Prospects for the development of the lignite Tataurovskoye deposit of the Trans-Baikal Territory

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Abstract. The article analyses the world coal production, describes the main types of coal depending on the stage of metamorphism, depicts the dynamics of world coal production, and the dynamics of coal production in Russia. The ratio of the volumes of coal production in Russia, depending on the method of production, is shown, the largest regions of Russia for coal production are shown. In conclusion, the layout of the main mineral deposits of the Trans-Baikal Territory and the volumes of coal production in the open-pit mines of the Trans-Baikal Territory in the period from 2012 to 2018 and coal production in the Vostochny section of the Tataurovskoye deposit are presented.

1. Introduction
Coal is a type of fossil fuel that is formed from parts of various ancient plants directly underground, exclusively without access to oxygen. Coal is one of the main sources of thermal energy and is also a valuable raw material for chemical processing in order to obtain the necessary products for industry.

The coal industry continues to be the main branch of the global energy sector, and coal fuel occupies a leading place in the structure of world energy consumption.

In times of increased industrial production, inexpensive energy raw materials are one of the main sources of consumption and energy conservation. Due to the significant world reserves of coal and affordable prices, in comparison with other types of fuel (gas, oil), coal mining has become the most expedient. All these reasons have led to an increase in world coal production by more than one and a half times, reaching about 7 billion tons.

2. Materials and methods
The coal industry is of great importance in the structure of the world economy since coal is used as one of the main types of fuel. The total reserves of coal around the world are 14 trillion tons, of which 52% is fossil coal, 48% is brown coal. The distribution of the world's coal reserves by major holding countries is shown in figure 1.
In accordance with the Russian classification, depending on the stage of metamorphism, the following types of coal are distinguished:

- brown;
- stone;
- anthracites;
- graphites.

Of the listed types of coal, we briefly characterize brown coal as a direct object of study. Brown coals are solid fossil coals that are formed from peat and are 65-70% carbon. In terms of age, it is the youngest of all types of fossil coal. It is formed at a depth of about one kilometer under the influence of high pressure and elevated temperature from organic dead remains.

Brown coal has a low calorific value due to its high moisture content (up to 43%) and volatile substances (38-50%). It is used as a local fuel, less often as a chemical raw material. The bulk of brown coal is used as fuel in thermal power plants. The low price of this coal is explained by the method of its
extraction - exclusively open, which ensures the production of inexpensive electricity, and attracts electric-intensive industries to the places of brown coal mining.

Coals are formed from brown coals at a depth of about three kilometres. It has a high calorific value due to the moisture content of 8-20% and, depending on the grade, from 75 to 95% carbon. More than 9/10 of the coal reserves, i.e. recoverable using existing technologies, concentrated in China, USA (more than 1/4); on the territory of the CIS states (more than 1/5); more than 1/10 of reserves in South Africa [1-2]. The map shown in figure 2 gives an idea of the world placement of the placement of coal and lignite basins.

In Western Europe, coal production has recently declined significantly, and the main leaders in coal production are China, the USA, India, Australia and Russia. They account for about 65% of the world's total coal production, which amounts to 4.7 billion tons per year. Russia ranks second in the world in terms of proven coal reserves [3-4] (figure 3).

From the diagram, it can be concluded that Russia ranks fifth in terms of production volume within 353.6 million tons, including open-cut mining - 254.2 million tons at 137 open-pit mines.

In the coal industry of Russia in 2018, there were 228 coal mining enterprises. Almost 254.8 million tons of coal were mined by the ten largest coal mining associations of the country, which accounted for 72.3% of the coal production in Russia. Table 1 shows the coal production in 2018 by the largest coal companies in Russia.

| Coal company                  | Production volume, million tons per year |
|-------------------------------|------------------------------------------|
| OJSC “SIBENCO”                | 97.612                                   |
| OJSC “UK Kuzbasrazrezugol”    | 45.485                                   |
| SDS-Ugol OJSC                 | 25.238                                   |
| Vossibugol OJSC               | 16.762                                   |
| OJSC “Southern Kuzbass”       | 14.150                                   |
| OJSC “Yuzhkuzbassugol”        | 10.790                                   |
| Sibugolmet CJSC               | 13.600                                   |
| OJSC “Vorkutaugol”            | 11.500                                   |
| OJSC “Yakutugol”              | 9.963                                    |
From the table, we can conclude that SIBENCO ranks first among other coal mining companies with a coal production volume of 97.612 million tons per year.

Depending on the depth at which the mineral deposits are located, there are various methods of coal mining. When the depth of the deposits is shallow, open pit mining is used. The open method is relatively cheaper and safer than the underground one. The choice of a certain type of development is carried out depending on the features of the relief and the position of the mineral deposits.

According to the State Program for the Development of the Coal Industry for the Period up to 2030, it is planned to increase coal production to 430 million tons, including by open-cut mining up to 300 million tons at 83 open-pit mines [5-6].

The diagram shown in figure 4 gives an idea of the ratio of coal production in Russia depending on the mining method.

![Coal production in Russia](image)

**Figure 4.** Coal production volumes in Russia, depending on the mining method.

The above diagram allows us to conclude that the volume of opencast coal production is almost twice as high as that of the underground method.

![Largest coal mining regions of Russia](image)

**Figure 5.** Largest coal mining regions of Russia, million tons.  
1 - Kemerovo region; 2 - Krasnoyarsk Territory; 3 - Komi; 4 - Irkutsk region; 5 – Trans-Baikal Territory; 6 - Sakha (Yakutia); 7 - Rostov region; 8 - Chelyabinsk region; 9 - Primorsky Territory.

The Trans-Baikal Territory is one of the oldest mining regions in the country and is characterized by large reserves of coal and brown coal. It ranks fifth among the largest regions of Russia in coal mining (figure 5).
3. Research results and their scope

The main type of fuel for the TPPs of the Trans-Baikal Territory energy system is brown coal, which is mined by open pit mining at local coal mines. On the territory of the Trans-Baikal Territory, brown coals as fuel and energy resources are accounted for at 15 deposits with balance reserves of 2.24 billion tons and forecast resources of 891 million tons. They form the basis of the operating coal complex of the region (Kharanorskye, Tarbagataiskoye, Urtuiskoye and Tataurovskoye deposits) with a total capacity of 14.2 million tons.

In the future, the development of brown coal mining in the Trans-Baikal Territory is associated both with the possibility of increasing productivity at existing enterprises, and with the development of deposits of the Priargunskaya group (Pogranichnoye, Kutinskoye, Priozerne) (figure 6) with balance reserves of more than 650 million tons and the Zashulansky field - 259 million tons [7].

![Figure 6. Layout of the main coal deposits of the Trans-Baikal Territory. The sign marks the Tataurovskoye coal deposit and the Vostochny open-pit mine Chitaugol LLC.](image)

In table 2, the volumes of coal production in the Trans-Baikal Territory of the main large coal mines for the period 2008-2014 are revealed.

**Table 2. Volumes of coal production at open-pit mines of the Trans-Baikal Territory, thousand tons.**

| Coal mining                      | Years   |
|----------------------------------|---------|
|                                  | 2012    | 2013    | 2014    | 2015    | 2016    | 2017    | 2018    |
| Open-pit mine “Kharanorsky”      | 4120    | 4127    | 4294    | 4199    | 3048    | 3360    | 3348    |
| Open-pit mine “Urtuisky”         | 2801    | 2901    | 3628    | 3203    | 3064    | 3380    | 3372    |
| Open-pit mine “Tugnuisky”        | 5607    | 5894    | 6856    | 10364   | 12608   | 12500   | 10126   |
| Open-pit mine “Vostochny”        | 1274    | 1245    | 1245    | 1313    | 1353    | 1301    | 1324    |
| Chitaugol LLC                    |         |         |         |         |         |         |         |
| Other small sections             | 142     | 155     | 285     | 336     | 519     | 725     | 512     |
Chitaugol LLC, Vostochny mine, carries out exploration, production and processing of coal from the Tataurovskoye brown coal deposit, which, in turn, is part of the structure of OJSC SIBENCO. The open pit mining of grade 2 BR brown coals is carried out by the open method of the Tataurovskoye brown coal deposit, which is located in the Uletovsky district of the Trans-Baikal Territory, 70 km from the city of Chita. The main part of the deposit is located in the Vostochny coal mine. The balance reserves of coal are about 381 million tons. The design capacity of the open pit is 1.5 million tons of coal per year. This enterprise produces about 1.3 million tons of coal annually. For 30 years of operation, the mine has shipped over 33 million tons of coal to consumers. The main consumers of coal are TGK-14 OJSC (Chitinskaya CHPP-1, CHEK), housing and communal services of the Trans-Baikal Territory, and the utilities sector of the Zabaikalsky Territory. Coal is consumed mainly by thermal boilers in Chita, nearby rural areas, Buryatia (about 500 thousand tons in 2015) [8].

Thus, the Vostochny open-pit mine is part of the largest coal mining company OJSC SIBENCO; has growing volumes of coal production, as well as large reserves; is in demand among the main consumers of coal (including the regional centre); is located near the city of Chita, which does not require large costs for the delivery of coal.

4. Conclusion
The main leaders in coal mining are China, the United States and Russia. Russia ranks second in the world in terms of proven coal reserves, and in 2018 in terms of production it ranks fifth with 353.6 million tons, including by open-cut mining - 254.2 million tons at 137 open-pit mines.

Among Russian coal mining companies, SIBENCO ranks first with coal production - 97.612 million tons per year.

Volumes of open pit coal mining are almost two times higher than underground mining and forecast estimates until 2030 suggest an increase in coal production to 430 million tons, including open pit mining up to 300 million tons at 83 open-pit mines.

The Trans-Baikal Territory ranks fifth in terms of coal production in Russia, in the Trans-Baikal Territory brown coal is accounted for as fuel and energy resources at 15 deposits with balance reserves of 2.24 billion tons and forecast resources of 891 million tons.

Open-pit mine “Vostochny” of the Trans-Baikal Territory carries out exploration, production and processing of coal from the Tataurovskoye brown coal deposit by the open method, which, in turn, is part of the structure of OJSC SIBENCO, has growing volumes of coal production, as well as large reserves; is in demand among the main consumers of the region and surrounding areas.

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