Integrated energy and water resource management in support of sustainable development in South-East Europe and Central Asia

Case study on the application of UNFC to energy and water resources of Kyrgyzstan

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Summary

The Case Study, "Application of the UNFC to Energy and Water Resources of Kyrgyzstan", sets out the vision of national consultants in the UNECE project entitled "Integrated Energy and Water Management in Support of Sustainable Development in Southeast Europe and Central Asia".

The project aims to develop a management and monitoring tool focused on the interconnection of energy and water systems and helping to manage the impact of energy production on water systems.

The case study concluded that:

- The UNFC can serve as a global information exchange tool that can be applied across all mining activities, covering water, solid minerals and fossil energy resources, including coal;
- The UNFC classification takes into account many factors when evaluating deposits (especially solid minerals), i.e. it gives a multifactorial assessment, which is quite simple to understand, and does not lead to a double interpretation of the situation;
- There is no single classification for energy and mineral resources in the Kyrgyz Republic; therefore, the adoption of the UNFC makes it possible to unite the two largest industries, which will form a single picture of all reserves of mineral and hydrocarbon raw materials.

1. Introduction

The Kyrgyz Republic is a typical mountainous country; about 43% of its territory is located at altitudes over 3000 m above sea level and only about 15% at altitudes below 1500 m. There are no marks below 500 m above sea level. The mountain ranges are separated by intermontane depressions and the Issyk-Kul lake basin. Powerful mountain ridges, with the exception of the Trans-Alai (Zaalai) Range, constitute a single western part of the Tien Shan mountain system.

The complex and long-term geological development of the Kyrgyz Tien Shan has created a wide variety of geological complexes, geodynamic settings and favourable conditions for the formation of various mineral deposits.

The Kyrgyz Republic has significant potential for many types of mineral raw materials. For the almost 80-year history of geological research (since the formation of the Kyrgyz Geological Administration in 1938), about 20 thousand deposits and ore occurrences of more than 150 kinds of various mineral resources have been identified by geologists on its territory. The mining industry in the country has always been one of the leading industries [4].

All minerals of the Kyrgyz Republic can be combined into four large groups - combustible, metallic, non-metallic, groundwater (including curative mud).

The following fossil energy resources - coal, oil, gas, peat - have been identified from combustible minerals on the territory of the Kyrgyz Republic.

Uranium and thorium are extracted from metallic energy resources as fossil energy resources and from groundwater the distinguished thermal waters.

Energy, coal and water are interconnected and interdependent and are the basis for promoting sustainable development of the country. The project aims to develop an integrated management and monitoring tool focused on the interaction of energy and water systems and to assist in managing the impact of energy production on water systems and can help identify best practices and measures to apply an approach to energy and water resources management.

Energy resources

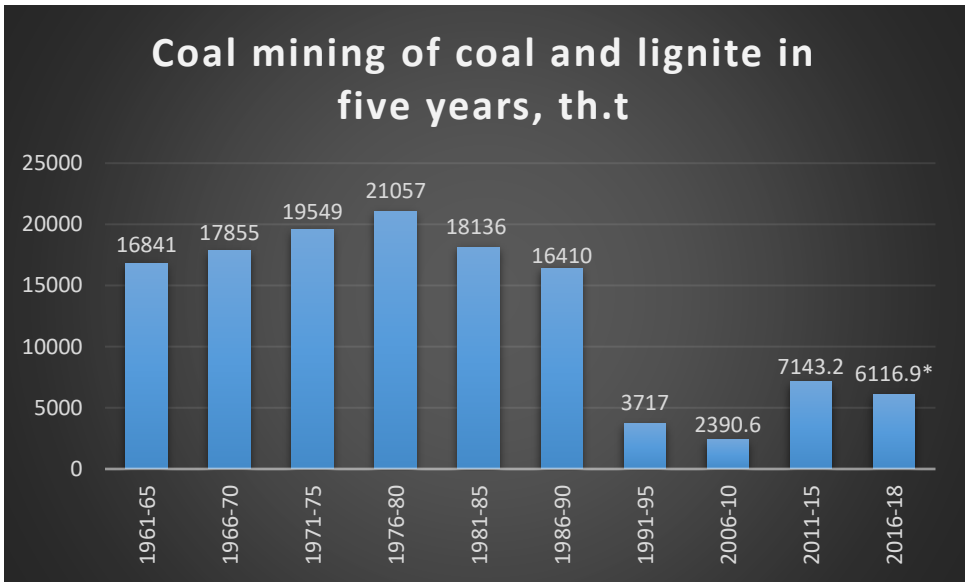
At present, one of the main priorities for Kyrgyzstan is the country's energy security, since Kyrgyzstan imports hydrocarbon raw materials from other countries, and its own coal reserves allow ensuring energy security, the number one priority is the development of its own deposits.

In the modern fuel and energy balance of Kyrgyzstan, fossil coal plays a leading role, accounting for more than half of energy resources. The bulk of the resources and reserves of fossil coal are concentrated in the south of the Republic.

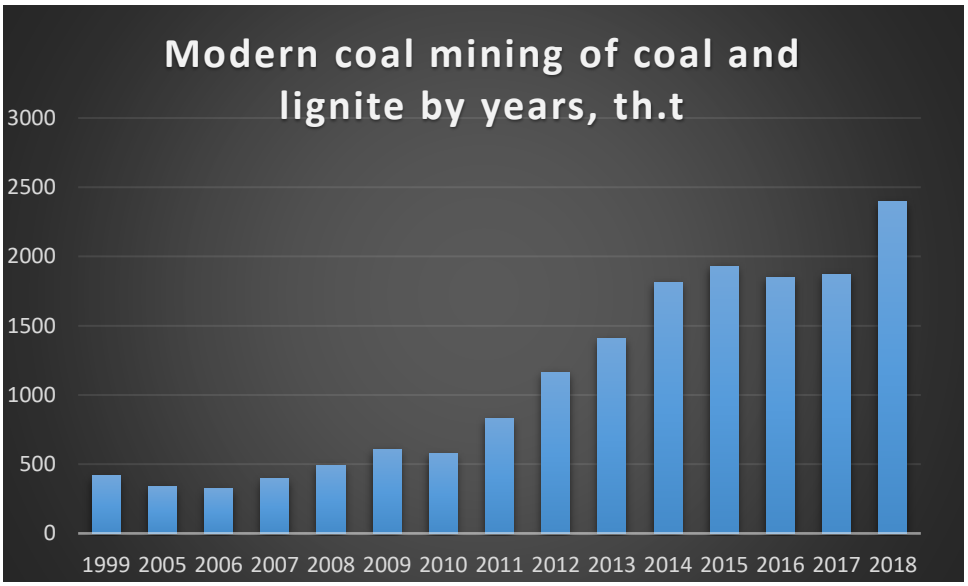
Kyrgyzstan has limited oil and gas resources, and coal is the main fuel. The coal industry is an integral part of the industry of Kyrgyzstan, which includes a complex of organizational, technical and technological processes associated with the search, exploration, storage, processing, transportation and sale of coal and its products.

In the Kyrgyz Republic, the reserves of 70 main coal deposits are estimated at more than 2.2 billion tons. On the territory of the Kyrgyz Republic, coals occur in the form of sheet-like deposits, interlayers or lenses in sedimentary strata of the Jurassic age. Coals are the most valuable raw material for the metallurgical and chemical industries and are widely used as fuel.

The exploitation of known deposits began at the end of the 19th century, and for some (Kok-Yangak, Tash-Kumyr, Sulukta, Kyzyl-Kiya), coal has been mined intermittently for 100 years. Over the 100-year history of operational work, there have been ups and downs in coal mining in the Republic [8, 13]. Now, reserves of small deposits or local areas are involved in the production.

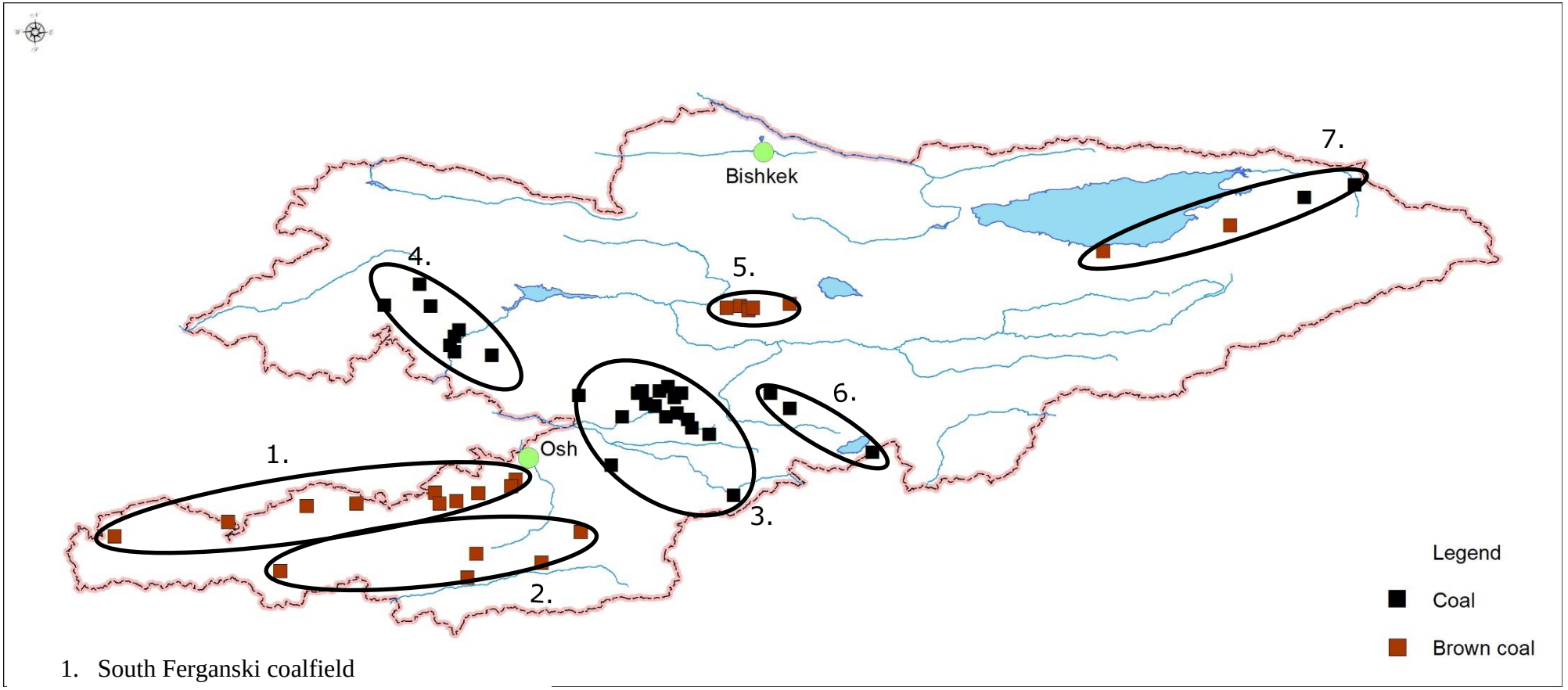


*- only three years



It can be predicted that the demand for coal in the medium and long term will grow steadily. In connection with the construction of an alternative North-South road and the construction of the China-Kyrgyzstan-Uzbekistan / Kazakhstan railway line, the country will become a major exporter of energy fuel in Central Asia.

Figure 1. Map of coal deposits



1. South Ferganski coalfield
2. Alai coal area
3. Uzgenski coalfield
4. North Ferganski coalfield
5. Kavakski coalfield
6. Alabuka-Chatyrkulski coal area
7. South Issyk-Kul coal area

The most widespread type of industrial use of coal is its combustion in the furnaces of various power plants (in particular, for residential heating premises in the winter season).

Building several of the thermal power station (TPS) are planed close with coal deposits.

Oil and gas.

The prospects of the territory of the Kyrgyz Republic for hydrocarbon raw materials are due to its location between the largest Chu-Sarysu (Kazakhstan), Fergana (Uzbekistan) and Tarim (PRC) oil and gas basins. Comparison of stratigraphic, paleofacial and structural features of rock complexes of intermountain depressions of Kyrgyzstan with adjacent territories indicates a great similarity in the conditions of their accumulation, further transformation and the formation of favourable structures for the placement of oil and gas deposits.

The state of knowledge of the intermountain depressions of Kyrgyzstan for oil and gas is generally poor. Geophysical surveys and drilling operations within the depressions of the northeastern part of the country were discontinued in the late 60s - early 70s of the last century. Studies in the south of the country (in the Fergana and Alay depressions), which continued for a little longer, were carried out in limited volumes and mainly covered the upper part of the Meso-Cenozoic cover. Seismic exploration was carried out, as a rule, using old, imperfect methods, and single deep boreholes characterized only local areas of depressions. The geological and geophysical information obtained in this case turned out to be insufficient to decipher the deep structure of the cover and the basement of the depressions and does not allow us to confidently delineate the promising areas of possible detailed oil exploration.

The most studied was Fergana depression. The presence of numerous oil outcrops in its marginal northeastern part contributed to the intensification of prospecting and exploration drilling in the areas adjacent to the fields and sections of the depression with the development of anticlinal structures identified by geological, geomorphological and geophysical methods. In various parts of the Kyrgyz sector of the Fergana oil and gas basin, over 500 wells were drill for various purposes (exploration, structural, parametric, production). The depth of the wells is mainly up to 3000 m. The efficiency of exploratory drilling was found to be low. The main reasons for this are the poor geophysical preparation of the areas for drilling, the study of only the upper part of the geological section of the sediments filling the depression, the focus of work exclusively on the identification of oil and gas deposits of the anticlinal type.

Other depressions were studied at different times, but the results obtained did not allow proceeding to more detailed work, with bringing the oil fields to mining.

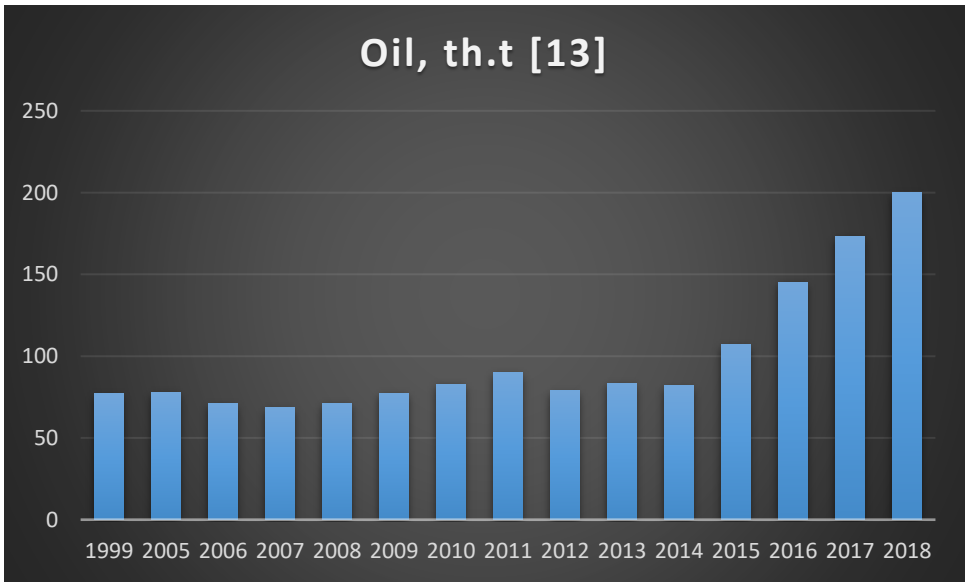
As already noted, proven oil and gas reserves have been established only in the Fergana Depression. 15 oil, gas and oil and gas fields were explored here at different times. All of them have been worked out to some extent. Geological oil reserves of

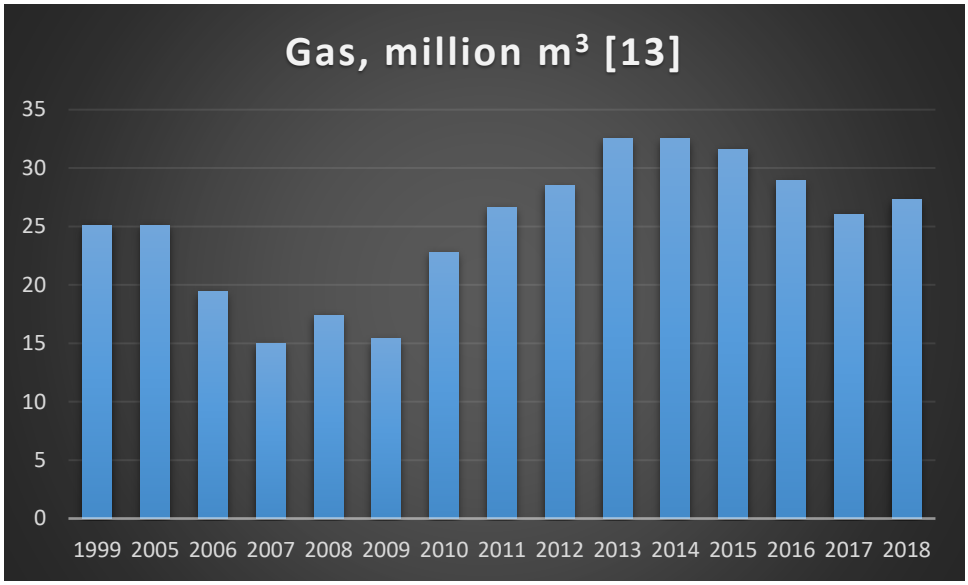
industrial categories currently amount to about 107 million tons, of which only about 13.7 million tons are recoverable, i.e. the degree of recoverability is very low - about 13%, which is associated with both unfavourable reservoir properties of oil-bearing strata and imperfect technology for oil extraction.

Natural gas reserves of industrial categories are about 6.3 billion m3. The predicted geological resources of conditional hydrocarbon raw materials in the Fergana depression at various depths of assessment are from 145 to 260 million tons. They are linked with the possibility of identifying new promising structures in the upper part of the geological section and with an in-depth systemic study of Paleozoic sediments.

Prospective horizons are located at different depths from 200 to 4000-5000 m.

The problem of providing Kyrgyzstan with hydrocarbons remains relevant, determining the effectiveness of economic development. Maximum oil production in 1955 amounted to 490 thousand tons. Explored reserves are located in hard-to-recover deposits, and production has not been significantly increased.





Of course, this amount is not enough [13] when consumed Kyrgyzstan lubricants gasoline and diesel fuel all brands, fuel oil, etc. over 2 million tons, and about 500 million m^3 of gas. With the above production, the Jalal-Abad, Kant and Kara-Balta oil refineries are partially loaded; therefore, the bulk of the fuel is exported.

Peat

Cover of peat on the territory of the Kyrgyz Republic is 0.02% [9]. The largest number of peat deposits is confined to lowland reed-sedge bogs of floodplain areas of the Naryn, Chu, Talas, and Jyrgalan river valleys and their tributaries. Peat deposits are small, with reserves ranging from 3 to 5 million m3. Some of the facilities were previously developed, but a significant number of peat deposits are located in sanitary and protected areas, and therefore cannot be involved in the operation. Therefore, we regard this type of energy resources as potential.

Metal Energy Resources

The metal energy resources within the Kyrgyz Republic include Uranium and Thorium. Exploration and development of these minerals started in the 40s of the last century. In the 1960s and 1970s, work in this area was curtail, due to the discovery of new, easily developed fields in Kazakhstan.

There are tens of uranium deposits and ore-manifestations within the Kyrgyz Republic. Kadzhysai, Kavak, Mailisai, Tuyamuyun, Shakaptar uranium mines have been exploited recently. But for the time being, they are closed. Only two deposit registered by uranium on the State balance.

At present, the Parliament of Kyrgyzstan adopted the Law "On the prohibition of activities related to the geological study of subsoil for the purpose of prospecting, exploration and development of uranium, thorium deposits in the Kyrgyz Republic."

Mining regulations

State Committee for Industry, Energy and Subsoil Use, in accordance with the Regulation on the State Committee for Industry, Energy and Subsoil Use of the Kyrgyz Republic dated July 15, 2016 No. 401. (As amended by Government Decisions of December 12, 2016 No. 653, September 18, 2017 No. 590), "... is the central executive authority responsible for the development and implementation of state policy in the field of industry, with the exception of the food industry (hereinafter - industry), fuel and energy complex and subsoil".

SCIESU acts on the basis of the Constitution of the Kyrgyz Republic (http://cbd.minjust.gov.kg/act/view/ru-ru/202913), the Law of the Kyrgyz Republic "On Subsoil" (http://cbd.minjust.gov.kg/act/view/en-ru/111782), as well as other relevant legislation of the Kyrgyz Republic in the field of subsoil use ("On Oil and Gas" (June 8, 1998 No. 77; As amended by the Law of the Kyrgyz Republic of March 9, 2004 No. 19; May 18, 2012, No. 58; May 29, 2012 No. 74; October 11, 2012 No. 171; February 13, 2013 No. 15; January 20, 2015 No. 19), "On Coal "(February 3, 1999 No. 18; As amended by the Law of the Kyrgyz Republic of June 18, 2005 No. 78; October 10, 2012 No. 170; July 30, 2013 No. 178; July 18, 2014 No. 144), Regulations on State Accounting and Control of water in the Kyrgyz Republic (As amended by the Government of the Kyrgyz Republic on November 4, 1997 N 643; February 25, 2002 N 100), and the corresponding Regulations on the SCIESU.

Water resources

Kyrgyzstan is the only country in Central Asia whose water resources are almost completely formed on its own territory, and this is its hydrological feature and advantages. The Republic has significant water and hydropower resources, and this is one of its main wealth.

The hydropower potential of the rivers is about 174 billion kWh, and the capacity is 19.8 million kW. Huge volumes of water resources are concentrated in 6580 glaciers; whose reserves are about 760 billion cubic meters.

In the hydrological aspect, two regions are distinguished on the territory of Kyrgyzstan - formation and dispersion of flow. The first is the mountainous part of the Republic with elevations of more than 2000 m, the area of flow dispersion is located directly below the area of its formation occupying the territory of foothill valleys and intermontane depressions.

In the water balance, the excess of the volume of water resources formed in the country exceeds the volume of their consumption in the territory of the Kyrgyz Republic. Therefore they are of interstate importance. The structure of water use in the Republic is as follows: about 90% of the water consumption is spent on irrigated agriculture, about 6% - for the needs of industry, less than 3% for the water supply of the population. Forestry, fisheries, energy and the services sector collectively use up to 1% of the total domestic water consumption.

The total amount of water consumed in the Republic is estimated at 10-12 billion cubic meters per year. Loss of water during conveyance in riverbeds, canals,

irrigation structures reaches 1.7-2.3 billion cubic meters. Due to natural (mostly relief) conditions of the Republic, small rivers are involved in supplying water to irrigated lands, with about 800 thousand ha or 76% of all irrigated lands which commanded under them. The stock of mountain springs is slightly regulated, only 80 thousand hectares (11%) of lands are irrigated from regulated sources, the remaining 720 thousand hectares are irrigated with the live flow.

In the Kyrgyz Republic, there are more than 2000 rivers longer than 10 km long, and their total length is almost 35 thousand km. Great importance in the development and functioning of the national economic complex, the increase of water and energy resources, the protection of the environment, the formation of an effective water balance have lakes, reservoirs and ponds. A significant amount of water is concentrated in lakes, small ponds, reservoirs. Their total area is 6836 square km. Predominantly the lakes are located in the high-mountain zone - 3-4 thousand meters above sea level.

On the balance sheet of the Department of Water Resources and Land Improvement, there is a state irrigation fund, which is an off-farm irrigation fund that consists of off-farm canals with a length of 5786.7 km, hydraulic structures - 7659 units, hydro posts - 3236 units, pump stations - 111 units, collector-drainage networks 1187.1 km, reservoirs -33 units with a total capacity of 1617.3 million m^3, night storage reservoirs (NSR) - 50 units, decade storage reservoirs (DSR) - 10 units.

Hydroelectricity is the basic branch of the Kyrgyz economy, which meets the country's internal needs for electricity and exports electricity to the CIS countries and far abroad. In conditions of growth in production, the electric power industry is one of the life-supporting sectors of the economy and one of the factors of economic development, and its reliable operation is the most important condition for the transition of Kyrgyzstan to a high standard and standard of living.

For the successful development of energy, the main direction is the construction of new promising hydroelectric power stations (HPSs) and an increase in electricity exports.

The high mountainous relief of the Kyrgyz Republic contributes to the accumulation of atmospheric moisture. The long-term average annual flow of the rivers of the Republic is estimated at about 45 billion m^3.

A total of 44 groundwater deposits [5] with potential freshwater reserves of 11 km^3/year and operation reserves of 5.3 km^3/year have been properly studied. As a whole, except for certain areas of South Kyrgyzstan, the country has sufficient reserves of drinking water for the long-term future.

More than 50 springs of warm and hot underground waters have been discovered to this time. The extent of mineralization of thermal waters is from 0.2-5g/l and more. The stage of exploration of these deposits is irregular: from weakly explored, preliminary evaluated deposits up to detail explored deposits and some, which are being developed.

Reserves of all above-mentioned deposits of thermal waters are not being used at their full capacity.

Currently, the use of Thermo mineral waters is not significant. The reasons for this situation are economical and natural conditions.

The exploitation of hydrothermal resources requires significant financial costs (drilling, operating equipment, distribution network). And the natural conditions, or rather the location, often do not allow to organize the sale of "products". Therefore, at present, these energy resources are used locally (in wellsite, and even then not everywhere) and only into a limited extent.

Water regulations

The fundamentals of domestic and foreign water policy of Kyrgyzstan as a framework are stated in the Water Code of the Kyrgyz Republic. This ideology as a whole complies with the key principles of Integrated Water Resources Management worked out by the world community. However, the further specification of water policy in the form of the National water strategy as stipulated in the Water Code was not set out until recently. Within the last 15 years, draft s of the Water Strategy concept was developed, but none of them was adopted officially.

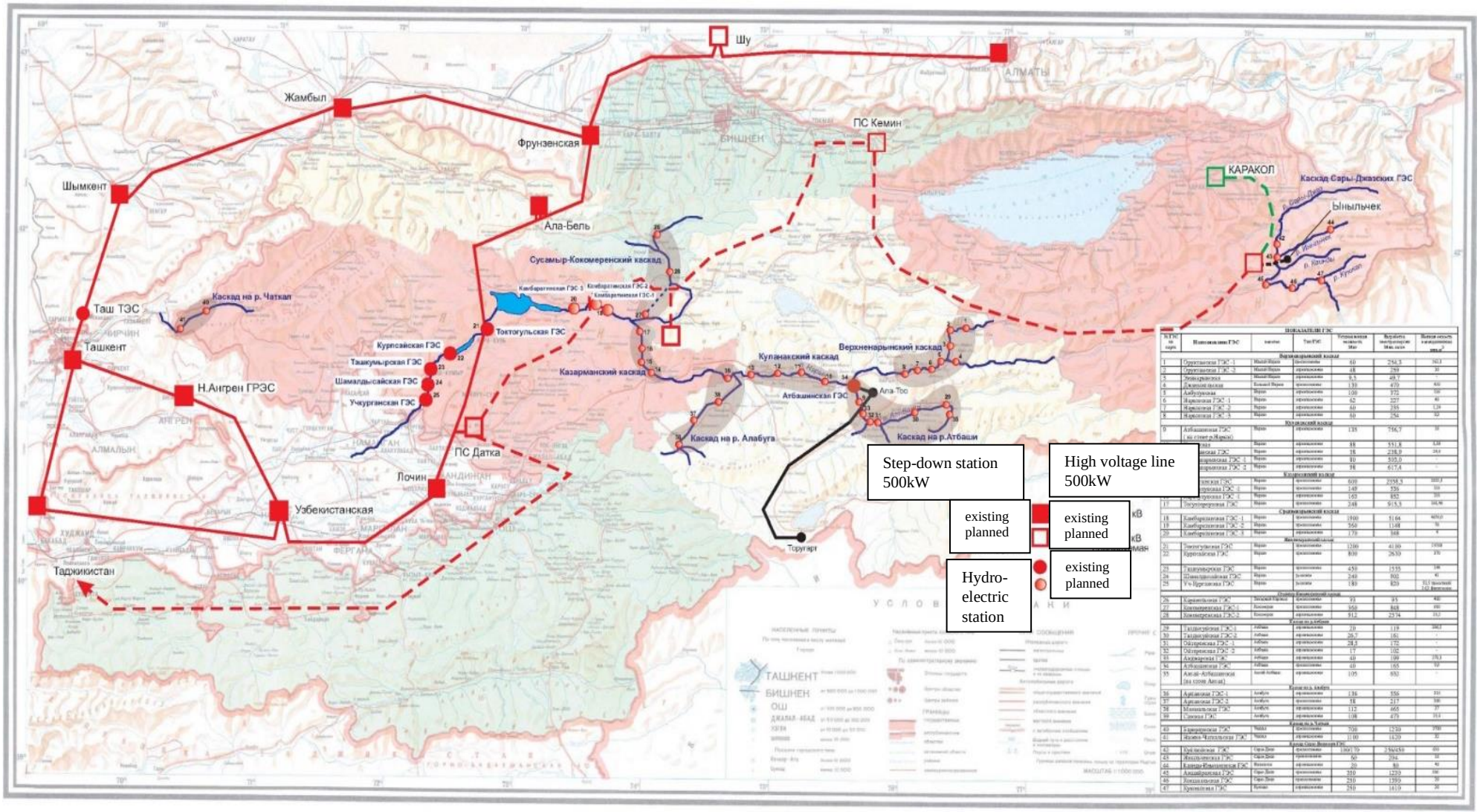
The key water-related legal acts of Kyrgyzstan include the following:

- water laws – the Water Code (2005), the law "On Drinking Water" (1999) and law "On Water" (1994);
- Regulations on State Accounting and Control of water in the Kyrgyz Republic (2002), and the corresponding Regulations on the SCIESU;
- environmental laws – the law "On environment" (1999) and the law "General technical regulation on the provision of environmental safety" (2009г.);
- the laws regulating complex sanitary-epidemiologic requirements
- the law "On health protection of citizens of the Kyrgyz Republic" (2005), the law "On public health" (2009), the law "On protection of consumers rights" (1997);
- the laws regulating procedures related to the quality of water resources as well as certification of entities performing this activity
- the law "On environmental expertise" (1999) and the law "On the basis of technical regulation in the Kyrgyz Republic" (2004);
- the laws regulating the quality of drinking water – the law "Technical regulations "On safe drinking water" (2012);
- the laws on the structure of the Government of the Kyrgyz Republic, local administration and local self-governance, land, subsoil, energy, emergencies, public associations of water users as well as other laws related directly or indirectly to Regulation of use and protection of water resources and public health.

Figure 2. Hydropower potential of the Kyrgyz Republic

Total hydropower potential of the Kyrgyz Republic - 15,500 MW

Technically feasible potential for use - 8,272 MW



A significant part of current legislation is of the framework type, and bylaws are required to clarify mechanisms for realization of legislative regulations. However, the standards and technical regulations applicable in Kyrgyzstan are based primarily on a system of standards developed in the ex-USSR over 1960 -1990, or modern standards of the Russian Federation and international standards. The outdated standards used frequently do not take into account the specifics of conditions of water resources and water use in the Kyrgyz Republic, the occurrence of new technologies and monitoring facilities, or new approaches to the Regulation of water quality developed by, for example, the countries of the European Union.

Currently, there are no linking documents between the United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources and the National Classifications for Energy and Mineral Reserves and Resources, so this paper uses the comparison schemes developed during the study.

Due to the lack of a unified classification for energy and mineral resources, for a more detailed comparison of the various classifications listed above, used in the territory of the Kyrgyz Republic with the UNFC, two objects were selected for the case study: one coal deposit (No. 1) and a groundwater deposit (No. 2).

There is currently no classification of reserves and inferred resources by renewable energy sources in the territory of the Kyrgyz Republic; therefore, no comparison was made for this type of deposits. In order to maintain confidentiality, the names of the objects were not disclosed.

2. National Classification system for energy and groundwater resources and mapping to UNFC

Kyrgyzstan Classification

Kyrgyzstan uses the "Classification of Reserves of Deposits and Inferred Resources of Solid Minerals", approved in 2000, which is based on the reserve accounting system ex-USSR.

The classification of reserves of solid minerals of the Kyrgyz Republic makes mainly qualitative requirements for the completeness of the exploration of deposits, which provides initial information for a feasibility study of conditions and calculation of reserves.

According to the degree of geological exploration, four categories of reserves (A, B, C_1, C_2) and three categories of inferred resources (P_1, P_2, P_3) are distinguished.

Table 1

Reserves category	Reserves characteristics
A	Category A includes explored mineral reserves with precisely defined boundaries of mineral bodies, their shapes and structures. Highlighted in the areas of detailing explored and developed deposits of the 1st group of geological complexity
B	Category B includes previously explored mineral reserves with roughly defined contours of mineral bodies, without an accurate representation of the spatial position of natural types of mineral raw materials. Category B reserves are allocated in the areas of detailed exploration and development of deposits of the 1st and 2nd groups of geological complexity.
C_1	Category C_1 includes reserves of explored deposits of the complex geological structure, as well as poorly explored reserves of minerals in new areas, taking into account extrapolation. Category C_1 reserves constitute the bulk of the reserves of explored and developed fields of the 1st, 2nd and 3rd groups of geological complexity, and can also be allocated in the areas of detailed fields of the 4th complexity group.
C_2	Prospective reserves are classified as C_2. Reserves of category C_2 are allocated during exploration of deposits of all groups of complexity, and in deposits of the 4th group of the complexity of geological structure, they constitute the bulk of the reserves involved in development.
P_1	Inferred resources of category P_1 take into account the possibility of expanding the boundaries of the distribution of minerals beyond the contours of C_2 reserves or identifying new ore bodies of minerals at ore occurrences, explored and explored deposits.
P_2	Inferred resources of the P_2 category take into account the possibility of discovering new deposits of minerals in the basin, ore region, node, field, the presumptive presence of which is based on a positive assessment of the occurrences of minerals, as well as geophysical and geological and geochemical anomalies, the nature and potential prospects of which are established by single workings.
P_3	Predicted resources of category P_3 take into account only the potential for the discovery of deposits of one or another type of mineral on the basis of favourable geological and paleogeographic prerequisites identified in the estimated area during medium-small-scale geological-geophysical and geological survey works, interpretation of space images, as well as analysis of results geophysical and geochemical research.

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

- balance (economic);

- off-balance (potentially economic), which are subject to separate calculation and accounting.

Balance (economic) reserves include reserves, the development of which at the time of assessment, according to technical and economic calculations, is economically efficient in a competitive market using equipment, technologies for the extraction and processing of mineral raw materials that ensure compliance with the requirements for the rational use of subsoil and environmental protection.

Off-balance (potentially economic) include:

1) reserves, the development of which at the time of assessment according to technical and economic calculations is not economically effective (unprofitable) in a competitive market due to low technical and economic indicators, but the development of which becomes economically possible when prices for minerals change, the emergence of optimal sales markets or new technologies;

2) reserves that meet the requirements for balance reserves, but the use of which at the time of assessment is impossible due to their location within water protection zones, settlements, structures, agricultural facilities, reserves, natural, historical and cultural monuments.

Off-balance reserves are calculated and accounted for if technical and economic calculations have established the possibility of their subsequent extraction or the expediency of incidental extraction, storage and storage for future use.

Off-balance sheet reserves are calculated separately, depending on the grounds for attribution to this group.

In addition to reserves and resources, the assessment of deposits takes into account the complexity of the deposit. In total, according to the complexity of the geological structure, four groups of deposits are distinguished:

1st group. Deposits with a simple geological structure, with large and very large, less often average sizes of mineral bodies.

Group 2. Deposits (areas) of medium complexity of geological structure with large and medium-sized bodies with disturbed bedding.

Group 3. Deposits (areas) of the high complexity of geological structure with medium and small-sized bodies of minerals with the intensively disturbed occurrence,

Group 4. Deposits (areas) with small, less often medium-sized bodies with extremely disturbed bedding or characterized by a sharp variability of thickness and internal structure.

UNFC Classification

The United Nations Framework Classification for Resources (UNFC) is a resource project-based and principles-based classification system for defining the environmental-socio-economic viability and technical feasibility of projects to develop resources. UNFC provides a consistent framework to describe the level of confidence of the future quantities produced by the project.

UNFC has been designed to meet, to the extent possible, the needs of applications pertaining to:

• policy formulation based on resource studies;

• resources management functions;

• corporate business processes;

• financial capital allocation.

UNFC is a principles-based system in which the products of a resource project are classified on the basis of the three fundamental criteria of environmental-socio-economic viability (E), technical feasibility (F), and degree of confidence in the estimate (G), using a numerical coding system. Combinations of these criteria create a three-dimensional system (Figure 3). Categories (e.g. E1, E2, E3) and, in some cases, sub-categories (e.g. E1.1) are defined for each of the three criteria as set out and defined in Annexes I and II.

The first set of Categories (the E axis) designates the degree of favorability of environmental-socio-economic conditions in establishing the viability of the project, including consideration of market prices and relevant legal, regulatory, social, environmental and contractual conditions. The second set (the F axis) designates the maturity of technology, studies and commitments necessary to implement the project. These projects range from early conceptual studies through to a fully developed project that is producing and reflect standard value chain management principles. The third set of categories (the G axis) designates the degree of confidence in the estimate of the quantities of products from the project.

The Categories and Sub-categories are the building blocks of the system, and are combined in the form of "Classes". UNFC can be visualized in three dimensions, as shown next Figure, or represented in a practical two-dimensional abbreviated version as shown in Figure

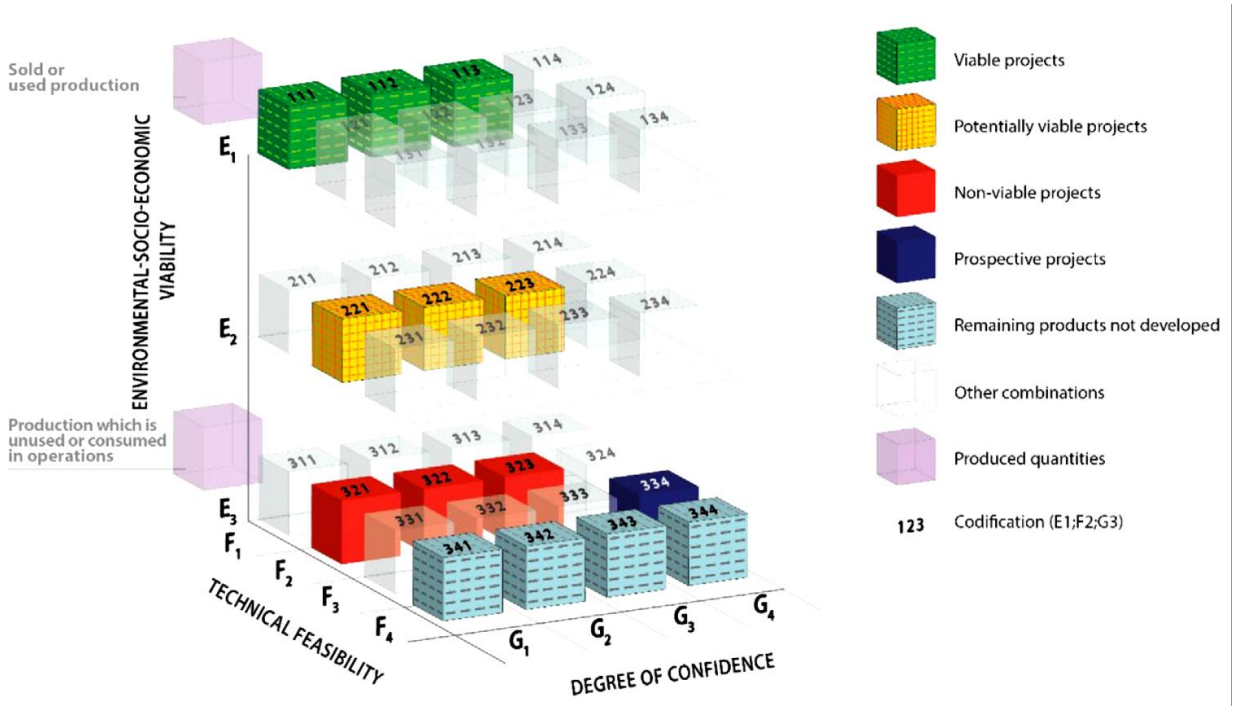


Figure 3

Comparison of the classification of the Kyrgyz Republic with the UNFC

The system of classification of deposit reserves and inferred resources of solid minerals of the Kyrgyz Republic is relatively comparable to the UNFC, but they also have a number of significant differences:

1. While the UNFC is based on three fundamental criteria: the environmental and socio-economic viability of the project (E-axis), the technical feasibility of the development project (F-axis) and the degree of confidence in the quantity of product (G-axis), the classification of the Kyrgyz Republic is based on two criteria: a) degree of readiness for industrial development and profitability of development (balance and off-balance reserves); b) geological knowledge. The first criterion for the classification of CRs combines the first two UNFC categories (E and F axis).
2. In the UNFC reserve classification for known (discovered) fields, three degrees of confidence in terms of geological knowledge are indicated: "high", "medium" and "low", they are represented by categories G1, G2 and G3, in the Kyrgyz Republic classification these degrees are represented by categories A (high), B (medium), C_1 and C_2 (low). For deposits known only from indirect data, category G4 is used, while in the Kyrgyz Republic classification, resource categories P_1-P_3 are used. A significant difference between the classifications of the Kyrgyz Republic and the UNFC is the fact that resources of categories. P_1-P_3 are not classified in the UNFC and are fully categorized 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 terms.

Table 2.

Mapping of UNFC Classes and Subclasses with the Classification of Reserves of Deposits and Inferred Resources of Solid Mineral Resources of the Kyrgyz Republic

Class	Subclass	UNFC			KR classification	
		E	F	G	Degree of Completion and Profitability of Development (E and F)	Reserves Category (G)
Viable Projects	On Production	1	1.1	1, 2, 3	Balance reserves ready for development	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 Viable Projects	Development Pending	2	2.1	1, 2, 3	Promising for industrial development balance reserves	A, B, C_1,C_2
	Development On Hold	2	2.2	1, 2, 3		A, B, C_1,C_2
Non-Viable 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
Remaining products not developed from identified projects		3.3	4	1, 2, 3	Unprofitable for industrial development or unrecoverable	A, B, C_1, C_2
Prospective Projects [No sub-classes defined]	Prospective Projects [No sub-classes defined]	3.2	3	4	Not defined for this class	P_1, P_2, P_3
Remaining products not developed from prospective projects		3.3	4	4		P_1, P_2, P_3

Reserves and inferred resources of "Classification of reserves of deposits and inferred resources of solid minerals of the Kyrgyz Republic", given that Kyrgyzstan is a UN member, in principle, can be easily identified within the UN International Framework Classification with the assignment of appropriate codes.

At the same time, the reserve qualification scheme in the UNFC project is largely based on the experience of assessing deposits with ore bodies that have clearly

defined geological boundaries. Only for these objects, and then only to a large extent theoretically, one can imagine a situation in which explored reserves may have a low degree of their economic and technological exploration (codes 331 and 332). For most of the deposits of solid minerals that do not have clearly defined geological boundaries, the calculation of reserves is carried out, as is known, on the basis of analytically calculated and constantly corrected in the process of geological exploration, depending on the economic indicators of development, the boundary values of the cut-off (minimum industrial) content. In other words, the economic and technological assessment of the corresponding degree of detail usually accompanies the corresponding stages of exploration, and it is almost impossible to separate them from each other. Therefore, in practice, reserves corresponding to codes 331 and 332, as a rule, do not have an independent meaning and are allocated only incidentally in areas (horizons) of detailed explored deposits located outside the contour of the proposed development.

In addition, the UNFC's proposed codification principle for resource/resource sharing, based on the priority of the Environmental and Socio-Economic Viability of the Project (E axis) indicator, is somewhat vulnerable. Economic assessments are, to a certain extent, subjective, which is due to the technical and technological level of project preparation. On the other hand, the economic conditions for the implementation of projects in different countries are often incomparable (physical and geographical conditions, national taxation system, conditions for attracting capital, etc.). In other words, stocks, the quantity and quality of which make it possible to qualify them as economical in one country, maybe non-economic in another, and vice versa. Therefore, it will hardly be possible to ensure at the international level the correct comparability of equally qualified "reserves/resources" in different countries. More objective is the criteria based, first of all, on geological estimates obtained at the corresponding stages (stages) of geological exploration. For example, a coal seam identified and delineated during exploration remains a coal seam both in Kyrgyzstan and in any other country, regardless of the nature and state of the economy. Its quantitative, qualitative and energy characteristics are comparable on a transnational scale, which cannot be said about the economic indicators of development.

As for groundwater, at the moment in Kyrgyzstan, there are no approved Classifications of reserves of fresh, technical or thermal-mineral waters. The classification of operational and predicted groundwater resources (adopted on February 25, 1983) is used as a working one, according to which uniform ones were established for ex-USSR principles of calculation and state accounting of operational reserves of groundwater according to the degree of their knowledge and national economic significance, conditions that determine the preparedness of groundwater deposits for industrial development, as well as the basic principles of assessing predicted groundwater resources.

If we talk about groundwater reserves, it is necessary to highlight the following elements:

operational reserves;
natural reserves;
natural resources;
attracted resources.

Their relationship can be represented in the following diagram (Fig.4).

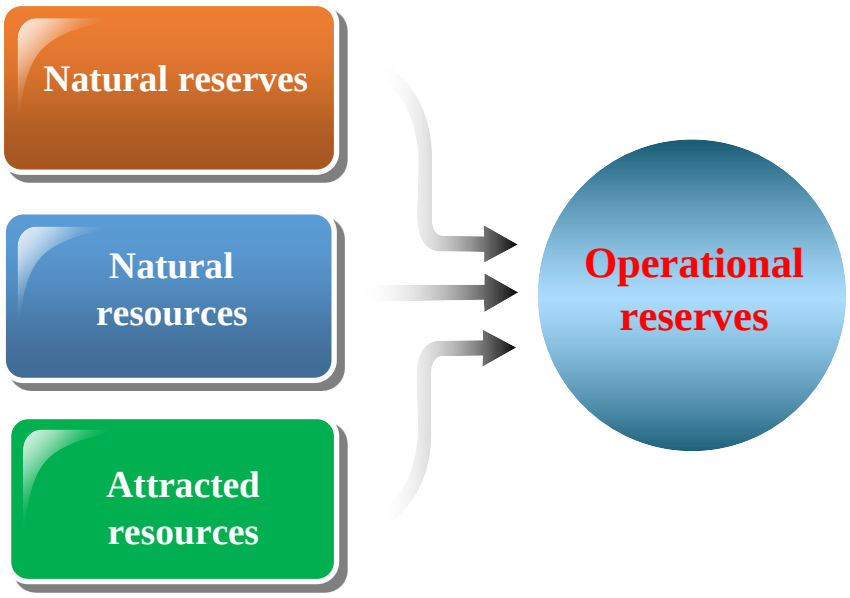


Figure 4

The operational reserves are understood as the amount of groundwater that can be obtained at the field with the help of technically and economically rational water intake structures at a given operating mode and at a water quality, that meets the requirements of its intended use in the national economy during the estimated period of water consumption.

The operational reserves of underground waters are calculated and accounted for according to the results of exploration hydrogeological works carried out at the field and according to the data on the exploitation of underground waters. Data on reserves are used in the development of schemes for the development of sectors of the national economy that extract and consume groundwater, in the preparation of annual, five-year and long-term state plans for the economic and social development of the ex-USSR, in planning geological exploration, and for deposits prepared for industrial development, in the design of water intake facilities, and enterprises producing and using groundwater.

Predicted groundwater resources, the presence of which is assumed on the basis of general hydrogeological concepts, theoretical assumptions, the results of geological and hydrogeological mapping, geophysical, hydrochemical, hydrological and water balance studies, are estimated within the boundaries of artesian basins, hydrogeological massifs and regions and reflect their potential operational capabilities. The data on the predicted resources are used to plan prospecting works

for groundwater, and are also taken into account when drawing up schemes for the integrated use and protection of waters.

The calculation and accounting of operational reserves and the assessment of predicted groundwater resources are carried out separately for each type of water (drinking, technical, medicinal mineral, heat and energy, including steam-water mixtures, industrial) in accordance with their intended (possible) use in the national economy or investment plan.

Assessment of the quality of drinking, technical and medicinal mineral waters is carried out in accordance with the requirements of state and industry standards, technical conditions and assignments of the organizations consuming them.

Mineral waters, classified in the prescribed manner as medicinal, are used primarily for medicinal and resort purposes. In exceptional cases, the bodies regulating the use and protection of waters may authorize the use of medicinal mineral waters for other purposes in agreement with the relevant health and resort authorities.

Assessment of the quality of industrial and heat-and-power waters is carried out in accordance with the conditions developed on the basis of the use of the most rational and efficient methods of extraction and processing of these waters in compliance with the requirements for their integrated use and for environmental protection.

Operational reserves of groundwater are calculated and accounted for, and predicted resources are estimated in cubic meters per day, steam-water mixture - in tons per day. In industrial waters, the amount of commercially important components (in tons) that can be obtained at the field during the estimated period of its development is also determined, excluding losses during water processing. For deposits of heat and power water, in addition to operational reserves, the heat power capacity of the field is estimated (in gigajoules, megawatts, tons of standard fuel).

According to the range of exploration, the exploitable groundwater reserves are divided into explored - categories A, B and C_1, and preliminary estimated - category C_2.

The predicted groundwater resources are categorized according to the range of their validity - P.

Operational reserves of groundwater by their value are divided into two groups, subject to separate calculation and accounting:

- balance, the use of which is currently economically feasible with the existing or industrialized advanced technology and technology for the extraction, treatment or processing of water in compliance with the requirements for the rational use of subsoil and environmental protection;
- off-balance, the use of which is currently economically inexpedient or technically and technologically impossible, but which under certain conditions can be further transferred to the balance sheet.

The appropriate degree of exploration of deposits prepared for industrial development is determined depending on the complexity of hydrogeological

conditions, as well as economic factors - the cost of funds and time required for the production of exploration hydrogeological works. Taking this into account, deposits or areas of large deposits (objects of independent industrial development) are subdivided into the following groups.

Group I. Deposits (areas) with simple hydrogeological, hydrochemical and geothermal conditions, with a calm occurrence of aquifers, are consistent in thickness and structure and homogeneous infiltration properties of water-bearing rocks, which determines the possibility of economically effective exploration at deposits (areas) of this group of reserves of category A.

Group II. Deposits (areas) with difficult hydrogeological conditions due to inconsistent thickness and structure of aquifers and heterogeneity of filtration properties of water-bearing rocks, or with complex hydrochemical or geothermal conditions. In the fields (areas) of this group, exploration of reserves of category A in large quantities is impractical due to insufficient efficiency and high cost of geological exploration. The reserves of the deposits (areas) of this group are explored mainly in category B and, partially, in category A.

Group III. Deposits (areas) with very difficult hydrogeological conditions due to the high variability of the thickness and structure of aquifers and filtration properties of water-bearing rocks or limited (focal) distribution of aquifers, as well as deposits (areas) with very difficult hydrochemical or geothermal conditions. The same group includes deposits (areas) of drinking and industrial waters, the effective development of which is possible with an artificial recharge of water intakes or the use of complex systems of water intakes (horizontal and beam), which requires the construction of exploration and experimental water intake during exploration. In the fields (areas) of this group, the identification of category A reserves during detailed exploration is impractical due to the high cost and low efficiency of exploration. The reserves of the deposits (areas) of this group are estimated mainly by category B and, partially, by category C_1.

3. Background information on the selected energy and groundwater resources

1. Coal deposit

Calculation of coal reserves for open-pit mining at coal deposit was made based on the results of drilling wells, driving surface mine workings (ditches) and a geological survey carried out earlier at a scale of 1: 2000.

Geological prospecting works carried out at this field by an aero-geological expedition in 1946 served as the basis for setting up detailed geological prospecting works. In 1951, on the basis of geological survey materials, a geological map was compiled at a scale of 1: 200000. In the course of these works, the described coal occurrence was discovered. Exploration work at the field was continued in 1983-1987, 2009 and 2015.

Previously calculated reserves in the open pit of the first stage of the coal deposit as of 12.07.2015 and as of May 10, 2017, were taken into account by the State Balance. In 2018, additional exploration of two sections of the field was carried out: 9 wells with a total length of 2,431.6 m were drilled, and 460 core samples were taken.

A topographic survey was carried out over the entire area of the deposit. A topographic map of 1: 2000 scale was compiled, which became the basis for compiling a geological map and constructing sections on a large scale.

Hydrogeological and mining conditions are favourable for the development of the deposit.

At the moment, commercial exploitation of the field is underway based on previously proven reserves in the first stage open pit.

The field has an industrial base and the corresponding infrastructure to build the potential for further exploitation of the field.

Based on the study of the petrographic composition and the most characteristic common features, reflecting the genetic characteristics and the main technological characteristics, the coal of the deposit belongs to the SS grade (weakly sintered) bituminous coal (according to the SIBNII Coal Processing Institute, Russia). Code number according to State Standard (GOST) 25543-2013 - 0942400.

Associated minerals and components of industrial interest are not of interest but can be used as rubble stone and pavement.

Based on the results of geological exploration, the coal reserves at the deposit were calculated by categories $C_1 + C_2$ in the amount of 42,354.7 thousand tons, including by categories: C_1 - 30004.4 thousand tons and C_2 - 12,350.3 thousand tons.

The stripping ratio was 5.1 m^3/t. The deposit is prepared for industrial development.

In accordance with the Instruction on the Classification of Reserves of Deposits and Inferred Resources of Solid Minerals (Coal and Oil Shale), a coal deposit can be attributed to the 1st group: their section of matured and relatively matured formations with simple mining and geological development conditions.

The density of the exploration network should provide an unambiguous assessment of the degree of complexity of the geological structure of the field and a reliable quantitative characteristic of the condition indicators.

Figure 5. Geological map

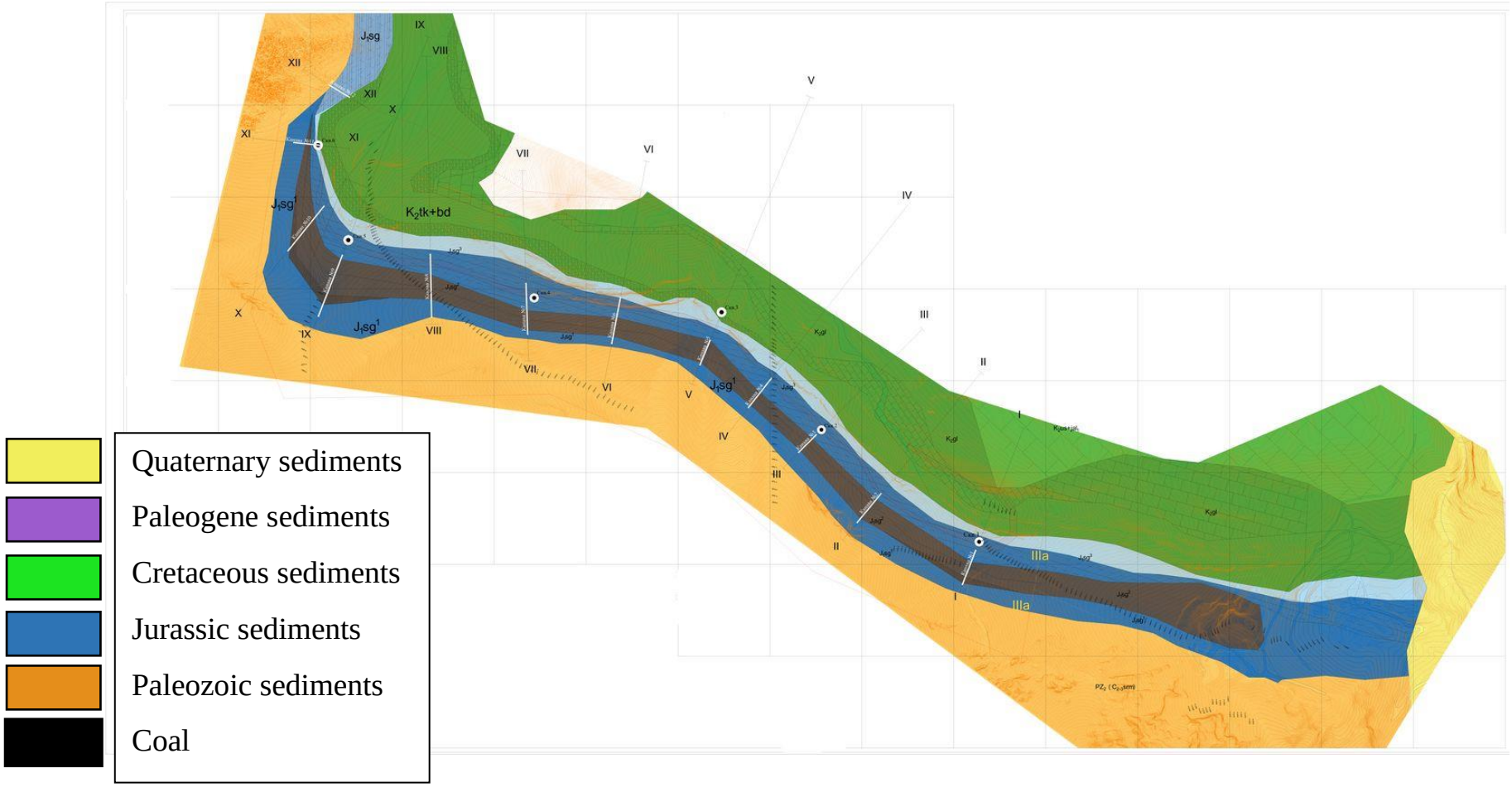


Figure 6. Geological cross-section

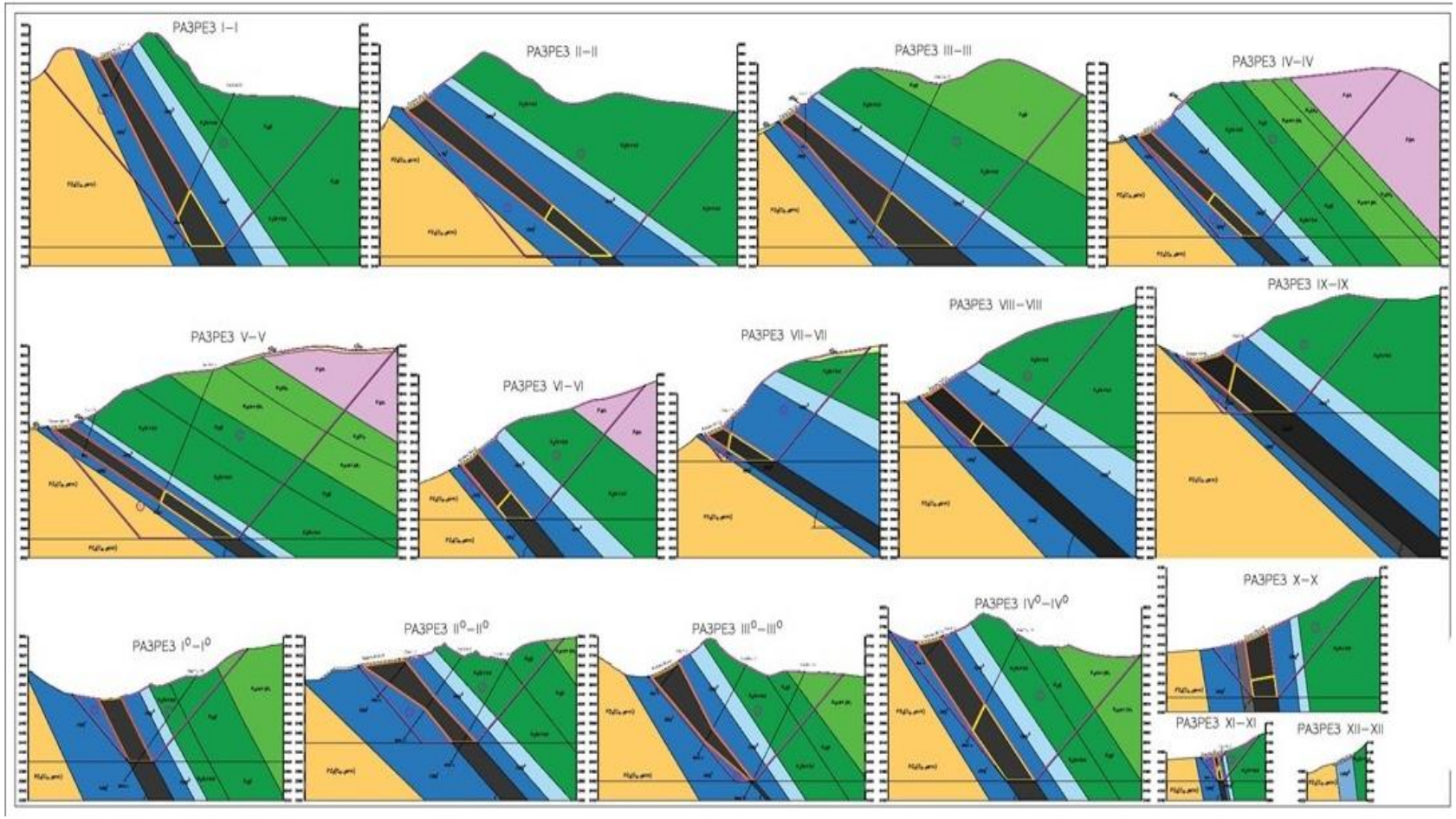
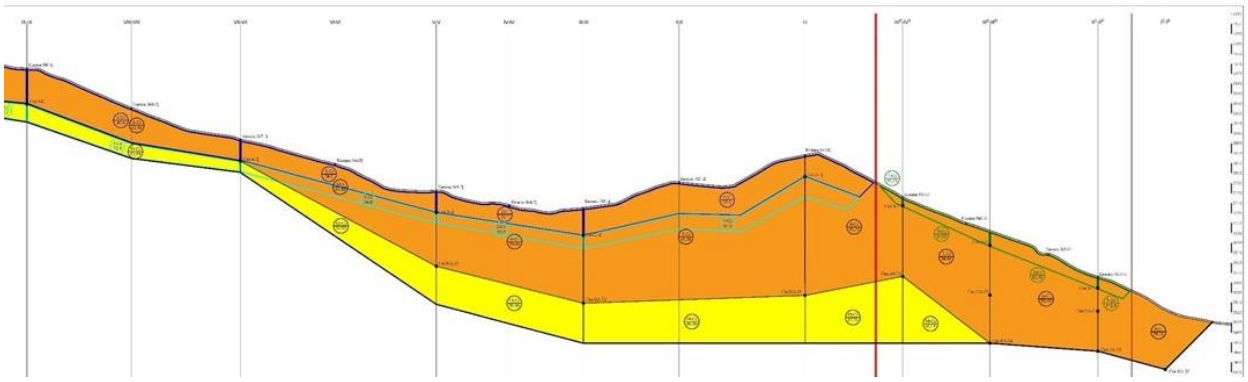


Figure 7. Block scheme



Block category C_1

Block category C_2

Table 3.

Approximate distances between wells in the plane of the reservoir in tectonically homogeneous blocks, m

Endurance morphology layers	Distances between wells by category of reserves					
	A		**B**		**C_1**	
	Between lines	Between wells on the lines between	Between lines	Between wells on the lines between	Between lines	Between wells on the lines between
Aged	600 800	200 400	800-1200	400 600	до 2000	до 1000
Relatively aged	300-400	150-250	400 600	200 300	до 1000	до 500
Unseasoned	—	—	250-300	150-250	до 500	до 300

The main results of the work performed:

- additionally studied the variability of morphology and spatial data of coal seams;

- studied mining and geological, hydrogeological, engineering-geological and other natural conditions and other factors affecting the further development of the deposit;

- studied the technological properties of coal;

- a general geological and economic assessment of the field was carried out to substantiate the feasibility of involvement in industrial development;

- based on the materials of the predecessors and on the materials of the newly completed geological exploration, the reserves were calculated anew.

Based on the results of laboratory tests of surface and core samples, it can be judged that the properties of the coal seam are unchanged along the entire strike. As can be seen from the table, the quality characteristics of the coals of the deposit almost do not differ in strike and dip.

The $C_1 + C_2$ category balance reserves of the field amounted to 42354.7 thousand tons,

The quality of the coals has been studied using core and furrow samples. According to the results of laboratory studies and analyzes carried out, the coals are classified as SS (weakly caking), coal.

Within the limits of the deposit, associated minerals and components of industrial interest are not of interest, but overburden can be used as rubble stone and for road surfaces. There are no toxic and harmful elements in coals.

Mining-geological, hydrogeological and mining-technical conditions of coal seam mining are not complicated and will not cause complications in open-pit mining. Overburden rocks, except for Quaternary ones, have good stability and high strength, which makes it necessary to develop the deposit using drilling and blasting operations and heavy equipment.

Thus, the deposit is prepared for the commercial development of coal by the open-cut method. It is possible to organize opencast coal mining, with an annual production capacity of 200-2000 thousand tons/year. The specific performance of the future coal mine will be adopted by the technical development project, taking into account the existing demand and supply in the domestic coal market.

In terms of quality, energy properties and ash content, the coals of the deposit are among the best in the region. The geological structure of the site, the thickness and simple structure of the coal seam make it possible to advance the present area into the category of the most promising

2. Groundwater resource

There are three stages in the history of the study of groundwater in Kyrgyzstan, reflecting the peculiarities of the development of the Republic:

1. The period until 1917, when the work was of a regional nature and was mainly aimed at studying mineral springs and studying springs for land reclamation.

2. Period 1917-1951, the work was aimed at a comprehensive study of hydrogeology. The works were both regional and more local. So great importance in the study of groundwater was played by specialized work to find sources of water supply, accompanied by large-scale hydrogeological surveys and the first drilling of relatively deep (up to 100, less often 150 m) water wells. Such work was carried out both in the valleys (for the water supply of settlements, industrial enterprises and agricultural land - water supply and water supply), and in mountainous areas (for the water supply of mining enterprises and workers' settlements).

In addition to fresh groundwater, mineral and thermal waters were studied. Regularities of distribution of mineral waters on the territory of the country were considered, specific conditions of distribution and formation of thermal and mineral waters, caused by the processes of modern tectonics, were determined.

3. The period since 1951 - the Kyrgyz complex hydrogeological expedition was created, in which all hydrogeological and engineering-geological works were concentrated. With the organization of the expedition, a systematic study of the hydrogeological conditions of Kyrgyzstan began.

As a result of the planned work, the territory of the Republic was completely covered by 1: 500000 survey, almost completely by 1: 200000 and 1: 500000 surveys. About 25,000 exploration and production water wells were drilled.

Based on the results of earlier work and work carried out at the present stage, as of 01.01.2020, in the territory of the Kyrgyz Republic, exploitable reserves of fresh groundwater were explored and approved, assessed and taken into account by the State Balance at 117 deposits, of which in the northern regions - 75 deposits, on the southern - 42 deposits.

The total approved and accounted for by the State Water Balance reserves of fresh groundwater in the Kyrgyz Republic for the sum of all categories is 25.4 million m^3 / day, including for industrial categories: A - 3.1 million m^3 / day; B - 3.6 million m^3 / day; by assessment categories: C_1 - 6.1 million m^3 / day; C_2 - 12.6 mln. m^3 / day.

The projected operational reserves of fresh groundwater in the hydrogeological basins of the Republic are about 30.4 million m^3 / day.

Kyrgyzstan is one of the richest in hydro-mineral resources in Central Asia. Their diversity in terms of mineral composition, temperature regime, conditions of formation and water manifestation is extremely high, which determines a very wide range of their application.

Unfortunately, the total number of occurrences and deposits of mineral waters is not known, since their systematization, the compilation of an inventory of deposits and water manifestations, an electronic catalog of wells and springs is still not available. At the same time, there are more than 112 deposits or areas of water showers in the whole of the Kyrgyz Republic. These are about 30 areas of the development of carbonic waters, more than 50 manifestations of warm and hot waters, there are radon, sulfide, ferruginous, etc. practically all the main balneological valuable groups of waters that are used in modern practice of spa treatment.

Thus, as of January 1, 2020, 39 deposits of mineral and thermal waters were supplied to the State Register of Mineral and Thermal Waters, characterized and exploited only through the withdrawal and use of groundwater from wells. MTV deposits in the springs within the areas of their pinch-out within the Northern region and in the Kyrgyz Republic as a whole are not taken into account by the state accounting and are not included in the State balance sheet.

As of January 1, 2020, on the territory of the Kyrgyz Republic, the total operational reserves of hydromineral resources, approved by the State Commission for Reserves and entered in the State Register, amount to about 43 thousand m^3/day.

4. Social, economic, and environmental aspects of the projects

1. Coal deposit

The lands on which the deposit is located are classified as "inconvenient" for use in agriculture. Cultivation of crops is not possible due to the steepness of the slopes and the lack of streams and reservoirs. The volume of mining work and the remoteness of deposits from settlements will not affect the ecology of the environment and the area as a whole.

In the course of exploration work at the deposit, the structure, composition, conditions of occurrence and qualitative characteristics of the mineral have been sufficiently studied.

The obtained values of maximum moisture capacity, hygroscopic moisture and actual density are typical for coal.

The coals of the deposit can be used as heat and power and in some technological areas, such as:

- for the production of generator gas in stationary gas generators;

- in the production of building materials (cement, brick, etc.);

- to obtain activated carbon.

The quality of coals is characterized on average by the following values: average ash content - 10.4%, average sulfur content - 0.88%, rather high calorific value, on average –32.81 MJ / kg (7536 kcal/kg). Thus, in general, coals can be characterized as low-, medium-ash, low-sulfur with good energy properties related to the SS grade, hard coal (according to SIBNII, Russia) Code number according to State Standard (GOST) 25543-2013 - 0942400. The coals are environmentally friendly.

The deposit has good transport conditions; there are highways from the administrative centre to the quarry. There are no settlements, power lines, gas pipelines, bridges and other security facilities on the work area and in its immediate vicinity.

The supply of coal, fuel, building materials can fully satisfy the local market.

The deposit is currently being developed. Mining operations for the extraction of coal are carried out in the open pit of the first stage.

Based on the additional results obtained, a project for the development of a deposit with an open pit of higher productivity is currently being developed.

It should be noted that the Company, which owns the license for the right to use subsoil in the coal deposit, has invested in the development and improvement of the region:

1. The road to Osh city has been fully rehabilitated, where investments of over 25 million soms (≈ 300K US$) have been made.

2. A road to the deposit was built, which facilitated the movement of local residents and the resettlement of shepherds in the summer. Investments for the road amounted to about 70 million soms (≈ 930K US$).

3. A preschool institution has been built with a cost of over 3 million soms (≈ 40K US$).

4. 5 bridges were rehabilitated and 4 bridges were rebuilt on the highway Osh - the field. The cost of these works was about 32.5 million soms (≈ 430K US$).

5. Every year the Company allocates coal free of charge under the program of social support for vulnerable groups of the local population.

6. Sports and cultural events are organized annually for the development of youth in the region.

The Company's plans also include the following tasks:

• Construction of schools, kindergartens and sports facilities to support the physical and spiritual development of the local population.

• Expansion of the road Osh city - field.

• Increasing the volume of coal for social support.

2. Groundwater resource

The geographical position of the Republic in the arid region predetermines the need for increased water consumption, especially in water supply to settlements and in agriculture, both for irrigation and for watering livestock. For industry, water supply is also not an unimportant factor, but due to the current economic situation, water consumption by industry has greatly decreased.

On the one hand, the degree of water availability allows the region to focus on one or another type of economic activity - agriculture, industry. A sufficient amount of water allows you to save money on the supply/delivery of water for production needs, which will further reduce the final cost of the manufactured product. This, in turn, will have a less negative impact on the purchasing power of the population and the competitiveness of products.

On the other hand, the poor availability of surface water makes it necessary to attract underground sources for water supply, which requires additional costs for organizing and operating wells, which ultimately leads to an increase in the cost of the products obtained, but at the same time, the population of the region has a job, which reduces social tension.

Several factors can be pointed out when considering the environmental aspect of water use.

1. Surface water is almost completely taken apart for irrigation, which leads to a decrease in groundwater recharge. Ineffective irrigation methods lead to land degradation, salinization, flooding and washout of the fertile soil layer.
2. During the operation of water intakes, a decrease in groundwater levels is observed, which, on the one hand, leads to the loss of a number of wells from operation due to their complete drainage; on the other hand, it allows draining areas with a high groundwater table, which leads to flooding of economically active areas - industrial sites and agricultural land. Also, an increase in the level of underground (ground) waters lead to the development of soil salinization processes, and as a consequence, the development of desertification in the regions.
3. One of the serious problems is the pollution of groundwater as a result of human activities within industrial areas and within urban and rural agglomerations.

These points lead to both a decrease in economic costs and an increase in them, which affects the cost of production.

Also, an important aspect is the deterioration of the quality of groundwater due to technogenic/anthropogenic human influence. In the course of pollution, not only the deterioration of water quality is observed, but also a decrease in their quantity (reserves) as a result of a decrease in the volume of quality water. This is especially true for shallow freshwaters.

One of the problems with the use of groundwater is the depletion of its resources. This is influenced by both anthropogenic human activities and the current situation with climate change, which negatively affects the processes of replenishing freshwater resources.

5. Field project status and feasibility for energy production and groundwater utilization

1. Coal deposit

The lands on which the deposit is located are classified as "inconvenient" for use in agriculture. Cultivation of crops is not possible due to the steepness of the slopes and the lack of streams and reservoirs. The volume of mining work and the remoteness of deposits from settlements will not affect the ecology of the environment and the area as a whole.

In the course of exploration work at the deposit, the structure, composition, conditions of occurrence and qualitative characteristics of the mineral have been sufficiently studied.

The scope of the geological exploration work performed was as follows: 18 wells were drilled; 16 ditches (4013.3 m3) were dug along 16 exploration profiles of 2000 m3 incisions, 759 samples were taken and analyzed to assess the quality of the coal. The adopted methodology and the scope of work performed made it possible to study the quality indicators and calculate the reserves for the field in the $C_1 + C_2$ categories.

Quantitative and qualitative characteristics have been studied with sufficient completeness and the required reliability. The coal reserves of the deposit are ready for industrial development.

The obtained values of maximum moisture capacity, hygroscopic moisture and actual density are typical for coal.

The coals of the deposit can be used as heat and power and in some technological areas, such as:

- for the production of generator gas in stationary gas generators;

- in the production of building materials (cement, brick, etc.);

- to obtain activated carbon.

The quality of coals is characterized on average by the following values: average ash content - 10.4%, average sulfur content - 0.88%, rather high calorific value, on average –32.81 MJ / kg (7536 kcal/kg). Thus, in general, coals can be characterized as low-, medium-ash, low-sulfur with good energy properties related to the SS grade, hard coal (according to SIBNII, Russia). The coals are environmentally friendly.

The hydrogeological and mining conditions of the deposit are favourable for opencast mining.

The deposit has good transport conditions; there are highways from the administrative centre to the quarry. There are no settlements, power lines, gas pipelines, bridges and other security facilities on the work area and in its immediate vicinity.

The supply of coal, fuel, building materials can fully satisfy the local market.

The deposit is currently being developed. Mining operations for the extraction of coal are carried out in the open pit of the first stage.

Based on the additional results obtained, a project for the development of a deposit with an open pit of higher productivity is currently being developed.

2. Groundwater resource

Groundwater deposit is located in the most economically developed region of the Republic. The beginning of hydrogeological research was associated with the growth of the economic development of the region and the gradual growth of the population and an increase in the number of industrial enterprises that needed both technological and household water. As a result of internal mass migration, new urban and rural agglomerations have been formed, which also require water supply with quality drinking water.

In the described area, work began before 1950 of the last century, and on the basis of the data obtained, using the results of generalizing the results of drilling wells, the first reserves estimate was made.

In 1964-66 the recalculation of the reserves of underground waters of the deposit was made, the reason for this was the growth of the population and the development of the industry. In 1973, there was another revaluation of reserves, and the last revaluation of reserves was carried out in 1995. Since that time, no work on revaluation of reserves has been carried out, although, according to the existing requirements, the lines of recalculation of reserves have already been approached. The reasons for this situation were: lack of full funding not only for specialized work on revaluation of groundwater reserves but also for ongoing work in the field of groundwater research; the absence (at the moment) of specialists in the calculation of groundwater reserves.

To calculate and recalculate the groundwater reserves at field 2, full complexes of geological and hydrogeological studies, hydrological and geophysical studies were carried out. The data of long-term experimental work were analyzed, which allowed later studies to clarify the previously established filtration parameters of the aquiferous complex of Quaternary sediments.

At the moment, the fixation of water use at this field is being carried out, as well as work is underway to control the quality of groundwater.

In the future, it is required to recalculate and clarify reserves both in this field and in other fields. Currently, reserves are taken into account for individual wells and springs, but not for fields as a whole.

6. Level of knowledge/confidence in estimates

1. Coal deposit

In the previous chapters, it was noted that a sufficient set of necessary types of work was completed at *coal deposit No.1* to be confident in the mineral resource base of the deposit, the quality of coal and the conditions for the development of the facility.

Direct development of the first stage open pit confirms the geological, hydrogeological, mining and geological and other conditions, which will greatly facilitate the task of rapid industrial development of the entire explored deposit.

Currently, a project is being drawn up and approved for the development of the field with a single open pit of high productivity.

2. Groundwater resource

As noted above, a full range of geological and hydrogeological studies was carried out at *groundwater project*, with a large volume of drilling, geophysical, chemical and analytical work. Also, information was obtained on the filtration properties of water-bearing rocks, and was carried out on isotopic studies of groundwater, a natural (conceptual) hydrogeological model of the deposit was drawn up and a geofiltration model of the deposit was compiled. A large volume of routine observations and observations of the state of groundwater has been processed.

All these works formed the basis for the recalculation of the reserves of this deposit.

Based on the work carried out, reserves (resources) at the groundwater deposit were estimated 2. The reserves were estimated at 0.8 million m^3 / day, including category A - 0.45 million m^3 / day, B - 0.3 million m^3 / day, C1 - 0.05 million m^3 / day.

7. Classification of the energy project and groundwater resources using UNFC

When considering groundwater deposits not only from the UNFC perspective but also from the perspective of other assessment systems, it should be borne in mind that energy resources (especially coal and peat) and groundwater play primarily a social role, which are taken into account in SDGs (Goal #6, #7, #9 and #12).

Looking at *coal deposit* from the UNFC perspective, it can be said that the deposit is being exploited for profit.

E axis.

The first of the criteria for evaluating a deposit according to the United Nations Framework Classification is the criterion of the environmental and socio-economic viability of the project.

As mentioned above, the commercial product that will be obtained during the development of the deposit will be coal, which can be used in various directions:

- heat and power raw materials;

- for the production of generator gas in stationary gas generators;

- in the production of building materials (cement, bricks, etc.);

- to obtain activated carbon.

Mining-geological, hydrogeological and mining-technical conditions of coal seam mining are not complicated and will not cause complications in open-pit mining. Overburden rocks, except for Quaternary ones, have good stability and high strength, which makes it necessary to mine the area using drilling and blasting operations and heavy equipment.

The economic efficiency of open-pit construction and field development is relatively good. Profitability, which is a measure of the economic efficiency of using fixed assets and working capital, and the payback period indicate a very good perspective of this project.

In the course of the development of *coal deposit*, in accordance with the requirements of the legislation of the Kyrgyz Republic, funds will be allocated to the local budget. These contributions will help improve the infrastructure of the region. In addition, 80% of workers are planned to be hired from among local residents, which will create conditions for improving the well-being of the population.

During the development of *coal deposit*, the main negative impact of the work is predicated on the atmospheric air, but given the remoteness of the field from settlements, this impact can be considered of low significance. The impact of the development on land and water resources is predicted to be of low significance.

Thus, no sharply negative impact on the environment during the development of *coal deposit No.1* is expected; the development company will take all measures to reduce the impact on the environment, as well as to prevent possible accidents. Open-pit mining is cost-effective, which corresponds to category E1 in the UNFC.

F axis

The next, but the no less important criterion for evaluating a deposit according to the United Nations Framework Classification is the criterion of the technical feasibility of a deposit development project.

At the moment, the field is developing coal in an open pit of the 1st stage, sufficiently detailed studies have been completed, which made it possible to draw up a development project for the entire field, which shows the technical feasibility of coal development. All parties associated with the project, including the government, committed themselves to the development (the State Committee for Industry, Energy and Subsoil Use of the Kyrgyz Republic) issued the Company a license for the right to use subsoil for the purpose of developing a coal deposit), which corresponds to the UNFC category F1.1.

G axis

The G-axis categories are intended to reflect the degree of confidence in the quantity of product, that is, all significant uncertainties (for example, geological uncertainty, uncertainty in the efficiency of the object, etc.) that affect the predictive estimate of the project. The number of uncertainty factors in relation to coal deposit can be attributed to the geological study of the coal seam.

The reserves at the field have been explored to categories $C_1 + C_2$, that is, along with a fairly sparse network. Thus, the distances between the lines are 1000-2000 m, and between the wells in the lines - 500-1000 m. The distances between mine workings on the surface along the profiles were 150-450 m.

The standards for calculating the coal reserves of *coal deposit No.1* were not calculated and were taken by analogy with another deposit located in a similar geological and geographical position, which is due to the similarity of the productive strata section and the quality of the coal, established according to the technical analysis of samples.

Taking into account the above, the reserves on the G axis according to the UNFC can be classified as G2.

In general, the reserves of the *coal deposit No.1* correspond to the UNFC category 1.1 1.1 2. Currently, these reserves are being mined in the open pit of the first stage, and a project for the development of the field as a whole has been drawn up. Thus, the status and validity of the project correspond to category F1.1.

Groundwater resource

Looking at *groundwater deposit* from the UNFC perspective, the following can be said.

It should be borne in mind that groundwater can be exploited both for the purpose of economic profit (bottling or as a technological process), and water supply to the general population without making a profit. In the second case, a significant role in financial costs falls on the state (exploration work, drilling, design, construction, commissioning and maintenance of the distribution network), the population actually pays only for the water itself.

In this review, we will consider the groundwater deposit as a source of water supply for the general population.

E axis

- considering the social significance of the exploitation of the groundwater deposit 2 and the low profitability of the ongoing projects, the groundwater deposit can be classified as E2, in some cases to E1.

F axis

- groundwater deposit two has been operated for a long time and projects for its exploitation are constantly updated, which is associated with the constant population growth in urban and rural agglomeration, on the basis of this, the deposit belongs to the F1 category.

G axis

- as described above, a huge complex for geological and hydrogeological studies was carried out at the field, the reliability of the data obtained can be characterized as high. Therefore the field can be classified as category G1.

Based on the above, the coding of the groundwater deposit can be 211 (to a greater extent) and 111 (in some cases), i.e. can be classified as potentially commercial and commercial projects.

8. Alignment to Sustainable Development Goals Implementation

Kyrgyzstan is a member of the United Nations, and in September 2015 it joined the new sustainable development program "Transforming Our World: The 2030 Agenda for Sustainable Development". This program includes 17 goals and 169 objectives that cover all major areas of social development.

In November 2018, the National Development Strategy of the Kyrgyz Republic for 2018-2040 was created. This strategy identified the main stages of development, including the mining industry.

Energy and water supply issues are among the first, which talk of their importance for the development of society and the reduction of poverty, a guarantee of

improving its health, one of the foundations of its well-being and creating conditions for expanding the labour market and increasing life expectancy.

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

The industry will develop in an integrated manner, effectively use its own mineral and raw materials and production base, while great importance will be given to the proportional location of enterprises throughout the country.

One of the main strategic directions of the social policy of the Kyrgyz Republic is to provide the population and other consumers with piped water and sanitation (sewerage).

It is necessary to achieve an increase in the efficiency of mining, the introduction of modern mining technologies with a minimum impact on the environment. The development of minerals should provide the formation of financial resources for development. Subsoil revenues should be directed not only to solving current problems, environmental development but also to strategic goals.

The priority will be the transition to the use of high-quality fuels, combined with the expansion of the use of alternative energy sources. The development of industrial zones in various regions will be encouraged.

In 2018, in the national development strategy of the Kyrgyz Republic for 2018-2040, the issue of water supply was also highlighted in a separate work program for the SDGs (3.2. Formation of a sustainable environment for development. Clean water).

Currently, a National Voluntary Review on Achieving the Sustainable Development Goals is being prepared [11], which will consider SDGs: # 6: Ensuring the availability and sustainable use of water resources and sanitation for all; # 12: Ensuring the transition to sustainable consumption and production.

Since 2015, the energy strategy of the Kyrgyz Republic has been actively developed. Overall, the strategy clearly addresses the SDGs – Goal # 7.

The Energy Strategy of the Kyrgyz Republic aims to ensure universal access to affordable, reliable, sustainable and modern energy sources for industry and all segments of the population.

For this, it is necessary to solve the following tasks:

• Ensure universal access to affordable, reliable and modern energy supplies.

Dozens of large and hundreds of small rivers and canals flow through the territory of the Kyrgyz Republic, into which thousands of high-mountain streams flow. With

a huge hydropower potential, which amounts to 142 billion kWh per year of electricity generation, only 10% of it is used.

At the same time, the hydropower potential of small rivers and watercourses is estimated by the possibility of generating electricity up to 8 billion kWh per year. For the conditions of Kyrgyzstan, the most promising areas of application of the hydropower potential of small watercourses should be considered decentralized facilities located in remote mountainous areas (farm, livestock complexes, geological and mining enterprises, road maintenance services, hydrometeorological, scientific and other observation stations, radio repeaters, tourist facilities recreational complex, pumping stations, forestry and hunting facilities, etc.), as well as residential buildings, social facilities, trade and consumer services, health institutions (hospitals, rest homes, boarding houses, health resorts, hotels, saunas, etc.), located in areas with centralized power supply. At the same time, the use of the energy of small streams should be considered not only from a purely ecological aspect but also from the point of view of solving socio-economic problems.

Currently, 16 small hydroelectric power plants are in operation, and there is a real interest of potential investors in the construction of new small hydroelectric power plants.

• Significantly increase the share of energy from renewable sources in the energy balance.

The use of hydropower from small streams - small rivers, streams and canals, related to renewable energy sources, are becoming especially important in connection with the problems of using fossil fuels, the tasks of saving them, as well as the global problem of climate change in connection with the emission of greenhouse gases into the atmosphere.

The operation of small hydroelectric power plants can have a significant impact on the energy situation in the Republic: an increase in electricity generation, unloading the power system in terms of capacity during peak load hours.

The greatest effect is to be expected in remote rural areas. This will significantly reduce the dependence of remote and rural areas on fuel supplies.

Studies carried out in the Kyrgyz Republic have shown that the hydropower potential of small rivers in all its regions in the near future makes it possible to build new small HPPs with a total capacity with an average annual output of over 1.0 billion kWh of electricity.

To obtain energy from environmentally friendly renewable energy sources, it is necessary to use installations that convert the energy of these sources into any other type of energy, which is primarily aimed at improving the power supply of relatively small objects located in areas remote from centralized electric and heat networks, oil and gas pipelines.

The potential resources of renewable energy sources in the Kyrgyz Republic are:

- small hydropower - 5-8 billion kWh / year,

- wind farms - 44.6 million kWh / year,
- solar - 490 million kWh / year,
- biomass - 1.3 billion kWh / year.

However, the practical use of RES in Kyrgyzstan is less than 1%.

The main problems in using the potential of renewable energy sources are as follows.

Economic: price and tariff policy for energy resources; lack of investment by both the state and consumers; lack of interaction between the private sector and the state; an insufficient level of diversification of energy supply sources.

Informational: a low level of awareness of all strata of society and the population about the benefits of the economical use of energy resources and the consequences of their wasteful consumption and theft.

Regulatory and legal: despite the definition in the laws of economic mechanisms that promote the development of this area, their widespread use in practice for the formation of investment potential due to low tariffs is just beginning.

• Increase the rate of improvement in energy efficiency.

The Kyrgyz Republic has a huge potential for increasing energy efficiency and energy-saving, which is estimated at 40-46% of the total energy consumption.

The technical potential of energy efficiency for the industry is, according to various estimates, about 11.2% of the annual energy consumption

The technical potential for energy efficiency in residential buildings accounts for about 88.1% of annual energy consumption.

• Increase international cooperation to facilitate access to research and technology in clean energy, including renewable energy, energy efficiency and the introduction of advanced and cleaner fossil fuel technologies, and encourage investment in energy infrastructure and clean energy technologies.

Electricity Policy Objectives:

- coordination of activities for the formation and maintenance of the state system of long-term forecasting of supply and demand in the wholesale and retail markets for electricity and capacity, including the development of a forecast for the balance of electricity, including in the context of regions and a system of measures aimed at meeting the needs of the economy in electricity energy;

- development of programs for the future development of the electric power industry;

- development of territorial planning schemes for electric power facilities;

- monitoring in order to predict a possible shortage of electric power, preparation and implementation of proposals for the formation of favorable conditions for capital investments or, if necessary, for state investments in the construction of electric power facilities in order to prevent the occurrence of a shortage of electric power;

- monitoring of implementation and preparation of proposals for adjusting strategic documents for the development of the electric power industry;

- formation of a set of measures to ensure the achievement of the development goals of the electric power industry;

- preparation of information and analytical materials in the field of development of the electric power industry;

- preparation of normative acts in the field of the development of the electric power industry in the medium and long term;

- development of measures for the modernization and reconstruction of power plants, substations, power lines and other power facilities.

9. Conclusions on UNFC classification of integrated energy and groundwater resource project(s) in Kyrgyzstan

Considering the classification of the UNFC, the following can be said:

1. The UNFC serves as a global information exchange tool that can be applied across all mining activities, covering water, solid minerals and fossil energy resources, including coal.

2. According to the UNFC classification, many factors can be taken into account when evaluating deposits (especially solid minerals); it gives a multifactorial assessment, which is quite simple to understand, and does not lead to a double interpretation of the situation.

3. The UNFC classification system is good in that it can provide a well-linked characterization of the deposit with the SDG goals, and that allows project implementers (most often states) to develop good SDG practices and principles.

4. In the Kyrgyz Republic there is no single classification for energy and mineral resources, therefore, the adoption of the UNFC through Bridging Document to the respective energy and mineral classifications as a first step will provide an opportunity to unite the two largest industries, which will form a single picture of all reserves of mineral and hydrocarbon raw materials.

5. In addition, the adoption of the UNFC will provide an 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.

But there are nuances. As mentioned above, the UNFC works well with solid minerals, but there are some difficulties (inconveniences) with the assessment of groundwater. So one deposit can fall into three areas with different degrees of readiness for development, with different geological, hydrogeological and specific knowledge. Then the field must be given 2-3 codes. Which leads to the "confusion" of the user by the subsoil.

In general, the operationalization of the UNFC requires:

(1) Formal decision to implement or implement the UNFC system initially through Bridging Documents;

(2) Memorandum of Understanding between UNECE and the Government of the Kyrgyz Republic;

(3) The transition to the UNFC, through Bridging Documents, should be carried out by the state department for geology and subsoil use of the Kyrgyz Republic;

(4) Order on the creation of a national group of experts on the harmonization of classification systems of Kyrgyzstan with the UNFC;

(5) Training of domestic professional staff on the implementation or application of the UNFC system;

(6) Professional training of government personnel (government, academy, a public company, etc.) in the implementation and application of the UNFC and UNECE framework.

In any case, Kyrgyzstan needs to finalize or revise the "Mining Code" and "Water Code", create and introduce a system of classification of reserves and resources of groundwater. The new classification system could be linked to the UNFC. And if we take into account that this system is gradually gaining weight, clearer rules of the "game" appear for the business community, which in turn will allow obtaining the necessary funding not only for "water" projects but also for projects for the development of solid minerals.

It takes time to adapt to the New Classification in Kyrgyzstan. The issue of adaptation and successful application of the UNFC in Kyrgyzstan requires optimal close interaction between the state and the subsoil user and the corresponding geopolitical, economic and technological platform.

The UNFC system, in comparison with the Reserves Classification in the Kyrgyz Republic, has some disadvantages, the main one of which is:

The main focus of the UNFC is focused on the economic indicators of the fields, while the geological feature of each object is unique and special in its own way. So in the Classification of reserves in the Kyrgyz Republic, groups are distinguished based on the complexity of the geological structure, which determines, regardless of the degree of exploration, the direction of further development of the field;

As practice shows, further development of deposits entails a number of other not unimportant problems. In the Kyrgyz Republic, there are often protests of local residents against the development of deposits. This aspect has recently gained a regular character, which complicates further investment. This, in our opinion, is

currently one of the important points that must be taken into account in the classification or grouping of deposits. Especially for the Kyrgyz Republic, this aspect should be considered as one of the sub-items when classifying deposits.

The classification of reserves currently used in the Kyrgyz Republic is based on the classification inherited from the times of the ex-USSR. At that time, social, environmental and a number of similar features were not considered as important. The main task was to provide processing plants and plants with the necessary raw materials.

As stated above, the present world order requires paying special attention to social, environmental consequences, as well as the introduction of safer and more technologically advanced production systems.

Thus, the implementation of the UNFC system should be consistent. It is not yet possible to completely abandon the current system of the National Classification for Energy and Mineral Reserves and Resources and switch to the United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources. This will require an analysis of all geological and technical and economic materials left over from the times of the USSR, and this is a very large amount of geological materials.

On the other hand, for the Kyrgyz Republic, the use of the UNFC provides a number of advantages, in particular, for attracting foreign investors who adopt UNFC standards. The application of the UNFC will provide complete information about the deposits and their valuation.

Currently, in the Kyrgyz Republic, a division of deposits is used according to the prospects and quantitative reserves of deposits, according to national significance.

• Competitive objects are objects that have reliably estimated reserves (for example, gold in an amount of at least 10 tons) and prepared for industrial development;

• Auction objects - objects with prospects for further industrial development or geological exploration, in which preliminary estimated or reliable reserves have been identified;

• Objects that are issued at the request of subsoil users by direct negotiations. These objects must be free and not included in the list of competitive, auction objects and on the territory of other subsoil users.

In general, the application of the UNFC system in the Kyrgyz Republic will give positive dynamics in the development of the country's mining sector. But as mentioned above, a full transition to the UNFC system at this time is impossible, the harmonization of the national classification, as well as various NLA and legislation of the Kyrgyz Republic is required. In addition, an analysis of the entire vast base of

geological and technical and economic materials left over from the times of the ex-USSR will be required. However, the UNFC assessment of large energy and mineral facilities of the country will allow attracting larger bona fide investments in the development of the country's economy, assessing state assets at the international level.

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[1] When compiling this report, the author used a large amount of literature from geological funds, which, for confidentiality purposes, are not referenced.

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