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Economic problems of the impact of urban HCS on the environment of the Republic of Kazakhstan

Abstract. *The problems of the effective functioning of the infrastructure of urban Housing and communal services (hereinafter referred to as HCS) of Kazakhstan are one of the priority areas in the framework of the social and economic policy implementation of the state in the context of sustainable development. Improving the infrastructure of the urban HCS requires the use of new economic mechanisms and attractiveness of housing and public utilities for investors in the worsening environmental conditions of the regions caused by the climate change due to the global warming, industrial interference of industrial enterprises, including housing and communal services.*

The article presents the research of economists in the formation and development of economic mechanism in ensuring environmental safety and the development of HCS is studying the environmental impact of HCS and identifying areas for improving the economic and environmental safety of housing and communal services. The article was prepared within the framework of grant funding for the implementation of the scientific project №AP 08957363 «Economic assessment of energy supply in the housing sector of the Republic of Kazakhstan».

Keywords: *housing and communal services, environmental safety, modernization, urban economy, economic assessment.*

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Introduction

Among the priorities of human behavior based on the diverse needs of people, the most important is comfortable living environment. Satisfying the need for a clean environment and environmental safety is a criterion that affects the settlement of certain regions, which form the attractiveness of choosing a place to live. Favorable climatic factors, clean air, and the availability of recreational resources have been and remain attractive to the population and determine the direction of population migration. The presence of natural pollutants, anthropogenic phenomena are on the contrary those elements,

that scare away residents. The attention to environmental quality, as an important aspect of the quality of life, can be explained by the fact that environmental quality is not only one of the elements for improving the quality of life of the population, but also its main component. Existing environmental problems are reflected in such an important component of the quality of life of the population as health. Public health is a kind of indicator of the socio-economic situation in the country, and its individual regions. The environment is influenced by various areas of economic activity, including housing and communal services. It should be noted that one of the problems in the activity of the HCS sector is

the organization of collection activities (including separate collection) and transportation of municipal solid waste, as well as the organization of electricity, heat, gas and water supply to the population, water disposal, and fuel supply to the population.

Terms of reference. The participation of a separate HCS in environmental pollution, is not critical at first glance and cannot be compared with the damage caused to nature, as metallurgical plants or pulp and paper mills. However, if we take into account the number of such farms in the territory, it becomes obvious that the share of environmental pollution and the negative impact on human health from the housing sector is significant enough to become the subject of close study and improvement.

Research goals. The study is aimed at studying the environmental impact of HCS and identifying areas for improving the economic and environmental safety of housing and communal services.

Research history. As a field of HCS research in the world scientific community, it has been studied since the mid-twenties of the last century - the period of the "world economic boom", and the problem intensified in the 1960s, 1980s and 2000s, i.e. periods of industrial development and industrialization of countries [1].

The scientific direction for the study of certain aspects of the development of HCS is presented in the works of such Kazakhstani scientists as Baybosynova AM, Bayandina GD, Kenzhgaliyeva Z.Zh., Korganbaeva AB, Mukasheva TA, Shalbolova U.J., Shelomentseva P.Yu. [2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13].

The issues of formation and development of the economic mechanism in ensuring environmental safety are the subject of numerous scientific works of Kazakhstani economists such as G. Andabaeva. [27], Soltanbekova B.E., Nurpeisova D., Kosdavletova K.K. Bekisheva S.D., Stamkulova K.U. [16, 17, 18, 19, 20, 21].

At the same time, issues related to the development of methods for assessing and choosing economic instruments aimed at developing HCS in ensuring the environmental safety of the Republic of Kazakhstan have not

been sufficiently studied. A review of previously conducted scientific research on the proposed topic showed that the base of domestic economic literature is practically low and requires filling with the results of new studies on the economic analysis of the development of HCS in ensuring environmental safety, taking into account the requirements where innovative solutions are used that are tied to the regional specifics of Atyrau.

Methodology

In the process of analysis and development of recommendations on the study of economic problems of the impact of HCS on the environment, system analysis, methods of economic evaluation and statistical analysis, comparison and groupings, analytical and normative will be applied.

Discussion and Results

The main source of environmental impact during the operation of residential development is utilities, including a set of enterprises and organizations serving the population. This includes sanitary and hygienic enterprises (water supply, sewerage, baths, laundries), urban transport, enterprises for the disposal and disposal of household waste, energy enterprises, facilities for external improvement (roads, bridges, etc.), hotels, etc.

The second factor is proximity to the consumer: if at present there is a tendency to move industrial zones outside of residential areas, then the waste for which utilities are responsible for processing are located in close proximity to the residents of this territory: waste water is discharged into the nearest body of water, a broken mercury-containing light bulb up to garbage collection is located near the playground, residential buildings are located in close proximity to the cogeneration plant.

The burning of garbage, which contains 0.5-0.7% nitrogen, 0.06-0.28% sulfur, 0.04-0.7% chlorine and hundredths of a percent of lead, nickel, copper, zinc, is another factor, increasing

the risk of negative impact of waste utilities. As you know, a number of harmful substances tend to accumulate in air, water, plants, animals and humans, as a result of which the consequences of their improper disposal become very difficult to trace - a negative effect may occur after years and decades and, moreover, not affect all residents territory, but only the most affected part of it - children, senior citizens, people with poor health.

An important source of urban air pollution is the burning of garbage, which contains: 0.5-0.7% nitrogen, 0.06-0.28% sulfur, 0.04-0.7% chlorine and hundredths of a percent of lead, nickel, copper, zinc. The gas emissions from waste incinerators include carbon dioxide, oxides of carbon, sulfur and nitrogen, ammonia, hydrocarbons, hydrogen chloride and fluoride, as well as highly toxic heavy metals. So, when burning 1 ton of urban waste, 23 g of lead, 4 g of mercury, 1.3 g of cadmium are released into the atmosphere [22].

Another of the latest anthropogenic factors in the field of HCS is the biological treatment of liquid municipal waste. Among municipal waste, solid waste is usually allocated, which is collected at special points, and then taken to landfills, and liquid, for the removal of which from the city there is a sewer system. After passing through the city sewer network, waste usually ends up in natural water bodies, but before that they must go through the biological treatment stage in special settling tanks. At the first stage, wastewater enters the rake compartment, where sewage is mechanically cleaned of various large debris. After this separation there are sand traps in which smaller debris remains. Then, through the system of primary sumps, water enters the aeration tanks, which are the main element of the entire treatment system. In aeration tanks, activated sludge bacteria that feed on organic pollutants are taken for work. Air tanks oxidizing organic compounds are constantly supplied to aeration tanks. The biological treatment method is based on the ability of certain types of microorganisms to feed on water-polluting substances under certain conditions, the structure of which is dominated by organics. Many types of microorganisms make up the activated sludge of a bio-treatment

plant. Propagating in wastewater, they absorb pollutants that enter the cells, and then under the influence of microbial enzymes undergo biochemical transformations.

HCS is the main source of contaminated wastewater to surface water bodies. They are accompanied by a stop of city and village water intakes, violation of the water supply regime. The location of industrial enterprises and other environmentally hazardous facilities in the sanitary protection zones of drinking water sources has led to the fact that all water taken from surface sources is subjected to special treatment. It is not possible to fully assess the environmental and economic damage caused to the environment by a separate HCS due to the multifactorial nature of the negative impact, many recipients, and a few other factors. Therefore, when assessing the quality of waste treatment and disposal by utilities, it is necessary to focus primarily on objective factors. In this regard, in the conditions of development and application of new technologies, it is important to pay attention to the development and implementation of a set of measures aimed at observing environmental safety requirements in the conditions of innovative development. In particular, the following should be noted:

- regular measurements of harmful substances in the atmosphere, hydrosphere, soil in the immediate vicinity of the HCS enterprise (especially in places of disposal / discharge / burial of waste) should be made, comparing them with the maximum permissible concentration (hereinafter - MPC);

- it is necessary to strengthen control over the quality and regularity of the removal of municipal solid waste from domestic areas, as well as the quality of their disposal.

- it is necessary to intensify the participation of the population in monitoring, analyzing and submitting information to the relevant services about violations of the norms and rules of activity of housing and communal services, which lead to deterioration of the environment and public health, as well as in deciding whether to continue to use the services this enterprise;

- regular activities are required to increase the ecological and innovative culture of the population, within the framework of which it is necessary to clarify the importance of a number of environmentally - oriented measures: separate collection of garbage; measures aimed at saving water, gas, heat; careful handling of mercury-containing products and devices and proper disposal of damaged products and devices, etc.;

- it is necessary to strengthen the «environmental» and «innovative» component of education of HCS workers (including in the framework of additional professional education) and the population of the territory.

Measures of this kind will intensify competition between utilities precisely from the standpoint of reducing environmental risks and will show the significance and importance for the economy of the efforts of each individual resident of the territory to protect the environment.

Thus, the life indicators of the urban population, including those that determine the country's face, such as the duration of a healthy life and state of health, have a decisive influence on their level at the state level.

A constant environmental problem in urban areas is air pollution. Its paramount importance is determined by the fact that air purity is a factor that directly affects the health of the population. The atmosphere has an intense effect on the hydrosphere, soil and vegetation, the geological environment, buildings, structures and other technogenic objects. Housing and utilities in large cities of Kazakhstan makes a very significant contribution to the pollution of the hydrosphere.

The urban population in Kazakhstan is constantly growing, new residential areas are being built, especially around large cities such as Almaty and the capital. New buildings may run into structural and environmental problems if future climate conditions are not considered at the design stage. To date, in areas of high risk (prone to floods, landslides, subsidence of the earth's surface, etc.), preliminary technical and economic studies using satellite remote sensing have not been carried out in order to reduce the impact of climate change on new construction projects.

The housing sector of Kazakhstan is one of the coldest countries in the world with rich energy resources and relatively low energy prices. In 2015, 46% of the population lived in rural areas, where only 4% of households are connected to the district heating system and 24% to network gas. In urban areas, 75% of households are connected to district heating and 61% use network gas. In addition to industrial and automotive emissions, during the (long) heating season, emissions from private households have a significant impact on urban air pollution levels. Coal is used for space heating - up to 30% in cities, but mainly in rural areas, where more than 70% of households use it, which leads to the formation of unfiltered emissions of SO₂, dust and PAHs from low sources and thereby has a significant negative impact on air quality. Coal consumption for domestic use per capita in Kazakhstan is one of the highest in the worlds [23]. According to the 2017 study "Energy Consumption in Households and Energy Poverty in Kazakhstan", 46 almost 20% of CO emissions in the country come from household sources (households), and the use of coal every year causes deaths as a result of CO poisoning. The use of other solid fuels other than coal, such as firewood, is also widespread in less prosperous areas where illegal logging and burning of waste takes place. Increased access to district heating systems or network natural gas would improve air quality in cities and especially in rural areas. Since prices for most of the energy carriers in Kazakhstan are subsidized, increasing the availability of gas supply systems will lead to the establishment of (subsidized) prices for natural gas below the level of coal prices in order to encourage citizens to switch to natural gas. Another tool to reduce emissions from the housing sector is to increase heating efficiency, which is currently low in Kazakhstan compared to other countries. According to the OECD publication "Improving Housing Energy Efficiency in Kazakhstan" in 2012, the average heat consumption per 1 m² in apartment buildings in Kazakhstan is three times higher than in Sweden [24]. Improving energy efficiency in the housing sector would have a major impact on air quality. Currently, insufficient investments

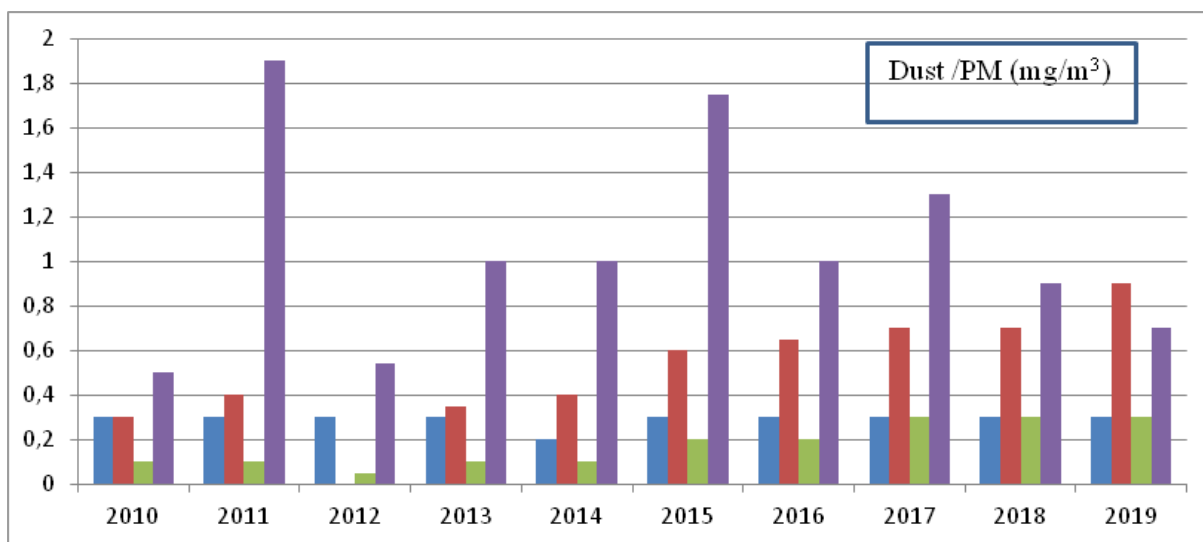
are made in the maintenance and repair of central and district heating systems, as well as in the modernization of installations to bring higher energy efficiency standards for household appliances and the reconstruction and thermal insulation of buildings and private houses.

Industrial air emissions, combined with emissions from a growing number of vehicles and emissions from heating wood and other solid fuels, are a source of severe air pollution in industrial areas and urban areas, which causes serious inconvenience and problems. health. Under adverse weather conditions in cities such as Almaty, Karaganda, Shymkent, Temirtau and Ust-Kamenogorsk, concentrations of pollutants, namely SO₂, NO and PM reach a very high level. At industrial facilities, modern technologies for reducing emissions have not been introduced, and to date, sufficient measures have not yet been taken to reduce atmospheric emissions in transport, for example, by switching to environmentally friendly fuels in order to ensure better and safer air quality for the health of the population. Kazakhstan has intensified work to expand sewage networks. In 2018, 560 sewage

treatment plants (WWTP) and 317 separate sewer networks operated in Kazakhstan. The length of the street sewer network was 5,600 km. In 2018 alone, 3,827.3 km of water supply networks and 210.3 km of sewer networks were commissioned. The installed capacity of WWTP in 2018 was 3,850,200 m³ per day. The number of sewage pumping stations increased in 2018 by 1,283 [25] units.

Emissions from the housing sector residential heating is a significant source of urban air pollution in winter. The lack of thermal insulation of buildings leads to low energy efficiency indicators. The energy efficiency of buildings in countries such as Germany and France is two times higher than in Kazakhstan [26].

From 2011-2012 Kazakhstan has legislation to improve energy efficiency in housing. The use of firewood, coal and other heat sources in private stoves and low-lying furnaces and the use of high sulfur fuels in district heating systems make a big contribution to the deterioration of air quality and lead to exceeding (accepted in the EU) air quality standards (for dust and SO₂, NO₂) and high winter air pollution index (fig 1, 2, 3).



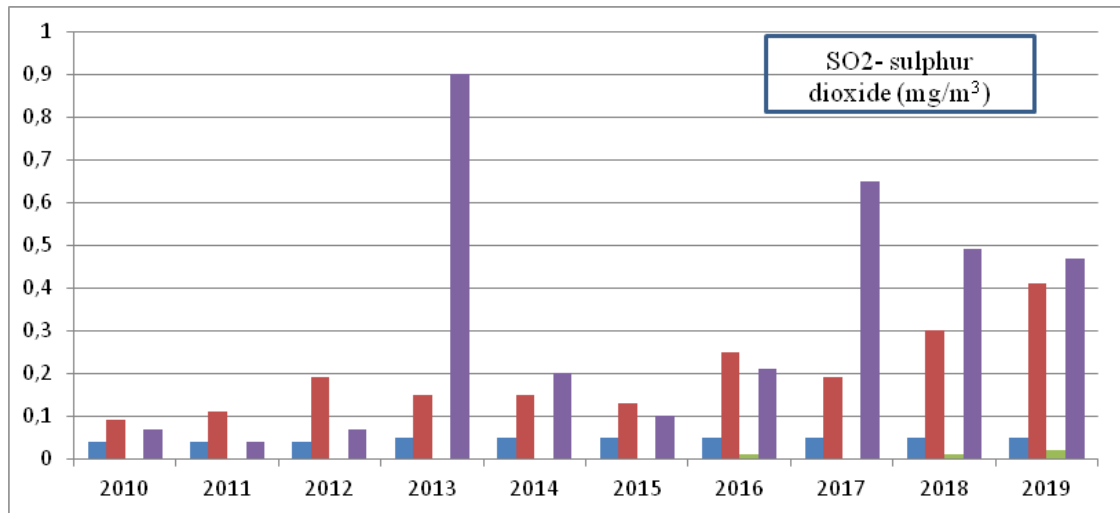
Figures 1 – Heat sources effect on the air quality (dust)

Dust – daily average MPC

Dust – mean year concentration

Dust – annual average MPC, multiplicity MPC

Dust – maximum mean daily concentration



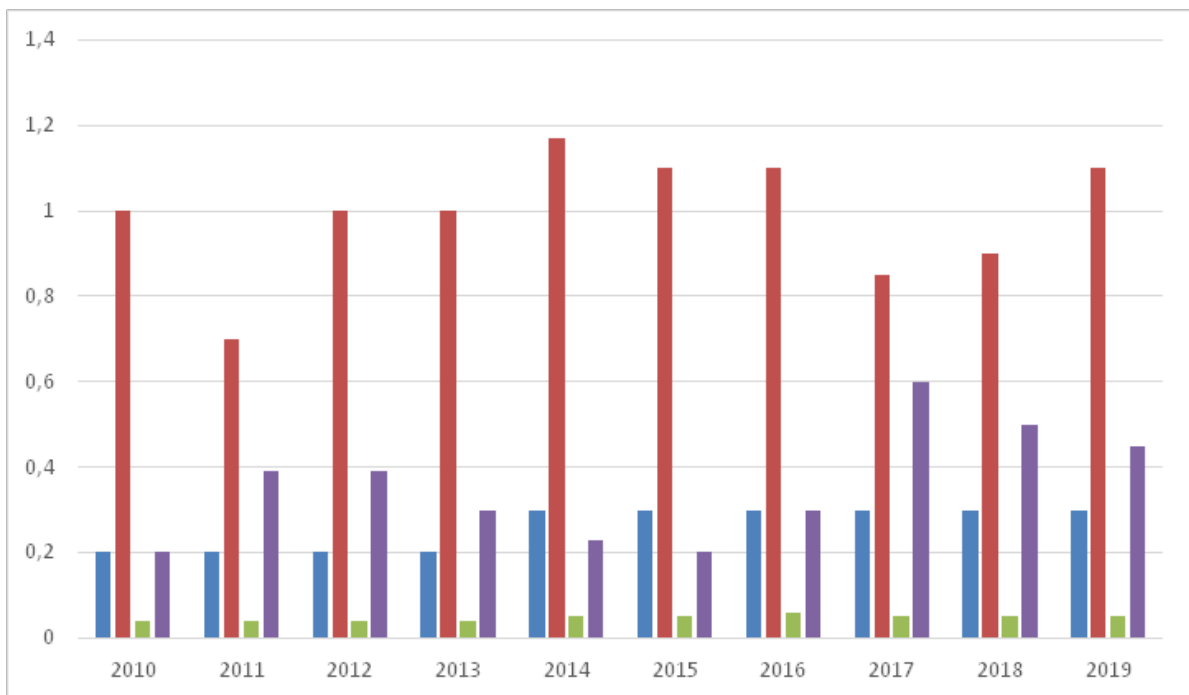
Figures 2 – Heat supply sources effect on air quality (SO2- sulfur dioxide)

Dust – daily average MPC

Dust – mean year concentration

Dust – annual average MPC, multiplicity MPC

Dust – maximum mean daily concentration



Figures 3 – Heat sources effect on the air quality (NO2- nitrogen dioxide)

Dust – daily average MPC

Dust – mean year concentration

Dust – annual average MPC, multiplicity MPC

Dust – Maximum average daily concentration

One of the priorities in the state program for the development of regions until 2020 is the modernization of the housing stock. It provides for the overhaul of multi-stored buildings with their insulation, installation of equipment to regulate the supply of heat, and means of measuring the consumed thermal energy [14].

Initially, this work was carried out as part of the program "Modernization of Housing and Communal Services", which was in effect since 2011, but later became an integral part of the unified state program for the development of regions. The need for its implementation was caused by the following circumstance.

As you know, a significant part of the housing stock (meaning high-rise buildings) in the cities of our republic has a long service life, and for the most part it has not seen a major overhaul. It is worth recalling that the mass construction of such housing began in the 1960s, which means that many houses turned 50 years old or more. The lack of insulation and thermal insulation, especially in high-rise buildings, which were built of concrete, weakly holding heat, the deterioration of the house networks led to the fact that a significant part of the supplied thermal energy was spent idle. In other words, a huge amount of coal and fuel oil was burned at the CHPPs, tenants spent a considerable amount each month on a heating charge, but far from all the heat reached the apartments. Experts said that unproductive losses reach 30% and even more. Meanwhile, the heating charge is the most expensive item of expenses for Kazakhstani families when it comes to utilities. Say, in Almaty, for heating a three-room apartment of 60 square meters in the old «Khrushchev», you have to give more than 15 thousand in January, and for the entire heating season - about 60 thousand tenge [27].

Modernization (it was necessarily specified that it is a question of thermal modernization) of housing was to be carried out according to the following scheme. Targeted transfers to local executive bodies have been allocated from the republican budget, which, considering applications received from condominiums, direct these funds to the overhaul of various houses. The

decision about what specific work needs to be done is made by the general meeting of tenants, and it also selects the contractor. Usually this is a repair (with possible warming) of the roof, entrance, basement, installation of an automated system for regulating heat supply depending on the outside temperature and a common house meter for the consumption of thermal energy (meter).

The money spent on major repairs is levied from the tenants, that is, it is repayable funds (they will then be spent on the repair of the following houses). A long maturity is established, while the local budget pays extra for low-income families. In addition, you need to consider that in a house that has undergone thermal modernization and in which both equipment that allows you to regulate the heat supply and a common house meter are installed, the heating fee is significantly lower than where there is none of this. Such savings practically cover the costs incurred by apartment owners. For example, if we talk about the same southern capital, then on average each Almaty family, due to the lack of metering devices, annually overpays about 20 thousand tenge. Multiply this by 10-15 years, for which installment plan is provided when paying for thermal modernization. That is, the expenses incurred by residents are largely paid off [27].

Quite actively, this work is ongoing in Shymkent, which has recently gained the status of the third metropolis in our country. If at first the townspeople were somewhat suspicious of the proposal to carry out thermal modernization, then this year applications from tenants of more than one hundred houses have arrived. For the main city of southern Kazakhstan, this is very important, because there are more than nine hundred high-rise buildings, whose age has exceeded half a century. By the way, this year the total amount of work on modernization of the housing stock amounted to approximately 3.5 billion tenge [28].

They undertook large-scale implementation of this direction of the state program for the development of regions in the city of Kentau, which is part of the Turkestan region. This year, overhaul of 14 houses is being carried out with

funds allocated from the republican treasury, and another three dozen with money from the regional budget. And there were so many applications from condominiums that next year it is planned to carry out such work in more than seventy high-rise buildings [28].

In the center of the neighboring region of Kyzylorda, in addition to the overhaul of houses, other measures are being taken, including innovative ones. In this city, the water used for heat supply is quite aggressive, so the pipes quickly become clogged with scale, rust, which leads to unproductive losses of heat energy. On the initiative of JSC "Kaztsentr HCS" today a pilot project on the use of German anti-corrosion agents is being implemented here.

In the North Kazakhstan region, during the period of this program, every tenth multi-story building was covered by modernization of the housing stock, for which 2.7 billion tenge was spent. The implementation of the program allowed to reduce the share of houses in need of major repairs, from 27% to 17%.

In the period from 2011 to 2017, 102 multi-apartment buildings were repaired in Atyrau - major repairs were made in 93 houses, 9 elevators were replaced in 3 houses. 89 funds were repaired with funds allocated from the republican and local budgets of the region in Atyrau. In 2014-2017, 13 houses were repaired with repayable funds in the amount of \$ 1.638 million, while the houses built in 1973-1982 (46%) were mostly modernized by MAB [7].

Modernization of the housing stock simultaneously solves several other important tasks. Related to the environmental situation in cities. Improving the efficiency of heating networks (including by reducing unproductive losses) can reduce the cost of coal, fuel oil for the generation of thermal energy and, accordingly, reduce emissions of harmful substances into the atmosphere.

Conclusion

Research has shown that the housing and utilities sector of the Republic of Kazakhstan, which has a direct impact on the environment,

has a number of economic problems in housing and communal relations. It is customary to solve problems through certain development scenarios – innovative, related to certain new Sciences, or traditional-by maintaining the current development plan. We believe that it is necessary to introduce an innovative development scenario, when the provision of housing and communal services is carried out through the creation of stimulating market conditions and effective interaction of consumers, suppliers of housing and communal services, state management bodies with the distribution of their rights and responsibilities.

Improvement of housing and utilities infrastructure in relation to reducing environmental pollution is recommended to be carried out in a comprehensive manner through such innovations as:

- 1) reduction of unit operating costs;
- 2) introduction of resource-saving technologies;
- 3) improving the efficiency of tariff regulation, which allows eliminating excess and reducing regulatory losses of natural monopoly entities;
- 4) review of all building codes and regulations aimed at strengthening and complying with energy efficiency standards;
- 5) introduction of energy efficiency classes for buildings and household energy-consuming devices.

Public investment in the housing and utilities sector will be carried out in accordance with the developed criteria for selecting investment projects, including requirements for economic feasibility, implementation of modern resource-saving technologies and corporate governance standards. However, the investment shortage of resources in housing and utilities contributes to the aggravation of the environmental crisis. In this situation, we cannot expect that state budget funding will quickly reach the required level.

In recent years, Kazakhstan has been implementing projects in the housing and utilities sector with the involvement of a public-private partnership mechanism, which requires mutually coordinated work of private business

and state (local, regional, city) management bodies. On the basis of PPP, there are processes of diversification, implementation of investment projects using innovative technologies, new materials, and new management systems in the housing and utilities sector.

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Қазақстан Республикасындағы қоршаған ортаға қалалық тұрғын үй-коммуналдық шаруашылығының әсер етуінің экономикалық мәселелері

Аннотация. Қазақстанның қалалық тұрғын үй-коммуналдық шаруашылығы (бұдан әрі – ТКШ) инфрақұрылымының тиімді жұмыс істеу мәселелерінің тұрақты дамуы жағдайында мемлекеттің әлеуметтік және экономикалық саясатын іске асыру шеңберіндегі басым бағыттардың бірі болып табылады. Қалалық ТКШ инфрақұрылымын жетілдіру жаһандық жылындың, өнеркәсіптік кәсіпорындардың, оның ішінде тұрғын үй-коммуналдық шаруашылық кәсіпорындарының техногендік араласуынан климаттың

өзгеруіне байланысты өңірлердің шиеленісіп отырған экологиялық жағдайында инвесторлар үшін ТКШ нысандарының тартымдылығының жаңа экономикалық тетіктері мен құралдарын пайдалануды талап етеді.

Мақалада экологиялық қауіпсіздікті қамтамасыз ету және тұрғын үй-коммуналдық шаруашылықты дамытудағы экономикалық тетікті қалыптастыру және даму саласы - тұрғын үй-коммуналдық шаруашылықтың қоршаған ортаға әсер ету факторларын зерттеу және тұрғын үй-коммуналдық шаруашылықтың экономикалық және экологиялық қауіпсіздігін арттыру бойынша бағыттарды анықтау бойынша ғалым-экономистердің зерттеулері келтірілген. Мақала №АР 08957363 «Қазақстан Республикасының тұрғын үй шаруашылығындағы энергиямен қамтамасыз етуді экономикалық бағалау» ғылыми жобасын гранттық қаржыландыру шеңберінде іске асыруға дайындалған.

Түйін сөздер: тұрғын үй-коммуналдық шаруашылық, экологиялық қауіпсіздік, жаңғырту, қала шаруашылығы, экономикалық бағалау.

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Экономические проблемы воздействия городского жилищно-коммунального хозяйства на окружающую среду Республики Казахстан

Аннотация. Проблемы эффективного функционирования инфраструктуры городского жилищно-коммунального хозяйства (далее ЖКХ) Казахстана являются одним из приоритетных направлений в рамках реализации социальной и экономической политики государства в условиях устойчивого развития. Совершенствование инфраструктуры городского ЖКХ требует использования новых экономических механизмов и инструментов привлекательности объектов ЖКХ для инвесторов в условиях обостряющейся экологической обстановки регионов, вызванной изменением климата из-за глобального потепления, техногенного вмешательства промышленных предприятий, в том числе предприятий жилищно-коммунального хозяйства.

В статье приведены исследования ученых-экономистов в области формирования и развития экономического механизма в обеспечении экологической безопасности и развития жилищно-коммунального хозяйства – изучение факторов воздействия жилищно-коммунального хозяйства на окружающую среду и определение направлений по повышению экономической и экологической безопасности жилищно-коммунального хозяйства. Статья подготовлена в рамках грантового финансирования на реализацию научного проекта №АР 08957363 «Экономическая оценка энергообеспечения в жилищном хозяйстве Республики Казахстан».

Ключевые слова: жилищно-коммунальное хозяйство, экологическая безопасность, модернизация, городское хозяйство, экономическая оценка.

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