The Impact of Kuzbass Industrial Enterprises on Environmental Safety

R M Kotov$^1$ and Ya V Formulevich$^{1*}$

$^1$Kemerovo State University, 6 Krasnaya str., Kemerovo 650000 Russia

E-mail: yana_for_27@mail.ru

Abstract. This study aims to assess the impact of Kuzbass industrial enterprises on the region’s environment, as well as to determine a modern ecological maintenance strategy. The authors reviewed statistical data on the ecology of the Kemerovo region (Russia), analyzing the data dynamically and structurally. Moreover, the authors examined the natural-anthropogenic complexes using sampling observation. The findings show that the leading cause of ecological problems in the Kemerovo region is a high volume of anthropogenic stress per unit of land. Environmental security is crucial to the development of the regional economic, scientific, and investment potential. In conclusion, the authors propose a series of measures aimed at environment conservation and ecological footprint reduction. The authors of the study devised new aspects for the regional environmental policy and defined the term “ecology protection investment.”

Keywords: Environmental component · Ecological situation · Regional economy · Development strategy · Ecology protection investment · Anthropogenic stress

1. Introduction

For several decades, ecological preservation has been one of the most important societal issues. Anthropic activity harms the environment and reduces local and global economic strength. Therefore, environmental conservation is the most important goal of long-term socio-economic development.

The primary sources of pollution are daily human activities and industrial activities. Reducing ecological damage is possible by such measures as:

- enforcing stricter environmental control over the industrial enterprises;
- increasing the efficiency of treatment and filtering facilities;
- implementing best available technologies at enterprises;
- rewarding the most eco-conscious enterprises.

However, these measures are costly and labor-intensive, which warrants the need for ecology protection investment.

Kemerovo Region is a developed industrial area with more than 45 thousand enterprises and businesses in all economy branches. Abundant natural resources of the Kuznetsk Basin encourage the region’s coal, metallurgical, chemical, and other industries, allowing the regional economy to grow and compete in international markets. However, the high density of resource-extraction, metallurgical, and chemical enterprises harm local ecology by gas emissions, and solid and liquid waste. These types of enterprises create the most anthropogenic stress in the region and dampen its potential economic growth.
2. Materials and Methods

More than 5,500 industrial, construction, agricultural, and other enterprises function in the Kuzbass, despite its relatively modest territory of 95,500 sq. km. Fifty of those companies are coal, metallurgic, and chemical industry giants, operating on the federal level.

The emissions from industrial and other enterprises in 2018 [7] amounted to 1.2 million metric tons, over half of which was methane. However, despite the constant production growth, the emissions (not accounting for methane) were reduced by 35%, if compared to 1997 [7]. This was achieved by closing old enterprises, modernizing or reequipping the active ones, and introducing best available technologies.

The ecological situation in the Kemerovo Region is best represented by air quality and air pollution indexes. According to the data provided by the regional office of the Russian Federal State Statistics Service [Rosstat] and by the Federal Supervisory Natural Resources Management Service [Rosprirodnadzor] [7], in 2018, the total volume of air emissions in the Kemerovo Region amounted to 1,718,848 tons.

Stationary sources produced 86.5% of that amount, while mobile sources, such as cars and trains, produced only 13.5%. In analyzing the emission dynamics data from 2008 to 2018 [7], the authors concluded that the total volume of emissions was reduced by 2.9% from 1,771,088 tons to 1,718,848 tons.

Moreover, the stationary source emissions were reduced by 0.5% from 1,495,504 tons to 1,487,648 tons, if compared to 2007 data. However, in comparison to the previous year, the emissions increased by 138,164 tons.

From 2008 to 2018, gross emissions from enterprises were reduced by 7,856 tons. The analysis indicates that the sample maximum of enterprise emissions happened in 2008 (1,515,411 tons), and by 2014 the emission volume reduced by 12.1%. Small increases in emissions have been observed in 2015 and 2016. However, in the current year, the emission volume reached the nine-year-maximum (1,487,648 tons produced by 1,167 enterprises). Compared to 2016, the volume of emissions increased by 10.2% (1,349,484 tons produced by 1,142 enterprises), mainly because of the increased methane emissions (47.2% up) in the past ten years.

The main stationary contributors to air pollution were mining enterprises (61.9% or 920,813 tons), manufacturing enterprises (21.5% or 320,563 tons), and energy, gas, steam, and air conditioning plants (14.7% or 320,563 tons). These three production branches are responsible for 98.1% of total emissions.

The most dramatic emission increases have been recorded in Novokuznetsk city (45,800 tons), Belovsky district (27,721 tons), Prokopyevsky district (26,253 tons), Kaltan city (23,594 tons), Lenisk-Kuznetsky district (16,861 tons), and in Kemerovo district (7,394 tons). The emissions in Kemerovo city amounted to 41,106 tons, ranking 8th by emissions in the region. Novokuznetsk ranked first with 313,330 tons.

Mobile sources are responsible for a significant part of emissions in Kemerovo, mainly because over 12,000 vehicles pass through the city every day, mostly cargo trucks. Therefore, the best way to improve the ecological environment of Kemerovo is to build a highway that bypasses the town. The road section needed to divert the traffic away from the Kuzbass capital should be 40 kilometers long.

The ecological problems in Novokuznetsk stem from the high concentration of metallurgic and coal mining enterprises. Forty-two such businesses are responsible for emitting more than a hundred pollutants and harmful gases. Both the city and the surrounding district are highly industrialized. Such enterprises as (1) OJSC ZSMK, (2) Abashevskaia mine, (3) Novokuznetsk Aluminium Works, (4) the objects of former Kuznetsk Iron and Steel Plant, (5) Abagur Sinter Plant, (6) Kuznetsk Thermal Power Plant, and (7) OJSC “Kuznetsk Ferro-alloys” operate on their territory. Moreover, the filtering equipment of most industrial enterprises is inefficient, only absorbing and neutralizing less than 85% of emissions. The remainder (550 kg per person per year) is deposited into wastewater or air. The air in Novokuznetsk is one of the most chemically-polluted in the country. Methane is the primary pollutant in Kuzbass, produced mostly by mining enterprises.
Novokuznetsk Urban Okrug is divided into several city districts. Tsentralny [Central] district has a high level of noise and air pollution from traffic. Ordzhonikidzevsky district has several active factories and mining facilities. They add coal dust to the overall air pollution level and make the district the least ecologically pleasant one. Zavodskoy [Factory] district hosts the West-Siberian Metal Plant (ZSMK), Novokuznetsk’s industrial behemoth, making it extremely inhospitable. Kuybyshevsky district, which was planned as an industrial area, is situated on the underground mining territories. Residential and industrial buildings intermix, which creates air, noise, and solid and liquid waste pollution.

Moreover, the Novokuznetsk environmental situation is further worsened by the climate and the geographical location of the city. Novokuznetsk is surrounded by mountains, which entrap smog and pollution inside the city. However, the air pollution monitoring system in Novokuznetsk is being improved continuously.

Industrial enterprises generate production and consumption waste, such as tar decanter sludge and coke and coal dust, all of which are recycled by adding it to the coal charge feed during coking. Tar decanter sludge is a by-product of cooling down coke gas and splitting the gas condensate into coal tar, water, and sludge in clarifier decanters. It is usually added to the coal charge feed for coking in the coal-preparation shop. Coke and coal dust gets caught by cyclonic dust separators, connected to the coking and coal-preparation shop equipment, and then heads to the coal-preparation shop for recycling.

The sample minimum for the ecology protection investment in Russia, reached in 2009 (81,914 mln. rubles), was connected to the global economic crisis and the lack of state interest in protecting the environment. The figure then climbed steadily and reached the sample maximum in 2014 – 158,636 mln. rubles – the highest it has been in 20 years. In the current year, a relatively minor decrease in investment (5,640 mln. rubles), if compared to the maximum, has been registered.

There has been an increase in capital investment in 2018 – 153 bln. rubles or 9.5% more than in 2016, without adjusting for the price difference. If one were to account for the price difference, the actual investment volume would increase only by 5–6%. Therefore, the substantial ecology protection investment decrease in the past two years (i.e., from 2014 to 2016) was not compensated for in 2017. Introducing best available technologies refers to environmental safety and developing new equipment and processes that improve the final product quality. Thus, modernizing outdated equipment and creating an environment that favors high-technology enterprises and import substitution production is a priority [4].

3. Results

The river cleanup efforts in the region have been intensified after the end of the “Year of Ecology” in 2017. The condition of Tom River varies depending on the regional district. The population and the geographical range of high-value fish species in Kuzbass rivers have increased. Grayling, which is supposed to only live in clean water bodies, has been sighted in the river Iskitimka within Kemerovo. Only systematic conservation efforts could achieve such results. As a part of “Year of Ecology,” 74 ecological protection measures have been undertaken: 62 of which were regional, and 12 were federal ones. One of these measures was the “Water sector development” subprogram [2]. In 2017, around three bln. rubles were allocated to the regional ecology protection fund. Since 2017, Kemerovo Region Department of Natural Resources and Environment manages a list of enterprises whose activities negatively affect the environment. In 2018 the list contained 1,226 entries.

The authors of this study conclude that the ecological situation in Kemerovo Region is still dire, but there are some improvement trends. The conservation efforts aim to minimize the environmental damage caused by industrial activities.

The ecological impact of the region’s industrial enterprises includes the following:

- air pollution by solid and gas waste;
- generation of the production and consumption waste.
There are no areas designated for the storage of production waste in the region. To store consumption waste (e.g., depleted mercury-vapor lamps, batteries, etc.), enterprises house private depots, cargo containers, barrels, refuse bunkers, and open concrete or asphalt-paved sites. All such temporary storage facilities must comply with hygienic requirements and the norms and limits of storing waste.

According to the annual report of industrial enterprises in 2018 [2], the conservation results were as follows:

- According to the form 2-TP (air pollution) of the federal statistic monitoring system, in 2016, gross emissions amounted to 226.6 t/year, which is 619.4 tons (or 12%) less than the established limit. The emission factor amounted to 1.56 kg per ton of coke, three times less than the industry average;
- According to the form 2-TP (waste) in 2018, the established limits were not exceeded;
- Pursuant to the Federal Law No 7-FZ “On environmental protection” and the Federal Law No. 52-FZ “On sanitary and epidemiological well-being of the population” and their bylaws, the enterprises of the region implemented the “Environmental Control Program” and “Program of industrial control over the sanitary rules and over realizing sanitary and anti-epidemic (preventive) measures”. According to the control graphs of the above-mentioned programs, no regulatory limits near the emission sources and inside the sanitary protection zones were exceeded.
- Pursuant to the Federal Law No. 458-FZ of December 29th, 2014, the enterprises started reissuing licenses and introducing waste passport systems in 2017.

An ecological policy of an enterprise consists of two elements: technological and societal. The specialized part entails modernizing critical machinery assets using the best available technologies to cut back on the negative environmental influence. The technical element consists of two things:

- Updating the production process and used technologies to comply with environmental laws;
- Implementing the best available technology to increase ecological security and the ecological indexes of enterprises.

The societal element entails two things:

- Scientific and technological cooperation with higher education establishments, scientific institutions, as well as public awareness campaigns, e.g., employee education, school outreach programs;
- Participating in regional and federal social projects.

4. Discussion

In February of 2019, South Korean ecological experts arrived in Novokuznetsk to determine the pollution sources and causes. Seoul plans to pay for the investigation, which is supposed to take six months. The first investigation stage results were sent to the Moscow project management office of “Clean Air”. Young Sunwoo, Konkuk University professor, determined that the highest pollution level in urban areas corresponds to summer [6]. Korean experts recommended automatizing and modernizing the environmental observation systems in Novokuznetsk by adding three new automatic weather stations to the eight existing traditional ones. It would increase the coverage and quality of air monitoring.

Moreover, Korean experts believe that Russian air quality indexes and pollutant concentration limits must be updated. Novokuznetsk municipal government regularly undertakes measures to lessen the anthropogenic influence and conserve the environment. Regular surprise inspections are conducted to investigate illegal waste placement and hold the transgressors accountable.

In the Law Code of Russian Federation, the term “Ecology protection investment” is not defined. However, for the purposes of this research, the authors deemed it necessary to define it. Ecology
protection investment is an investment in environmental policies, conservation measures, and innovative research that results in better ecological security and less environmental damage.

Today’s investors prefer eco-conscious enterprises. Furthermore, even the stocks of businesses that ecologically reorient their manufacturing rise in value, especially if the environmental efficiency of production reaches the maximum possible level.

The metallurgical manufacturing processes produce much waste, like air pollutants, dust, and wastewater. However, modern metallurgical enterprises recognize the importance of ecology and systematically try to lessen their negative influence on the environment and human health.

According to the Ministry of Industry and Trade data [5], investments into ferrous metallurgy amounted in 2011–2018 amounted to 2.04 trln. rubles, which allowed to reduce the fixed capital depreciation rate from 53% to 42%. A significant part of investments is diverted to ecological measures, energy efficiency, and traffic infrastructure development.

5. Conclusion

The Strategy for Social and Economic Development of Kemerovo Region until 2035 (the Strategy from now onward) declares making Kuzbass clean the gubernatorial priority. In line with the Strategy, a new license-issuing procedure will be developed and implemented. This procedure will include harsher ecological regulations, i.e., reclaiming disturbed soils, maintaining a balanced hydrological regime, complying with sanitary protection zone boundaries, and relocating citizens that live in the areas affected by new coal enterprises [3].

There are plans to build 16 new water treatment plants on the enterprise territories and reconstruct 11 defunct ones, build three new heating plans with high-efficiency gas filtering equipment, install six new pieces of gas filtering equipment, and reclaim 27 disturbed soil areas. Four new recycling enterprises will appear in the region. Some of these are LLC “NewTek,” OTR tire recycling center, and LLC “Kuznetskekologiya,” car tire and rubber recycling enterprise.

A series of conservational and environmental-balance-restoring measures will be undertaken. For example, as a part of the Strategy, PJSC “Azot” will expand its condensing power plant to prevent pollutants and greenhouse gas emissions. Additionally, 59 special conservational measures will be undertaken in Novokuznetsk, including gas-filtering equipment reconstruction, heating plant repairs, and development of eco-efficient manufacturing processes, based on the experimental Eco-technopark.

Russian economic reforms led to radical changes in the economic environment, which complicated the activity of most enterprises. The new economic climate created the need to reform economic and ecological security management systems. By taking part in financial affairs, an enterprise also gains economic independence and responsibility for its business performance. Therefore, an enterprise must create a management system that would allow it to be efficient, competitive, and economically-stable [8]. Enterprise management system must hold the environmental security of the region as a top-priority development trajectory.

In line with the Strategy, coal surface mining enterprises implement new rock blasting methods with electronic detonators. It would reduce the harmful influence of explosions on the nearby settlements and environment and increase worker safety.

During St. Petersburg International Economic Forum in June 2019, the governor of Kemerovo Region entered into an ecology protection agreement with Kuzbass enterprises and supervisory bodies. [4]. The presidential decree of May 2018 declared ecology protection a strategic objective of Russian Federation development. In compliance with the agreement, “EVRAZ ZSMK” will update the electrostatic precipitators connected to the boilers of West Siberian Thermal Power Plant, implement a closed final-cooling cycle for coke-oven gas, and build sulfur scrubbers. Siberian Generating Company will repair dust-collecting systems in the boilers and reimplement coal pulverization equipment. “Kuznetsk-ferroalloys” will switch to open ovens with dry gas purifiers.

The government of Kemerovo Region plans to create conservation areas in line with the ecological program “Clean coal – Green Kuzbass”. To lessen the environmental damage of coal industry,
Kuzbass will divert more attention to underground mining, providing the best possible manufacturing safety.

Transitioning to best available technologies is an opportunity for the domestic industry to create internationally competitive equipment and displace foreign manufacturers on the domestic market. At the beginning of June 2019, during St. Petersburg International Economic Forum, the Kemerovo Region government signed 26 cooperation agreements with major enterprises, federal ministries, and other regional governments. The expected amount of investments into Kuzbass, resulting from the implementation of these agreements, is 38 billion rubles. A number of these agreements [4] between Kuzbass and the Ministry of Natural Resources and the Environment of the Russian Federation, The Federal Supervisory Natural Resources Management Service, and significant regional enterprises directly aim to improve the ecology of Novokuznetsk.

The government of Kemerovo Region develops a new regional ecological standard for all industrial enterprises to follow on the gubernatorial initiative. Kemerovo Region is the first one to adopt such a measure in Russia. Ecology experts study the use of BAT on coal mining and processing enterprises. The main goal is to adopt BAT at all industrial enterprises.

During the “Days of Kuzbass” in the Federation Council, an idea of “silent coal mining” was announced. The notion entails putting buffer zones between the objects of coal industry and citizen housing or other public buildings – two kilometer-long for strip-mining operations and one kilometer-long for coal storages and new loading stations. The already existing loading stations inside population centers are to be re-purposed.

The regional government reached an agreement with the enterprises, using public roads to transport coal. Over the next years, they must construct their railroad branch lines, haul roads, or local coal-preparation plants. Until then, coal enterprises must compensate for the harm caused to roads and the environment. Concerning coal dust and noise pollution caused by strip-mining, the regional standard will also include the “silent explosion” technique (electronic detonation) and dust suppression equipment.

Solving ecological problems and maintaining environmental security is impossible without the help of the most modern science.

References
[1] Analytic Center Affiliated to the Government of Russian Federation n.d. Bulletin on current trends in the Russian economy Available at: https://ac.gov.ru
[2] Kemerovo Region territorial body of Russian Federal State Statistics Service n.d. Statistical yearbook Available at: https://kemerovostat.gks.ru
[3] Kemerovo Region Government n.d. Eight development priorities. Plan of socio-economic development measures of the Kemerovo region until 2035 Available at: http://kys6acc-2035.pdf
[4] Kemerovo Region Government n.d. Official website Available at: https://ako.ru/
[5] Ministry of Industry and Trade of the Russian Federation n.d. Official website Available at: https://minpromtorg.gov.ru
[6] Regional newspaper “Kuzbass” n.d. Coal will be cleaned up Available at: http://kuzbass85.ru/2019/06/08/ugol-vyvedut-na-chistotu
[7] Russian Federal State Statistics Service 2018 Environmental protection of Russia: Statistical collection Available at: https://gks.ru
[8] Zhidkova E A, and Dudinskaya T K Eds. 2010 Enterprise’s strategic management in modern conditions Economy and Efficient Production Organization 13 pp 23-27