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Modern tools for managing the climate economy of Kazakhstan

Abstract

Object: The purpose of the article is to examine the effects of climate change and propose appropriate measures to reduce emissions.

Methods: The article used systematic, analytical and statistical methods to manage the climate economy. The research methodology draws on qualitative research into current and evolving issues related to the impacts of climate change. To systematize the methods, official statistical data from the Global Change Data Laboratory and the Bureau of National Statistics of the Republic of Kazakhstan were used.

Findings: The article analyzes per capita carbon dioxide emissions from fossil fuels and industry, as well as the dynamics of costs and investments in air and climate protection. According to the authors, government policy to ensure reliable energy to achieve sustainable development goals cannot be achieved without taking into account environmental requirements. Reliance on low-cost, carbon-intensive energy solutions while ignoring environmental issues makes it difficult for the country to reduce its carbon emissions. Climate economics must focus on lean production.

Conclusions: Modern tools for managing the climate economy should be aimed at effective planning for the use of natural resources, the use of digital technologies to track and manage energy, and investing in enterprises involved in the disposal of food waste.

Keywords: natural resources, emissions, climate economics, management, ecology, investment.

Introduction

Currently, climate change is one of the most serious problems in the world. Climate risks can have serious and immediate impacts on sectors of the economy, financial markets and households. Many countries have already taken on the task of taking additional measures to combat climate change. However, there are significant unresolved issues in the development and implementation of climate policy, especially regarding timing, size and expected impacts.

The World Bank's country report on climate and development for Kazakhstan (2022) shows that actions to combat climate change will complement and accelerate the country's economic transformation, as well as benefit the development region. The World Bank has proposed measures to introduce renewable energy sources due to the wear and tear of devices in the electricity sector.

We all know that one of the main factors of climate change is the high level of gas emissions resulting from the use of fossil fuels. As economies have grown over the past few decades, energy consumption has increased and environmental degradation has become widespread. Against the backdrop of rising global temperatures, loss of animals and plants, deforestation and increased air and water pollution, it is urgently necessary to increase environmental sustainability and combat climate change.

Therefore, it is possible to obtain results by developing and implementing turning national adaptation strategies related to the management of the climate economy. However, there are currently no effective mechanisms that can provide support in the form of technology, capital and managerial expertise to facilitate the development and expansion of climate policy. Therefore, the study of modern tools for managing the climate economy is becoming relevant.

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Literature Review

In recent years, there has been a significant increase in scientific research in the field of climate change economics, mainly related to energy markets and environmental impacts. The new areas of research are mainly related to policies focused on Sustainable Development, Natural Resource Management and environmental models.

Many scientists have studied the relationship of the climate economy with other processes. For example, Yue Xi et al. (2023) has proven that climate policy changes will be influenced by renewable energy consumption in the future, and scientists warn that "attention should be paid to the risks of climate change in periods related to each type of energy". Gricelda Herrera-Franco and other researchers (2023) analyzed the interactions between water, energy, food communication and climate change, covering the basis of policy, sustainability, management and decision-making processes. Najia Saqib (2022), on the other hand, has studied the causal relationship between the use of renewable energies, economic growth and the environment. Xia Chen and other scientists (2021) found that the impact of climate change on clean energy investment varies significantly in countries with different levels of clean energy investment.

Some economists directly associate Climate Change with the use of Natural Resources. Brian W. Miller et al. (2023) considered resource management issues in the context of climate change. In their opinion, these issues are not simple: "a high degree of uncertainty interferes with our ability to predict environmental trajectories with confidence, and the resources affected often contain multiple management patterns or are subject to competing management goals". According to George Halkos and Shunsuke Managi (2023), environmental economics evaluates the benefits of the environment, while Resource Economics analyzes the allocation of scarce resources.

Of course, one of the greenhouse gases affecting climate change is carbon dioxide emissions. Petterson Molina Vale (2016) addressed the issues of Inter-time discounting and emission reduction. In his opinion, emissions research should be related to the economy of insurance against catastrophic risks, trade and climate economics, as well as the economy of adaptation to climate change. Balint T. et al. (2017) notes that the energy sector is the main producer of carbon dioxide emissions, so it plays a fundamental role in the transition to a low-carbon economy.

Failure to manage the climate economy effectively can have various environmental consequences. Najia Saqib et al (2023) has proven that the link between technological innovation, economic growth, renewable energy sources and environmental footprint has important policy implications for environmental sustainability. Mahfuz Kabir et al. (2022) studied the environmental risks and global warming resulting from the predominant use of fossil fuels. In their opinion, with the total supply of greenhouse gases, there is a need to use renewable energy sources to eliminate the negative impact on ecology, the environment and the atmosphere.

Thus, the climate economy has become a more integrated science of Natural Resources and their productivity and sustainable development. The scientific works of the researchers analyzed the interactions between water, energy, food communication and climate change, covering the basis of the processes of policy, sustainability, management and decision-making of the climate economy. At the same time, the issues of effective use of Natural Resources, the impact of greenhouse gas emissions on ecology, the environment and the atmosphere are analyzed.

Methods

The authors use systematic, expert and statistical methods of managing the climate economy. The research methodology is based on qualitative research into current and emerging issues related to the impact of climate change. To systematize the methods, official statistical data of the laboratory of Global Change data and the Bureau of national statistics of the Republic of Kazakhstan were used.

Results

Many areas of the Sustainable Development Goals (SDGs) adopted at the United Nations General Assembly (2015) are designed to support the transition to a climate economy. For example, SDGs-7 (affordable and clean energy), SDGs-12 (responsible consumption and production) and SDGs-13 (action to combat climate change) are directly related to the climate economy. However, reliable energy supply to meet the Sustainable Development Goals cannot be met without taking into account environmental requirements. Therefore, it is necessary to consider the climate economy taking into account the directions of environmental requirements.

The main tool for regulating climate policy in Kazakhstan is the Environmental Code (2021). This Code provides for the introduction of an emissions trading system, that is, a market mechanism, which requires an annual reduction in emissions by 1.5% by 2030.

However, this mechanism is not fully implemented due to the use of fossil fuels in the Republic of Kazakhstan. For the same reason, it was found that per capita carbon dioxide emissions from fossil fuels and industry are at a very high level (Fig. 1).
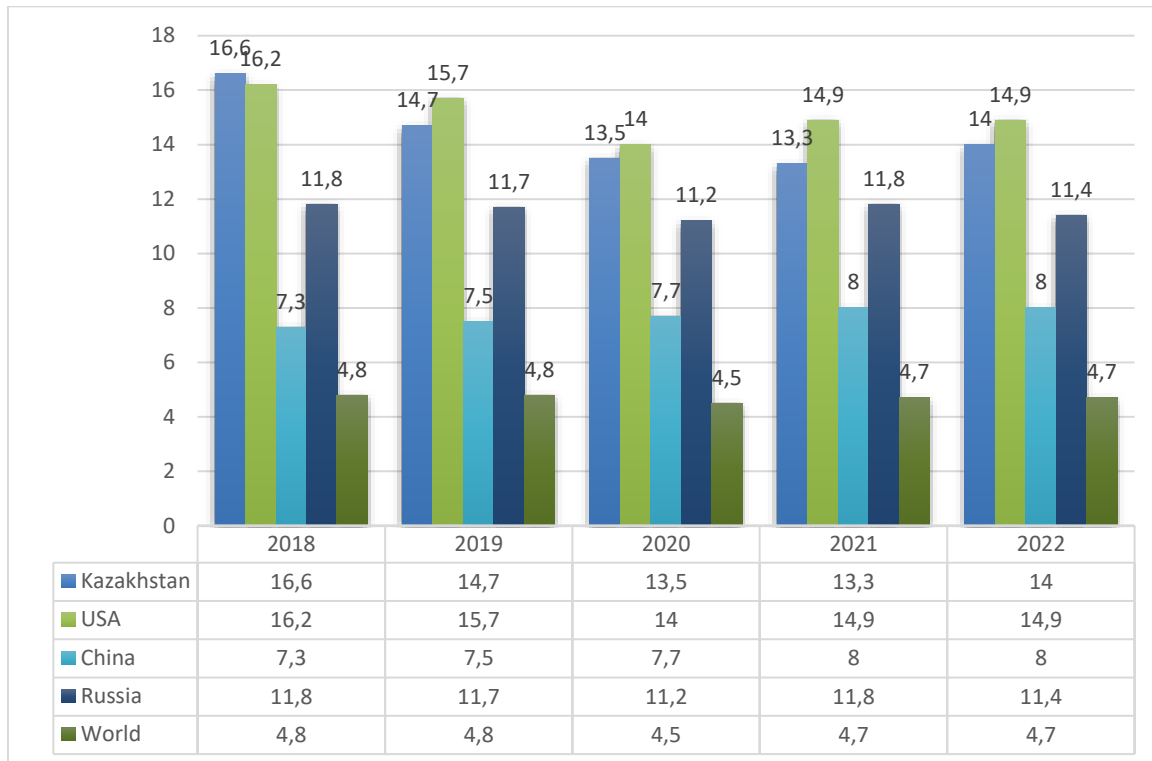

	2018	2019	2020	2021	2022
Kazakhstan	16,6	14,7	13,5	13,3	14
USA	16,2	15,7	14	14,9	14,9
China	7,3	7,5	7,7	8	8
Russia	11,8	11,7	11,2	11,8	11,4
World	4,8	4,8	4,5	4,7	4,7

Figure 1. Emissions of carbon dioxide (CO_2), tons per capita from fossil fuels and industry

Note – source: compiled by the authors based on the Global Change Data Lab (2023)

The figure shows data from the states of the United States (14.9 tons), Kazakhstan (14 tons), Russia (11.4 tons) and China (8 tons), where per capita carbon dioxide losses are higher than the world level (4.7 tons). Currently, the countries of the United States, Kazakhstan and Russia depend on fossil fuels, that is, coal. For this reason, these states release a large amount of carbon dioxide (CO_2) emissions into the air. The Chinese state switched to renewable energy sources in subsequent years.

The Republic of Kazakhstan has a number of legislative and regulatory documents that make it possible to take the necessary measures to reduce emissions. For example, the action plan for the implementation of the Concept of the Republic of Kazakhstan for the transition to a "green economy" for 2021–2030 (2020) and the Concept for the development of the fuel and energy complex of Kazakhstan until 2030 (2014) provide for the main measures in the heat and electricity generation sector that affect the reduction of emissions.

Recognizing the importance of mitigating the effects of climate change, our country has adopted a number of climate change policy initiatives in recent years. However, ignoring environmental concerns and relying on low-cost, high-carbon energy solutions has made it difficult for the country to reduce greenhouse gas emissions. The country's rapid economic growth is directly related to the large-scale consumption of fossil fuels. For this reason, the main energy sources include cheap oil, coal and natural gas.

To reduce Kazakhstan's dependence on natural resources, it is necessary not only to promote the development of enterprises aimed at a green economy, but also to invest a number of financial resources.

In the period from 2018 to 2022, costs and investments in the protection of atmospheric air and climate are growing every year (Fig. 2).
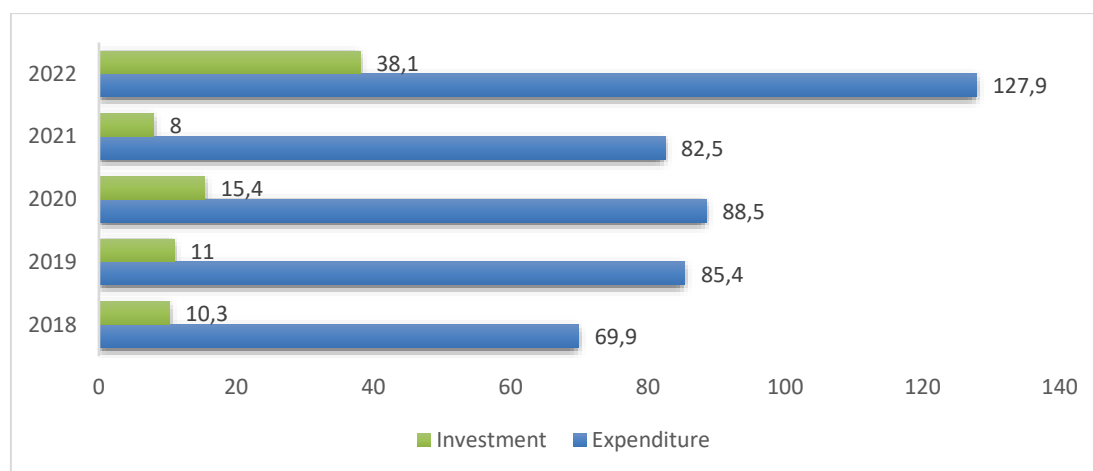
Figure 2. Expenditures and investments in the protection of atmospheric air and climate in the Kazakhstan Republic, billion. tenge

Note – source: compiled by the authors based on data from the National Bureau of Statistics (2023)

According to data from the National Bureau of Statistics (2023), 69.9 billion dollars were allocated for atmospheric air and climate protection in 2018 and in 2023, 127.9 billion tenge were spent. These funds are aimed at preventing pollution, cleaning flue gases and ventilation emissions by changing the production process to protect the air, preserve the climate and protect the ozone layer, as well as expert measurements, control, laboratory tests and much more.

Over the past five years, the volume of investments aimed at protecting atmospheric air and climate has increased from 10.3 billion tenge (2018) to 38.1 billion tenge (2022). These investments are made in new construction, expansion, reconstruction and modernization of facilities (including costs for the modernization of the facility carried out during major repairs).

The problem of solid household waste, which affects climate change, releasing harmful greenhouse gases into the atmospheric air, needs special study. Among the main factors that directly or indirectly impede the effective management of household waste in Kazakhstan, urbanization and the development of food and household markets lead to a steady increase in the volume of waste in the country. Also, most of the household waste is recyclable, in addition, these resources and materials can be used to create new products that may be in demand in the modern market. These include rubber and plastic products, glass, paper, fabric and many other materials.

Evidence of these results is the change in the formation of solid household waste per capita in the Republic of Kazakhstan (Fig. 3).
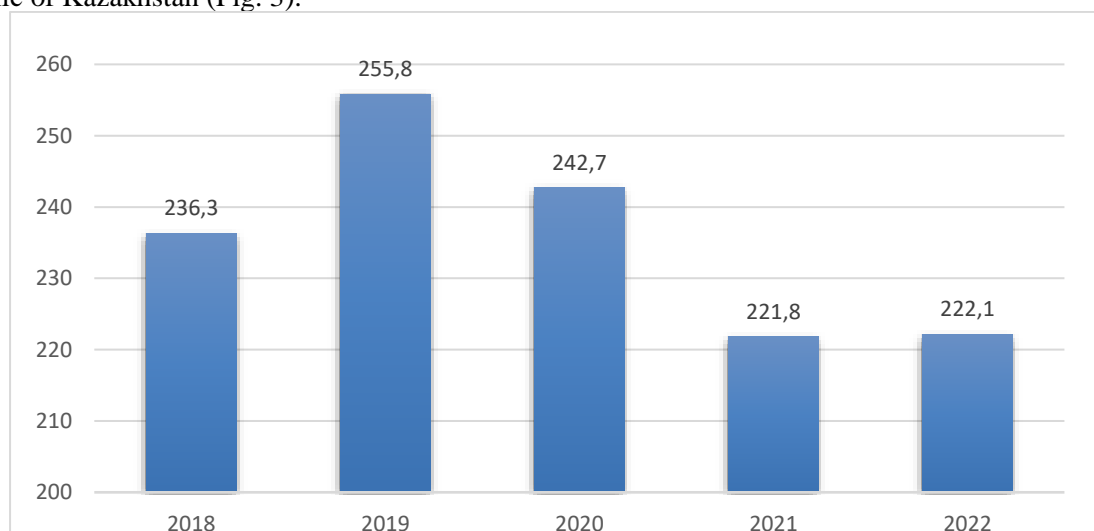

Figure 3. Formation of solid household waste per capita in the Republic of Kazakhstan, kg

Note – source: compiled by the authors based on data from the National Bureau of Statistics (2023)

For the period from 2018 to 2022, the per capita production of solid household waste decreased from 236.3 kilograms to 222.1 kilograms in the Republic of Kazakhstan. This change is influenced by the creation of a system of selective waste collection, waste processing and sorting stations, the construction of waste processing plants, the development of the secondary raw material market, and the development of a system of benefits for enterprises.

It should be noted that despite significant general achievements in ensuring the timely disposal of household waste in Kazakhstan, solid household waste remains relevant and requires an integrated approach to creating a legal mechanism for handling such waste and its practical application. To do this, it is necessary to prevent the formation of waste by making changes in the production process, collect and transport waste, process and dispose of hazardous waste (heat treatment, disposal to landfill, other methods), process and bury safe waste (incineration, disposal to landfill, other methods), conduct expert control and laboratory tests.

Let's build a multiple regression model with a dependent variable Y and three independent variables X1, X2, X3, where

Y – Carbon dioxide emissions per capita (co_2) from fossil fuels and industry (ton);

X1 – Costs for the protection of atmospheric air and climate (thousand tenge);

X2 – Investments in the protection of atmospheric air and the problems of climate change (thousand tenge);

X3 – Solid waste generation per capita (kg).

The quantitative analysis was carried out on the basis of data from the official website of the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan https://stat.gov.kz //.

To check the variables for multicollinearity, we construct a matrix of paired coefficients (Table 1).

Table 1. Matrix of paired coefficients

	Y	X1	X2	X3
Y	1			
X1	-0.43904497	1		
X2	-0.20669913	0.65705914	1	
X3	0.283246737	-0.4169634	-0.418295287	1

Table 1 shows that the most significant relationship is between the dependent variable Y and X1 (-0.439), and the relationship is reversed. That is, the growth of one indicator leads to a decrease in the second (and vice versa). The next most important influence on Y is the X3 factor. The relationship between them is direct, since the coefficient is positive (0.283). This means that with the growth of solid household waste, carbon dioxide emissions per capita are also increasing. The matrix of paired coefficients demonstrates the absence of multicollinearity between variables ($X_{ij} < 0.7$), which allows us to include all the factors considered in the model. We put forward 2 hypotheses:

1. H_0: all coefficients $b_1, \ldots, b_n = 0$, that is, there is no linear relationship between the variables Y and X_i.

2. H_1: $b_1, \ldots, b_n \neq 0$, that is, there is a linear relationship between Y and at least one X_i.

To test the hypotheses, let's build a multiple linear regression in MS Excel (Table 2).

Table 2. Regression analysis results

CONCLUSION OF THE RESULTS						
Regression statistics						
Multiple R	0.8730					
R-square	0.7622					
The normalized R-square	0.0486					
The standard error	1.3002					
Observations	5					
Analysis of variance						

	df	SS	MS	F	Significance F	
Regression	3	5.4174	1.8058	1.0682	0.0495	
Remains	1	1.6906	1.6906			
Total	4	7.108				
	Coefficients	The standard error	t-statistics	P-Value	Lower 95%	Upper 95%
Y- intersection	21.5269	14.1250	1.8240	0.03697	157.9480	201.0019
X1	-0.1726	0.1027	-1.7815	0.03416	-1.4770	-1.1318
X2	-0.2790	0.1823	1.9307	0.03684	-2.0371	-2.5951
X3	0.0168	0.0497	1.8372	0.04930	0.6152	0.6488

The analysis of variance showed that the observed value of F of the Fisher criterion is greater than the tabular one, since the *"Significance of F" is less than 0.05*. So the H_0 hypothesis is rejected and the alternative hypothesis H_1 is accepted that at least one coefficient $b_i \neq 0$, that is, there is a linear relationship between Y and X_i. This means that the constructed multiple regression model is reliable and statistically significant.

As Table 2 shows, the regression coefficients are statistically significant: the "P – Value" for the coefficients should be no more than 0.05. This is the probability of an error. In the constructed model, all coefficients are significant, since they correspond to the condition P – Value < 0.05.

Thus, the evaluation of the model showed that all the coefficients of multiple regression are statistically significant and reliable.

Interpretation of the resulting model:

1. An increase in the cost of protecting atmospheric air and climate by 1 thousand tenge will lead to a decrease in carbon dioxide emissions per capita by an average of 0.173 tons;

2. An increase in investments in atmospheric air protection and climate change problems by 1 thousand tenge will reduce carbon dioxide emissions per capita by an average of 0.279 tons;

3. An increase in the formation of solid waste per capita by 1 kg will increase carbon dioxide emissions per capita by an average of 0.0168 tons.

Discussions

It is known that it is necessary to understand climate change from a scientific point of view, to facilitate the impact on countries around the world, and to take urgent measures to adapt. Because concentrations and emissions are growing despite uncertainty and drop points in climate forecasts, causing environmental consequences.

Climate economics focuses on cost-effective production, which aims to improve productivity levels while reducing carbon emissions by developing a more uniform operating routine. In turn, lean manufacturing seeks to reduce carbon emissions and reduce environmental costs across the entire value chain. Therefore, modern tools for climate economic management should be aimed at solving the following tasks:

- effective planning of the use of Natural Resources. One of the main sources of planning in natural resource management is climate forecasts for the future. This requires the development of a complex of systemic approaches to determine the interaction between climate, land, energy and water policy;

- use of digital technologies for energy monitoring and management. The introduction of digital technologies in corporate governance can lead to improved communication between stakeholders, more accurate data analysis, more efficient production flows, and various process improvement initiatives;

- investment in enterprises engaged in the disposal of household waste. Currently, food waste is becoming a major problem contributing to climate change, as they not only occupy a valuable place in landfills, but also emit harmful greenhouse gases when decomposed.

Conclusions

Taking into account the peculiarities of the domestic and foreign climate economy, the following conclusions can be drawn:

- currently, the climate economy is becoming a more integrated science of Natural Resources and their productivity and sustainable development. In the scientific works of researchers, the climate economy is considered as the interactions between water, energy, food communication and climate change, which contain the basis of policy, sustainability, management and decision-making processes. Also, scientists pay

great attention to the issues of efficient use of Natural Resources, the impact of greenhouse gas emissions on ecology, the environment and the atmosphere;

- public policies related to the provision of reliable energy to achieve the Sustainable Development Goals cannot be implemented without taking into account environmental requirements. Ignoring environmental concerns and relying on cheap, high-carbon energy solutions makes it difficult for the country to reduce carbon emissions. Therefore, the climate economy should be directly related to economical production;

- modern tools for managing the climate economy should be aimed at effective planning of the use of Natural Resources, the use of digital technologies for tracking and managing energy, and investment in enterprises engaged in the disposal of household waste.

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Қазақстанның климаттық экономикасын басқарудың заманауи құралдары

Аңдатпа:

Мақсаты: Мақаланың мақсаты — климаттың өзгеруінің салдарын зерттеу және шығарындыларды азайту бойынша тиісті шараларды ұсыну.

Әдісі: Мақалада климаттық экономиканы басқарудың жүйелік, сараптамалық және статистикалық әдістері қолданылған. Зерттеу әдістемесі климаттың өзгеруінің әсеріне қатысты ағымдағы және дамып келе жатқан мәселелерге сапалы зерттеулерге негізделген. Әдістерді жүйелеу үшін жаһандық өзгерістер туралы деректер зертханасының және Қазақстан Республикасы Ұлттық статистика бюросының ресми статистикалық деректері пайдаланылды.

Нәтижесі: Мақалада жан басына шаққандағы көмірқышқыл газының қазба отындары мен өнеркәсіптен шығарылу көрсеткіштері, сондай-ақ атмосфералық ауа мен климатты қорғауға жұмсалатын шығындар мен инвестициялар динамикасы талданған. Авторлардың пікірінше, тұрақты даму мақсаттарына қол жеткізу үшін сенімді энергетиканы қамтамасыз ету жөніндегі мемлекеттік саясатқа экологиялық талаптарды ескермей қол жеткізу мүмкін емес. Экологиялық мәселелерді елемеу кезінде арзан және көміртекті көп қажет ететін энергетикалық шешімдерге тәуелділік елге көмірқышқыл газының шығарындыларын азайтуды қиындатады. Климаттық экономика үнемді өндіріске бағытталуы керек.

Қорытынды: Климаттық экономиканы басқарудың заманауи құралдары табиғи ресурстарды пайдалануды тиімді жоспарлауға, энергияны қадағалау және басқару үшін цифрлық технологияларды пайдалануға, тұрмыстық қалдықтарын кәдеге жаратумен айналысатын кәсіпорындарға инвестициялауға бағытталуы тиіс.

Кілт сөздер: табиғи ресурстар, шығарындылар, климаттық экономика, менеджмент, экология, инвестиция.

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Современные инструменты управления климатической экономикой Казахстана

Аннотация:

Цель: Целью статьи является рассмотрение последствия изменения климата и предложение соответствующих мер по снижению уровня выбросов.

Методы: В статье были использованы системные, аналитические и статистические методы для управления климатической экономикой. Методология исследования опирается на качественное исследование текущих и развивающихся проблем, связанных с последствиями изменения климата. Для систематизации методов были использованы официальные статистические данные Лаборатории данных о глобальных изменениях и Бюро национальной статистики Республики Казахстан.

Результаты: Авторами проанализированы показатели выброса углекислого газа на душу населения от ископаемого топлива и промышленности, а также динамика затрат и инвестиции на охрану атмосферного воздуха и климата. По их мнению, государственная политика по обеспечению надежной энергетики для достижения целей устойчивого развития не может быть достигнута без учета экологических требований. Зависимость от недорогих и углеродоемких энергетических решений при игнорировании экологических проблем затрудняет стране сократить выбросы углекислого газа. Климатическая экономика должна быть направлена на бережливое производство.

Выводы: Современные инструменты управления климатической экономикой должны быть направлены на эффективное планирование по использованию природных ресурсов, применение цифровых технологий для отслеживания и управления энергией, инвестирование средств в предприятия, занимающиеся с утилизацией пищевых отходов.

Ключевые слова: природные ресурсы, выбросы, климатическая экономика, управление, экология, инвестиция.

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