Role of the coal industry in regional sustainability of Krasnoyarsk Region

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Abstract. This study is an attempt to analyze the prospects for the sustainable development of the coal industry in the Krasnoyarsk Region of Russia. The authors examined several important milestones in the formation of the industry and revealed some major issues, which hinder the development of the coal industry in Krasnoyarsk Region. This paper also evaluates the current state of the coal industry and discusses the plans for its further development from an economic and environmental point of view.

1. Introduction
In the 21st century, due to considerable structural shifts in the economy and society, as well as the emergence of new economic sectors, the public attitude towards traditional industrial sectors is changing. That process is also occurring in Krasnoyarsk Region, where industries such as mining and, especially, coal mining have traditionally been the foundation of the regional economy. Today, the region’s residents are increasingly concerned about the negative impact that coal industry has on the region’s environment. The purpose of this article is to examine the emergence of the coal industry in Krasnoyarsk Region during rapid industrialization in the Soviet Union, as well as its development in modern times from the perspective of sustainability.

2. Materials and methods
This research is based upon a wide range of published and unpublished studies on the development of the coal industry in the region. One of the most prominent data sources used in this paper is the State Archive of the Novosibirsk Region. Furthermore, the authors used data on the current state of the coal industry in Krasnoyarsk Region, and data from non-financial reports released by the key enterprises of the region’s coal industry. Such reports contain data on the coal producers’ environmental investments and projects. Another important source of data for analyzing the coal industry development since 1990
is data obtained from the Federal State Statistics Service of Russia, including its regional office of Krasnoyarsk Region, Republics of Khakassia and Tuva. With regard to methodology, the research employs: the historical and comparative methods, which allowed the authors to find similarities and differences between different periods of the coal industry development; the method of historical analogy, the synchronous method, and the method of establishing proportions.

3. Results

Data on coal deposits in Siberia has been collected since the beginning of the 18th century, and according to the current estimates, the largest coal deposits in Russia are located in this geographical region. For instance, Krasnoyarsk Region accounts for about 40% of standard quality coal reserves in Russia and almost 25% in terms of the proven coal reserves [1]. Despite the fact that the first coal mining activities in Siberia took place at the end of the 18th century, the industry really took off due to the completion of the Trans-Siberian Railway, which drastically boosted the demand for coal. The resources of the Minusinsk Coal Basin (Chernogorsky coal deposit) were extracted more actively at that time. The regional coal industry also served the ships navigating the Yenisei river, as well as local enterprises [2]. However, the volume of coal production still remained relatively low during that period [3].

By the time the Soviet Union started its rapid industrialization program, despite the low level of the country’s general economic development, the coal industry had already played an important role in Krasnoyarsk’s regional economy, supporting the region’s transport infrastructure and local manufacturing. As we mentioned earlier, most of the coal mining in the region took place at the Minusinsk Coal Basin (Chernogorsky coal deposit), but some coal mining activity also occurred at the Korkinsky coal mine [4]. The Soviet industrialization program required a substantial increase in coal production and, as a result, led to considerable investments in the region (table 1).

| List of projects                        | Kuznetsk Coal Basin | Cheremkhovsky Coal Basin | Minusinsk Coal Basin |
|---------------------------------------|---------------------|--------------------------|----------------------|
| Capital repairs of existing enterprises | 2500                | 191                      | 87                   |
| Expansion and mechanization of mining operations | 12330              | 337                      | 588                  |
| Construction of new coal mines        | 19850               | 2908                     | None                 |
| Housing construction for employees    | 13315               | 700                      | 175                  |
| Total                                 | 48000               | 4136                     | 840                  |
| Share of the total investments, %     | 90.6                | 7.8                      | 1.6                  |

The Soviet government intended to allocate most of the funds to the development of the Kuznetsk Coal Basin, which would become the second largest energy center in the country. That aspiration of the government led to the fact that even on the eve of the country's full transition to five-year plans and rapid industrialization, the growth rate of the coal industry in Siberia turned out to be considerably higher compared to the USSR on average: 85% in Siberia vs 61.7% in the USSR [5].

Nevertheless, the Kuznetsk coal basin was not the only factor that contributed to such high growth rates. In the 1930s, the coal enterprises located on the territory of today’s region of Khakassia were put under direct control of the Soviet government, rather than the regional authorities [6]. Labor productivity increased drastically due to the modernization of equipment. Thus, labor productivity of coal miners increased by 4 times in 1927 alone [7].

Furthermore, in the early 1930s, the authorities began the industrial development of the Achinsk brown coal deposit [8]. Coal was also produced in the Norilsk region to provide the fleet with coal supplies, while the Korkinsky coal mine supplied coal to Krasnoyarsk [4]. New mines were opened in the Khakass - Minusinsk coal basin [2].
One of the most important issues for the coal industry of Siberia during that period was an acute shortage of skilled workers, which led to industrial equipment downtime (especially coal-cutting machines). In general, about 20% of the machinery was idle at Siberian coal enterprises [6]. That problem was also typical for other regions of the USSR [9]. During the second five-year plan period, the central government attempted to raise the skill level of coal workers by means of training programs. In 1933, coal mining activity started in the Kansk coal basin [10]. Then, in 1935, a new coal mine “Zaozernovsky” was opened. Due to the growing demand for coal, investments in the region’s coal industry continued to increase. Thus, in 1932, 4.9 million rubles were allocated for the development of the Chernorogsky and Minusinsk basins, whereas in 1938, the investments increased up to 7.7 million rubles [2]. Despite the significant growth of investments in the region’s coal enterprises, the government’s investments in other key coal mining areas were even greater. During the second five-year plan period, investments in the coal industry of Kuzbass (Kuznetsk Basin) totaled 534.1 million rubles, while in the USSR overall, investments in coal reached 2936.4 million rubles [11]. Despite certain issues (with regard to the level of mechanization), coal enterprises were being provided with more equipment, and by 1934, after the reconstruction at several coal mines of the Chernogorsky basin, most of the enterprises had been completely mechanized. In 1935, the Chernogorsky coal mine, which was part of the “Kuzbassugol” (Kuzbass Coal) coal production cluster, utilized about 15% of the total number of heavy coal-cutting machines available in the cluster. The Chernogorsky coal mine was the main coal-producing area in the region. In 1935, it accounted for about 80% of the total coal production in Krasnoyarsk Region [9]. Despite the fact that the output targets, set by the central government in the five-year plans, were not always reached fully (including the first five-year plan for the coal industry in Krasnoyarsk Region), the actual level of coal production in the region was increasing continuously (figure 1) [12]. During the second five-year plan period, the gross output of the coal industry in Krasnoyarsk Region almost tripled, from 3043 up to 9365 thousand rubles. Overall, over the second five-year plan period, coal production in the USSR increased by more than 11 times, from 10.2 million tons in 1932 to 117.6 million tons in 1937 [11]. The rapid development of coal mining in the region led to the establishment of “Khakasugol” (Khakassia Coal) as a coal producer, separate from a major coal producing cluster “Kuzbasugol” (Kuzbass Coal) in 1936 [2]. At the beginning of 1937, the newly established “Khakasugol” received the “Irshinskie” coal mines, which used to be part of “Vostoksibugol” (East Siberia Coal) [13].

A new stage in the development of the region’s coal industry began after the post-war discovery of considerable coal layers in the areas of Borodino, Nazarovo, Partizansky, and some other territories. In the 1960-80s, the Soviet Union was developing a large-scale project named Kansk-Achinsk Fuel and Energy Complex (KATEK). The program involved a massive development of coal deposits as well as the construction of thermal power stations and other industrial enterprises. In 1979, construction began on the Berezovsky coal mine and the Berezovskaya thermal power station, as well as a new city named Sharypovo. The KATEK was a large-scale nationwide construction project of the USSR. Youth groups and workers, as well as athletes and performers, would come here from all over the country in order to participate in the project. In 1986, the construction site of the Berezovskaya thermal power station was also visited by the players of the USSR national ice hockey team (by players such as Krutov, Kasatonov, Makarov) [3].

As we can observe, the Soviet development of the coal industry at that time was largely extensive, and the detrimental environmental impact was never considered an obstacle.

In the 1990s, Krasnoyarsk Region, as well as the entire country, saw a decrease in the level of coal production. However, by the early 2000s, coal production began to recover and started to rise again. Currently, there are over 10 coal-producing companies in Krasnoyarsk Region, which produce both brown and hard coal. Among them are: “Sibugol” (Siberian Coal), “SUEK-Krasnoyarsk”, “Russian Coal”, “Krasnoyarskkrayugol” (Krasnoyarsk Region Coal), “VostokUgol-Dikson” (East Coal - Dikson), “Chulym-Ugol” (Chulym Coal), “Severrazrezugol” (North Coal Mine), “Razrez Sereulsky” (Sereulsky Coal Mine), “Razrez Kansky” (Kansky Coal Mine).
Coal production in Krasnoyarsk Region and in the country overall

| Year   | USSR, million tons | Krasnoyarsk Region, million tons |
|--------|--------------------|----------------------------------|
| 1928   | 35,5               | 0,1                              |
| 1932   | 64,4               | 0,3                              |
| 1937   | 128                | 0,5                              |
| 1990   | 52,3               | 32,1                             |
| 1995   | 395                | 263                              |
| 2000   | 258                | 258                              |
| 2005   | 299                | 299                              |
| 2010   | 372                | 322                              |
| 2015   | 439                | 39,5                             |
| 2018   | 41,9               | 41,9                             |

Figure 1. The level of coal production in Krasnoyarsk Region and in the country overall.

The largest open-pit coal mines in Krasnoyarsk Region belong to Siberian Coal Energy Company (SUEK). The total number of SUEK employees in the region is about 5 thousand people, and, on average, SUEK's facilities account for 2/3 of the total coal production in the region [14].

4. Discussion

However, despite the high level of coal production in Krasnoyarsk Region, its share in the total national coal output is decreasing. One of the key reasons for this, in our opinion, is that Krasnoyarsk coal producers predominantly mine brown coal, which rarely goes for export. Thus, such coal stays in the domestic market and is consumed within the country. In 2020, some recent studies were published on the state of the coal industry in major coal-producing regions of Siberia [15]. The authors point out that Siberia, which has traditionally been the top coal producer in Russia, is now facing serious social and environmental consequences, such as irreversible landscape alteration, deforestation, and diseases in the population living near coal-mining facilities (figures 2 and 3).

Figure 2. View of the Borodinsky coal mine, Krasnoyarsk Region, 1989.

Figure 3. View of the Borodinsky coal mine, Krasnoyarsk Region, 2016.

The negative impact caused by the coal enterprises is also highlighted by the Russian government. Thus, from 2012 to 2018, the volume of harmful emissions released into the atmosphere increased from 987 thousand tons to 1110 thousand tons, whereas the land remediation efforts decreased by 1.7 times [16].

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At the same time, we should not underestimate the environmental programs of coal producers aimed at reducing the negative impact of their activities and ensuring sustainable practices. In 2017, Russia’s largest coal-mining company SUEK formulated a new environmental strategy until 2023, which was intended to reduce the negative environmental impact of the company. In 2016-2017, the SUEK company restored 781 hectares of land. From 2013 to 2017, the company’s total environmental expenses increased from 400.5 million rubles to 2253 million rubles. In 2017, the company started taking measures to improve the quality of the raw materials as well [17].

On June 13, 2020, the Prime Minister of the Russian Federation formally approved the program for the development of the coal industry until 2035 [16]. Therefore, it seems clear that, at present, the government has no plans to abandon coal, which means the coal industry will maintain its presence in Krasnoyarsk Region. The Russian government emphasizes the need to develop coal mining on the Taimyr Peninsula in the North. They also intend to create an Arctic port named “Yenisei”, focused on the coal exports in Krasnoyarsk Region, and build an industrial cluster for the production of coal concentrate from coking coal. Overall, they plan to spend more than 65 billion rubles on the implementation of that major coal industry development project in the Arctic zone of Krasnoyarsk Region.

5. Conclusion
As we can see, having gone through several major stages of modernization, the coal industry still occupies a large share of the economy of Krasnoyarsk Region. One of the first major breakthroughs for the coal industry in the region may be attributed to the period of rapid industrialization in the USSR, when over the course of the first two five-year plans, coal production increased by more than 10 times. Another surge in coal production occurred after the development of the Kansk - Achinsk Fuel and Energy Complex, which made Krasnoyarsk Region one of the leading coal producers in the country. At that time, sustainability was not a national priority, and the Soviet government did not consider the detrimental environmental impact of the coal industry to be an issue.

At present, the Russian government continues to promote the coal industry, having set out a long-term coal industry development strategy until 2035. Nevertheless, nowadays, people are becoming increasingly aware and concerned about the environmental impact of coal companies, thus, raising more and more questions about their environmental responsibility. The government itself seems to share that concern by announcing the national Strategy of Environmental Security until 2025, which laid out higher environmental standards and requirements. Another government’s initiative was the program called Ensuring Environmental Security in the Coal Industry.

Besides, public organizations as well as non-government / non-profit organizations also play a crucial role in protecting the environment from harmful industries ensuring people’s safety as well as the region’s sustainability in general.

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