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The proceedings are the papers of students, undergraduates, doctoral students and young researchers on topical issues of natural and technical sciences and humanities.

В сборник вошли доклады студентов, магистрантов, докторантов и молодых ученых по актуальным вопросам естественно-технических и гуманитарных наук.

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which is an effective tool for modernizing regional universities, increasing their competitiveness and attractiveness. Also, Kazakhstan can become an academic mobility center for the countries of Central Asia and Greater Eurasia, providing its own format of education as "Study in Kazakhstan". Finally, in order to implement these projects, it is necessary to create a good system and infrastructure by attracting investments and increasing funding for the education sector.

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REDUCING AIR POLLUTION IN KAZAKHSTAN: MAIN CHALLENGES AND THE INTERNATIONAL PRACTICE

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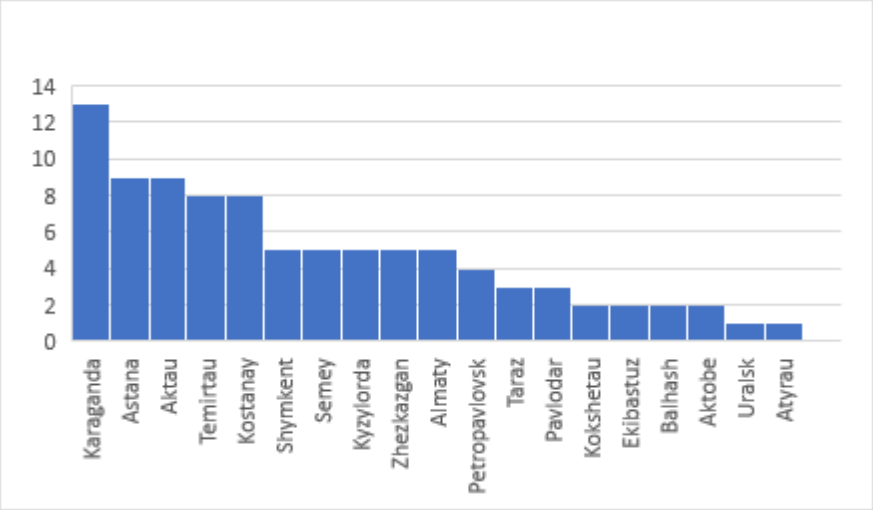
Atmospheric air pollution is one of the most serious environmental factors affecting the health of every person and remains a global problem. According to the World Health Organization (WHO), nearly seven million people worldwide die every year from diseases attributable to breathing polluted air [1].

In many cities of Kazakhstan, air pollution has also reached a critical level. Poor air quality poses major health risks for residents of large cities in Kazakhstan. According to the environmental monitoring of atmospheric air, by the end of 2020, out of 45 industrial cities and megacities, 10 cities belonged to a high level of atmospheric air pollution. These are the cities of Astana, Almaty, Karaganda, Temirtau, Atyrau, Aktobe, Balkhash, Ust-Kamenogorsk, Zhezkazgan and Shymkent. The total volume of emissions of pollutants amounted to 2.5 million tons [2]. In 2022, according to the annual information bulletin on the conditions of the environment of the Republic of Kazakhstan of Kazhydromet, the results also were not satisfying (See *Figure 1*).

Figure 1. Pollution level of the principal cities of the Republic of Kazakhstan (air pollution index) for 2022 (Diagram is made by author on the basis of statistical information of Kazhydromet) [3].



The main sources of air pollution are coal burning in power plants and households, heavy industry and transport in densely populated cities. Inhalation of polluted air leads to a number of serious consequences: asthma, chronic bronchitis, cardiovascular diseases, chronic obstructive pulmonary disease (COPD), lung cancer, allergies, premature birth in pregnant women and even Alzheimer's disease [4]. Therefore, in this article the main reasons of air pollution in Kazakhstan are analyzed in detail, the recommendations of experts, international organizations are provided and the world experience in reducing air pollution is illustrated.

First of all, the recent growth of mining and processing of mineral resources, such as lead, zinc, phosphorus, and chromium productions produces a huge volume of waste. 20 billion tons of this waste is accumulated and a third of them contaminate the air on a daily basis. Domestic mining enterprises use old, inefficient purification systems, as a result of which tons of harmful substances are released into the atmosphere [5]. For instance, in Ust-Kamenogorsk and Temirtau, pollution is typical for any season. The ArcelorMittal Temirtau Metallurgical Plant systematically violates the requirements of environmental legislation, causing serious harm to the health of local residents. Over the past year, fines totaling 5.8 billion tenge were imposed on it. As for Ust-Kamenogorsk, most of the large industrial enterprises, namely Ust-Kamenogorsk titanium and magnesium Combine, Kazzinc LLP, Ulba Metallurgical Plant, Condenser Plant and some others are located in the city area, where people mostly live. In Aktobe and Atyrau, outdated sewage treatment plants are also the main cause of dirty impurities in the atmosphere [4].

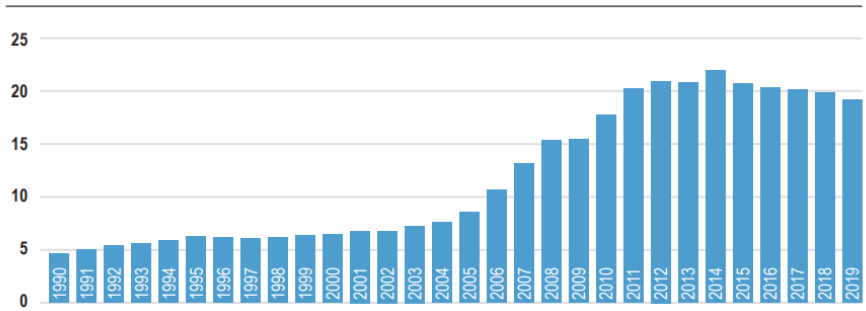
Secondly, coal is considered as the dirtiest type of fuel. Its combustion leads to emissions of sulfur and nitrogen oxides, suspended particles (PM), heavy metals, which are associated with neurological consequences and developmental disorders in humans and animals. Coal ash is stored in specially designated ash dumps in the open air, polluting the environment. The cheapness of coal is the main argument of its supporters. However, the price of coal does not take into account the economic damage caused: irreversible damage to public health, medical costs, loss of productivity, health care costs, loss of tourist attractiveness of the region and other invisible costs.

The largest coal-fired power facilities are concentrated in Central Kazakhstan in order to provide energy to the heavy industry of the Karaganda and Pavlodar regions. In addition, almost every major city in Kazakhstan has thermal power plants to provide heat and electricity. Weak environmental regulation of coal–fired power plants and the lack of modern emission reduction devices has led to the fact that the current emissions of coal–fired power plants in Kazakhstan exceed the limits for Europe:

- for solid particles – by more than 10 times,
- for nitrogen oxides - by more than 20%,
- for sulfur oxides - by more than 2.5 times [6].

Another main contributor to air pollution is gasoline and diesel fuel motor vehicles. The increased number of cars, particularly in the main cities of Kazakhstan, results in a high level of air pollution by nitrogen dioxide, carbon monoxide, and organic substances [5]. Since 1990, there has been a rapid increase in the number of passenger cars in Kazakhstan, which consequently inevitably led to an increase in emissions of pollutants from the transport sector. The rapid growth in the number of passenger cars may be due to the inefficiency of public transport and the lack of alternatives for the population. Thus, the provision of the population with passenger cars in personal ownership increased from 4.7 units per 100 people in 1990 to 19.2 units per 100 people in 2019 (See *Figure 2*).

Figure 2. Provision of the population with passenger cars in personal ownership, units per 100 people of the permanent population [6].



To address this challenge, the Government of Kazakhstan need to make efforts to reduce air pollution in its cities. This is also part of the country's ambitious plan to decarbonize its economy and achieve carbon neutrality by 2060 by transitioning towards renewable sources of energy [1].

It has been suggested that the government should take the following systematic measures to improve the current environmental situation, including the prevention of high levels of air pollution:

1) Systematic measures to monitor the quality of the atmosphere and its impact on the health of the population living in the sanitary protection zone of industrial enterprises need to be introduced.

2) It is necessary for industrial enterprises to actively reduce the number of harmful substances emitted into the air in adverse metrological conditions and to strengthen control over the level of vehicle emissions and toxicity. Urgent measures are needed in relation to the Thermal power plants: the modernization of two coal-fired TPP plants with the transfer to gas or the construction of new gas-fired power plants. A clear policy of switching households from coal to gas or electricity with a program to support the poor and vulnerable segments of the population is needs to be developed. It is also necessary to introduce a gradual ban on the burning of coal in households in the city and nearby settlements, as is customary in world practice.

Turning to the world practice, in the early 60s of the twentieth century, coal mining provided employment for millions of people in Europe, but since then the number of jobs in the European coal sector has been rapidly and continuously declining. In the Ruhr (Germany), employment in the coal sector declined from 473,000 in 1957 to 11,448 by the end of 2013, and then to zero by the end of 2018. To solve the problems associated with the restructuring process of this scale, a targeted and coordinated set of legislative, collective and contractual provisions and initiatives with the active participation of social partners were made. An individual re-employment strategy was developed for each affected employee.

The adoption of "ultra-low" emission standards for coal-fired power plants in China led to the equipping of more than 95% of coal-fired power plants with modern emission control devices by the end of 2017.

India has introduced NO2, SO2, PM emission standards for power plants built between 2003-2016 and stricter standards for plants built after 2017.

Thailand has introduced emission standards for existing power plants and new power plants operating since January 5, 2010. Modern emission control devices are used at coal-fired power plants in Thailand: electro filters and desulfurization of flue gases with wet limestone for emissions with PM and SO2.

Many countries have banned or severely restricted the use of coal in households to reduce emissions and reduce mortality due to air pollution: after the ban on the sale of coal in Dublin in 1990, studies confirmed a significant decrease in the concentration of "black smoke" and a decrease in mortality from respiratory diseases [6].

3) At the same time, it is necessary to expand the public transport system of Kazakhstani cities, the primary example is Almaty. The millionaire city should have modern, fast and affordable transport – metro, high-speed bus transport (BRT) and light rail system (LRT). In addition, all cars, trucks and public transport are being converted to gas. To do this, it is necessary to close gasoline stations inside and outside the city and install gas (LPG) stations in their place [7]. Another steps that should be made in order to reduce the number of car users:

• Urban planning aimed at creating a compact, multifunctional urban environment that provides access to the necessary services within "walking distance".

• Integrated urban planning with an emphasis on non-motorized movement and high-quality public transport (TOD). Reducing travel time on public transport is an important factor preventing the use of cars.

• Taxation of vehicles and motor fuel.

• Introduction of zones with paid entry, paid parking.

• Creation of bicycle and pedestrian infrastructure with a developed network that allows you to move from one area of the city to another safely and continuously.

• Development of a public transport network with a large share of electric transport.

• Creation of high-speed public transport systems (BRT, LRT).

• Introduction of increased requirements for the content of emissions in city zones for certain vehicles [6].

To sum up, air pollution in Kazakhstan is caused by many factors and poses serious threats to public health. Ambient air in the cities of Kazakhstan is polluted due to mining and processing of mineral resources, oil and gas production, gasoline and diesel fuel motor vehicles, industrial enterprises. As a result, people face number of health problems, and the risks are getting higher every year. Therefore, it is necessary to take measures that can contribute to the reduction of harmful emissions in the air, that include the monitoring of the air quality, switching households from coal to gas, development of transport infrastructure to reduce the number of vehicles.

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КОНЦЕПЦИЯ НАЦИОНАЛЬНОЙ БЕЗОПАСНОСТИ И ОПРЕДЕЛЕНИЕ УГРОЗ БЕЗОПАСНОСТИ (НА ПРИМЕРЕ РЕСПУБЛИКИ КАЗАХСТАН)

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