

REVIEW OF THE COAL SECTOR IN REPUBLIC OF TAJIKISTAN



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Brief Historical Background

The earth's depths of the Republic of Tajikistan are rich in coal. This was first mentioned in the notes of the Arab travelers of the 10th century. Deep study of the national resources started in the middle of the XVIII century. The description of specific deposits started with Shuraba in 1902 when three locations were specified, the geological map was drawn and the estimation of reserves was made. The systematic study of coal deposits in Tajikistan by geologists began in 1928.

According to the latest geological data, there are over 36 deposits and occurrences of coal in Tajikistan which represent all sorts of this solid fossil fuel: from lignite to hard coal, including coking coal and anthracite. Ultimate reserves of these deposits and occurrences exceed 4.3 billion tons. The coal deposits of Tajikistan have been studied unevenly and to quite low extent.

Artisanal mining started in 1901 on the Shurab I area, by 1910 the amount of production reached 15 thousand tons. Until the second half of the 1980s, the coal industry of the republic and its raw material resources base were systematically developed. The fastest growth rates were recorded in 1986-1992, when the explored reserves increased almost 10 times (respectively, 0.026 billion tons and 0.29 billion tons).

Production dynamics, however, show the opposite: in 1988, production decreased and amounted to 77.7% of production in 1970, and in 1996 it was only 40% of the production in 1990. Later on until 1994 the amount of reserves and production level have developed although at a slow pace. Since 1994, the amount of forecast resources and explored coal reserves have changed insignificantly. From 1991 to 2000 the extraction of coal decreased from 500 thousand tons per year to 20 thousand tons per year.

Obvious is the fact that the abrupt transition in 1990-2000 from the centrally planned economy to the free market economy without the effective system of state regulation and control, as well as civil war (1992-1997) led the republic to the deepest economic crisis, a sharp decline in production, including in the fuel and energy complex.

As of the beginning of 1993 the Republic of Tajikistan as part of the USSR had the following data on coal: forecast resources - 3.39 billion tons, explored reserves - 0.29 billion tons. Coal production in 1970 amounted to 0.9 million tons, in 1988 - 0.7 million tons, in 1990 - 0.5 million tons. That is, in the Soviet era 600-700 thousand tons of coal were produced annually in the Republic of Tajikistan, and its annual consumption in the national economy reached 1.5 million tons. After the collapse of the Soviet Union and until 2001 the mines Fan-Yagnob and Shurab operated with annual production of 20.6 thousand tons of coal. The forecast resources and the explored coal reserves in the republic have changed little since 1993.

In 1997, the Government of Tajikistan approved the Coal Industry Development Program for the period 1998-2010, according to which coal production in the country in 2001 was planned at level of 1.1 million tons, although in fact it reached 26,000 tons of coal. This coal was mainly used for heating purposes.

In 2001, the Government approved the Concept for the Development of the Fuel and Energy Infrastructure of the Republic of Tajikistan for 2003-2015. According to this program, it was planned to produce 300,000 tons of coal by 2005, but in fact only about 90,000 tons were produced. The main factor hampering the successful implementation of these programs (in the opinion of the officials responsible for the extraction of coal) in both cases was the lack of financial resources, including foreign investments in the coal industry of Tajikistan.

Coal deposits of Tajikistan

Coal deposits of Tajikistan are concentrated in two coal basins: Tajik (Gissar-Darvaz) and Fergana. The first of them covers the absolute majority of deposits and occurrences concentrated in Central and Southern Tajikistan. Deposits and occurrences of Northern Tajikistan belong to the South Fergana coal basin.

The coal deposits of the Tajik coal basin in the vast majority of cases are exposed in the mountain ranges of the Tien Shan and Pamir-Alay, framing the Afghan-Tajik basin. The industrial potential of the Tajik coal basin is significant. In its limits there is a unique Nazar-Ailok deposit with low-ash and low-sulfur anthracites, large in Central Asia coking coal deposit Fan-Yagnob and a whole group of small areas of hard coal - energy and chemical raw material.

Six coal basins are distinguished in the Central Asian coal-bearing province: Gissar-Darvaz, South Fergana, East Fergana, North Fergana, Kavak and Issyk-Kul. The basins are divided into coal areas, and the latter - into deposits, including plots, grounds and fields. The carbon content of the deposits and occurrences of Tajikistan is confined to the Lower Middle Jurassic deposits, and only the coal of the Miyonadu deposit – to the Middle-Upper Triassic sediments. According to the amount of coal reserves, all the deposits of the republic belong to the group of small ones (up to 50 million tons), except the Fan-Yagnob deposit belonging to the group of medium deposits.

On the territory of Tajikistan there are four regions of development of carbonaceous deposits, each one has a number of characteristic features according to geological zoning:

1. Zarafshan-Hissar
2. South-Hissar
3. The Pamir Darvaz
4. South-Fergana

The biggest, largest in acreage coal-bearing area that has the maximum number of coal veins is Zarafshan-Hissar. The coal-bearing strata extends in almost uninterrupted strip from Penjikent to the river head of the Zarafshan River. Here there are three coal zones:

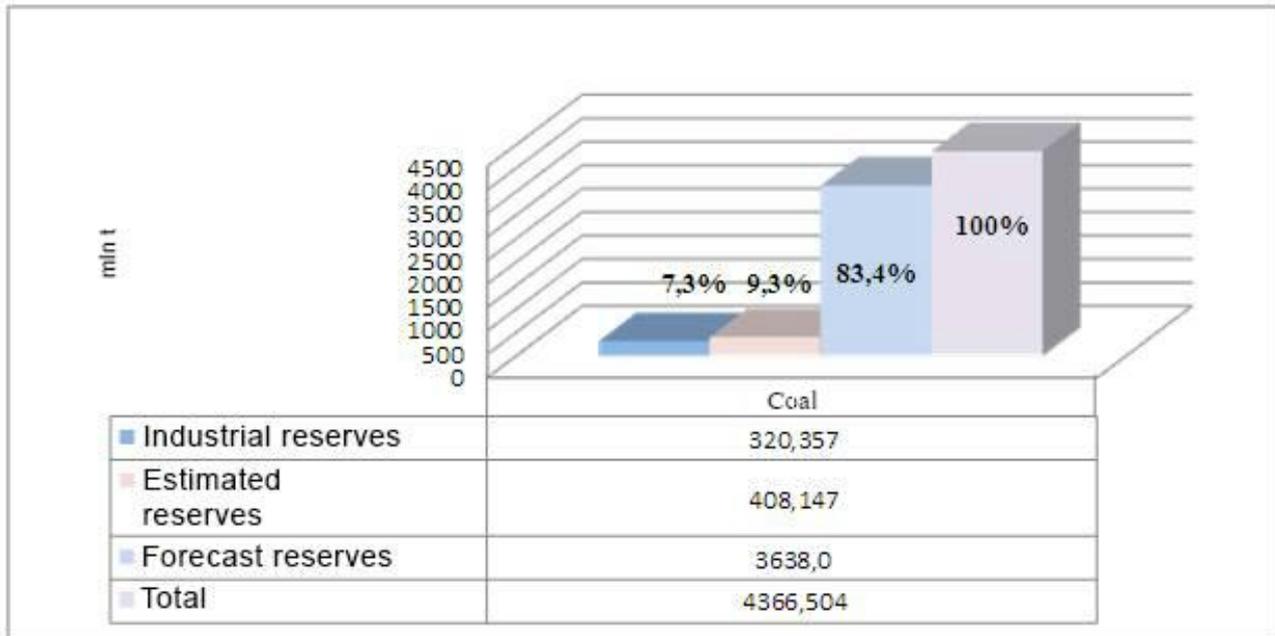
1. Western zone includes the deposits: Kshtut-Zauran, Shishkat, Magian, Tavasang and occurrences Revat, Vashan, Obi Loy, Zarkhok, Voru.
2. Central one is represented by the Fan-Yagnob deposit and the occurrences Margib, Varsout, Tagobi-Kul.
3. Eastern zone includes the deposits Guzn, Nazar-Ailok and occurrences Surhat, Guvin, Darh, Arsaut, Kamol Khodja, Revut.

The Republic of Tajikistan is rich in coals located in various parts of its territory. According to the Ministry of Industry and New Technologies, coal reserves are sufficient not only to satisfy the needs of fuel and energy complex for decades, but also to create a chemical industry.

Out of 40 deposits and occurrences of coal known at the territory of Tajikistan, only two have been studied in detail: Shurab and Fan-Yagnob. Except of the Fan-Yagnob all other deposits of the republic belong to the group of small ones (up to 50 million tons). In a number of deposits there were carried out preliminary exploration and audit works. At some deposits mining operations were carried out at different time (Ziddi, Nazar-Ailok, Miyonadu, Magian, Kshtut-Zauran, Tashkutan, Suffa, Shuroobod, Ravnov).

Tajikistan has over 4.3 billion tons of potential coal resources, out of which 320.3 million tons are industrial reserves of coal of high calorific value.

Accounting stock of coal reserves in the Republic of Tajikistan



The main share of the coal reserves of the country falls on the coal deposit Fan-Yagnob, where the calorific value of coal is 7936-8463 kcal / kg. The second in terms of coal reserves is the brown coal deposit Shurab with coals of black color that have calorific value of 4000 kcal / kg.

The Nazar-Ailok deposit with high-quality anthracite belongs to the unique coal deposits in the world. The calorific value of this coal is 7282-9100 kcal / kg, and the ash content is not more than 2%. These coal reserves can be used in a wide range of industries. As for today, despite such high calorific value, coal is basically used for heating needs.

Current state of the coal sector

The coal industry of the Republic of Tajikistan is characterized by a diversity in geographical location, mining and geological conditions as well as level of technological infrastructure of mines and open-cast mines. Mines and open-cast mines are located mainly in high-mountainous and submontane areas. There are different methods used at mines and open-cast mines to open and prepare mine and open pit fields, different systems for the development of deposits, means of cleaning and preparatory work, and other production processes. However, the overall technical level of production, technical and economic indexes of enterprises are low and require long-term improvement.

The annual volume of coal production in the Republic of Tajikistan during Soviet period of was about 1 million tons with an annual demand of the national economy of about 1.5 million tons. In the period until 2001 only Fan-Yagnob and Shurab coal mines operated with an annual average production of 20.6 thousand tons of coal. The coal production reached its maximum in 1979 and constituted 980 840 tons. The decline in coal production began in the eighties and in 1991 it was at level of 313 000 tons. This was due to the collapse of the Soviet Union and the cessation of centralized supplies of equipment and government subsidies, which also had a negative impact on coal production (in 1997 there were produced only 17 000 tons).

MINING SECTOR

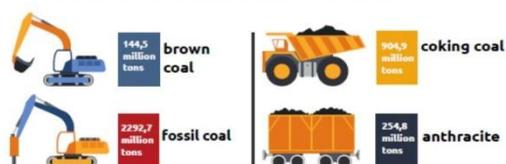
COAL



Tajikistan possesses 4 areas of coal-bearing strata exploration (deposits), with each area having a number of characteristics of geological zones:

There are 40 deposits and occurrences of coal with all varieties of this type of solid fuel

Total expected coal reserves are estimated at **4.3 billion tons:**



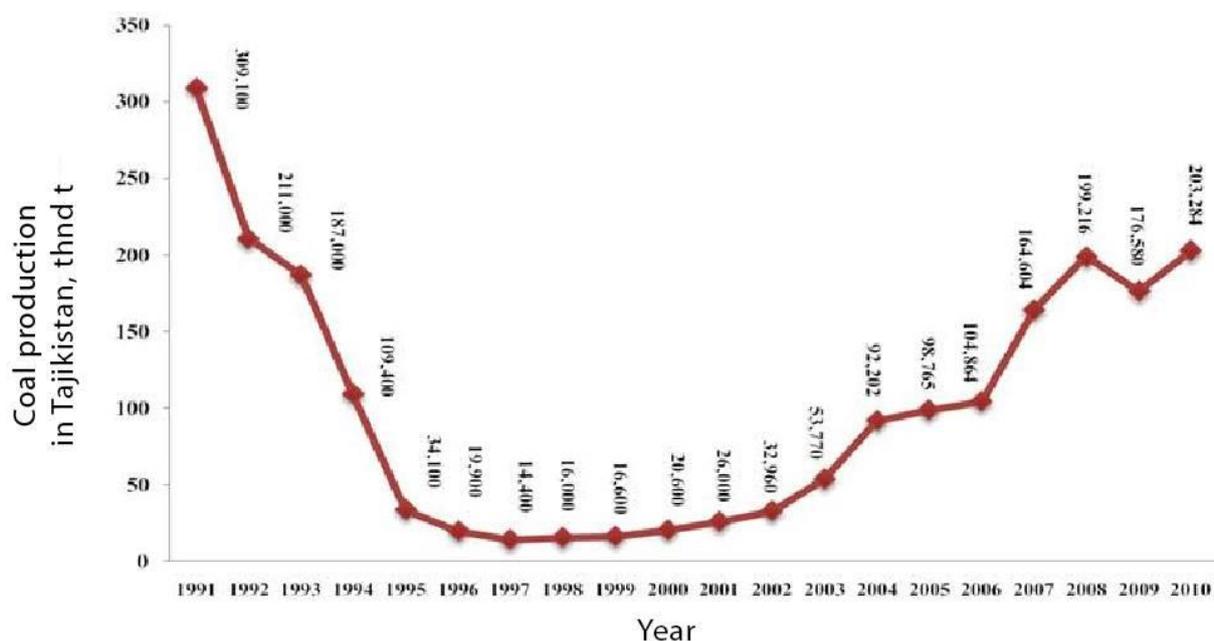
In the years of independence, due to the shortage of electricity and natural gas, the demand for coal has increased. Despite the large coal reserves according to the statistical data it was imported to the republic in amount: in 2005 – 3 130 tons, in 2006 – 2 082 tons, in 2007 – about 6 000 tons, in 2008 – 18 000 tons, in 2009 – 3 690 tons and in 2010 – 6 700 tons.

Due to the insufficient technical update of fixed assets in the mines, the lack of an effective potential of coal production, partly due to the low-quality reserves that don't meet standards and conditions of mining and geological work (reservoir thickness, its bedding, etc.) there were reopened previously liquidated or put on hold enterprises (coal deposits and occurrences of Toshkutan, Chashmasang, Ravnov, Mogiyon and others). Currently there are 6 state and 13 non-state enterprises operating at 14 deposits and coal occurrences producing coal in mines and open cast mines.

The level of industrial and technical potential of the coal industry in comparison with the enterprises of neighboring coal-mining countries is low. Especially significant lag is noted in the underground coal mining process. The state of the open-cast mines fund that provides 70% of the total coal production requires improvements too. The production capacity here is only used by 40-50%.

For the development of the coal industry in the period 2003-2010 the Government of the Republic of Tajikistan allocated financial support to coal mining enterprises in the amount of 5 million 133 thousand somoni and 1 million 220 thousand somoni for geological exploration works. Thus, coal production in 2007 reached 164.7 thousand tons which in comparison with 2000 indicates an increase in volumes of more than 8 times.

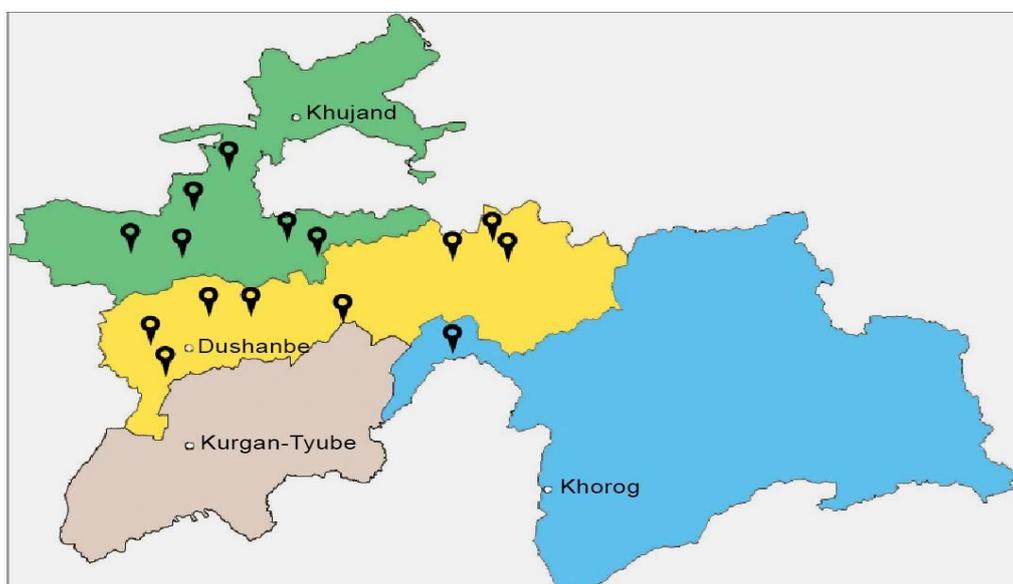
Coal mining in Tajikistan in the period from 1991 to 2010



In Tajikistan, two deposits with their plots are being developed by shaft and mine gallery methods, and 12 deposits – by open-cast method on 17 open-cast mines. There are 8 operating enterprises at the territory of the Sughd region: OJSC Angisht (Shurab deposit), state enterprise Fan-Yagnob Mine (Eastern flank of the Fan-Yagnob deposit), Talco-Resource LLC (West and Central flank of the Fan-Yagnob deposit), the Coal Mining Department of Metallurgical Plant LLC (the Central flank of the Fan-Yagnob deposit, the Rovat plot), Dion Angishti Tojikiston LLC (Mogiyon deposit), Koni Angishti Guzn LLC (Guzn deposit), TA Anzob LLC Ugolnaya mine gallery (Western ground of the Fan-Yagnob deposit).

There are 9 enterprises operating at the territory of the republic: state enterprise KA Ziddi (West flank of the Ziddi deposit), Sanggalt LLC (East flank of the Ziddi deposit), state enterprise KA Nazar-Ailok (Shikor-Khona plot of Nazar-Ailok deposit), Kamarob LLC (Kaftarhona site of Nazar-Ailok deposit), Shirkati Tichoratii Saiod LLC (Saiod coal-occurrence), Vuromun LLC (Miyonado deposit), Ganch LLC (Chashmai-Sang coal-occurrence), state enterprise KA Toshkutan (Toshkutan deposit), Anavak LLC (Hakimi coal-occurrence). In the Khatlon region there is a state enterprise KA Shuroobod (Shuroobod deposit) and in Gorno-Badakhshan region – VTI-Pomir LLC (Ravnov deposit).

The main areas of coal mining in Tajikistan



The authorities of the republic believe that the availability of raw materials and abundant known coal reserves create conditions for their widespread use, both in the energy and industrial sectors. Today, more than 200 industrial and energy enterprises use coal as an alternative technological fuel, replacing natural gas. These measures have reduced the dependence of the republic's economy on the import of natural gas and oil products. And an efficient use of coal, and subsequent development of the chemical industry and non-ferrous metallurgy, can lead the country to the raise in economic development. It should be noted that the main consumers of coal are:

- Energy sector (TPP, boiler stations 45%);
- Industrial enterprises (41%);
- Population (11%);
- Budgetary organizations (3%).

It is planned to create conditions in Tajikistan to build up 3 interconnected industrial chains that would use different types of coal, including:

- A) coal - electric power production - production of construction materials;
- B) coking coal - coke - products for the chemical industry;
- C) coal - gasification - production of mineral fertilizers.



Carierny plot. View from the opposite side, the western flank of the eastern ground of the Fan-Yagnob deposit

State bodies responsible for the development of the coal sector

Until 2013, the Ministry of Energy and Industry was responsible for carrying out state policy and legal regulation in the sphere of the fuel and energy, industrial and defense-industrial complexes, technical and technological regulation of construction materials production, food and processing industries.

The Ministry of Industry and New Technologies was established according to the Presidential Decree No. 12 of 2013. All tasks related to industry were delegated from the Ministry of Energy and Industry and to the Ministry of Industry and New Technologies. Since 2013 the latter is also an authorized state body in the field of innovation (Government Decree No. 38 of 2013).

The Ministry of Industry and New Technologies of the Republic of Tajikistan is the central executive body responsible for maintaining of a unified state policy and legal regulation in the spheres of industry, fuel complex and the development of new technologies, including the defense industry, machine-building industry, metal processing and chemistry, ores, construction materials, coal, food and processing industries.

In the structure of the Ministry there is the Office of the Coal Industry, which maintains a unified state policy and legal regulation in the coal industry. The Office manages, coordinates and controls the activities of coal organizations and enterprises, regardless of ownership and departmental subordination.

In addition there is the state unitary enterprise Angishti Tojik (Tajik coal) operating in the newly formed Ministry. In particular, SUE Angishti Tojik manages state enterprises of the coal industry, analyzes their financial and economic activities, participates in the work of commissions on privatization of state enterprises of the coal industry. Together with local authorities it monitors the fulfillment of the terms of licenses for the use of mineral resources and in conjunction with the Ministry of Finance exercises control over the distribution and designated use of state financial support to the coal industry.

Involvement of investors, coordination and implementation of investment proposals for the construction of industrial and processing enterprises, the issuance of licenses lay within the competence of the Ministry and other authorized bodies under the final decision of the Government of the Republic of Tajikistan.

On the basis of approved investment agreements and projects for the construction of coal mines and the development of open-cast mines the State Unitary Enterprise Angishti Tojik performs management and timely implementation of production processes, supervision of the compliance with the requirements specified in the agreement, and the submission of relevant reports and information to the Ministry.

According to the requirements of sectoral regulations and instructions the engineering investigations in case of accidents and accidents at production facilities are initiated by the order of the Ministry. They are carried out by structures of the State Technical Mines Inspectorate and representatives of trade union organizations. After completing the investigation and determining the causes of accidents and misbreaks, a relevant act is drawn up, the amount of loss is calculated and follow-up remedial action is described in a separate decree.

Legislative framework

Given the opportunities for coal mining, the Government of Tajikistan has created a legislative base for the development of the mining industry. In particular, the following laws were adopted or amended: "On the investment agreement" (March 2013), "On concessions" (December 2011), "On licensing of certain types of activities" (April 2004 with a number of additions and changes in subsequent years), "On mineral resources" (July 1994 with changes in 2010 and 2013), "On Coal" (April 2012). The following documents were adopted: the Decree of the Government of the Republic of Tajikistan "On Measures for the Development of the Coal Industry of the Republic of Tajikistan in the Period 1998-2010", the Concept for the Development of the Fuel and Energy Complex of the Republic of Tajikistan in the Period 2003-2015, Uniform Rules for the Development of Deposits and Mineral Resources Use, Uniform Safety Rules for Mining and Exploration, as well as a number of other acts.

The concept of the development of the coal industry of the Republic of Tajikistan in the period until 2010 was aimed first of all at overcoming the industry crisis and turning it into the stable and developed one in the fuel and energy complex. Also it was aimed to improve the performance of coal-mining enterprises and organizations, the create of new enterprises for the extraction and exploitation of coal, development and update of the material and technical base of coal-mining enterprises and organizations, strengthening of the position of the coal industry among other fuel and energy industries, and thus creating favorable conditions to increase the capacity of the industry.

In the period 2005-2010 the coal industry policy in was aimed to following tasks:

- Strengthening of coal mining enterprises and provision of state financial support to them;
- Geological study of new coal deposits, creation of new coal mining enterprises;
- Exploration of the geological structure, the qualitative characteristics of coal veins and increase of industrial reserves;
- Restoration of technical facilities and provision of enterprises with modern equipment;
- Improvement of the industrial and technical base and infrastructure of the coal industry.

On April 4, 2012, the "Law on Coal" was adopted in Tajikistan, aimed at intensive extraction of this fuel and attraction of investments in this sector. On April 20, 2012, the head of state, Mr. E. Rahmon, in his communication to the Majlisi Oli (Parliament) of the Republic of Tajikistan made a statement in which he noted in particular: "... it is possible to meet the economy's demand for combustible materials through the efficient coal mining, and widespread use of coal in industry as an alternative energy source."

Since May 1, 2012, Tajikistan has banned the export of coal. The relevant decree was adopted by the Government of Tajikistan on April 27, 2012. However, in July 2013, Minister of Economic Development and Trade Sh. Rakhimzoda said that after the accession of Tajikistan to the World Trade Organization, some normative acts were automatically annulled, in particular, the decree on imposing a ban on the export of coal.

Investments in the coal industry

After creating investment friendly climate the financial support of the coal sector in the republic was resumed both from the side of the government and foreign and national investors. As a result, the number of coal mining organizations increased. At the same time, it became possible to update the material and technical base of these organizations.

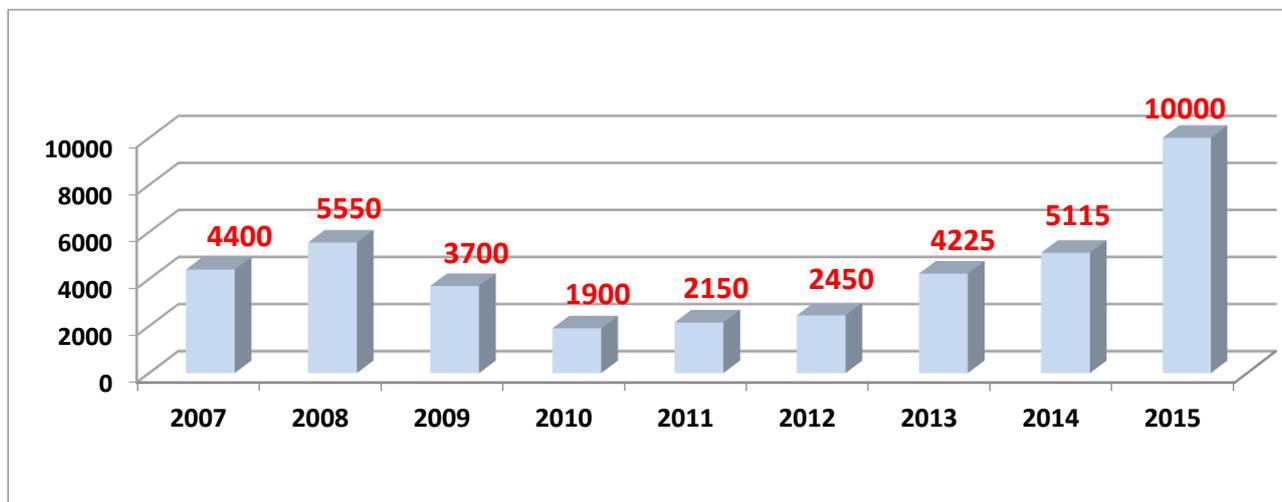
As a result of efforts create to new potentials and raise efficiency in the coal industry the number of enterprises has reached 19. Most of them were created due to support of national and foreign investors, who in the period of 2007-2015 invested more than 40 million US dollars for purchase of special mining equipment. Until 2014 the coal industry has been receiving state financial support in the amount of 1.2 million somoni annually. In 2007, for the first time, there was introduced a technology to produce briquettes and export coal to Afghanistan and Pakistan. As well in 2013, the technology of synthesis of coal gas was used to provide the SUE Talco (aluminum plant) and the boiler station Vostochnaya with fuel.



Synthesis of coal gas production facility, SUE Talco

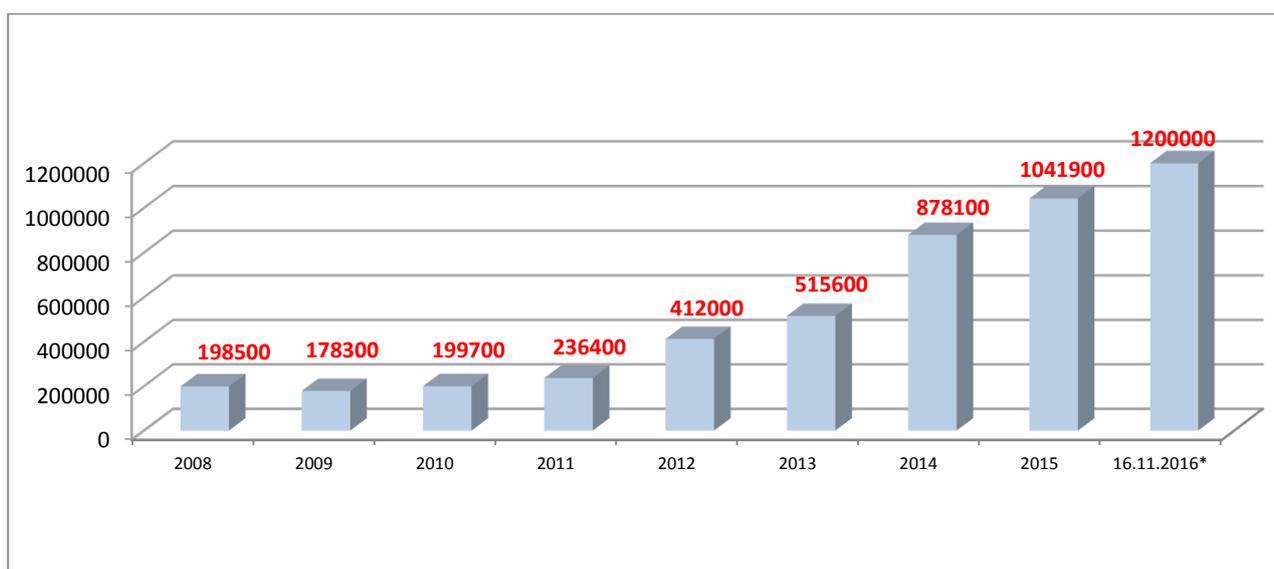
A number of contracted foreign companies Sadlbek Gold Corporation LLC (England), KeTaKa LLC (China-Tajikistan-Kazakhstan), Rovat LLC (India), Teng-Long LLC (China), Dion Angishti Tochikiston LLC (USA), Kaysun Mining Corporation LLC, Rostovgiproshakht LLC during the last 5-7 years financed projects in the coal sector of the republic's industry. Foreign companies made a financial contribution to the development of such coal deposits as: Nazar-Ailok, Fan-Yagnob, Ziddi, Miyonado, Ravnov and Shurab.

Attraction of domestic and foreign investments in 2007-2015 (in US dollars)



As a result of measures taken in recent years coal production has gradually increased and reached 1 million 41 thousand tons in 2015. This is the highest indicator for the period of independence of the country and in the history of the republic, it is 3.3 times higher than the one in 1991. The main share of coal is produced by the following state and private enterprises: unitary enterprise Fan-Yagnob Mine (57.7%), Talco-Resource LLC (13.1%), unitary enterprise Koni Angishti Ziddi (11.2%), OJSC Angisht (5.6%), unitary enterprise Nazar-Ailok (5%), Sayod LLC (3.2%) and 4.2% by other enterprises.

Coal production in the period from 2008 to 2016 (thousand tons)



* Source: Tajikistan national news agency Khovar. 16.11.16.

Prospects of the coal industry for the period 2010-2020 are aimed at the following tasks:

- To create an up-to-date coal mining complex, which would cover in full the needs of the national economy;
- To transform and update the industrial and technical base of the enterprises of the coal industry;
- To attract local and foreign investors, as well as commercial banks for the development of the coal industry;
- To study non-traditional methods of using coal as an alternative type of energy;
- To carry out geological exploration works to increase industrial reserves.
- To create favorable conditions for coal-mining enterprises, so that by 2020 the production capacity of the coal industry covers not only the needs of the national economy, but also permits to export coal and coal products.

New combined heat and power plants on coal

Tajikistan has a constant shortage of electricity during the cold season. As a country where 96% of electricity is produced by hydropower, which is clearly seasonal, Tajikistan produces more electricity in summer than it consumes, and in winter, on the contrary, it suffers from an acute electricity shortage (due to a sharp drop in water level in reservoirs and growing demand for energy). Every year in the cold season the republic lacks about 2.5-3 billion kW/h (data for 2014).

According to the UNDP estimates about 1 million people out of 8 million population of Tajikistan (mainly in rural areas) experience constant difficulties due to limited access to electricity and other energy sources. And according to the World Bank approximately 70% of the population suffers from widespread electricity shortages in winter.

In order to reduce energy dependence on other states, increase the energy security of the republic and ensure the growing demand of industrial enterprises and the population for electricity and heat, the government decided to increase coal production and transfer boiler stations in the cities and combined heat and power plants to new technologies based on coal combustion.

Combined heat and power plant Dushanbe-2

The construction of the first stage of the Dushanbe-2 CHPP (in the capital of the republic) began in November 2012 after signing of an interstate agreement between Tajikistan and China. In January 2014 the ceremony of launching of the first stage of the CHPP, which consists of two power generating boilers with a total capacity of 100 megawatts (or about 2.5 million kW/h of electricity per day) was held. This CHPP uses local coal.

The first stone for the foundation of the second stage of a 300 MW CHP plant was laid by the President, Emomali Rahmon, and the President of China, Xi Jinping, in September 2014. The total cost of the second stage of the Dushanbe-2 CHPP is about \$ 350 million, 80% of which is allocated as a concessional loan by the Export-Import Bank of China, and the rest is financed by the energy holding company Barki Tochik. All the necessary equipment was produced in China and shipped to Dushanbe. The second stage of the Dushanbe-2 CHPP was launched in December 2016. The main contractor of the construction is the Chinese company Tebian Apparatus Stoc Co. (TEBA). Now the total capacity of the combined heat and power plant has reached 400 MW.

According to official data, two filtration systems are installed at the facility – woven and electric ones, which ensure a low level of emissions of combustion products into the atmosphere. Special gas purifiers process up to 99.8% of emissions, and the solid waste of CHPP will be used in the production of construction materials.

Projects for the construction of new coal-fired power plants

The investment projects in the industry foresee the development of the largest coking coal deposit Fan-Yagnob, the construction of the Shikor-Khona open-cast mine at the Nazar-Ailok deposit, and the comprehensive development of the Ziddi deposit to support the Dushanbe-2 CHPP.

It is expected that coal will be widely used to produce electricity, coke and liquid fuels, which will not only cover the republic's demand for fuel, but will also contribute to achieving energy independence. The share of coal in the fuel balance of the republic by 2021 may increase up to 3.3 million tons. The demand for coal fuel can be covered by the coal mining enterprises of state enterprise Fan-Yagnob Mine, OJSC Angisht", Talco-Resource LLC and unitary enterprise Ziddi. For the period up to 2021 it is planned to construct 700 MW of new installed capacities at power plants that are fueled by Fan-Yagnob coal reserves and 300 MW – at the plants that are fueled by the coal from Shurab deposit.

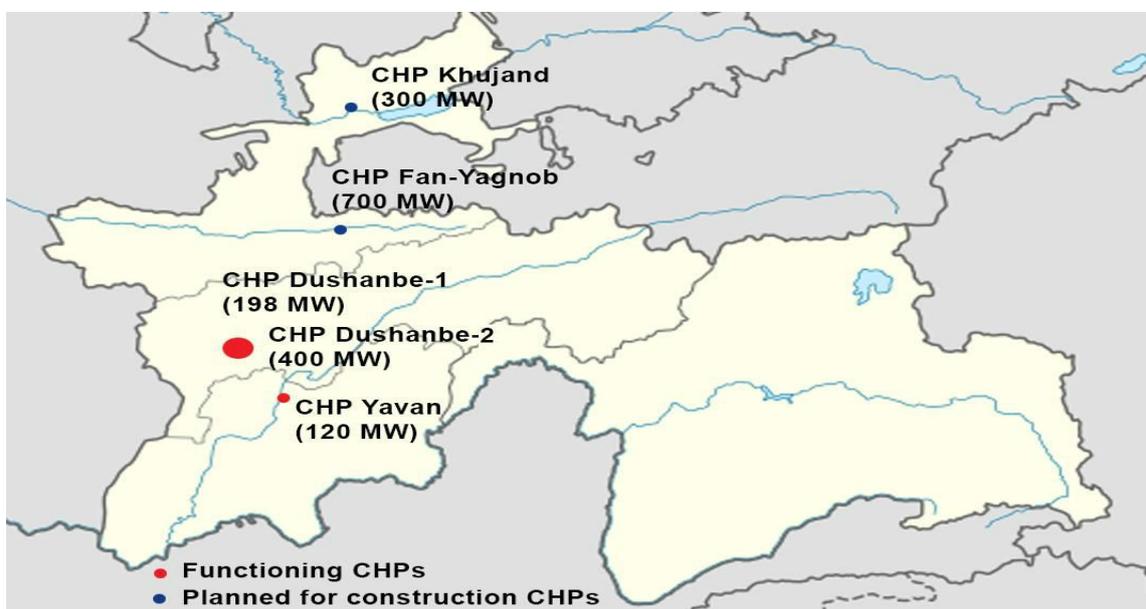
Due to the planned construction of TPP at the Fan-Yagnob deposit, the demand for coal can increase by more than 3.2 times and reach about 2.3 million tons per year: at Ziddi deposit – 10 times and will constitute 1 million tons per year, at Shurab deposit – 20 times and constitute 1.2 million tons per year.

Since 2016, the Ministry of Energy and Water Resources, together with other ministries and agencies, is searching for investors to finance the feasibility study and the construction of a TPP with a capacity of 700-1000 MW. A specific investor is not yet defined.

In 2008, the Ministry of Energy and Industry signed the Memorandum, and in 2009 – the Protocol on Cooperation with the China National Machinery Group Corporation (CMEC) for the construction of coal-fired thermal power plants, including a power plant based on the Shurab lignite deposit.

There was made a decision to construct a 300 MW thermal power plant, it was made on the basis of a research and a survey of the area, data on coal reserves, available infrastructure, and the electricity demand in the northern region. According to the feasibility study of the project, developed by the CMEC, the total cost of construction of two units of 150 MW capacity is 330 million US dollars.

At the end of December 2015, the Government of Tajikistan approved the draft agreement for the concession of the Shurob thermal power plant with the Malaysian company HOS Powertech International SDN BHD (Decree of the Republic of Tajikistan of December 30, 2015, No. 789). However, later it became known about signing an agreement with the German company Hos Powertech International SDN, which plans to spend \$ 400 million on the project. A feasibility study to determine the technical, environmental and economic feasibility of the project is under development.



This means that at the moment it is discussed the financing for two more new TPPs with capacity of 300 and 700-1000 MW respectively:

- It is planned to build the largest coal-fired power plant with a capacity of 700 to 1,000 MW in the Ayni district in the immediate vicinity of the Fan-Yagnob deposit, and use the coal mined there as fuel. A specific investor is not defined.
- It is also planned to commission a CHP plant with a capacity of 300 MW in the city of Khujand near the Shurab coal deposit. A specific investor is not defined.

Summary table of thermal power plants of Tajikistan

| No | Name | Installed Capacity | Owner | Fuel | Location |
|----|---------------------------|--------------------------------------|---|--|-----------------------------------|
| 1. | Dushanbe CHPP | 198 (Does not work at full capacity) | OJSC Dushanbe CHPP (in the management of OJSHC Barki Tojik) | The main CHPP fuel is natural gas, reserve fuel is low sulfur fuel oil | Dushanbe city |
| 2. | Javan CHPP | 120 (Does not work at full capacity) | OJSC Javan CHPP (in the management of OJSHC Barki Tojik) | The main CHPP fuel is natural gas | Town of Javan, Khatlon region |
| 3. | Dushanbe-2 CHPP | 400 | OJSC Dushanbe-2 CHPP (in the management of OJSHC Barki Tojik) | Local coal | Dushanbe city |
| 4. | Shurab CHPP (project) | 300 | Local coal | Local coal | Town of Khudjand |
| 5. | Fan-Yagnob CHPP (project) | 700-1000 | In the management of OJSHC Barki Tojik | Local coal | Fan-Yagnob deposit, Ayni district |

Plans and proposals for coal production for the period up to 2030

According to the Ministry of Industry and New Technologies in order to develop the coal industry for the period up to 2030 the following tasks should be completed:

- To create favorable conditions in order to increase coal production and cover the republic's demand for solid fuel;
- To update production and technical facilities, reconstruct, renew and restore productive capacities, develop an infrastructure, attract contracting companies, construct mines and open-cast mines at coal-mining enterprises according to the programs for the development of state enterprises;
- To attract national and foreign investments, preferential long-term bank loans for the technical re-equipment of enterprises and raise the economic interest of enterprises to increase coal production, strengthen the raw materials base of enterprises, create testing laboratories and technical supervision service that meet international quality standards;
- To implement job policy in which new working places will be created for the local population and highly qualified engineering and technical specialists will be hired for enterprises;

- To introduce modern technologies for coal mining and processing, produce environmentally safe products in accordance with international standards.

The increase of coal energy capacities entails environmental problems. Therefore, when constructing thermal power plants, it is necessary to introduce advanced technologies that will reduce the negative impact on the environment. Environmental protection management foreseen by international certified systems in all projects includes the organization, implementation and monitoring of environmental protection activities.

The government plans to widely develop existing and new fields:

- High-quality coal deposit Fan-Yagnob has a great strategic and socio-economic importance for the republic. Large production reserves, high quality coal that is efficiently coking and has rich chemical composition, low production costs make the development of the Fan-Yagnob deposit extremely important. The construction of a coal processing and enrichment facility at this deposit may create more than 400 new jobs;
- The intense exploitation of Mogiyon, Shishkat, Bolshoy Shishkat and Kishtut-Zavron coal deposits in the central and western parts of Tajikistan, whose reserves are estimated at 160 million tons, can play a crucial role as a source of energy for all the sectors of economy in the region;
- The volume of industrial and geological reserves of the Western Ziddi coal deposit is estimated at level of more than 90 million tons. In order to increase the productivity of coal mining for more than 1 million tons until 2019 investments are needed. Exploitation of this deposit will cover the needs for coal in energy and industrial sector of the Gissar valley and other regions of the south of the republic;
- Exploitation of anthracite coal at Nazar-Ailok deposit. The local coal is considered to be one of the rarest and expensive types of coal. It is economically impractical and inefficient to use it as fuel only;
- The development of the Ravnov coal deposit in the Darvaz region and the Miyonadu in the Tavildara district;
- The development of the coal occurrence Dashtijum can cover the shortage of fuel in the regions of Kulyab and Vakhsh.

Some industrial enterprises of the republic could cover their gas needs by extracting the coal bed methane at Fan-Yagnob deposit. The deposits of sorbed methane in coal beds at Fan-Yagnob are estimated at level of billions of cubic meters. It should be noted that during the exploration work on the Fan-Yagnob deposit the issue of the use of coal bed methane for commercial purposes was not considered.

Environmental protection

The work of the enterprises of the coal industry of the republic usually is accompanied by a multilateral negative impact on the environment. The large-scale technogenic impact of coal industry on the environment shows the need for a more detailed assessment of the state of affairs and development of new approaches and technical solutions in all areas of environmental protection.

In order to get a license for the extraction and development of coal deposit, an enterprise must get an obligatory ecological expert opinion of the Committee for Environmental Protection under the Government of the Republic of Tajikistan.

The main sources of atmospheric air pollution at coal enterprises are the technological processes of mining (drilling and blasting operations, loading and transportation of mined rock, internal and external dumping), open coal storages, burning rock dumps. These sources emit coal and rock dust and other harmful substances into the atmosphere.

In order to prevent emission of harmful substances into the atmosphere from unorganized sources at coal enterprises various methods and technical means are used: irrigation of the rock mass during the work of excavators, preliminary moistening of the unworked coal, dust capture during drilling of blasting holes, water stemming, moistening of roads with water and special agents etc. The other main problem of coal enterprises is the pollution of water resources. It is still unresolved the problem of water inflows into the mines and the worked out areas at the open-cast mines, the reduction of the pollution level of sewage of all categories.

The lands are withdrawn from the general use for the following needs of the coal industry: mining, industrial sites, various types of communications and external rock dumps. The total area of landscapes damaged by mining operations (without re-cultivation) until 2009 was more than 10 hectares. On an average, for extraction of 1 thousand tons of coal about 0.1 hectares of land are withdrawn. The most common types of damage to landscape include mining, rock dumps, deformations of the earth's surface, etc.

Coal enterprises submit quarterly and annual reports to the environmental monitoring services with data on waste produced, materials used, land use, the amount of equipment used, etc. Coal mining enterprises pay dedicated tax. In addition, enterprises are responsible for recultivation of lands. Representatives of the Committee for Environmental Protection are in charge to conduct planned inspections and monitoring of enterprises.

Some experts point out that near large deposits there are often bootlegs (illegal small mines) that produce coal and unlawfully sale it to the population.

There is an acute shortage of qualified specialists in the coal mining industry especially in the field of new technologies, geological and engineering sphere, economic and environmental analysis. In order to solve this problem young specialists should be commanded for internship in foreign companies and research institutions. Foreign qualified specialists should be attracted to the republic to instruct and train local specialists in the field of new technologies and innovations.

Operating mines, mine galleries and open-cast mines

Mines No. 8 and No. 1/2 are being exploited by OJSC Angisht, located in the Isfara district, in the northern part of the Shurab field, 12 km south-west of town of Isfara. There is a spur track and an asphalt road. Power supply comes from power transmission line-35 of Kairakkum HPP. The region is economically developed. The length of the mine field is 3.8 km, the width is 1.3 km, the area is 4.9 km², the absolute height is 1015-1350 m. The annual volume of coal produced is about 55 thousand tons.



Cage shaft of Mine No. 8

Mine galleries 13 and 14, the plot Carierny (East flank of the field Fan-Yagnob) are exploited by the state enterprise Fan-Yagnob Mine. It is located in Ayni district of Sughd region, 90 km to the north of Dushanbe. The absolute height of the site is 1680-2800 m. State enterprise Fan-Yagnob Mine works in underground coal mining as an independent structure since 1987.

Fan-Yagnob Mine was built in mid-80s, the maximum underground production in 1988 constituted 52 thousand tons. In recent years 20-23 thousand tons are produced. The mine field has been opened by mine galleries, the chamber-and-pillar method is applied. The coal vein No. 9 with reserves of 2.9 million tons is being developed.



Panorama. East flank of the eastern ground of the Fan-Yagnob deposit

On the southeastern flank of the Western ground of the Fan-Yagnob deposit the **TA Anzob Joint Venture, LLC** is represented by the **Ugolnaya mine**. Since 2007 it performs exploratory tunnel driving and pre-production mining of coal for the needs of a mining plant.



Panorama of exploratory galleries of the Western ground

Khushona open-cast mine, Carierny plot is exploited by the state enterprise Fan-Yagnob Mine since 2007. It administratively refers to Ayni district, it is connected with the city of Dushanbe by a 90 km asphalt road. The Carierny plot is located on the western flank of the eastern ground of the coal deposit Fan-Yagnob.



Panorama. Production Unit No. 1, state enterprise Fan-Yagnob Mine.

In 1991, Karagandagiproshakhta developed a feasibility study for the open-cast exploitation on the Eastern ground – the Carierny plot with a nominal capacity of 315 thousand tons of coal per year. In 1991, Karagandagiproshakhta as well implemented open-cast mining project at the Carierny plot of the Eastern ground, which would increase the capacity of this open-cast mine up to 1,500 thousand tons of coal per year. Annual output of coal is about 600 thousand tons.

Kante open-cast mine is being exploited by Talco-resource LLC from 2013. It is situated in Ayni district, with the city of Dushanbe is connected by a 110 km asphalt road. The open-cast mine is located on the western flank of the coal deposit Fan-Yagnob. The annual volume of coal production is about 200-300 thousand tons. It is planned to build mines on the plots Kante and Dzhizhikrut with an annual capacity of 300-500 thousand tons per year, respectively.

Rovat open-cast mine is being exploited by the Coal Mining Department of the Combinat of Metallurgy Tojik LLC since 2015. It is situated in the Ayni district, and is connected to the city of Dushanbe by a 100 km asphalt road. The open-cast mine is located on the Central flank of the coal deposit Fan-Yagnob. The design duty of the mine is about 500 thousand tons. It is planned to build mines with annual output of 300 thousand tons.

Guzn open-cast mine is being exploited by Guzn LLC since 2008. It is located on the territory of the Gorno-Matchinsky district of Sughd region, connected with the district center by a 50 km long dirt road. The electricity supply is a state-owned power line, situated in the village of Pastigav 15 km away from the mining site. The absolute height of the site fluctuates within 2000-3600 m. The productivity of the section is about 2 thousand tons.

Gezan open-cast mine of the Mogiyon deposit is being exploited by Dion Angishti Tojikiston LLC since 2010. It is located 45 km to the south of the city of Penjikent, in the basin of the Shing and Mogiyon rivers. Due to the complicated mining and geological conditions for the opencast mining, the Dion Angishti Tojikiston LLC was mandated to carrying out underground mining of the site. Currently, a project of the underground mining of the IV coal vein of the Gezan plot by a adit method is under development.

Khazora open-cast mine is being exploited by the subsidiary enterprise (SE) Koni Angishti Ziddi since 2001. The annual volume of coal production is about 120 thousand tons. The Ziddi coal deposit is located 72 km to the north of Dushanbe and 10 km away from the Dushanbe-Chanak highway. The absolute height of the site is 2300-2800 m. The Ziddi coal deposit is divided by the Sanggalt River into two plots: the Western and the Eastern.

In 1992, a small enterprise (SE) Khazora and production association Tajik Geology began a pilot open-cast mining of the Western plot of the deposit. Since 1997 the mine is exploited by the Takob mining processing plant. Since 2001 the unitary enterprise (UE) Koni Angishti Ziddi conducts work on extraction of coal by an open-cast mining according to the Khazor working project. Industrial reserves of the field of the open-cast mine constitute 1019,7 thousand tons with an annual production of 20-40 thousand tons.

East Ziddi open-cast mine (under construction) is being exploited by Sanggalt LLC since 2008. The eastern flank of the Ziddi coal deposit is located 3 km away from the Khazor open-cast mine, on the northern slope of one of the spurs of the Hissar range in the Ziddin intermontane basin and is stretched along the right bank of the river Sanggal, covering an area of 3.5 km². The annual volume of coal production is about 100 thousand tons.



Panorama of the Ziddi deposit.

Saiod open-cast mine has been exploited by Shirkati Tajikochity Sayed LLC since 1993. Saiod deposit is located 67 km to northeast of Dushanbe city, in Vakhdat district, at the southwestern end of the Karategin range, on the left bank of the Pendema river valley. The annual volume of coal production is about 40 thousand tons. There is a report with the calculation of reserves compiled on the basis of the results of the uncompleted reconnaissance and evaluation works (1991-1994).

In 1992 the Sredazugol Production Association has developed the project "Development of the Saiod pilot open pit mine with a production capacity of 40 thousand tons of coal per year"; the pilot coal mining was started in 1991 by small enterprise (later on changed to LLC) – Saiod.



Panorama. Producing unit, Shirkati tichoratii Saiod LLC

Toshkutan open-cast mine is being exploited by Koni Angishti Toshkutan since 2001. The Toshkutan deposit is located on the southern slope of the Gissar range, on the watershed of the Karatag and Shirkent rivers. Administratively refers to the territory of the Tursunzade region. Absolute height is 2200-2300 m. The annual volume of coal mining is about 2 thousand tons.

Chashmai-Sang open-cast mine is being exploited by the Ganj LLE since 2001. The coal occurrence is located in the Gissar region, on the southern slope of the Gissar range, 48 km away from Dushanbe. Absolute height of the area is 2100-2200 m. The annual volume of coal mining is about 1 thousand tons.

Miyonado open-cast mine is being exploited by Vuromun LLC since 2001. It is located in the Tavildara district in favorable physical and geographical conditions, in the Obi-Hingou river basin, on the northwestern slope of the Darvaz ridge. This is the largest and most important deposit in the Pamir-Darvaz coal region, as it is intended to supply fuel to all areas of Gorno-Badakhshan autonomous region. In the 1991-1992 the Mobile Mechanical Department of Raipotrebsoyuz of Leninsky district (now the district of Rudaki) conducted a pilot mining. In 1995, the PFA Alliance under the license of Tajikglavgeology carried out pilot-industrial quarry mining of coal. In 2001 the Vuromun LLC started pilot open-cast mining. The annual volume of coal production is about 2.5 thousand tons.

Shikor-Khona open-cast mine is being exploited by the state enterprise Koni Angishti Nazar-Aylok. It is located in Rasht district, 51 km from the village of Haita and 300 km from Dushanbe. Absolute height is 3200-4000 m. The deposit covers an area of the intermountain basin on the southern slope of the Zeravshan range. Because of this and because of a number of characteristic features the deposit is attributed to the Zeravshan coal region.



Transportation of coal from the Nazar-Ailok deposit.

Kaftarkhona open-cast mine (under construction) is being exploited by Kamarob LLC, the pilot mining started in 1998. The annual volume of coal mining is about 25 thousand tons. The Kaftarkhona plot is situated on the western flank of the Nazar-Ailok deposit and is confined to the southern slopes of the Zerafshan range, it is located in one of its blocks (an asymmetric graben). It is administratively located in the Rasht district, 72 km away from the village of Navobod.

Shuroobod open-cast mine is being developed by state enterprise Koni Angishti Shuroobod since 2002. Shuroobod deposit is located at the territory of Shokhinsky district, 70 km to southeast of Kulyab city, on the right bank of the Pyanj river, in the border zone with Afghanistan. Absolute height of the site is 2000-2300 m. The annual volume of coal mining is about 2 thousand tons.

Ravnov open-cast mine is developed by VTI-Pamir LLC. The annual volume of coal mining is about 2 thousand tons. The deposit is located 30 km to the north-west of Saghirdshat settlement, on the eastern slope of the Khazreteshi range. It is located in the territory of Darvaz district of Gorno-Badakhshan autonomous region. Absolute height of the site is 3200 m.

Bibliography:

1. Abdurakhimov B.A., Okhunov R.V. Coal industry of Tajikistan: raw materials base, condition and development prospects. Dushanbe: Nedra, 2011. - 248 p.
2. Classification of reserves of deposits and forecast mineral resources (Resolution of the Government of RT No. 2009, No. 429).
3. The state balance of coal reserves in the Republic of Tajikistan for 2009. Dushanbe. State Geological Fund, 2010.
4. Mikhailov V.V. Main areas of coal accumulation in Central Asia // Geology of coal deposits and flammable shales of the USSR. vol.6. M.: Nedra, 1968.
5. "Regulations on the Ministry of Industry and New Technologies of the Republic of Tajikistan" approved by the Decree of the Government of the Republic of Tajikistan of March 3, 2014, No. 147 (as amended by RT Government Decree No. 149 of March 13, 2015)
6. The Agency for Statistics under the President of the Republic of Tajikistan, 2016. p. 520
7. Speech of the President of the Republic of Tajikistan, the Leader of the Nation, Emomali Rahmon, at the launch ceremony of the stage two of Dushanbe-2 CHPP, 08.12.2016
8. Mining magazine, special edition 2016. 25-years of independence of the Republic of Tajikistan
9. Energy Today Magazine, 2010, No. 2/3.
10. Resheto A.N. Report on research work. Section 7. Study of Coals of Central Asia. Nazar-Ayloksk anthracite deposit. Eastern Research Coal Chemistry Institute. Ekaterinburg. 1987.
11. Valiev Sh.F., Niyozov A.S. The development of lands damage by mining in Tajikistan and some ways to recultivate them. Dushanbe: Donish, 2004.
12. Okhunov R.V. Collection of materials on the Special American Business Internship Training program: mining industry: coal mining and enrichment. USA, 2009.