parliament) and deputies of local authorities. A variety of forms of ownership and their equal legal protection are guaranteed.

The land can be state, municipal, private and other ownership. Foreigners can be land users for mineral resources with some exceptions due to environmental (forestry lands) and safety (border control) reasons. The state power in the Kyrgyz Republic is based on the following principles:

- The executive power is exercised by the President. He is elected by popular vote.
- Division of legislative, executive, judicial power, their agreed operation and interplay.

Under the Constitution, the state power in the Kyrgyz Republic is represented by the President, Jogorku Kenesh (Parliament), Government and local state administrations, Supreme Court, Regional Courts, District Courts and judges of the system of justice.

The President is the head of state, the highest official of the Kyrgyz Republic. The President determines directions of internal and external state policy, represents the Kyrgyz Republic at international relations, takes measures for the protection of the sovereignty and territorial integrity of the country, provides unity and continuity of state power, agreed operations and interplay of state organs, their responsibility before the people.

The supreme legislative power is vested in the Jogorku Kenesh (the Parliament of the Kyrgyz Republic). Jogorku Kenesh consists of two chambers. The following refers to the management of Jogorku Kenesh: introduction of modifications and amendments in the Constitution; Enactment of laws; Official interpretation of the Constitution and laws enacted by it; Change of borders of the Kyrgyz Republic; Approval of laws.

In the Kyrgyz Republic, the executive power is exercised by the Government and its subordinated ministries, state committees, administrative departments and local state administrations (Figure 45). The Government is headed by the Prime Minister who appointed by the President and approved by Jogorku Kenesh. The Government consists of the Prime Minister, First vice-prime minister, vice-prime-ministers, ministers, chairmen of state committees and directors of state agencies and services of the Kyrgyz Republic. The Prime Minister determines trends of activity of the Government, organizes its work and personally is answerable for its activity, annually introduces the report on Government activity into the Assembly of National Representatives.

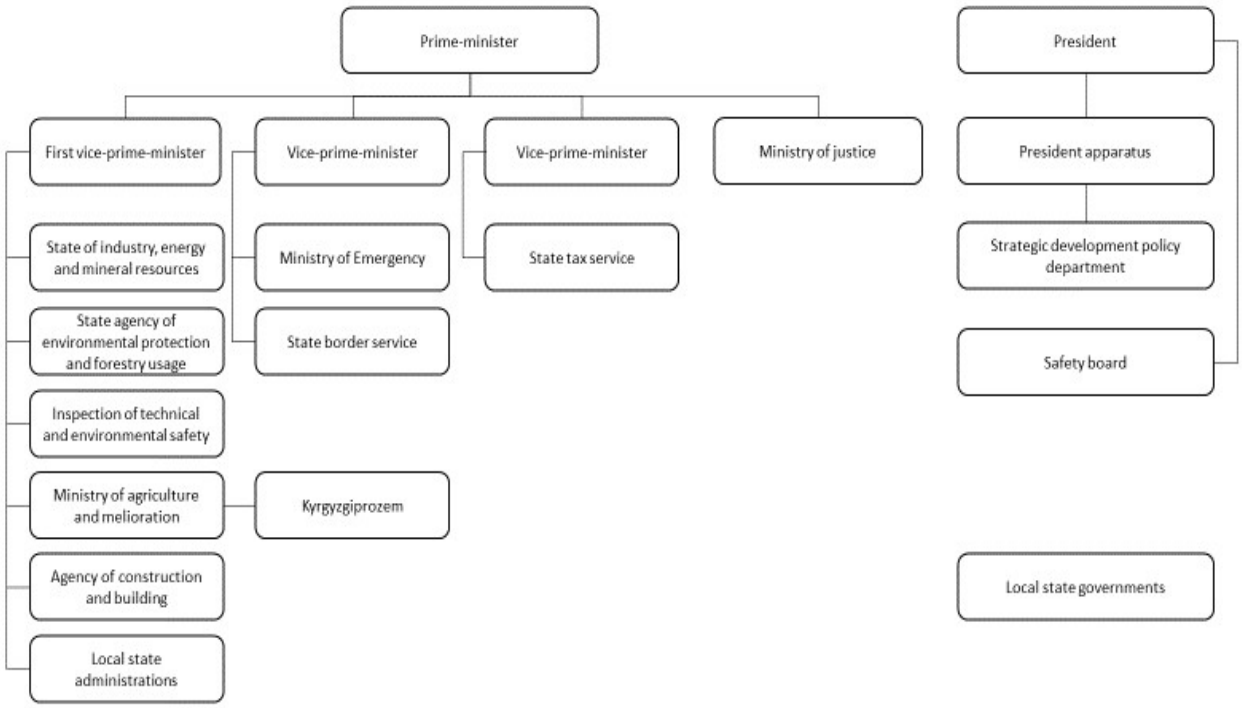

Figure 45. Structure of the state regulation of subsoil use

The Government of the Kyrgyz Republic supervises over activities of ministries, state committees, administrative departments and organs of local state administration. The executive authority in areas, regions and cities is exercised by local state administrations. Decrees of local state administrations adopted within the limits of its competency are obligatory for execution on the applicable territory. The supervision of exact and uniform execution of the legislative acts is exercised by the Prosecutor's Office of the Kyrgyz Republic.

Courts of the Kyrgyz Republic are the Supreme Court, Regional Courts (courts of areas, Bishkek and Osh city, regions and cities), District Courts and regional courts (courts-martial). A judge obeys only to the Constitution and the law. A judge has the right to inviolability and immunity, is provided according to his status with social, material and other guaranties of his independence. Judges are elected by the Parliament on presentation of the President.

The local self-management in the Kyrgyz Republic is exercised by local communities, which in accordance with the law and under their own responsibility, manage local affairs. The local management is exercised by local Keneshes and other organs formed by people itself. Local Keneshes approve and control the programmes of social and economic development of the territory and social protection of the population. Local Keneshes act irrespective of local state administration.

The Kyrgyz Republic has the diplomatic relations with 67 countries and is the member of the United Nations, Commonwealth of Independent States, Organization for Security and Co-operation in Europe, World Trade Organization, World Bank, International Monetary Fund, Asian Development Bank, European Bank for Reconstruction and Development, Islam Development Bank and other international organizations.

An activity of exploring or mining enterprises is regulated by the common codified laws regulating any business, such as the Tax code, Labor code, Civil code, Land code etc., with special sections with a specificity of mining. Besides, there are laws with relations to mining. First of all, it is the Subsoil Law, next to the laws "On Coal", "On Mineral Oil and Gas", "On Concessions", etc. Totally in the Kyrgyz Republic, there are 24 direct regulatory acts and up to 37 indirect. Subsoil users should pay up to 35 different taxes and payments.

The latest Subsoil Law No.49 was adopted 12 April 2018 with the following main items:

- The state ownership for subsoil mineral resources.
- The licenses could be acquired for geological research, exploration, mining and special activity (gas storages, etc.).
- The state ownership to the geological information, but with the permission of it using by third parties in different ways.
- Land and other natural objects disturbed during mining should be recovered for their further usage by special funds of subsoil user.

- No matter type or origin of subsoil user.
- A license may be put in pledge or be transferred to the third parties.
- Proved mineral resources of mineral deposits are subjects to the state expertise.
- The state control for prevention of losses of mineral resources and elective mining.

Licensing of subsoil usage is realised by the State committee of industry, energy and mineral resources. At the present time about 2400 licenses are acting on seven types of mineral deposits (petroleum, coal, metals, precious metals, non-metals, underground waters, regional exploration) and three types of subsoil usage (prospecting, exploration and development).

All kinds of subsoil usage and mining of all kinds of mineral raw materials, including underground waters being in the municipal, private and diverse pattern of ownership are subject to licensing. The exceptions are for small-scale mining of raw materials and artisanal gold mining based on special regulatory acts.

The right to use the subsoil is granted by direct negotiations, tenders and auctions.

The tenders are announced and are conducted by the Commission based on special Government decree for the each of strategic deposit. Strategic deposits are relevant objects of national value approved by a special decree of the Government. Currently, there are 35 strategic deposits in the list.

The auctions are organized by State committee of industry, energy and mineral resources for the deposits which are not in the strategic list or for the blocks which receive more than two applications for direct negotiations.

The direct negotiations are based on the application of the investor, which can be approved or disapproved by Commissions organized by the State committee of industry, energy and mineral resources.

The conditions of the direct negotiations, auctions and tenders are regulated by special regulatory acts but have few similar: form of application, information about the final beneficiary of the investor, interim programme of deposit development or exploration and financial wealth of investor.

The exploration and development of subsoil mineral resources by several licenses for different kinds of mineral resources can be conducted. The mutual relation and disputes between the licensees in such cases is regulated State committee of industry, energy and mineral resources.

The investor has the right, with the consent of a state organ on the usage of subsoil mineral resources, to pass in the deposit the right to use subsoil mineral resources to the third persons for collateral security of financing of the mining project.

All taxes and payments are regulated by the Tax Code

CLASSIFICATION AND MANAGEMENT FRAMEWORK FOR ENERGY AND MINERAL RESOURCES

The State system of reserves calculation is based on the following regulatory acts:

- Decree on the State Commission on Mineral Resources by Government of the Kyrgyz Republic;
- Decree of the State Balance on Mineral Resources by State committee of industry, energy and mineral resources of the Kyrgyz Republic;
- Decree of the State Cadastre on Mineral Resources by State committee of industry, energy and mineral resources of the Kyrgyz Republic;
- The instructions of a reserve calculation for some mineral resources;
- The instructions on the application of the classification of reserves of various branches of minerals.

In the Kyrgyz Republic, there is the Classification system of mineral resources of 1981. This is the last Classification which was accepted by the Soviet Government. There are few changes in instructions of reserve calculation, but the base is still the same.

In accordance with the level of geological assurance, four reserve categories are established under the Soviet classification scheme: A, B, C_1 and C_2. Reserves under categories A, B and C_1 are assigned to the proved or explored reserves while those under category C_2 are assigned to preliminarily assessed reserves.

CATEGORY A

These resources consist of the most highly proved part of explored resources. They have been extensively investigated, and the mode of occurrence, shape and structure of an ore-body is known. These data are derived from drilling and mine works.

With A category resources, the technological properties of the ore minerals, including the hydro-geological, engineering-geological and other natural, environmental features, have been studied in detail, ensuring the acquisition of preliminary data necessary for designing ore processing flow-sheets and compiling a detail technical report for the development of the deposit. The contour of the mineral reserves is established in accordance with data from boreholes and mine works.

CATEGORY B

These reserves include those deposits whose characteristics have not been studied quite so thoroughly although some of their major characteristics have been delineated. The extent of these resources is determined with the help of information from drilling and mining operations, but their explorations are permitted to a limited extent only.

With B category resources, economic minerals are defined and delineated where possible; in cases where the definition is impossible, the spatial distribution of industrial mineral types and grades is established. The technological properties of category B minerals are studied to a detail needed for the selection of a basic processing flow-sheet while hydro-geological, engineering-geological, geotechnical and other natural conditions are examined to a degree which enables a qualitative and quantitative characterization of their principal parameters and determination of their influence on the development of the mineral deposit.

CATEGORY C_1

These reserves are even less well delineated. Only their most general characteristics are known.

The changeability and possible discontinuity of mineral bodies are assessed while hydro-geological, engineering-geological and other natural features are studied to the degree that allows only a preliminary characterization of their main parameters.

CATEGORY C_2

Preliminary explored resources, category C_2, are established on the basis of geologic, geophysical and geochemical studies, and measurements of the ore-body in exploratory activities.

Resources in this category can also be estimated by extrapolation of geologic data. With category C_2 reserves, the quality and technological properties of the minerals are determined through analysis of only a few laboratory samples or by analogy with better-studied portions of the same or similar deposits. Hydrogeological, engineering geological and other natural conditions are assessed based on evidence and observations in the mine working and boreholes from other sites and by analogy with data available from the vicinity of the deposit.

Projected or probable resources consist of an undiscovered portion of the mineral base. Their appraisal is based on geological data from similar and explored deposits elsewhere. In contrast to reserves, probable resources are not computed but evaluated in a numerical form. Project or probable resources are also known as prognostic resources.

As with reserves, probable resources are evaluated for an entire country, for economic areas, ore basins and fields and individual deposits. Probable resources provide an indication of the expansion possible of a mineral-raw materials base and form a basis for current and long-term economic planning and defining geological exploration and prospecting activities.

Based on the level of geological assurance, probable resources fall into three categories: P_1, P_2 and P_3.

CATEGORY P_1

These probable resources are those of explored deposits or those currently being explored as well as the resources of new deposits where prospecting has been completed.

Category P_1 probable resources can be reclassified into reserves with an expansion of the mineral distribution area or discovery of new ore-bodies at the deposit. The quantitative appraisal of the deposit is based on an understanding of the type of deposit and its origin.

CATEGORY P_2

Project resources of undiscovered deposits thought to exist on the basis of evidence from geologic surveys, prospecting and geophysical and geochemical tests comprise category P_2.

The availability of resources in this category is deduced from the estimation of ore occurrences as well as geophysical and geochemical anomalies whose nature has been determined through the course of largescale (1:50000) mapping—category P_2 probable resources from a basis for planning long-term prospecting and assessment programmes.

CATEGORY P_3

These probable resources are those of potentially promising areas, districts, basins, and ore fields which do not contain mineable mineral deposits but based on stratigraphic, lithological, tectonic and paleogeographic evidence may reveal new deposits.

Quantitative estimates of this resource category are based on an analogy with better-studied regions, areas and basins, where explored mineral deposits of the same genetic type occur. Category P_3 probable resources from a basis for planning future large-scale geological mapping and prospecting programmes for mineral deposits.

The State Committee of industry, energy and mineral resources of Kyrgyz Republic expresses interest in implementing by the Kyrgyz Republic the International reporting standards of results of geological exploration, resource assessment and reserves calculation according to the CRIRSCO template.

Committee for Mineral Reserves International Reporting Standards (CRIRSCO) was formed in 1994 with the aim - to contribute to earning and maintaining that trust by promoting high standards of reporting of mineral deposit estimates (Mineral Resources and Mineral Reserves) and of exploration progress (Exploration Results).

At the Annual Meeting of International Council of CRIRSCO in Jakarta, Indonesia 30 October 2017 it was signed three sides memorandum between the State committee of industry, energy and mineral resources, the International Council of CRIRSCO and Kyrgyz Mining Association about Implementing international standard KyrRC based on CRIRSCO template.

Plan for the transition to international standards was agreed by the State committee of industry, energy and mineral resources and it was established intergovernmental Working Group.

The transition of the entire system of requirements for geological materials, including the necessary changes in legislation, in full compliance with the CRIRSCO template, will allow a broader presentation of mineral resources and mineral resources of Kyrgyzstan for specialized mining, geological and investment institutions of the world, which, in turn, more broadly integrates the mountain sector and the economy of Kyrgyzstan into the world economic system and will lead to the expansion and deepening of investment in the mining sector of Kyrgyzstan.

By now, it was approved the draft of KyrRC Standard by Working group, consultants of the International Council CRIRSCO, specially appointed for Kyrgyzstan for advising and facilitating the implementation of the procedures of Kyrgyzstan to join CRIRSCO family. Currently, KyrRC Standard is reviewed by specialists of the mining industry in Kyrgyzstan.

Membership of CRIRSCO is open to all country or regional National Reporting Organizations (NROs) whose application demonstrates that they meet the criteria for membership. For this purpose, it was established Kyrgyz Society of Subsoil Experts for creating National Institute of Competent person.

Absence of approving generally world-wide accepted standards to a large extent isolates the mining industry of Kyrgyzstan from world financial investment institutions and, in fact, discriminates foreign mining companies that are forced to work according to “the best practice” standards, but the results of the work carried out according to the standards of the former USSR, which have already been abandoned in many post-soviet countries.

ENERGY AND MINERAL RESOURCE ENDOWMENTS

Fifteen petroleum deposits have been discovered to this time, including six oil deposits (Changyrtash, Chigirchic, Mailisai, Karagachi, Beshkent-Togap-Tashravat, Tamchi), five gas-oil deposits (Mailisu IV Vostochny Izbaskent, Mailisu III, Niyazbek-Severny Karakchikum, Northern Rishtan), four gas deposits (Suzak, Southern Rishtan, Sarykamysh, Sarytok). Total perspective area for oil and gas exploration is 22.3 thousand km^2 in Kyrgyzstan, and from them, more than 5 thousand km^2 is placed in the Fergana depression. Produced reserves of oil are about 12 million t, and reserves of gas are 6.5 billion m^3. It has been produced about ten million t of oil and 7.5 billion m^3 of gas since the beginning of reservoir engineering in the Fergana depression. There are 313 oil and gas wells, including 247 producing wells on the balance of “Kyrgyzneftegas” joint-stock company. Extraction of produced oil and gas are 43% and 50% accordingly. There aren’t large oil-gas deposits within Kyrgyzstan. Host rocks composed of sandstones and limestones of Triassic, Cretaceous, Paleogene and Neogene ages. Sandstones of Paleogene age are spread most widely than others. There are two reservoir types - porous and mixed. The porosity of rocks is 6-24.1%, and permeability is 0.02-3360 mD. Roof-sheet pools have clay lithological or tectonic screen.

Seventy deposits of coal and coal-showings have been discovered to this time. They have formed four coalfields (South Ferganski, Uzgenski. North Ferganski, Kavakski) and three coal areas (Alai, South Issyk-Kul, Alabuka-Chatyrkulski). Sediments of Triassic and Jurassic ages, which consist of interstratified clays, argillites, siltstones, sandstones, and conglomerates with coal layers composed these deposits. Commercial coal beds of Early Jurassic age are spread in the low part of sedimentary rocks sequence. A number of coal seams in the deposits are ranged from 1 to 50 with thickness from 0.5 up to 100m. There are 1345000 thousand tones of coal on the State balance on 01.01.1999, including 1026800 thousand tones by A+B+C_1 category and 318200 thousand tones by C_2 category. Total and probable reserves are estimated at 6.73 billion tons. Coal production was ranging 3 to 4 million t/year until 1991. For the time being, coal production is 300-400 thousand t/year on the Kok- Yangak, Tashkumyr, Abshyr, Uch-Korgon, Almalyk, Sulyukta, Dzhergalan, Kara-Kiche, Minkush and others more small deposits. For supplying Bishkek city with coal, it is planning to increase coal production on Kara-Kichi deposit (1 million t/year). The building of the railway has started to this deposit.

Several tens of iron deposits and iron showings have been discovered in Kyrgyzstan, but their reserves are not registered in the State balance. Probable resources of iron within Kyrgyzstan are considered as three billion tones. The stage of their exploration is low. Only the surface of these deposits has been studied without any types of underground working.

All well-known world types of iron deposits are marked out within Kyrgyzstan: iron quartzites (Dzhetymski, Baidulinski deposits), titanium-magnetite ores in ultrabasic (Bala-Chichkan deposits), skarn magnetite (Gava, Oi-Kain, Kalmakashu, Ortotokoiski deposits), sedimentary-sideritic (Narynski deposit). There are unique deposits, as in their construction take part haematite-magnetite bodies in contact with gabbro-peridotite intrusive (Nadir deposit) and magnetite bodies in limestones (Nizhni Kemin deposit). There are run of mine ores (30-50%) and low–grade ores (<30%) by containing iron. Two deposits can be considered as large (Dzhetymski, Bala-Chichkan), one as the middle (Baidulinski – 210 million t.) and others as small – < 100 million t of iron. Small skarn deposits with reserves of iron less than one million t, at a grading of 30-50%, spread most widely. The future perspective of ferrous metallurgy can be connected with development Dzhetymski and Bala-Chichkan deposits. Nadir, Gava and Nizhni Kemin small deposits can be used as the base for not big metallurgical works.

Several tens of aluminium deposits have been discovered in Kyrgyzstan. Two genetic types of deposits marked out from them: sedimentary bauxites and intrusives of nepheline-syenites. Bauxite showings were found in limestones of Late Devonian-Middle Carboniferous age in Southern Fergana area, where they occurred in Pre-Jurassic crust of weathering. Small nepheline-syenite intrusive stocks of Permian age have been discovered in Middle and Southern Tien Shan. The largest aluminium deposits are shown on the map, which includes: three bauxite deposits and two deposits of nepheline-syenite. The reserves are not registered in the State balance. Total reserves and probable resources of Al_2O_3 are estimated as 47.2 million t in bauxites and more than 411.3 million t in syenites within Kyrgyzstan. Small deposits represent bauxite showings with reserves of each deposit about 1-25 million t of Al_2O_3. Deposits of nepheline-syenites have been considered as middle by their reserves (more than 200 million t of Al_2O_3). Grading of aluminium oxide is ranged from 18% to 46.8%. Sedimentary deposits have been divided by flinty modulus (Al_2O_3 /SiO_2) on bauxite (Akshygylski, Katranbashynski deposits – modulus > 2.0) and elite (Karanglinski deposit – modulus <2.0). Quality of nepheline-syenite ores (K_2O + Na_2O/Al_2O_3 relation not more than 3.3-3.4 and SiO_2/Al_2O_3 relation is close to 1) is satisfying industrial demands. The stage of investigations of these deposits is low – the level of prospecting and geological study.

It has been found more than one thousand showings of copper mineralization within Kyrgyzstan. Copper mineralization most spread in Kyrgyz range, Chatkalski region and Eastern Alai. Mainly this is a quartz-chalcopyrite vein in different rocks, which are not profitable for mining. It hasn't been discovered any large deposits with reserves more than three million t. Four deposits can be considered by their reserves as the middle (0.5-3 million t.) while the others are small. There are 226.4 thousand t. by C_1 category (0.81%), 116.8 thousand t. by C_2 category (0.92%), total – 343.2 thousand tons on the State balance (Kuru-Tegerk, Uchkoshkon, Mironovskoe deposits).

General mineral-raw base of Kyrgyzstan by copper is about 2 million t of total reserve and more than six million t. of probable resources. The average content of copper in the ore is 0.2-1.0%. The largest deposits by their reserves are: Kutu-Tegerek (1.02 million t., content – 0.6%), Taldybulak (0.75 million t., content – 0.2%), Oital (0.6 million t., content – 0.17%). The stage of exploration of these deposits is low. On Kuru-Tegerek and Bozymchak deposits were conducted only preliminary exploration and other prospecting works were stopped on the prospecting stage.

There are hundreds of lead and zinc deposits and their showings of mineralization within Kyrgyzstan. Several mining enterprises have been processed lead and zinc ores of Boordu, Aktyuz, Sumsar, Kan, Kan-and-Gut and Kyrgan deposits till recently. For the time being, they are closed because of exhausting of rich ores. There are 23 thousand tones by B+C_1 category and 3.9 thousand t. by C_2 category of lead (Kutessai II, Mironovski deposits), 14.8 thousand t. by C_1 category and 1.7 thousand t. by C_2 category of zinc (Kutessai II deposit). 226.1 thousand t. of lead (Kutessai II,

Mironovski, Ikichatski, Temir-Bulak, Chaar-Kuduk and Arsy deposits) and 7.3 thousand t. of zinc (Kutesai II deposit) are over balance reserves. Deposit Kan-and-Gut is on the brunch-wise balance with reserves of lead 3.4 thousand t and zinc 1.6 thousand t. by C_2 category.

General mineral-raw base of these two metals by several tens deposits and showings of mineralization can be estimated as one million t. of lead and 389 thousand t. of zinc. Total reserves of lead are estimated at 1.273 million t, and probable reserves of zinc are 283 thousand t. In most cases, they are not active. Except for worked out deposits, there are others where were conducted detailed exploration, such as Ichikatski, Chaar-Kuduk, Ken-Shanyk, Chat-Karagaiski, Arsy, Cholok-Terek, Ak-Kul. The geological study was conducted on Dzhartash, Belenteke, Tash-Tyube, Kuvakinski, Tura-Bulak and Taldybulak deposits in 1950-1960.

There are eight tin deposits, 31 large showings of tin mineralization and a lot of other small ones within Kyrgyzstan. Four deposits are shown on the map from them. There are reserves of two deposits on the State balance (Trudovoe, Uchkoshkon; 125.76 thousand t. by $B+C_1$ category (0.59%), 84.03 thousand t. by C_2 category). 25.6 thousand t. (0.27%) are in overbalance reserves. 11.34 thousand t. (1.22%) of tin, reserves are on the balance of extractive industries. Most part of tin mineralization is situated in the Northeast of the country including eight deposits and 13 ore points. Other showings of tin mineralization haven't been detailed explored or spreading of tin mineralization on the depth has been explored weakly.

There are several tungsten-tin deposits, and ore showings within Kyrgyzstan, including 11 explored deposits and 37 large ore showings. Two tungsten deposits (Kensu, Meliksu) and four complex deposits, with tin (Trudovoe, Terekty) and molybdenum (Keptash, Vodopadnoe) mineralization are shown on the map.

There are 52.4 thousand t (0.38%) by C_1 category and 72.7 thousand tons (0.41%) by C_2 category of tungsten in two deposits (Trudovoe, Kensu). These reserves are registered in the State balance. Total reserves and probable resources are estimated at 431.8 thousand tons within the Republic. The most part of commercial deposits is located in the northeast of the country. Almost all deposits have been explored, and ore showings are partially evaluated in depth.

There are 200 ore showings of arsenic, but only Uch-Imchek, Bel-Alma, Turuk and Uchkolski of them have mono-arsenic mineralization. Mainly, arsenic is as an admixture – in gold, polymetallic and rare metal deposits. Two deposits (Uch-Imchek, Bel-Alma) are shown on the map. Total reserves of arsenic in only arsenic deposits are estimated as 204.09 thousand tons. These reserves are not registered in the State balance.

There are six deposits and a lot of ore showings of molybdenum including 20 large ones. On the map are shown Chon-Tash and Koksaiski molybdenum deposits, Sary-Dzhaz uranium-molybdenum-vanadium deposit, Keptash and Molodyozhnoe molybdenum-tungsten deposits. There aren't only molybdenum deposits on the State balance. Kutessai II molybdenum-rare-earth detail explored deposit has 2.4 thousand tons of molybdenum (0.012%) by $B+C_1+C_2$ categories. Total reserves and probable resources of molybdenum are 247.187 thousand tons with contents – 0.012-0.08%; 0.39%. The stage of exploration is low. Main reserves of molybdenum ores are concentrated on Sary-Dzhaz and Kutessai II deposits. Others deposits badly explored on the depth, mainly only their surfaces have been investigated.

There are several tens of deposits and ore showings of beryllium. But the commercial potential of beryllium oxide is concentrated in 7 deposits and eight ore showings. Only four of them, mostly largest deposits, are shown on the map: Kalesai, Uzun-Tashty, Chetendy, Tyuktu-Archa. Three last are located near each other, forming one ore-junction. Reserves of only one deposit – Kalesai, are registered in the State balance - 11.6 thousand t of beryllium by C_1+C_2 categories at a grade of 0.127%. Total reserves and resources of beryllium oxide on the base of 14 largest deposits and ore showings are estimated at 95.166 thousand tons. Mainly beryllium mineralization is concentrated in lithium-beryllium deposits. The stage of exploration of beryllium deposits is high.

In the extensive group (about 400) of different types and different scales of mercury deposits and its ore showings, which have been discovered within Kyrgyzstan, stand out 15 deposits and 36 ore showings. Almost all of them, including explored deposits and those that are for the time being under exploitation, is located in the South of country. Chonkoi, Khaidarkan, Chauvai, Zardobuka largest mercury deposits are located in the South of Kyrgyzstan too. Six deposits are shown on the map, including Khaidarkan deposit that at present are being developed and Chonkoi, Chauvai, Symap suspended deposits. There are reserves of three deposits (Khaidarkan, Chonkoi, Chauvai) on the State and branch of mining industry balances. Reserves of mercury on these balances are 42.04 thousand t including 12152 tons (0.176%) by $B+C_1$ categories and 29887t (022%) by C_2 category. There are 2275t (0.17%) by the C_1 category in overbalance ores. Total reserves and probable resources of mercury are 73.3 thousand tons within Kyrgyzstan. Grade of exploration of mercury deposits is high. Most of them have been investigated on the depth except single deposits as Zardobulak.

There are 78 deposits and large ore showings of antimony within the South of Kyrgyzstan. Ten deposits are shown on the map, including Kadamzhai, Khaidarkan, Terek deposits, which for the time being are under exploitation. Reserves of 6 deposits - one is mono-metal antimony deposit and others – complex deposits (with mercury and gold), are registered in the State balance (namely Kadamzhai, Terek, Abshyr, Khaidarkan, Kassan, Northern Aktash). Reserves of antimony by B category are 2.6 thousand tons (.96%); by C_1 category – 174.3 thousand tons (1.77%); by C_2 category 94.2 thousand tons (1.54%); 1.5 thousand tons (0.97%) are in overbalance ores; total – 271.1 thousand tons. Total reserves and probable resources within Kyrgyzstan are estimated at 856.99 thousand tons, but their main part has not been explored properly. Largest deposits have been explored in detail; large ore showings have been explored on the depth and on the small ore showings have been investigated the only surface.

Several tens of deposits, different by their reserves have been discovered to this time. These deposits have complex ores, and oxides of rare earth, tantalum-niobates and trace elements represent them depending on the relation of majority and minority of these elements in ores marked out rare earth deposits with admixtures of tantalum and niobium or vice versa. Lithium, rubidium, scandium, zirconium and hafnium are the typical admixtures of trace elements in both types of deposits. Especially the two last elements (zirconium and hafnium) in some deposits reach commercial concentrates.

There are about 2500 original showings of gold mineralization within Tien Shan of Kyrgyzstan, and they are spread throughout of the country. Most of them are represented by small ore showings without a commercial perspective, but about 100 showings of gold mineralization need further exploration.

Reserves of seventeen deposits are registered on the State balance, namely: Makmal, Jerooy, Kumtor, Soltonsary, Taldybulak Levoberezhny, Kurandzhailyau, Terekskoe, Terekkan, Terek-Mezhplastovoe, Abshyr, Ishtamberdy, Kuru-Tegerek, Dolpran, Perevalnoe, Mironovskoe, Chalkuiryuk-Akdzhylga, Chpchama. Their reserves of gold at the beginning of 1999 were: 379.138t by B+C_1 categories at a grade of 4.2g/t, 87.609t by C_2 category at a grade of 6.22g/t and overbalance ores contained 60.6t at a grade of 2.06 g/t. There are reserves of seven deposits on the branch industry balance, 527.909t namely: Dzhamgyr, Nichkesu, Komator, Taldybulak Levoberezhny, Kyzyltash, Altyn-Dzhylga, Kumtor. Their reserves are: 2.555t by C_1 category at a grade of 4.89 g/t, 217.089t by C_2 category (4.64g/t); over balance reserves are: 0.150t by C_2 category (1.79g/t), 308.115t by P_1 category (4.66g/t). Officially registered reserves of gold are 1055.256 tons. By several dozens of deposits and ore showings, which are not registered on these balances, probable resources can be estimated at 1.0-1.5 thousand tons. It is considered reserves of new deposits in prospective areas in compare with already discovered can't be equal. Accordingly, with the above mentioned gold potential of Kyrgyzstan estimated at 3-4 thousand t.

Most intensively prospecting for discovering gold deposits have been conducting during the last 20 years. The stage of exploration the territory of Kyrgyzstan for gold mineralization and some gold deposits is very low. Soil sampling for gold spectrum analysis has been carried out only on the half area of the country. From a number of gold deposits and ore points, only seven deposits have been detailed explored (Makmal, Jerooy, Kumtor, Mironovskoe, Perevalnoe, Terek, Terekkan); else seven deposits have been previously explored (Ishtamberdy, Chapchama, Karatyube, Bozymchak, Kurandzhailyau, Taldybulak Levoberehzny, Kuru-Tegerek); while the other 45 deposits and ore showings haven't been evaluated thoroughly, however. There are more than one thousand of biochemical (soil) and heavy concentrate (placer) anomalies, which haven't been investigated so far.

There are tens of uranium deposits and ore showings within Kyrgyzstan. Kadzhysai, Kavak, Mailisai, Tuyamuyun, Shakaptar uranium mines have been exploited recently. But for the time being, they are closed. There are not any reserves of uranium on the State balance. The rare mineral base of this metal in Kyrgyzstan, together with placer deposits, is estimated at 33 thousand tons. Mainly, all uranium deposits are small by their reserves and from them stand out: Kavak (2587.4t at a grade of 0.137%), Kok-Moinok (1473t at a grade of 0.06%), Dzhylskoe (1016t at a grade of 0.06%), Aramsinskoe (806.2t at a grade of 0.17%), Atdzhailyau I (724.6t at a grade of 0.07%), Utor-Tuyuk (703.6t at a grade of 0.147%) deposits.

There are more than 2500 deposits and showings of 120 types of non-metallic minerals. They are united in 10 geological-commercial groups on the map: coloured stones, agrochemical raw materials, salts and chemical raw materials, raw materials for ceramics and glass production, raw materials for lime and cement production, building stones, raw materials for concrete and mortar production, raw materials for claydite and aggloporite production, facing stones, other non-metallic minerals.

GOLD

Currently, there are nine indigenous gold deposits under development – Kumtor, Bozymchak, Solton-Sary, Terekkan, Ishtamberdy, Dzhamgyr, Kara-Kazyk, Taldy-Bulak Levoberezhny, Kuranjayloo. Dynamics of gold production is presented in Table 14.

Table 14 – Gold production in Kyrgyzstan (kg)

	2010	2011	2012	2013	2014	2015	2016	2017
Production	24637	22798	16127,4	27759,7	32677,2	17655,2	36267,6	16052,1
incl. Kumtor	23768	20846	14324,8	26613	29125	14807	30761	10083,2

In 2010-2017, 239,132 tons of gold (including losses) was produced, 205,23 tons of which is Kumtor deposit. The increase in reserves due to exploration, exploitation and revaluation of deposits amounted to 463.035 tons, of which 202.772 tons in the Kumtor deposit. Gold output is presented in Table 15.

Table 15 – Gold output in Kyrgyzstan (kg)

	2010	2011	2012	2013	2014	2015	2016	2017
Gold output	18071,6	18920,5	11199,7	19505,8	18404,1	16894,3	18224,4	18573,4
incl. Kumtor	17660,5	18138,0	9805	18674,6	17657	16195	17137	17503,4
Makmal	240,5	363,6	367,4	456,5	282,7	272,3	172,7	193,5
Terekkan	106,4	76,1	89,7	103,1	-	-	-	-
Solton-Sory	64,2	70,0	70,8	63,0	51,35	49,1	29,5	68,2
Jamgyr		172,4	390,8	208,6	413,09	377,9	679,41	587,7
Ishtamberdy		100,4	476,0	-	-	-	205,8	220,6

PLACER GOLD

Alluvial gold was mined at the following fields: Sulu-Tegerek, Kara-Tyube, Buchuk, Baymak, Chanach, Kumbelsu, Kynda, Tokoiluu, Kara-Bulak and Zhartysuu. Placer gold production in Kyrgyzstan is presented in Table 16.

Table 16 – Placer gold production in Kyrgyzstan (kg)

	2010	2011	2012	2013	2014	2015	2016	2017
Gold output	155,6	157,4	189,8	282,1	84,157	62,466	57,93	8,82

From 2010 to 2017 as a result of alluvial mining, gold reserves decreased by 1,138.273 kg. In recent years, five gold enterprises have been commissioned in the country - Ishtamberdy, Kara-Kazyk, Dzhamgyr, Taldy-Bulak Levoberezhny, Bozymchak and Kuranjayloo, which produce gold ore and concentrates. The necessary production infrastructure is being built at the Jeruy, Kuru-Tegerek and Chaarat fields (Tulku-Bash section). The following fields are at the development stage of the feasibility study and design: Buchuk, Shambesai, Unkur-Tash, Terek, Perevalnoe and Terekkan. The most significant gold mining company in the industry is the Kumtor Gold Company.

NON-FERROUS AND RARE METALS

Prospects for the development of non-ferrous metallurgy associated with the construction of mining enterprises in the deposits of tin and tungsten Trudovoe, Uchkoshkon and Kensu. Copper will be mined along with gold mining. Other well-known deposits and ore occurrences in terms of the quality of raw materials, reserves and resources at current world prices cannot be considered as a source of raw materials for new enterprises.

ANTIMONY

For nearly 70 years, the Kadamzhai and Terek fields have been the raw material base of the Kadamzhai antimony plant. In small quantities, the supply of antimony concentrate was also carried out by the Khaidarkan Mercury Factory. Antimony production in Kyrgyzstan is presented in Table 17.

Table 17 – Antimony production in Kyrgyzstan (tons)

	2010	2011	2012	2013	2014	2015	2016	2017
Antimony	842,4	892,1	924,2	1474,1	26,1	53,0	40,0	11,7

Even in the Soviet period, antimony deposits were largely developed, enterprises processing antimony concentrates were reoriented to supplies from other regions of the former USSR and to imports from the CIS member states. Significant amounts of antimony concentrate were supplied from Tajikistan. Due to the shortage of metal antimony in the world, antimony products are currently highly liquid and in demand. However, it does not develop the Kadamzhay field, the residual reserves of which are about 80 thousand t of metal, with the existing capacity, they would be enough for 15 years of full load. The main enterprise operating in this industry is the Kadamjay antimony plant; meanwhile, at the design stage of the mine are LLC Tereksai Zhashtary and LLC Huacin.

MERCURY

The Khaidarkan Mercury Factory is the world's only manufacturer and exporter of primary mercury. The demand for mercury, especially for mined mineral resources, is significantly reduced due to the implementation of the Minamata Convention on Mercury, which requires the acceding countries to phase out primary mining of mercury and prohibits parties to import mercury derived from primary mining from countries that have not ratified the Convention. In 2009, the Kyrgyz Republic approved the National Mercury Production Plan in Khaidarkan, developed with the support of the United Nations Environment Program. This document contains activities necessary to stop mercury production in the framework of environmental and social issues. Mercury production in Kyrgyzstan is presented in Table 18.

Table 18 – Mercury production in Kyrgyzstan (tons)

	2010	2011	2012	2013	2014	2015	2016	2017
Mercury	98,7	111,3	68,8	29,0	46,3	28	8,3	2,9

IRON

Known iron deposits are mainly related to small deposits with poor and common ores and are poorly studied. The state balance, reserves of iron ore are accounted for the Nadir deposit in the amount of 978 thousand t and is mined as an additive in the production of cement for South Kyrgyz Cement CJSC and Southern Combine of Building Materials LLC. Explored geological reserves in the C1 category of the deposit are 17.3 million t of ore with an iron content of 37.5-42.2%.

COAL

The second in economic value after the gold mining industry is the coal mining industry. The time of its birth dates back to the end of the 19th century at some coal fields (Kok-Zhangak, Tash-Kumyr, Sulukta, Kyzyl-Kiya); coal has been produced intermittently for more than 100 years. Up to 1980, the industry constantly increased production volumes, the peak of productivity fell in the period 1976-1980 when on average more than 4.2 million t/year of coal were mined (of which 2.6 million t were mined underground, and 1.6 million t open-pit mines). Since then, a gradual decline in production began: average annual production in 1981-1985 was 3.6 million t, in 1986-1990 - 3.3 million t. A massive drop in production occurred after 1991 (less than 500 thousand t). From 2012, growth began, and in 2017 more than 1.9 million t were produced.

The basis of the organizational structure of the coal industry is currently formed by 54 coal small and large companies. In 1991, the total number of employees in the industry was 15,923 people, in 2017, according to various estimates, from 3,200 to 4,000 people. The main reasons for the decline in coal mining are:

- The presence in the industry of a large number of mines and cuts with complex mining and technological conditions that have become unprofitable in the market;
- The lack of a single state policy to maintain the fuel and energy complex and stable direct financial support during the collapse of the USSR;
- The orientation of the energy industry in the 1990s to the use of imported coal;
- The ubiquitous transition to electricity consumption, which led to the loss of the coal industry of the domestic market;
- Deterioration of the financial condition of the industry due to the insolvency of consumers, the imbalance of the refundable financial mechanism;

- The exhaustion of the service life of mining and mining equipment (depreciation of fixed assets exceeds 80%), its service life is about 30-40 years.

At present, the country's annual demand for coal is about 2.4 million t.

Coal mining is offset by the exploration of new deposits and the flank sections of previously explored deposits. Coal production in Kyrgyzstan is presented in Table 19.

Table 19 – Coal production in Kyrgyzstan (tons)

	2010	2011	2012	2013	2014	2015	2016	2017
Coal production	575	839	1100	1422,4	1829,8	1938,7	1852,1	1926,5
Companies	42	44	47	51	77	92	97	105
Deposits	47	49	53	56	84	100	105	113

Coal mining is among the most labour-intensive and inefficient processes (production per person per day is about one ton). With the underground mining method, in the prime cost of coal, wage costs with charges make up about 50% of the total production costs, and the high cost of road transportation, which makes coal production unprofitable at distances of 500-600 km from the market, has a huge impact on the cost of coal.

COKING COAL

Uzgen basin is the largest coking coal reserves in Kyrgyzstan and includes 17 deposits. Only at the TuyukKargash deposits in the Uzgen district of the Osh region and Kok-Kiya in the Toguz-Torou district of the Jalal-Abad region, the estimated resources of coking coal are 275 million t. Coal briquette production has a long-term perspective on the market, but overall demand for traditional briquette is low. Requires a smokeless, more environmentally friendly briquette. Briquette, as a commodity product turned out to be in the same market niche with competitive high-quality coal at a significantly higher cost.

Currently, there are no coal processing enterprises in the country, and there is no system for training specialists in technological energy processing of coal in domestic higher education institutions. Traditional energy technologies have already reached the limit of economic and environmental efficiency. Of considerable interest is the development of new methods and equipment that ensure the processing of coal into useful products, taking into account the requirements of environmental safety.

The use of coal for energy in its current form is the most “dirty” production compared to the use of other energy sources. The creation of environmentally friendly technologies to produce competitive products and generate electrical and thermal energy is a priority in many countries with large deposits of coal.

The need for more active development of the coal industry and an increase in coal production in the coming years is determined by the existing shortage of resources in the energy sector of the republic. Existing prospective coal reserves in the republic make it possible to fully provide the economy with solid fuel in increasing amounts.

NON-METALLIC INDUSTRIAL RAW MATERIALS

The mineral resource base of the country fully covers the needs of the production of building materials with regard to growth. However, in the domestic market of building materials, foreign products dominate, despite the costs incurred during the transportation of building materials.

More than two hundred enterprises are registered in Kyrgyzstan, which extracts a half dozen different types of non-metallic minerals, mainly building materials. The dynamics of the results of activities shows that the number of fields involved in exploitation is steadily increasing, while the number of enterprises is decreasing, which indicates a positive trend of consolidation.

FRESH AND MINERAL-THERMAL GROUNDWATER

Currently, in Kyrgyzstan, 115 fresh groundwater deposits are explored and accounted for by the State Water Balance of Groundwater of the Kyrgyz Republic. The total approved operating reserves for the fields are 25382.249 thousand m^3/day. Forty-four deposits operational reserves in the amount of 10,545.2 thousand m^3/day, approved by SCR of the Kyrgyz Republic, and 71 deposits reserves in the amount of 14,837.049 thousand m^3/day were approved by the State Committee for Reserves and taken into account by the State Water Balance of the groundwater of the Kyrgyz Republic.

Reserves of thermal-mineral groundwater in the amount of 42.5 thousand m^3/day were approved by the State Committee for Reserves on 40 deposits.

Practically all water resources have been explored in the southern regions of the republic, and their growth in the future is unlikely. There are still undiscovered resources in the north of the country.

Currently, about 305 licenses for groundwater abstraction have been issued. The vast majority (90%) of the right to use subsoil for the selection of groundwater belongs to local companies. Control over groundwater withdrawal is insufficient; there are many cases of unauthorized water withdrawal from wells. In most cases, the volumes of water withdrawal are not taken into account by the devices; accordingly, the mechanism for collecting royalties provided for by the Tax Code of the Kyrgyz Republic is not adjusted. The population provided with tap water pays only for the delivery of water, but not for the water itself. As a result, high-quality drinking water is wastefully used for irrigation and technical needs.

SOCIAL AND ENVIRONMENTAL ASPECTS OF ENERGY AND MINERAL PRODUCTION

The large fund of discovered and explored deposits and the extremely low probability of discovering new ones provide an opportunity to assess the economic potential of the mining industry and predict its future development. For this purpose, for almost all fields of Kyrgyzstan of commercial interest, options have been calculated that allow plausibly to predict the development trend of the mining industries with macroeconomic parameters.

The inertial scenario proceeds from the current state of the mining industry without modernization of legislation, management, the optimistic scenario provides for the maximum possible growth, above which progress is unlikely.

After the results of the calculations, we can draw the following conclusions:

- The global stock market is very low in assessing mineral assets in Kyrgyzstan, which limits the ability of venture capital companies to mobilize funds for geological exploration projects and the development of deposits;
- Rates of speculative transactions are closer to the fair value of deposits than valuations of stock markets;
- Planned tenders and auctions will bring minimal revenues to the state budget;
- It is required to significantly improve the investment image of Kyrgyzstan by strengthening guarantees to investors and reducing other risks in order to increase the value of mineral resources.

It is necessary to promote the policy of informing participants of international capital markets (investment funds and banks) about the business environment in Kyrgyzstan since potential investors do not have basic information about Kyrgyzstan

The market value of all gold mineral resources known today in Kyrgyzstan and obtained from the calculation by the income method is low and lies in the range of 3-5 billion US dollars.

Currently, the situation on the world market for mineral products is extremely favourable for Kyrgyzstan, due to the rapid growth of prices for traditional mineral resources: gold, silver, mercury, rare earth metals, tin, copper, antimony, molybdenum. Over the past decade, prices have increased by 4.5 times for gold and silver, rare earth — by six times, tin, antimony — by 2.5–3 times, for mercury by more than 20 times. For a long time in Kyrgyzstan, it was not understood that mineral reserves in deposits have a market value.

The biggest mistake of the nineties was the creation of joint ventures with state equity participation without a valuation of the contribution of the Kyrgyz side in the form of a field.

Licenses for the development of mineral resources were issued free of charge, which in the middle of the 2000s gave rise to a powerful wave of speculation without the intention of developing the deposits;

Later, another extreme appeared: by incompetent analysts, the value of deposits was determined by multiplying mineral reserves in the ground by the market value of products. As a result, estimates were repeatedly inflated and reached values in many billions and even trillions of US dollars.

The emergence of a mining enterprise in rural areas is inevitably associated with certain socio-economic consequences. By their nature, they are ambiguous: along with the negative consequences associated with the alienation of land, some deterioration of the ecological situation, negatively affecting the health of local people, there are new socio-economic opportunities associated with the creation of additional jobs, improving infrastructure, etc. However, it is necessary to take into account that these activities also lead to new social and environmental consequences.

Due to the changing lifestyle of the community, a new type of business appears, and it is necessary to take into account that after the closure of an enterprise, residents should be able to return to their previous structure and develop farming and cattle breeding on their territory. Many studies have shown that the emergence of new high-paying jobs

increases the purchasing power of local employees of the enterprise and, as a result, stimulates the local production of goods and services. On the other hand, growing demand causes a local price increase, which has a negative effect on the rest of the population.

When planning socio-economic strategies, mining enterprises within the framework of corporate responsibility should take measures to mitigate such consequences (raising the level of pasture productivity, restoring agricultural land, restoring floodplain forests, etc.). At the same time, it is precisely such programmes that ensure sustainable social, ecological and economic development of the community. When designing the development of new deposits, the stage of liquidation of production should be described taking into account the indicated factors.

At present, the ecosystem approach is partially fixed in the natural resource and environmental legislation of the Kyrgyz Republic. At the same time, there is no mechanism for implementing the ecosystem approach in regulating environmental relations and protecting natural resources. In turn, state environmental monitoring is carried out in relation to individual natural objects: land, water, forests, etc. However, ecosystems are not considered as a separate object of state environmental monitoring.

A serious omission is the lack of parameters of the standard state of natural ecosystems (primary biological productivity and biomass per square kilometre, state of biodiversity, etc.), which does not allow a clear assessment of the specific damage and the necessary measures for compensatory measures to improve the state of the natural environment in the area of responsibility mine. The current system of environmental protection is reduced to payments for environmental pollution (emissions, discharges of pollutants, waste disposal). Payments for environmental pollution from mining enterprises are transferred to special accounts of state territorial funds for environmental protection and development of the forest industry. The further fate of the payments listed is unknown: the procedure for their use and the mechanism for restoring the environment from the funds received are not defined. These funds, as a rule, are directed to the implementation of measures that are not related to the spent sites of the mining industry. A scientifically based and legally fixed mechanism for determining environmental damage is required. A significant number of subordinate regulatory legal acts (instructions, guidelines) were terminated in connection with the adoption of the Law of the Kyrgyz Republic “On Regulatory Legal Acts”, and there are also no mechanisms for implementing existing regulatory legal acts.

In the process of nature management, civil, criminal and administrative liability for harming ecosystems is not clearly established. The sanctions provided for by the existing legislation for violation of the established requirements for environmental protection are disproportionate to the damage caused.

In addition, modern advanced technologies and methods of mining, the rational use of energy and natural resources, environmentally safe waste management and their recycling are not well introduced, and these practices are not legally encouraged.

Existing practice shows that the current system of environmental protection, based on the payment of penalties, is not effective and, in fact, is not the protection of the environment. It is necessary to study the possibility of applying the new approach to environmental protection, based on compensatory restoration of natural ecosystems, bringing disturbing systems to “proper condition”, securing this mechanism at the legal level, as well as applying advanced technologies and mining methods.

TECHNOLOGICAL EFFICIENCY AND INNOVATION

The mining sector of Kyrgyzstan, which possesses significant mineral resources and mineral reserves, has not been sufficiently used as a potential for the development of the Republic’s own economy since the country gained state sovereignty. The current situation is explained by many factors, of which the most significant are the following.

First, the results of geological work on the assessment of identified deposits and manifestations of various minerals in Kyrgyzstan for the previous period are based on the standard adopted in the former USSR, which is regulated by the “Instructions for the application of reserves classification ...” and relevant instructions for drafting projects, reports from estimates of reserves, feasibility studies of conditions and expediency of production, and other regulatory documents. The essence of the documents reflects a conservative approach to the assessment of resources and reserves of mineral deposits, when the predictive assessment of the object is based primarily on proven geological parameters, in some damage to the economic component of the mineral as a real asset. The need for the reporting materials to be in compliance with the unified requirements, standards and guidelines adopted in the former USSR creates some over-regulated environment in the assessment of mineral resources and reserves. The latter makes these reports insufficiently transparent, understandable and informative for the actors of the modern market economy - investment financial institutions.

Secondly, the saturation of reports on the assessment of objects of mineral raw materials and reserves with information of a special nature, relating not only to geological, geological, geophysical, hydrogeological, economic and environmental requirements, for all its strict formalization carries an excessively large amount of information not used even by experienced industry experts.

The inclusion of redundant information in reports, in accordance with the requirements of existing standards, predetermined the complexity and a large number of submissions on the assessment of reserves and resources of the subsoil. The lack of understanding of various aspects of the implementation of mining and geological projects, including economic and environmental, led to the opposition of these projects to part of the population and local communities of Kyrgyzstan.

The assessment of mineral resources and reserves according to the GKZ methodology, as already noted above, was based on the principle of achieving maximum geological knowledge of the object and was highly conservative in its requirements. On the one hand, it minimized possible risks in the development of deposits by the owner (in this case, the state), and on the other hand, was accompanied by a significant increase in the cost of work. At that time, this system met the requirements and ensured a high level of reliability of the information on the country's mineral resources. The focus of the Russian classification is the degree of detail and comprehensive information on minerals. The definition of the category of resources and reserves was based on direct data on the occurrence, morphology, concentration and other characteristics of the ore bodies. To assign the reserves to one group or another, a certain set of geological survey activities was to be performed.

Its conservatism, which is relevant to scientific work, today does not always meet the needs of modern business. Assessment of the degree of entrepreneurial risk and methods of its management falls within the competence of businessmen and their partners (banks, insurers, other financial institutions), and not the state - the owner of the subsurface. The aforementioned conservatism itself often has not so much scientific and practical as bureaucratic roots.

Business planning in the mining industry should rely, to a greater extent, on a reasonable symbiosis of accurate geological data and economic feasibility. These requirements are met by the CRIRSCO template, whose assessments are free from the influence of bureaucratic procedures and often make it possible to more adequately and promptly assess the economic situation around the field and justify an adequate amount of funding for its study and development.

DATA AND KNOWLEDGE MANAGEMENT

There is the statement that geological information on the subsoil is the property of Kyrgyzstan. But geological information about subsoil obtained in the course of financing by entrepreneurs, enterprises and organizations, including joint and foreign, is their property for the period of the right to use subsoil, after which information about the subsoil is transferred free of charge to state ownership and transferred to national geological funds.

Geological information provides to a subsoil user at the time of subsoil use and other interested persons.

The State Geological Information Fund includes geological information about the subsoil, as well as archives, collections of samples of stone and core material, paleontological remains, thin sections, polished sections, museum collections, and a library of special literature on paper and electronic media. The State Geological Information Fund is completed on the basis of a compulsory copy of the geological information system by transferring it free of charge to all subsoil users. Subsoil users must annually submit to the State Geological Information Fund geological reports on paper and electronic media, including geo-referenced sampling databases.

It is possible to use geological information by third parties by special permissions due to the confidentiality period based on the following items:

1. The objectives of the cadastre and the State balance of mineral reserves of the Kyrgyz Republic;
2. The formation of geological information resources on the structure and development of the subsoil, the laws of their distribution and other data, the formation of which is necessary in order to organize the state geological study of the subsoil.

There are two levels of access to geological information resources in the Kyrgyz Republic:

1. Introductory – using geological information in the State Geological Information Fund without copying;
2. Allowing electronic or paper copying of documents containing more detailed geological information.

Price of introductory access to geological information costs one minimum rate payment per 1 hour. Minimum rate payment is equal to 100 soms ~ 1.2 euro.

Price for full access consists of 2 parts:

1. Working with materials is equal to the introductory level;
2. According to the following table (Table 20)

Table 20 – Price for full access to geological information in Kyrgyzstan

Type of report	Rates	For 1 page of text	For 1 dm^2 of graphic	Minimum rate payment, soms
Regional survey	1	0,1	0,5	100
Exploration	2	0,1	0,5	100
Preliminary exploring	2,5	0,1	0,5	100
Detailed exploring	5	0,1	0,5	100
Development	7	0,1	0,5	100

Students and graduate students of higher and secondary specialized educational institutions have the right to use geological information resources of the State Geological Information Fund within the framework of the familiarization level of access and are exempt from payment for using geological information resources within limits.

In some cases, access to geological information resources is constituting the State secret.

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UNFC CASE STUDY

On the territory of the Kyrgyz Republic, there are unified principles for calculating, assessing and state accounting of energy and mineral reserves and prognostic resources based on the “Classification of deposits reserves and prognostic resources of solid minerals of the Kyrgyz Republic” [1], “Classification of deposits reserves, oil and combustible gases perspective and prognostic resources”[2].

Currently, there are no Bridging Documents between the United Nations Framework Classification of Energy and Mineral Reserves and Resources and the National Classifications of Energy and Mineral Reserves and Resources. Therefore, the comparison schemes developed in the study are used in this work.

Due to the lack of a unified classification for energy and mineral resources, for the more detailed comparison of the various classifications listed above that are applied in the Kyrgyz Republic with the UNFC, two areas were selected for the Case Study: the first one is a solid mineral deposit, and another one is oil and gas deposit. In order to maintain confidentiality, the names of the studied areas are not disclosed.

As an object of study with solid minerals, a deposit of gold, silver and copper was taken (hereinafter deposit No.1). The terrain is rocky-talus, sharply partitioned with an absolute elevation of 3,700-4,000 m. The deposit belongs to the 3rd group of complexity: a complex geological structure, represented by vein zones with ore bodies up to 1-2 m or more in thickness, with a very uneven distribution of mineralization, often discontinuous. At the moment, quite detailed studies have been completed in the part of the deposit, balance reserves of the first stage in categories C_1 and C_2, which correspond to category E1.1.G3 in the UNFC, have been put on the State Balance. In addition, a mining project has been drawn up, which demonstrates the expediency of mining, which corresponds to category F1.3.

Deposit No.2 (the second object of study) is a multi-pool type with a wide stratigraphic range of oil and gas production. All pools of the deposit are stratified, crested. In 2012, a recalculation of oil and gas reserves was compiled for stratum IV and VIII. Reserves on category C_1 of the deposit No.2 for stratum IV and VIII amounted to oil – 4623.616 thousand t, free gas – 162.375 million m^3, dissolved gas – 297.212 million m^3. Of these, 1019.9 thousand t of on-balance oil

reserves and 65.241 million $m^3$of dissolved gas on category C1, which correspond to the category E2.G3 in the UNFC. Currently, on these reserves at deposit No.2 works is in progress to draw up a project for mining the deposit, attracting investors and searching for additional geological information. Thus, the status and validity of the project correspond to category F2.1. The remaining reserves of oil, free and dissolved gas are non-recoverable, i.e. in the UNFC, they correspond to the category E3.3. F4.G3.

Such sector of the industry as renewable energy sources (RES) in Kyrgyzstan is underdeveloped; the relevant regulatory framework is not sufficiently developed in this sector. On the territory of the Kyrgyz Republic, presently, there is no classification of reserves and prognostic resources for renewable energy sources. Given the above, a comparison of the classification on the example of an object with a renewable energy source was not carried out, but the study provides brief information about the prospects of using renewable energy sources in Kyrgyzstan, as well as the possibility of introducing UNFC in this industry.

NATIONAL CLASSIFICATION SYSTEM FOR ENERGY AND MINERAL RESOURCES AND MAPPING TO UNFC

DESCRIPTION AND DETAILS OF THE NATIONAL CLASSIFICATION AND MANAGEMENT SYSTEM

The classification system of the Kyrgyz Republic is based on the classification of the USSR. This classification of reserves shows mainly qualitative requirements on the completeness of exploration maturity of a deposit, providing baseline information for a feasibility study of conditions and reserves calculation.

According to the degree of geological knowledge, four categories of reserves (A, B, C_1, C_2) and three categories of prognostic resources (P1, P2, P3) are distinguished (Table 21).

Table 21 – Reserves categories and characteristics

Reserves category	Reserves characteristic
A	Category A includes detailed explored mineral reserves with precisely defined boundaries of the mineral bodies, their forms and structure. Reserves stand out in the detailing areas of exploration and mined deposits of the 1st group of the complexity of the geological structure.
B	Category B includes previously explored mineral reserves with approximately defined contours of mineral bodies, without accurately reflecting the spatial position of minerals natural type. Category B reserves are stand out in the detailing areas of exploration and mined deposits of the 1st and 2nd groups of the complexity of the geological structure.
C_1	Category C_1 includes reserves of explored deposits of the complex geological structure, as well as poorly explored mineral reserves in new areas, taking into account extrapolation. Reserves of category C_1 comprise the bulk of reserves of explored and mined deposits of the 1st, 2nd and 3rd complexity groups of the geological structure, and can stand out in the detailing areas of deposits of the 4th complexity group.
C_2	Category C_2 includes perspective reserves. Reserves of category C_2 stand out during the exploration of deposits of all complexity groups, and in deposits of the 4th group of the complexity of the geological structure make up the bulk of the reserves involved in mining.
P_1	Category P_1 prognostic resources take into account the possibility of expanding the boundaries of mineral distribution beyond the C2 reserves or identifying new ore bodies of minerals in ore occurrences, explored and exploring deposits.
P_2	Category P_2 prognostic resources take into account the possibility of discovering new mineral deposits in the basin, ore region, cluster, field, which estimated presence is based on a positive assessment of the mineral occurrences discovered during large-scale (in some cases, medium-scale) geological surveys and prospecting works, as well as geophysical and geochemical anomalies, which nature and possible prospectivity are established by single workings.
P_3	Category P_3 prognostic resources take into account only the potential possibility of the discovery of deposits of one or another type of mineral-based on favourable geological and paleogeographic prerequisites identified in the evaluated region during medium-small-scale geological and geophysical surveys, geological surveys, interpretation of satellite images, and also during analysis the results of geophysical and geochemical studies.

According to the economic value, the reserves of solid minerals and the mineral components contained in them, subject to state accounting, are divided into two main groups:

1. On-balance (economic);
2. Off-balance (potentially economic), which are subject to separate calculation and accounting.

On-balance (economic) reserves include reserves, the mining of which at the time of assessment according to technical and economic calculations is economically effective under competitive market conditions using equipment, mining technology and minerals processing, ensuring compliance with the requirements for the rational use of subsoil and environmental protection.

Off-balance (potentially economic) include:

1. Reserves, which mining at the time of the assessment according to technical and economic calculations is not economically efficient (unprofitable) in competitive market conditions due to low technical and economic indicators, but which development becomes economically possible when mineral prices change, optimal sale markets or new technology occurs;
2. Reserves meeting the requirements for on-balance reserves, but the use at the time of assessment is impossible due to the location within the water protection zones, settlements, facilities, agricultural facilities, natural reserves, natural monuments, history and culture.

Off-balance reserves are calculated and taken into account if the feasibility studies have established the possibility of their subsequent extraction or the expediency of associated extraction, storage and preservation for future use. Off-balance reserves are calculated separately depending on the basis for attribution to this group.

Thus, the system for classifying reserves of deposits and prognostic resources of solid minerals of the Kyrgyz Republic is difficult to compare with the UNFC. They have a number of significant differences:

1. While the UNFC is based on three fundamental criteria's: economic and social viability of the project (E), the status and validity of the deposit development project (F), and geological knowledge (G), the classification of the Kyrgyz Republic is based on two criteria: (1) state of readiness for industrial development and profitability of mining (on balance and off-balance reserves); (2) geological knowledge. The first classification criterion of the Kyrgyz Republic combines the first two categories of the UNFC (axis E and F).
2. In UNFC reserves classification for known (discovered) deposits, three degrees of reliability for geological knowledge are indicated: "high", "medium" and "low", they are represented by categories G1, G2 and G3, in the classification of the Kyrgyz Republic, these degrees are represented by categories A (high), B (medium), C1 and C2 (low). For deposits known only by indirect data, the G4 category is used, while the P1-P3 categories are used in the classification of the Kyrgyz Republic. A significant difference between the classification of the Kyrgyz Republic and the UNFC is the fact that resources of categories P1-P3 in the UNFC are not classified and fully classified as "probable".
3. The main difference between the two classifications is the fact that the UNFC uses a numerical code system, while the Kyrgyz Republic classification uses a textual description of all conditions.

Comparison of classes and subclasses of UNFC with the Classification of deposit reserves and prognostic resources of solid minerals of the Kyrgyz Republic is presented in Table 22.

Table 22 – Comparison of classes and subclasses of UNFC with the Classification of deposit reserves and prognostic resources of solid minerals of the Kyrgyz Republic

Class	Subclass	UNFC			Classification of the Kyrgyz Republic	
		E	F	G	State of readiness and profitability of development (E и F)	Reserves category (G)
Commercial projects	In mining	1	1.1	1, 2, 3	Ready for mining onbalance reserves	A, B, C_1, C_2
	Approved for development	1	1.2	1, 2, 3		A, B, C_1, C_2
	Justified for development	1	1.3	1, 2, 3		A, B, C_1, C_2
Potentially Commercial Projects	Development pending	2	2.1	1, 2, 3	Perspective for industrial development on-balance reserves	A, B, C_1, C_2
	Development on hold	2	2.2	1, 2, 3		A, B, C_1, C_2
Non-commercial projects	Development unclarified	3.2	2.2	1, 2, 3	Estimated reserves requiring additional exploration	P_1, P_2, P_3
	Development not viable	3.3	2.3	1, 2, 3		P_1, P_2, P_3
Additional quantities		3.3	4	1, 2, 3	Unprofitable for industrial development or non-recoverable	A, B, C_1, C_2
Exploration Projects	Subclasses not defined	3.2	3	4	For this class is not defined	P_1, P_2, P_3
Additional quantities		3.3	4	4		P_1, P_2, P_3

CLASSIFICATION OF RESERVES, PERSPECTIVE AND PROGNOSTIC OIL AND COMBUSTIBLE GAS RESOURCES, AND MAPPING TO UNFC

Presently, in the Kyrgyz Republic, there is no State-approved classification of deposit reserves, perspective and prognostic resources of oil and combustible gases. During state accounting and calculating the reserves of deposits, perspective and prognostic oil and gas resources of the Kyrgyz Republic are based on the classification approved by the Decree of the Council of Ministers of the USSR dated April 8, 1983 [2].

This Classification establishes unified principles for calculating and state accounting of deposit reserves and prospective resources of oil and combustible gases (combustible gases mean natural hydrocarbon gases – free gas, gas cap gas and gas which was dissolved in oil) in the subsoil according to their degree of knowledge and economic value, conditions that determine the preparedness of explored deposits for industrial development, as well as the basic principles of assessing the prognostic oil and gas resources.

The reserves of oil, gas, condensate and the components of industrial importance contained in them are classified according to the degree of knowledge into explored categories A, B and C_1 and preliminary estimated category C_2. Oil and gas resources according to their degree of validity, are divided into perspective – category C_3 and prognostic – categories D_1 and D_2 (Table 23).

Table 23 – Reserves categories and characteristics

A	Pool reserves (or a portion thereof), studied in detail, providing complete determination of type, shape and size of the pool, effective oil and gas saturated thickness, type of reservoir, nature of changes of reservoir properties, oil and gas saturation of productive stratum, composition and properties of oil, gas and condensate, as well as main features of the pool, on which conditions for its development depend. Category A reserves are calculated for the pool (part) drilled in accordance with the approved project for the development of an oil or gas deposit.
B	Reserves of the pool (or a portion thereof), which oil and gas bearing is established based on the obtained industrial inflows of oil or gas in wells at various hypsometric elevations. The type, shape and size of the pool, the effective oil and gas saturated thickness, the type of reservoir, the nature of changes of reservoir properties, the oil and gas saturation of productive stratum, the composition and properties of oil, gas and condensate in stratum and standard conditions and other parameters, as well as main features of the pool that determine conditions for development have been studied to a sufficient degree to draw up a project for development of deposits. Category B reserves are calculated according to the pool (part) drilled in accordance with the approved technological scheme for the development of an oil deposit or a pilot development project for a gas deposit.
C_1	Category C1 represents the reserves of a deposit (or of a portion thereof) whose oil or natural gas content has been determined on the basis of commercial flows of oil or natural gas obtained in wells (with some of the wells having been probed by a formation tester) and positive results of the geological and geophysical exploration of non-probed wells. The type, shape and size of the deposit and the formation structure of the oil- and gas-bearing reservoirs have been determined from the results of drilling exploration and production wells and by those geological and geophysical exploration techniques that have been field-tested for the applicable area. The lithological content, reservoir type and characteristics, oil and natural gas saturation, oil displacement ratio and effective oil and natural gas saturation depth of the productive strata have been studied based on drill cores and geophysical well exploration materials. The composition and characteristics of crude oil, natural gas and gas condensate under in-situ and standard conditions have been studied based on well testing data. In the case of an oil and natural gas deposit, the commercial potential of its oil-bearing fringe has been determined. Well productivity, hydro- and piezo-conductivity of the stratum, stratum pressures and crude oil, natural gas and gas condensate temperatures and yields have been studied on the basis of well testing and well exploration results. The hydrogeological and geocryological conditions have been determined based on well drilling results and comparisons with neighboring explored fields. Category C1 reserves are computed on the basis of results of geological exploration work and production drilling and must have been studied in sufficient detail to yield data from which to draw up either a trial industrial development project in the case of a natural gas field or a technological development scheme in the case of an oil field.
C_2	Category C2 reserves are preliminary estimated reserves of a deposit calculated on the basis of geological and geophysical research of unexplored sections of deposits adjoining sections of a field containing reserves of higher categories and of untested deposits of explored fields. The shape, size, structure, level, reservoir types, content and characteristics of the hydrocarbon deposit are determined in general terms based on the results of the geological and geophysical exploration and information on the more fully explored portions of a deposit. Category C2 reserves are used to determine the development potential of a field and to plan geological, exploration and production activities.
C_3	Category C3 resources are prospective reserves prepared for the drilling of (i) traps within the oil-and-gas bearing area, delineated by geological and geophysical exploration methods tested for such area and (ii) the formation of explored fields which have not yet been exposed by drilling. The form, size and stratification conditions of the assumed deposit are estimated from the results of geological and geophysical research. The thickness, reservoir characteristics of the formations, the composition and the characteristics of hydrocarbons are assumed to be analogous to those for explored fields. Category C3 resources are used in the planning of prospecting and exploration work in areas known to contain other reserve bearing deposits.
D_1	Resources are calculated based on the results the region's geological, geophysical and geochemical research and by analogy with explored deposits within the region being evaluated. Category D1 resources are reserves in lithological and stratigraphic series that are evaluated within the boundaries of large regional structures confirmed to contain commercial reserves of oil and natural gas.
D_2	Resources are calculated using assumed parameters on the basis of general geological concepts and by analogy with other, better studied regions with explored oil and natural gas deposits. Category D2 resources are reserves in lithological and stratigraphic series that are evaluated within the boundaries of large regional structures not yet confirmed to contain commercial reserves of oil and natural gas. The prospects for these series to prove to be oil-and gas-bearing are evaluated based on geological, geophysical and geochemical research.

Reserves of oil, gas, condensate and components of industrial importance contained in them are divided into two groups according to national economic value, which are subject to separate calculation and accounting: on-balance - reserves of deposits (pools), the involvement of which for development currently is economically feasible; off-balance - reserves of deposits (pools), involvement of which currently is not economically feasible or technically and technologically impossible, but which in the future can be converted into on-balance reserves.

The preparedness of explored oil and gas deposits (pools) for industrial development is determined by the degree of their knowledge, regardless of the size and complexity of the geological structure.

Explored deposits (pools) or parts of deposits (pools) of oil and gas are considered prepared for industrial development in compliance with the following conditions:

- on-balance and recoverable reserves of oil, gas, condensate and components of industrial importance contained therein are approved by the State Committee for Mineral Reserves of the Kyrgyz Republic and an assessment of the prospective resources of oil, gas and condensate of the deposit is given;
- approved recoverable reserves of oil and condensate, on-balance reserves of gas, as well as the reserves of components of industrial importance contained therein, used in the design of enterprises for the mining of oil and gas, must be at least 80% of category C1 and up to 20% of category C2. The possibility of industrial development of explored deposits (pools) or parts of deposits (pools) of oil and gas in the presence of reserves of category C2 more than 20% is established in exceptional cases of the State Committee for Mineral Reserves of the Kyrgyz Republic when approving reserves on the basis of the expertise of calculation materials;
- composition and properties of oil, gas and condensate, the content of components of industrial importance in them, the features of deposit (pools) development, the flow rates of oil, gas and condensate, hydrogeological, geocryological and other environmental conditions have been studied in the degree ensuring receipt of baseline data for compiling a technological scheme for the development of an oil deposit or a Pilot Development Planning Project of a gas deposit;
- in the area of explored deposit, the raw material base of construction materials and possible sources of drinking water and technical water supply should be evaluated to ensure that the needs of future enterprises for oil and gas production are satisfied;
- there is information about the presence of absorbing horizons in exploratory wells that can be used during design and survey works to study the possibilities of discharging industrial and other wastewater;
- recommendations on the development of activities to ensure the prevention of environmental pollution have been composed.

Obviously, the “Classification of deposit reserves, perspective and prognostic resources of oil and combustible gases” and the “Classification of deposit reserves and prognostic resources of solid minerals” are partially similar, therefore, part of the discrepancies in the classification of solid minerals with the UNFC will be duplicated in comparing the classification of oil and combustible gases.

In view of the above, between the classification of deposit reserves, perspective and prognostic resources of oil and combustible gas used in the Kyrgyz Republic and the UNFC, the differences can be established:

1. In UNFC reserves classification for known (discovered) deposits, three degrees of reliability for geological knowledge are indicated (axis G): “high”, “medium” and “low”, they are represented by categories G1, G2 and G3. For deposits known only by indirect data, the UNFC uses category G4. Whereas in the classification used in the Kyrgyz Republic, reserves according to the degree of knowledge are divided into explored - categories A, B and C1 and preliminary estimated - category C2, and resources - into perspective - category C3 and prognostic - categories D1 and D2;
2. Similar to the classification of solid minerals of the Kyrgyz Republic, in the classification of oil and combustible gases, the concept of on-balance and off-balance reserves is used, as well as the degree of readiness of explored oil and gas deposits (reservoirs) for industrial development, they combine the first two categories of UNFC (axis E and F)
3. Similar to the previous comparison, the main difference between the two classifications is the fact that the UNFC uses a numerical code system, while the classification used in the Kyrgyz Republic uses a textual description of all conditions.

Comparison of UNFC classes and subclasses with the Classification of deposits reserves, perspective and prognostic resources of oil and combustible gases (USSR, 1983) is presented in Table 24.

Table 24 – Comparison of UNFC classes and subclasses with the Classification of deposits reserves, perspective and prognostic resources of oil and combustible gases (USSR, 1983)

Class	Subclass	UNFC			USSR Classification, 1983	
		E	F	G	Degree of readiness (E, F)	Reserves category (G)
Commercial projects	In mining	1	1.1	1, 2, 3	Ready for mining on-balance reserves	A, B
	Approved for development	1	1.2	1, 2, 3		A, B
	Justified for development	1	1.3	1, 2, 3		A, B
Potentially commercial projects	Development pending	2	2.1	1, 2, 3	Perspective for industrial development on-balance reserves	C_1, C_2
	Development on hold	2	2.2	1, 2, 3		C_1, C_2
Non-commercial projects	Development unclarified	3.2	2.2	1, 2, 3	Estimated reserves requiring additional exploration	C_1, C_2
	Development not viable	3.3	2.3	1, 2, 3		C_1, C_2
Additional quantities		3.3	4	1, 2, 3	Unprofitable for industrial development or non-recoverable	A, B, C_1, C_2
Exploration projects	Ready for discovery perspective object	3.2	3	4	For this class is not defined	C_3
	Probable prospecting object	3.2	3	4		D_1
	Possible prospecting object	3.2	3	4		D_2
Additional quantities		3.3	4	4		C_3, D_1, D_2

BACKGROUND INFORMATION OF THE PROJECTS

DEPOSIT NO.1

The systematic prospecting for minerals on a scale of 1:100000 began in 1949. In the future, the area of deposit No.1 was systematically studied from 1957 to the present, starting from preparing works in order to prepare for the study of a geological map on a scale of 1:200000 (1957) and prospecting works on a scale of 1: 50000 (1958) , which was accompanied by heavy concentrate and lithochemical prospecting on leakage fluxes.

In 1966-1967 the deposit was covered by prospecting and revising works on tin and polymetals at a scale of 1:25000. In the process of works, accompanied by trench sampling of mine workings, heavy concentrate and lithochemical sampling of loose sediments, tin-silver-polymetallic ore occurence was discovered. At ore occurrences, abundant small (up to 40 × 6.5 m) lenticular and nest-shaped polysulfide bodies were sampled, with pyrite-arsenopyrite-chalcopyrite-sphaleritegalena composition with contents of tin 0.03-1.18%, silver – 34-883 g/t, lead – up to 28%, zinc – up to 14%, copper – up to 8.8%, cadmium – more than 1%. Subsequently, the prognostic resources of category P_2 were estimated, lead – 80 thousand t, zinc – 55 thousand t, silver – 100 tons, tin – 4 thousand t, copper – 8 thousand t. The presence of gold in ores has not been evaluated. And it was recommended for further detailed study (Figure 46).

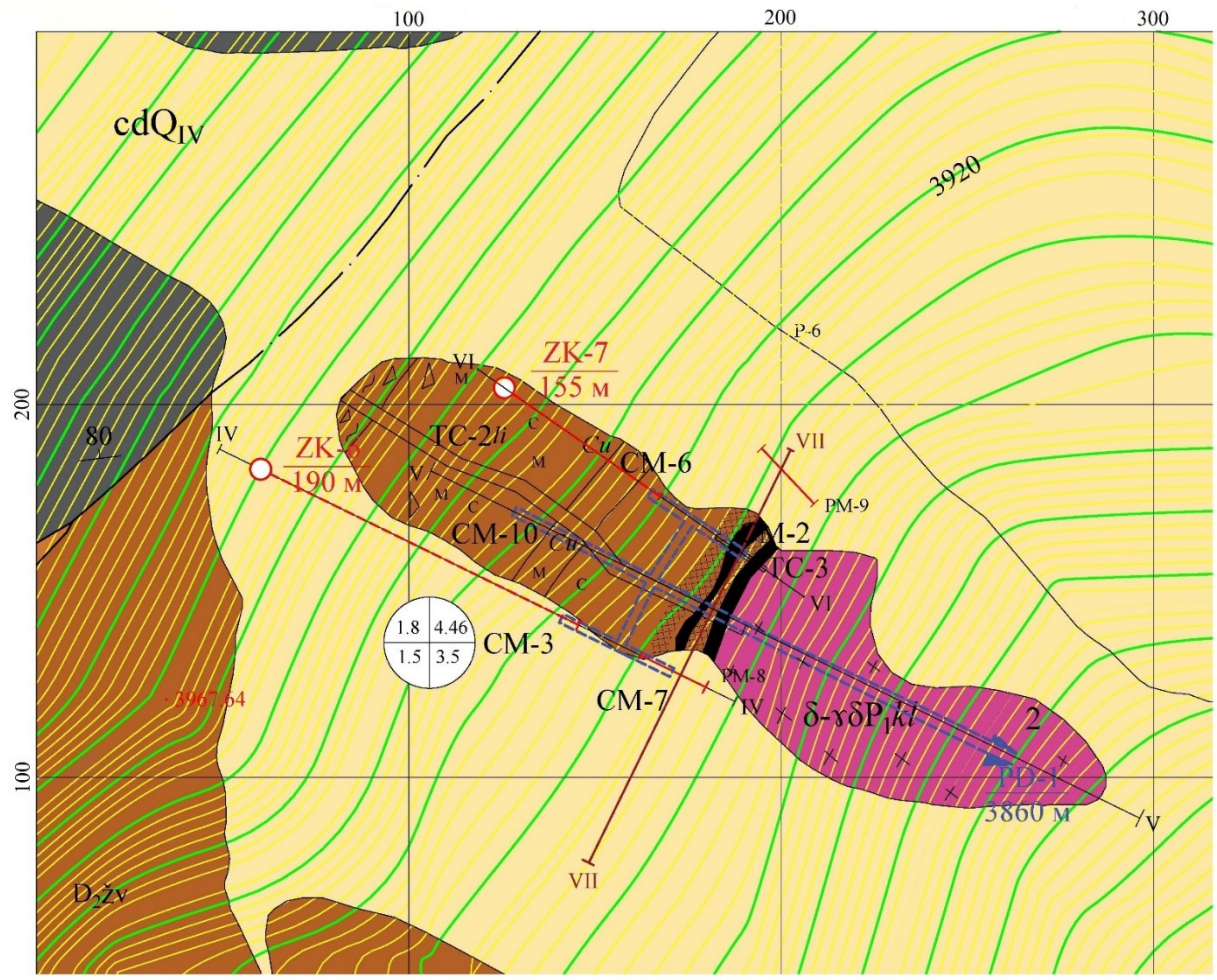

Figure 46. Map of the actual material of the calculating ore body No.1 of deposit No. 1

In 1981-1984 the area became a part of the territory of detailed prospecting on a scale of 1:10000. The work of the group was aimed at assessing the perspectivity of the region regarding gold antimony, tin-silver-antimony mineralization. As a result of the works, along with antimony and tin-polymetallic mineralization in the mineralized zones and mineralization points, elevated gold contents were established.

In 1983-1987 the area was covered by the State Geological Survey on a scale of 1: 50000. At the same time, conditional maps were compiled: geological, minerals, patterns of distribution and prognosis of minerals. New data on Paleozoic stratigraphy, magmatism, tectonics and minerals were obtained. For the first time, when considering the history of the geological development of the area of work, an attempt was made to decipher the structure based on the principles of geodynamics. At the same time, an important indicator role of magmatites is shown, without which any paleo reconstructions cannot pretend to completeness and objectivity.

In 1999, the gold mineralization of the area was estimated using available geological materials. According to this assessment, gold-polymetallic deposit No.1 was allocated. The prognostic resources of which were: category P_1 for skarn and sulfide bodies to a depth of 20 m –126 kg of gold, content is 8.8 g/t, category P_2 for the mineralized zone to a depth of 50 m – 145 kg of gold, content is 4.9 g/t. Associated components are copper, silver, bismuth, zinc, tin.

In 2010-2012, prospecting routes of 1:10000 scale were completed. The closeness of routes averaged 2-2.5 l.km per 1 km^2. In areas of development of small intrusions, the closeness of prospecting routes was higher, 110 l. km were completed. In the same period, lithochemical sampling on secondary halos, trenching and their sampling were carried out, as well as geophysical studies on a scale of 1:5000 were performed. According to the results of sampling, halos of gold, silver, copper, lead, zinc and bismuth were revealed.

Targeted works on gold were not carried out until 2017. Area estimation was carried out only according to the surface works. Mineralization to the depth was not studied either by boreholes or mine workings. Significant abilities of deposit No.1 are concealed under the overburdens, which occupy a significant part of the area.

In 2017-2019, with the aim of identifying and calculating the reserves of gold and associated useful components, exploration works were carried out on ore bodies No.1 and No.2 of the deposit No.1. Based on the results of the works, first-stage reserves were calculated for ore body No.1 for categories C_1 and C_2 and the following reserves were approbated: gold – 1652.7 kg, copper – 2468.7 tons, silver – 7920.5 kg with an average content in ore of 5.79 g/t, 0.84%, 27.22 g/t, respectively.

At the moment, detailed studies on ore body No.1 have been completed, and mining project has been drawn up that demonstrates the expediency of mining. The mining of the ore body is planned to be carried out by underground method using a system with sub-level caving of ore.

Exploration works which were carried out in 2017-2019 allowed to calculate only a part of ore body No.1 reserves, that is, reserves of the first stage were calculated, in the future it is planned to observe ore body No.1 to the north-east and south-west, because its continuance is fixed by geophysical research both by IP (induced polarization) method and magnetometry method (Figures 47, 48, 49).

For ore body No.2, the works carried out earlier is not sufficient for setting reserves and it is planned to explore it with wells. In addition, during the exploration of ore body No.2, one of the wells crossed ore body No. 3 located in the mineralized zone No. 3, which is located on the hanging side of the fault, along which the D_2žv dolomites came into contact with C_1v limestones. Subsequently, its further exploration is recommended.

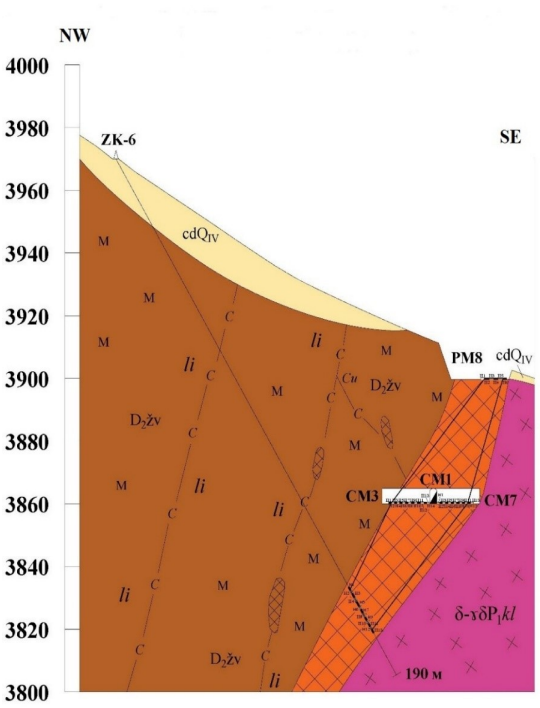

Figure 47. Exploration section IV-IV of deposit No.1

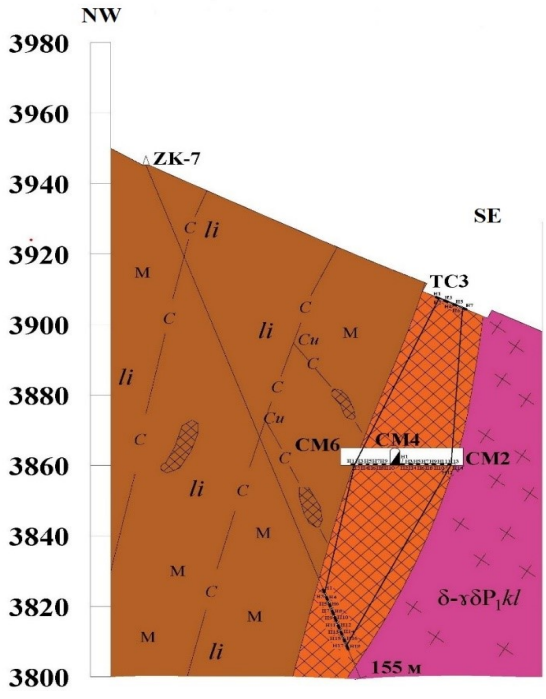

Figure 48. Exploration section VI-VI of deposit No.1

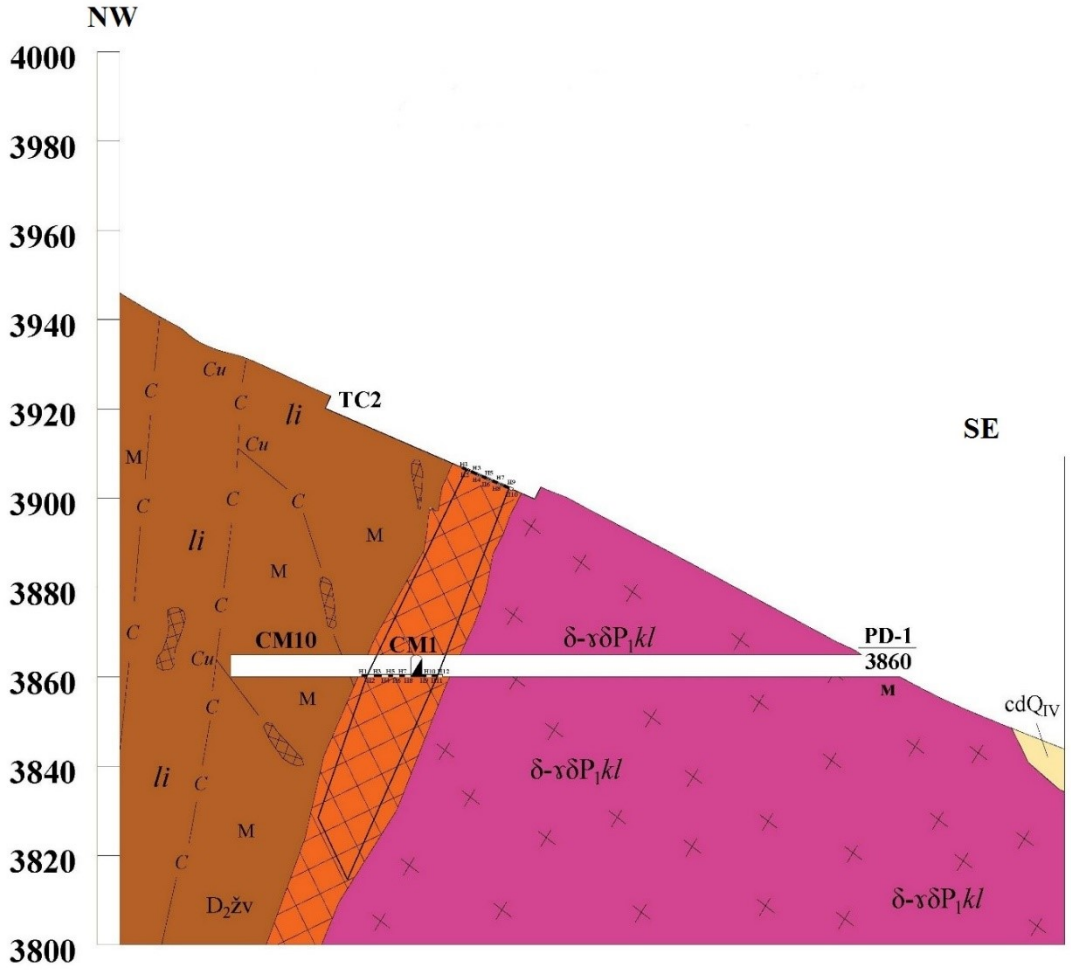

Figure 49. Exploration section V-V of the deposit No.1

DEPOSIT NO.2

The first fragmentary information on the geological structure of the licensed area was found in archival documents dated 1871. This year indicates the presence in the area of Cretaceous sediments, which are discordant with older rocks.

V.N. Weber, who worked in the region in 1902-1928, made a great contribution to the study of the deposit area geology. In 1909-13 on the instructions of the Geological Committee, he carried out a ten-verst geological survey. When describing routes, the researcher noted anticlinal folds. In the valley of the dry channel, V. N. Weber described a complete section of the Cenozoic sediments.

In 1911, as a result of studying the sections of the region's oil deposits, Paleogene and Cretaceous sediments were divided into a number of suites, reference marking horizons were highlighted inside them, interstratal movements in folds, accompanying them layers corrugation, their thrust against each other, as well as the inconsistency of structural drawings for Neogene, Paleogene and Cretaceous formations, were identified and described.

In 1935-1947 a study of the stratigraphy of Cretaceous and Paleogene sediments of the deposit No.2 area was made. In 1935-1936, a new stratigraphic scheme of Cretaceous and Tertiary sediments was developed, which was widely recognized and disseminated. In final form, this scheme is published by the author somewhat later, in 1944-1953. The scheme for Paleogene sediments, with minor modifications and changes, is used to date.

Since the beginning of the 30s, geological surveys of different scales were carried out in the area of work on promising structures identified by reconnaissance studies.

In 1934, both gas and geological surveys were carried out at a scale of 1: 5000. Geological maps, despite some schematics, are very detailed and well-founded.

In 1946, a detailed instrumental survey was carried out on a scale of 1:10000.

The first geophysical works in the area of the field are dated 1952-57. According to electrical exploration data, a map of equal depths of the Paleozoic foundation and a map of the thickness of cover conglomerates were compiled.

In 1954-56 a schematic structural map was compiled on a scale of 1: 200000 along the roof of the Vth Paleogene strata of the Adyr part of the region with a brief description of individual folds. Later (1960), a similar map was compiled on the roof of the Vth strata of the Turkestan layers using seismic data's along the reference reflecting horizon of the Eocene at a scale of 1: 100.

As a result of a gravimetric survey of a scale of 1:500000 – 1:1000000 and an aeromagnetic survey of a scale of 1:200000, covering the entire region, which was carried out in 1966, a complete picture of the structure of the earth's crust and the most important geostructural elements that found expression in geophysical fields were taken. The notion of the relief of the Paleozoic foundation of the Meso-Cenozoic depressions is substantially concretized.

In 1970, a study of the presence of oil and gas of the Cretaceous and Jurassic sediments was carried out in the area. A diagram of the tectonic zoning of the Meso-Cenozoic structures was compiled; an analysis of the presence of oil and gas in strata-reservoirs was made which was identified in the Jurassic and Cretaceous sedimentary complexes. In total, seven strata confined to the middle section were identified in the Jurassic section. In sediments of the Cretaceous system, the author identified ten productive stratas. In 1971, a final report was compiled, in which, according to the received data, a map of the presence of oil and gas in a scale of 1:100000 was presented.

In 1973-75 SRM study of the structural features of the Mesozoic Cenozoic was made in order to search and prepare for deep drilling of oil and gas perspective structures within the zone of the licensed area (Figures 50, 51).

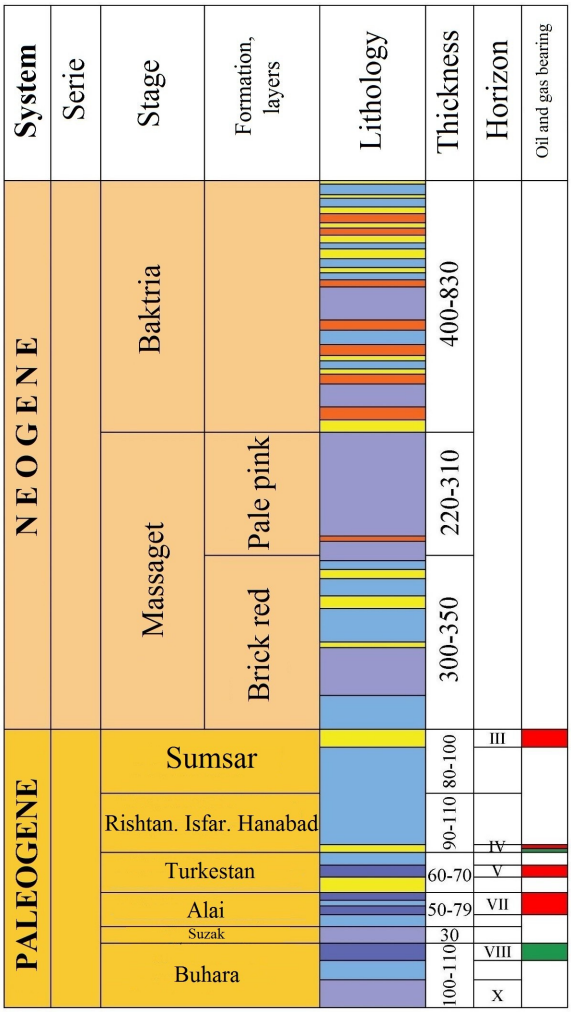

Figure 50. Lithological and stratigraphic section of the deposit No.2

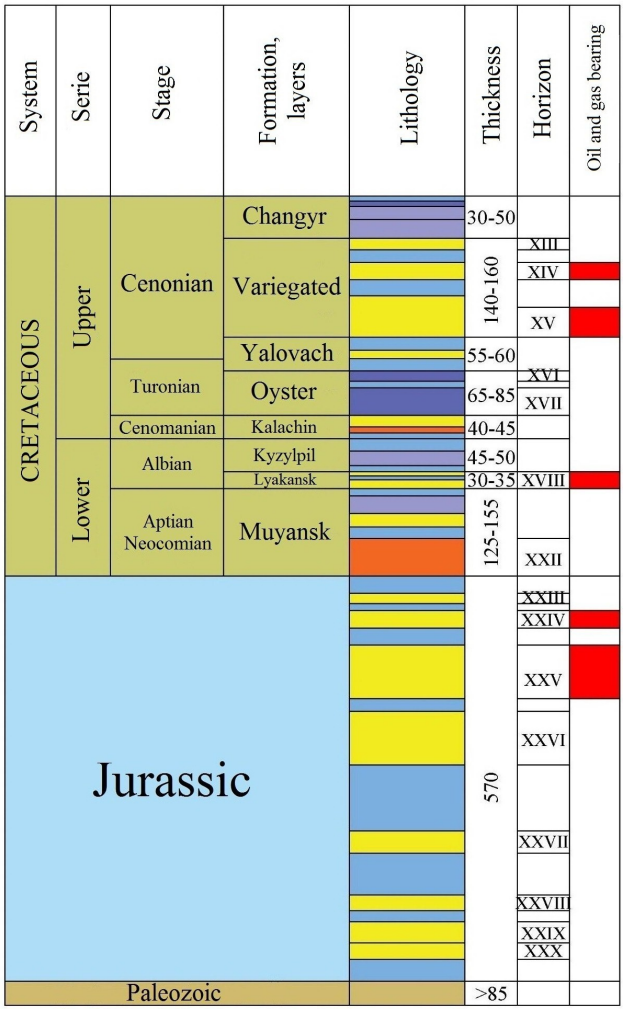

Figure 51. Lithological and stratigraphic section of the deposit No.2 (cont.)

On the results of the works, structural maps were constructed for the reflecting horizons of the Paleogene and Cretaceous, and drilling on the structure of 4 deep wells was recommended.

In 1975-78, the geological structure of the area was studied for the first time by a complex of geophysical and geochemical methods (CDP (common depth point), gas and gas-mercury surveys, VSP (vertical seismic profiling).

In the beginning of 80s, the entire described territory was covered by gravimetric surveying at a scale of 1:200000, magnetic survey and aerogammaspectrometry at a scale of 1:50000 (1983). As a result of the work, a gravimetric map, maps of magnetic and gamma fields, maps of concentrations of uranium, potassium and thorium, reflecting the specifics of the geological and tectonic structure of the area, were created. A number of prospective areas were highlighted (Figures 52, 53, 54).

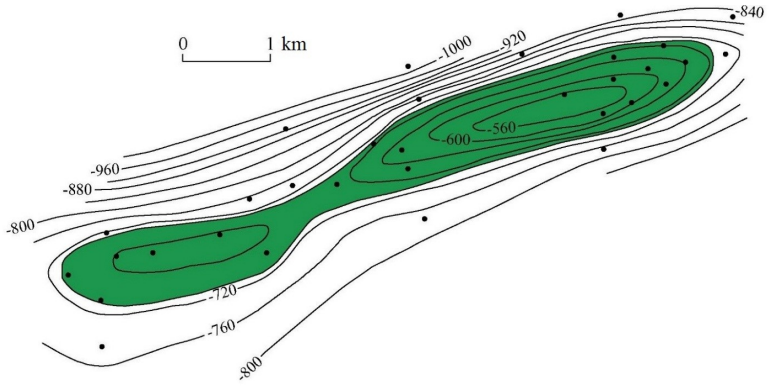

Figure 52. Structural map on the roof of horizon VIII of the deposit No.2

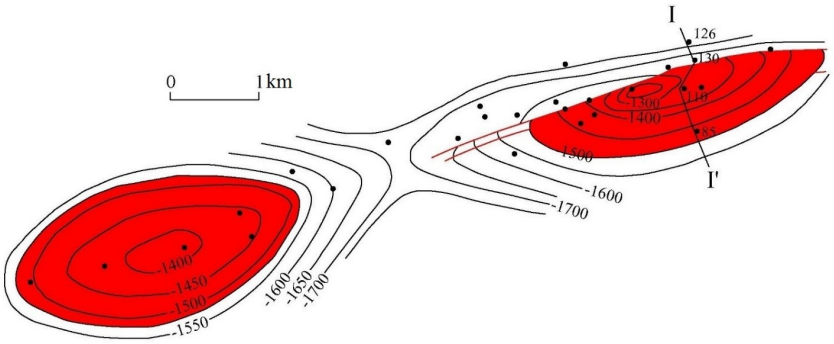

Figure 53. Structural map on the roof of horizon XXV of the deposit No.2

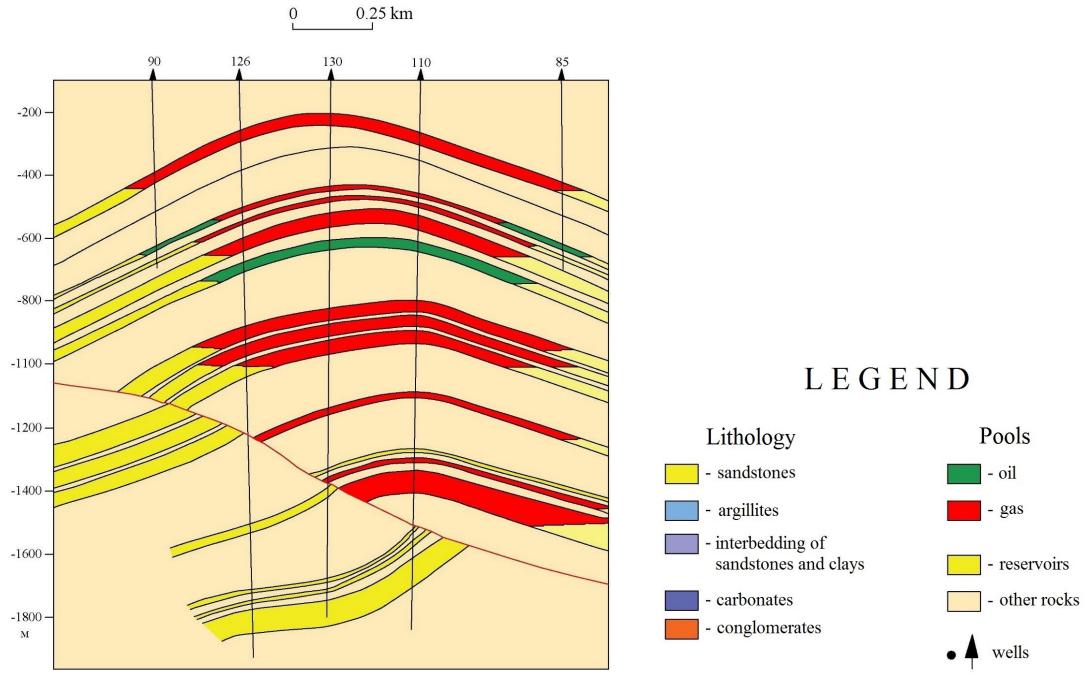

Figure 54. Section along the line I-I'

According to the results of gravimetric and magnetic surveys, a complex-block structure of the pre-Paleozoic foundation of the region was established. Sediments having different dense, magnetic and radio-geochemical characteristics are delimited.

From 1961 to 2010, oil and gas was mined at deposit No.2. In 2011, the field was not developed. The volume of mined products as at January 1, 2012 amounted to: IV layer – 585 thousand t of oil and dissolved gas, 16,189139 million $m^3$of free gas; VIII strata – 3407 thousand t of oil.

In 2012, on strata IV and VIII recalculation of oil and gas reserves of deposit No.2 was made. Total reserves on the category C_1 of deposit No.2 amounted to: oil – 4623.616 thousand t, free gas – 162.375 million m^3, dissolved gas – 297.212 million m^3.

The recalculation of reserves in 2012 was based on a limited number of materials. If more information is obtained from the predecessors, or data obtained during future works at the deposit, reserves can be transferred and recalculated to the side of greater reliability.

At the moment, work is underway to draw up a project for developing the deposit, attracting investors and searching for additional geological information.

SOCIO-ECONOMIC AND ENVIRONMENTAL ASPECTS

DEPOSIT NO.1

The commercial products of the concentration plant are copper-gold and silver concentrate. Gold, silver and copper are widely used in the jewellery industry, metallurgy, electronics, mechanics, military, chemical industry, engineering, communications, light industry and medicine, which guarantees the constant attractiveness of raw materials in the financial world.

Mining and marketing of copper-gold with silver concentrate is profitable in the current market conditions and under realistic scenarios of future market conditions. Currently, the price of gold in the domestic market of the country is about 1,500 US dollars/ounce, the market price of silver in the country is 590 US dollars/ kg, and the price of copper is set at about 5,825 US dollars/t. All necessary contracts are already executed.

In the immediate proximity of the considered deposit No.1, the same company developed a gold ore deposit, during the development of which a concentration plant was built. When developing deposit No.1, it is planned to use the same plant, which will lead to the reduction of capital investments.

The economic efficiency of the construction and development of the deposit is relatively good. The profitability, which is a measure of the economic efficiency of the use of fixed production assets and working assets according to calculations, will be 17.2%, and the payback period of investments is 1.8 years (the term of provision with reserves is 5.8 years), which fully indicates the very good prospects for this project. As a result, about 835 million soms will come from the implementation of the project to the budget of the Kyrgyz Republic. Thus, the development of the deposit No.1 by underground method is profitable. In addition, additional exploration will be carried out and in the future, it is planned to develop the deep parts of considered zones, flanks and other areas for underground mining, for which part of the capital costs for the underground works area can be allocated to the explored areas, which will generally improve the economic indicators on the developed underground works area.

During the development of the deposit No.1, in accordance with the requirements of the legislation of the Kyrgyz Republic, funds will be deducted to the local budget. These deductions will contribute to improving the infrastructure of the region. In addition, 80% of workers are planned to be hired from the local population, which will create conditions for improving the welfare of the population.

An open-pit method of development of this deposit would strengthen the negative attitude of the local population, which in the end could stop the development, therefore, despite the cost of the chosen method compared to open-pit development, it is planned to develop the deposit No.1 by underground method, in order to avoid unnecessary conflicts with the local population.

There are no settlements directly on the area, the nearest settlements are located 5-8 km south of the deposit. The vegetation in the region is very scarce and represented mainly by motley grass. The grass cover is developed to a height of 3600 m, above which lifeless talus and rock ridges are mainly found. The fauna of the area is poor. Groundwater during tunnelling and drilling was not found.

During the development of deposit No.1, the main negative impact of the works is predicted on atmospheric air, but with the remoteness of the deposit from settlements, this impact can be considered as low significance. To reduce the

impact of the mine on atmospheric air, if necessary, irrigation with industrial water of the mining face and ore carrier road will be carried out in warm weather. Construction and mining equipment that has certificates of compliance with exhaust gas composition parameters, noise level, vibration and other environmental impacts will be allowed to work at the deposit. On land and water resources, the impact of development is projected as an impact of low significance.

Ore processing will be carried out at a concentration plant located 18 km from deposit No.1. Due to the fact that the processing complex is located at a significant distance from residential settlements (more than 1 km), the environmental impact is not expected to be significant. To reduce the impact of emissions of pollutants into the atmosphere during the crushing, dust suppression by humidification with water will be carried out. It is planned a closed cycle for the use of aqueous solutions, and the discharge of solutions into the surrounding water basins is excluded. The base of the tailing site is equipped with an impervious membrane, which will provide reliable protection of groundwater from the penetration of cyanide solutions into them. In addition, cyanides under the influence of oxygen after two months are completely decomposed. Thus, a severely negative impact on the environment is not expected, from the side of the company, all measures will be taken to reduce the impact on the environment, as well as to prevent possible emergency situations.

DEPOSIT NO.2

The economic efficiency of the deposit construction and development has not been studied in more details, and it will be studied during the preparation of the development project, but it is necessary to note that mining works at deposit No.2 has already been done from 1961 to 2010, and the calculated residual oil reserves indicate the prospect of the restoration of oil mining from IV and VIII stratums at the deposit No.2. Reserves of dissolved gas do not provide for commercial value.

The early involvement of deposit No.2 in operation is a mutually beneficial and promising business for both the investor and the Kyrgyz Republic (KR), which currently imports more than 80% of oil and oil products. To date, extensive factual material has been accumulated that allows us to consider this deposit as very promising for hydrocarbon raw materials. Deposit exploitation will allow maintaining the existing structure of the oil and gas industry of the Kyrgyz Republic and will contribute to its further development.

In the distance from the cliffs of the river, the surface of deposit No.2 has absolute elevations of 800-820 m above sea level, and is accessible for any type of transport. The entire area of the deposit, in most cases, is covered with pebble rocks, which creates very favorable conditions for the laying of dirt roads. The entire licensed area is accessible for road transport all the year around; highways are suitable for heavy transportation. There are dirt roads along the entire area of the deposit along the main latitudinal depressions and meridionally oriented valleys of temporary watercourses and streams. Roads are passable for 12 months a year and suitable for transporting heavy loads and special equipment. In the area of operations, there is a railway station 85 km east of the license area. Directly north of the deposit area, in 30 km the railway junction (station) is located. Thus, a well-developed road system in the region and on the deposit itself indicates the absence of problems associated with the transportation of raw materials, which could lead to higher costs and lower profitability of the enterprise.

Two small settlements adjoin the area of the deposit. During the implementation of the deposit No.2 development, in accordance with the requirements of the legislation of the Kyrgyz Republic, funds will be allocated to the local budget. In addition, 60-80% of workers are planned to be hired from local residents, which will create conditions for improving the welfare of the population. Due to the desert nature of the relief, the territory of the deposit is not suitable for cultivation of agricultural crops and it is used only for pasture purposes in the spring. With the onset of summer, sparse vegetation dries, and flocks of sheep go higher to mountains.

At the moment, the environmental impact of deposit development has not been studied yet, and there are no recommendations on the development of measures to ensure the prevention of environmental pollution. These issues will be considered during drawing up a development project.

FIELD PROJECTS STATUS AND FEASIBILITY

DEPOSIT NO.1

The rocks composing the ore body and adjacent to it are not aquiferous. During the drilling of the wells, as well as during the tunnelling, there were no losses of flushing fluid and water inflows. Due to the location of the ore body on a steep slope, rainwater and snowmelt water freely flow down the slope. There are no water sources near the ore body. Thus, the hydrogeological conditions of underground mining have been identified as very favourable; they will not create difficulties in the development of the mine and can be assessed as simple.

The deposit has good transport conditions; there are dirt roads from the administrative centre to the mine, as well as from the mine to the concentration plant. A normal truck can pass along these roads. On the area of works and in its immediate vicinity, there are no settlements, power lines, gas pipelines, bridges and other security facilities. The supply of raw materials, fuel, construction materials can fully satisfy the local market.

In addition, the karst-forming process in the deposit area is not developed. According to seismicity, the area belongs to the 9-point zone. Based on the above, we can conclude that the technical conditions for mining at the deposit are simple.

Detailed exploration works at deposit No.1 began in 2017. The purpose of the detailed exploration was to obtain explored reserves in categories C_1 and C_2 through the exploration of the ore bodies of deposit No.1. Exploration of ore body No.1 was carried out by bulldozer cuttings (955 m^3) in combination with ditches (385 m^3), tunnelling at an altitude of 3860 m (247.5 l.m), as well as drilling deviated wells (345 m). Exploration of ore body No.2 was carried out by digging ditches (270 m^3), tunnelling on the horizon of 3740 m (187.1 l.m.), as well as drilling deviated wells (560 l.m). In addition, a topographic survey of the area of works on a scale of 1:2000 was carried out, as well as the fixing of all the mine workings.

All potentially ore-bearing intervals opened by ditches, adits and cuts were subjected to trench sampling and opened by drilling wells to core sampling. In total, 94 core samples and 215 trench samples were taken, of which 5 core samples and ten trench samples were taken for internal control of sample analysis. The average discrepancy in the main component (gold) between the control and the main samples was 2.4% (5% is acceptable). The obtained results allow us to conclude that the errors that occur do not go beyond the norms characterizing the correct processing and analysis of samples. Thus, the reliability of the analytical results of sampling on the deposit allows them to be used in reserves calculating.

Besides trench and core samples, one technological sample was selected from the adit, according to this technological sample, the material composition and technological properties of ores were studied. The purpose of these studies was to provide a technically feasible and economically reasonable treatment process for the development and use of mineral resources, through a detailed study of this type of gold. According to the results of the study, two types of ore were identified: pyrite in calcareous breccia and skarn and chalcopyrite in skarn. The bulk is pyrite. In addition, a flotation scheme with two cleanings was proposed.

In order to obtain additional information on the composition and properties of ores and enclosing rocks mineralogical, petrographic and other studies were carried out within site. Crushed samples, samples for the making of thin sections, polished thin sections and determination of unit weight were sampled on workings. According to the results of mineralogical studies of the ore process, the main metal minerals in the ore are chalcopyrite, pyrite, limonite, etc. Enclosing rocks mainly include hornblende, pyroxene, quartz, graphite and others. The above methods, as well as the results of work carried out in 2010-2012, clarified the position of ore bodies No.1 and No.2, their sizes, shapes and contents. Consequently, of complex works on the surface (ditches, cuts) and adits horizons, as well as drilling from the surface, data's on ore bodies were obtained. Good results were obtained that met the requirements of detailed exploration.

Geological exploration works allowed to calculate the reserves of the first stage in the contours of the mine workings for ore body No.1 of deposit No.1 in categories C_1 and C_2, for ore body No.2, the works carried out are not sufficient for placing the reserves on the State balance and it is planned to continue exploration by wells.

In the north-east and south-west directions, the explored body No.1 sharply goes under overburden, in further exploration, it is planned to trace it to the north-east and south-west, because its continuation is recorded by geophysical studies, both by the IP (Induced Polarization) method and the magnetometry method. Its further exploration is planned by tunnelling and drilling wells.

In addition, during the exploration of ore body No.2, one of the wells crossed ore body No. 3 located in the mineralized zone No. 3, which is located on the hanging side of the fault, along which the D_2žv dolomites came into contact with C_1v limestones. Subsequently, its detailed exploration by ditching and drilling of deviated wells is recommended. Based on the obtained results, a Project for the exploitation of this deposit was developed, and it is also planned to develop a project for subsequent additional exploration.

As indicated above, the development of the ore body will be carried out by underground method, using a mining system with ore shrinkage and ore sublevel caving, by ore haulage from mine workings. This development method is selected based on the relief, bedding of the ore body, and also to avoid conflicts with the local population.

DEPOSIT NO.2

There are no small water sources on the surface of deposit No.2. Only one river flows in the deposit, dividing the structure into two parts. During the drilling of exploratory wells, water inflows were not observed at the deposit, even when drilling on a light clay mud with a unit weight of 1.20-1.25 g/m^3. They can prove themselves during prolonged downtime when suspended clay particles fall out of the mortar. When testing wells, water overflow was observed, but not in all wells, only in some of the drilled Paleogene sediments. The flow rates of overflowing water in all wells are insignificant. Based on the foregoing, we can conclude that in the Paleogene sediments, there are no high pressure waters. All stratal water of the Paleogene of deposit No.2 belongs to the calcium-chlorine type with a high concentration of salts.

As mentioned above, the entire licensed area is accessible for road transport year-round, highways are suitable for heavy transportation, which indicates a well-developed road network in the region and at the deposit No.2. On the territory of the deposit, there are no underground, underwater and ground communications and protected natural areas. There are no drinking water intakes in the zone of influence of the deposit. Thus, the mining conditions of the deposit are favourable for the development of reserves.

In 1950, deposit No.2 was put into detailed exploration. Due to the displacement of the crest of the Paleogene fold to the south for 2.8 km (as established by seismic surveys), the first three wells laid near the axis of the fold based on geological survey data did not give results. Further drilling, taking into account the displacement of the crest, lead to the discovery of gas deposits: in 1955 – in horizons V and VII, in 1956 – in horizon III and oil deposits in horizons IV and VIII. Subsequently, the gas content of the Cretaceous and Jurassic sediments was established.

Exploration began in 1950 by drilling well 1, which was located on the surface axis of the fold. At design depth of 1500 m, the well did not emerge from the Neogene sediments. Well 2 was drilled 550 m south of the first one in 1954, and at the depth of 2330 m it opened the VII horizon of the Paleogene. As a result of testing of the VII, V and IV stratums, inflows of stratal water were obtained. Well 3 was drilled in 1955, 500 m south of the second. When testing the VII stratum, water with a small amount of gas, from the V stratum of the Paleogene – water with oil films, from the IV – water with oil were obtained. Simultaneously with drilling in 1955, seismic surveys were carried out, which revealed an anticlinal bend of the reflecting horizon 1800 m south of well 3. Well 4, located in the crest (according to geophysical data) of the upheaval, in 1955 industrial gas content of the VII and V horizons and the industrial oil content of the IV horizon of the Paleogene revealed. In 1956, an oil gusher was obtained from stratum IV. In the same 1956, oil gushers from stratum VIII were received in wells No. 6 and No. 8, and gas content of the stratum III was established. Later, industrial oil and gas reservoirs were discovered in the Cretaceous and Jurassic sediments.

Initial explored reserves of oil – 4.5 million t, gas – 7.9 billion m^3. In 2012, reserves were recalculated using available information for two horizons.

CONFIDENCE IN ESTIMATES

DEPOSIT NO.1

The deposit area is composed of carbonate sediments of the Middle Devonian, Lower. Carboniferous (C_1v) and carbonate-terrigenous sediments of the Lower-Middle Carboniferous (C_12). At deposit No.1, three main mineralized zones are distinguished.

As a result of complex works on the surface (ditches, cuts) and adits horizons, as well as drilling from the surface, data were obtained on ore body No.1 and No.2. As mentioned above, the exploration works allowed the calculation of reserves of the first stage in the contours of the mine workings for ore body No.1 of deposit No.1 in category C_1, and for ore body No.2, the works carried out is not sufficient to place reserves on the State balance and further exploration is planned.

The size of the explored ore body No.1 at deposit No.1 is small. The explored length of the bed is only 61 m. The thickness of the ore body is 10.4-17.8 m. The ore body is traced to the dip to 7085 m. The dip angle of the ore body is 55-75°.

Ore body No.1 is represented by a vein-like body of uneven on thickness (a pronounced bulge is noted) with an uneven content of useful components. The content of the ore body is uneven (appendices 1-3). Based on the above in terms of the complexity of the geological structure, the deposit belongs to 3 group: a complex geological structure, represented by vein zones with ore bodies thickness up to 1-2 m or more with a very uneven distribution of mineralization, often discontinuous.

The exploration network of wells for category C_1 is approved for strike and dip – 40×40 m. Drifts were carried out along the strike of the zone from the adit, and cross headings through 20-30 m were carried out from the drifts, which also corresponds to the closeness of the exploration network for category C_1 reserves. For category C_2, geologically justified extrapolation to half of the distance between the workings that opened the useful strata.

For the explored ore body No.1 of deposit No.1, the entire range of geological exploration was carried out: prospecting routes, lithochemical sampling along secondary aureoles, excavation of ditches and cuts, excavation of underground mines, core drilling, sampling, chemical-analytical and topographic and geodetic studies, study of ore material composition and their technological properties. Thus, ore body No.1 along the strike and dip was studied in details.

The necessary and sufficient degree of exploration of solid minerals reserves is determined depending on the geological structures complexity of the deposits. The considered goldpolymetallic deposit No.1, as indicated above in terms of the complexity of the geological structure, refers to deposits of 3 group: a complex geological structure, represented by vein zones with ore bodies up to 1-2 m or more in thickness, with very uneven mineralization distribution, often discontinuous. Reserves of deposits of this group are prospected mainly in categories C1 and C2, which corresponds to the categories of reserves calculated according to the results of detailed exploration carried out in 2017-2019.

To calculate the balance reserves of the first stage of ore body No.1 of deposit No.1, the cut-off grade was taken 1 g/t, the maximum thickness of substandard ores was 1.0 m, the minimum thickness of ore bodies was 1.0 m, and the limiting grade of ore was 2.47 g/t. The listed parameters of conditions for the assessment of reserves were obtained by the results of a feasibility study.

Considering the simple structure of ore body No.1, its sustained thickness, inclination angle, and also relatively uniform mineralization distribution, reserves were calculated using the method of geological blocks with the projection of the ore body onto a vertical plane. To verify the results, a calculation was also performed according to the method of geological blocks with the projection of the ore body on a horizontal plane, the difference between the two methods of calculation is less than 5%, which indicates the correct choice of methods for calculating reserves.

In each calculating block, the average true thickness of ore bodies was determined. By this thickness and the vertical projection area, the volume was determined. The product of this volume to the density of ore (the value of which is 3.0 t/m^3) gives ore reserves for the block. The reserves of gold, silver and copper were calculated by multiplying the ore reserves to the weighted average content of useful components in it, which was determined by considiring the replacement of topcut grades.

The average gold content of individual workings (calculation sections) was determined as the weighted average of private samples for their length, taking into account conditional limits, and the average gold content of the calculation block was determined as the weighted average of all calculation sections through the total thickness included in the calculation block.

In order to identify and suppress top-cut grades, it was customary to prevent overstating a separate breakdown of the average weighted grade by more than 20%. With this approach, the possibility of a sharp overstatement of the contents due to top-cut grades and, at the same time, a reduction of average contents, and, consequently, the reserves of the deposit, is excluded.

According to the calculation results, the on-balance reserves of the first stage of ore body No.1 in categories C_1 and C_2 amounted to: gold – 1652.684 kg, copper – 2468.7 tons, silver – 7920.5 kg with an average ore grade of 5.48 g/t , 0.82%, 26.26 g/t, respectively.

DEPOSIT NO.2

Deposit No.2 is a multi-pool type with a wide stratigraphic range of oil and gas productivity.

At deposit No.2, horizons III, V, VII of the Paleogene contain gas pools with very small accumulations of oil in separate areas. In crest position part of horizon IV, a gas cap is developed with an oil slug, the width of which reaches 750 m within the hollow southern wing. Horizon VIII is oil-bearing.

The largest area of oil and gas content is horizon IV. The length of the pool is 8 km, width 1.8 km, height 320 m; the sizes of the gas cap are respectively: 5.5 km, 0.6 km and 240 m. The gas content area of horizons III, V, VII is approximately the same and is 7 × 1.1 km, the heights are respectively 240, 180, 140 m. An even smaller area (5.8 × 0.8 km) is occupied by the oil pool of horizon VIII. The height of the pool is 160 m.

Gas pools in the Cretaceous sediments (horizons XIV, XV-a, XVIII and XXII) occupy the highest part of the structure and have small sizes. A gas pool has been discovered in Jurassic sediments. All pools are stratified, crested.

Horizon III is gas-bearing, with signs of oil content. Horizon III lies in the roof of the Sumsar layers at a depth of 1070-1350 m. It is represented by gray fine-grained quartz sandstones with intercalations of raspberry-coloured clays. The total thickness of the horizon is 24.5 m, the total thickness of the productive layers is 14 m. Porosity ranges from 9 to 38% and averages 20%; permeability averages 86 mD. The initial reservoir pressure is 129 atm, the initial gas flow rate is 580-900 thousand m^3. The gas content contour of a reservoir of III stratum is determined at elevation – 400 m.

The stratum IV of the Rishtan stage contains oil and gas. The oil pool of the IV stratum in plan lies outside the oil pool of the VIII stratum. Horizon IV in the upper part is represented by dense gray limestones, and in the lower part by gray fine-grained sandstones with interlayers of green clays and marls. The total thickness of the horizon is 10.4, effective – 2.6 m. The average porosity is 17%, the depth of the horizon is 1300-1420 m. The initial strata pressure in the gas cap is 149, in the oil pool 156 atm.

The stratum V in the sediments of Turkestan stage is gas-bearing, and during the sampling condensate was discharged along with gas in well No.23. Horizon V is composed of gray and greenish-gray limestones with interbeds of green clays and marls. The total thickness of horizon is 11 m, effective thickness is 5 m. The average porosity is 10%, the permeability in the studied samples does not exceed 136 mD. The occurrence depth of the productive part of the horizon is 1370-1450 m, strata pressure is 148 atm. The initial gas flow rate for wells ranges from 80-420 thousand m^3/day.

Horizon VII within the deposit is gas-bearing. And it is represented by gray dolomitic limestones with a 3rd layer of green clay, dividing the horizon into two parts. Limestones contain interlayers of dark green marls and bluish-gray anhydrides. Since the reservoir properties of both parts of the horizon are identical, they are considered together. The total thickness of the horizon VII is 34 m, the effective thickness is 15.3 m, the occurrence depth within the pool is 1380-1520 m. The initial strata pressure is 150 atm, the initial flow rate is 190-420 thousand m^3/day.

Horizon VIII is oil-bearing. There is no gas cap within the stratum. Occurrence of the horizon VIII is in depth of 1470-1590 m. It is composed of gray and white sandy limestones with interlayers of green and brown clays, bluish-gray anhydrides and gray sandstones. The total thickness of the horizon is 33 m, the total thickness of productive interlayers does not exceed 16 m. Porosity 1521%, average porosity 18%, permeability 160-180 mD. The lower sandy part of the horizon stands out as horizon IX, but due to the absence of an impenetrable seal, both horizons in field practice are combined into one object. The initial strata pressure in the oil pool is 144 atm, the initial flow rate with a 6-mm nozzle is 35-40 tons/day, with a 10-mm nozzle 70-90 t/day.

There are four gas-bearing horizons in the Cretaceous complex, the reservoir properties of which are poorly studied.

Occurrence of the horizon XIV is in the middle of the variegated stage of the Upper Cretaceous. The reservoir are sandstones containing a gas pool. When testing well 12, a gas gusher was obtained with an absolutely free flow rate of 1130 thousand m^3/day.

Horizon XV-a is related to the middle part of the Yalavach Formation, represented by sandstones. It contains gas pool. In well 18 in 1958, a gas gusher was obtained with an absolutely free flow rate of 1280 thousand m^3/day.

The horizon XVIII of Lakan Formation is composed of limestones with interlayers of clay. Effective power 17 m, effective porosity 12%. Absolutely free flow rate reaches 500 thousand m^3/day.

Horizon XXII is related to sediments of the Muyan Formation of the Lower Cretaceous, composed of limestones. It contains gas pool. The gas flow rate in well 18 in 1959 reached 252 thousand m^3/day.

The Jurassic sediments horizon contains a gas reservoir. The reservoir is limestone, of which in 1959 in the interval 2030-2040 m in well 67 gas was obtained with an absolutely free flow rate of 40 thousand m^3/day.

Among the gases of the deposit, horizon VII gas, which contains a greater amount of hydrogen sulfide, occupies a special place.

The characteristic of gases of Cretaceous sediments is as follows: density 0.645-0.687 g/m^3, hydrogen sulfide content is insignificant, methane 93-96%, nitrogen + rare 3-5%.

Available information allows possibility to recalculate reserves for horizons IV and VIII.

At deposit No.2, the oil pool in the IV stratum is held in conjunction with slug located between the gas cap and the stratal waters supporting the oil pool. The length of the deposit is about 8 km. Horizon IV in the upper part is represented by dense grey limestones, and in the lower part by grey fine-grained sandstones with interlayers of green clays and marls. The contouring of the reservoir is based on the results of well testing.

The boundary between the oil pool and atmospheric waters in the eastern part of the structure is taken on well 16 that supplied oil and well 15 that supplied water. The southern border is taken at wells 31, 29, 26 that supplied oil and

well 15 that supplied water. Thus, the southern and western borders pass at elevation 660 m. In the northern part of the structure, oil was received from west to east in wells 32, 25, 30 and 16, and is delimited at elevation 700 m. The western part of the structure, as can be seen from the graphic appendices, it is flattened and accepted by us at an elevation of 660 m.

The contouring of the boundary between the oil pool and gas cap is also based on well testing results. Based on the testing data of wells 4, 12, 23, 21 that supplied oil and wells 13, 5, 10, 20 that supplied gas, we note that the southern boundary passes at elevation of 580 m, and the northern boundary is 560 m.

The maximum length of an oil deposit from east to west is 8.5 km, and from north to south 2 km. The oil area (S_1) is 7.909 km^2. The true oil-bearing area, adjusted for a dip angle of 20°, will be:

$$S\ (C_1) = S_1/Cos\alpha = 7.909/0.93969 = 8.4166\ km^2$$

Horizon VIII is oil-bearing. There is no gas cap within the stratum. Occurrence of the horizon VIII is in a depth of 1470-1590 m. It is composed of gray and white sandy limestones with interlayers of green and brown clays, bluish-gray anhydrites and gray sandstones.

The contouring of the pool is based on the results of well testing. So, according to the test results, oil was obtained from wells 4, 6, 22, water with oil from wells 20, 10, water from wells 19, 5, 16, 15. Thus, the oil-water contact ideally passes at elevation 710 m. The maximum length of oil pools from east to west is 6.5 km, and from north to south 0.8 km. The oil-bearing area (S_1) is 3.856 km^2. The true oil-bearing area, adjusted for a dip angle of 25°, will be:

$$S\ (C_1) = S_1/Cos\alpha = 3.856/0.9063 = 4{,}2547\ km^2$$

In 2012, a recalculation of reserves was compiled based on a limited amount of materials. If more information is obtained from the predecessors, or data obtained during future works at the deposit, reserves can be transferred and recounted to the side of greater reliability. Reserves of category C_1 of the deposit No.2 for stratums IV and VIII amounted to: oil – 4623.616 thousand t, free gas – 162.375 million m^3, dissolved gases – 297.212 million m^3, of these on-balance reserves on category C_1:1019.9 thousand t of oil and 65.241 million m^3 of dissolved gases.

CLASSIFICATION OF THE SELECTED PROJECTS USING UNFC

Based on the above information, each of the studied objects can be classified using UNFC.

DEPOSIT NO.1

The first of the criteria for evaluating a deposit according to the United Nations Framework Classification is the criterion for the economic and social viability of the project (E-axis).

As indicated above, a commercial product of a concentration plant is copper-gold with silver concentrate. Mining and marketing of copper-gold with silver concentrate is profitable in the current market conditions and under realistic scenarios of future market conditions. Currently, the price of gold in the domestic market of the country is about 1,500 US dollars/ounce, the market price of silver in the country is 590 US dollars/kg, and the price of copper is approximately 5,825 US dollars/ton. All necessary contracts are already executed. The economic efficiency of construction and development of the deposit is relatively good. The profitability, which is a measure of the economic efficiency of the use of fixed production assets and working assets according to calculations, will be 17.2%, and the payback period of investments is 1.8 years (the term of provision with reserves is 5.8 years), which fully indicates the very good prospects for this project. As a result, about – 835 million soms will come from the implementation of the project to the budget of the Kyrgyz Republic.

During the development of the deposit No.1, in accordance with the requirements of the legislation of the Kyrgyz Republic, funds will be deducted to the local budget. These deductions will contribute to improving the infrastructure of the region. In addition, 80% of workers are planned to be hired from the local population, which will create conditions for improving the welfare of the population.

An open-pit method of development of this deposit would strengthen the negative attitude of local population, which in the end could stop the development, therefore, despite the cost of the chosen method compared to open-pit development, it is planned to develop the deposit No.1 by underground method, in order to avoid unnecessary conflicts with the local population. During the development of deposit No.1, the main negative impact of the works is predicted on atmospheric air, but with the remoteness of the deposit from settlements, this impact can be considered as low significance. On land and water resources, the impact of development is projected as an impact of low significance.

Ore processing will be carried out at a concentration plant located 18 km from deposit No.1. Thus, sharply negative impact on the environment during the development of field No.1 is not expected. Company will take all measures to reduce environmental impact, as well as to prevent possible emergencies. Mining of deposit No.1 by underground method is profitable, which corresponds to category E1.1 in the UNFC. In addition, additional exploration will be carried out and in the future it is planned to develop the deep parts of the considered zones, flanks and other areas for underground mining, in connection with which part of the capital costs for the underground works area can be allocated to the exploration areas, which will generally improve the economic indicators of the working area of underground works.

The next, but no less important criterion for evaluating a deposit according to the United Nations Framework Classification is the criterion for the status and validity of the project (F-axis).

As mentioned above, presently, on ore body No.1 of deposit No.1 detailed studies have been completed, and development project has been drawn up that demonstrates the expediency of mining. The development of the ore body is planned to be carried out by underground method using a system with sub-level caving of ore. Thus, the deposit corresponds to category F1.3.

The third criterion underlying the classification is the assessment of the reliability of the data used. Based on the results of detailed exploration, which was carried out in 2017-2019, reserves were calculated. On-balance reserves of the first stage of ore body No.1 in categories C_1 and C_2 were: gold – 1652.684 kg, copper – 2468.7 tons, silver – 7920.5 kg with an average ore grade of 5.48 g/t, 0,82%, 26.26 g/t.

As is known in the UNFC, three degrees of geological knowledge reliability are indicated for known (discovered) deposits: “high”, “medium” and “low”, they are represented by categories G1, G2 and G3. In the classification of the Kyrgyz Republic these degrees are represented by categories A (high), B (medium), C_1 and C_2 (low). Thus, the reserves calculated according to the results of the works of 2017-19 are related to reserves with low reliability of knowledge. But it should be noted that for deposits of the 3rd group of geological complexity, the low reliability of the reserves studied is sufficient for further development.

Finally, deposit No.1 is classified as: E1.1 F1.3 G3, that is, mining of the deposit No.1 and the marketing of minerals are profitable under current market conditions and realistic predictions of future market conditions. Mineral reserves are classified as reserves with a low reliability rating. At the moment, detailed studies have been completed in deposit No.1 which were targeted to demonstrate the expediency of mining by implementing a specific development project or mining operations.

DEPOSIT NO.2

Consider the first criterion for evaluating a deposit according to the United Nations Framework Classification, namely, the criterion of economic and social viability of the project (E-axis).

The economic efficiency of the deposit construction and development has not been studied in more details and it will be studied during the preparation of the development project, but it is necessary to note that mining works at deposit No.2 has already been done from 1961 to 2010, and the calculated residual oil reserves indicate the prospect of restoration of oil mining from IV and VIII stratums at the deposit No.2. Reserves of dissolved gas do not provide for commercial value.

The early involvement of deposit No.2 in operation is a mutually beneficial and promising business for both the investor and the Kyrgyz Republic, which currently imports more than 80% of oil and oil products. A well-developed road network in the region and on the deposit indicates the absence of problems associated with the transportation of raw materials, which could lead to higher costs and lower profitability of the enterprise. Two small settlements adjoin the area of the deposit. During the implementation of the deposit No.2 development, in accordance with the requirements of the legislation of the Kyrgyz Republic, funds will be allocated to the local budget. In addition, 60-80% of workers are planned to be hired from residents, which will create conditions for improving the welfare of the population.

Due to the desert nature of the relief, the territory of the deposit is not suitable for cultivation of agricultural crops and it is used only for pasture purposes in the spring. With the onset of summer, sparse vegetation dries, and flocks of sheep go higher to mountains. As of now, the environmental impact of deposit development has not been studied yet, and there are no recommendations on the development of measures to ensure the prevention of environmental pollution. These issues will be considered during drawing up a development project. Thus, the profitability of mining and marketing has not been confirmed yet, but based on realistic predictions of future market conditions, there are reasonable prospects for profitable mining and marketing in the foreseeable future (E2).

The mining conditions of the deposit No.2 development were studied in more detail above, it should be noted that they are favorable for mining the reserves. At the moment, work is underway to draw up a project for developing the deposit, attracting investors and searching for additional geological information. Based on this, it can be concluded that preliminary studies of deposit No.2 show the presence of pool, the validity of mining that can be assessed by specific development project. Thus, the project continues to be implemented on the deposit in order to justify development in the foreseeable future and can be classified as F2.1. It is necessary to note that all of the above characteristics related to the on-balance reserves determined at the deposit. Off-balance reserves are characterized as unprofitable by the UNFC and can be attributed to E3.3. F4.

Presently, based on available data, it has become possible to calculate or estimate oil and gas reserves for stratums IV and VIII. Oil and gas reserves were calculated for category C_1. It should be noted that the calculation of reserves for category B is doubtful, because reserves for this category are calculated on the basis of approved technological scheme for deposit development, which is absent in the Kyrgyz Republic and will be developed. According to the methodology, reserves of category C_1 are calculated according to the results of exploration and exploitation drilling and should be studied to the extent that provide initial data for drawing up a technological scheme for oil deposit development or a deposit pilot development project. Thus, category C_1 is the most optimal.

As indicated above, the reserves of category C_1 in the UNFC refers to reserves with a low degree of reliability, that is, corresponds to category G_3. If more information was obtained from the predecessors, or data obtained during future works at the deposit, reserves can be transferred and recalculated to the side of greater reliability. Thus, deposit No. 2 can be assigned by code E2. F2.1. G3 in UNFC, but do not forget that there are additional quantities of oil and gas in the stratum that correspond to code E3.3. F4. G3.

ALIGNMENT TO SUSTAINABLE DEVELOPMENT GOALS IMPLEMENTATION

National Development Strategy of the Kyrgyz Republic for 2018-2040 was created in November 2018. In this strategy, the main stages of mining industry development were identified, which are described below.

Kyrgyzstan has a competitive industry in the country's priority sectors, which promotes full and productive employment and decent work. The industry structure is diversified and export-oriented, it relies on its own resources and production base, and it is integrated into regional and global value chains, taking into account participation in integration associations such as the EAEU, as well as interfacing of the EAEU and One Belt – One Road projects. The modernization and expansion of the capacities of existing sectors were carried out.

Citizens will have access to productive and highly profitable jobs that stimulate technical education and creativity. The industry will develop comprehensively, effectively use its own resource and production base, while the importance will be given to the proportional distribution of enterprises throughout the country. Complementary industries will be integrated as part of clustering solutions to increase competitiveness for types of products.

It is necessary to achieve an increase in the efficiency of mining, the introduction of modern mining technologies with minimal environmental impact. The development of minerals should ensure the formation of financial resources for development. Incomes from subsoil should be directed not only to solve current problems of developing the environment, but also to strategic targets. Renewable capital funds should be created, which will be aimed at developing the future, developing technologies, innovations, innovations in business, economy, culture, etc. This activity will continue until the missions of economic and social development of Kyrgyzstan will be sustainable and fully provided with funding from other sources. Subsoil use should be carried out in compliance with the whole range of environmental protection requirements, including the rehabilitation of natural landscapes and disturbed lands, and under public control. Important is the support of scientific research and training of specialists in the field of subsoil use. The development of competitive production of high-quality oil products and construction materials will ensure saturation of domestic market and development of export potential. The high dependence of Kyrgyzstan on the import of fuels and lubricants, the lack of sufficient own reserves of hydrocarbon materials necessitate a policy to encourage the increase of extraction and production of fuel of high environmental quality standards. The priority will be the transition to the use of high-quality fuels in combination with the expansion of the use of alternative energy sources. At the same time, it is necessary to diversify energy sources for the needs of the country's economy.

The development of significant reserves of non-metallic minerals in conformity with environmental protection requirements and the interests of local communities, the production of high-quality modern construction materials will create conditions for the accelerated development of the construction industry. This will contribute to increasing of the housing construction, social and industrial facilities, the transition to new architectural and construction systems, types of buildings and modern technologies.

Conditions will be created for developing the potential of the jewelry industry with the key objective of entering international markets. It is necessary to create sub-sectors of the manufacturing industry, particularly assembly plants, components, and the restoration of idle enterprises. The development of industries should ensure the growth of productive employment and decent work for citizens of the country; cooperate to the development of industrial technologies and exact sciences in Kyrgyzstan. Domestic manufacturing industry should be focused on the formation of export potential and import substitution of certain goods. The basis of industrial policy will be the localization of foreign industrial enterprises, entry into intercountry value chains, and creation of favorable conditions for access to production infrastructure. The development of industrial zones in various regions will be encouraged.

The adoption of the UNFC in Kyrgyzstan will lead to improvement of the investment climate, which would make it possible to advance towards the achievement of SDG 7 and 9. In addition, an increase in investment flows will directly affect the social status of the people, which will advance the achievement of SDG 1, 2 and 8. The environmental aspect will arguably not change as a result of the implementation of UNFC, but attracting investment in renewable energy can support the achievement of SDG 11 and 13.

RENEWABLE ENERGY SOURCES IN KYRGYZSTAN

Kyrgyzstan has enormous potential for the use of renewable energy sources, the topic of using these sources every day is becoming increasingly important. According to the estimation of the State Committee for Industry, Energy and Subsoil Use of the Kyrgyz Republic and data from foreign institutions, the energy potential of renewable energy sources in Kyrgyzstan are:

- Solar energy – 490 million kWh/year;
- Water energy, small rivers and watercourses - 5-8 billion kWh/year;
- Wind energy – 44.6 million kWh/year;
- Biomass energy - about 1.3 billion kWh/year.

However, the practical use of renewable energy in Kyrgyzstan is less than 1%. Difficulties in attracting investment are the main obstacle to the development of renewable energy in Kyrgyzstan.

SMALL HYDROPOWER PLANTS

Dozens of large and hundreds of small rivers and canals flow through the territory of the Kyrgyz Republic, into which thousands of alpine streams flow. The republic ranks third in the CIS after Russia and Tajikistan. Country has a huge hydropower potential, which amounts to 142.5 billion kWh/year of electricity generation, only 10% is used.

Currently, 16 small hydropower plants (HPP) are operated in the Republic. On proposals of specialists, now it is possible to build 87 new small HPP with a total capacity of 178 MW and an average annual output of up to 1.0 billion kWh of electricity. In addition, it is possible to restore 39 previously existing small HPP with a total capacity of 22 MW and an average annual output of up to 100 million kWh of electricity. The total hydropower potential of the 172 rivers and watercourses surveyed in the republic with a water flow of 0.5 to 50 m^3 per second exceeds 80 billion kWh/year, of which the technically acceptable hydropower potential for development is 5-8 billion kWh/year [4]. Figure 55 provides a map of perspective small HPP in the Kyrgyz Republic.

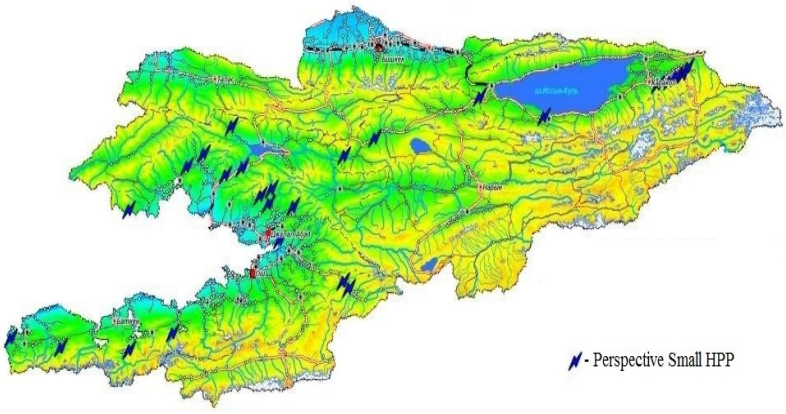

Figure 55. Map of perspective small HPP in Kyrgyzstan

SOLAR ENERGY

There are enough sunny days in Kyrgyzstan, therefore, solar energy is in the second place on perspectivity. But in the current conditions, Kyrgyzstan needs large capital expenditures and investments. With current electricity tariffs in the Kyrgyz Republic, attracting investors is problematic due to the long payback period of such project. Presently, there are no large solar stations in Kyrgyzstan; small photovoltaic panels are mainly used in small enterprises and households.

Under UNIDO, jointly with UNDP and WHO, the project "Reliable energy supply to rural medical and obstetrical stations" installed photovoltaic stations (3 kW and 1.5 kW) in all regions of the Republic in 19 medical and obstetrical stations, which ensured uninterrupted operation of these stations, thereby ensured the continuous provision of medical services to the population, including women and children [3].

In 2018, in Kyrgyzstan, together with the Asian Development Bank, a project was launched to introduce new technologies in the field of renewable energy resources (RES) energy-saving technologies in the Kyrgyz Republic. Presently, 300W autonomous power supply kits are being installed with household appliances (a set of solar panels, a controller with rechargeable batteries, a TV, a fridge / freezer, LED bulbs / lamps).

So, as a result of the analysis and consultations, taking into account the fact that this year has been declared the Year of Regional Development, the State Committee of Industry, Energy and Subsoil use suggested distributing these kits for the electrification of several villages, including Ken-Suu village of the Zhumgal region of the Naryn province. The complexity of the mountainous terrain and the lack of roads was an obstacle to the electrification of the village.

In addition, in the Ken-Suu village of Zhumgal Region of Naryn Province, the State Committee of Industry, Energy and Subsoil use together with the technical team of ADB consultants and employees of "National Energy Holding Company" OJSC have already installed 15 sets of the above installations. On successful use of such devices, the State Committee of Industry, Energy and Subsoil use together with ADB will analyze the implementation of these sets of autonomous energy supply throughout the country for partial electrification of non-electrified areas [6].

WIND ENERGY

According to weather stations, in the regions of the Kyrgyz Republic wind velocity ranges from 0.8 to 6 m/s and the potential of wind energy also varies depending on its velocity. The reserve of wind energy potential, calculated by the average annual wind velocities, is set at approximately $49.2*10^5$ tons of reference fuel. The specific power of the wind flow energy also fluctuates in a fairly large range:40-180 W/m^2 annually; 30-230 W/m^2 monthly; 100 W/m^2 in average.

Average annual specific energy of wind flow varies from 170 to 1300 kWh/m^2, and average monthly value does not exceed 50-60 kWh/m^2. Wind flows energy gross potential is 2 billion kWh/year, of which 44.6 million kWh are technically feasible, about 4 million kWh can be considered economically viable. Such a spread is explained by the distribution conditions of the wind rose in high mountain regions. The analysis carried out according to the static data of weather stations showed that more than 50% of all winds are light winds and calms (0-1.5 m/s), 30-40% are weak winds (2-5 m/s), and 10-20% - for moderate and fresh winds (6-10 m/s). Low-energy autonomous consumers are mainly located in lowland and foothill zones, where the energy potential of the wind flow is low. In areas where the winds with significant velocities (8-12 m/s) and with high-energy potential, consumers are almost absent [5].

A perspective object of the Kyrgyz Republic for wind energy is Boom Gorge. A cascade of wind turbines can be established along this gorge. But because hurricane winds often occur there, wind generators must be structurally protected from strong winds. Ultimately, all costs will be justified. If there was interest and finances, it would be possible to establish at least a few experimental facilities, obtain the results and draw the appropriate conclusions.

APPLICATION OF THE UNFC TO RENEWABLE ENERGY

To date, the main problems in the implementation of projects for the introduction of renewable energy sources are insufficiently developed appropriate regulatory framework and low electricity prices. In addition, as mentioned above, in Kyrgyzstan there is no classification of reserves and prognostic resources for renewable energy sources, which complicates the attraction of investors in this field.

The cost of electricity produced by large HPP is lower than that generated from renewable energy sources. Considering basic tariff for electricity generated by large HPP, established in the Kyrgyz Republic, the payback period for investments in renewable energy sources is much longer than in Europe, which repels most investors.

Every year, the area of glaciers in Kyrgyzstan is reduced, as a result of which the water content of rivers is reduced. According to predictions, in 2022 the Kyrgyz energy system will experience a shortage of electricity from 0.8 billion kWh/year, in 2028 to 6 billion kWh/year. The power shortage will continue even after the completion of the projects currently underway for commissioning the 2nd hydraulic unit of the Kambarata HPP-2, reconstruction of the Toktogul,

Atbashy and Uchkurgan HPPs [7]. In addition, by 2100, Kyrgyzstan's glaciers may disappear altogether. Given the fact that 90% of the electricity is generated through the generation of water resources, Kyrgyzstan has to import all the missing volume from other countries. To avoid such costs, the state must expand its energy sources now. Despite the long payback periods for investments in renewable energy sources, a certain percentage of electricity generation, which should increase every year, in Kyrgyzstan should be obtained through renewable sources. Compulsory transition to RES will not only provide the state with electricity in the future, but will also act as a backup in emergency situations.

On August 15, 2019, a new version of the Law "On Renewable Energy Sources" of the Kyrgyz Republic (dated 24.07.19, No. 99) came into force, which provided for a number of legislative measures aimed at the development and widespread use of RES in Kyrgyzstan. Now the government faces the task to finalize some moments and harmonize all related regulations of the current law.

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NATURAL RESOURCE MANAGEMENT IN TAJIKISTAN

Republic of Tajikistan, a state located in Central Asia. It borders with China, Afghanistan, Uzbekistan and Kyrgyzstan. The area is 142.6 km^2. The population is 9 million people (Figure 56).

Figure 56. Map of Tajikistan

The territory of the republic is 93% mountains and it is rich in mineral resources. However, the country's enormous natural resources did not fully serve the economy of the Republic but were involved in the general development scheme of the Soviet Union planned economy. Hence, the raw material orientation of the mining sector of Tajikistan was predetermined.

Mineral resources are the basis for the development of the economy of any country; they determine the economic potential, the development and location of productive forces, and the use of labor resources. Explored mineral reserves are part of national wealth.

During the years of the geological service in Tajikistan, significant amounts of geological exploration have been performed. On the basis of proven mineral reserves, various sectors of the national economy have been created and are operating - mining, fuel and energy, construction, stone processing and others.

Analyzing the documents, which provide data on mineral deposits in the countries of Central Asia, it is necessary to ascertain the fact that a more detailed study of these materials in the territory of Tajikistan has the possibility of opening large objects for involvement in the mining industry.

At the current transition stage of the economies, the issues of strengthening cooperation of states in geological exploration and use of mineral resources, restoration of research and production links between geological departments of neighboring countries are especially important.

All geological exploration in the Republic of Tajikistan today is carried out at the expense of the budget, bilateral agreements and foreign investment.

The Geological Survey of Tajikistan is ready to cooperate with local and foreign companies for the maximum harmonization of legal regulations on subsoil use, exchange of information, as well as on other issues.

ROLE OF ENERGY AND MINERALS PRODUCTION IN NATIONAL ECONOMY

To provide reliable energy supply to the economy of the country, a programme of diversification of generating sources is being implemented based on the development of small hydropower, the construction of thermal power station

(TPS), and the coal industry has been developed. The construction and reconstruction of thermal power station, combined heat and power plants, power lines and substations, as well as the implementation of reforms in the energy sector, have significantly improved the supply of electricity to the population, ensured sustainable energy infrastructure and exported electricity to neighboring countries in the summer time. In particular, the construction of the Sangtuda-1 and Sangtuda-2 hydropower stations, the first stage of the Dushanbe HPP, the South-North, Lolazor-Khatlon and Khujand-Aini transmission lines were completed and commissioned.

A positive experience of public-private partnership in the energy sector has been acquired in the form of a concession agreement, the construction of autonomous energy sources. Implemented projects to create a unified energy system of the country based on the unification of the energy systems of the south and north of the country. Measures have been taken to intensify exploration to identify new deposits of energy resources. Public and international recognition of the safety impact of the project of Rogun hydro power plan (HPP) on downstream countries has been achieved, its economic efficiency, environmental safety and financial viability have been substantiated and the first unit of this station has been commissioned.

Energy production in the national economy is very high, because without energy production, industry, mining and geological industry, in general, national economy does not develop. With abundant energy resources and energy production, the pace and growth of industry is developing rapidly. With abundant reserves of coal, oil and gas, it will be possible to build large hydro power stations. With an abundance of electricity, the production of aluminum and other minerals is developing.

Tajikistan has very rich hydropower resources, the total potential of which is 527 billion kWh, ranking 8th in the world in this indicator and one of the first places in the world per capita. The Government of Tajikistan, relying on rich hydropower resources, regards the construction of large HPP as a priority area for the development of the country's economy.

Tajikistan currently has reserves of coking coal and anthracite, drilling and hard coal, the total proven reserves of which in total amount to 4.6 billion tons, including 900 million t of commercially valuable coking coal reserves, low-grade brown coal in the amount of 2.29 billion tons, anthracite - 250 million t.

In addition, there are relatively rich mineral resources. Tajikistan has a wide range of mineral resources; whose reserves are quite rich. Currently, deposits of more than 70 names of mineral resources have been discovered and reserves have been confirmed in more than 400 deposits containing precious metals, nonferrous and rare-earth metals, ferrous metals, non-metallic minerals and coal.

The deposits of precious metals are represented by deposits of gold and silver, with silver reserves in Tajikistan taking the first place in Central Asia, and the amount of proven reserves is 53 thousand t. Among the reserves of non-ferrous and rare-earth metals, Tajikistan ranks first among the Central Asian states in terms of reserves of lead and zinc, second in terms of reserves of antimony, with a large deposit of antimony located in Tajikistan. There are deposits of non-ferrous and rare-earth metals, which mainly include lead, zinc, nickel, copper, antimony, tungsten, tin, molybdenum, beryllium, strontium and aluminum. The deposits of ferrous metals are represented by deposits of iron ore and manganese. The deposits of non-metallic minerals mainly contain rock salt, barium sulfate, boron, fluorspar, phosphates, asbestos, clay for making bricks, limestone, quartz sand, gravel, semi-precious and semiprecious stones.

Among the various types of mineral resources, ores of non-ferrous metals and precious metals are relatively priority mineral resources. However, in most cases they are either not mined, and if mined, in a primitive way. In the future there is a great potential for the development of this direction.

GOVERNMENT POLICIES AND PROGRAMMES IN ENERGY AND MINERAL RESOURCES

POLICY AND LEGAL FRAMEWORK

The laws of the Republic of Tajikistan governing the activities of the mining and geological industry are as follows:

- On subsoil
- On investments, on concessions,
- Production Sharing Agreement,
- About licensing of certain types of activities,
- About precious metals and gems,
- About oil and gas,
- About coal
- Tax and Customs Codes.

As a result of improving the legislative framework for attracting investment in the Republic of Tajikistan, at present, the number of applicants has increased several times to participate in the competition for licenses for geological study and mining operations.

Worth to note that the number of foreign investments in the mining industry increases every year. The state guarantees equal rights between foreign and domestic investors. Favorable investment climate contributed to attracting investment in the oil and gas industry of the republic.

The Government of the Republic of Tajikistan pays special attention to improving the existing legislation, making changes and additions to them, aimed at improving the investment climate in the exploration and mining industries.

The right to use land and mineral resources (Law of the Republic of Tajikistan "On Subsoil"). The objectives of legislation on subsoil use is to regulate the work on subsoil use in order to protect the interests of the Republic of Tajikistan and its natural resources, rational use and protection of the subsoil of the Republic of Tajikistan, protect the interests of subsoil users, create and ensure conditions for the development of all forms of economic activity, strengthen the rule of law in subsoil use.

The Government pays great attention to the development and implementation of economic development plans. The "Development Program for the Economy of Tajikistan" defines development plans in the areas of export, energy, transportation, food security and others, and at the same time receive a package of relevant documents.

SECTOR ORGANIZATION AND REGULATORY INSTITUTIONS

The state institutions involved in the administration and management of subsoil use (including geological research, licensing of mineral resources and license management, management of cadaster and mineral resources and inspection of mines, etc.) in the Republic of Tajikistan are:

- Ministry of Industry and New Technologies (MINT),
- Ministry of Energy and Water Resources (MEWR)
- Agency for State control for the Safe Conducting Works in Industry and Mining under the Government of the Republic of Tajikistan,
- Main Department of Geology (MDG),
- State Commission of the Republic of Tajikistan on Mineral Reserves.

As a key result of the functional analysis and the subsequent strategic review, information was received that MDG currently performs most of the powers and functions with respect to the management of subsoil use, and therefore is the main goal and beneficiary of the proposed reorganization. In addition, there are several government agencies that perform similar or equivalent administrative functions, in accordance with their respective operational and administrative powers to control certain types of natural resources. Accordingly, MEWR is central to the management of hydrocarbon resources, such as oil and natural gas. Similarly, MINT administers activities related to the extraction of metal and non-metallic resources, coal and building materials. With regard to the inspection and control of exploration and operational activities, the appropriate distribution of functions among several government organizations was determined.

FISCAL DESIGN AND ADMINISTRATION

In the field of development of public financial management the following is in place: development of programme budgeting and introduction of the practice of "budgeting capacity" for executive bodies; linking the budget process with strategic planning; improvement of tax administration in order to increase collection, reduce the administrative burden on responsible taxpayers, increase transparency and predictability of the tax system; development of fiscal decentralization; Increasing transparency and accountability, through ensuring the general availability of information, including through the inclusion of quasi-fiscal operations in financial reporting, improvement of parliamentary control and the participation of civil society in the budget process.

CUSTOMS CODE:

Article 345, paragraph 4. The import of production and technological equipment and components to it is exempt from payment of customs duty, to form or replenish the authorized capital of the enterprise or retool existing production, provided that this property is used directly for the production of goods. Exempt from the payment of customs duties and personal property imported into the Republic of Tajikistan by foreign employees of enterprises with investments directly for their own needs.

TAX CODE:

Articles 144, 145:

- Reduced income tax from 25% to 15%;
- Enterprises are exempt from income tax in the year of state registration and starting from the year following the year of initial state registration when they are made by the founders, taking into account the minimum investments established by legislation, to the statutory fund of such enterprises in the following investments, for a period of:
    - 2 years, if the volume of investments is up to 500,000 US dollars;
    - 3 years, if the volume of investment is between 0.5-2 million US dollars;
    - 4 years, if the volume of investments is between 2-5 million US dollars;
    - 5 years, if investment exceeds 5 million US dollars.

Article 156:

- Expenses for geological exploration and preparation work for the extraction of natural resources are considered as financing for fixed assets and are deductible from gross income in the form of depreciation deductions.

Article 211, paragraph 4:

- The import of industrial and technological equipment and its components for the formation or replenishment of the authorized capital of the enterprise is exempt from value added tax.

Article 224:

- The rate of value added tax is reduced from 20% to 18%.
- Taxes on natural resources are paid in the case of the use of natural resources, including subsoil use under subsoil use contracts and (or) the use of water to generate electrical energy.
- When using natural resources, their users in the manner determined by the legislation of the Republic of Tajikistan, also pay other taxes and other obligatory payments to the budget established by the Tax Code and other regulatory legal acts of the Republic of Tajikistan.
- Taxes on natural resources include:
    - taxes on subsoil users (subscription bonus, commercial discovery bonus, royalties for mining);
    - royalty for water.

The subscription bonus is a one-time fixed tax of the subsoil user for the acquisition of a subsoil use right in the territory specified by the license (permit). The subscription bonus is paid by the person who won the tender for the right to use the subsoil or obtained the right to use the subsoil on the basis of direct negotiations in accordance with the legislation of the Republic of Tajikistan and also received one of the following licenses (permits) in the prescribed manner: - a license (permission) for geological study; - license (permission) for the extraction of minerals.

The commercial discovery bonus is a one-time fixed tax from the subsoil user for the discovery and registration of economically feasible mineral deposits for mining, as well as for obtaining mining rights in the territory specified by the license (permit).

The royalty for mining is a tax paid by the subsoil user separately for each type of minerals mined in the Republic of Tajikistan, regardless of whether they were delivered (shipped) to buyers (recipients) or used for their own needs.

The Law of the Republic of Tajikistan “On Environmental Protection”, adopted by Decree of the Government of the Republic of Tajikistan on August 2, 2011 No. 760, defines the legal basis of state policy in the field of environmental protection and is aimed at ensuring sustainable socio-economic development, guaranteeing the human right to a healthy and favorable environment, strengthening the rule of law, preventing the negative impact of economic and other activities on the environment, organizing the rational use of pr natural resources and environmental security.

The law regulates relations connected with the interaction of society and the environment, arising from the implementation of economic and other activities related to the impact on the environment in the territory of the Republic of Tajikistan.

The protection and use of land, subsoil, water, air, flora and fauna, including forests, as well as environmental objects of particular ecological, scientific and cultural value, especially protected natural areas, are governed by relevant laws and other adopted on its basis and in accordance with it by the normative legal acts of the Republic of Tajikistan.

Relations arising in the field of environmental protection, in the part necessary to ensure the sanitary and epidemiological safety of the population, are regulated by the legislation of the Republic of Tajikistan on the sanitary and epidemiological safety of the population and the protection of public health, as well as other legislative acts of the Republic of Tajikistan aimed at ensuring favorable for human environment.

To implement the state policy in the field of environmental protection, a system of environmental protection has been created in the Republic of Tajikistan and its activities are aimed at ensuring the rights of citizens to a healthy and prosperous environment.

The organizational basis of the state policy in the field of environmental protection are programmes, strategies and plans for environmental protection, developed by the authorized state body of the Republic of Tajikistan in the field of environmental protection, approved by the Government of the Republic of Tajikistan.

Protection from pollution, damage, damage, exhaustion, destruction and other negative impact of economic and other activities of individuals and legal entities are subject to: the land, its subsoil, the soil; surface and groundwater; atmospheric air, the ozone layer of the Earth; the animal and plant world, including forests in all their species diversity, as well as their genetic stock. State nature reserves, groundwater formation zones, rare geological discoveries and mineralogical formations, paleontological objects and other subsurface areas of particular scientific, cultural and other value and other zones are subject to special protection in the manner specified by the legislation of the Republic of Tajikistan.

REVENUE MANAGEMENT AND IMPLEMENTATION

Industry is a leader in material production. In this industry a significant part of the gross domestic product is created in almost every country in the world.

The state budget, which today has a socially-oriented focus, is not a budget for industrial development, the government focuses on the social sphere, which, on the one hand, is positive, as the quality of medical, educational and other social services improves and thus improves social security of citizens of the country. On the other hand, with such a distribution of the budget expenditures, the financial needs of the real economy and, in particular, industry, remain practically unmet. For example, the share of expenditure on mining and processing of minerals, mining and construction decreased from 1.52% of the total expenditure part of the country's budget in 2000 to 0.85% in 2010.

The only industry of the republic to which a sufficiently large amount of budget funds is directed is the fuel and energy complex. The trend shows that the state, since 2000, is gradually increasing funding for this industry. If this trend continues in the future, it will lead to almost complete de-industrialization of the country, a critical lag behind the neighboring countries. Thus, the state needs in the future to revise the structure of budget expenditures in the direction of a gradual increase in financing of industrial sectors of the economy. This can be achieved, either by increasing the revenue side of the budget, or by reducing the costs of other items.

The state should not only increase revenues in order to increase the expenditure side of the budget for industry, but also optimize the structure of other budget expenditures. For example, in the field of medicine, cost optimization can be achieved through fair, open competitions and tenders, where medical equipment and drugs are supplied not by an affiliated company at inflated prices, but by a company that is ready to offer the most optimal equipment for price and quality. Conducting such a balanced, transparent policy in all sectors of the economy, the state is able to solve the existing problems both in the sphere of material production and in other sectors of the economy. In connection with the above, the state industrial policy should be multidirectional, and for its solution a variety of tools and mechanisms should be used, starting with fiscal measures and ending with the attraction of foreign investment.

Specific priorities in this direction are:

1. In the field of energy:
   (a) ensuring reliable energy supply of the country's economy with efficient use of energy resources;
   (b) ensuring the transition of the country's hydropower industry to the budget-forming sector of the country, its decisive role in reducing poverty, promoting not only its own development, but also other sectors of the economy;
   (c) further development of small hydropower, both to reduce poverty and ensure access of the population, especially rural, to social benefits, and for the general development of the economy, first of all, small business;
   (d) ensuring the transition of Tajikistan from the regional and world leader in potential reserves of hydropower to the leaders in the efficiency of development and use of the country's energy potential and, on this basis, promoting the interests of national energy on foreign markets both through appropriate energy diplomacy and through the use of market mechanisms.

2. In the field of mineral resources:
   (a) growth in production and sales of industrial products competitive in domestic and foreign markets;
   (b) the organization of an effective system for the reproduction of personnel capable of creating and developing industrial technologies and producing innovative products;
   (c) creation of institutional bases for sustainable and preventive development of industries, the creation of innovative high-performance clusters;
   (d) development of a national system of selective import substitution based on the processing of local resources.

CLASSIFICATION AND MANAGEMENT FRAMEWORK FOR ENERGY AND MINERAL RESERVES/RESOURCES

DESCRIPTION AND DETAILS OF THE CLASSIFICATION AND MANAGEMENT SYSTEMS

The classification of deposits and forecast mineral resources is developed in accordance with Article 5 of the Law of the Republic of Tajikistan "On Subsoil Low" and clause 8 of the “Regulations on the State Commission of the Republic of Tajikistan on Mineral Reserves”, approved by the Government of the Republic of Tajikistan and establishes uniform principles for the Republic of Tajikistan reserves classification and projected solid mineral resources. The classification of mineral reserves and forecast resources establishes uniform principles for the Republic of Tajikistan on the classification of deposits, reserves and forecast resources of solid minerals and does not apply to deposits of groundwater, oil and gas.

The object of calculating mineral reserves is a deposit (part of the deposit) of minerals. The object of the assessment of the estimated mineral resource are metallogenic (mineragenic) zones, basins, ore areas, fields, ore occurrences, sides and deep horizons of deposits. Mineral reserves are calculated based on the results of geological exploration and operational work carried out in the process of studying and industrial development of deposits. Predicted mineral resources are estimated on the basis of favorable geological prerequisites, a reasonable analogy with known deposits, based on the results of geological survey, geophysical, geochemical, assessment and prospecting works. Calculation and accounting of reserves for a field (or its part), assessment and accounting of forecast resources of mineral resources of a subsoil ground is made in units of mass or volume as a whole, in accordance with economically justified parameters of conditions, confirmed by state expertise, without taking into account losses and dilution during mining, enrichment and processing of minerals. In determining the reserves of mineral deposits, compulsory separate calculation and accounting shall be made for the reserves of the main and together with them occurring mineral resources, as well as the main and associated components contained in them (metals, minerals, chemical elements and their compounds). economic rationales for inventory calculation.

The quality of minerals is studied taking into account the need for their integrated use, processing technology, quality requirements for minerals and technical conditions. At the same time, the contents of the main and associated, toxic and harmful components, the form of their location and the distribution features in the products of enrichment and processing are determined.

All identified and economically estimated mineral reserves, quantity and quality, economic importance, mining, hydrogeological, ecological and other mining conditions, which have undergone state expertise and approved by the State Commission of the Republic of Tajikistan on mineral reserves, are subject to state accounting. The necessary and sufficient degree of exploration of solid mineral reserves is determined depending on the complexity of the geological structure of the deposits (subsoil areas), which are divided according to this attribute into the following groups:

1. deposits of the 1st group. Deposits of simple geological structure. These features of the fields provide an opportunity in the process of geological exploration of reserves calculation for categories A, B and C1.
2. deposits of the 2nd group. Deposits of complex geological structure. These features of the fields provide an opportunity in the process of geological exploration of reserves calculation for categories B, C1 and C2.
3. deposits of the 3rd group. Deposits of very complex geological structure. These features of the fields provide an opportunity in the process of geological exploration of reserves calculation for categories C1 and C2.
4. deposits of the 4th group. Fields with small, rarely medium-sized bodies with extremely disturbed occurrence. These features of the field structure provide an opportunity in the process of geological exploration of reserves calculation by categories C2.

Mineral reserves according to the degree of exploration are divided into categories A, B, C1, C2. Predictable resources are subdivided into categories P1, P2, and P3 according to their degree of reasonableness.

Stages of exploration for solid minerals in the Republic of Tajikistan are presented in Table 25.

Table 25. Stages of exploration for solid minerals in the Republic of Tajikistan

Stage	Assignment of work	Results	Note
Regional geological study of the territory: (a) geological and geophysical studies at a scale of 1:1,000,000-1,500,000; (b) geophysical, geological survey, hydrogeological and engineering geological work on a scale of 1:200,000 (1:100,000)	The study of the geological structure of large regions of the country and the patterns of distribution of minerals within them. Creation of a geological and geophysical basis for determining the main features of the geological region and general patterns of mineral resources. Study of the geological structure of the region and justification of the search criteria and signs of minerals to identify promising geological structures	The state geological map, on the basis of which the prospective structures with respect to minerals are established, their search criteria and characteristics. Geological, geophysical and forecast maps, supporting deep sections of geological regions. A geological map of the sheets of the adopted graphic, a map of minerals with the selection of geological structures that are promising for minerals. Gravity, magnetic, radiometric maps. Predicted mineral resources by category P3 with the determination of their possible geological and economic value	Upon detection of sign of minerals on a large area, it is possible to stage prospecting work until the completion of the geological survey of the region.
Geological survey work on a scale of 1:50,000 (1:25,000) with a general survey	Systematic large-scale study of the geological structure of the territory, identification of geological conditions favorable for the localization of mineral resources, predictive assessment of promising areas	The state geological map of the studied areas with the allocation of projected basins, ore fields for prospecting and prospecting and assessment work; assessment of the estimated mineral resources by category P2 and the determination of their possible geological and economic value	If the occurrence of minerals is detected over a considerable area, it is possible to stage the exploration of subsequent stages until the completion of the geological survey of the region.
Exploratory work	Identification of deposits and signs of minerals and determining the feasibility of their further study	Identification of individual deposits or groups of mineral deposits with an assessment of the estimated resources of category P2 and the determination of their possible geological and economic value	On some types of minerals and wellstudied areas, the concentration of mineral manifestations may be determined by the estimated resources of category P1
Exploratory and evaluation studies	Preliminary assessment of identified mineral deposits and the choice of the object for preliminary exploration	Establishment of the possible industrial value of the identified mineral deposit with an estimate of reserves in category C2, and in less studied areas in category P1 and preparation of technical and economic considerations for TPPs to decide whether to conduct preliminary exploration	Exploratory and evaluation studies can be carried out after any previous stage of geological surveys or searches in areas where promising mineral deposits have been identified.

Stage	Assignment of work	Results	Note
Preliminary exploration	Industrial field (deposit) assessment	Industrial field assessment; mineral reserves are calculated according to categories C1 and C2 based on temporary conditions; a Technical-economical report (TER) will be compiled to substantiate the expediency of detailed exploration of the field	Very large objects – basin or ore zones extending to large depths, can be explored in parts, within boundaries.
Detail exploration	Preparation of the deposit or its part for industrial development	Obtaining baseline data necessary for designing a field development in compliance with the requirements of the classification of reserves according to field readiness for industrial development; design and approval in the prescribed manner Technical and economic justification (TEJ) for the permanent condition; calculation of reserves and approval of them in State Commission for Mineral Reserves	For fields of major economic importance, which are subject to priority development, the detailed exploration of which is associated with significant costs for the excavation of underground workings, it is possible to combine the stage of detailed exploration with the opening and preparation of the object for development
Pre-exploration of the deposit: a) not industrialized	Preparation for industrial development of previously explored deposits Sequential study of insufficiently studied parts of the field and exploration of the areas being cut (plots) in order to replenish the spent mineral reserves or expand the raw material base of the operating enterprise	Generalization of materials on the additional work carried out; if necessary, recalculation of previously approved mineral reserves, reassessment of the Technical- Economic justification of conditions and reserves in the State Committee for Reserves Generalization of materials on the additional work carried out; if necessary, recalculation of previously approved mineral reserves, reassessment of the TEJ of conditions and reserves in the State Committee for Reserves	-
Operational exploration	Refinement of the data obtained during detailed exploration on the number, quality and conditions of occurrence of mineral bodies prepared for development in order to operationalize production planning and monitor the completeness and quality of reserves mining	Operational reserve estimates prepared and ready for excavation blocks; materials specifying the parameters of cross and clearing workings; baseline data to control the completeness of the deposit, determine the loss of mineralization	-

RELATIONSHIP WITH OTHER INTERNATIONAL SYSTEMS

In today's difficult economic conditions, the owners of deposits in the country still conduct geological exploration, investing significant funds. Usually this process is led by “active managers” who do not have a geological education, but who count money well. Geologists, submitting to “active managers,” conduct exploration according to their experience and the requirements of state bodies. Often, geologists are forced to act within the framework of tight budget constraints, tacking between the demands of owners and government agencies (although there are exceptions). Owners need to obtain information on where the reserves are located and to put them on balance as quickly as possible in order to speed up the start of field development.

Everything would be fine, but at a certain stage, when subsoil users want to get a loan or attract foreign investments, there is such a problem as a mismatch of the exploration work carried out in terms of documenting the requirements of international reports (for example, Australian-Asian JORC-2012 or 101 [1, 2]).

And here comes the later insight that the available materials have almost no value for attracting funding. And why not make the least effort in advance – for example, develop standards for drilling enterprises, documentation of ditches and core samples, sample preparation, apply standard samples in analytics and do analyzes in certified laboratories? It is precisely this requirement that is not in the requirements of state bodies, and the experts of these bodies “take for granted” what is written in the geological exploration reports, without questioning these data.

Visiting the fields, it is seen how good deposits are ruined because of the greed of their owners, saving on the quality of drilling, sample preparation and analytics. It is the quality of geological exploration and analytics, when evaluated according to international standards, that is the main requirement for the assessment of mineral resources.

Geologists own the software DATAMINE, MICROMINE and others at least at the level of basic. Problems arise further. Assessment of deposits, as is known, is an art, and having attended courses, for example, MICROMINE, within 5 days, you will not become a master of this art. Of course, in large mining companies there are entire departments, dozens of experienced specialists in the field of block modeling, who are constantly improving and improving their skills. But how to be small and medium-sized companies, where the software is often “broken”, and self-study work on it, who have not completed even the initial courses on “block modeling”? Here again, one need to seek help from an independent auditing company, whose experienced specialists will help make the right model, check its quality, and most importantly, objectively assess (or check the estimate) resources / reserves.

RELATIONSHIP WITH UNFC

Currently, the UN resource classification is not applied in the Republic of Tajikistan. But the organizations responsible for subsoil use in the republic are interested in involving this classification and this will probably happen in the coming years.

ENERGY AND MINERAL RESOURCES ENDOWMENTS

OVERVIEW OF MAJOR ENERGY AND MINERAL RESOURCES

Tajikistan has rich hydropower resources. Due to the availability of abundant hydropower resources, measures on the large-scale development in Tajikistan of sources of thermal power have not yet been resolved. Outcomes from an integrated approach to coal reserves in Tajikistan and the allocation of energy resources, Tajikistan, while developing in the future, while maintaining the priority development of hydropower, will have to make serious efforts to develop thermal power as an important addition to hydropower, eliminate the bottleneck in Tajikistan’s energy sector, maintain normal functioning the country's economy and the life of the population.

It is necessary to comprehensively consider the state of energy resources, the level of economic development, the location of industry in the future, the electricity demand, the acceptable level of electricity prices, the placement of electricity sources, the scale of construction, the construction schedule and the project to create a power grid. Preferential policies in the field of modernization of the energy sector, increasing the ability of the energy sector to

attract foreign investment, maximize the use of foreign investment and foreign assistance to expand the construction of power grids inside the country. Acceleration of preliminary work on small hydropower facilities, restoration of small hydropower facilities unable to function normally, the earliest manifestation by small-scale power engineering of its role for the earliest resolution of energy supply issues in vast rural areas.

Mineral resources require a long development cycle and for a short time can't become a significant production power. The development of mineral resources, however, is an area in which the country has advantages, and in the future could be the main basis for the accumulation of wealth in Tajikistan and the qualitative improvement of the industrial structure.

It is necessary to increase the number of equipment employed in geological exploration, increase the degree of exploration work and the potential of mining, expand the area of geological exploration, as much as possible to acquire information about mineral reserves in the country and their location. At the same time, it is necessary to stimulate the construction and improvement of the class of the accompanying basic infrastructure facilities, strive to synchronize the introduction of infrastructure facilities and the development of mineral resources. It is necessary to develop development plans and policies in the field of the mining industry and related fields, clearly define the sequence of development of mineral resources, and create a rational guide mechanism for the transfer of rights to the development of mineral resources. Conditions for investment in the development of mineral resources should be improved, foreign capital should be attracted for geological exploration, mining and processing of minerals, to expand benefits in the field of taxes and fees, land lease, export of profits and guaranteeing the rights of investors at the same time. Efforts should be also made to improve legislation in the field of natural resource extraction, develop processing and deep processing of natural resources in combination with the extraction of natural resources, lengthen the chain of industries engaged in this area, and at the same time work out and develop legislative provisions regulating the export of natural resources, limiting direct export of raw materials, stimulating development processing of natural resources. At the same time increasing the number of people employed in the mining industry, there will be an increase in value added.

ANNUAL PRODUCTION, TRADE, REVIEW OF THE CURRENT STATE AND PROSPECTS

OIL AND GAS

In Tajikistan, 25 oil, condensate and gas fields have been discovered, most of which are under development. To date, the state balance of oil reserves includes 20 fields, of which 12 are located within the Fergana Basin, and 8 are located within the Afghan-Tajik Basin. All open deposits of Tajikistan multi-layer deposits are confined mainly to the Paleogene deposits, and to a lesser extent to the Cretaceous and to a small extent to the Jurassic deposits. Collectors, which are the reservoirs of hydrocarbon accumulations, are sandstones, siltstones and limestones. In general, Tajikistan has significant hydrocarbon resources, of which about 1% are converted into industrial categories.

The maximum volume of production falls on 1973 and 1979, when 520 million $m^3$of gas and 418 thousand t of oil were produced. Most of the developed fields are at a late stage of development and are accordingly developed by 80-85%. High water cut (80-90%), lack of discovery of new deposits led to a drop-in production. So, if in 1986 oil and condensate production reached 450 thousand t, gas – 250 million m^3, then in 2017 oil – 23.482 thousand t, gas – 1492 thousand m^3. Worth to note that, today subsalt deposits, deep wells, which were drilled on the areas of South-Western Tajikistan, are considered to be more promising objects, most of them have not reached the design depth, and the subsalt deposits studied have not yet produced a positive result.

With a view to sustainable, dynamic and balanced development of the oil industry, the Government of the Republic of Tajikistan on March 18, 2015 No. 1190 adopted the Law of the Republic of Tajikistan "On Oil and Gas". The law establishes the legal, economic, organizational framework and state policy in the field of oil and gas and aims to develop this industry in the Republic of Tajikistan. The discovery of one gas field in the Cretaceous and Upper Jurassic sediments would solve many problems of the fuel and energy complex, and the economy of the Republic. There is no doubt that for any state in the development of the economy the most important place is occupied by the energy sector, which is particularly relevant to the Republic of Tajikistan.

The annual capacity (2018) of hydrocarbon feedstock in the country amounted to 23,780 tons of oil and 1,600 thousand m^3 of gas. The volume of production of petroleum products in Tajikistan is insignificant against the background of imports of petroleum products from abroad. According to the "Avesta" in the Ministry of Energy and Water Resources, in the two months of 2019, the country produced about 3.7 thousand t of oil, which is 1.8% less than in 2018. According to the source, during this period 43.4 t of gasoline and 835.4 t of diesel fuel were produced in the country. Meanwhile, only in February 2019, Tajikistan imported more than 27.4 thousand t of petroleum products worth over 18 million US dollars. Indicators of imports of petroleum products in 2018 exceeded those of 2017 by 20.7 thousand t, and in value by 44.9 million US dollars. Russia remains the main supplier of petroleum products. Also, oil products in Tajikistan were supplied from Turkmenistan, Kazakhstan and other countries. At present, the republic's demand for fuel and lubricants is almost completely satisfied by importing these products from abroad, which leads to regular price increases for fuel, especially during the planting season.

To stabilize the situation in the country's oil market, the government of the republic called on investors to invest in the construction of oil refineries in order to somehow reduce their greater dependence on foreign suppliers.

COAL

The subsoil of the Republic of Tajikistan is rich in coal. According to the latest geological data, there are 40 deposits and manifestations of coal in Tajikistan, which represent all the varieties of this type of solid fossil fuel: from brown coal to hard coal, including coking coal and anthracite. The total reserves of these deposits and occurrences exceed 4.3 billion tons (Figure 57).

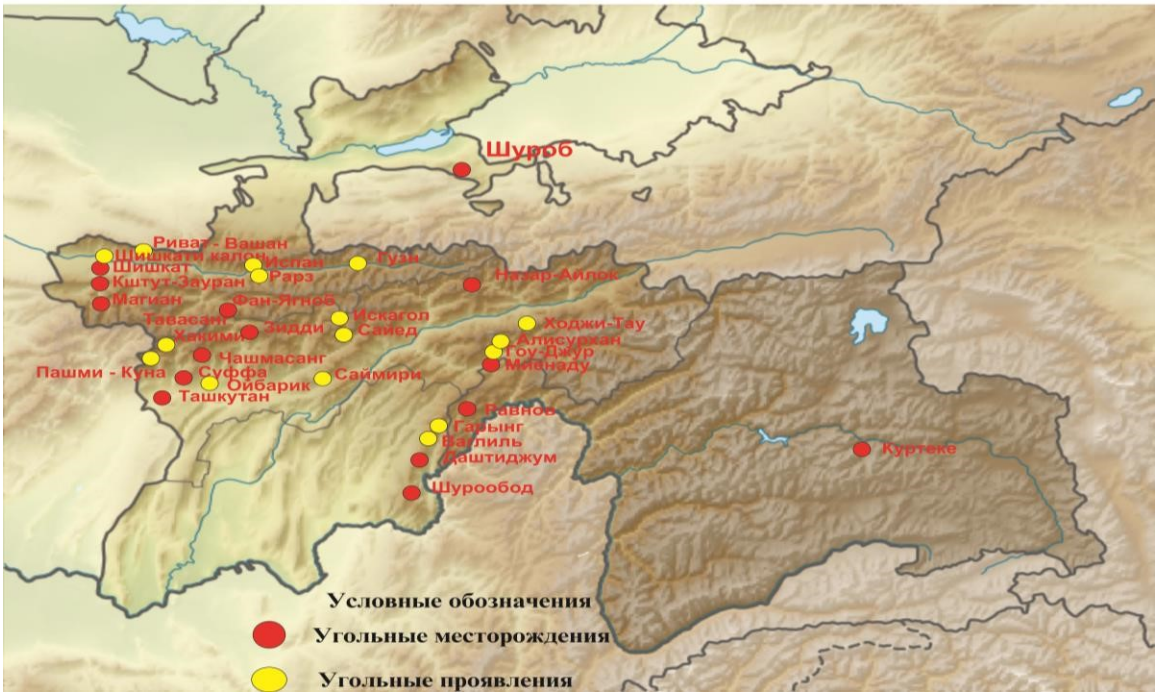

Figure 57. Tajikistan coal deposit map

The largest, most extensive coal-bearing area, which is represented by the maximum number of coal seams, is Zarafshano-Gissarsky. The coal-bearing stratum extends in a continuous strip from Penjikent to the headwaters of the Zarafshan River. According to the Ministry of Industry and New Technologies, coal reserves are sufficient not only to provide the fuel and energy complex for decades, but also to create a chemical industry.

Today, more than 200 industrial and energy enterprises use coal as an alternative process fuel, replacing natural gas. Productive use of coal, and on this basis the development of the chemical industry and nonferrous metallurgy, can become the main source of achieving the goals of the country's economic development.

Annual production (2018) of coal in the republic amounted to more than 1,907 thousand t. The main consumers of coal are energy sector (thermal power plants, boiler houses 45%); industrial enterprises (41%); population (11%), and budget organizations (3%).

URANIUM

The geological study of radioactive materials in the Republic of Tajikistan is carried out by a specialized organization under the Main Department of Geology, the State Unitary Enterprise "Geological Prospecting Expedition of Radioactive and Raw Materials". At present, the expedition is conducting a geological study of uranium deposits on the southern slopes of the Gissar Range.

MINERAL RESOURCES

The Republic of Tajikistan has enormous reserves of antimony ore. Zeravshan-Gissar mercury-antimony belt, having a width of up to 35 km and a length of up to 200 km. Mining operations are carried out only on one field.

In the north of the country explored and partially involved in the development of deposits of lead-zinc ores. Tajikistan is one of the leading places in the world in terms of reserves of lead-zinc ores.

Of the 20 deposits and signs of lead and zinc studied in the territory of the republic, 19 lead-zinc and polymetallic deposits are located within the Karamazar mining region, only the Mirkhant deposit is located in Central Tajikistan. The deposits of the Karamazar mining region are concentrated mainly in the Zarnissor and Adrasman ore areas.

On the territory of Tajikistan there are 3 gold provinces - Karamazarskaya, South-Tien-Shan (Central Tajikistan) and Pamir.

Tajikistan is the largest province of silver ore deposits in Central Asia. The main part of silver deposits is located within the Sughd region. The explored reserves of silver are mainly concentrated in the Karamazar mining region, where the silver polymetallic deposits themselves are located - Bolshoi Konimansur, Konimansurskoe, Kanjol. The unique silver field of Konimansuri Kalon is fully prepared for industrial development. At Karamazar there are also prerequisites for identifying new objects at deeper horizons.

Tajikistan is rich in precious and semiprecious stones. Features of the geological structure, mineragenic specialization, the presence of a large number of diverse deposits of jewelry and ornamental stones push the territory of the Republic of Tajikistan into the category of highly promising regions of gemstone in the world.

More than 1,000 sites and deposits of lapis lazuli, ruby, sapphire, amethyst, scapolite, polychrome tourmalines, cordierite, agate, carnelian, topaz, rhodonite, marble onyx, spinel, clinohumite, garnet, goethite, serpentine, ornamental marble, facing stones: marble, conglomerate – breccia, gabbro, granite, etc.

RENEWABLE ENERGY

Tajikistan systematically began to engage in research in the field of renewable energy since the 80s of the last century. In the period from 1980 to 2005 employees of the Physicotechnical Institute S.U. Umarov of the Academy of Sciences of the Republic of Tajikistan, together with specialists from the Special Design and Technological Bureau of the Academy of Sciences, developed and implemented more than 20 solar power plants.

The Academy of Sciences of the Republic of Tajikistan, together with other interested ministries and departments of the country, prepared and submitted to the Government of the Republic of Tajikistan a Targeted Comprehensive Program on the widespread use of renewable energy in Tajikistan for years, the goal of which is:

- creation, development and widespread use of promising technologies to produce electrical and thermal energy based on renewable energy resources;
- contributing to the country's fuel and energy balance;
- assistance in raising the living standards of the population through the introduction of modern technologies for the use of renewable energy sources;
- reduction of consumption of non-renewable energy resources of organic origin;

- training of highly qualified personnel in the field of renewable energy;
- ensuring social well-being and economic growth through the development of remote areas;
- aiding in solving the problems of unemployment, education and preservation of the environment.

Hydropower is the main potential source of energy in Tajikistan. The geographical latitude and climatic conditions of Tajikistan make it possible to effectively use renewable energy sources: solar radiation, the energy of small rivers (micro and mini-HPP), and biogas. For widespread use of renewable energy, government support from the Government of the Republic of Tajikistan and international organizations is needed. Some hope in this regard is the beginning of the creation of a regulatory framework.

This refers to the Targeted Comprehensive Program on the Use of Renewable Energy Sources in Tajikistan for Years, prepared by the Academy of Sciences of the Republic of Tajikistan together with the interested ministries and departments of the Republic of Tajikistan. Since most of the population in Tajikistan lives in rural and mountainous areas, energy decentralization and stable energy supply is the basis for sustainable development of rural and mountainous areas and can ensure the rational use of natural resources and, in the long run, contribute to solving the problem of sustainable energy supply and environmental conservation.

In addition, in the territory of the Republic of Tajikistan, are 437 deposits and signs of building materials have been identified and studied to varying level. These are deposits: agloporitovy raw materials, gypsum, facing stones, sawn stones, building stones, raw materials for air lime, expanded clay raw materials, brick raw materials, building sand, sand and gravel mixtures, perlite raw materials, glass raw materials, raw materials in cementless production, raw materials for pottery, raw materials for drainage pipes, raw materials for ceramic tiles, raw materials for mineral paints, raw materials for silicate bricks, raw materials for cellular concrete and cement raw materials.

SOCIAL AND ENVIRONMENTAL ASPECTS OF ENERGY AND MINERALS PRODUCTION

Environmental challenges and vulnerabilities remain significant, especially in the context of mitigation and adaptation to climate change. These problems have gained great importance after 2015, which include the rational use of water resources, ensuring the resilience of human settlements, taking urgent measures to adapt to climate change, protecting terrestrial ecosystems, land degradation, preventing and eliminating the consequences of natural disasters, and expanding access to clean water and sanitation. The rural population of Tajikistan is more vulnerable to environmental degradation.

Extraction of primary energy resources, their transportation, production of electric and thermal energy at power plants, in boiler houses has a very significant adverse impact on the environment, which consists in the release of harmful substances into the atmosphere and hydrosphere, thermal pollution of the environment, increased radioactive background, land alienation for power facilities.

Accumulation of carbon dioxide, methane and other gases in the atmosphere due to the burning of huge amounts of organic fuels (coal, natural gas, petroleum products - boiler fuel for power plants, boiler houses and process furnaces, gasoline, diesel and jet fuels for transport) in power generating and energy consuming installations - One of the main causes of the greenhouse effect. The layer of greenhouse gases does not allow heat back into space, and the average temperature of the surface layer of the atmosphere gradually rises.

As a rule, any energy saving measure entails positive environmental effects. Therefore, when deciding on the appropriateness of the costs of these activities and determining their priorities, it is necessary to make a quantitative assessment of environmental effects. The value of energy saving for the preservation of human health and habitat is as follows:

1. The first energy saving effect is associated with the possibility of not constructing new fuel bases, fuel supply infrastructures, energy-producing sources, transportation and energy distribution networks;
2. The second most important energy saving effect is the reduction of anthropogenic emissions of greenhouse and polluting gases by reducing the amount of fuel burning, that is, maintaining the atmosphere clean;
3. The third effect of energy saving is the conservation of the hydrosphere.

The modern period of human development is sometimes characterized by three “E”: energy, economy, ecology. Energy in this series occupies a special place. It is decisive for the economy and for ecology. The economic potential

of states and the well-being of people depend on it. It also has the strongest impact on the environment, ecological systems and the biosphere as a whole. The most acute environmental problems, such as climate change, acid precipitation, global pollution, rapid depletion of fossil fuels, are directly or indirectly related to the production or use of energy. Energy belongs to the primacy not only in chemical, but also other types of pollution: thermal, aerosol, electromagnetic, radioactive, vibration. Therefore, the ability to solve basic environmental problems depends on the solution of energy problems. Energy is a branch of production that is developing at an unprecedented pace. If the population size in the conditions of the modern population explosion doubles in 40-50 years, then in the production and consumption of energy this happens every 12-15 years.

The problems of finding alternative ways of obtaining energy have always interested humanity, but they have never been so exciting as they are today. World energy consumption has become commensurate with the reserves of combustible minerals - the basis of modern energy. The fact that nature has been created over geological eras (millions of years) has been consumed over several decades. If up to 1980, 150 billion tons of oil were produced in the world, then for the last 20 years of the twentieth century it is supposed to use almost 1.2 times more, which threatens not only the exhaustion of easily accessible, cheap deposits, but also serious environmental complications.

Around the world, fossil fuel, nuclear and hydropower are used to produce electricity and heat. Provided that energy resources will be consumed at an ever-increasing pace, the following approximate terms of their complete consumption are called: coal – at the end of the XXII century; oil and gas – at the end of the XXI century; Uranium – In the middle of the XXI century.

However, some futurologists believe that before humanity burns the last kilogram of fuel, it will use up the last kilogram of oxygen. According to available calculations, oxygen consumption is growing rapidly. So, if in 1960, it took 1.3 billion tons of oxygen to burn all types of fuel, then in 1980 it was 12 billion tons, and in 2000 energy consumed about 60 billion tons of atmospheric oxygen.

In addition to the problem of limited natural resources, there are a number of other negative consequences of the use of organic fuel on the environment. Thus, the extraction of oil and natural gas leads to subsidence of the soil. Oil and gas accumulated in porous rocks beneath the surface of the Earth serve as a kind of “cushion” supporting the rock lying on top. When this pillow is removed, the earth's surface in the area of oil and gas is lowered to a depth of 10 m. In addition, the extraction of minerals from the earth's interior leads to a redistribution of gravitational stress in the earth's crust, which sometimes ends in earthquakes.

The environmental impact of energy depends heavily on the type of fuel used. The most “clean” fuel is natural gas, which gives the least amount of air pollutants when it is burned. This is followed by oil (fuel oil), coal, brown coal, shale, peat.

As mentioned above, in the process of burning fuel a lot of side substances are formed. When coal is burned, a significant amount of ash and slag is formed. Most of the ash can be caught, but not all. All waste gases are potentially harmful, even water vapors and carbon dioxide CO2. These gases absorb the infrared radiation of the earth’s surface and a part of it is reflected back to the Earth, creating the so-called “greenhouse effect”. If the level of CO2 concentration in the Earth’s atmosphere will increase, global climate change may occur.

When burning fuel, heat is generated, part of which is released into the atmosphere, leading to thermal pollution of the atmosphere. This, ultimately, entails an increase in the temperature of the water and air basins, the melting of glaciers and the like. This whole process of accumulation of heat can lead to a noticeable increase in temperature on Earth, if the use of energy continues to grow at the same pace as it is now. In turn, an increase in temperature can cause profound climate changes throughout the Earth.

TECHNOLOGICAL EFFICIENCY AND INNOVATIONS

In this direction, the development should receive the mining industry, energy, transport, telecommunications, food and light industry, building materials industry, tourism, as well as the financial sector.

Special attention in sectoral and regional development programmes should be given to products that already have comparative competitive advantages. Already at this stage it is necessary to consider potential points of growth adjacent to these industries. Along with the existing enterprises of the industry (some of them will be reconstructed),

new enterprises of the mining and manufacturing industries (non-ferrous and ferrous metallurgy, building materials industry, light and food industries, chemical industry and other industries) will be put into operation.

In general, the number of new jobs in industry will increase by 1.5 times. Taking into account modern needs and existing financial opportunities in the development of the national energy sector, at this stage it is necessary to continue the implementation of the construction programme for small HPP in the framework of diversifying energy sources and their forms of ownership, to ensure financial rehabilitation of the energy system based on improved payment discipline, restructuring of the energy sector, and an adequate tariff policy, implementation of energy saving and energy efficiency measures in all sectors of the national economy.

The issues of diversification of generating sources of energy based on the construction of thermal power plants and the development of the coal mining industry, as well as the implementation of projects to reduce energy losses and improve the efficiency of the use of existing energy capacities will be important. This stage will be connected with actions in the field of improving the quality of work of existing types of transport, ensuring increased involvement of natural resources into economic circulation and the development of new lands, growth of transit traffic, reduction of transportation costs and increased security. A characteristic feature of this stage of development will be the adjustment of new mechanisms for implementing state social policy in the direction of modernizing the management system of the sectors forming human capital, and institutionalizing the system of production and social entrepreneurship. Social security and competition will be key growth objectives. During this period, work will be organized to carry out the necessary research and preparatory activities to create the basis for the accelerated development of the country's regions.

DATA AND KNOWLEDGE MANAGEMENT

In Tajikistan, in the mining and geological sector, since 2005, significant actions have been taking place, both from the Main Department of Geology under the Government of the Republic of Tajikistan, and cooperation with the international organizations in with the Geological Department of Tajikistan. Under the Department of geology there is a State Geological Archive, which is the main base of geological information. Until very recently, most of the information, reports, maps, graphic applications, etc. were in paper format.

As part of the cooperation of the Geology Department with other geological services, such as Iran, Finland, Germany, China, Britain, etc., serious attention was paid to the management of geological data and the training of local specialists. For example, in 2009, within the framework of the project, cooperation with the Geological Service of Iran established the “Earth Science Information Center”, which continues working up to present. For more than three years, more than 30 local specialists have been trained in the field of geomatics. The main purpose of this center is to collect, study and use geological and geographical information, also digitizing old and new data.

Also, in 2011, within the framework of the project, a cooperation with the Finnish Geological Survey in the geological fund itself created an information center with powerful copying equipment and a server for storing digital data. As one of the key aspects of the project was to attract international investors to the country's mining industry, a web portal was created for the geo-portal of Central Asia: www.cacgeoportal.org; www.geoportal-tj.org.

Today, for various projects and a grant from the World Bank, the geological fund has been completely scanned and most of the graphic material has been digitized. Within the framework of cooperation with the British Geological Survey, it is planned to develop a data management plan combine servers of different projects and create a single database. A plan for accessing information is being developed, as well as training of local specialists in the creation, management and dissemination of data.

The collaboration of the Main Department of Geology with the Aga Khan Agency for Habitat created the Open Center for Exogenous Geological Processes, where a database of exogenous geological processes was created and connected to the Agency of Emergency and Civil Defense of the Republic of Tajikistan with a Policom system and a joint online platform for sharing information (Web application – GeoNODE).

It is worth noting that the mining industry of Tajikistan in the near future may become one of the first in regard to providing and dissemination the data online.

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UNFC CASE STUDY

The Republic of Tajikistan has abundant and available hydropower resources, which conditionate limited measures for large-scale development of thermal energy sources, and relevant issues have not yet been resolved. While maintaining the priority for hydropower development, Tajikistan will have to make serious efforts to develop thermal energy as an important complement, as well as to eliminate the bottleneck in Tajikistan's energy sector, and support normal functioning economy of the country and ensure decent standard of living of its population.

Tajikistan has rich mineral resources. Over the years, about 600 deposits and more than 800 manifestations of 50 types of minerals have been discovered in the Republic. For the Case Study, the following objects as shown in Figure 58 were selected.

Figure 58. Map of the territory of the Republic of Tajikistan, location of research objects

The classification of reserves and predicted mineral resources is developed in accordance with Articles 5 of the Law of the Republic of Tajikistan "On Subsoil" and clause 8 of the Regulation on the State Commission of the Republic of Tajikistan on Mineral Reserves, approved by the Government of the Republic of Tajikistan. It establishes principles for classification of deposits, reserves and predicted (forecast) solid mineral resources that are common for the Republic of Tajikistan, yet it does not apply to underground water and oil and gas deposits.

The use of the latest methods and technologies for integrated geological exploration of the subsoil, as well as attracting capital of national and foreign investors on mutually beneficial conditions, will allow to achieve maximum results from the use of the country's natural resource endowment. In this regard, there is great interest in the application of the UNFC system in the mining and geological sector of the Republic.

Currently, proposals are being studied for revaluing reserves in accordance with the Australian Accounting Standards for Exploration Results, Mineral Resources and Ore Reserves (JORC) as well. Unlike the Soviet Union's one, this classification has an explicit division of each category of reserves and resources, based on economic and technical factors. In the Soviet system, it is not difficult to transfer some of the resources, e.g., of category P1 to reserves of category C2, part of reserves of category C2 to reserves of category C1, part of reserves of category C1 to reserves of category B, reserves of category B to reserves of category A.

When determining reserves in any system, common goals are understanding the situation regarding the possibility of industrial development of the field and making decisions on the appropriateness of development, determining the level of reliability of the assessment of its geological reserves. At the same time, the classifications use general principles for assessing deposits, which involve the collection and evaluation of geological data, determining the geometry of the ore body, calculating resources and reserves suitable for mining, while simultaneously checking the reliability of the obtained data.

NATIONAL CLASSIFICATION SYSTEM FOR MINERAL RESOURCES AND BRIDGING (MAPPING) TO UNFC

NATIONAL CLASSIFICATION SYSTEM FOR MINERAL RESOURCES

National classification system for mineral resources covers the whole range of resources and reserves: from regional exploration planning to explored reserves with strictly defined boundaries at existing mines. The system is fully consistent with mining law and tax system. However, it is designed for leadership, management and planning, but not for market financing. Also, it provides for the use of manual rather than computerized methods of calculation.

DESCRIPTION AND DETAILS OF THE NATIONAL CLASSIFICATION AND MANAGEMENT SYSTEM

The national classification system for mineral resources distinguishes the following classes (unprofitable or less profitable are classified as off-balance reserves.):

1. Forecast resources:
   (a) P3 – No accurate confirmed data;
   (b) P2 – According to geophysics / geochemistry / mapping;
   (c) P1 – According to limited data from drilling, ditch testing and exposure studies.
2. Reserves:
   (a) C2 – Systematic testing, additional research;
   (b) C1 – A denser network of testing, more detailed additional research;
   (c) B – A denser exploration network or partially explored ore reserves with strictly defined (rock) boundaries;
   (d) A – In-detail explored ore reserves with strictly defined boundaries. (A and B are usually only for detail studies areas within C1 category)

All reserves must be registered with the State Reserves Committee (GKZ RT) before obtaining a production permit. Industrial reserves are included in the State Balance. The current challenges with regard to classification system include the following:

- There are many different ideas about matching between the Soviet and international categories;
- A widespread misunderstanding of the State Reserves Control system and the difference between the classification systems;
- Resolution of these contradictions is too expensive: duplication of work with parallel calculation of resources / reserves according to GKZ RT and the international system;

- As a result, reserves estimate for the purposes of State Reserves Control and the international system often differ dramatically.

The State Reserves Control system divides 4 classes of geological complexity of solid minerals deposits (from the simplest "1" to the most complex "4") to determine the required density of the exploration network. The specified complexity class also determines the levels of categories of resources and reserves that can be assigned and included in the reporting for this solid minerals object. The allocation of solid minerals resources is based on the level of geological exploration, and also includes off-balance reserves subject to the existence of reasonable prospects for their cost-effective production in the future.

COMPARISON OF NATIONAL CLASSIFICATION SYSTEM WITH UNFC AND OTHER INTERNATIONAL SYSTEMS

The JORC classification easily matches categories A, B and C1. For these categories, all technical parameters have been established and economic calculations have been sufficiently made to begin development of deposits. Reserves of category C2 in adjoining blocks can be used in the calculations as a potential for the growth of industrial reserves. In areas within which there is no object with reserves of categories A, B and C1, reserves of category C2 may correspond only to designated or even calculated resources. There is also such a category of reserves as "Off-balance". Such reserves, even with a sufficiently high degree of knowledge, cannot be comparable with the designated and calculated resources, since their development is currently economically unprofitable (however, with big reservations, off-balance reserves can be included in the feasibility study for future mining).

Correspondence of GKZ RT (Soviet) and the JORC classification systems is presented in Table 26. Comparison of the classification system of reserves and forecast resources of solid minerals of the Republic of Tajikistan with UNFC can be presented as in Table 27.

Table 26 – Correspondence of GKZ RT (Soviet) and the JORC classification systems

GKZ RT	JORC
Reserves A and B	Proved Reserves / Certain Resources
Reserves C1	Proved and Probable reserves / Designated Resources
Reserves C2	Probable reserves / Designated and Calculated Resources
Reserves P1	Calculated resources
Reserves P2	Forecast resources
Reserves P3	No equivalents

Table 27 – Comparison of the classification of reserves and forecast resources of solid minerals of the Republic of Tajikistan with UNFC

Classes defined by categories and sub-categories						GKZ RT reserves and forecast categories
Class		Sub-class	Categories			
			E	F	G	
Known deposit	Commercial project	On production	1	1.1	1,2,3	A, B, C_1
		Approved	1	1.2	1,2,3	B, C_1, C_2
		AOR development	1	1.3	1,2,3	C_1, C_2
	Potential commercial project	Justified	2	2.1.	1,2,3	C_1, C_2
		For development	2	2.2	1,2,3	C_1, C_2, P_1
	Non-commercial project	Pending exploration	3.2	2.3	1,2,3	C_2, P_1
		Development not viable	3.3	2.3	1,2,3	P_1, P_2
Potential	Exploration projects	[No sub-classes defined]	3.2	3	4	P_3
		Additional quantities in place	3.3	4	4	P

CASE STUDY I: APPLICATION OF UNFC TO MINERAL DEPOSIT GALENIT

BACKGROUND INFORMATION ON THE PROJECT

The Galenit deposit (see Figure 58), studied over 10 years (1950-1960), was explored in detail to a depth of 200 m. Its surface is mapped on a scale of 1:1000 on an instrumental basis of the same scale. The ore zone from the surface has been explored by ditches, pits and short adits. To the depth, the field was studied by 2 adit horizons and 2 horizons from the mine. Thus, by exploration work, Galenit field has been explored with enough detail both on the flanks and to the depth and is prepared for exploration.

Within the deposit, 4 main ore bodies and 11 small ore lenses with industrial ores and 11 ore bodies with off-balance ores were noted. For all ore bodies, reserves have been calculated. Total amount of reserves calculated for Galenit field and the surrounding area is presented in Table 28.

Table 28 – Reserves calculated for Galenit field

Category	Ore	Lead	Zinc	Copper	Bismuth	Cadmium	Silver
	thousand t				t		kg
$B+C_1$	7646,3	127,8	183,7	11,85	819,40	1925,2	134059,4
C_2	3707,8	42,3	103,8	2,79	254,71	523,1	78957,3
P_1	1529,4	26,0	40,0				
Galenit Deposit area:							
C_2	1764,7	30,0	46,0				
P_1	1764,7	30,0	46,0				

The ore bodies are confined to Tudaksai fault, made by a powerful quartz vein. Mineralization is localized along crushing zones mainly in quartz and, in a subordinate value, in hydrothermally altered rocks (mainly in granodiorites and felsites, developed both inside the vein and near the latter). Ore bodies have the form of steeply falling veins and lenses, complicated by blows and pinches. Their strike coincides with the general strike of the fault plane and is north-east 27-350 m. The fall of ore bodies prevails north-west and vertical, but there are cases of reverse fall (southeast) with angles of incidence in both cases from 60 to 900. The length of ore bodies ranges 301000 m or more with an average thickness of 1,35 to 8.5, and an average lead content of 1.2-2.27% and zinc 2.27-3.20%. The average ore grade in the deposit is as follows: 1.67% lead, 2.61% zinc, 0.17% copper, 0.01% cadmium, 0.03% bismuth, and 18.8 g/t silver. The ore in the vast majority is sulfide, easily enriched by selective flotation. The contents of lead and zinc in the concentrates exceed 50%. The value of the concentrate increases due to extraction from lead concentrate – bismuth and silver, and from zinc – cadmium and copper.

The prospects of the ore field are not limited to these deposits, though. Revaluation of some deposits is possible; during exploitation of deposits, a discovery of blind ore bodies is also possible.

In total, 3.7 million rubles were spent on Galenit deposit during its operation. The costs of exploration directly amounted 3.2 million rubles. The total number of estimated reserves in conventional lead is 325.6 thousand t. Hence, the cost of exploring 1 ton of conditional lead costs 9.83 rubles, and 1 ton of ore costs 0.44 US dollars. Thus, the cost of exploring 1 ton of conditional lead in Galenit deposit is significantly lower than in other explored deposits of Karamazar. The work performed at the Galenit field is characterized by high efficiency and profitability.

Detailed exploration of the field (ditches passed through 20-25 m from each other, cuts through 25-30 m, height between horizons – 50-100 m) allows developing the field without additional costs. Moreover, according to the relief conditions, difficult mining conditions, relatively low stripping ratio (3.8-4.3 m^3/t), the field can be profitably mined open pit to a depth of 160-185 m, with a profit of 7-8% (with planned profit 5%). In total, during the exploration of the field, ditches were completed in the amount of 10,415.9 m^3, 23 pits were drilled with a total depth of 278.4 m, 12 short-length adits were drilled with a total depth of 375.3 m, 23 surface wells were drilled with a total of 5.99 thousand m, and 19 underground wells with a total of 652.7 running m, 7 major tunnels were drilled with workings

from them, 394 core samples and 10233 furrow samples were taken. Large volumes of exploration work carried out at the field ensured a high degree of reserves reliability. The reserves were calculated for the B+C1 category in the following amounts:

- lead – 17.8 thousand t;
- zinc – 183.7 thousand t;
- copper – 11.85 thousand t;
- cadmium – 1925.2 t;
- bismuth – 819,4 t;
- silver – 134.1 t.

Reserves of categories under GKZ – B, C1, C2, in accordance with UNFC – E1, F1.2, G1,2.

The Galenite field is currently not being developed, while it is prepared for industrial development. The recommended mining method is open mining.

SOCIO-ECONOMIC AND SOCIO-ENVIRONMENTAL ASPECTS OF THE SELECTED PROJECT

ECONOMIC ASPECTS

The study of Karamazar has a rich history, the beginning of which dates back to the Middle Ages. The Galenit field was discovered in 1950.

The indigenous population of the region is Tajiks and Uzbeks. They are engaged in horticulture and cattle breeding, less often in agriculture on irrigated and rainfed lands. The population density is quite low, and its distribution is determined by the presence of permanent surface watercourses. Settlements are usually located in the middle course of rivers. The transport and economic conditions of the region are favorable and contribute to the development of the mining industry.

In the immediate surroundings of the Galenit deposit are the fluorite deposit Naugarzan and the Angren coal deposit. In the western part of the district there are polymetallic deposits Konimansur, Karatashkutan, Zambarak, Taryekan and Chukurdzhilga.

Due to the fact that the Galenit deposit is remote from mining enterprises, it is proposed to construct an enrichment plant directly near the deposit on the basis of the Galenit and Zakhkhanasai ores. In the future, the local ore base will be expanded due to several nearby polymetallic deposits. All these deposits are separated from each other by no more than 3-18 km.

Galenit field is connected by unpaved roads with the neighboring deposits and the district center of Shaidan village located 40 km south-west. From the regional center – the city of Khujand, where there is a railway station – the field is 145 km away.

To provide water for the future mine, it is proposed to use underground waters of alluvial-proluvial deposits of the Gudas River Valley. The calculated amount of water not only fully provides, but also significantly exceeds, the maximum demand in water for industrial, technical and household drinking purposes, based on the estimated need for water.

From local materials for construction, rubble stone-granodiorite and clay can be used. In the Shaydan region there are deposits of limestone, sandstone and others. There is no construction and fixing wood, as well as fuel, so their delivery is required. The State network may be utilized to supply electric power for the future production.

SOCIO-ENVIRONMENTAL ASPECTS

Development of ore deposits is a type of economic activity that affects almost all components of the environment. The result of this effect is the pollution of the atmosphere, groundwater and surface water, soil cover, water

withdrawal from the underground hydrosphere, soil from the earth's surface and rocks from the bowels. Below is an overview of the ecological state of the environment in the area of activity of the future enterprise.

1. Atmospheric air. The main sources of air pollution are mining facilities and technological processes of the processing plant. At the mine, the sources of hazardous emissions are operational blasting operations. For dust suppression, all workings will be equipped with devices for hydro irrigation, as a result of which dust emissions will be insignificant. In places of possible dust emission (jaw crusher, cone crusher), home-made rectangular-type wet dust collection units with a size of 2.5x1.5x1 m are installed. The boundaries of the regulatory sanitary protection zones for the facilities of the enterprise are adopted according to the standard. Predicted impact on the atmosphere is assessed as acceptable.
2. Water supply. Groundwater is the source of technical water supply to the mine, concentration plant and auxiliary manufactory located at the industrial site. The hydrogeological conditions of the development of the deposit are generally favorable, due to the sharply dissected relief with a low erosion basis, as a result of which groundwater drains intensively and does not accumulate. Due to favorable hydrogeological conditions, monitoring of the environmental status of groundwater in the area of the enterprise is not provided. Environmental impact on water resources is assessed as permissible.
3. Soil and land resources. Technogenic impact on soils and land resources in the area of the plant's activity takes place at the sites of waste accumulators. The main production waste of the enterprise is the sludge (tailings) of the ore dressing process and the host rock. A tailing dump and a dump of enclosing rocks are provided for their storage. Minimization of the negative impact of these wastes on the environment is ensured by environmental measures provided for by the construction and operation projects of the plant. To restore the disturbed lands after the end of the life of the mine and the processing plant, restoration of the disturbed lands is provided. The predicted impact on soils, taking into account the development of estimated reserves, is assessed as permissible.
4. Vegetation and wildlife. The flora and fauna of the area where production facilities are located are very poor, and there are no specially protected species of animals and plants. The activities of the enterprise in the development of proven reserves will not lead to a change in the existing species composition of the plant and animal life of the region. Subject to environmental and production requirements, the impact on the flora and fauna is expected to be within acceptable limits.
5. Social environment. The operation of the mine and the processing complex in compliance with the necessary environmental measures will be of positive importance, thanks to the creation of additional jobs and the receipt of valuable mineral raw materials.

With the completion of field development, the initial state of all environmental components in the areas occupied by production facilities will gradually recover. The results of the environmental impact assessment conclude that the ecosystem that has developed in the zone of influence of the enterprise during the period of its operation, is stable, and no additional negative impact is expected during further development of the lower horizons of the field. The environmental measures envisaged by the construction and operation projects of the plant's production facilities are effective, no additional measures are required. In the future, special attention should be paid to conducting further environmental monitoring in the area, as an important component of environmental protection measures.

FIELD PROJECTS STATUS AND FEASIBILITY

TECHNOLOGICAL ASPECTS OF FEASIBILITY

The technological properties of the ores of Galenit deposit were established by examining 7 technological samples, of which 5 were taken from underground workings and represented by sulfide and mixed ores, and 2 samples were taken on the surface from ditches through ore bodies. All samples were taken throughout the entire exploration of

the deposit and characterized the main types of ores depending on their chemical and mineral composition, texture, structure and physical properties, and varieties of the same type.

The aim of the research was a detailed test of the enrichment of each type of ore, the development of methods and concepts of concentration with the establishment of qualitative and quantitative indicators. Before the enrichment test, a detailed study of the material composition was carried out by spectral, chemical, and mineralogical analyzes.

All samples were taken using the furrow method at sampling intervals with the industrial content of the useful component. The initial size of the material is 50 mm. Sample preparation for technological testing consisted of crushing the sample material and reducing the weight of the sample. The weight reduction of the sample was carried out in accordance with the fineness of the material:

$$QQ=KKdd^{2}$$

where: Q – weight of the sample (kg); d – diameter of the largest piece of material (mm); K – coefficient applicable to the field (0.2).

The material composition of the ore bodies is ore-bearing rocks – hydrothermally altered granodiorites, highly silicified, and quartz. The main ore minerals in the samples are galena, sphalerite, chalcopyrite and pyrite. At the deposit, 3 technological differences (types) of ores were identified: (1) sulfide; (2) mixed semi-oxidized; (3) oxidized (based on their characteristics the technological tests were conducted).

Technological tests were carried out mainly by flotation methods and consisted in the development of a technological enrichment scheme and a reagent mode in order to obtain conditioned concentrates by affordable means. The research results should be considered satisfactory and, based on these data, the ores of the deposit are well-enriched. As a result of technological tests, a processing scheme was proposed, including ore grinding up to 79.4% class-0.074 mm, main lead flotation (4 min), 2 rough lead concentrate cleanings (4 min or 1.5 min), agitation of lead flotation tailings with lime and sulphate (4 min), basic zinc flotation (8 min), 2 purifications of rough zinc concentrate (4 min and 4 min). Thus, macroscopically isolated types of ores were subjected to technological tests. A study of the material composition of the samples established a complete analogy of the host rocks, as well as vein and ore minerals. The character of interspersing sulfides and their intergrowth with waste rock and among themselves is also similar. For mixed and oxidized ores, significant ironiness was noted and the composition of ore minerals characteristic of oxidized ores. However, each sample separately has some individual features, which were reflected in the choice for each of them of the technological scheme and reagent mode. The ores of the Galenit deposit are fairly easily enriched by flotation.

The issue of the enrichment of sulfide, mixed, and oxidized ores has been positively resolved, although a high recovery of the latter to concentrate has not been achieved for oxidized ores due to the presence of non-floating forms of lead. It should be taken into consideration that when processing these ores, 2 fundamentally different technological schemes are possible: (1) Processing of sulfide ores; (2) Processing of oxidized ores. Mixed ores can be processed according to the scheme developed for sulfide ores with a corresponding change in the reagent mode. In this case, the following enrichment indicators are possible:

1. For sulfide ores – lead concentrates with lead content of 58.68% when extracting 90.8%, and zinc concentrates with zinc content of 50.90-45.06% when extracting the latter into concentrate 88.92-93.30%.
2. For mixed ores – lead concentrates with lead content of 45-50% with recovery of 8870.75%, and zinc concentrates with zinc content of 45.50-50-55% with extraction of 60.085%.
3. For oxidized ores – lead concentrates with lead content of 44.85-42.0% with recovery of 77.5-71.2%.

In addition, it must be noted that lead concentrates contain up to 632.5 g/t silver, which increases the cost of these.

PERFORMED DETAILED EXPLORATION AND RESULTS

When choosing the Galenit field exploration methodology, the following main factors were considered:

1. The average and small sizes of ore bodies along strike and dip, their discontinuity, variable thicknesses of 0.5-30 m, a steep drop of 60-900.

2. Uneven distribution of useful components.
3. The rocky relief of the deposit, the confinement of the ore bodies to the fault zone made by a quartz vein, the latter stands in the relief for 15-20 m, forming a series of ledges. The vein along its entire length is intersected by three large ravines.
4. The water cut of the field is insignificant, the influx of water into the mine workings does not exceed 15-20 m3/h.
5. The rocks composing the deposit and the ore body are unstable, highly fractured and fragmented.

Exploration of such deposits by one borehole cannot give positive results, so, according to the drilling data, it is impossible to contour ore bodies sufficiently, to obtain reliable content of useful components, the intersection of fragmented ore zone rocks negatively affects core output. Such ore bodies can be most fully characterized only with the help of mine workings, especially since the relief favors their laying. Given the above factors, the Galenit field was explored mainly by mine workings in combination with wells.

According to the industrial classification proposed by GKZ RT, deposits of a type such as Galenit belong to the second subgroup of group II. The density of the exploration network for ore bodies of the deposit, attributable to the second subgroup of group II, for categories C, should be 75x100 m; for category B – 30x60 m. The ore bodies at the Galenit deposit were prospected using the following procedure.

The surface of the field is mapped at a scale of 1:1000 on an instrumental basis of the same scale. Ore zones from the surface were explored by ditches, the latter passed across the strike through 20-30 m. Due to the good exposure of ore zones, pits were drilled, mainly for opening ore bodies under powerful Quaternary sediments in ravine. The distance between them was taken 40-80 m.

The terrain conditions favored the exploration of the field with adits with a system of drifts and dispersal. Based on this, the field was sequentially explored by adit workings at the horizons: 1 adit horizon (adit No. 4-6; marks are 1629 and 1624 m, respectively); 2 adit horizon (adit No. 7; with workings to the level of 1578 m). On the north-eastern flank, due to a sharp increase in the relief, additional adits No. 3, 5 and 13 of their mark 1673, 1701 and 1702m, respectively, were completed, the last 2 were exclusively for exploration of ore body No. 5.

All these workings were passed along the strike of the ore zone, and to intersect the power of all ore bodies, cuts were made from the indicated workings through 25-30 m. Such a dense network of exploration workings was adopted at the first stage of exploration of the field (until 1954) and was approved by GKZ RT; it is due to the above factors adopted when choosing the methods of field exploration.

From the beginning of field exploration, its deep horizons were explored by core drilling wells. Wells were drilled along the profiles, but the distances between the profiles were not maintained and ranged from 100 to 200 m.

The vertical distance between the wells ranged from 50 to 100 m. Due to the sharp curvature of the wells, the latter cut the ore body, but at a given depth, so the vertical distance between the points of cutting the ore bodies by the wells was obtained from 10 to 40 m. Wells were drilled from the bottom of the openings to the complete intersection of the fault zone.

Surface mine workings were sketched at a scale of 1:100 in the picket magazine of a standard sample, while one wall and the bottom of the ditch were sketched. The wall of the ditch, which was better exposed, was sketched. The sampling location was tied to the beginning of the ditch. Underground mining was documented at a scale of 1:50. Separate details were sketched on a larger scale, sketched in a picket notebook. In the horizontal workings, both walls and the roof were documented, which were drawn in the form of a reamer, according to the requirement of the instruction.

Along the line of conjugation of the right wall and the sole, the development, as it were, is cut and rotated around the line of conjugation of the left wall with the sole until the sweep coincides with the drawing plane. Documentation of scatterings and drifts was always carried out from the surveying point located in the center of the mine from which they pass.

Boreholes were documented in drilling logs, which recorded the penetration of wells on individual runs, the diameter of the drilling, the geological column, the percentage of core ascents by elevations, the sampling intervals, the data

of measurements of anti-aircraft and azimuthal curvatures, the description of the core by intervals and the sampling data. Kern was marked on separate dies.

All mine workings were tested using the furrow method; the sample size was taken equal to a width of 10 cm, a depth of 5 cm. The furrow length was usually taken equal to 1 m. In order to clarify the confinement of mineralization to certain types of rocks, sections of furrow samples were limited to the limits of one breed variety; the furrow length ranged from 0.5 to 1.5 m. Since there are no clear contours of ore bodies at the deposit, ore zones were tested over the entire thickness of quartz veins, hydrothermally altered mineralized and fragmented rocks. In addition, contouring samples were taken at 2-3 m in seismic power. Samples were taken along the ditches along the bottom, while the bottom of the ditch was leveled and cleaned.

Underground mine workings, traversed across the strike of ore bodies, were tested along the wall, approximately 1 m from the bottom. At the same time, the wall that is closer to the bottom of the leading mine was tested. This testing methodology was adopted from the beginning of the exploration of the field and was applied until the end of the exploration of the field.

Well testing was carried out on core and sludge. The sample was taken half of the core, split along the axis; the second half of the core has been preserved. The lengths of the intervals tested are generally equal to 1.0-1.5 m. Due to the low percentage of core output, the length of the tested interval usually exceeded 2.0-2.5 m. The length of core samples was determined by the thickness of individual lithologically heterogeneous in lithology and degree of change rocks cut by the well, as well as the thickness of various mineralized zones. To determine the content of associated components (Ag, Au, Cu, Cd, Bi, etc.), combined samples were compiled from duplicates of the main samples.

In total, over the entire period of its exploration (1950-1960), 10,627 samples were taken, of which 2,994 samples (about 30% of total) were included in the calculation of reserves (inventory calculation), and internal and external controls were made for most of these samples.

The samples were processed mechanically in a crusher, according to the scheme, using formula as referenced in (1). The coefficient *k* is adopted by analogy with other polymetallic deposits of the region for which it was specially calculated. The grinding of samples was carried out up to 1 mm. Mixing of the sample material was carried out using the ring and cone method, and reduction was carried out by quarting.

Samples of the Galenit deposit were analyzed, up to and including 1954, in the central chemical laboratory of the Uzbek Geological Department. After the transfer of the deposit to the Tajik Geological Administration, analyzes were carried out until May 1956 in the central laboratory of the Office in Dushanbe. From May 1956 until the end of exploration, analyzes were carried out in the chemical laboratory of the Kanimansur expedition. Samples were analyzed for lead, zinc and partially for copper. The determination of lead, zinc and copper was carried out by the polarographic method. Gold and silver analyze were performed by the Central Laboratory of the Tajik Geological Administration and the laboratory of the Sredaztsvetmetrazrazvedka.

In the second half of 1956, the expedition organized a spectral laboratory. The laboratory performs a semi-quantitative analysis of 56 elements. With the organization of the spectral laboratory, only those samples began to undergo chemical analysis, according to which the content of the main components, according to spectral analyzes, was at least tenths of a percent.

The analyzes of the Central Laboratory of the Uzbek Geological Administration were monitored by the Central Laboratory of the Kazakh Geological Administration and, in part, by the laboratory of the Sredaztsvetmetrazvedka trust; analyzes of the laboratory of the Tajik Geological Administration - the laboratory of the Kazakh Geological Administration, analyzes of the laboratory of the Kanimansur GRE were controlled by the laboratories of the Tajik Geological Administration.

The main analyzes, according to external control data for lead, are somewhat underestimated, and according to internal control data, somewhat overestimated. The absolute average value of the systematic error for lead does not exceed thousands of a percent, which indicates the sufficient reliability of the analyzes.

In 1952, geophysical work was conducted on the area and in the vicinity of the Galenit field. The work was carried out by the Uzbek Geophysical Expedition. The expedition carried out experimental and methodological work, the

purpose of which was to develop a comprehensive methodology for prospecting for deposits of polymetals and rare elements (tin and tungsten) in various geological conditions using electrometry, magnetometry and spectrometallometry.

Along with the search, the expedition carried out parametric studies of the electrical magnetic and gravitational properties of the rocks.

LEVEL OF KNOWLEDGE / CONFIDENCE IN ASSESSMENTS

GEOLOGICAL OR OTHER ASPECTS

Geological map of Galenit deposit and its cross-section are presented in Figures 59 and 60, respectively.

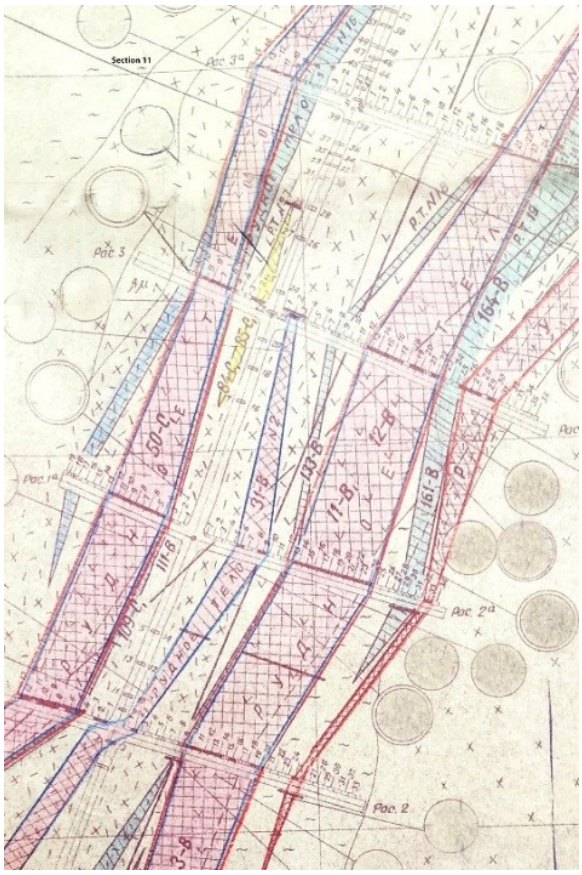

Figure 59. Geological map of Galenit deposit

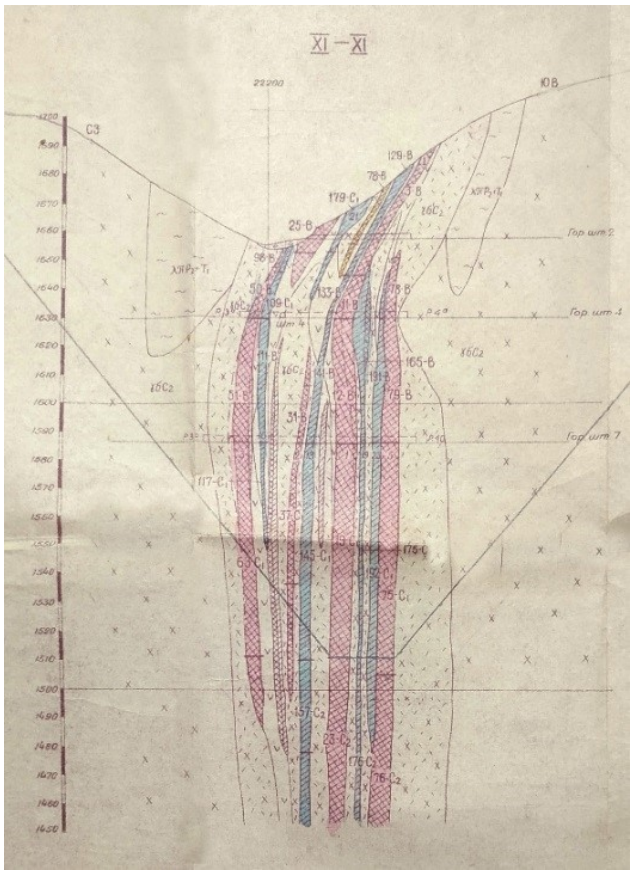

Figure 60. Cross-section of Galenit deposit

The Galenit polymetallic deposit is confined to the fault of the same name, the seam of which is made of a powerful quartz residential complex. Mineralization is confined to a quartz vein, less often to altered silicified granodiorites, felsites and granites. The length of the ore-bearing zone reaches 1.2 km, with a thickness of 5 to 60 m.

According to the sampling data, 4 main ore bodies and 11 balance ore lenses are identified within the ore-bearing zone. According to the fall, the length of the waste ore bodies varies over a wide range. The strengths of ore bodies along strike and dip are unstable with a coefficient of variation 80-155. The contents of lead, zinc and associated components along the ore bodies are uneven; the degree of variability of the contents is characterized by a coefficient 80-135.

According to the instructions for applying the classification of reserves to deposits of lead and zinc ores (1951), the Galenit deposit should be assigned to the second subgroup of the second group according to the complexity of the

structure. In 1954 According to the complexity of the structure of ore bodies, the Galenitskoye deposit was assigned to group III, which corresponds to the second subgroup of the second group of the existing classification. The correctness of classifying the field as group III was confirmed in the reviews of the report and the GKZ RT protocol.

For the field of the second subgroup, category B includes reserves explored by mine workings on a 50x20 m or 60x3 0m grid. Category B reserves qualify for the Galenit field as concluded between the surface and the first adit horizon, as well as within the horizons of mine workings, passed along a 25x50 m and 50x50 m grid. Category C1, in accordance with the requirements of the instruction, includes reserves explored by mine workings for sulfur of 50x100 m. In addition, category C1 is assigned adjacent to the mine workings and the contouring of interpolation at half the distance between the horizons and the workings and extrapolation of 75 m below the horizon. Reserves of category C2 are contoured by an external circuit, by extrapolation (100 m), and also based on geological forecasts. Suspension 75-100 m below the explored horizon was taken on the basis that wedging of ore bodies with depth at the deposit is not observed.

FIELD DEVELOPMENT AND ITS EFFECTIVENESS

Field development is possible both underground and open pit. However, open-cast mining has several undeniable advantages, which allows it to be recommended as the main method of development. The mining conditions for underground mining of the deposit, due primarily to the extreme instability of the rocks of the fault zone, are very complex; as a result, the use of highperformance and economic development systems will be associated with great difficulties.

For mining a quarry, adverse mining conditions will not have a significant impact. The presence of exposed quartz veins with mineralization up to 30 m high allows you to work out the upper part of these veins with minimal overhead costs. The volume of overburden operations is also significantly reduced due to the absence of deposits overlapping ore bodies.

The development of the field to a depth of 160-185 m in the central part and 110-120 m on the flanks should be carried out only in an open way, as a result of which about 80-90% of all reserves of categories B+C1 will be worked out. Great economic effect can be obtained as a result of using tunnels adits, which are passed through 15 m. Using spurts will drastically reduce the cost of expensive drilling operations and will allow powerful massive explosions along the entire length of the quarry.

The schemes for calculating the overburden coefficient during ore mining by the mining method are shown in Figure 61 and 62.

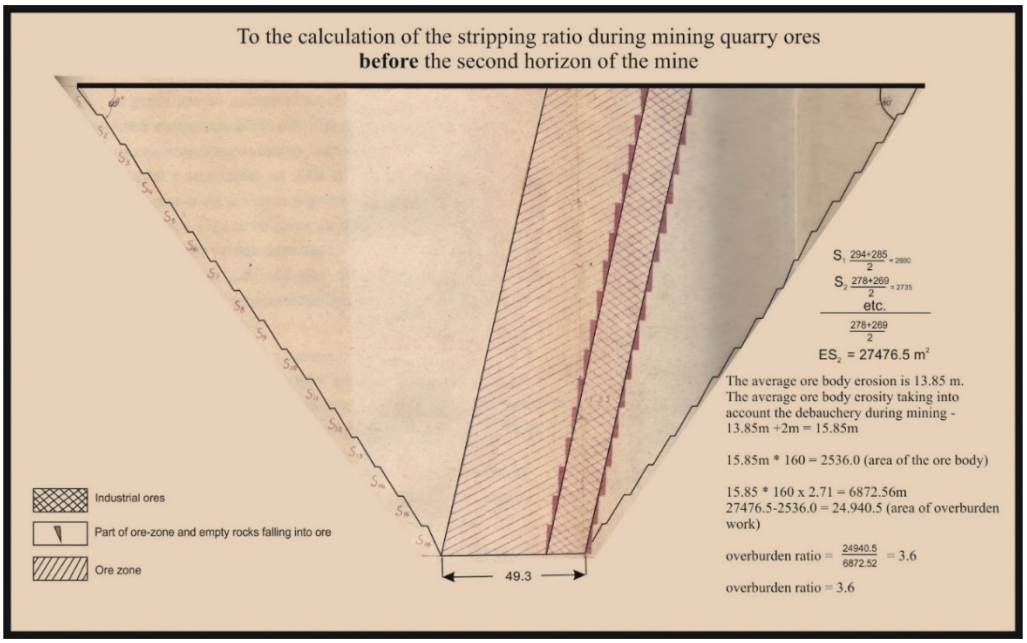

Figure 61. Scheme for calculating overburden coefficient during ore mining before second horizon

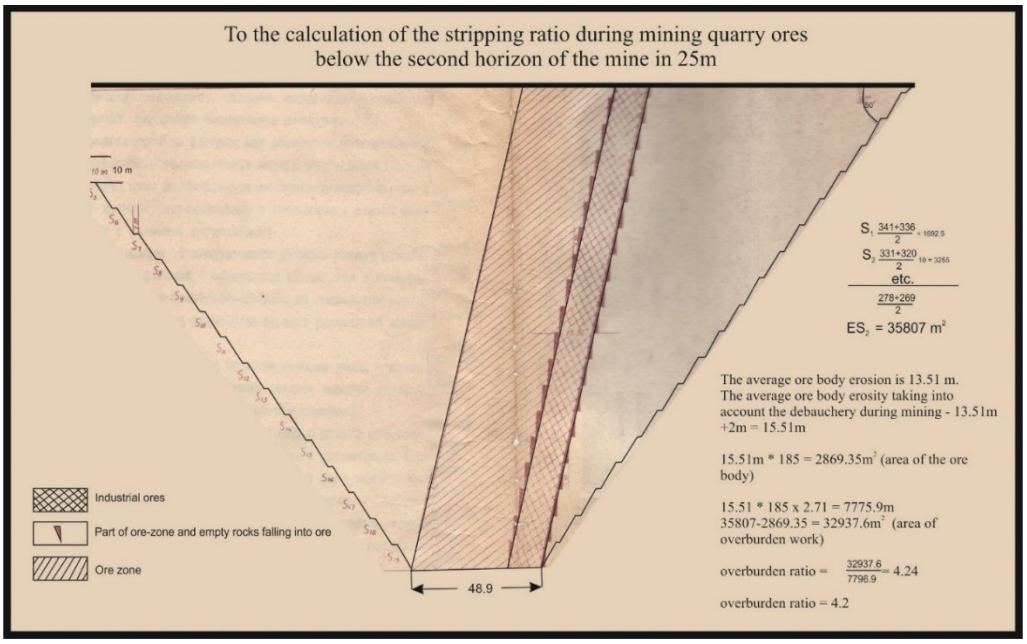

Figure 62. Scheme for calculating overburden coefficient during ore mining below second horizon

On the south-western flank under the dump of empty rocks, sai Maly Kazhnopsay can be used, in the central – Tudaksai, and in the north-eastern part – Kansai. Underground mining with any system will be unprofitable but considering that open-pit mining will achieve greater profit, it makes sense to conduct underground mining another 150-200 m below the final pit depth.

CALCULATION OF QUANTITIES AND VOLUMES

Exploration work for Galenit deposit began in 1950. On the recommendation of GKZ RT, exploration of the field was continued to a depth using two horizons of mine No. 1. According to the protocol No. 474 of the meeting of the commission, the following conditions were approved for the Galenit field:

1. The minimum industrial grade of conditional lead in the ore according to the calculation unit, taking into account the extraction of zinc, silver and cadmium, is taken to be 2.50%; zinc in oxidized ores is not taken into account.
2. The boron content of conditional lead in the sample when contouring the balance ore is taken to be 1.30%.
3. The conversion of zinc into conditional lead is carried out at a rate of 0.6.
4. The minimum capacity of the ore body included in the calculation of reserves is 1.0 m. With a lower power of the body and a high content of valuable components in the ore, be guided by the corresponding metro percent.
5. In areas of ore bodies of high power, interlayers of non-conditioned ores and waste rocks with a thickness of up to 2.0 m are included in the calculation of balance reserves.
6. The onboard content of conditional lead in the sample for contouring off-balance reserves is 0.7%.
7. In the balance ore circuit, reserves of associated components are calculated: silver and cadmium.

In these geological conditions and with the adopted exploration system, the most acceptable methods for calculating reserves are the methods of geological and operational blocks and the method of sections (horizontal sections). A combined method of counting simultaneously by 2 of the above methods is also possible.

The average contents of lead, zinc and associated components from exploratory sections were calculated using the arithmetic mean method, since, mainly, mining samples were taken in 1 m sections, with the exception of some samples taken from surface mine workings. For balance and off-balance ore lenses, in the absence of analyzes, the cadmium, bismuth and silver contents were taken according to the graph of the correlation between the associated and main components (Figure 63). To check the accuracy of reserve estimation by various methods, a comparative calculation was made of the reserves of lead and zinc for ore body No. 5 using the method of geological blocks, the results of which are shown in the table below (reserves calculated using the horizontal section method are taken as 100%). Reserves calculated by category using the horizontal section method – lead 15.2 thousand t – 100%; zinc 76.6 thousand t – 100%. Reserves calculated by the method of geological blocks of lead 15.2 thousand t – 100%, zinc – 80.53 thousand t – 105.1%.

Ore bodies were contoured according to the requirements of approved standards. Category B included reserves concluded between exploratory horizons, if the height between them did not exceed 50-60; also, reserves located between the surface and the horizon of mine workings, if the latter was separated by no more than 60 m from the surface. Blocks of reserves of category B, the conclusion inside the ore bodies, relied on mining. Analysis of geological data allows us to conclude that mineralization extends to great depths without visible pinching and deterioration of ore quality. At the same time, the deposit has been explored on average only 150 m, with a total length of the ore-bearing zone exceeding 1100 m. Considering the foregoing, extrapolation of C1 reserves below the internal contour was performed at 75 m, i.e. half the average intelligence depth. Category C2 reserves were suspended from the lower block of C1 reserves by unlimited extrapolation per 100m. The contents and capacities for blocks of category C2 were taken overlying horizon. reserves on balance lenses uncovered by one or more workings belonged to category C1. Sampling and determination of volumetric weights of ores were carried out systematically during the entire period of exploration of the deposit for all exploratory horizons.

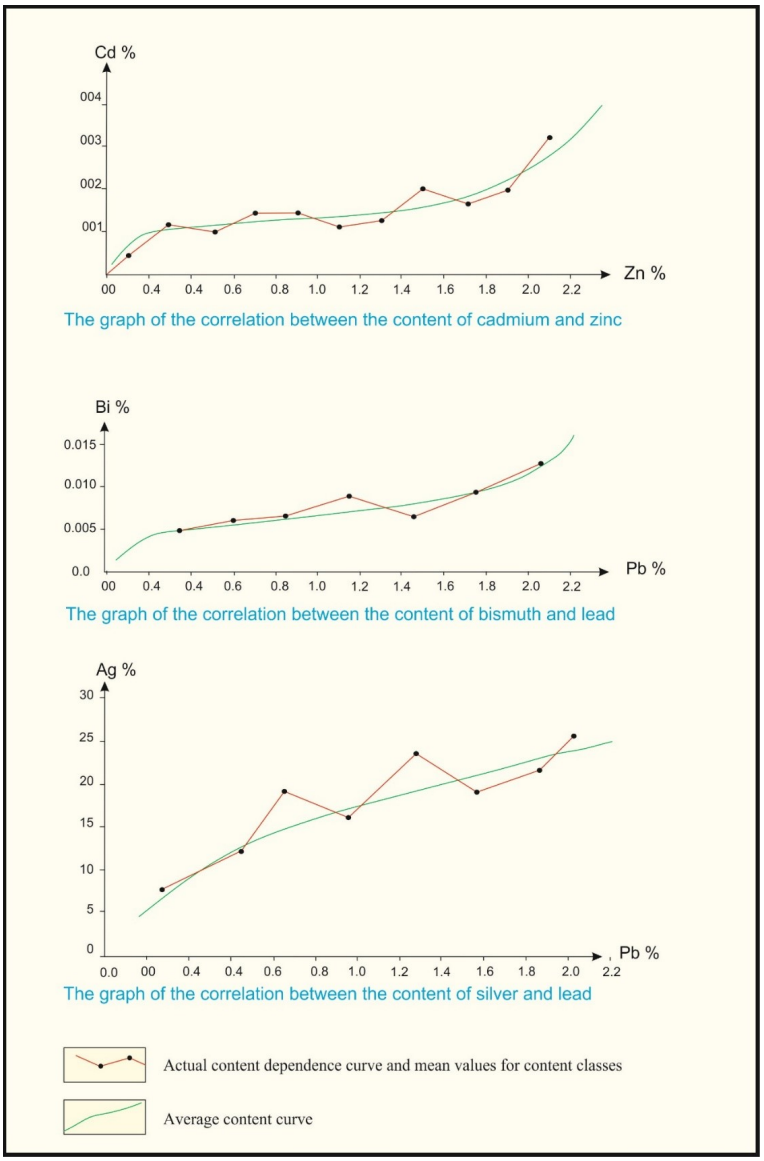

Figure 63. Correlation between the associated and main components for the purpose of cadmium, bismuth and silver contents estimation in balance and off-balance ore lenses

Given that sulfide ore samples were taken below groundwater, the water saturation coefficient should not differ significantly from the humidity coefficient. For oxidized ores, the water saturation coefficient should be significantly higher than the humidity coefficient, since the zone of oxidized ores is above the level of groundwater and the ores are practically dry. The water saturation coefficient is 2.31, and the porosity coefficient is 6.28. A relatively high coefficient of water saturation of bundles with high porosity of ores due to leaching of ore minerals.

Using the geological map, the contours of the ore bodies between the exploration sections were refined, the average strike of the ore bodies was determined, the elevations of the centers of the ore bodies were taken to make projections, etc. On the testing plans, ore bodies with industrial off-balance contents were outlined in accordance with the conditions, blocks were detuned in a horizontal plane, etc. On the plans, main data of the test results are written out in special tables: numbers, samples, their lengths, lead, zinc, copper, bismuth and cadmium contents in weight percent, and silver – in grams per ton (g/t). Geological sections were compiled after 100 m, and in some cases, to clarify the geological structure and morphology of ore bodies, sections were compiled after 50 m or more.

CLASSIFICATION OF THE SELECTED PROJECTS USING UNFC

OVERVIEW OF SOCIO-ECONOMIC INFORMATION, INCLUDING SOCIAL AND ENVIRONMENTAL (E AXIS)

The lead-zinc deposit Galenit is explored in detail and prepared for operation. The reliability of the estimated reserves is high. The feasibility study for the development of the deposit gives grounds for the fact that with the option of annual extraction and processing of ore in the amount of 200 thousand t, the enterprise will operate for up to 28 years. A significant part of the budget is formed by the enterprise in the form of taxes.

Therefore, the socio-economic feasibility of ore mining, concentrate production and marketing can be classified in accordance with UNFC-2009 in category E1.

REVIEW OF PROJECT FEASIBILITY INFORMATION (F-AXIS)

The high quality of ores of the Galenit deposit, the compactness of the ore bodies, the high degree of their exploration, continuous field exploration at the deposit, and the stable sale of products (concentrates) ensure a stable economic position of the enterprise with satisfactory internal rate of return (IRR) performance of 11.6% and average annual profit for the entire period of development. Some of the reserves of the deep horizons of the field (about 20%) that have not yet been discovered by underground mining are characterized only by preliminary technical and economic assessments. Therefore, the feasibility study of ore mining, production of concentrates and their marketing can be classified according to UNFC-2009 in category F1.2.

REVIEW OF GEOLOGICAL KNOWLEDGE / CONFIDENCE IN ESTIMATES (G-AXIS)

The latest assessment of the field's reserves, made by 3D modeling using Micromine, while ensuring proper quality control of testing and analytical work, confirmed by studies comparing exploration and production data, provide a high degree of confidence in the estimates. At the same time, on the deep horizons of the deposit, where production exploration has not yet been carried out, some of the reserves have been studied with a lower degree of detail than on those horizons where ore is mined. This part of the reserves is characterized by less confidence in valuations.Therefore, the degree of geological exploration and confidence in reserves estimates of the Galenit field can be classified according to UNFC-2009 into F1.2 categories.

CLASSIFICATION OF THE PROJECT USING UNFC SCHEME

Based on the above review of the Galenit project on the axes of the UNFC-2009 classification, lead-zinc ore reserves can be classified as E1, F1,2, G1,2.

CASE STUDY II: APPLICATION OF UNFC TO OIL DEPOSIT NAFT

The Naft oil field is located in the southern part of the Vakhsh valley. Exploratory wells in the field's area covered deposits of Neogene, Paleogene, Danish and Cenonian age, while exploratory wells No. 31 and No. 32 also uncovered the upper part of the Turonian.

Oil reserves of the second horizon are classified by category B amounting to 8.4 million t. Recoverable reserves amount to 3.36 million t. Oil reserves of the first horizon are classified by category C1, belong to off-balance and amount to 173 thousand t. By recoverable oil reserves according to the classification of GKZ RT of the Republic of Tajikistan, the field belongs to the category of small fields.

DESCRIPTION AND DETAILS OF THE NATIONAL CLASSIFICATION AND MANAGEMENT SYSTEM

The classification of GKZ RT establishes uniform requirements for the classification of reserves and resources of oil, natural hydrocarbon gas (free gas, gas caps and gas dissolved in oil) and condensate, their accounting for the state in the subsoil according to the degree of their knowledge and development. The basic concepts of categories of reserves and categories of resources are used in the classification of GKZ RT.

Oil, gas and condensate resources are subdivided into promising (category C3) depending on their degree of knowledge. Category C3 – estimated resources prepared for exploratory drilling within the oil and gas region. Estimated resources are used in the planning of exploratory work.

Reserves of oil, gas, condensate and related components are divided into proved categories A, B, C1 and previously estimated (unopened) categories C2. Category A – reserves are calculated based on the field (or part thereof) drilled in accordance with the approved field development project and serve as the basis for optimizing the system and the process of developing oil, gas and condensate reserves. Category B – reserves are calculated on the basis of the field (or part thereof), drilled in accordance with the approved technological scheme of field development, and serve as the basis for the development of the project. Category C1 – reserves of the field (its parts), the oil and gas potential of which is determined based on commercial inflows of oil, gas and condensate obtained in wells, and positive results of geological and geophysical studies in unverified wells. Category C2 – reserves of the field (its parts), the presence of which is justified by the data of geological and geophysical studies.

COMPARISON OF THE CLASSIFICATION OF GKZ RT WITH UNFC

The classification of field reserves, prospective and forecast oil and natural gas resources reflects the results of a phased geological study of the subsoil. Stages of the study of the subsoil are carried out by implementing the relevant projects. Each project has goals, deadlines, quality requirements and specific risk levels. There are 4 main stages of the study of mineral resources, while each stage of the study of mineral resources has a specific assessment of resources and reserves by categories: regional, exploratory, exploratory and operational.

Reserves of category C1 are calculated based on the results of exploration and development work and should be studied to the extent that they provide initial data for the development of the technological scheme of the field. They can be distributed based on drilling and well testing, provided that commercial oil and gas flows are received. Reserves of category C2 are calculated in unexplored parts of the field adjacent to areas with higher categories of reserves. They are used to determine field prospects, to plan exploration work, or to design field development.

Similar principles for phased exploration and project management are set out in the UNFC. With a certain degree of conditioning, the categories of geological exploration within the UNFC can be compared with the classification of the GKZ RT, for example:

- category G4 is comparable to resource category C3
- category G3 – from the valuation category of reserves C2
- category G2 – with reserves categories C1 and C2
- category G1 – with reserves categories A, B.

It is also tentatively possible to compare the criteria for the status and feasibility of a field development project under UNFC with phased subsoil use projects in the Republic of Tajikistan:

- category F4 under UNFC is comparable to regional work,
- category F3 under UNFC is comparable to the exploration stage,
- category F2 under UNFC is comparable to the exploration stage,
- category F1 under UNFC is comparable to field development.

The study of a specific area in G1 category, the economic feasibility of production and sale in the G1 category within the framework of the UNFC, is achieved through the phased implementation of projects from F4 to F1.

BACKGROUND INFORMATION ON NAFT DEPOSIT PROJECT

PREVIOUS WORK

As a result of exploration drilling on the anticlinal fold, two oil deposits were discovered in the Bukhara rock-layer (Lower Paleogene). The largest deposit is confined to fractured dolomitic limestones of the second horizon. The

second, a small deposit, is contoured in the carbonates of the first horizon. Well-developed fracturing in both horizons leads to a fairly high productivity of wells.

The Naft deposit was introduced into prospecting work in 1959. A total of 9 wells were drilled. Of these, 2 prospecting and 7 exploratory with a total footage of 13,932 m. The distance between the wells is 400-700 m, between the profiles 700-750 m. As a result of drilling, the presence of oil deposits in the first and second horizons of the Bukhara layer of the Paleogene, the configuration of the deposits and the conditions of occurrence of oil were established.

During the test, all wells were put into trial operation in order to clarify operating mode of the first and second horizons of the Bukhara rock-layers. Average production rates for wells range 40150 m^3/day. The total amount of oil produced during operation amounted to 15,800 tons.

Comparison of geological and geophysical data on exploratory wells of the deposit area shows that most of the section of the Bukhara rock-layers are represented by highly porous, permeable rocks that can serve as good oil and gas reservoirs, and the total reservoir thickness in the section of productive deposits of the Bukhara rock-layer reaches 100 m, which is a favorable factor to accumulate in them industrial reserves of oil and gas. The oil reserves of the second productive horizon are classified according to category B, belong to the balance and in accordance with the accepted calculation parameters amount to 8.4 million t. Recoverable reserves with a recovery factor of 0.4 are 3.36 million t. Oil reserves of the first horizon are classified by category C1 and belong to off-balance, and in accordance with the accepted calculation parameters make up 173 thousand t.

CURRENT STATUS OF THE PROJECT AND PROSPECTS

The most effective method for identifying enclosed structures, such as Naft deposit, is structural drilling, the results of which provide the most justified materials for setting up exploratory drilling. Of the 9 exploratory wells drilled at Naft deposit, only 1 well was beyond the oil content circuit.

By drilling wells on Naft deposit, industrial oil content was established, deposits were contoured, and oil reserves were calculated by categories C1 for the first horizon and B for the second horizon of the Bukhara Paleogene layers.

According to well testing and trial operation, the most rational system and field development regime were selected. The efficiency of production intensification by hydrochloric acid treatment of the bottom-hole zone has been verified.

Exploration of the Paleogene and Upper Cretaceous sediments in the area is completed, and the further direction of prospecting and exploration should be focused on deposits of the Lower Cretaceous and the Jurassic system.

SOCIO-ECONOMIC AND SOCIO-ENVIRONMENTAL ASPECTS OF THE PROJECT

The planned implementation of the project is desirable from a socio-economic point of view and is possible without harmful environmental consequences.

ECONOMIC ASPECTS

The total cost of exploration for the field amounted to approximately 3.1 million US dollars. According to estimates, recoverable oil reserves amount to 3.36 million t. The performance indicator of oil exploration is expressed in 236.9 t/m of deep drilling. At a total cost of all types of work carried out on the area of the Naft field for the discovery and exploration, 1 ton of oil is worth 0.94 US dollars. With a total cost of exploration of 2.16 million US dollars, the cost of exploring 1 ton of oil is 0.65 US dollars.

SOCIAL ASPECTS

In terms of subsoil users, the oil company is engaged in the search, exploration, development of oil and gas fields and oil production, with further sale of commercial oil in the domestic and foreign commodity markets. At the same time, Naft deposit with estimated oil reserves is not an object for covering expenses on social problems of the region. With the commissioning of an oil refinery, Naft deposit can be considered an object of providing the enterprise with raw materials. The commissioning of the enterprise will provide an opportunity to create new jobs in the region.

ENVIRONMENTAL ASPECTS

As part of the development of the fields, a preliminary assessment of the impact on which may cause unwanted changes in certain components of the environment, is developed. The area of planned activity is limited to a sensitive area of anthropogenic impact, in which minor changes are expected as a result of economic activity. In order to avoid negative impact on environmental components, environmental protection measures must be carefully observed. In this regard, technologies and technical solutions that would have the least impact on the environment were included in the project. The main components of the affected environment are the air basin, water area, subsoil, flora and fauna of the territory and the social environment.

Based on the analysis of the current situation, the design decisions made, and the consequences predicted by them, maps for calculating the dispersion of pollutants in the surface layer of the atmosphere were additionally modeled. Pollutant emissions do not exceed the maximum permissible standards.

STATUS OF FIELD PROJECTS AND FEASIBILITY

TECHNOLOGICAL ASPECTS OF FEASIBILITY

The first exploratory wells, based on structural drilling materials, focused on the search for oil and gas deposits in Paleogene and Cretaceous deposits. However, due to the low hypsometric position of the field in the structure of the Kyzyltumshuks ridge, the date and senon horizons turned out to be flooded, and the most promising deposits of the Cenomanian and Alb, which are associated with large oil and gas deposits in neighboring states, were unattainable due to abnormally high reservoir pressures aquifers in turon.

Since the Naft deposit is floating (it is supported by the pressure of the bottom and marginal waters), it is advisable to arrange the wells on a uniform grid in such a way as to avoid premature flooding with contour and bottom water. In addition, this arrangement of wells is dictated by the high viscosity of oil in the reservoir. Considering the detailed study of the field and using the data obtained, the following conclusions can be drawn:

1. To develop deposits, apply a uniform grid over a square system with distances between wells of about 250 m.
2. It is necessary to open the formation at its full capacity, perforation should be performed at 1/4 of the formation's capacity, counting from the roof of the horizon.
3. It is mandatory to carry out hydrochloric acid treatment of the bottom of the well, which often leads to an increase in well productivity by a factor of tens. This will significantly reduce the development time of the deposit.
4. Buffer pressure below 1.5 atm at the beginning of operation is impractical to reduce.
5. In order to maintain reservoir pressure and maximize oil recovery during field operation, consideration should be given to injecting gas or air into the reservoir.

LEVEL OF KNOWLEDGE / CONFIDENCE IN ESTIMATES

GEOLOGICAL AND TECHNICAL ASPECTS

Based on the assumption of the Brach anticline structure and nature of the deposits (it was supposed to open the reservoir deposits), the following methodology was chosen. Wells were laid along two profiles across the strike of the structure: 2 wells were drilled in the north-western and south-eastern piles of the structure. A total of 9 wells were drilled, among which 2 are prospecting and 7 are exploratory, with a total footage of 13,932 m.

Field-geophysical studies in wells – electrometry – was carried out using the gradient probe method (M2A 0.25B) and the potential probe (B2A 0.25M). Lateral logging was carried out by 5 gradient probes.

In the process of drilling wells, continuous core sampling was carried out in the intervals of occurrence of productive horizons of the Bukhara layers. For some wells, core samples were taken from several intervals of the Danish,

Cenonian, and Upper Turonian stages. The position of the water-oil contacts was determined by well test data; for this purpose, geophysical- field research materials were obtained, which were obtained from almost all wells. The oil reservoir of the second productive horizon of the Bukhara layers at the Naft Deposit was discovered by 8 exploratory wells, and 1 well remained behind the oil profile.

According to exploratory drilling data, numerous geological and production-geophysical materials have been obtained with enough coverage of the geological structure of the area, its tectonics, stratigraphy, the position of productive horizons in the section and the change in their properties in terms of oil content. Based on the trial operation of the wells and the study of hydrogeological conditions, which made it possible to determine the reservoir regime, a rational field development system was selected. Based on the physical properties of the oil and the regime of the reservoir, the oil recovery coefficient is conventionally assumed to be 0.4.

Guided by the “Instructions for the application of the classification of reserves to oil and gas fields” and considering the above, oil reserves of the second horizon of Naft Deposit are classified as B.

CLASSIFICATION OF NAFT PROJECT USING UNFC

OVERVIEW OF SOCIO-ECONOMIC INFORMATION INCLUDING SOCIAL AND ENVIRONMENTAL (E AXIS)

The results of exploration could not determine the economic viability of oil production due to lack of information. Thus, the economic feasibility of oil production and sales during the exploration phase can be classified in sub-category E3.2 of UNFC-2009. The economic feasibility of oil production and sales during commercial development as part of UNFC-2009 can be classified into categories and subcategories E1.1 and E2.

VIEW PROJECT FEASIBILITY INFORMATION (F AXIS)

The work performed on Naft deposit during the exploratory phase from the point of view of project feasibility (axis F) is categorized as F3 according to UNFC-2009. To confirm the presence of a deposit (or deposits) on the identified prospective structures, it was necessary to conduct additional exploration work. Most of the area has been drilled by exploratory wells, but commercial production has not yet begun. This said, the feasibility of the project in accordance with UNFC2009 should be classified as F1.1 and F1.2.

OVERVIEW OF GEOLOGICAL KNOWLEDGE / RELIABILITY OF ESTIMATES (G AXIS)

The resource assessment of the field was based on data from exploratory drilling and field geophysical work. Such data, largely similar to data for the region, are characterized by a significant range of uncertainty (Table 29). Therefore, according to UNFC-2009, the exploration and reliability of the estimates (G-axis) correspond to category G4. Exploration work and the reliability of estimates at Naft deposit can be classified as G1+2.

Table 29 – Definitions of categories and additional explanations and comparisons with the classification of mineral reserves of the Republic of Tajikistan

	Definition	Additional explanations	GKZ RT classification
E1	Confirmed the economic feasibility of production and marketing	Mining and marketing are cost-effective in current market conditions and under realistic scenarios of future market conditions. All necessary approvals / contracts are either already issued, or there are reasonable grounds to believe that all such approvals / contracts will be received within a reasonable time. Short-term adverse market conditions do not threaten economic feasibility if long-term forecasts remain positive.	Balance reserves (economic), the development of which at the time of assessment according to technical and economic calculations is economically effective in a competitive market using equipment, technology for the extraction and processing of mineral raw materials, ensuring compliance with the requirements for the rational use of mineral resources and environmental protection.
E2	It is anticipated that production and marketing will become economically viable in the foreseeable future.	The profitability of production and sales has not yet been confirmed, but on the basis of realistic forecasts of future market conditions, there are reasonable prospects for profitable production and marketing in the foreseeable future.	Off-balance reserves. Such reserves, even with a sufficiently high degree of knowledge, cannot be comparable with designated and withdrawn resources, since their development at the moment is obviously economically unprofitable. However, with big reservations, off-balance reserves can be included in the feasibility study for future mining.
E3	It cannot be assumed that production and marketing will become economically feasible in the foreseeable future, or the estimates are made at a too early stage that does not allow determining economic feasibility	Based on realistic forecasts of future market conditions, it is currently believed that there are no acceptable prospects for profitable production and marketing in the foreseeable future; or the economic feasibility of production cannot be determined due to lack of information (for example, at the assessment stage). Also included are quantities that are projected to be recovered but which are not for sale.	Not regulated

	Definition	Additional explanations	GKZ RT classification
F1	Feasibility of production during the implementation of a specific development project or during mining operations is confirmed	Production is currently underway at the field (deposit); either a development project is underway, or mining is ongoing; or sufficiently detailed studies have been completed proving the validity of production during the implementation of a specific development project or during mining operations.	Feasibility studies (Technical-Economical Studies) of feasible permanent conditions are developed on the basis of materials from completed exploration work and have as their goal the establishment of the scale and industrial value of the field to determine the feasibility and economic efficiency of its industrial development, and accordingly, to decide on financing an investment project for the development of the field. Moreover, all estimated financial calculations for the accepted version of the field's industrial development are carried out within the framework of the real acceptable values of all modifying factors. The overall validity of the study should be characterized.
F2	The feasibility of mining in the implementation of a specific development project or during mining requires further evaluation	Preliminary studies show the presence of deposits or deposits of such shape, quality and quantity that the feasibility of production using a specific (at least in the broad sense) development project or mining can be evaluated. Additional evidence and/or studies may be required to validate production.	A feasibility study of temporary conditions is a variant study to justify rational methods and systems for field development and an effective technology for processing raw materials. An integral part of the feasibility study is a financial analysis based on realistically acceptable values of technical, structural, operational-production and economic factors sufficient to establish recoverable reserves in the volume of the field, the viability of the mining project and, accordingly, the feasibility of investing in further exploration work depend on the quantity and quality of the deposit. The overall validity of the study should be characterized.
F3	The feasibility of production during the implementation of a specific development project or during mining cannot be evaluated due to a lack of technical data.	The most preliminary studies (for example, at the stage of geological exploration), which can be based on a specific (at least conceptually) development or mining project, indicate the need to collect additional information in order to confirm the presence of a deposit (or deposit) such a form, quality and quantity of raw materials that it will be possible to assess the validity of production.	The estimated deposits, the reserves of which, their quality, technological properties, hydrogeological and mining engineering conditions have been studied to a degree that allows us to justify the feasibility of further exploration and development. According to the degree of knowledge, the estimated deposits must satisfy the following requirements: (1) it is possible to qualify all or most of the reserves in category C2; (2) the material composition and technological properties of the mineral are evaluated with the completeness necessary to select a basic technological scheme of processing that ensures the rational and integrated use of the mineral.

	Definition	Additional explanations	GKZ RT classification
F4	No development or mining project	Subsoil quantities of raw materials (in situ) that cannot be mined by any of the currently existing mining development or mining methods	Not regulated
G1	Quantities assigned to a known deposit that can be estimated with a high degree of confidence	To estimate the amounts in the bowels of the energy and mineral resources extracted in the form of solid minerals, they are usually divided into discrete categories, where each discrete estimate reflects the degree of geological exploration and reliability related to a certain part of the field. Ratings are classified into the corresponding categories G1, G2 and / or G3. In the case of evaluating the liquid recoverable resources of fossil fuels and minerals, their mobility usually does not allow attributing the recoverable quantities to individual parts of the field or deposit. Recoverable quantities must be estimated based on the impact of the development scheme on the field as a whole and categorized based on three scenarios or outcomes equivalent to categories G1, G1 + G2 and G1 + G2 + G3.	Proved reserves / exploitation reserves in explored deposits represent an estimated category of the highest degree of reliability, both from a technical and economic point of view. Based on this, the main criteria for highlighting this category are: (1) the degree of geological reliability of proven reserves / "operational reserves" in explored deposits should correspond to the degree of geological reliability of the measured resources / "reserves of category C1 (A, B); (2) the reliability of the assessment of all admissible modifying factors should be sufficient to make a decision on financing and implementing an investment project for the development and development of the field. A mandatory attribute of the reliability assessment is a sensitivity analysis, which shows the influence of possible deviations of the characteristics of the most important modifying factors from the actual ones, taken in the calculation of technical and economic indicators and the integrated development efficiency of the field.
G2	Quantities assigned to a known deposit that can be estimated with an average degree of confidence.		Probable reserves / operational reserves at the evaluated fields have a lower level of reliability than the proven ones, but their assessment has a quality level sufficient to serve as the basis for a decision within the company on exploration and subsequent involvement of the field in commercial operation, taking full account of current factors risk. Based on this, the main criteria for highlighting this category is that the degree of geological reliability of probable reserves / "operational reserves" at the estimated fields should correspond to the degree of geological reliability of the estimated resources / "reserves of category C2" (deposits of all complexity groups) and "reserves of category C1" (deposits of the 4th complexity group).

	Definition	Additional explanations	GKZ RT classification
G3	Quantities concentrated on a known deposit that can be estimated with a low degree of confidence.		P1 category forecast resources consider the possibility of discovering new mineral deposits within the basin, mineral province, node or ore field, the estimated presence of which is based on a positive assessment of large-scale geological surveys (with appropriate mapping) and exploration of mineral occurrences. The predicted resources P1 in quantitative terms with reference to local areas serve as the basis for setting up detailed search surveying operations.
G4	Estimated quantities attributed to a potential deposit, based mainly on indirect evidence	The quantities estimated at the exploration stage are characterized by such a significant range of uncertainty and associated risk that subsequently no mining or mining project will be carried out with the aim of extracting these estimated quantities of raw materials. In cases where a single assessment is carried out, it should contain the expected result, however, if possible, the full range of uncertainty regarding the size of the potential field should be documented (for example, in the form of a probability distribution). In addition, it is also recommended to document the possibility (probability) that a potential deposit will become a commercial deposit.	Forecast resources of category P2 consider only the potential for discovering deposits of a mineral based on favorable geological and paleogeographic prerequisites identified in the evaluated region during medium-small-scale geological and geophysical and geological surveying. Quantitatively estimated P2 resources serve as the basis to produce geological mapping at a scale of 1: 50,000 and prospecting.
			Regional geological exploration

PROJECT CLASSIFICATION USING THE UNFC SCHEME

Based on the above project overview, along the three axes of UNFC-2009 oil reserves at the Naft deposit can be classified as follows: E1.1, E2, F1.1, F1.2, G1 + 2.

Oil reserves of industrial categories B+C1 correspond to E1.1, F1.1, G1 according to UNFC-2009. Oil reserves of C2 grading categories correspond to E2, F1.2, and G2.

ALIGNMENT TO SUSTAINABLE DEVELOPMENT GOALS IMPLEMENTATION

The Republic of Tajikistan is taking initiatives related to use of hydropower resources, which is a priority in providing the population of the Republic with electricity. Tajikistan has abundant hydropower resources. Due to the availability of rich hydropower resources, measures for the large-scale development of sources of thermal energy in Tajikistan have not yet been resolved. Outcomes from an integrated approach to coal reserves in Tajikistan and the allocation of energy resources, Tajikistan, while developing in the future, while maintaining the priority development of hydropower, will have to make serious efforts to develop thermal energy as an important complement to hydropower, eliminate the bottleneck in Tajikistan's energy sector, and support normal functioning economy of the country and the life of the population.

In the Republic of Tajikistan, industry is the leading branch of material production. A significant part of the gross domestic product of almost any country in the world is being created in this industry. State industrial policy should be multidirectional, and various instruments and mechanisms should be used to solve it, starting with fiscal measures and ending with attracting foreign investment. The Government of the Republic of Tajikistan has been given the task of taking measures to transfer the Republic from agrarian-industrial to industrial-agrarian. The following objectives have been adopted in the field of mineral resources:

1. Increase in the volume of production and sale of industrial products competitive in domestic and foreign markets;
2. The organization of an effective system of reproduction of personnel capable of creating and mastering industrial technologies, producing innovative products;
3. The creation of an institutional framework for the sustainable and preventive development of industries, the creation of innovative high-performance clusters, and
4. The development of a national system of selective import substitution based on the processing of local resources.

Of great importance in the Republic of Tajikistan is the construction of roads and railways. One of the strategic tasks of the state is to bring the country out of the communication deadlock, opening roads in all directions. With this task, the country has practically recovered. Now there are roads in all directions. The country's railway network is also developing. The government is doing everything to raise the living standards of the population. Every year the budget financing of the main types of production is increasing.

The Government of the Republic of Tajikistan has set a task for companies to produce competitive products within the country. Subsoil users should switch to the production of final products, i.e. measures are being taken to reduce the export of ore concentrates from deposits abroad. During the construction of metallurgical plants, new jobs will appear and, accordingly, replenishment of the state penalty will occur due to tax injections.

The President of Tajikistan noted at the conference “Water for Sustainable Development 20182028”: “Long-term observations indicate the increasing impact of climate change on the nature and socio-economic situation in Tajikistan and Central Asia. According to these observations, over the past sixty years, the average annual air temperature in Tajikistan has increased by one degree Celsius, the frequency and intensity of natural hydrometeorological phenomena have increased.” In terms of climate, Tajikistan is one of the most vulnerable countries in the entire region of Europe and Central Asia. 93% of the territory of Tajikistan is mountains, and only 7% of the land is considered flat. The population is 9 million people, and for every inhabitant there is only 0.06 hectares of irrigated land. Tajikistan is highly vulnerable to shocks caused by climate change, such as droughts, floods, landslides, etc. It is estimated that by 2050, up to one third of glaciers in Central Asia will completely disappear, which will sudden increase the risk of flash floods from breaking glacial lakes.

The Government of the Republic of Tajikistan annually allocates budgetary and extra-budgetary funds for the prevention and liquidation of natural disasters. A significant part of these funds is directed to the resettlement of the affected population, the provision of material assistance to them, as well as to shore protection.

The government is intensifying cooperation with regional and international organizations in the field of natural disaster reduction. There are multilateral and bilateral international agreements on disaster cooperation. Currently, a working group of representatives of the Ministry of Emergencies of Kazakhstan, Kyrgyzstan and the Committee in Tajikistan on the creation of a Central Asian center for disaster risk reduction is functioning in Almaty. The establishment of this center will facilitate coordination of efforts in this direction. In Central Asia, where water resources are often generated in some countries, and are used mostly in others, there is a need to develop a unified regional strategy for adaptation to climate change-related conditions.

The National Development Strategy of the Republic of Tajikistan for the period until 2030 has been prepared taking into account the changes that have occurred in recent years in the country and the world, the Central Asian region and the Eurasian space, and in particular, the impact of the global financial and economic crisis of 2007-2009 and its consequences on the national the economy. The document specifies the direction of development of the country, defined in the Concept of the transition of the Republic of Tajikistan to sustainable development. The supreme goal of the long-term development of Tajikistan is to improve the living standards of the country's population by ensuring sustainable economic development.

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NATURAL RESOURCE MANAGEMENT IN TURKMENISTAN

Turkmenistan's (Figure 64) economy is predominantly agricultural. Agriculture accounts for almost half of the gross domestic product (GDP) and more than two-fifths of total employment, whereas industry accounts for about one-fifth of GDP and slightly more than one-tenth of total employment. In 1988 the per capita net material product (NMP) output was 61% of the Soviet average, fourth lowest of the Soviet republics. In 1991, 17.2% of the work force was engaged in private-sector occupations such as farming, individual endeavors, and employment on agreement; 0.7% worked in rented enterprises, and the rest worked for state enterprises, social organizations, and collective farms. Turkmenistan had a total primary energy supply (TPES) of 26.75 Mtoe in 2014. Electricity consumption was 14.64 TWh. Most of this primary energy came from fossil fuels. All of the electricity is generated with natural gas.

Figure 64. Map of Turkmenistan

The geology of Turkmenistan includes two different geological provinces: the Karakum, or South Turan Platform, and the Alpine Orogen. Basement rock is only exposed at the surface in three places on the Turkmenistan plain. Shale with lenses of spilite, jasper-like rocks and silicified limestone outcrops in the center of the Tuarkyr elevation. Together with gabbro, serpentinized pyroxenite and diabase and numerous radiolarian fossils, they form an ophiolite mélange from the Paleozoic, overlain by 4 km of sandstone, clay, tuff and conglomerate. Late Paleozoic igneous rocks are exposed on the Krasnovodsk Peninsula, including granite, gabbro and acid volcanic rocks dating to 450 to 350 million years ago. The third exposure is on the left bank of the Amudarriya River, where 285 to 280 million year old cataclastic granite intrudes Devonian clay and carbonate sediments. Precambrian schist, amphibolite and gneiss, Middle Paleozoic granite, gabbroid, metamorphosed volcano-sedimentary rocks and Late Paleozoic intrusives are known through drillholes in the South Turan Platform. Geologists divide the platform basement into Precambrian massif and fold zones related to the Hercynian orogeny.

ENERGY AND MINERAL RESOURCES

Oil and gas are the dominant natural resources in Turkmenistan, with over 50 deposits discovered before the end of the 20th century. The West Turkmen Depression, also known as the Transcaspian Depression, is the main oil-producing area primarily from Pliocene rocks. Intensive oil extraction began in the 1940s, reaching 16 million t by 1973. After Russia, the US and Canada, Turkmenistan is the fourth largest natural gas producer in the world. Most gas reserves are

held in structural traps in Jurassic, Cretaceous and Paleocene rocks in the East Turkmenistan Turan Platform, at depths of 1.5-5.0 km, within uplifts of the Turkmen Anteclise and Amudarija Syneclise. The Murgab Depression is the single most productive area for gas, with the massive 1.8 trillion m^3 Dauletabad-Donmez gas field and 300 billion m^3 Naip field. In addition to gas deposits, Turkmenistan has the largest bromine and iodine reserves in the world as well as Karabogasgol Bay with large reserves of mirabilite and sodium sulfate. The eastern region of Guardak-Kugitang has abundant potassium salt, halite and sulfur, while the Oglanly deposit in Great Balkhan in Eocene sediments is a major supply of bentonite. Keramsite and other material is mined for construction. Oases supply the cities of Cis-Kopetdag and Tedzhen-Murgab with drinking water and groundwater is widely extracted for use in the arid oil fields, particularly the Yaschan freshwater aquifer at Uzboy. Turkmenistan has mineral water springs at Archman, Ashkhabad and Bayram-Ali.

Turkmenistan has more than 200 identified deposits of minerals, including barite; celestine; coal; copper; clays, such as bentonite and kaolin; gypsum; lead; marble; potash; quartz sand; salt; sand and gravel; sulfur; and zinc. The country's most important mineral deposits, from an economic perspective, are its natural gas and crude petroleum deposits and bromineiodine brine. Turkmenistan also has some of the world's largest gas fields that are located in the Murgab basin in the east, the South Caspian basin in the west and the Amu Darya basin in the southeast.

Turkmenistan ranked third in the world in iodine production and seventh in bromine production in 2016. Turkmenistan had the world's fourth-ranked proven natural gas reserves (after Iran, Qatar, and Russian Federation), which were estimated to be 17.5 trillion m^3. The country's proven crude petroleum reserves were estimated to be 600 million barrels. In 2016, the nonfuel minerals produced in Turkmenistan included ammonia, bentonite, cement, gypsum, lime, salt, and urea. The state Committee of Turkmenistan on statistics reported production rates of growth for most economic categories that it tracked, including those for construction materials, metals, mineral fertilizers, and mineral products.

In 2016, Turkmenistan remained a leading natural gas exporter among Caspian and Central asian countries. Turkmenistan produced 66.8 billion m^3 of natural gas, of which 38 billion m^3 was exported by pipeline to China (73%), Iran (19%), Russia (7%), and Kazakhstan (1%).

In 2015, the Government adopted an amended Law on Subsoil 2014 (formerly the Law on Subsoil 1992). According to the new Law on subsoil 2014, the subsoil and its resources throughout Turkmenistan, including the Caspian Sea sector, are the property of the Government and cannot be purchased or sold. All activities related to crude petroleum are controlled by the Hydrocarbon Resources Law. If a signed international agreement includes rules that differ from the rules set forth in the Hydrocarbon Resources Law, then the rules of the international agreement are to be applied.

The objectives of the amended Law on Subsoil 2014 include the following: (1) protection of the interests of Turkmenistan and its citizens, the rights of subsoil users, and mineral resources; (2) establishment of legal guarantees; and (3) creation of favorable conditions for the economic growth of the country and for investors. The law also states that the companies that use subsoil areas should conduct complete geologic exploration, use mineral resources efficiently, pay fees for the use of subsoil resources, and follow the environmental requirements to prevent contamination of the subsoil.

According to the amended Law on subsoil 2014, the use and protection of mineral resources is overseen by the Cabinet of Ministers of Turkmenistan, Federal agencies, and local authorities. The Cabinet of Ministers also includes the State Commission on Mineral Resources. The licenses for exploration are issued for 6 years with the possibility of being extended for 2 years; the mining licenses are issued for 20 years with the right to be extended for 5 years; and the licenses for exploration and mining (combined) are issued for 25 years.

The Government is accelerating the development of the nonhydrocarbon sector, most notably by adopting the National Program for Socio-Economic Development for 2011–2030. The programme includes modernization of the country's infrastructure and promotion of FDI, which are intended to help diversify the economy of Turkmenistan and reduce the country's reliance on hydrocarbon resources. The priority sectors include electric power, chemicals, construction, oil and gas, and other industries.

The Government is also focusing on increasing trade with neighboring countries, to develop natural resources, and to construct necessary infrastructure. In 2015, the Governments of Afghanistan and Turkmenistan planned to cooperate in the energy and transport sectors by constructing a second terminal that would allow the shipment of petroleum products. Currently, Turkmenistan sells petroleum products to Afghanistan through existing terminals on the Turkmenistan - Afghanistan border.

Turkmenistan's mineral industry was dominated by state-owned enterprises, and the natural gas and oil industry, by partnership enterprises. State-owned SI Turkmenhimiya Holding operated 10 facilities in Turkmenistan—PO Maryazot, the Turkmenkarbamid plant, IA Turkmenmineral, the Khazar chemical plants, PO Garabogassulfat, the Balkanabad iodine plant, the Bereketskiy iodine plant, the Guvlyduz Salt Factory, the Dokunkhimiya company, and the Institute of

Chemistry. SI Turkmenhimiya Holding was responsible for the implementation of new technology in chemical facilities, the distribution of fertilizers and chemical products to the agricultural industries and the citizens of Turkmenistan, and the export of fertilizers and chemical products.

Turkmenistan's government is continuously investing in oil and gas, to modernise and expand the electricity and heat sector by 2020. Moreover, the energy sector is almost fully subsidised, with citizens receiving free electricity, heat and gas up to a certain level of consumption, until 2030, but the government is taking steps to reduce subsidies to curb domestic demand and increase exports (Figure 65).

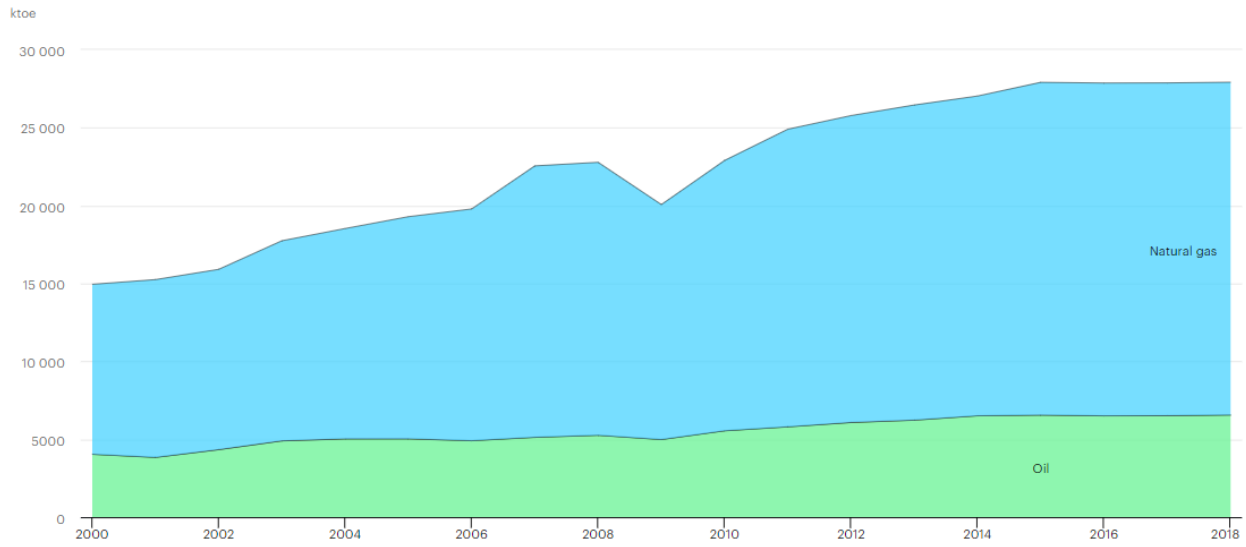


Figure 65. Total energy supply (TES) by source, Turkmenistan 2000-2018 (Source: IEA)

Turkmenistan is part of the EU4Energy Progamme, an initiative focused on evidence-based policymaking for the energy sector. Turkmenistan's current and future economy is highly dependent on crude petroleum and natural gas exports; therefore, the country is actively searching for new routes to export natural gas. The TAPI pipeline is in progress; however, the country faced some issues that could prevent this project from being completed on schedule. in 2016, Turkmenistan continued to focus on the development of the nonhydrocarbon mineral sector. some signs of the emphasis on the nonhydrocarbon sector is Turkmenistan's investment in chemical and construction material plants, modernization of the existing iodine and bromine plants, and the construction of a potash-processing plant; the investment is likely to result in production increases for these minerals during the next few years.

Turkmenistan's current and future economy is highly dependent on crude petroleum and natural gas exports; therefore, the country is actively searching for new routes to export natural gas. The TAPI pipeline is in progress; however, the country faced some issues that could prevent this project from being completed on schedule. in 2016, Turkmenistan continued to focus on the development of the nonhydrocarbon mineral sector. some signs of the emphasis on the nonhydrocarbon sector is Turkmenistan's investment in chemical and construction material plants, modernization of the existing iodine and bromine plants, and the construction of a potash-processing plant; the investment is likely to result in production increases for these minerals during the next few years.

ALIGNMENT TO SUSTAINABLE DEVELOPMENT GOALS

Since the adoption of SDGs, Turkmenistan has achieved significant progress in its social policy, began the market transformations, and stepped up climate change adaptation and mitigation measures. The positive results in providing the population with affordable and high-quality medical services and education are being maintained; while the reforms continue aimed at improving healthcare and education systems. Country has embarked upon the development of market relations, which is accompanied with the continuation of the socially-oriented economic growth and greening of economic sectors, rational use of natural resources and effective adaptation to climate change. At the same time, special attention is being given to inclusivity of national reforms, and ensuring equal opportunities and full participation of women in economic, political and cultural life of the country. Steps identified for further implementation of SDGs include:

- The need to continue efforts for strengthening the statistical capacity. Turkmenistan will work on development of the national SDG indicators framework, collection of comprehensive, reliable and disaggregated data, and establishment of the national SDGs database. This will ensure the completion of setting the baseline for

implementation and monitoring of relevant country strategies and tracking the progress towards achieving the SDGs. At the same time, we hope to continue fruitful collaboration with the UN agencies and international organizations and rely on their all-round assistance in this work.

- Enabling the financing for development is a key component in implementation of the 2030 Agenda. Turkmenistan is improving its public finance management system, including through fiscal regulation in order to mobilize domestic resources. Yet, it is important to supplement the increase in domestic finance with international assistance. Therefore, being committed to addressing the issue of financing for sustainable development, we believe that it is important to promote partnerships and cooperation with the UN system, Bretton Woods institutions and international development banks, as well as to provide access to concessional and innovative financing for the middle-income countries. We look forward to the assistance of international community in this important endeavor.
- Turkmenistan remains coherently committed to issues of building peaceful societies by realizing human rights and human dignity, disarmament and non-proliferation, promoting global and regional cooperation and engagement frameworks, and working together in addressing global challenges. Turkmenistan will continue working on development of the UN Special Programme for the Aral Sea Basin to address water and environmental issues in Central Asia.

Turkmenistan's initiatives aims at consolidating international efforts to addressing the major issues of the global agenda cannot be implemented single-handedly - they require an active engagement of international community, along with technical assistance and investments from international organizations and multilateral banks.

Turkmenistan, as a country located in arid zone, feels the effects of climate change. In this regard, particular emphasis is placed on the climate change adaptation and mitigation measures not only in economic sphere, but also in the environmental and social fields. The country is a party to the United Nations Framework Convention on Climate Change and the Paris Agreement on climate change. The Government of Turkmenistan is convinced that each country's contribution to global efforts aimed at reducing the impact of climate change, and the global partnership would yield positive results in this area.

In response to global climate change, strengthening the resilience and adaptive capacity (SDG 13.3) is of the highest importance. It will require the financing of rational use of ecosystems (SDG 15.a) and forests (SDG 15.b), development of sustainable infrastructure (SDG 9.1), increasing the share of renewable energy (SDG 7.2), rational use of natural resources (SDG 12.2), as well as raising awareness through education and ensuring access to information (SDGs 16.10, 13.3, 12.8, 4.7). Moreover, response measures shall be integrated into the national strategies (SDG 13.2), which include activities focused on halting natural habitats degradation (SDG 15.5), ensuring the account of ecosystems value (SDG 15.9), integrated water resources management (SDG 6.5), as well as improving resilience of the poor (SDG 1.5) and transfer of environmentally sound technologies (SDG 17.7). At the national level, this will require raising capacity for effective climate change-related planning and management (SDG 13.b), capacity building (SDG 17.9) and public, public-private and civil society partnership (SDG 17.17), as well as responsive, inclusive, participatory and representative decision-making at all levels of society (SDG 16.8).

High quality, relevant and reliable data is required for effective monitoring of progress made towards SDGs implementation. An assessment of SDGs data gaps has been carried out on the basis of questionnaires of the United Nations Economic Commission for Europe (UNECE) and UN Children's Fund (UNICEF) to understand the current status of data availability in Turkmenistan. The analysis showed that 88 (50,3%) SDG indicators out of all SDG indicators adopted in Turkmenistan had been achieved. In this regard, the government will direct the efforts to achieve Level I and II indicators. Activities are underway to draw up a list of national indicators to establish the national system of indicators and SDGs monitoring.

System of Environmental-Economic Assessment (SEEA) is very much relevant in bringing together SRM and achievement of SDGs. UNFC is built into the SEEA framework and adoption, and implementation of integrated resource management will promote overall sustainability in this sector. Such an approach is essential to bring about balanced social, environmental and economic gains for Turkmenistan.

NATURAL RESOURCE MANAGEMENT IN UZBEKISTAN

The geological industry is a basic component of the national economy, which is a combination of management structures, industrial and scientific organizations that satisfy the state and society demand in the field of geological study of the territory of the Republic of Uzbekistan; replenishment of the mineral resource base of the country, monitoring and conservation of mineral resources, as well as running the mining relations.

The State Committee of the Republic of Uzbekistan on geology and mineral resources (hereinafter Goscomgeology) is entrusted with the system of state management of the geological industry in the Republic. It implements a unified state policy and legal regulation in the field of study, use, rehabilitation and conservation of mineral resources, as well as monitoring the state of the subsurface resources.

Searching and valuation of deposits is carried out both at the expense of the State budget and the special account of Goscomgeology (it is formed from the assets of the Navoi and Almalyk MMC) under the state programmes, and at the expense of the subsoil users on a license basis. Oil and gas exploration works is carried out by "Uzbekneftegaz" JSC.

The Committee provides government services for the geological subsoil study with approval of solid mineral resources and groundwater (except for oil and gas); geological records and funds collecting, generation and storage; licensing of subsurface resources; governmental accounting and state expertise of reserves, information and appraisal of the exploration projects. Supervision functions in the field of government control over the geological study, use and conservation of mineral resources are carried out.

ROLE OF ENERGY AND MINERALS PRODUCTION IN NATIONAL ECONOMY

Mineral resources are important and play huge role in the national economy. With further deep processing of raw materials and production of high value-added products on their basis, the share of mineral resources in terms of budget revenues increases significantly.

Today, in the structure of the primary fuel and energy resources of the country, 97% are oil and gas, 2.3% – coal, 0.7% – hydropower. One of the largest companies in the country is UzTransGaz. Over 85% of coal fuels are used in the electricity sector. Electricity production in Uzbekistan in 2016 amounted to 59 billion kWh. In the electric energy system of Uzbekistan, there are 45 power plants with a total capacity of more than 12.4 thousand MW, including the total capacity of 16 power plants of the “Uzbekenergo” SJSC – more than 12 thousand MW. The potential for electricity production is 56-57 billion kWh. The installed capacity of power plants in Uzbekistan is about 50% of the generating capacity of the entire Unified Energy System of Central Asia.

Electric power generation is carried out mainly at thermal power plants, including the Angren, NovoAngren, Navoi, Talimarjan and other stations. The largest power station in Uzbekistan and throughout the Central Asia is the Syrdarya TPP at an installed capacity of 3000 MW (commissioned in 1966). Hydroelectric power plants of Uzbekistan are as follows: Gissar hydroelectric station (45 MW), Farkhad hydroelectric station (126 MW), Andizhan hydroelectric station (190 MW), Charvak hydroelectric station (600 MW), Chirchik-Bozsu cascade of hydroelectric station (1200 MW).

Uzbekistan is among the world leaders in the supply of certain types of minerals: gold, uranium, copper, phosphate, molybdenum, etc. At present, Uzbekistan ranks 7th in the world in terms of uranium reserves (4% of world uranium reserves), holds 4th place in the world in terms of total gold reserves, and 7th place in terms of gold production. Uzbekistan is in the 15th place in terms of gold reserves in tons (data of the World Gold Council as of December 2018).

PRODUCTION

The state balance of mineral reserves is formed in Goscomgeology and annually approved, and the relevant data are provided to the Ministry of Economy, the Cabinet of Ministers of the Republic of Uzbekistan, to interested ministries, departments, local authorities, etc., in order to plan the development programmes and organize production on the basis of local raw materials (Table 30, as at January 2018).

Table 30 – Global rank of Uzbekistan in terms of reserves and production by major types of minerals

№	Mineral	Unit of measurement	Reserves		Production (2017)	
			Quantity	Global rank	Quantity	Global rank
1	Gold	t	5990.5	3	89.9	9
2	Silver	t	21559.9	9	232.3	22
3	Uranium	thousand t	96.7	11	3.5	7
4	Copper	thousand t	16336.2	12	137.1	24
5	Tungsten	thousand t	123.6	6	-	-
6	Oil	million t	177.2	44	0.9	47
7	Natural gas	billion m^3	2276.5	21	54.4	24
8	Coal	million t	1950.1	16	3.5	30

Reserves of Phosphorite ores, Potassium Salts and Kaolin are also present (71758.9, 68896.2 and 249992.3 thousand t, respectively), and their annual production amounts 325.6, 310.6 and 3519.0 thousand t, respectively.

The growth of industrial production in the metallurgical, construction and other industries, as well as the integrated development of territories, requires proper provision of their additional industrial reserves of minerals, taking into account the significant expansion of geological exploration.

Geological exploration at the rate of production at the level of 2017, in the main areas focused on maintaining the current balance and expansion of the mineral resource base for gold and uranium by "Navoi MMC" SE, for gold and non-ferrous metals (copper, lead, zinc) by "Almalyk MMC" JSC, for agricultural products by "Uzkimesanoat" JSC (phosphorite ores, potassium salts), etc. For tungsten, rare metals and rare earth elements, quartz and the expansion of the mineral resource base is aimed at the creation of new industries.

Annual production of natural gas in the Republic amounts to 54.4 billion m^3, oil – 0.9 million t, coal – 3.5 million t. Along the way, sulphide sulphur is extracted from ore deposits – 842.1 thousand t, bismuth – 22 t, cadmium – 237.2 t, rhenium – 5.3 t, indium – 1.1 t, tellurium – 48 t, selenium – 101.1 t, molybdenum – 1457.7 t. Also, annually Navoiazot JSC produces ammonia – 550 thousand t, ammonium nitrate – 950 thousand t, nitrogen-phosphate fertilizer – 180 thousand t. Other valuable minerals include copper, gypsum, silver, tungsten and zinc.

Copper is mined at one of the largest deposits in Central Asia, the Kalmakir deposit, at least of 130 thousand t/year. Lead and zinc are mined in the Handiza own field, and as associated components in other complex fields. Phosphate rock (Jeroy) and potassium (Tyubegatan) deposits are being developed. And also, the main part of the population is provided with groundwater sources. Currently, geological exploration is underway to provide inaccessible settlements with potable groundwater.

In general, the state of the mineral resource base of the Republic for a number of strategic minerals (precious metals, uranium, oil and gas, mineral fertilizers, groundwater, building materials, etc.) is assessed as satisfactory.

The Republic also has deposits of iron (Tebinbulak), tungsten (Ingichke, Koytash, Lyangar, Sautbay and others), manganese (Dautash, Takhtakaracha), combustible shale (Aktau, Sangruntau), graphite (Taskazgan), which are currently not mined. During 2017, gold was mined – 89.9 t, silver – 232.3 t, uranium – 3.6 thousand t, copper – 137.1 thousand t, oil – 0.9 million t, gas – 55.4 billion m^3.

The subsoil of the Republic possesses still unexplored types of minerals (platinoids, chromium ores, rare and other metals, abrasives, perlites, caustic soda, mineral wool, basaltoids, etc.) that require the formulation of a complex studies such as: geological, physico-chemical, experimental-technological and technical-economic. Provision is made by the strategic concepts till 2030 for increase in gold, uranium and copper production. Since 2017, the development of the Nukrakon silver deposit has begun with metal production of at least 5 tons. Until 2030, the project implementation for involving the Yoshlik-1 copper porphyry deposit in the processing of ores is contemplated. By 2021 it is planned to develop the Uch-Kulach polymetallic ore deposit by open mining with zinc output of 5.2 thousand t/year. Investigations for extraction of petroleum resins and associated metals from oil shale are in progress.

In particular, the identified deposits, based on the results of geological exploration are further involved in the development by the State Enterprise “The Navoi MMC”, the “Almalyk MMC” JSC, the “Uzkimyosanoat” JSC and other organizations, as well as by the private sector. Geological exploration at production rates on the level of 2018 in general guidelines are focused on existing balance maintenance and scoping studies for gold and uranium at the State Enterprise “The Navoi MMC”, and for gold and non-ferrous metals (copper, lead, zinc) at the “Almalyk MMC” JSC. The

expansion of the mineral resource base for tungsten, rare metals and rare-earth elements, quartz and basalt raw materials is aimed at creating new producing departments.

Uzbekistan has proven reserves of coal in the amount of 1872.4 million t, including: brown coal - 1822.5 million t, and bituminous coal - 49.8 million t. Inferred resources amount to 323.4 million t of coal. Coal production in the Republic is carried out at three fields: Angren (brown coal), Shargun and Baisun (bituminous coal). "Uzbekugol" JSC is the only company representing the coal mining industry in the country. The main activities are exploration, production, supply, storage, processing and sale of coal products, as well as a number of related minerals. In 2017 Uzbekistan increased coal production by 4.4 % compared to 2016 to 4,038 million t. The main consumer of coal fuel is the electricity sector, which accounts for over 85% of total coal consumption.

STRUCTURE OF THE INDUSTRY

The sectoral structure of industrial production in Uzbekistan is composed of the following industries: electric power, fuel industry, ferrous metallurgy, non-ferrous metallurgy, chemical and petrochemical industries, metal-fabricating industries, forestry, woodworking and paper-pulp industry, construction materials producing industry, light industry, food processing industry and other industries.

The industrial composition of Uzbekistan's production sector is improving and taking the form of an interconnected complex. Machine-building, electric power, non-ferrous metallurgy, chemistry, metalworking were developed by priority rates; that is, those industries that determine scientific and technical progress, developed at a faster pace. Only within the last few years, such major industrial enterprises as the Tashkent and Syrdarya state district power plants, the Navoi electrochemical plant, the Almalyk chemical plant, the Angren rubber plant, the Tashkent motor plant, the Samarkand factory of household refrigerators, the Kuvasay porcelain-faience factory, etc were constructed in the Republic.

Uzbekistan is one of the industrialized Republics of the Central Asian region. About 24% of its GDP is formed in industry. According to preliminary data of the State Committee of Statistics of the Republic of Uzbekistan, in 2017, industrial production in Uzbekistan increased by 1.1% compared with the previous year. According to analysts of the agency, growth in industry in 2017 as a whole was achieved due to the growth of the added value of the mining industry and the development of quarries (+14.6%) and the manufacturing industry (+2.8%). The share of industrial production in the GDP structure made up 26.7%.

As previously reported with reference to official sources, Uzbekistan’s GDP in 2018 was forecasted in the amount of 290.6 trillion soums, the GDP deflator is 14.1%, the consumer price index is 12.4–13.4%.

MAJOR COMPANIES AND FACILITIES

In particular, the discovered fields, as a result of geological exploration, are further involved in the development of Navoi MMC, JSC Almalyk MMC, JSC Uzkimyosanoat, JSC Uzbekneftegaz, JSC Uzbek Metallurgical Complex and other organizations, as well as the private sector.

SE "Navoi MMC" work off deposits of gold by hydrometallurgical plant (Mining and Metallurgical Plant): MMP-1 - Aristantau, objects of Ziaetda ore field (Karakutan, Yangi-Davon, Yambash); MMP -2 - Muruntau, Myutenbay; MMP -3 - Kokpatas, Daugyztau; MMP -4 - Charmitan, Guzhumsay, Urtalik; MMP -5 – Amantaytau.

In 2018, it began development of silver field Kosmanachi. The main part of silver mining is carried out simultaneously from complex deposits of gold, copper and polymetals. JSC "Almalyk MMC" fulfills deposits of gold, copper and polymetals (lead, zinc):

- Angren mining administration – Kochbulak, Kyzylalmasay, Kairagach
- Chadakskoe mining administration – Guzaksay, Pirmirab
- Kauldinskiy mining administration – Couldi
- Kalmakyr mining administration – Complex-Kalmakyr, Sary-Cheku, Eshlik 1,
- Khandisa mining administration – Base metals – Khandisa

JSC "Uzbekneftegas" fulfills all hydrocarbon deposits (264 field: 213 deposits of gas, 137 oil and 176 condensates. Of the total number 107 fields is in development). JSC "Uzkimesanoat" fulfills deposits of agricultural raw materials: phosphorite ore (Djeroy) and potassium salts (Tubegatan).

JSC "Uzbek metallurgical complex" is working on secondary metal.

POLICY AND LEGAL FRAMEWORK

Subsoil use, regulation of relations arising from possession, use and management of subsoil (mining relations) are considered by the Law of the Republic of Uzbekistan "On Subsoil" [Law of the Republic of Uzbekistan "On Subsoil" dated September 23, 1994 No. 2014-XII].

The basic objectives of this Law are to ensure rational, integrated use of mineral resources for meeting minerals requirements and other needs, conservation of mineral resources, protection of the environment, safe conduct of works when in subsoil use, as well as the preservation of subsoil users' rights, and protection of interests of the individuals, society and state.

The State Committee of the Republic of Uzbekistan on Geology and Mineral resources is responsible for the implementation of a unified state policy in the field of geological study, subsoil use and protection, as well as the management of mining relations.

A process of mineral resources concentration in the hands of individual large corporations is observed at the world. In the Republic of Uzbekistan, the main or strategic types of mineral raw materials are concentrated in the government sector.

This stresses the dynamic development of geologic branch both in present conditions and current economic situation. At the present time, exploration work is being conducted by Goscomgeology (for solid minerals and groundwater) and "Uzbekneftegaz" JSC (for hydrocarbon raw materials).

The annual financing of exploration for solid minerals amounts at least 80 million US dollars. The main volumes of geological exploration are associated with the replenishment of gold, uranium and metallic mineral reserves (up to 72% of the total amount of financing). In addition, in recent years, exploration works for iron, manganese, coal, oil shale, rare metals and rare earth elements, uranium, etc. has been re-launched or enhanced. About 45% of the total provision for geological exploration are directed to prospecting evaluation and exploration for gold, about 17% for uranium, 10% for other metallic minerals, 4% for groundwater, 3% for non-metallic minerals, 7% for areal study, 5% for research scientific works, etc. Every year, over 200 million US dollars are expended in exploration for oil and gas.

A stable rate of growth is ensured in all areas; and exploration for non-conventional and new types of minerals, which have not been previously explored, is also being conducted.

To date, Goscomgeology is carrying out geological exploration for more than 30 types of minerals, whereas this figure did not exceed 3-4 types 20 years ago. Goscomgeology is engaged in an increase of works for various types of minerals (in addition to strategic ones) in order to achieve complete self-sufficiency of the Republic with mineral raw materials. Thus, geological exploration is aimed primarily at assurance of stable and long-term work of operating and emerging capacities of mining and-metallurgical combines, creating a reliable mineral resource base of needy industries for new types of minerals (rare metals, nickel, cobalt, bauxite ore, celestin and others) with the creation of a competitive climate on the domestic and foreign markets. From year to year the number of discovered deposits in the Republic increases (Figure 66).

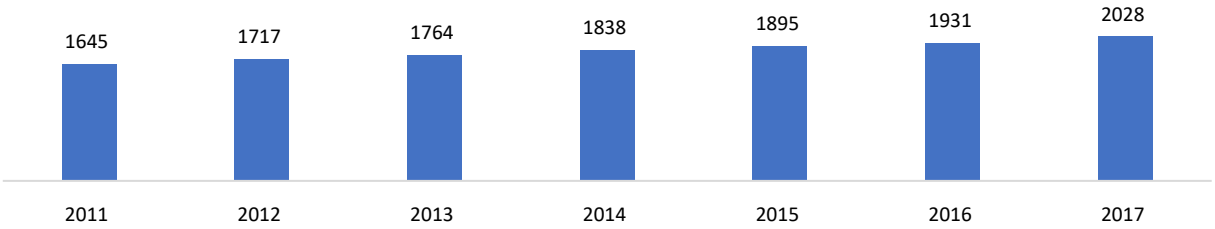


Figure 66. Total number of deposits in Uzbekistan

One of the key tasks of Goscomgeology is to attract private partners for growing scopes and increase the efficiency of geological exploration. Efficiency of geological exploration with least costs is ensured. For example, about 0.5 US dollars is expended in gold mining gain.

At present, long-term exploration programmes for geological exploration, covering the years 2017-2021, have been developed. A conceptual framework for geological exploration expansion until 2030 and 2035 is under development.

SECTOR ORGANIZATION AND REGULATORY INSTITUTIONS

The state policy on the management of the subsoil has the following form (Figure 67).

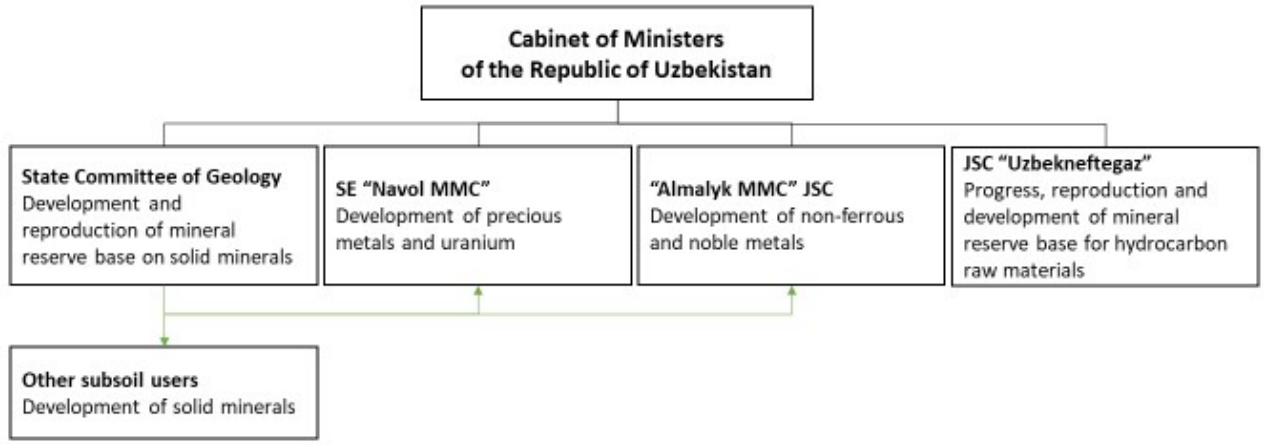


Figure 67. Sector organization and regulatory institutions in Uzbekistan

FISCAL DESIGN AND ADMINISTRATION

Due to the extraction and processing of mineral resources, the contribution of energy and mineral reserves and resources to the economy of Uzbekistan will be more than 16% of national GDP.

GDP structure by branch of economy (2017) is: the share of agriculture in the country's GDP amounts to 19.2%, the share of services in GDP is 47.3%, and industry in GDP is 33.5%.

The proceeds from royalties in the form of tax on the use of mineral resources (except hydrocarbons) for 2017 amounted to 3,484.3 billion soums. With 2017 GDP – 254,043.1 billion soums, respectively, the contribution of the industry in the form of taxes for the use of subsoil resources is 1.37% of the total GDP.

In addition, a further annual increase in the tax on the use of subsoil is expected, taking into account the growth trend in attracting foreign and local investors for geological exploration and development of mineral deposits.

The proceeds from royalties in the form of tax on the use of mineral resources (except hydrocarbons) for

2017 amounted – 3,484.3 billion soums. With 2017 GDP – 254 043.1 billion soums, respectively, the contribution of the industry in the form of taxes for the use of subsoil resources is 1.37% of the total GDP.

Receipts from royalty in the form of subsoil use tax for minerals (except for oil and gas) for 2017 amounted to 435.5 million US dollars. At GDP in 2017 composing more than 30 billion US dollars, respectively, the contribution of the industry in the form of taxes for subsoil use makes up 1.37% from the overall volume of GDP. Moreover, a further annual increase of the subsoil use tax is expected, with allowance for the growth trend in attracting of foreign and local investors for geological exploration and development of mineral deposits (Figure 68).

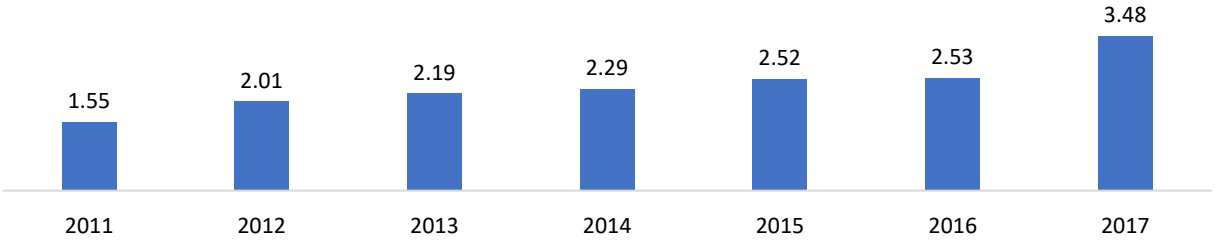


Figure 68. Subsoil use tax funds history (trillion sums)

Along with this, with the further deep processing of raw materials and output of high added value products on their basis, the share of mineral resources in terms of budget revenues, increases significantly.

REVENUE MANAGEMENT AND IMPLEMENTATION

Exploration for solid minerals and groundwater by the State Committee of the Republic of Uzbekistan on geology and mineral resources is carried out 100% of the budget. For 2019, the programme plans to allocate 788.0 billion soums (93.8 million US dollars) for geological exploration. It is planned to increase gold reserves by 89.7 t, silver - 174.1 t, uranium - 5000 t, lead - 22 thousand t, zinc - 24.5 thousand t, copper - 39 thousand t, tungsten – 3.5 thousand t, etc.

Geological exploration for hydrocarbon raw materials is carried out mainly by own funds of JSC "Uzbekneftegaz". For 2019 prescribed 2179,9 billion sums (or 259.5 million US dollars). At the same time, it is planned to increase gas reserves – 60.0 billion m^3 and liquid hydrocarbons (oil and condensate) – 3.6 million t.

SUSTAINABLE DEVELOPMENT GOALS IMPLEMENTATION

Subsoil use, regulation of relations arising from the possession, use and disposal of mineral resources (mountain relations) are considered by the Law of the Republic of Uzbekistan “On Subsoil” [Law of the Republic of Uzbekistan “On Subsoil” dated 23September 1994 No. 2014-XII].

The activities of the companies of the mining and metallurgical complex are regulated by the following legislative acts: Key Law – Law of the Republic of Uzbekistan “On Subsoil”, adopted in 2002. In recent years, the country has adopted a number of legal acts expanding investment cooperation in the mining and geological industry:

1. Cabinet of Ministers Resolution No. 328, which approved lists of promising areas of strategically important types of solid minerals
2. Presidential Decree No. 3479 "On measures for the stable supply of industries of the country with popular types of products and raw materials"
3. Presidential Decree No. 3578 "On measures to fundamentally improve the activities of the State Committee of the Republic of Uzbekistan on geology and mineral resources".

It should be noted that at present, regulatory and legal acts are being updated in all sectors based on the relevance of the country's development at a rapid pace.

CLASSIFICATION AND MANAGEMENT FRAMEWORK FOR ENERGY AND MINERAL RESOURCES

DESCRIPTION AND DETAILS OF THE CLASSIFICATION AND MANAGEMENT SYSTEM IN UZBEKISTAN

Currently, the Methodological guidelines on the exploration of the stages (solid minerals) adopted by the State Committee on Geology in 1999 are in force in the Republic of Uzbekistan. Classification of mineral reserves (resources) of Uzbekistan is as follows (Table 31).

Table 31 – Stages of geological exploration for solid minerals of Uzbekistan Republic

Stage 1. Regional geological study of the territory of the Republic of Uzbekistan			
A. Regional geological and geophysical surveys on scale 1:1000000-1:500000	B. Regional geological survey, geophysical, geoecological, geodynamic, geochemical, aerospace geological, hydrogeological and engineering-geological works of scale 1:200000 (1:100000)	C. Local conventional ultradeep work	D. Other small-scale studies and generalizations in terms of international cooperation in the study of the geological structure of the Earth, etc.
Stage 2. Geological survey scale 1: 50000 (1: 25000) (Possible P_2 - (P_3))			
Stage 3. Search			
A. Specialized early search works operations (possible P_2 (P_3))		B. Prospecting works (P_2 – P_1)	
Stage 4. Valuation			
A. A priori estimate (C_2, FS)		D. Detailed assessment minefield (C_2 – C_1, FS)	
Stage 5. Prospecting (C_2 – C_1, FS)			
Stage 6. Additional exploration			
Stage 7. In-mine exploration			

RELATIONSHIP WITH OTHER INTERNATIONAL SYSTEMS

Comparison of national classification and CRIRSCO is presented in Table 32.

Table 32 – Comparison of national classification and CRIRSCO

National Classification	$A+B+C_1$	C_1+C_2	P_1	P_2+P_3
Template categories CRIRSCO	Measured resources	Indicated resources	Inferred	Exploration results

ENERGY AND MINERAL RESOURCE ENDOWMENTS

The Republic of Uzbekistan is among the world leaders by range of coverage of selected types of minerals: gold, uranium, copper, phosphate, molybdenum, etc.

As of January 1, 2018 the State balance of minerals of the Republic of Uzbekistan includes 2028 deposits, of which: construction materials – 867, groundwater – 649, hydrocarbons (oil, gas, condensate) – 244, precious metals (gold, silver) – 97, non-ferrous and rare metals – 12, radioactive metals – 38, mining raw materials – 37, mining chemical raw materials – 32, stone-precious raw materials – 30, coal and combustible shale – 7, ferrous metals – 5 (Figure 69). There are 90 gold deposits and 40 uranium deposits in the Republic, which are being developed at about 50%.

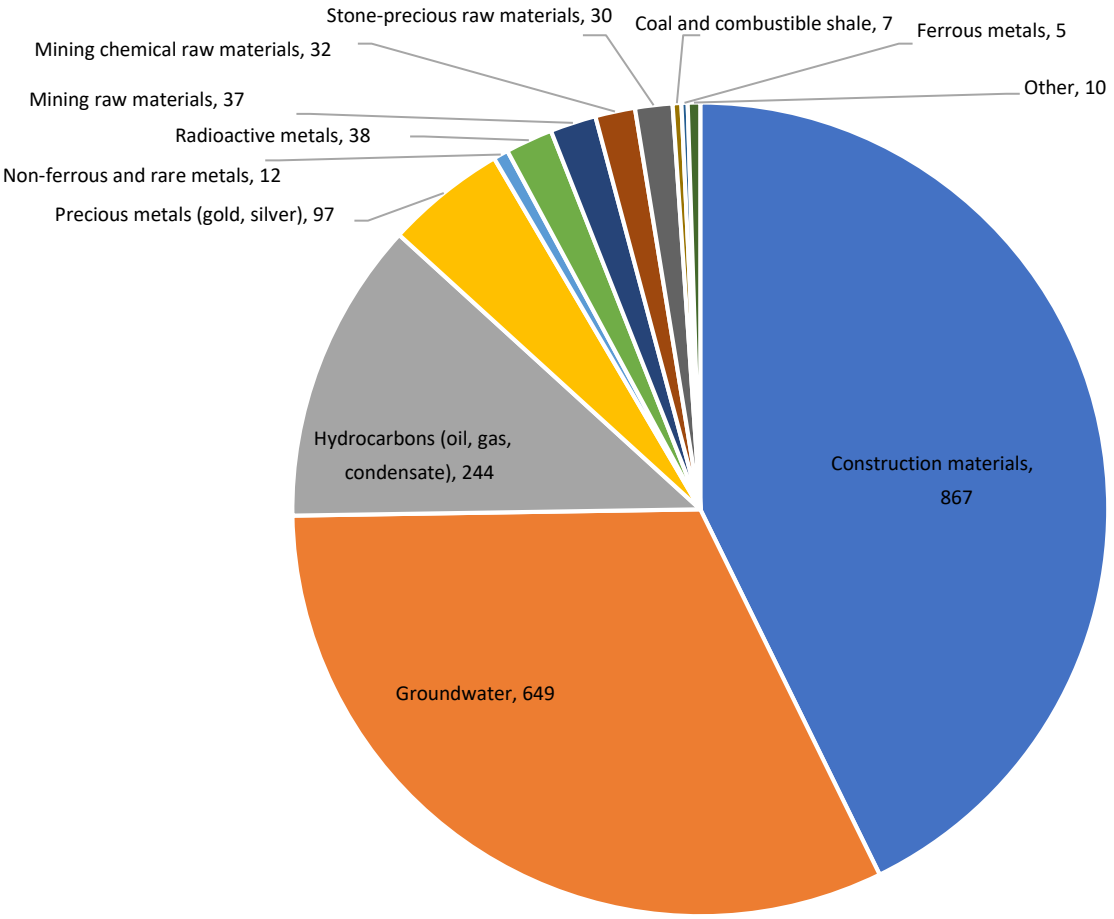


Figure 69. Deposits in accordance with the State balance of mineral reserves of the Republic of Uzbekistan

COPPER

Total reserves of copper amount to 16336.2 thousand t, gold extraction made up 137.1 thousand t, at the current rate of production-reserves are sufficient for more than 100 years.

The copper producer in Uzbekistan, the "Almalyk MMC" JSC is one of the largest producers of non-ferrous metals in the Central Asian region. The share of AGMK accounts for about 90% of silver production and 20% of gold in the country.

The plant includes two mining enterprises, two concentrating mills and two metallurgic plants with their infrastructure. The total volume of production is estimated more than 300 million US dollars/year. The plant has the right to develop deposits of copper-molybdenum and lead-zinc ores in the area of Almalyk town (Tashkent region). The raw material base of AGMK is the "Kalmakyr" and "Sary-Cheku" deposits of copper-porphyry ores (Tashkent region) and the "Uch-Kulach" (Dzhizak region) deposit of lead-zinc-barite ores.

GOLD

Uzbekistan ranks third in the world in terms of total gold reserves and ninth in terms of production. In 2017, 89.9 tons of gold were mined. Total gold reserves are 5990,5 tons, at the current rate of production reserves are sufficient for more than 50 years.

Currently, 81 gold deposits have been discovered in the Republic, 25 of which are being developed.

Gold mining in the country is concentrated in 2 major enterprises — the Navoi and Almalyk mining and metallurgical combine (AGMK and NGMK). In recent years gold production at the "Navoi Mining and Metallurgical Combine" state enterprise (NMMC) amounted to more than 60 tons with the total production of this metal in the Republic of about 90 tons. The NMMC production complex unites five metallurgical plants in Navoi (Mining and Metallurgical Plant-1), Zarafshan (Mining and Metallurgical Plant-2), Uchkuduk (Mining and Metallurgical Plant-3) and Zarmitan (Mining and Metallurgical Plant-4), Mardjanbulak gold recovery factory (MGRF) in the Mardjanbulak village of the Samarkand regionTungsten

Known reserves of tungsten are 123.6 thousand t in 8 fields. Currently, geological exploration is being carried out on 4 promising areas. Deposits are not worked out. In accordance with the order of the President of the Republic of Uzbekistan, a tungsten cluster was created, which covers all known tungsten deposits.

CEMENT

Cement production accounts to 76% of the total construction materials production sector; and increased from 3.7 million t in 2002-2014 to 7.5 million t in 2014 (Table 33).

Table 33 – Designed capacity of cement enterprises, thousand t

Operating plants		Designed and under construction plants	
Enterprise *	Capacity	Enterprise *	Capacity
JSC "Kizilkumcement"	3 500	IP TITAN CEMENT LLC	221
JSC "Akhangarancement"	1 740	JV Shangfeng Bridge of Friendship	1 200
JSC "Bekabadcement"	1 250	OOO Yaypanshifer	100
JSC "Kuvasoycement"	1 080	DP "Gallaorocement"	100
Jizzak Cement Plant	1 000	Sherobod Cement Plant	1 500
JV Fergana Cement LLC	120	SP LLC "Surkhantsementinvest"	360
Turon Eco Cement Group LLC	100	Total	3 531
OOO Farhadshifer	100		
Everest Metal Favorite LLC	100		
Kezar LLC	60		
JV LLC "Sing Lida"	100		
PE "Buyuk"	60		
Total	9 210		
Grand total		12 482	

* All operating, designed and under construction enterprises are full-cycle production plants.

According to the parameters laid down in the programme of measures to ensure structural reforms, modernization and diversification of production for 2015-2019, it is planned that the production of cement in Uzbekistan will grow annually by an average of 3.5% and reaches 8.9 million t by 2019 of 15 varieties.

The programme provides technical re-equipment of the key player in the cement market of Uzbekistan, the «Kyzylkumcement» JSC priced at 30.7 million US dollars at its own expense and modernization of the grinding department of «Bekabadcement» JSC priced at 5.5 million US dollars.

Currently, according to «Uzstroymaterialy» JSC, there are 4 cement plants operating in the company's system. More than half of the production – more than 3 million t/year of cement, using an economical dry method, is produced by «Kyzylkumcement» JSC, the youngest cement enterprise of Uzbekistan, founded in 1978.

The second largest plant, the «Akhangarancement» JSC, this year will mark the 72 year's anniversary; its capacity allows producing more than 1.7 million t. «Kuvasaicement» JSC designed for production of 1 million t cement, this year will be 52 years old. Foreign capital exists in «Akhangarancement» JSC; the controlling stock interest belongs to the large Russian holding company Eurocement Group.

According to experts' opinion, the cement industry is fuel-and energy-intensive. The share of fuel and energy in the structure of costs of production and sales reaches 50%. Currently, at three Uzbek plants, with the exception of the largest "Kizylkumcement", the energy-intensive wet method of production is dominated. Fuel consumption in the wet method is much higher than at the "dry" method.

Increase in cement production in Uzbekistan is also due to the efforts of the Almalyk MMC, which in 2014 together with the Turkish company Dal Teknik Makina Ticaret ve Sanayi A.S. put into operation a plant for the production of portland cement and white cement in the Zafarobad district of the Jizzak region. The plant's capacity is 350 thousand t of white cement and 760 thousand t of portland cement. The total cost of the project amounted to 120.3 million US dollars. The project was funded at the expense of the plant's own funds (46.1 million US dollars) and a loan from the Fund for Reconstruction and Development of Uzbekistan (74.2 million US dollars).

According to the forecast, «Almalyk MMC» JSC before the 2019 year will build another cement plant in the Sherabad district of the Surkhandarya region by a capacity of 1.5 million t of portland cement and at a preliminary cost of 225 million US dollars. Financing sources were set up the plant's own funds in the amount of 24.4 million US dollars, funds from the Fund for Reconstruction and Development of Uzbekistan equal to 90 million US dollars and loans from Uzbek commercial banks in the amount of 110.6 million US dollars.

The global indicator characterizing the degree of industry development is the level of cement consumption per capita. At 2014 year-end, it was amounted of about 234 kg in Uzbekistan. For comparison: cement consumption in the Czech Republic, Poland, and Egypt is at the level of 200-400 kg per person, in Germany, Italy, Spain is at a level of 400-800 kg. By 2019, Uzbekistan plans to produce 8.9 million t of cement annually. According to forecasts, by 2020, per capita cement consumption in Uzbekistan will be at least 328 kg/year.

POTASH

"Uzkhimprom" JSC plans in 2018-2030 to increase the production of mineral fertilizers in 2 times – up to 2.4 million t/year. Plans to increase capacity are fixed in the «road map» for modernizing production facilities, deepening the processing of basic products, making rational use of assets and introducing modern management methods into the activities of «Uzkhimprom» JSC. The «Road Map» was approved by a resolution of the President of Uzbekistan Shavkat Mirziyoyev. It is planned that the total output of chemical industry in Uzbekistan will increase 4.5 times by 2031, and exports will grow 4 times. At the same time, according to plans, the share of output of organic chemistry in the total production will grow from 7 to 54%. For these purposes, 29 investment projects for modernization, expansion and creation of new processing industries at an estimated value of 4.8 billion US dollars, mainly involving direct foreign investments is planned to be implement. It is noted in the "road map" that "systemic problems that limit further development and diversification of the chemical industry, attraction capital improvement of existing and construction new chemical production facilities, and expansion of export supplies remain" in the industry.

One of the key problems of chemical industry in Uzbekistan is the facilities obsolescence. Thus, enterprises with production of complex mineral fertilizers are outdated by 60-70% that results in over-expenditure of energy resources and an increase in chemical products cost. In addition, due to the weak development of deep processing in Uzbekistan, the chemical products are imported annually by 1.5 billion US dollars.

By April 15, 2019, the government of Uzbekistan was commissioned to make proposals on reforming the chemical industry system and increasing its investment attractiveness, taking into account the recommendations of international consulting companies.

"Uzkimyosanoat" JSC incorporates chemical enterprises of the Republic. The structure of society includes 13 industrial enterprises, 13 territorial distribution organizations engaged in the sale of mineral fertilizers to agriculture, scientific research and design Institutes.

NATURAL GAS AND PETROLEUM

In total, 264 oil and gas fields have been discovered in the Republic. According to the facts in the report of the Center for Economic Research (CER) of Uzbekistan, on retention of the current trends and volumes of resource consumption,

natural gas and coal reserves in Uzbekistan will be sufficient for the next 20-30 years, while oil reserves are almost depleted.

The largest corporations in the power industries of Uzbekistan are CNPC (China National Petroleum Corporation), KNOC (Korea), Gazprom, Lukoil, Uzbekneftegaz. Natural gas reserves amount to 2239.9 billion m^3 and production makes up 3.5 billion m^3. Uzbekistan ranks 11^{th} in the world in natural gas extraction, and 10^{th} in the world in consumption of natural gas. Oil reserves amount to 178.1 million t, proven oil reserves make up 81 million t. Production makes up 0.9 million t (806 thousand t as of 2017). The main oil fields are located in the Karakalpak Autonomous Republic and in six administrative regions: Kashkadarya, Bukhara, Surkhandarya, Namangan, Andijan and Fergana. The main volume of reserves is concentrated within the Kokdumalak field, the largest in the country. The development of this field (over 50% of the reserves are concentrated in the territory of Turkmenistan) is carried out in accordance with the intergovernmental Agreement between Uzbekistan and Turkmenistan signed on March 1997. In accordance with the terms of the Agreement, part of the extracted oil is supplied free of charge to the Seidinsky oil refinery in Turkmenistan (Table 34).

Table 34 – Crude oil production, million t

Year	2010	2011	2012	2013	2014	2015	2016
Total	3,9	3,6	3,2	3,0	2,2	2,2	2,1

Since 2003, Uzbekistan has been importing oil from the Kumkol field in southern Kazakhstan. In addition to Kazakh oil supply, volumes of Turkmen raw materials were supplied to Uzbekistan. Chinese "Petrochina" in 2016 supplied about 111 thousand t of gas condensate (in 2015 – 125 thousand t) to Bukhara oil refinery from Turkmenistan.

Two major oil refineries – the Bukhara oil refinery (of a fuel profile with a capacity of 2.5 million t/year), Fergana oil refinery (fuel and oil profile with a capacity of 5.5 million t/year), and the Alty-Aryk oil refinery (fuel and oil profile with a capacity of 3.2 million t/year) are operating in Uzbekistan. According to some reports, due to the decrease in oil production, their utilization does not exceed 50%. In the Surkhandarya region a small Uzbek-Russian JV "Jarkurgannefteprocessing" also operates for heavy oil refining (Table 35).

Table 35 – Production of oil products, million t

Product	Y ear			
	2013	2014	2015	2016
Gasoline	1,8	1,07	1,07	1,13
Kerosene	0,25	0,16	0,16	0,18
Diesel fuel	1,12	0,99	1,09	0,98
Heating oil	0,19	0,12	0,07	0,10

52% of oil products consumed in the country are used in transport, 16% – in agriculture, 13% – in power industry, 5% – in industry.

COAL

Uzbekistan possesses proven reserves of coal in the amount of 1900 million t, including: brown coal — 1853 million t, bituminous coal— 47 million t. Inferred resources amount to over 5.7 billion tons of coal. Large reserves of bituminous coal are concentrated in the southern regions — the Surkhandarya and Kashkadarya regions. Currently, coal mining is carried out in three fields: Angren brown coal deposit, and Shargun and Baisun bituminous coal deposits. Coal mining on the territory of Uzbekistan is carried out by:

- "Uzbekugol" JSC of the State Joint Stock Company "Uzbekenergo" develops Angren brown coal deposit:
  - by open mining - the Unitary Enterprise "Razrez Angren»;
  - by underground mining - Unitary Enterprise "Administration of coal mining underground method";
- "Apartak" JSC develops Angren brown coal deposit by open cut method by the "Apartak" coal strip mine;
- "Shargunkumir" JSC develops Shargun and Baisun coal deposits by underground method with partial processing of extracted coal into coal briquettes at Shargun briquette factory and Baisun briquette unit;
- "Erostigaz" JSC develops Angren brown coal deposit by in-situ gasification.

In 2016, 3.87 million t of coal were produced. In 2017, production of coal reached 3.92 million t; in 2019, this figure is estimated 4.78 million t; the planned production volume for 2021 is 11.67 million t.

In general, it is planned to allocate 690.5 million US dollars for the development and modernization of the coal industry of the Republic in 2017-2021. Within these measures, it is planned to implement six investment projects. Upon that, 87.5 million US dollars will be own investments of coal enterprises. Commercial banks of the country will allocate 155.6 million US dollars, the Fund for reconstruction and development of Uzbekistan – 68.7 million US dollars. In addition, concessional loans of Shanghai Cooperation Organization in the amount of 378.7 million US dollars will be attracted for implementation of these projects.

One of the largest projects targeted for implementation will be replacement of physically and morally outdated equipment at the enterprises of the industry. Its preliminary cost is estimated at 170.2 million US dollars. Within the framework of the project, it is planned to purchase mining technological and auxiliary equipment.

Along with this, it is planned to update the fleet of railway equipment of the "Uzbekugol" company for which 59.6 million US dollars will be spent. On these funds, coal miners will purchase locomotives, traction units, dump cars. It should be noted that due to all these projects, the volume of overburden mining in the Republic in 2018 increased to 22.3 million m^3, and by 2021 – to 27.8 million m^3, which is 1.3 times more.

URANIUM

According to the International Atomic Energy Agency (IAEA), Uzbekistan is on the seventh place in the world by uranium reserves (4 per cent of world uranium reserves) and fifth by its production. Currently about 40 deposits have been explored.

According to the data of Goscomgeology, the explored and estimated uranium reserves amount to 185.8 thousand t, of which 138.8 thousand t are uranium of sandstone-type, 47 thousand t are blackshale type.

The monopoly uranium producer in the Republic is the Navoi Mining and Metallurgical Combine (NGMK). The plant plans to increase uranium production to more 3 thousand t by 2020. Until the early 1990s, NGMK produced annually up to 3.5 thousand t of low-enriched uranium.

The Republic does not have its own nuclear industry and all produced low-enriched uranium is exported.

By the decree of the President Shavkat Mirziyoyev dated July 19, 2018 On measures for the development of nuclear energy in the country, the Agency for the development of nuclear energy "Uzatom" was established under the Cabinet of Ministries.

70% of the country's electric energy is generated using gas, 14% - hydro-electric power stations, 13% - coal, 3% - oil. By 2030, according to forecasts, the planned nuclear power plant will account for 15% of the produced energy, gas - 54%, hydroelectric power - 14%, coal - 11%, oil - 3%, renewable sources - 3%.

According to the agreement with the State Corporation "Rosatom", in Uzbekistan by 2028 it is planned to build a nuclear power plant. The complex will be comprised of two power units by a capacity of 1200 megawatts each.

RENEWABLE ENERGY

The Republic is rapidly working on the commissioning of renewable energy sources.

Uzbekistan has a good prospect of using renewable energy sources in remote and ecologically disadvantaged regions. Climatic and geographical conditions of the country make the future use of renewable energy resources (RES) very promising. First of all, it concerns solar energy. The potential of solar energy in Uzbekistan is estimated at 50,973 million t of oil equivalent. In Uzbekistan, solar time reaches 2000 hours in the North and 3000 hours in the South. During the day, solar radiation fluctuates within 7-10 hours, in the North the annual solar radiation is 4800 MJ/m^2, in the South — 6500 MJ/m^2. (Figure 70)

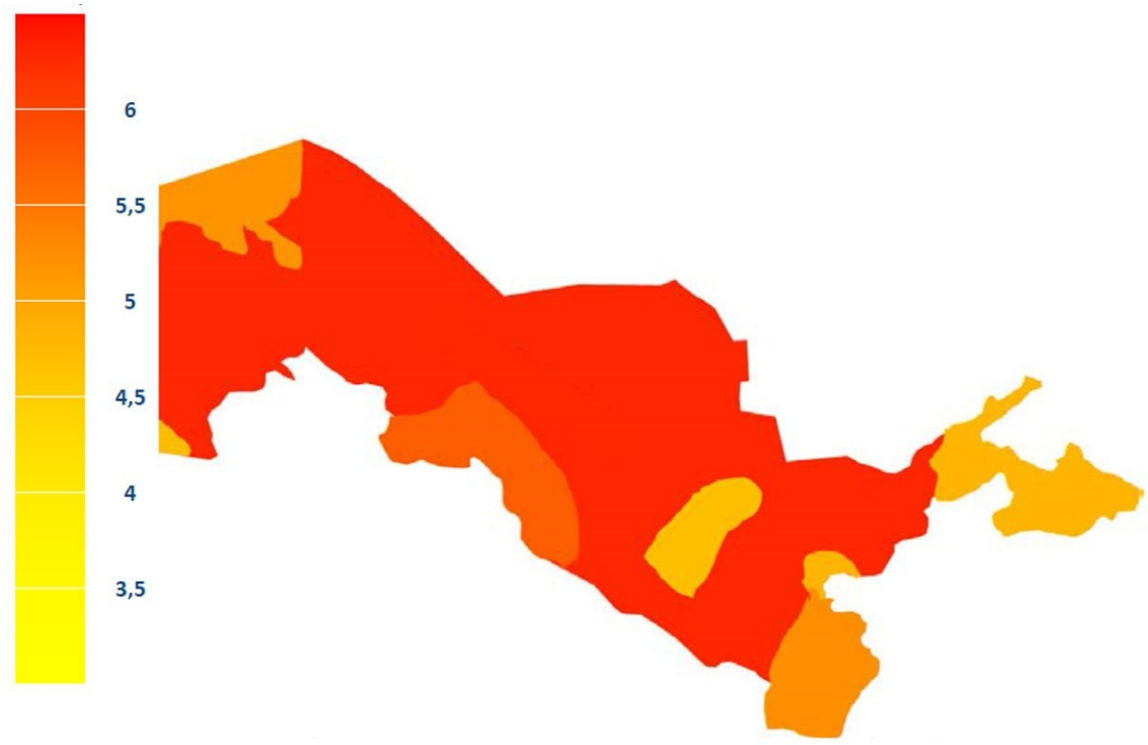
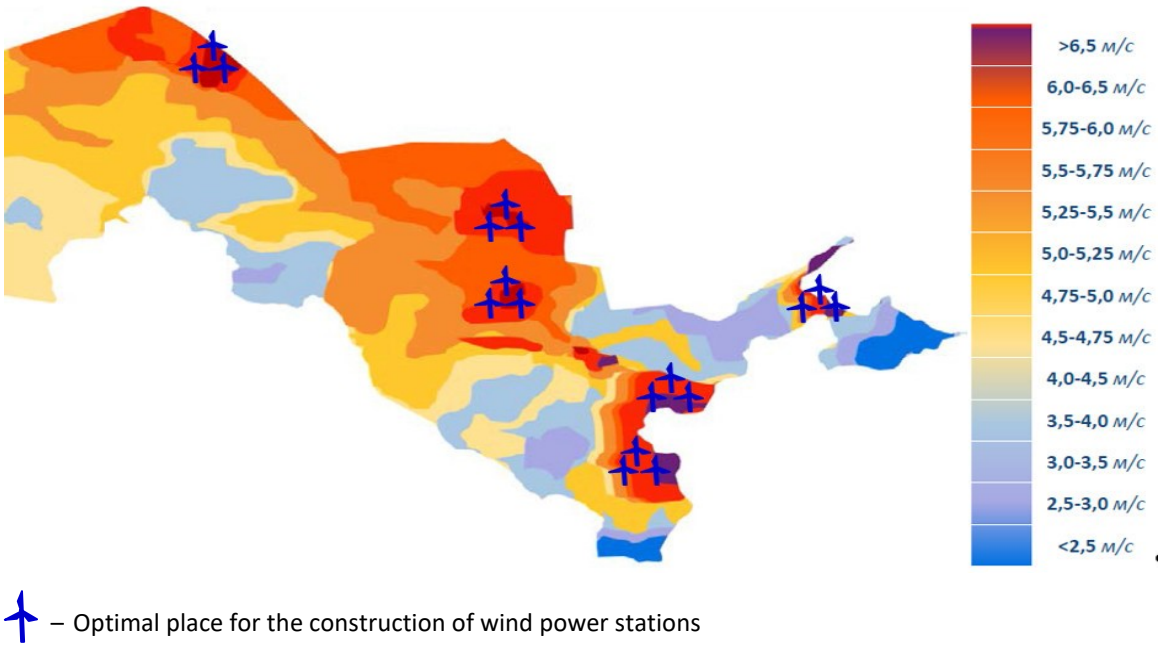


Figure 70. Daily amount of total solar radiation (kW*h/m)

One of the renewable energy sources used in the world is wind energy. The potential of wind energy in Uzbekistan is estimated at 2.2 million t of oil equivalent. In accordance with the geographical location of Uzbekistan, wind flows are seasonal in nature. On the plains, the average annual wind speed is 2.0-5.0 m/sec (Figure 71).

Specialists of the Academy of Sciences, research institutes, and research centers conduct researches and carry out developments of RES. The center for economic researches in 2011 prepared an analytical report "Alternative energy sources: the possibility of using in Uzbekistan", which assesses the future energy balance of the Republic of Uzbekistan for the period up to 2020, briefly summarizes the rich international experience in the introduction of alternative energy sources to assess the possibilities of its application to the conditions of Uzbekistan.



– Optimal place for the construction of wind power stations

Figure 71. The potential of wind energy in Uzbekistan

One of the main governmental decisions on the development of renewable energy and energy efficiency upgrading in Uzbekistan is the decree of the President of the Republic of Uzbekistan "On the Program of Measures for the Further

Development of Renewable Energy, Improving Energy Efficiency in the Economy and Social Sector for 2017-2021". This decision noted that in accordance with the 'Program of measures to reduce energy intensity', the introduction of energy-saving technologies and systems in the sectors of the economy and the social sphere for 2015-2019, approved by the Presidential Decree No. PP-2343 of May 5, 2015. In the Republic in recent years a wide range of measures has been implemented to ensure energy conservation in the sectors of the economy and the social sphere.

In this regard, 4 investment projects for the construction of solar and wind power plants were included to the current program; among them three are solar stations by a capacity of 100 MW each in the Samarkand, Surkhandarya and Navoi regions and one wind station by a capacity of 102 MW in the Navoi region.

The electricity generation forecast by 2030 to 105 billion kWh.

Suggested solutions to this daunting task are the following:

1. Intensify energy efficiency and energy saving (reserve is 30-40%).
2. Widely introduce steam gas technologies.
3. Introduction of wind and solar energy (potential is 10 GW of solar and wind energy).
4. Increase the share of coal and shale in electricity generation.
5. Examine the possibility of building nuclear power plants until 2035.
6. Comprehensive study of water and energy problems, taking into account transboundary rivers.

Since 2000, Uzbekistan's GDP has grown almost 2.5 times, and the population from 1991 to 2018 has increased by 65%. Under these conditions, the generation of electricity per capita has almost halved - by 75%. The capacity of the current TPPs is not enough, so a new stable and cheap energy source is needed.

The commissioning of two units of 1.2 GW each by 2028 will give Uzbekistan 20% of all the necessary energy; this will allow to diversify the economy and release part of the resources due to, for example, additional hydrocarbon exports.

SkyPover (Canada) will build solar power plants at a total capacity of 1000 MW for 1.3 billion US dollars. This is the first industrial project in the history of Uzbekistan for the production of solar energy. It will bring about 2.9 billion US dollars in the country's GDP and create thousands of work positions.

ANNUAL PRODUCTION, TRADE, REVIEW OF CURRENT STATUS AND OUTLOOK

ANNUAL PRODUCTION

Information on reserves and production of main types of minerals in Uzbekistan (Table 36).

Table 36 – Reserves and production of main types of minerals in Uzbekistan

Mineral resource	Unit of measurement	Stocks	Mining (2017)	Production, years
Gold	tons	5990,5	89,9	> 50
Silver	tons	21559,9	232,3	> 50
Uranium	thousand t	96,7	3,6	17
Copper	thousand t	16336,2	137,1	> 100
Tungsten	thousand t	123,6	-	
Oil	million t	178,1	0,9	
Natural gas	billion m^3	2239,9	55,4	> 50
Coal	million t	1950,1	3,5	> 50

Currently, in the first instance, geological exploration works are focused on development and reserve replacement of gold, silver, uranium, tungsten, lead-zinc, etc.

Non-metallic raw material is the main object of geological exploration and development of their deposits by business entities. In this regard geological exploration for promising sites with a view to identify large deposits is provided in the long-term perspective.

Considering the ever-increasing demand of the population and industries of the Republic for water resources, a heavy increase of yearly growth in groundwater reserves is contemplated. In this regard, the special priority will be given to substantiation of water supply for population in the remote and inaccessible areas using drinking quality underground waters.

TRADE

EXPORTS OF HYDROCARBONS

"Uzbekneftegaz" JSC holds 11th place in the world in natural gas production. Oil production in Uzbekistan in 2017 amounted to 806 thousand t; natural gas production amounted to 6.4 billion m^3.

The largest corporations in the energy sector of Uzbekistan are CNPC (China National Petroleum Corporation), KNOC (Korea), Gazprom, LUKOIL, Uzbekneftegaz. Uzbekistan ranks 10th in the world in natural gas consumption.

In addition to Kazakh oil delivery, the volumes of Turkmen raw materials arrived in Uzbekistan. In 2016, the Chinese Petrochina supplied about 111 thousand t of gas condensate (in 2015 - 125 thousand t) from Turkmenistan to the Bukhara refinery. In total, 52% of the petroleum products consumed in the country are used in the transport sector, 16% in agriculture, 13% in the power industry, and 5% in industry.

Imports of Russian oil to Uzbekistan in 2017 amounted to 68.2 thousand t.

Gas processing is carried out at the Mubarek gas processing plant (commissioned in 1971). Currently, the plant's capacity is about 30 billion m^3 of natural gas and the production amounts to more than 570 thousand t/year of gas condensate.

The China-Central Asia gas pipeline starts at the border between Turkmenistan and Uzbekistan, and transits through Uzbekistan and Kazakhstan and ends at the Khorgos Chinese border checkpoint. The length of the pipeline is 1833 km. Construction began at the end of June 2008; In October 2010, the second pipe string was commissioned. The construction of the third (last) string of the gas pipeline was completed in 2013.

EXPORT VALUE

The main export items of Uzbekistan are services, gold, energy and oil products, textile products, ferrous and non-ferrous metals, food products, chemical products. From 1991 to 2018 there was a significant change in the export structure of Uzbekistan: the main product of the Republic is service sector (its share in exports amounts to 21.3%), while the share of cotton fiber in exports decreased from 59.7% to 1.6%; the share of food increased (from 3.9% to 7.7%), chemical products (from 2.3% to 6.3%), ferrous and non-ferrous metals (from 4.6% to 8.2%). In the structure of imports, the main share is accounted for machines and equipment - 42.5%, chemical products and products from it - 13.1%. Foreign trade turnover for 2018 amounted to about 33.8 billion US dollars (exports – 14.257 billion US dollars; imports – 19.557 billion US dollars).

Among the CIS countries, the main foreign trade partners are Russia, Kazakhstan, Kyrgyzstan, Ukraine, Belarus, Tajikistan and Turkmenistan, which account for 36.8% of external turnover, among other countries – China, Turkey, the Republic of Korea, Germany, Japan, Afghanistan, Latvia, USA, Iran, France, Italy, Lithuania, India, which account for 63.2% of the total external turnover.

The main export markets for Uzbek gas remain Russia and China. Also, small deliveries are carried out in neighboring countries. In the Russian Federation, natural gas goes through the Bukhara - Ural and Central Asia - Center gas pipelines. Last year, Gazprom and Uzbekneftegaz signed a contract for 2.5 billion US dollars. According to the document, starting from 2018, Uzbekistan annually, within five years will supply 4 billion m^3 of gas. In addition, Uzbekistan intends to increase in 2018-2020 the annual volume of gas supplies to China to 10 billion m^3, in as per the mid-term agreement. Fuel is supplied to China along three lines of the Central Asia - China gas pipeline.

OUTLOOK

it is expected that the growth of industrial production and raising the standard of living in the country will increase the demand for energy resources (Figure 72).

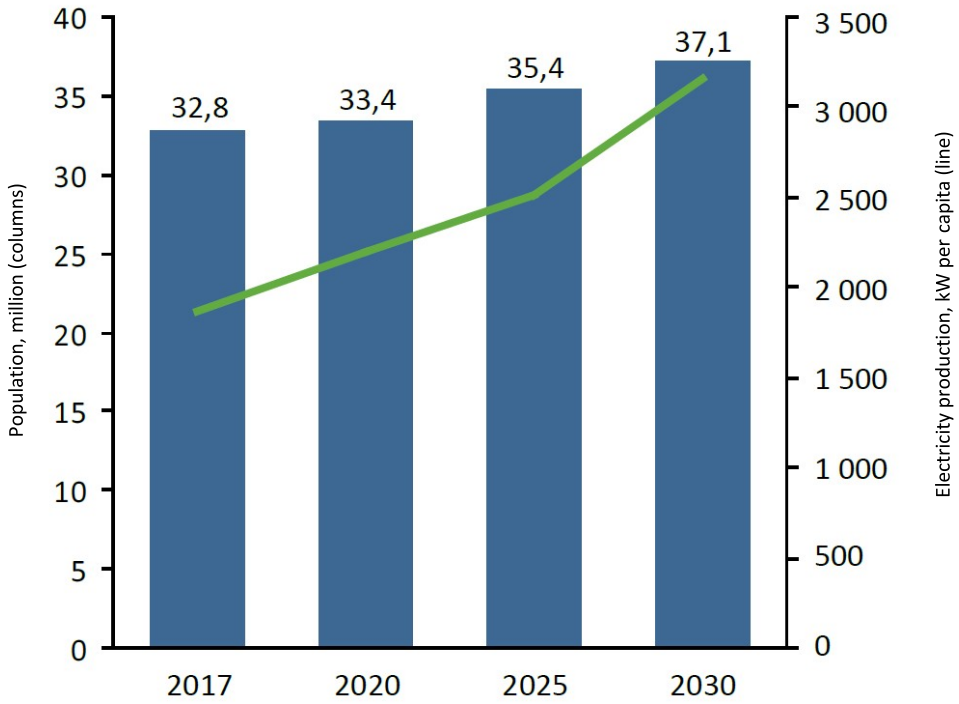


Figure 72. Forecast of increase in demand for electric energy in Uzbekistan until 2030

Since 2000, GDP of Uzbekistan has grown almost 2.5 times, and the population from 1991 to 2018 has increased by 65%. Under these conditions, the electricity generation per capita has almost halved – by 75%. The capacity of the current thermal power-stations (TPS) is not enough, so a new stable and cheap energy source is needed.

At the same time, the analysis shows that in 2017, energy consumption amounted to 69 billion kW/h. About 85% is produced by thermal power plants and 15% by hydroelectric power plants.

Electricity consumption is projected to be increased to 105 billion kW/h by 2030.

High management efficiency of all types of energy, including reducing costs and increasing productivity, increasing the depth of processing, improving the overall energy efficiency of economy of the Republic of Uzbekistan. The main targets till 2035 are as follows (Table 37).

Table 37 – The main targets till 2035

Key figure	Unit	2017	2035
Drilling Rig Performance	m/month	800	1200
Natural gas extraction	billion m^3/year	64	80
Gas condensate extraction	million t/year	2,06	3,5

A working meeting of Chairman of the Board of «Gazprom» PJSC and Deputy Prime Minister of Uzbekistan, Chairman of the Board of «Uzbekneftegaz» JSC, was held in St. Petersburg, and press-service of the Russian company reports: "Parties discussed the course of bilateral cooperation between companies. In particular, they discussed co-developing of the Shakhpakhty field [Shakhpakhty is gas condensate field discovered in 1962 in the south-eastern part of the Ustyurt plateau in Uzbekistan]. The cooperation issues in Uzbek gas purchase by Gazprom have been also discussed at the meeting". It will be remembered that in 2017, Gazprom and Uzbekneftegaz concluded an agreement on strategic cooperation. In May 2018, Gazprom and Uzbekneftegaz signed an Addendum No. 2 to the Agreement.

FOREIGN DIRECT INVESTMENTS IN THE SECTOR

The average annual volume of mastered investments in the Republic remains at the level of 2-2.5 billion US dollars (less than 4% of GDP), which is lower than the average figure for countries with transition economies (3.4 billion), and also lower than indicators of some CIS countries (Kazakhstan 15-20 billion – 7-8% of GDP, Azerbaijan 5-8 billion - 15-20%, Belarus 3-6 billion - 8-10%).

The volume of foreign direct investments in the economy of Uzbekistan in 2019 may double in comparison with the current year and amounts to 4.1 billion US dollars (in 2018 it is at the level of 2.4 billion US dollars).

According to the resolution of the Cabinet of Ministers of the Republic of Uzbekistan dated May 31, 2017 "On approval of selection criteria and lists of promising areas and deposits of strategic types of solid minerals, for geological study and industrial development of which the foreign investments are attracted", 29 deposits and 111 promising areas of solid minerals are offered to foreign investors. In particular, investors are offered 12 fields and 31 promising areas for precious metals, 18 areas for non-ferrous metals, 14 fields and 51 areas for rare and rare earth metals.

Geological study of 12 prospective areas and development of 6 deposits with such companies as B2 Gold (Canada), Rosgeoperspektiva (Russia), Shindong Resources (South Korea), TUMAD (Turkey), NordGold (Great Britain) agreements were reached and cooperation agreements were concluded in 2018.

Currently, out of 435 known subsoil blocks that are promising to identify deposits of precious, non-ferrous and rare metals and uranium, 380 blocks (87%) are uncovered by medium-term and long-term programmes for the development and reproduction of the mineral resource base of the Republic, and 120 (71%) solid minerals deposits are not involved in mining.

In accordance with the Resolution of the President of the Republic of Uzbekistan dated July 19, 2018, No. RP-3874, in 2018 implementation of 3 investment projects is provided. In threes implemented investment projects, the direct foreign investment has been utilized 4 million US dollars, in particular:

- Together with the Japanese corporation JOGMEC, the project “Conducting a geological study of the promising area of uranium in the Navoi region” is being implemented. The project in 2018 disbursed investments in the amount of 2.5 million US dollars, for the project as a whole – 5.4 million US dollars. Drilling work has now been completed and a geological report is being prepared for transmission to the Japanese side.
- Together with the Korean company Shindong Resources, the project “Development of the Sautbay tungsten deposit (I stage)” is being implemented with an implementation period of 2013–2022. According to the project, investments in the amount of 1 million US dollars were assimilated in 2018, and in the whole project – more than 4 million US dollars of foreign direct investment. A feasibility study of a project with a cost of about 70 million US dollars has been developed, and work is underway to issue a license for the use of a subsoil block.

In 2019, it is planned to increase the direct foreign investments in solid minerals by 10 times.

In the oil and gas sector, as part of the Investment programme in 2016, with the participation of foreign investments and loans, only 14 projects with a total cost of foreign investments amounted to 16.3 billion US dollars were implemented. At the same time, the main direction of the projects of "Uzbekneftegaz" JSC on investment projects is as follows:

- carrying out geological exploration;
- hydrocarbon production and processing; - natural gas transportation;
- production of polymer products, gas cylinders;
- construction of a new gas processing complex, CNG filling stations, certified centers for installation of gas cylinders for compressed gas on vehicles, etc.

In all sectors, including those directly related to mineral resources, the attraction of direct foreign investments has been determined for the long term, for example: the Khimprom of Uzbekistan until 2030 will attract 29 promising investment projects to modernize, expand and create new processing plants to implement 4.4 billion US dollars direct foreign investments. In Uzbekistan, the attraction of direct foreign investment and innovative technologies is given national importance. Thus, total investments in fuel-and-energy complex are envisaged to account for 23-28 billion US dollars by 2025, 37-46 billion US dollars by 2030, and 70-86 billion US dollars by 2035.

A private equity fund has been established in Uzbekistan with a capital of 1 billion US dollars. For the effective work of the fund, a special management company will be set up in the form of a joint stock company with a 100 state share with an authorized capital of 5 million US dollars, formed at the expense of the Fund for Reconstruction and Development of Uzbekistan.

Completion of state assets privatization process, attracting of major international players to exploration, production, as well as processing and transportation sectors. Disaggregation of assets in oil and gas industry and electric power industry.

The largest corporations in the energy sector of Uzbekistan are CNPC (China National Petroleum Corporation), KNOC (Korea), Gazprom, Lukoil, Uzbekneftegaz. For example, on May 2018, Gazprom and Uzbekneftegaz signed a production sharing agreement for the further development of the Shakhpakhty field. The document provides for the continuation of gas production until 2024. In 2017, Gazprom’s purchase of natural gas in Uzbekistan amounted to 5.5 billion m^3.

Attraction of foreign investments for solid minerals is envisaged under enforcement of the Resolution No. RP-3000 “On measures for accelerating the attraction of foreign investments in geological exploration and development of strategic solid minerals” as part of execution of the Resolution of the President of the Republic of Uzbekistan.

Goscomgeology jointly with private companies is carrying out works on the implementation of exploration projects that will ensure of investments inflow in geological exploration and will make it possible to discover mineral deposits. Today, cooperation with a number of mining and investment companies, such as: B2 Gold Corp. (Canada), JOGMEC Japanese National Corporation, Rosgeoperspektiva Group of Companies (Russia), Shindong Resources (Korea), MTA (Turkey), Orano Mining (France), IFG Capital (Luxembourg), etc. has been established.

Currently, together with the Japanese Corporation JOGMEC the "Geological study of promising uranium areas in the Navoi region" project is being implemented; in cooperation with the Korean company "Shindong Resources" the "Development of the Southbay tungsten deposit of (phase I)" project is being implemented; together with the Russian company "Rosgeoperspektiva" the "Geological study at the Kazakhtay and Kazakhtay 1 areas in the Navoi region promising for copper and gold deposits discovery" project is being implemented.

The availability of explored gold reserves at the current rate of production amounts to more than 50 years, uranium - more than 20 years, copper - more than 100 years. An increase in copper production is stipulated within the introduction of the Yoshlik 1 deposisit to development. Increase productivity of existing MMP with involvement in processing of out of balance ores and mineralized mass.

Creating a cluster of tungsten industry in the Republic of Uzbekistan. IFG Capital Partners will explore the possibility of developing a tungsten deposit in Uzbekistan. IFG Capital Partners will organize industrial development of the field if the research proves to be positive. In order to attract investments to this industry, it is necessary to reform the Tax Code for mining companies in accordance with international standards.

The long-term programmes adopted over the past two years are aimed on accelerating the development, modernization and expansion of production of large mining and smelting industry enterprises. An increase by 2026 in production of outputs in the Navoi MMC by 30% in the Almalyk MMC investments in the amount of 2.9 billion US dollars and an increase by 2023 in copper production by 28%, and zinc by 75% is contemplated.

NMMC is one of the largest gold producers in Central Asia. The plant is fully owned by the state. Gold production at NMMC in recent years was about 80%. The NMMC production complex of at the present time unites four metallurgical plants: in Navoi (MMP-1), Zarafshan (MMP-2), Uchkuduk (MMP-3) and Zarmitan (MMP -4). It is planned to gradually increase the production of gold and uranium, as well as silver at least 5.0 t/year.

The state pays priority attention to the comprehensive development of the Navoi mining and metallurgical combine. In particular, within the framework of the MMC development programme until 2026, about 30 large investment projects at an overall cost of more than 3 billion US dollars will be implemented in stages; more than 30,000 work positions will be created.

The Almalyk MMC is the only copper producer in Uzbekistan. The plant is owned by the state at 97.53%, while the management of the state share is handled by the SFI Management Group. The company produces refined copper, zinc metal, lead and molybdenum concentrates and other products. AMMC accounts for about 90% of silver production and 20% of gold in the Republic.

Since 2015, the assets of the “Uzbek Plant of Refractory and High-Temperature Metals JSC (UzKTZHM, Chirchik, Tashkent Region) have been fully transferred to the AGMK, therefore, this company has become a monopolist in the production of tungsten.

According to expert estimates, the general demand of Uzbekistan for ferrous metal rolling is only 36.1% due to the processing of scrap and waste of ferrous metals at «Uzmetkombinat» JSC, located in the Bekabad town, the rest part (63.9%) is imported from CIS countries, primarily from Russia, Kazakhstan and Ukraine.

SOCIAL AND ENVIRONMENTAL ASPECTS OF ENERGY AND MINERALS PRODUCTION

In Uzbekistan, despite the reduction in growth rates, a moderately extended level of population reproduction will remain at the average annual growth rate of 1.3%, meanwhile the population will increase to 37 million people by the beginning of 2031. In general, for the period of 2013-2030 absolute population growth will be over 7 million people.

Since 2000, GDP of Uzbekistan has grown almost 2.5 times, and the population from 1991 to 2018 has increased by 65%. Under these conditions, the generation of electricity per capita was decreased almost by twice – on 75%. The capacities of current thermal stations are already insufficient, so it is necessary to use new stable and cheap energy sources.

Putting into operation of two power generation plants of 1.2 GW each by 2028 will give Uzbekistan 20% of all the necessary energy, which will diversify the economy and release some of the resources for example, out of additional export of hydrocarbons.

Maintenance of mining operations for the main types of minerals (gold, uranium, copper, lead-zinc, oil-and gas, etc.) will ensure stable economic growth.

TECHNOLOGICAL EFFICIENCY AND INNOVATIONS

One of the main tasks in this branch is to conduct a unified technical and technological policy in the development of geological exploration, application of the latest achievements of science, technology and advanced production experience to ensure high quality and technical and economic indicators of geological exploration.

Effective implementation of measures for modernization of the mining and geological industry due to the accelerated introduction of modern efficient geology-prospecting equipment, providing with advanced equipment and innovative technologies is also being considered.

The widespread introduction of advanced information and communication technologies into the exploration process with consideration for the expansion of the range of public services provided through electronic data exchange.

Increase of investment attractiveness and adoption of innovative technologies for carrying out exploration works is being contemplated.

DATA AND KNOWLEDGE MANAGEMENT

In this direction, the main priority is given to the introduction of modern information and communication technologies, including within the framework of Electronic Government system creation, the main task of which should be cardinal improvement of inter-agency electronic interactions and a sector for provision of services to government agencies, businesses and citizens.

At the same time, for the geological industry - the producer of information about a status of reserves record and estimation, and employment of mineral resources, the key becomes the achievement of unity, integrity and process orientation of information support as the basis for rational nature management and information actuality.

The guidelines of further adoption of information and communication technologies in the activities of Goscomgeology are the following:

- Collection, processing, transmission and storage of geological information on the basis of modern technical and technological communications;
- Creation of a consolidated information and analytical products on geological objects and processes necessary for recording, assessing of the state, reserves and employment of mineral resources of the Republic based on the development and implementation of information and analytical, as well as geographical information systems of the industry;
- Gradual digitization of the State Geological Fund of the Republic;
- Development and implementation of information systems in the framework of creation of the “Electronic Government” system, which envisages an enhancement of efficiency, quality of provision and availability of public services for the population and business entities;
- Introduction of modern information and communication technologies in management and industrial processes, management of financial flows, as well as enhancement of work efficiency of the production and management personnel;
- Liberalization and simplification of the procedure for granting the right of subsoil blocks use by applying the information and communication technologies;
- Affording openness of the activity of Goscomgeology, introduction of modern forms of providing information relating to the rights, freedoms and legitimate interests of individuals and legal entities;
- Development of the technical and technological, communication infrastructure of the industry.

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UNFC CASE STUDY

NATIONAL CLASSIFICATION SYSTEM FOR ENERGY AND MINERAL RESOURCES AND BRIDGING OR MAPPING TO UNFC

DESCRIPTION AND DETAILS OF THE NATIONAL CLASSIFICATION AND MANAGEMENT SYSTEM

Currently, the Methodological guidelines on the exploration of the stages (solid minerals) adopted by the State Committee on Geology in 1999 are in force in the Republic of Uzbekistan (Figure 74).

Figure 73 – Map of the Republic of Uzbekistan and location of the objects selected for Case Study

Classification of mineral reserves (resources) of Uzbekistan is as follows (see Table 38):

1. Stage 1. Regional geological study of the territory of the Republic of Uzbekistan
2. Stage 2. Geological survey of 1:50,000 (1:25,000) scale
3. Stage 3. Prospecting
   (a) Specialized advanced prospecting works
   (b) Prospecting works
4. Stage 4. Evaluation
   (a) Preliminary assessment
   (b) Detailed field assessment
5. Stage 5. Exploration
6. Stage 6. Supplementary exploration
7. Stage 7. Operational exploration

Table 38 – Stages of geological exploration for solid minerals in Uzbekistan

Stage 1. Regional geological study of the territory of the Republic of Uzbekistan			
A. Regional geological and geophysical surveys on a scale 1:1000000-1:500000	B. Regional geological survey, geophysical, geoecological, geodynamic, geochemical, aerospace geological, hydrogeological and engineering-geological works of a scale 1:200000 (1:100000)	C. Local conventional ultradeep work	D. Other small-scale studies and generalizations in terms of international cooperation in the study of the geological structure of the Earth, etc.
Stage 2. Geological survey scale 1: 50000 (1: 25000) (Possible P_2 - (P_3))			
Stage 3. Search			
A. Specialized early search works operations (possible P_2 (P_3))		B. Prospecting works (P_2 – P_1)	
Stage 4. Valuation			
A. A priori estimate (C_2, FS)		D. Detailed assessment minefield (C_2-C_1, FS)	
Stage 5. Prospecting (C_2-C_1, FS)			
Stage 6. Additional exploration			
Stage 7. In-mine exploration			

RELATIONSHIP WITH OTHER INTERNATIONAL SYSTEMS

Comparison of national classification and CRIRSCO is presented in Table 39.

Table 39 – Comparison of national classification and CRIRSCO

National classification	A+B+C_1	C_1+C_2	P_1	P_2+P_3
Template categories CRIRSCO	measured resources (Rus.: “измеренные ресурсы”)	indicated resources (Rus.: “исчисленные ресурсы”)	Inferred (Rus.: “предполагаемые ресурсы”)	Exploration results (Rus.: “результаты геологических исследований”)

TEBINBULAK TITANO-MAGNETITE ORES DEPOSIT

PREVIOUS WORK

The Tebinbulak area of titano-magnetite associated with the gabbro-pyroxenite massif of the same name was discovered in 1937. Ya.S. Wisniewski. The Tebinbulak deposit of titano-magnetite ores has been known since 1937, and was subsequently studied during geological surveying at a scale of 1:100000 (1953-1956) and prospecting (1955-1956). As a result of special thematic works carried out in 1963-1966 by the Ministry of Geology of Uzbekistan, it was classified as Kachkanar (Ural, Russia) type and recognized as commercially interesting. In this regard, in 1968-1970, comprehensive geological and geophysical studies were conducted on the area of the deposit with drilling of several boreholes which confirmed the presence of titanium-magnetite mineralization.

A qualitatively new stage in the study of the Tebinbulak intrusion began with special work on the topic “Intrusions of ultrabasic and basic rocks of Uzbekistan and their ore content, performed in 1963–66 (VV Baranov et al., 1966). In these years, the manifestation, according to its petrological and metallogenic features, was attributed to the Kachkanar geological and industrial type. The estimated forecast resources of 1.5 billion tons have made it possible to classify it as large, industrially interesting objects and recommend it for setting up exploration work. Then these works were carried out in three stages:

- geophysical work and lithochemical testing;
- technological research of ores and
- compilation of a geological and economic justification for the feasibility of exploration.

According to the results of gravimetric studies, a significant depth of distribution of ultrabasic intrusive rocks was determined (more than 1.0 km) (its potential productivity was determined at 1.5 billion tons). Terrestrial magnetic imaging of a base of 1: 10000 revealed 18 large anomalies with an intensity of more than 1000 gamma, the nature of which is explained by impregnation of titano-magnetite. These anomalies were extended in the meridional direction with the following parameters: length from 350 to 2650 m, with a width of 40 to 425 m.

Later, in the period of 1968-1996 (interruptedly), more detailed geological and geophysical studies (gravimetric, magneto metric), prospecting and prospect evaluation survey were carried out at the deposit.

According to the results of geological exploration carried out at the deposit, it was found that the Tebinbulak titanium-magnetite ore deposit is spatially and genetically associated with the gabbro-pyroxenite intrusive massif of the same name. The intrusive massif is confined to the Urusay deep-seated fault zone and is located in the core of the synclinal fold among siliceous, terrigenous (sandstones, siltstones) and greenstone (schists) rocks with intercalations of limestone. It represents an asymmetric body stretching from south to north, 4.5x1.8 km in size, with the fall of the western contact of the intrusion to the east at an angle of 65-70 degrees and the eastern – presumably to the west at an angle of 80-85 degrees. Ultrabasic rocks – pyroxenites, tebinites, wehrlite, peridotites are dominated in the composition of the intrusion. The rocks of the main composition are represented by gabbro, gabbro-syenites.

According to the results of prospecting and appraisal work carried out at the Tebinbulak field in 1991-96. (V.V. Baranov, 1996), forecast resources were calculated for categories C2+P1+P2 to a depth of 300-600 m and amounted to 3943.8 million t of ore. In 1990, geological re-exploration of the western part of the Sultanuvays mountains was started at a scale of 1: 50,000 with deep geological mapping of the pre-Mesozoic basement. In the course, the prospects of certain areas of the mountain system for copper and gold mineralization were confirmed (Logvin et al. 1997). Similar work in the eastern part of the region was completed in 2003 by OJSC Regionalgeology (Artykov, Dementeyenko et al., 2003). The materials obtained as a result of geological exploration of the territory of Sultanuvays and identified several areas that are promising for the detection of ore concentrations of gold, copper, tungsten and other metals, are summarized in the work of O.N. Nikitina et al. (2007). Geochemical studies of the second half of the twentieth century revealed two sublatitudinally oriented zones within Sultanuvays. Haloes of chalcophilic siderophilic elements – Cu, Ni, Co, Cr, Pb, Zn, Pt – in connection with ultramafites, peridotite-gabbral stratified intrusions, and massive syenito-diorites are widespread in the northern part.

By its petrological and mineralogical features, the Tebinbulak massif is very similar to the Kachkanarsky, Gusevgorsky and other dunite-pyroxenite-gabbroic massifs of the Urals, with which the largest deposits of titanium-magnetite ores are associated. The ores of the Kachkanarsky and Gusevogorsky deposits belong to the low-titanium type of iron ores, they have been developed for more than 35 years, and the use of these ores as an iron feedstock is considered to be the task solved by industry. In the Ural mining and metallurgical region, titanium-magnetite ores are the main type of ores – 85% of production in 2000. Titaniummagnetite ores of the Tebinbulak deposit also belong to the low titanium type of iron ores.

Titanium-magnetite ores of the Tebinbulak deposit represent zones (sites) of disseminated, vein-disseminated mineralization, forming steeply dipping "bands" of meridional strike in ultrabasic rocks of the intrusive massif. In the Eastern zone, the "Exploration within the Eastern zone and advancing specialized exploration works on the northern flank of the Tebinbulak titanomagnetite ore deposit in the Sultanuvais Mountains" were carried out for 2011-2014. Based on the results of 2011-2015, the mineralogical-petrographic and geochemical information on the rocks composing the area of the deposit was systematized, the geological structure of the deposit, the morphology of 10 identified ore bodies and the depth of their distribution were clarified. The Tebinbulak deposit was studied (estimated) based on preliminary, detailed assessment and exploration results for 2012-2017 (Table 40).

Table 40 – Covered amount of the main types of geological exploration

Name	Units of measurement	Volume
Trenching	m^3	15100.2
Open pit mining	m^3	-
Core drilling	linear m	28911.1
Sampling:		
• Trench sampling of section 10x5cm	pcs/m	4157/5023
• Line- chip sampling from ditches	pcs	693
• Well geochemical sampling	pcs	650
• Core sampling	pcs/m	9841/22709.4
• Technological sampling	t	1.446

As a result of a preliminary, detailed assessment and exploration of the Tebinbulak deposit of titanomagnetite ores in the Sultanuvays Mountains, the geological structure of the Tebinbulak deposit was revised and previously identified ore bodies and deposits No. 1 were correlated, and their morphology and content of useful components in vanadium-containing titaniummagnetite ores were clarified, that made it possible to more objectively calculate the reserves in them.

CURRENT STATUS OF THE PROJECT

Currently, geological sections were tied up along all exploration profiles, the geological and structural position, the elements of occurrence and the parameters of the ore deposit and ore bodies and their relationship with each other (compact connection) were adjusted. Mineralogical and geochemical studies have been performed for studying the material composition of titanium-magnetite and other ores. The necessary amount of sampling works and geophysical research in trenches and holes made it possible to tie up the identified continuation of zones along strike and to make reserves estimation.

A titanium-magnetite concentrate containing 20-22% iron was obtained. According to the recommended scheme, a magnetic iron-containing concentrate was obtained with a yield of 20%, containing on average 59.61% of iron upon extraction of 64.15%, and also a concentrate with a yield of 3.94%, containing on average 56.5% of iron upon extraction 11 % The total extraction of iron in concentrate is 75%.

In 2014, NIIMR SE investigated a sample No. 6 weighing 1127 kg, composed of four private samples taken from ditches No. 2 and 6, an experimental quarry and old ditch No. 103, with the aim of developing an enrichment technology and obtaining the optimal recovery scheme for useful components from titanium-magnetite ore of the Tebinbulak deposit.

Uralmekhanobr Institute previously processed 2 ore samples from the Tebinbulak deposit. Sample No. 1 was processed in 1971. According to the total iron content, this sample was not representative for the deposit as a whole. The iron content in this sample was 26.4%, while in the approved reserves this indicator is in the range of 15-16%. Therefore, these tests are not taken into account. Sample No. 2, processed in 1983, was representative, therefore, the indicators obtained in the studies of this sample were taken as the basis for the calculations.

Based on the conducted technological studies, an enrichment scheme is recommended, including dry magnetic separation of ore in a particle size of 25-0.01 mm, two-stage enrichment of an intermediate product by dry magnetic separation in the first stage to 0.50.01 mm, in the second stage to 95%, minus 0.074 mm. From ore with a mass fraction of iron of 15.53%, an iron-vanadium concentrate was obtained in an amount of 10.9% with an iron content of 65.5%, vanadium pentoxide 0.63%, titanium oxide 3.02%, while extracting iron into a concentrate 46, 0% At the same time, 15.6% of tails of dry magnetic separation with a total iron content of 9.72%, magnetite 1.99% and 73.5% of wet magnetic separation (WMS) tails with a total iron content of 9.3%, magnetite 0.99% were isolated.

From the practice of the Kachkanarsky mining and concentration plant (GOK) it is known that 1.575 tons of concentrate are needed to produce 1 ton of pig iron – these data are the basis for the calculation. According to the results of studies on the ore beneficiation of the Tebinbulak deposit, it was found that the concentrate yield is 10.9% with an iron content of 65.5%.

As a result of technological research and laboratory analysis of the ore composition, the material composition of the ore was studied by chemical, spectral, granulometric and mass spectrometric methods. The main valuable component of ore is iron, the content of which, according to the results of chemical control analysis, averaged 13% in terms of iron (Fe_2O_3 – 18.57%). The composition of the original ore contains useful impurities of titanium oxide in the amount of 1.74% and vanadium pentoxide – 0.06%; of harmful impurities, the total sulfur content is less than 0.4%, phosphorus pentoxide – 0.13%. The main ore minerals are finely disseminated, and therefore, fine grinding is required to separate iron minerals and gangue. Conducted laboratory studies on the concentration of iron ores by gravity, with dry magnetic separation, with different particle sizes, modes and current strength revealed. At the same time, the indicators obtained during ore concentration of -0.315 + 0 mm fineness at a current strength of 12A should be considered a good result. Under these conditions, a concentrate containing 56.14% (Fe_2O_3 – 50.60%, FeO – 26.64%) of iron was obtained, while extracting it 41.84% from the ore.

Therefore, in order to increase the extraction of valuable components, the ore is proposed to be subjected to finer grinding and staged WMS. The obtained concentrate should be granulated before processing in order to combine fine particles. In this case, one can get a better concentrate and increase the extraction of the main component.

Semi-industrial technological sample No. 1/2015 - weighing 1250 kg was selected by gross method from private samples in ditches No. 2.10a, 12 in the Eastern ore zone within the planned quarry of the primary mining of the Tebinbulak deposit. A sample was selected for technological research at the GP “IMR” to study the material composition and develop a technology for the enrichment of titanium-magnetite ore (2015-2016).

Based on the results of the studies, a scheme was recommended for processing the studied ore sample, including grinding the ore to a particle size of -0.15 + 0, WMS and cleaning of the non-magnetic fraction at a current strength of 12A. When enriching the ore of the deposit according to the recommended scheme, it is possible to obtain a concentrate containing 63.35% of iron while extracting it 62.45%.

A direct calculation of geological reserves combined into a common quarry contour of the Tebinbulak deposit with titanomagnetite ore of the entire deposit at B+C1 category totaling 695.8 million t at an average grade of 19.2% Fe_2O_3, at cut-off grade of 15% was made.

The Tebinbulak deposit possessing reserves and significant forecasted resources of titanomagnetite ores similar to the Kachkanarsky ones, which are now successfully developed in the Urals, may be of undoubted and practical interest in the near future. The conducted mining and geological study cases, analysis of technological studies and economic calculations showed the possibility in principle of establishment of a full metallurgical cycle plant without inclusion of the blast furnace production (pig iron production) in the technological chain at certain studies of ore quality. Recommendations on the searching of improving the efficiency of obtaining vanadium containing products of the standard quality, which requires additional research on the expenses and costs of this type of product, as well as market study, were also given.

OUTLOOK

In the process of further studying of the technological properties of the ore of the deposit, it is necessary to conduct additional technological tests of a representative sample (subcommercial volume), in view of the significant difference between the throughout recovery and yield of an enriched ore (concentrate) obtained in the studies of Uralmekhanobr (Russia) and Outotec (Germany, 2014).

The uneven formation and collection of scrap across regions of the country, as well as the significant volatility of scrap procurement from the timely withdrawal and repair of fixed assets, price and other market factors create additional risks in the supply of scrap metallurgy. This requires covering the deficit through imports or the active development of production of mining and processing of own mineral raw materials.

A feature of the current state of ferrous metallurgy is that it does not have its own stable mineral resource base. This explains the import of iron ore. Given this, one of the priority areas for the development of the local raw material base should be an effective solution to the issue of providing raw materials for metallurgical production, with optimally balanced imports from neighboring countries (Russia, Kazakhstan, China) and further work on the search and development of local raw materials.

In the Republic for the medium term, the expansion of the raw material base of the industry is considered by deepening the processing of ferrous metals, increasing the degree of extraction of useful components from ore, as well as the processing of metal waste.

Study, development and implementation of transfer technologies for mineral processing equipment in a modular design for processing and beneficiation of iron ore deposits, tailings and industrial formations of mining and metallurgical and energy enterprises (metallurgical and energy slags) containing scarce metals, including rare earths, are considered. It is planned to create a mining and smelting plant on the basis of the Tebinbulak deposit, which will provide raw materials for the production of tool steels, as well as for the production of special products. Therefore, by the end of 2019, the project plans to complete all technical and technological studies, and also, to complete a bank feasibility study for the field to expose the field to a wide range of foreign investors.

TSENTRALNY BITUMINOUS COAL SITE

PREVIOUS WORK

The first information about the geological structure of the area dates back to 1919 (Figure 74). Special prospecting works for coal were carried out in 1933 and as a result of these works a qualitative characteristic of the composition of coal in the seams was first given. In 1939, coal seams were studied in the core of the Ketmen-Chaptinskaya anticline. Coal seams were tracked for 1.5 km along strike and practical interesting 3 coal seams No. 1, 2 and 3 were identified. In 1940-1943, prospecting works were carried out at a scale of 1:25000. As a result of the conducted works the forecast of coal by seams No. 1, 2 and 3 was made.

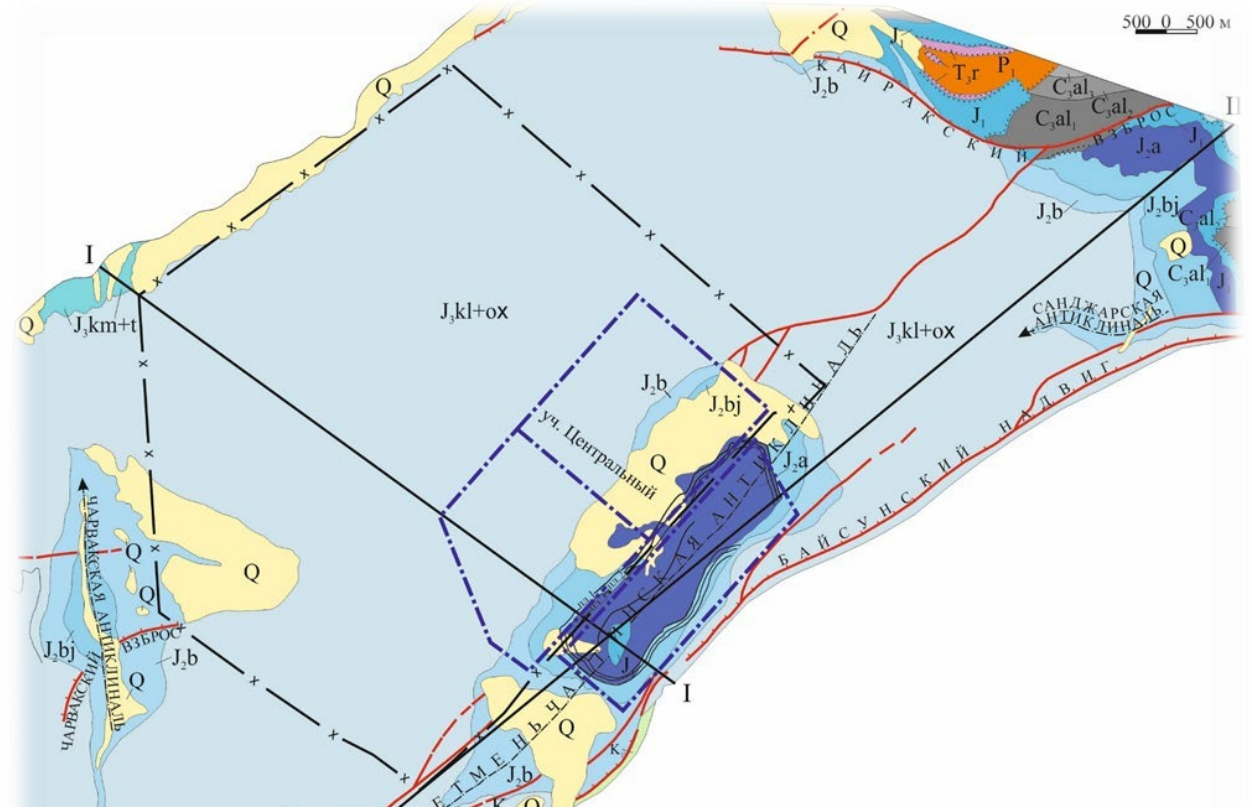

Figure 74. Geological map of the Tsentralny site

After the Patriotic War, during the recovery and development of the coal industry, the requirements of the State Reserves Committee for the study of coal deposits increased significantly. In this regard, there was a need to reassess previously explored coal reserves, in accordance with new instructions in 1958, exploration work at the Baysunskoye field was restored. Searches were conducted in the southern and western areas within the previously studied areas. In order to clarify the reserves and general prospects of the field, 5 wells were drilled, 301 l.m of adits and 3,120 m^3 of ditches were completed. As a result of the work performed, a geological report was compiled with the calculation of reserves for prospecting and structural exploration of the object. Despite the expansion of the Western area, due to well drilling, almost no absolute increase in proven reserves has been obtained. In addition to calculating reserves in the explored areas, a predictive assessment was made of the coal potential of the “Promising” area on the northwestern wing of the Ketmenchaptinskaya anticline. The total number of forecasted coal reserves at the field was determined in

the amount of 450 million t and was justified only by the presence of industrial coal seams in the south-western explored part of the field.

In 1962-67, work was continued on the north-western and north-eastern flanks of the area by drilling deep wells No. 14, 15 and 16. Carboniferous formations of the Gurud Formation were studied for the first time at deep horizons of the area, and industrial coal content was confirmed at a distance of 10 km to the north-west in the fall from the outcropping of formation No. 1 on the day surface. Forecasted coal reserves in formations 1, 2 and 3 on the area are determined at 204.0 million t. In 1965-67, Fattakhov et al. Conducted a state geological survey at a scale of 1: 50,000 on the area of sheets J-42-63 and J-42-51-G, as a result of which the stratigraphy, tectonics and minerals of this area were studied in detail. In 1980-83, detailed searches were conducted on the area by drilling deep wells (5119.0 m) and geological surveying at a scale of 1:10000 per 93.0 km^2. As a result of these works, new data were obtained that significantly change the results of calculating the forecast resources of past years. Search wells Nos. 21 and 22 on the Charvak anticline and 29 on the northwestern wing of the Ketmen-Chaptinskaya anticline opened reservoir No. 1 with a thickness of 0.3 m, 0.25 m and 0.6 m, respectively, which led to a decrease in the average thickness of the reservoir when calculating reserves up to 1.3 m. The volumetric mass of coal in bed No. 1 was determined in VUKHIN (Sverdlovsk) and is equal to (with an average ash content of 11%) 1.45 t/m^3. The prospective area involved in the calculation of forecast resources for category P2 amounted to 77.5 km^2. With the indicated parameters, taking into account a decreasing confidence coefficient of 0.8, P2 reserves amounted to 121.6 million t of coal. It was not until the 1960s, that based on the established requirements of the State Reserves Committee, the exploration works resumed and searches and exploration were done in this area. In 1982-1986, prospecting and evaluation works have been carried out. At the same time, the characteristics of the site were studied in detail, and the quality of coal was reliably established by a complex of laboratory studies and its industrial value as a source of electric power carrier was proved.

CURRENT STATUS OF THE PROJECT

The reserves of seam No. 1 of the Tsentralny block were approved, corresponding to “T” grades by B+C1+C2 categories in the amount of 12,693 thousand t, and the forecast resources by P1 category in the amount of 15,860 thousand t were calculated. Currently, in accordance with the recommendations of previous work, underground mining, surface testing wells, research are ongoing.

Since 2018, a detailed assessment is being conducted at the Tsentralny site to study flanks and deep horizons. Office work was carried out, the processing of field geological materials passed through the wells in 2018.

Vertical wells No. 51, 60 and 61 for crossing ore bodies to a depth of 1225 m, in order to open coal seams No. 1 and 2, are being drilled. Geochemical samples obtained from core wells in the amount of 72 pcs. All core samples taken from coal wells were sent to the laboratory of Uzbekugol JSC for the conduct of coal chemistry analyzes in Angren.

OUTLOOK

In the Republic, the share of new energy sources in world energy consumption will increase, however, traditional sources (oil, gas, coal) and nuclear energy will continue to hold their leading positions.

Creation by 2025 of a complex for the local use of coal processing products and the creation of pilot plants for the production of synthetic liquid fuels from coal, including a complex of demonstration plants for deep coal processing processes with subsequent industrial development of the technology for producing synthetic liquid fuels in the coal industry in 2025-2030. It should be noted that the key importance is not only the production of individual products, but the expansion of relationships and the integrated development of industries. Work to attract foreign investment will also continue.

SOCIO-ECONOMIC AND SOCIO-ENVIRONMENTAL ASPECTS OF SELECTED PROJECTS

TEBINBULAK TITANO-MAGNETITE ORES DEPOSIT

ECONOMIC ASPECTS

The economy of the region is determined by agriculture in the irrigation zone by the waters of the Amu Darya River; livestock; passing through it (close to the area of projected works) the railways Nukus-Turtkul-Miskin, Miskin-Uchkuduk; Nukus-Turtkul highway; high-voltage line from Takhiatash GRES; Gazli-Nukus gas pipeline.

The Republic of Uzbekistan has reached a high level of industrial development; it is becoming a major industrial center in the Central Asian region. Currently, the total demand for ferrous metallurgy products exceeds 2.0 million t, and the existing production capacity for the production of rolled ferrous metals makes up 1.1 million t. Covering the metal

deficit is associated with significant foreign currency expenses (procurement and transportation) and depends on supplies from foreign countries.

The ever-increasing metal consumption and the need for iron and steel products induce to raise the question of creating our own iron ore raw material base in the Republic of Uzbekistan, as a very urgent problem requiring a reasonable, well-considered solution. The Tebinbulak deposit, possessing reserves and significant forecasted resources of titanomagnetite ores, may be of undoubted and practical interest in the near future.

SOCIAL ASPECTS

The favorable location of the field (near the railway and highway, power transmission lines, gas pipelines, water pipes) makes it very attractive, and the construction of an enrichment plant will provide a significant number of local people with work.

Particularly noteworthy is the extremely convenient position for the future integrated development of the Tebinbulak field. The cluster itself, with its infrastructure, including the main components (open pit, GOK, MK, roads, conveyors, dumps, auxiliary services) is located near the existing power lines, gas pipeline, drinking water conduit and the proximity of the Amu Darya River for industrial water, the A-380 international highway , the railway line as a whole is compact, and therefore economical.

ENVIRONMENTAL ASPECTS

The Land legislation (GOST 175103-86 “Protection of the Earth's nature” and the law “On land restoration”) provide for the rational use of all lands and their protection. Field exploration works were carried out in the mountains, where the top soil layer is practically absent, and were attended by the movement of motor transport, borehole drilling, ditch cut, trenching, and test pit sinking. During these operations, the envisaged set of measures to protect the soil layer and vegetation was carried out. Technological processes in the extraction and concentration of ores cannot be imagined without process water supply. When open pit mining, the natural process is mine drainage.

Considering the high evaporation potential in the area of an industrial enterprise construction, in order to improve environmental cleanliness, the periodical covering the tailings storage with loesslike soils is assumed by the project.

TSENTRALNY BITUMINOUS COAL SITE

ECONOMIC ASPECTS

The geological structure of the Tsentralny site and the morphology of bed No. 1 were studied with sufficient density and detail. The deposit area has favorable conditions for the operation and construction of a mining enterprise. The nearest Shurchi railway station is located in 60 km and the large Uzbek highway is in 8 km south-east from the object.

The feasibility study was compiled under the bed No. 1 of the Tsentralny site: the development method is mine, the average thickness of a bed is 1.42 m, the maximum depth is 2090 m, the amount of inclination is 5-18 degrees, the ash content is 8.4%, and the lower specific heating value is 7875 MJ/kg. The studied reserves with an annual productivity of 200 thousand t for 55 years with a return to capital in industrial construction are 12 years. The total cost of 1 ton of coal produced is approximately 20 US dollars.

SOCIAL ASPECTS

There are sufficient labor resources in the area. The development of the facility as an energy resource sufficiently raises the economy of the region. Currently, the developed Baysunskoye field is one of the suppliers of energy fuel in the south of Uzbekistan. Providing energy resources to enterprises under construction and planned for the long term will require an increase in the capacity of the mining enterprise.

At present, the exploration of the facility provides coal for the mine, possibly due to proven reserves. Without a doubt, the developed infrastructure in the region associated with the energy resource serve as the solution to many social issues.

ENVIRONMENTAL ASPECTS

Works on the study of toxic components in coal and mine waters were carried out in accordance with the “Instructions for the study of toxic components during the exploration of coal and shale deposits”. Analyzes for determining the toxicity of groundwater showed that toxic elements in mine water (As, Ba, Be, V, Bi, W, Cd, Co, Mn, Cu, Mo, Ni, Pb, Sr, Sb, Tl, Ti, Cr , Zn) and in coal (S, As, Be, V, Co, Mn, Pb, Cr, Ni, Se) do not exceed the “critical concentration”. When in concentrated use of coal in large power plants, the large entry of toxic elements into the environment is not forthcoming.

The air-pollution control in the projected area of the mining enterprise operation is simplified by the underground mining method and coal handling by motor vehicles to a distance of not more than 10 km. The complex of measures for the protection of surface waters provides for the treatment of domestic wastewater and mine drainage waters. Their reset is possible along the Tuada sai. After preliminary disinfection and purification, the water can be used for household water needs.

After preliminary research, the wastes from mining, concentration and burning of coal is possible to use in the following ways:

- building materials and for the manufacture of building materials;
- valuable components (Al, Fe, P, etc.) extraction;
- production of lightweight concrete aggregates (agglomerate, expanded clay, etc.).

When performing mass searches, the radioactivity of the rocks does not exceed the background values for the region and no radioactive anomalies were identified.

FIELD PROJECTS STATUS AND FEASIBILITY

TEBINBULAK TITANO-MAGNETITE ORES DEPOSIT

TECHNOLOGICAL FEASIBILITY ASPECTS

The mining conditions of the Tebinbulak deposit allow carrying out open-cut mining – by a quarry (Figure 75). At the deposit the geotechnical complex of strong (intrusive rocks: pyroxenites, tebinites, hornblendites), rarer – medium-hard (metamorphic rocks: schists, marbled limestones and skarns) rocks is mainly developed.

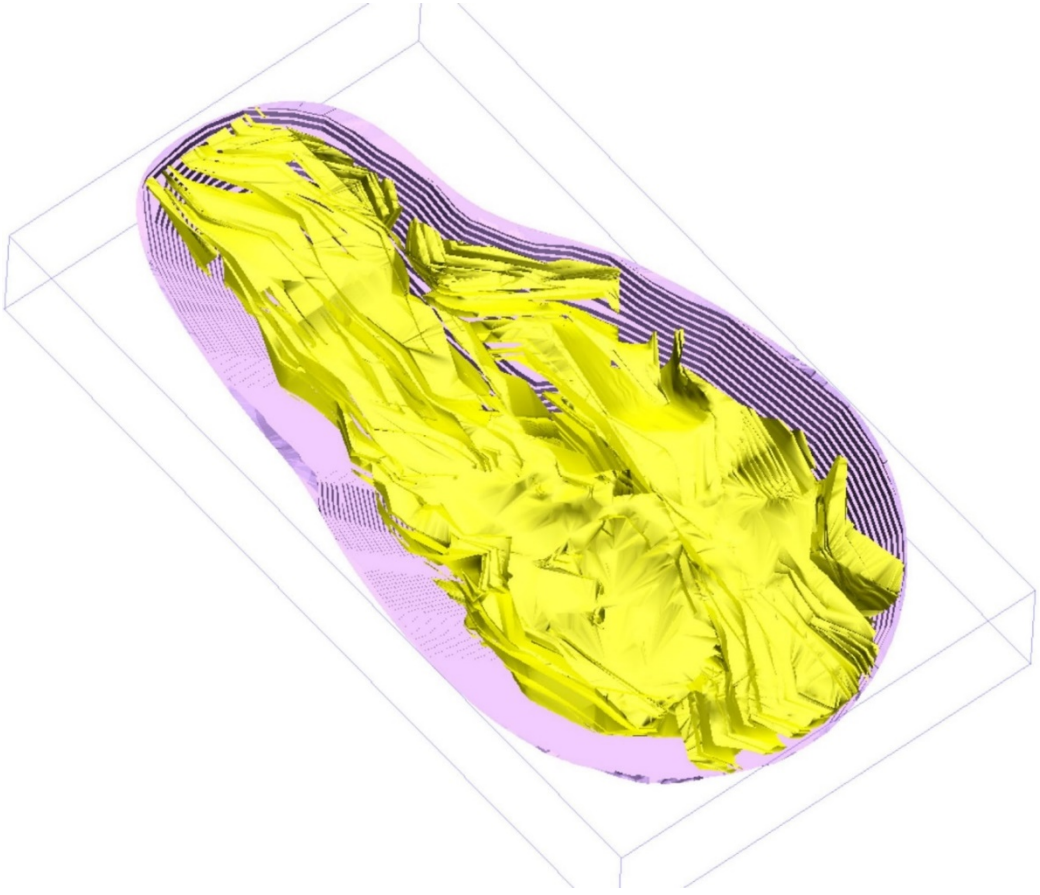

Figure 75. Quarry scheme for Tebinbulak titano-magnetite ores deposit

Strata inclination and ore-bearing zones exposed by ditches and boreholes, consistent with the shape of the intrusion (lopolith) in a contact with the metamorphic rocks of the Lower Devonian: western – at 70-80°, eastern – at 65-75°. The rocks are slightly fractured, in the zones of tectonic disturbances and strongly fractured in the zones of weathering. The average density of the ore is 3.33 t/m^3, natural humidity is 1.0% (conditional), and the coefficient of fortress according to the scale of M.M. Protodyakonov is 7-9.

Overburden rocks (pyroxenites, gabbroids) are planned to be processed into crushed stone and sand, and rock cuttings into cinder blocks. Also, the high-temperature zones of silicification (quartzite), suitable for the production of heat-resistant materials are developed in the host rocks.

Based on the obtained results and technological tests, the following was established:

- density – from 3.33 to 4.09 g/ m3;
- bulk density – 2.71 t/ m3;
- water absorption – 0.10-0.51%;
- magnetic susceptibility – 49x10-6 m3/kg;
- magnetization – 4.1 A m2/kg;
- residual magnetization – 0.6 m2/kg;
- network index of crushing – 36 kWh/t micrometer1/2;
- crushing index – 4.8 m3;
- coefficient of strength – 3.3-4.8 rock drillability;
- specific crushing work – 31-41 J/m3;
- primary specific work of destruction – 400-810 J/m3.

DETAILED STUDIES CONDUCTED

The developed ore processing scheme of the Tebinbulak deposit is almost similar to the ore processing scheme of the Kachkanar deposit (Ural), and included: 2 grinding stages with a final grinding coarseness of 95% of a class – 0.074 mm and 2 WMS operations, with a concentrate re-cleaning of the 2nd stage of WMS. Before the second separation operation, a deslimation operation is provided.

TSENTRALNY BITUMINOUS COAL SITE

TECHNOLOGICAL FEASIBILITY ASPECT

In the coal-bearing stratum of the deposit, the industrial coal mineralisation is confined to sediments of the upper subsuite of the Gurudsky suite of the Jurassic period.

Prospecting and evaluation works were carried out in accordance with the approved project documentation and existing methodological guidelines. Ore body No. 1 was explored by lithological-facies sections in the adit – 1680 l.m, lithological sections in the adit – 1530 l.m, description of paleontological points – 30 points, mining works – 10,148 l.m. A total of 155 ore samples, 400 trench channel samples, 2 technological samples (1.5 t each), and 2 samples were taken to determine the bulk density as a whole. In total, 9 blocks were studied in the studied stratum No. 1. All blocks of the reservoir are between the horizons +1,700 and +1,850 m. Mass searches were made in the process of driving the underground mine workings.

DETAILED STUDIES CONDUCTED

Since 2018, a preliminary and detailed assessment has begun for studying the flanks and deep horizons of the area. Also, it should be noted that high quality coal may be the raw material for the metallurgical plant under construction. At present, desk work is underway to process field geological materials passed through wells of previous years. In the process of drilling are 3 wells to open coal seams No. 1 and 2 to a depth of more than 1000 m. All core samples taken from coal wells were sent to the laboratory of Uzbekugol JSC for coal chemistry analyzes in Angren.

LEVEL OF KNOWLEDGE / CONFIDENCE IN ESTIMATES

TEBINBULAK TITANO-MAGNETITE ORES DEPOSIT

GEOLOGICAL AND TECHNICAL ASPECTS

Tebinbulak deposit covers 5.2 km^2 and is composed of volcanic, terrigenous and mixed mass of the Paleozoic basement. In the geosynclinal era of the geological development of this region, ultrabasic and alkaline rocks of the Tebinbulak (C1-2) (peridotite, wehrlite, pyroxenite, tebinite, hornblendite, amphibole and pyroxene gabbro) and Jamansai (C2-3) (gabbro-syenite) complexes were occurred; this has exerted a significant effect on the ore content of the region.

Ore mineralization has been established to depths of 812 m (C-5), and according to geophysics (magnetic gravity exploration and induced polarization (IP) to depths of 900 m from the surface. This zone is composed mainly of

disseminated ores (up to 97%) with a content of 10-20% titanomagnetite in them, with an admixture of pyrite, pyrrhotite and chalcopyrite (up to 1%). An impregnation of titanomagnetite of irregular, isometric shape with a size of 0.1-2.0 mm, sometimes 5-7 mm, develops along the boundaries of non-metallic minerals, filling the space between them. Disseminated ores consisting of 50-60% of ore minerals that contain: magnetite (92-95%), ilmenite (3-5%), chalcopyrite (0.5-1%), hematite (0.5-2.0%) are less common. Titanomagnetite is evenly distributed throughout the rock, filling the gaps between the grains of the rock-forming minerals. The grain size is 0.33.0 mm. Ores of this type form separate segregations in disseminated ores, and are also found among secant veins. Veins of massive titanomagnetite ores are found in the central part of the Western ore zone, less often in its northern part and in the east of the intrusion. The strike of the veins is, as a rule, submeridional, less often north-west, in the northern part of the massif is north-east, sometimes they fan out.

The length of the vein is traced within 20-114 m, at a thickness of 0.2-3.0 m. Ore minerals in them make up 85-95% and are mainly represented by a medium-grained (0.5-2.0 mm) aggregate of isometric precipitations of titanomagnetite with individual inclusions of sulfides. The main parameters for estimation of predicted ore resources of the Eastern zone, uncovered by trenches on the surface, and to a depth of 400m by boreholes on a uniform network, are calculated as follows:

- for the ore zone of the titanomagnetite ores of the Tebinbulak deposit, the output of the parameters of the ore intervals for the workings was performed by the weighted average method;
- average thickness of ore zone is determined according to surface data and drilling results as arithmetic mean;
- average volumetric weight of rocks with titanomagnetite ore is calculated as arithmetic mean with fluctuations from 3.3 to 4.09 t/m^3;
- linear ore-bearing factor is defined as the ratio of the length of the conditioned ore intervals in the mine to the thickness of the ore zone, and in case of an incomplete intersection of the ore zone – to the mine length.

ESTIMATES OF QUANTITY AND VOLUME

Geological exploration was carried out on the basis of available geological data with the excavation of ditches, pits and drilling of core wells to determine the nature of geophysical anomalies, opening, testing, localization of ore bodies and calculating reserves for them.

A feasibility study has been developed for exploratory standards for calculating the reserves of titanium-magnetite ores in the Tebinbulak deposit. Standard geophysical surveys for wells (GIS) and pilot studies to determine the magnetic testing of drilled wells and core cores were carried out, with the preparation of instructions for this type of testing.

All topographic and geodetic works in the Western and Eastern zones were carried out according to the project and served as material for calculating reserves and constructing geological sections. To compile a feasibility study, a report was prepared as of 01.10.2017. with geo-economic, geological information, a characteristic of the quality of titaniummagnetite ores, mining and technical features, and reserves estimation for C1 categories. Calculation of forecast resources of titano-magnetite ores according to cat. P1 by direct calculation by the method of vertical sections from the horizon of 0.0 m to -100 m amounted to 243.27 million t, with average Fe_2O_3 contents of 18.21%. As part of the report, a feasibility study was developed on the feasibility of developing the field and exploration conditions for calculating industrial reserves by categories B+C1.

The methodology for calculating reserves was adopted according to the “Temporary instruction for applying the classification of reserves to iron ore deposits. T., 2003”. Thus, the Tebinbulak deposit falls into the second group, subgroup 2B, in which the distance between exploration profiles of 200-400 m and a dip of 200-100 m is required to calculate the geological reserves of category C1. In the requirements of the instructions, the location of the profiles and the distance between the wells, the studied parts of the Western and Eastern zones fit. A total of 14 profiles were passed through 200 m each, with a distance between the wells of 100 m and a depth of up to 500 m (cf.), the surface was examined by ditches, which were used for continuous testing, including in ore-bearing zones by furrow testing. When calculating the reserves of titano-magnetite ores by category C1, following the analogy with the well-known Kachkanarsky deposit, the following initial parameters were adopted:

- the on-board content of Fe2O3 total is 15% (on Kachkanar, the board is 18%);
- the average content of total Fe2O3 is 18.3%;
- average bulk weight of ore – 3.33 t/m3;

The calculation of geological ore reserves by categories B+C1 of ore deposit No. 1 for the allocated blocks was determined by direct calculation. Calculation of geological ore reserves was performed in the outline of the selected block between sections 3-10. In both end profiles, the calculation of geological reserves was carried out in accordance with the requirements in half, i.e. not 200 m, but 100 m. Calculation of the geological reserves of titanium-magnetite

ores within the Tebinbulak deposit between profiles 3 and 10 for categories B+C1, using vertical parallel sections on a tobasis scale of 1:1000. The calculation of geological ore reserves by B+C1 categories of ore deposit No. 1 for the allocated blocks was determined by direct calculation. The cutoff grade of the metal is 15%. The difference in reserves by B + C1 categories between the traditional calculation and the Micromine environment amounted to 7.22 million t (1,703.04 million t (Micromine) minus 1,695.82 million t (traditional)).

TSENTRALNY BITUMINOUS COAL SITE

GEOLOGICAL AND TECHNICAL ASPECTS

The area of the site is composed of sedimentary rocks from the Upper Triassic (Keuper) – Lower Jurassic to the Quaternary sediment. At the deposit, the middle and upper subformations of the Gurudsky formation, as well as the lower and upper sub-formations of the Dogibadamsky formation of the Lower Jurassic are coal-bearing. Geologically, the Central Coal section is confined to the north-western part of the Baysun Trough (megosynclinal), which is a large modern negative structure of the type of intermountain depression. Tectonic movement dates back to the early Jurassic, causing a redistribution of areas again and accumulation. The uplifts that existed in the early Jurassic turned out to be areas of accumulation with an altered sedimentation complex of the Gurud and Ugibadi Dam.

In the composition of the Gurud Formation, the terrigenous materisal is finer-grained. The Gurudsky coal accumulation stage was characterized by peat accumulation in the swampy deltas, the periphery of the drift cones and on flat alluvial plains, the thickness of the strata is 0.6-2.5 m. On the alluvial plains, the strata are well-kept. Coal deposits and coal accumulations in the Surkhantau, Baysuntau, Kugitanga mountains and parts of the Yakkabag mountains are associated with the Gurud stage.

The Degibadam stage arose against the background of the first major marine transgression in the upper Bajos. The rocks are represented by a gamut of marine, submarine, wave-breaking, lagoon facies. Deltaic rocks caused the flowering of lake landscapes and the formation of peatlands. However, the subsidence of the territory did not favor sustainable peat accumulation (coal seams of working capacity are not found in the Baysunskoye field).

ESTIMATES OF QUANTITY AND VOLUME

Prospecting and evaluation works have been carried out on the site. 4 benches were studied at the deposit, and bench No. 1 is the most - productive. The deposit has been explored by adits.

According to the existing classification, the bench No. 1 by thickness refers to thin (0.711.20 m) and medium thickness (1.21-3.50 m), to the “relatively seasoned (persistent)” group. According to the bedding conditions, the bench belongs to gently sloping (dip coal 18º) monoclinal. Actual incidence angles are 5-18º.

The total inflow of water at the mouth of the adit is from 4.4 l/s (15.8 m^3/hour) to 7.8 l/s (28.2 m^3/hour) with a total length of about 7000 l.m.

The main quality characteristics of coal are as follows:

- mass fraction of working moisture – 0.82%;
- ash content – 14.72%; - devolatilization – 14.3%.
- mass fraction of total sulfur – 0.59%;
- the highest specific heat of combustion – 8,689 kcal/kg;
- the lowest specific heat of combustion – 7,809 kcal/kg.

At the deposit, reserves were calculated by categories B+C1 amounted 6,986.0 thousand t and by category C2 – 5,707.0 thousand t. When calculating reserves, 1.5 t/ m^3 volumetric mass was applied.

CLASSIFICATION OF SELECTED PROJECTS USING UNFC

TEBINBULAK TITANO-MAGNETITE ORES DEPOSIT

REVIEW OF SOCIO-ECONOMIC INFORMATION INCLUDING SOCIAL AND ENVIRONMENTAL (E-AXIS)

The Tebinbulak iron ore deposit according to the criteria of economic and social viability of the project (E-axis) is a commercial project.

In total, 245 holes have been drilled on the Tebinbulak iron ore deposit. The reserves of the deposit are calculated to a depth of 350 m. The cutoff grade of the metal is 15%. Extraction of iron in concentrates is 65.82%. The development

method is open-cut mining (quarry). It should be noted that the Tebinbulak deposit is located in a very favorable infrastructure: nearby there is a highway, a railway, power transmission line, a water conduit and gas pipeline lines.

The scheme for obtaining final commercial products is as follows: (1) obtaining iron concentrate; (2) cast iron (middle link); (3) steel (finished product). Upon steelmaking up to 1.5 million t annually, the estimated reserves will last for 40 years. The payback period is 17.8 years. The average annual income from sales is 1,140,616.5 thousand US dollars. The development of the deposit is expected not only to meet the domestic demands for steel in the Republic, but also provides for its export; provision is made for attraction of foreign investments with a view to deposit development.

The region has sufficient labor resources. Mining of iron ores invariably benefits people and inflicts damage the environment. The following environmental problems arise as a result of production: air pollution, soil degradation, water pollution and impact on flora and fauna. The main production processes in the quarry (drilling and blasting operations, excavation and loading of rock mass, traffic, etc.) are accompanied by emissions of dust and gases. These works stipulate dust- and- gas-protective measures: wet drilling, use of TNT-free explosives, sprinkling of bottom-hole, roads, sites, and ventilation. All this reduces the negative impact on the environment and stabilizes the atmosphere. The maximum permissible emissions are established for each source, ensuring that the established maximum permissible concentrations (MPC) are not exceeded (Table 41).

Table 41 – List of noxious substances and their gross emissions

Name of noxious substance	MPC m.s. SRLI mg/m^3	Class of hazard	Emission of substance, t/year
Overburden dust	0,37	3	137,243
Iron oxide	0,2	3	0,0094
CaO	0,15	3	10,94
Benzopyrene	1*10-6	1	0,000125
Aldehydes	0,035	2	1,707
Hydrocarbons	1	4	9,176
Carbon monoxide	5	4	82,799
Nitrogen dioxide	0,085	2	40,9613
Sulphurous anhydride	0,5	3	17,066
		TOTAL:	299,902

In order to reduce emissions of harmful substances into the atmosphere, feasibility study provides following measures:

- strict geological surveying and technical supervision of compliance with the adopted parameters of the development technology system, as well as the implementation of environmental protection measures;
- specify the geological structure and contours of the enclosing rocks in mine plans;
- wet dust suppression during all loading and hauling, drilling and blasting operations;
- purification of aspiration air at reloading nodes;
- ensuring the operative condition of mining-and-winning and transport equipment to prevent the ingress of fuels and lubricants into a soil. When equipment repair, wastes (waste oils) must be collected in special containers and transported to places for oil collectors established by the sanitary and epidemiological station;
- on diesel equipment (vehicles, loaders, bulldozers, etc.), devices are installed to neutralize the exhaust gases;
- installation of special pit privies and other structures for the discharge of utility fluids.

In addition to the aforementioned measures, a reduction in gas contamination is also achieved by selecting fuel for the gas balance for open-cut road transport and organizing strict control over the work of the latter.

To ensure environmental protection in the part of the repair and storage facilities and auxiliary facilities, it is planned to purify the air during the operation of grinding machines by means of dust suction units and use water recirculation system for washing equipment and cars after wastewater treatment in local treatment facilities.

The relief of the site is submontane, that seals on the wind regime, creating natural ventilation. The size of the sanitary protection zone (SPZ) is 500 m for dispersing of harmful substances into the atmosphere. In order to prevent disturbance of the soil cover during the movement of vehicles and technological equipment, the construction of pit roads with hard surface is planned.

In general, taking into account the payback period and average content approved for the development of the Tebinbulak iron ore deposit, it can be classified as E1.2 in accordance with UNFC.

REVIEW OF PROJECT FEASIBILITY INFORMATION (F-AXIS)

The project feasibility (F-axis) plays an important role, especially when it is referred to huge construction on giant fields' development. The Tebinbulak iron ore deposit has substantial reserves, and its development requires the construction of an overlarge ore mining and processing enterprise. According to the feasibility study, the payback period will make up 17.8 years and is commercially viable.According to the Technical Design Assignment, the calculations are carried out prior receipt of the final commercial products (rolled metal, slabs, sheet steel and pipes); based on this, the feasibility study provides for the construction of a mining-andmetallurgical combine.

Iron ores of the deposit are supposed to be developed by open pit mining with further processing of an ore by process stage. Large, medium and small crushing is carried out in the crushing department, and then the ore is conveyed along the conveyor line to the magnetic separation workshop. The resulting concentrate is processed into pellets, then the iron is smelted in an unconventional way (nonblast-furnace iron-making), steel products are produced in the converter plant, which are further processed into metal rolling and other steel products. Simultaneously, vanadium-containing concentrate is melted out.

The annual productivity of the open pit by ore is determined from the target level of development of the designed mining and smelting complex, which determines the production of 1.1 million t/year of steel, and makes up 8.58 million t/year of ore. The development period of explored reserves is 77.4 years. Considering the scale of the project enterprise, financial and economic calculations were carried out for a period of 23 years (3 years of investment and construction period and 20 years of production). At present, a Bankable Feasibility Study is being prepared by specially invited experienced companies.

Based on the above, the object can be classified as F1 according to UNFC.

REVIEW OF GEOLOGICAL KNOWLEDGE / CONFIDENCE IN ESTIMATES (G-AXIS)

The Tebinbulak deposit has a fairly high exploration maturity – a detailed assessment. At the same time, the estimated ore reserves by B+C1 categories amount to 1,695.82 million t (of which by B category are 269.2 million t).

The ore has been studied to a depth of 900 m. The length of the vein is traced 20-114 m apart, at a thickness of 0.2-3.0 m. Ore minerals in them make up 85-95% and are mainly represented by a medium-grained (0.5-2.0 mm) aggregate of isometric precipitations of titanomagnetite with individual inclusions of sulfides.

Thereby, the quantities can be estimated with a high degree of confidence and assigned G1 according to UNFC.

CLASSIFICATION OF THE PROJECT USING UNFC SCHEME

As Tebinbulak deposit qualifies as E1.2 F1 G1, the project is classified as “commercial”.

TSENTRALNY BITUMINOUS COAL SITE

REVIEW OF SOCIO-ECONOMIC INFORMATION INCLUDING SOCIAL AND ENVIRONMENTAL (E-AXIS)

The geological structure and morphology of the bed have been studied with sufficient completeness and detail. Mode of occurrence of the coal-bearing strata and coal seam are determined by continuous measurements at a distance of up to 3 km along the strike.

The geological structure of the bituminous coal site, the seam No. 1 of the Tsentralny site, according to the grade composition refers to lean sintering coal (“T”) and is a high-quality power fuel. Coal has a low ash content, low humidity, low grit, and high calorific capacity and refers to energy fuel with high heat engineering qualities. Coal does not have closeburning properties and does not apply to coking. The content of rare and trace elements in coal within clarke, toxic elements are present within the limits allowed by GOST. Works on the study of toxic components in coal and mine water was carried out in accordance with the "Instructions for the study of toxic components in the exploration of coal and shale deposits". Analyzes for determination of the groundwater toxicity showed that toxic elements in mine water (As, Ba, Be, V, Bi, W, Cd, Co, Mn, Cu, Mo, Ni, Pb, Sr, Sb, Tl, Ti, Cr , Zn) and in coal (S, As, Be, V, Co, Mn, Pb, Cr, Ni, Se) do not exceed MPC. In concentrated using of coal in large power plants, large releases of toxic elements into the environment are not expected. The air-pollution control in the projected area of the mining enterprise is simplified by the underground method of mining and coal delivery by motor vehicles to a distance of not more than 10 km.

In accordance with the compiled feasibility study, the cost of 1 ton of coal makes approximately 20 US dollars, the payback period is 12 years at an annual output of 200.0 thousand t, and the reserves will last for 35 years. Underground mining of the deposit is profitable, and the development of the project improves the economy of the region.

The deposit area has favorable conditions for the operation and construction of a mining enterprise. There are local building stones (quarry stone, clay, sand, gravel, etc.). The nearest Shurchi railway station is located in 60 km, and the large Uzbek tract is in 8 km to the southeast of the deposit. Also, there are sufficient labor resources in the area.

In this regard, the economic and social viability of the project corresponds to category E1.1 in accordance with UNFC.

REVIEW OF PROJECT FEASIBILITY INFORMATION (F-AXIS)

Quite detailed studies were carried out at the Tsentralny coal deposit, and feasibility study substantiated economic efficiency of its development by underground mining (scheme of opening the coal seam No. 1 (1:2000) was done.

It should be noted that a preliminary and detailed assessment is currently underway to study the flanks and deep horizons with the calculation of industrial reserves; and the transfer of the available reserves (C2) to the higher categories (C1) will undoubtedly increase the attractiveness of the deposit. These exploration works are planned to be completed by 2022.

Thus, the deposit corresponds to category F1.2 in the UNFC classification.

REVIEW OF GEOLOGICAL KNOWLEDGE / CONFIDENCE IN ESTIMATES (G-AXIS)

The 1982-1986 prospecting and appraisal works calculated reserves in the following categories: B – 1,102 thousand t, C1 – 5,884 thousand t and C2 – 5,707 thousand t at an average thickness of 1.46 m. The economics is calculated according to B+C1 categories (total 6,986 thousand t; reserves of C1 category are assigned to the category with an average degree of reliability). The Tsentralny deposit is sufficiently studied and is considered promising for the construction of an exploration and production enterprise.

Based on the above, the deposit is classified as G2 according to UNFC.

CLASSIFICATION OF THE PROJECT USING UNFC SCHEME

In view of the foregoing, the deposit can be classified as E1.1. F1.2. G2, and thus be considered as “commercial project”.

ALIGNMENT TO SUSTAINABLE DEVELOPMENT GOALS

NATIONAL APPROACHES

The geological industry is the basic component of the country's economy, which is a combination of management structures, production and scientific organizations that meet the needs of the state and society in the field of geological study of the territory of the Republic of Uzbekistan, reproduction of the country's mineral and raw material base, monitoring and protection of mineral resources, as well as mining relations.

The product of exploration is industrial mineral reserves in the subsoil. Minerals, being the material basis for the development of the state’s economy, serve as the country's natural advantage and ensure human welfare. In general, geological research, being in the initial chain of identification and development of raw materials, is intimately associated with the activities of industries engaged in the extraction, processing and production of mineral raw materials with the further organization of production with high added value based on them.

Currently, not only in the mining or mining-and-geological branch, but also in all sectors of the Republic, there are conceptual frameworks for development until 2024, a strategy until 2030, and a concept for a long-term development strategy for Uzbekistan until 2035 [3].

INDUSTRY APPROACHES

In the exploration industry, researches are currently being conducted upon the medium-term programme 2018-2019, and a programme 2020-2021 has been developed taking into account the transition to openness and attracting investments in the mining and geological industry. In addition, provision is made for extension of exploration works in new promising and inaccessible areas of the Republic with the aim of forming a reserve search pool of strategically important minerals (gold, silver, uranium, copper, tungsten, polymetals) and new types of minerals (ferrous, non-ferrous, rare and rare-earth metals and etc.) by identifying promising new facilities that ensure the priority development of exploration and industry in these territories.

International consulting companies were involved and strategies for the development of the mineral resource base of the Republic of Uzbekistan were developed taking into account the introduction of modern international standards and international best practices. Currently, more than 120 promising areas are proposed for geological exploration and about 30 deposits of gold, uranium, tungsten, iron and lithium are offered for industrial development with the attraction of foreign investments.

It should be noted that starting in 2020, for individual projects (of prospecting works) exploration works will be carried out taking into account international reporting standards. Application of the UNFC system certainly serves for efficient attraction of investments, conducting international research in the field of energy and mineral resources, carrying-out of an analysis in the field of resource management, industrial process planning and efficient allocation of capital.

CASE STUDY PROJECTS' SPECIFIC ASPECTS

The projects considered in this study play a special role in the rapidly growing pace of the country's economy. The objects are interconnected, since the development of the Tebinbulak titanium-megnetite deposit requires high-calorie coal. Bituminous coal from Tsentralny site meets the requirements.

The uneven formation and collection of scrap across regions of the country, as well as the significant volatility of scrap procurement from the timely withdrawal and repair of fixed assets, price and other market factors create additional risks in the supply of scrap metallurgy. This requires covering the deficit through imports or the active development of production of mining and processing of own mineral raw materials.

A feature of the current state of ferrous metallurgy is that it does not have its own stable mineral resource base. This explains the import of iron ore. Given this, one of the priority areas for the development of the local raw material base should be an effective solution to the issue of providing raw materials for metallurgical production, with optimally balanced imports from neighboring countries (Russia, Kazakhstan, China) and further work on the search and development of local raw materials. It is planned to begin development of the Tebinbulak field by 2025. The Tsentralny coal deposit is considered as additional sources of energy raw materials in the region.

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SUMMARY AND CONCLUSIONS

Central Asia is well endowed with immense energy reserves. The region has the potential for discovering more resources. The region's position between Europe and East Asia, Central Asia provides immense opportunities in the trade of natural resources. Resources of hydrocarbons, especially gas, are vast. Hydropower capacity and deposits of coal and uranium are additional sources. Excellent wind regimes make the region one of the world's best in wind power potential, while the abundant sunshine offers prospects for large-scale conventional and thermal solar power. Together, these resources could ensure self-sufficiency and help make the region an important market for trading, transport, and sales of energy far into the future.

Economic reliance on one or a few resource commodities makes a nation susceptible to global price fluctuations. One way to ward against these and other potential consequences is to diversify energy production to include clean energy sources, particularly thermal solar and wind power.

Given the rich endowment of natural resources, Central Asia stands to gain from the application of UNFC for meeting its sustainable development objectives. UNFC will be able to aid optimal use of energy, mineral and water resources for the benefit of the people and their prosperity without placing undue pressure on the environment. As the region continues to grow at a fast pace and become more and more industrialized, it will be prudent to have an integrated resource management regime put on place to assure sustainability of the natural resource endowments.

Some of the conclusions and recommendations that arise from this project are summarized in the next sections.

KAZAKHSTAN

In recent years significant changes have been made to legislation of the Republic of Kazakhstan in order to attract domestic and foreign investment for the mineral resource base. They have started the transition from the State Commission classification of mineral reserves to international classification systems.

The transition to CRIRSCO classification system of solid minerals is also being performed in Kazakhstan. In 2016 the country became the 10th member of CRIRSCO. Moreover, it is planned to use the SPE-PRMS system for classification of hydrocarbons.

UNFC is being tested for classifying geothermal resources. The classification system of groundwater has not been changed. The possible reason is that there is no unified system of classification of groundwater reserves. Under present conditions, groundwater, as an integral part of water resources and as the most precious mineral, is an important strategic resource for water supply security and sustainable development of any state. Groundwater is the most extracted raw material in the world with a total water withdrawal of about 982 thousand m^3/year (31.14 thousand m^3/second). The annual renewable resource amount is 12,700 thousand m^3/year (402.7 thousand m^3/second). In the 20th century, the extraction of groundwater increased by five times.

Taking into account the world experience, groundwater reserves are considered mainly as a source of freshwater to ensure drinking water supply. According to the UN experts, in the 21st-century water will become a more important strategic resource than oil and gas, as one ton of freshwater is already more expensive than oil in arid climate (in the Sahara Desert and in North Africa, in the centre of Australia, the RSA, the Arabian Peninsula, Central Asia).

The lack of clean, fresh surface water makes many countries use groundwater resources more actively. The reason is that groundwater, as a source of water supply, has a number of advantages in comparison to surface water. Groundwater usually has better quality; it is better protected from pollution and contamination; it is not subject to seasonal and long-term fluctuations, and in most cases, groundwater does not require expensive treatment. During last 25-30 years, more than 300 million wells have been drilled in the world for water production. In many European countries (Belgium, Germany, Hungary, Denmark, Romania, Switzerland), groundwater use exceeds 70% of total water consumption. In Denmark, Lithuania and Austria, groundwater is the only source of fresh water for the population.

The problem of ensuring water security in the situation of limited and vulnerable surface water resources is an important component of the national security programme of the Republic of Kazakhstan. According to expert assessment, as a result of rapidly growing water demand and a reduction of sustainable water reserves, the lack of water is expected to be 13 thousand m^3 by 2030, and by 2050 it can reach 20 thousand m^3 (70% of water demand). The most acute problem is the unsatisfactory state of the drinking water supply of the population. Groundwater is the only strategic water resource in the country in this situation.

The total amount of inferred groundwater resources is 2038 m^3/second (64.3 thousand m^3/year or 62.7% of the average long-term surface water resources). The inferred fresh groundwater resources are estimated at 1282 m^3/second (40.4 thousand m^3/year). More than 1.5 thousand groundwater deposits have been explored in the country; the amount of the proven operational reserves is 488 m^3/second (15.4 thousand m^3/year or 38% of the inferred freshwater resources).

Thus, in order to solve the problems of drinking water supply hydrogeologists should establish clearly the amount of water of the desired quality that can be extracted from the productive aquifer without harming the environment or minimizing the damage during the estimated period.

It seems relevant to develop a special UNFC for groundwater which will be used all over the world and will provide groundwater resource classification, reporting and management systems.

An important task of the development of the mineral resource complex of Kazakhstan is to increase the resource base of solid minerals and hydrocarbons. UNFC-2009 can create the most favourable conditions for investors.

The special significance of UNFC-2009 is that this classification is based on three fundamental criteria – the economic and social viability of the project (E), the status and validity of the field development project (F) and geological exploration (G) – using numerical and linguistic independent coding schemes. It is noteworthy that unlike other (numerous) classification systems, the UNFC is applicable to any emissions of mineral raw materials, as well as to renewable energy sources and anthropogenic resources.

This is due to the fact that the UNFC takes into account the maximum number of factors when evaluating any objects.

Given that in the modern world, the number of multi-resource companies operating in different countries is growing, the need for a unified classification system is obvious. UNFC-2009 is the first version of the Classification at a level where general principles are established, and which can serve as the basis for international research in the field of energy and minerals.

UNFC can be a tool for global accounting of mineral resources, which ensures the comparability and compatibility of various classifications used today in Kazakhstan and other countries. Of course, it will be advisable to use the UNFC at the level of state planning and subsoil management. In this case, taking into account national characteristics, it is necessary to take into account international experience in integrating the national system in the UNFC, in particular the experience of the Russian Federation, which was the first to implement the integration process in the UNFC, while they did not blindly copy and implement this system, but adopted the so-called transitional document taking into account its specifics and the unified internal system for estimating reserves already existing there.

Constraints in the use of UNFC

Limitations in the use of the UNFC include the need for significant adjustment of national legislation both in Kazakhstan and in other countries. And this process, as you know, always happens very slowly.

A difficult question is the responsibility of the Competent Person for the results of his evaluations. There are unclear questions about the methods of verification of reliability, as well as the system of responsibility for inaccurate assessments of objects by Competent persons.

The legal provisions existing in Kazakhstan today, enshrined in the Constitution of the Republic of Kazakhstan, speak of the ownership of minerals, described as “the property of the people”. Therefore, for the implementation of the UNFC, it is also necessary to develop mechanisms of state control in this area.

In this case, it is necessary to take into account precisely the national interests of our country, first of all, to increase environmental and environmental requirements, as well as the norms of social responsibility of subsoil users.

Also, when introducing and unifying systems, it is desirable to establish the priorities of national legislation over the proposed international legal provisions in this area.

Given the lengthy work of state bodies in the field of improving legislation and creating a base of by-laws, the introduction of a new system may take a long period of time.

Benefits in using UNFC for alignment to SDGs

The advantages of using the UNFC to estimate mineral reserves include the possibility of using it to increase the investment attractiveness of our country in the eyes of the world community within the framework of common reporting standards.

It should also be noted that using the UNFC reporting system is able to ensure the transfer of stocks and resources from one system to another, for example, from the SCPC system to the SPE-PRMS system.

The UNFC can also serve as the basis for harmonizing national valuation systems and national regulatory systems with international systems and help integrate the national system in the international market. Moreover, reporting on the basis of the principles of socio-economic feasibility will ensure the construction of rational consumption and production models.

Improving the level of scientific and technological development is achievable by introducing the best world experience in this area through the introduction and integration of the UNFC.

Also, in the context of globalization, the UNFC can serve as a system for harmonizing the global exchange of information, since, being an integral set of common rules, it will facilitate the paths of global communication, will lead to the revitalization of global partnership mechanisms for sustainable development.

General principles and reporting mechanisms will help to significantly increase the efficiency of development of the sphere of mining by increasing investment attractiveness.

All this should lead to a significant development of the exploration and mining sectors, and this, in turn, to the sustainable development of the country's economy, increase the level of employment and welfare of the population.

Thus, the benefits of using UNFCs are fully consistent with the Sustainable Development Goals. and will help ensure that four of the seventeen SDGs are achieved: on promoting sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all; on creating a solid infrastructure, promoting inclusive and sustainable industrialization and innovation; on providing rational patterns of consumption and production; on strengthening the means to achieve sustainable development and revitalizing global partnership mechanisms for sustainable development.

KYRGYZSTAN

Having the rather small territory, the Kyrgyz Republic possesses a considerable mineral base of many kinds of mineral resources. There are tens of mining and mining-metallurgical operations, open pits, mines at deposits of gold, mercury, antimony, tin, tungsten, coal, oil, gas, salt, facing stones and construction materials, underground fresh, mineral and thermal waters. The mining of rare-earth metals, copper, silver, bismuth, molybdenum, aluminium, uranium, thorium, vanadium, iron, semiprecious and precious stones is in the long term planned. Their commercial reserves have been prospected and prepared for development or can be prospected and prepared for development in the shortest time.

Despite considerable problems connected with reorganization of the economics of Republic for the market relations, the majority of enterprises of the mining and mining-metallurgical sector have saved production, personnel, and the developed infrastructure adequate to modern requirements. They have business ties with the consumers of their commodity inside the republic, from countries of CIS and long-range foreign countries in Europe and Asia.

Mineral raw materials of many deposits and mineral commodities have an export orientation and ensure the strong position of Kyrgyzstan on the world market of mineral raw materials and metals, owing to the fact that quality of commodity produced at the mining-metallurgical enterprises (gold, antimony, mercury, rare earth elements, uranium, molybdenum, tin, tungsten, fluorspar etc.) has the world standards and stable demand. It gives some advantages to Kyrgyzstan in competition with the producers from CIS countries and other countries of the world, requires fewer efforts to retain the reached positions on traditional kinds of mineral raw materials and metals, and also to enter the world market with new kinds of commodity.

The diverse raw mineral materials base of the republic with considerable mineral reserves and good technologic characteristics of ores used by world industry allows successfully and profitably to implement many mining projects with engaging of the foreign investments and international mining corporations having modern management and high technologies.

The priority of the future development of the mining sector in long-term measurement is predetermined in rather high potential of mineral resources and that 80% of the territory of Kyrgyzstan is occupied by highland, where other industries cannot successfully develop.

Because of market conditions, the approach to exploration and preparation for the industrial development of mineral reserves has been changed, taking into account present conditions of the world market. Mineral deposits, where there is a possibility to single out areas for mining rich and easy-enriching ores for first years, have priority because it allows a decreasing period of repayment of credits obtained for construction.

The value of mineral raw materials of mineral deposits in Kyrgyzstan is in tens billions of US dollars. It allows in a long-term outlook through the development of the mining industry, to strengthen the economy of the republic, to create thousand new working places and to provide an inflow of considerable receipts into the budget.

The long-term projects of the mining sector attract considerable credits for construction for new mines, as the mining-metallurgical sector is an object of long-term interests of large multinational mining companies and financial structures. The development of the mining-metallurgical sector guarantees the creation of new working places in allied industries of economics: construction, transport, power engineering, communication, services, delivery of goods; promotes the

development and maintaining of infrastructure in regions of mines' activity, that is very important for some remote areas of the republic.

The value of the contribution of the mining industry into the economics of republic is well visible on an example of gold mining and other mining-metallurgical enterprises. They provide currency earnings and tax revenue, creation of new working places in the mining and allied industries, development and support of the regional infrastructure, increasing of export and gross domestic product.

The UNFC Case Study demonstrated that the system serves as a tool for global information exchange that can be applied at all mining activities, covering solid mineral and energy resources, including oil, natural gas, coal and uranium.

The application of the UNFC will ensure the harmonization of terminology and definitions by using an effective digital coding system that applies to all types of fossil energy and mineral reserves and resources, which will allow access to the international stock market and, therefore, will increase the overall investment climate in the Kyrgyz Republic.

The main advantage of the UNFC is that it provides a common framework for the solid mineral and oil and gas sectors, for which classification systems have been developed independently of each other.

In the Kyrgyz Republic, as in other Central Asian countries, there is no single classification for energy and mineral resources, so the adoption of the UNFC will provide an opportunity to combine the two largest industries of the Kyrgyz Republic, which will form a single picture of all mineral and hydrocarbon reserves.

In addition, the adoption of the UNFC will provide the opportunity to obtain accurate information on the availability of all non-renewable resources, and thereby assist in the development of appropriate long-term energy strategies.

The basis of reserves classification of the Kyrgyz Republic is the classification inherited from the time of the USSR. At that time, social, environmental and several similar features were not considered important. The main objective was to provide the necessary raw materials for processing plants and industrial complexes.

The UNFC, in comparison with the system for applying the classification of reserves in the Kyrgyz Republic, has several disadvantages. The main one is the fact that in the UNFC, the main emphasis is focused on the economic indicators of deposits, while the geological feature of each object is unique and special in its own way. So, in the system for applying the classification of reserves in the Kyrgyz Republic, the grouping is applied based on the complexity of the geological structure, which determines the direction of further development of the deposit regardless of the degree of exploration.

Practice shows that the further development of deposits entails a number of other important problems. In Kyrgyzstan, protests by local residents against the development of deposits are not rare. This aspect, recently, has become regular, which complicates further investment. In our opinion, nowadays, it is one of the important points in classification or grouping of deposits. Especially for the Kyrgyz Republic, this aspect should be considered as one of the subclauses of deposits classification.

As stated above, this world requires special attention to the social, environmental consequences, as well as the introduction of safer and more technologically advanced production systems. The adoption of the UNFC in Kyrgyzstan will lead to improvement of the investment climate, which would make it possible to advance towards the achievement of SDGs 7 and 9. In addition, an increase in investment flows will directly affect the social status of the people, which will advance the achievement of SDGs 1, 2 and 8.

The environmental aspect will not change as a result of the implementation of the UNFC, but attracting investment in renewable energy can lead to faster achievement of SDGs 11 and 13. Therefore, the implementation of the UNFC system should be coherent. A complete abandonment of the current system of the National Classification of Energy and Mineral Reserves and Resources and the transition to the United Nations Framework Classification System for Energy and Mineral Reserves and Resources takes time because it requires a reanalysis of all geological and technical-economic materials left over from the USSR.

Currently, the Kyrgyz Republic uses the separation of deposits according to the prospective and quantitative reserves of deposits in national significance.

- Competitive objects are objects that have reliably estimated reserves (for example, at least 10 tons of gold) and ready for industrial development;
- Auction objects are objects that have prospects for further industrial development or geological exploration, which have previously estimated or reliable reserves;
- Objects that issued on request of subsoil users. These objects should be free and should not enter the territory of competitive, auction objects and the territories of other subsoil users.

It is necessary to carry out an assessment, namely, of the competitive objects, as well as renewable energy objects of the Kyrgyz Republic according to the UNFC system. Competitive objects will give a clearer and more realistic picture of the deposit and save time for future investors and the government of the Kyrgyz Republic. It will allow assessing to the risks and economic efficiency of investing. Moreover, renewable energy objects on the territory of the Kyrgyz Republic require urgent investment.

The application of the UNFC system in the Kyrgyz Republic would give positive dynamics in the development of the country's mining sector. As mentioned above, a complete transition to the UNFC system takes time. The issue of adaptation and successful implementation of the UNFC in Kyrgyzstan requires optimally close interaction between the state and the subsoil user and the corresponding geopolitical, economic and technological platform.

An assessment by the UNFC system of large energy and mineral objects of the country will make it possible to attract large bona fide investments in the development of the country's economy. In my opinion, it is worth noting that when applying the UNFC in Kyrgyzstan, certain classes should be distinguished according to the assessment of environmental and social impacts, because when implementing projects in Kyrgyzstan, there is an acute problem with solving these problems.

In addition, as mentioned above, sector of renewable energy sources (RES) in Kyrgyzstan is poorly studied. The start of the UNFC implementation in Kyrgyzstan should begin from this sector of the industry, as currently there are no classifications in this field. The implementation will be simpler, and by using this example, the state will gain some experience on working with the UNFC, which will be useful in the future.

For the implementation of the UNFC in Kyrgyzstan the harmonization procedures of the National Classifications of the Republic with the UNFC should be launched. In harmonizing of the classification, particular attention should be paid to the specifics of the mining and energy industries in Kyrgyzstan. It is necessary to consider the social and environmental problems of Kyrgyzstan. In addition, in parallel with the harmonization of classification, the state should bring into conformity some subordinate legislation of the Republic.

The next, but no less important step for the implementation of the UNFC is the preparation of a Bridging Document, which explains the relationship between the UNFC and the classification system obtained by harmonization and approved by the UNECE experts group.

When implementing the UNFC in Kyrgyzstan, it is important to take into account the experience of countries that have already implemented this classification system or working in this direction. Especially, it is necessary to pay attention to the experience of implementing of CIS countries (Russian Federation, Kazakhstan, etc.).

The application of the UNFC in this field will help to harmonize the regulatory framework of the Kyrgyz Republic in the shortest time. In addition, the application of the UNFC will allow getting more accurate information on the potential of the Kyrgyz Republic in the field of RES, which will attract investment and allow the development of this sector.

The start of the UNFC implementation in Kyrgyzstan should begin with renewable energy because now there are no established classifications in this area. The implementation will be simpler, and on its example, the government will gain some working experience with the UNFC, which come in handy later.

TAJIKISTAN

In Tajikistan, solution of challenges related to the low energy efficiency of the economy of the republic is required; the need to ensure sustainable energy and fuel supply of the population and industry; reduction of anthropogenic impact and loads of the fuel and energy complex on the environment; ensuring reliable energy and economic security.

To ensure the stability of energy and fuel supply in the republic, the following issues must be solved:

- development of a long-term forecast of the energy needs of the Republic of Tajikistan and possible ways to ensure them;
- development of fuel and energy and water resources, creation of an appropriate infrastructure with the attraction of state and foreign investments;
- on the basis of a long-term forecast, the conclusion of long-term bilateral and multilateral interstate agreements between producer and consumer countries for the supply of energy resources with the mutual commitment of the parties to implement these agreements;
- restoration of the functioning of unified systems of gas, oil, coal, electricity;
- improving the regulatory framework for the free movement of capital, labour and technological equipment between the fuel and energy complexes of the partner countries;

- development and rational use of the mechanism of relations in the markets of foreign countries, taking into account the mutual interests of the partner countries;
- solving personnel problems of the fuel and energy complex;
- creating conditions for the growth of national and foreign investments in the fuel and energy industry.

The named measures are the first necessary steps in solving the problem of energy supply of the national economy of the republic and creating the basis for stable and sustainable economic growth.

The UNFC Case Study proves that a systematic approach to SRM can provide a closer integration of policies, especially programmes of sustainable development of a country or company, in the implementation at the project level. UNRMS is being proposed as a tool that can link policy objectives with project implementation. Such a set of tools is currently unavailable, and this drawback can be largely explained by the constant drawback in translating policy objectives into practical results observed across the globe. UNRMS draws on its experience with UNFC, which classifies resources into different classes according to three main criteria: socioeconomic viability (E), technical feasibility (F) and level of knowledge (G). Thus, UNFC provides a common terminology and classifies resources into projects based on a combination of criteria.

A resource approach to determining the priorities for the development of the export potential of the industry of the Republic of Tajikistan in modern conditions, when there is an active process of integration of the country into the world economy, the role of the natural factor in the development of the Tajik economy is growing. It is this factor that should become the driving force of structural transformations, the formation of new specialized industries and ensure economic growth. In this regard, the assessment of the country's natural resources is one of the important components of solving the problem of increasing the export potential of the Republic.

The country's natural resources can be defined as the initial base of production, based on which the national economy is developing. It consists of bioclimatic, fuel and energy and mineral resources:

1. Bioclimatic resources. Tajikistan has unique climate conditions. Climate as a natural resource is an important factor in the development of the entire economy and agriculture.
2. Fuel and energy resources. Tajikistan has unique hydropower resources. The Republic accounts for about 4% of the economically efficient hydropower potential of the globe. The total capacity of all rivers of the Republic is estimated at 32.3 million kW in power or 527 billion kW/h in energy production, of which more than 230 billion kW/h is technically possible and economically feasible today. Based on the foregoing, we can say with confidence that hydropower is the main strategic direction for the development of water resources.
    (a) Oil and gas. The main gas and oil regions of Tajikistan are in its northern and southern parts. In the northern part of Tajikistan, prospects for oil and gas have 25 areas. In the southern part of the Republic, about 125 areas have prospects for oil and gas. According to experts, the total geological reserves of oil in Tajikistan are estimated 467 million t, free gas – 1036 billion m3.
    (b) Coal. In Tajikistan, there are more than 35 coal deposits, for some of the total and industrial reserves are calculated. The balance reserves of coal in the Republic amount to 714.14 million t, and the forecast – 3703.4 million t. Coal Resources in the Republic’s fuel balance account for a large part. Therefore their development can not only weaken Tajikistan’s dependence on imports of gas and oil products but also further facilitate the transition to their export.
3. Mineral resources. The territory of Tajikistan is rich in a wide variety of minerals. Of Ferrous and alloying metals, deposits of iron, tungsten and molybdenum have been discovered in the Republic. Of the non-ferrous and rare metals in the subsoil of Tajikistan, deposits of lead, zinc, gold, silver, copper, antimony, mercury, tin, bismuth, strontium and aluminium raw materials are known. Recently, a large amount of exploration and research work has been carried out, which has allowed identifying deposits of fluorspar, boron, glass sand, rock crystal. Mineral deposits have been discovered for the chemical industry – dolomites, rock salt. The Republic has large reserves of raw materials for the building materials industry – limestone, gypsum, mineral paints, marble, granite, lapis lazuli, spinel, turquoise, amethyst, garnet, tourmaline, sapphire, etc.

However, all the resources of the Republic are used in scanty volumes, and some are not used at all. Therefore, the main task is the speedy introduction of these rich natural resources into environmentally and economically justified operation.

Thus, the resource approach helps to determine that the priority sectors in the development of the export potential of the industry of the Republic of Tajikistan in the near and distant future can be the electric power industry, coal industry, mining, non-ferrous metallurgy, chemical, light and food industries.

TURKMENISTAN

Turkmenistan's continental and dry desert climate offer tremendous potential for solar power plants. Especially in the regions Kuli, Gasan and the capital, Ashgabat, the surface receives the most usable sunlight in the CIS region. In 2010, Turkmenistan had the world's fourth-largest proven gas reserves, giving it the region's second-largest GDP per capita and foreign direct investment. Due to natural gas being almost the only source for power generation, very low subsidized retail electricity tariffs and the absence of a legislative framework, the share of renewable energy in the overall installed capacity is only 0.18% – the lowest in the region.

Turkmenistan's current and future economy is highly dependent on crude petroleum and natural gas exports; therefore, the country is actively searching for new routes to export natural gas. The TAPI pipeline is in progress; however, the country faced some issues that could prevent this project from being completed on schedule.

Turkmenistan continued to focus on the development of the nonhydrocarbon mineral sector. Some signs of the emphasis on the nonhydrocarbon sector are Turkmenistan's investment in chemical and construction material plants, modernization of the existing iodine and bromine plants, and the construction of a potash-processing plant; the investment is likely to result in production increases for these minerals during the next few years.

In policy documents on climate change mitigation, the Turkmen Government aims to increase renewable energy generation, but a legislative framework to promote and support investment in renewable energy does not yet exist. The Second National Communication of Turkmenistan under the United Nations Framework Convention on Climate Change calls for a National Development Programme for Renewable Energy Sources in Turkmenistan until 2010. The programme will increase the utilization of renewable energy sources.

In June 2012, the President approved the National Strategy on Climate Change, which was presented at the World Sustainable Development Summit: Rio+20. The strategy outlines the country's long-term vision for promoting renewable energy and low-emission development of the economy. The government is now preparing two actions plans on mitigation and adaptation in support of the strategy implementation. These plans were expected to be approved and launched in 2014. In line with the strategy, the government decided to create a National Climate Change Fund to finance climate change mitigation and adaptation projects, including renewable energy generation.

Given the complex resource development challenges in Turkmenistan, the country can benefit from the application of UNFC. The system will ensure that resource endowments are development in a balanced and integrated manner and assure protection of the fragile ecosystems. The actions will also support the attainment of commitments to climate action and help make progress towards a circular economy.

UZBEKISTAN

The strategic goal of the state policy in the geological industry is rational use, economic rehabilitation and conservation of the mineral and raw material potential of the Republic and focus on the implementation of a consistent administrative and management reform in Goscomgeology.

The Republic has enough reserves of the main types of minerals: gold, uranium, copper, lead, zinc, potash fertilizer, phosphorite, oil-gas, etc.; as well as for geological exploration and increasing the reserves of the main types of minerals.

The works for the harnessing of green - renewable resources are carried out in high gear. For the first time in the history of Uzbekistan, the projects for solar power generation on an industrial scale (with a capacity of 1000 MW) are considered. The construction of 2 NPP units is planned. To do this, the country has sufficient reserves of uranium.

The low degree of geological knowledge (or practical lack of knowledge) of certain types of mineral raw materials, the absence of adverse geographic and economic, mining and technical and other conditions, as well as nonsufficiency of the adequate technological solutions in matters of geological exploration, production, enrichment and processing of mineral raw materials, necessitates assigning relevant tasks to geological surveys.

- Works for the development of deposits (which are currently not being developed), with the attraction of foreign investments for geological exploration and mining, are underway.
- Training of national competent persons in the main areas of minerals.
- Phased transition to the assessment of deposits by the UNFC to attract potential investors.
- Work is underway to train national personnel - "competent persons" for all types of minerals.
- Currently, a list of gold deposits is being compiled for the transition or revised estimation under the JORC classification.

Application of the UNFC in the exploration industry of Uzbekistan will require a reassessment of solid minerals reserves of all previously explored and being explored deposits based on the criteria of a market economy. Similar works are already being carried out at the facilities of existing mining and metallurgical plants. And also, during 2019, additional

studies on the Tebinbulak iron deposit are conducted according to international reporting standards (they are already being completed); that will increase the reliability of the facility.

Significant scales and broad prospects for the development of the mineral resource base of the Republic with the existing developed infrastructure based on the application of the latest techniques and technologies of subsoil integrated geological exploration, as well as attracting capital of republican and foreign investors on mutually beneficial conditions, will achieve maximum results from the use of natural resources of Uzbekistan.

In connection with the above, the country is very interested in the application of the UNFC system. Yet when deciding on the adaptation of the Uzbek classification to UNFC, the great responsibility is placed on the prospect evaluation – first of all, objectivity, with provision for the mining parameters of the object, especially such huge objects as the Tebinbulak deposit.

Currently, the lack of national staff for the UNFC system implementation restricts its widespread use. At this time, some works are underway in the industry for capacity building.

In order to eliminate restrictions, the annual programme of development and reproduction of the mineral resource base of the Republic of Uzbekistan provides for training. And also, appropriate budget allocation is provided. When training personnel, selection requires the coverage of qualified geologists from all territorial regions of the industry.

The main benefits of UNFC application for harmonization with the Sustainable Development Goals are:

- As the economic development of the country on the fast track, UNFC is the only classification for international research;
- The adaptation of the national classification with UNFC is carried out without special efforts, on the condition of availability of certain knowledge (geological, the economic priority of the country, completeness of minerals development, resource conservation, normative legal documents of the industry, etc.);
- For the active policy of attracting foreign investments in the mining and geological sector of Uzbekistan, the UNFC system offers advantages.

CONCLUSIONS

UNFC is a project-based classification and management system applicable to all energy and mineral resource projects including renewable energy, anthropogenic resource projects as well as underground storage projects, including CO_2 storage. The key advantages of UNFC are:

- A single, language-independent, numerical framework to report all extractives - petroleum and minerals
- Alignment and harmonization with common industry used systems such as Petroleum Resource Management System (PRMS) and the various Committee for Mineral Reserves International Reporting Standards (CRIRSCO) family of codes
- Applicability to solids, liquids and gases, especially minerals produced from fluids such as lithium and potassium brines, which are not included in the CRIRSCO family of codes
- A full accounting of in place and recoverable quantities including, commercial quantities, quantities for non-commercial use, sub-economic and technically non-recoverable quantities and waste which can aid long-term investment decisions making and planning
- Applicability to Injection Projects such as Carbon Capture and Storage (CCS), thus making integrated clean energy projects easier to report
- Applicability to renewable energy projects, thus aiding unified reporting of hybrid energy projects
- Applicability to anthropogenic resources, for supporting the circular economy in extractives
- Applicability to groundwater resources, thus connecting to the food-water-energy nexus
- Unified reporting of all resource assets, extractive and non-extractive; tangible and intangible
- Unique for guidelines on social and environmental aspects and alignment to Sustainable Development Goals, thus embracing the aspirations of the modern society towards good social, environmental and economic outcomes
- Alignment with the global System of Environmental-Economic Accounting (SEEA), which is being adopted by all countries for reporting national resource accounts and uses UNFC for extractive accounts
- Integration of financial reporting with other areas of resource management such as policy making, national resource governance and company business process innovation
- Governance structure under a UN ECOSOC mandate combining efforts of Governments, industry and professional societies
- Alignment with the requirements of resource management at regional levels of European Commission and African Union Commission and many national governments.

UNFC is a voluntary system used by countries, companies or individuals from the sustainable management of energy and mineral resources. UNFC is developed by the United Nations Economic Commission for Europe (UNECE) with more than 70 years of experience in resource management in Europe and specifically in resource classification for more than 25 years. UNFC has been recommended for worldwide use by the United Nations Economic and Social Council (ECOSOC), one of the six main organs of the United Nations.

UNECE's Expert Group on Resource Classification (currently being renamed as Expert Group on Resource Management) is responsible for the development of UNFC. The Expert Group is an advisory body that reports to the Inter-Governmental body of UNECE, the Committee on Sustainable Energy. The Expert Group is an open platform, which has the participation of over 300 individuals on their own or representing international organizations, professional associations, governments from over 80 countries, regional bodies such as European Commission, African Union Commission, civil society organizations, academic institutions and the industry.

Since the adoption of 2030 Agenda for Sustainable Development or the Sustainable Development Goals (SDGs) in September 2015, managing energy and raw material resources in a sustainable manner has become paramount to all stakeholders such as Governments, companies and investors. This has to be read along with the Paris Climate Accord, which seeks low-carbon pathways in the appropriate strategies.

Classification of resources is the basis on which such policies are formulated – Governments manage their resources, industry conducts its business and capital is allocated. None of the SDGs can be reached without energy and raw materials, yet it is known that environmental impacts result from the deployment of these resource projects regardless of how it is done. Therefore, the efficient use of resources becomes increasingly important under the prevailing trends of the day. There is a need to focus on the mechanisms that give the efficiencies required to create an acceptable future for an increasing world population coming out of poverty.

Successful resource management requires relevant information on the resource base, understanding of the factors that are responsible for progressing the resources to production, adequate framework conditions set by Governments and

society and enterprising capacity, also termed integrative dynamic capabilities in the public, private and financial sectors.

UNFC delivers on the above requirements. It is built to house resource inventories, and it focuses on “what we get” and not on “what we found” although quantities in place are part of it. Under the UNFC scheme, the information is carried by the project, not the deposit. The focus of UNFC is on the quantities that the project will yield in the form of sales and non-sales production and how much will be left in the subsoil or not used. UNFC inventories are constructed by categorising separately the economic, social and environmental conditions for development, their industrial status and the uncertainty with which the quantities are defined. The projects themselves carry other important management information such as time series of production, emissions, costs, labour etc.

UNFC not only includes projects information as above but is the only system that uniformly applies these principles to all resources – minerals, petroleum, renewable energy, anthropogenic resources and injections projects for geological storage. Such integration is crucial to the future, where sustainable development and carbon neutrality weigh in as overarching requirements. Search for acceptable pathways will depend on integrated resource management projects rather than fragmented models of the past. This is already happening in many places with combinations of off-shore petroleum and wind energy, mining and solar energy, etc. In the future, tighter integration of fossil fuel production, utilization and carbon capture and storage (CCS) will be a requirement. UNFC provides the model for this integration to be portrayed seamlessly.

UNFC is also aligned with resource development/production value-chain. This is particularly useful since a chain is no stronger than the weakest link. Often, a gap reverberates throughout the system and makes it dysfunctional as a whole, especially in an age where new social, environmental, and economic realities dominate. A barrier or contingency regarding socio-economics, technological maturity or level of understanding could ripple up or down the value chain in an asymmetric manner. Understanding, avoiding and mitigating these impacts is essential throughout the life-cycle of a resource project.

Success relies on having globally comparable data – which could be a great push for increased efficiency in policymaking, in Governmental resource management as well as for the industry in different regions of the world operating in the same markets and through appropriate financing from the international capital markets. It has been argued that the use of UNFC being a tool for resource management is necessary to reach all SDGs, and in particular 7, 9, 12 and 13.

UNFC is bridged to the classifications most commonly in use, such as CRIRSCO, PRMS and national systems in Russia and China. The adaptation of UNFC is currently expanding exponentially with significant progress in its application in Europe, Africa and elsewhere.

UNFC has been adopted widely in many countries. African Union Commission has the initiative “UNFC for Africa”, to develop and implement a unique continental system for the sustainable management of mineral and energy value chain in Africa. This will be applicable for the 55 countries in Africa, which mostly do not have national systems for the classification and management of resources. Accordingly, the African Mineral and Energy Resource Classification and Management System (UNFC-AMREC) is being designed and is likely to be finalized by 2019-2020. This system applies to mineral, oil & gas, and renewable energy. UNFC-AMREC will also incorporate the Pan-African Resource Reporting Code (PARC) for public disclosure requirements.

“UNFC for Europe” is an initiative of the European Commission for harmonizing the classification and management of raw material and energy resources in Europe. Several Horizon 2020 projects have work packages to test and implement UNFC as the resource management framework in Europe.

“UNFC for the Americas” is proposed as a comprehensive system sensitive to indigenous cultures and diverse environments of the Americas. Drawing upon the experiences of the pilot study that is being carried out in Mexico, Association of Ibero-American Geological and Mining Services and Latin American Mining Organization (OLAMI) are pursuing the development and implementation of a Latin-America-wide system.

“UNFC for Eurasia and the Asia-Pacific”, connecting the vast and diverse Eurasian landmass and Oceania is also under discussion. Already, UNFC bridging has been carried out for Russia and China. India is considering updating its UNFC-1997 based system to the current version of UNFC. Philippines has recently remarked that its JORC based Philippine Mineral Reporting Code (PMRC) is inadequate to meet the current aspirations for resource development, and hence could be seeking to replace it with UNFC. There are initial discussions in Australia led by Geoscience Australia to have a common framework for Australasia.

Recently, the relevant inter-governmental bodies in UNECE has approved the expansion of UNFC to United Nations Resource Management System (UNRMS). With the development of UNRMS, which will have UNFC at the core, it is expected that all stakeholders – Governments, Industry, Financial Institutions and the Civil Society Organizations – will find a universal system that can steer resource production as a sustainable activity, acceptable to all.

UNRMS will provide a “global workspace”, which will aid the analysis and understanding of the non-linear impacts of several factors, clustered along the socio-economic and environmental, project feasibility and level of knowledge aspects and use it for effective decision making. This will not only make the resource value-chain resilient but also capable of gaining from exposure to uncertainties, which are increasingly likely in the future. The future uncertainties lie in the manner the future technological revolution is unfolding, sometimes called the “fourth industrial revolution”. It also lies in policy implications such as carbon prices and other potential events that may drive investors away, for example, from fossil energy and accelerating investments in decarbonization technologies. In such fluid and volatile scenarios, UNFC-UNRMS will be opportunistically placed to support resource management effective manner suited to company, national and regional requirements.

The application of UNFC and UNRMS holds immense promise to resource-rich Central Asia region. The region can benefit from the adoption of UNFC and UNRMS as harmonized systems for the integrated and sustainable management of all natural resources. The application will promote good social, environmental and economic outcomes for the region.