CTTN Research Grants Program 2024

Climate Change in Kazakhstan: State Policy and Public Awareness

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Abbreviations

CCPI	Climate Change Performance Index
CH_4	Methane
CO_2	carbon dioxide
ETS	emissions trading system
EU	European Union
GDP	gross domestic product
GHG	greenhouse gas
LULUCF	land use, land use change and forestry
N2O	nitrous oxide
NHRE	non-hydropower renewable energy development
OECD	Organization for Economic Co-operation and Development
R&D	research and development
RES	renewable energy sources
UNDP	United Nations Development Programme

Abstract

This study analyzes Kazakhstan's climate policy and provides survey results on public awareness of climate change risks, consequences, and state measures to mitigate them. Kazakhstan has adopted several important documents for transitioning to a green economy and achieving carbon neutrality. These strategies aim to involve the general population in addressing climate change risks by raising awareness and disseminating education and knowledge. However, the survey results show that, despite 57.3% of respondents believing that the government of Kazakhstan is making efforts to combat climate change, only 13% are fully informed about the country's Environmental Code. However, 57.7% of respondents expressed willingness to change their consumer habits, and 53.4% were ready to pay additional taxes to address climate risks if these funds were used efficiently. Another important finding from the survey is respondents' positive opinions regarding the role of science and climate scholars. The findings of this study suggest that the government should develop a persistent communication policy on climate change to strengthen cooperation among the state, businesses, scholars, and the public.

Introduction

Climate change and its consequences are among the most frequently discussed issues on the global agenda. Climate activists, economists, politicians, and many other experts have identified various scenarios resulting from climate change. In particular, climate change and its ecological consequences can transform economic and political systems, leading to substantial damage. Stern (2008) noted that greenhouse gas (GHG) emissions are externalities and represent the biggest market failure. The negative influence of climate change differs across sectors, with agriculture being among the most affected. Higher temperatures, weather variability, shifting agroecosystem boundaries, invasive crops, and pests reduce crop yields, the nutritional quality of major cereals, and livestock productivity (World Bank, 2021). Climate change contributes to increased food prices, causing great concern in low-income and food-import-dependent countries (Carraro, 2016). Furthermore, climate change and the agricultural sector have bidirectional effects, as crop and livestock production for food remain important contributors to climate change. Climate change can undermine agricultural activities (Khitakhunov, 2021a). Notably, climate change affects human health, including mental health and well-being. Rural communities are among the most vulnerable groups; therefore, well-informed rural populations are concerned about the environmental, financial, health, and social effects of climate change (Austin et al., 2020).

The government of Kazakhstan has paid special attention to climate change and developed and approved important documents to mitigate its consequences. Kazakhstan's climate strategy is based on the concept of the transition to a "green economy," the Environmental Code, and the "Strategy for Achieving Carbon Neutrality by 2060." Within the framework of these documents, the government aims to reduce emissions by increasing the share of gaseous, renewable, and nuclear energy sources. According to Shadrina (2020), Kazakhstan is a regional leader in non-hydropower renewable energy development.

In the September 2024 State of the Nation address, Kazakhstani President Kassym-Jomart Tokayev set a goal *to improve the environmental situation and cultivate respect for the environment*. He noted the need to adopt the most advanced technologies and establish a modern emission monitoring system. Furthermore, he supported and popularized the idea of increasing forest areas and provided an example of the "Clean Kazakhstan" initiative, in which approximately 3 million people collected more than one million tons of garbage. President Tokayev called for long-term efforts to disseminate information and raise awareness among citizens, making both regional and local governors responsible for such actions (Akorda, 2024).

Kazakhstan strongly supports global and regional climate initiatives and was the first country in Central Asia to ratify the Paris Agreement and adopt a Carbon Neutrality Strategy

(Akorda, 2023). Recently, countries of Central Asia signed the concept of development of regional cooperation "Central Asia – 2040," which names climate cooperation as a key priority for strengthening regional integration.

Achieving all climate goals set by the government demands cooperation among policymakers, businesses, scholars, and the public. However, Kazakhstan's private sector has shown only minor participation in climate initiatives. Global businesses continue to display contradictory attitudes towards climate change. For example, in the United States, large companies have actively fought against climate policies through lobbying, political campaigns, and academic research (Samuel, 2021), whereas in Europe, companies perceive renewable energy development as a "new measure of corporate success" (Fredeau and Kortenhorst, 2021).

According to Vakulchuk et al. (2023), climate change has been neglected in the field of Central Asian studies, and several scholars have ignored the severe security threats that climate change poses to the region. Furthermore, they mentioned that limited knowledge about climate change in Central Asia may result in higher environmental and economic costs and called for new in-depth studies to raise climate change awareness.

Notably, despite the adoption of strategic documents on climate change and several government initiatives, the current participation and readiness for change of the general population remain uncertain. Without active public support and participation, any efforts made may have a limited impact. Thus, the purpose of this study is threefold. First, it analyzes Kazakhstan's climate policy. Second, it reveals the findings of an online survey conducted in the general population of Kazakhstan, particularly in Almaty, showing public awareness of climate risks and consequences, as well as state policy measures. Finally, recommendations for improving state policy through public engagement are provided.

Literature review

Several surveys have reported various findings regarding public awareness of climate change and government policies. According to a survey conducted in Pune, India, the urban population is aware of global climate change but has poor knowledge of global efforts (Pandve et al., 2011). In another survey, residents of the coastal city of Mytilene, Greece, acknowledged the existence of climate change and expressed positivity about making lifestyle changes and paying for environmental protection mitigation measures. Information campaigns and educational initiatives can enhance public understanding of the relationship between lifestyle and climate change (Tourlioti et al., 2024). Educational attainment is the strongest predictor of climate change awareness worldwide. Improving basic education, climate literacy, and public understanding of

the local dimensions of climate change are vital for public engagement and support for climate action (Lee et al., 2015).

In Kazakhstan, scholars conducted opinion surveys and interviewed ecological experts and eco-activists. An opinion survey conducted by the Climate Change Project of the United Nations Development Programme (UNDP) in Kazakhstan found that among 200 respondents, the majority (approximately 63%) were aware of climate change but not of the relevant government measures and policies. The Internet was the main source of information on climate change for 86% of respondents (UNDP, 2020). Kumar (2022a) interviewed ecological experts from Kazakhstan's Ministry of Ecology, Geology, and Natural Resources. According to the experts, the insufficient level of public environmental awareness could be explained by the *"low level of culture and consumerist attitude and behavior"* and *"lack of public knowledge on environmental education."* However, technological advancements have helped improve the level of environmental awareness among the general population, and experts have argued that civil society can help solve environmental problems. Kumar (2022b) interviewed eco-activists in Kazakhstan who raised the issue of low environmental awareness and called for environmental education to be provided to everyone. These eco-activists noted the strong need to form an ecological culture in families and society. They provided many reasons for low public awareness, ranging from imperfections in the education system to a lack of environmental journalism. According to the activists, despite the lack of environmental education programs with a tangible effect, environmental awareness among youth and urban citizens is rising. Notably, half of the eco-activists were also unaware of government measures. The experts distinguished civil society's role in addressing environmental awareness issues and identified a wide research gap in awareness in Kazakhstan.

Furthermore, Tursynbayeva et al. (2020) conducted a survey finding that students have an impersistent positive interest in environmental problems and participation in ecological activities to improve the environment. They obtain information on climate change mainly through the Internet, followed by the media and television, and university training. The desire to improve the ecological situation is a key factor driving students' environmental activities. They also expressed the opinion that, to improve environmental awareness and culture, the public needs to pay attention to school programs and climate issues in the media and on television and organize environmental campaigns. The authors concluded that students have a sufficient level of motivation and interest in organizing and participating in ecological activities but lack theoretical knowledge. Makhanov (2021) used Google Trends data to show that people in Kazakhstan do not generally show much curiosity regarding climate change when online, which might signal a low level of public awareness. Hence, climate change has not received the level of attention that it warrants. Makhanov argued that increasing awareness of climate change issues in the general population

should be part of public policy. According to Abibulloyeva and Amanbayuly (2024), government agencies in Central Asian countries and international organizations that deal with environmental issues, especially climate change, do not sufficiently consider young environmentalists' opinions. However, owing to limited opportunities for specialized higher education in climate science, many young people do not appear to view environmental issues as important.

Lack of motivation and distrust remain key barriers to public engagement in climate policy development. Hence, climate change communication is crucial for improving knowledge and awareness. Moreover, individual, local, and traditional knowledge must be combined with scientific knowledge to support climate change adaptation in local communities (Khatibi et al., 2021). Notably, in the case of climate change, public awareness significantly lags behind scientific advancements; thus, raising public awareness is a valuable addition to the scientific approach to addressing climate change issues (Rahimi, 2020). For example, understanding the harmful effects of carbon emissions can stimulate a higher demand for renewables. Therefore, policymakers must foster knowledge-building among the public to move towards the extensive use of renewable energy to promote long-term improvements in natural environmental quality (Gozgor et al., 2020). Promoting energy conservation practices and raising public awareness are critical for improving the management of existing energy resources (Kayumov and Razzaq, 2024). Thus, educational initiatives, information campaigns, and high motivation are crucial for increasing public awareness of climate change.

Methodology and data

The primary aim of this study was to identify the current level of awareness among residents of the city of Almaty regarding climate change and their readiness to take measures to mitigate its adverse environmental effects. An online survey was conducted to achieve this goal. A key aspect of a successful online survey is appropriate sample composition. Thus, this survey used a stratified sample. Table 1 presents the division of the total population into the selected strata.

Table 1. Quantitative sample

Category	Sample percentage	
Region of Residency:	Almaty, Kazakhstan	
Sex:	Male: 51.46%	Female: 48.54%
Age (years):	18–25: 22.82%	26–35: 20.39%
	36–45: 20.63%	46–55: 17.72%
	56–65: 10.19%	66+: 8.25%

In survey research, determining an appropriate sample size is crucial to ensure the reliability and generalizability of the findings. This study aimed to determine the required sample size for surveying the population of Almaty, Kazakhstan. As one of the largest cities in Kazakhstan, Almaty represents a significant demographic pool for sociological investigations.

Determining an appropriate sample size involves several key parameters, including population size, desired confidence level, margin of error, and estimated population proportion. These factors collectively influence the precision and accuracy of survey results. The formula commonly used for sample size determination in survey research is as follows:

$$n = \frac{N * Z^2 * p * (1 - p)}{E^2 * (N - 1) + Z^2 * p * (1 - p)}$$

where:

- n represents the required sample size,
- N denotes the population size,
- Z corresponds to the z-score associated with the desired confidence level,
- p represents the estimated proportion of the population, and
- E signifies the margin of error.

Considering a population size (*N*) of 2,235,000 individuals in Almaty, and assuming a conservative estimated proportion (*p*) of 0.5, which maximizes variability, the sample size required to achieve a 95% confidence level with a 5% margin of error was calculated by substituting the given values into the following formula:

$$n = \frac{2235000 * 1{,}96^2 * 0{,}5 * (1 - 0{,}5)}{0{,}05^2 * (2235000 - 1) + 1{,}96^2 * 0{,}5 * (1 - 0{,}5)} \approx 384$$

Rounding up to the nearest whole number provided a required sample size of approximately 384. This calculated sample size helped ensure a high level of confidence and precision in the survey results, allowing for robust statistical analysis and inference.

The survey was conducted online to obtain data closely aligned with the initial strata. The survey reached 507 respondents. The author developed a structured questionnaire divided into four main sections, each addressing a specific theme.

The first section (Climate change awareness) of the survey assesses the respondents' level of knowledge and awareness regarding climate change issues and their understanding of key concepts such as the greenhouse effect and main causes of climate change. This information helps assess how well respondents understand fundamental climate change concepts and phenomena, which is crucial for further analyzing their attitudes toward climate-related issues.

The second section (Climate change policy assessment) focuses on evaluating actions and policies to combat climate change. It includes questions on whether respondents believe that the government is taking sufficient measures to address climate change, what steps they consider necessary to mitigate the economic impact of climate change, and which political actions they deem most necessary to alleviate the consequences of climate change.

The third section (Readiness for change) analyzes personal involvement and readiness for change. The questions in this section address the frequency of discussions on climate change issues, willingness to change consumer habits to combat climate change, the importance of education and information dissemination on climate-related issues, and participation in environmental initiatives or movements.

The fourth section (Collaborative initiatives) focuses on perceptions and opinions about various initiatives and collaborations. It includes questions about respondents' views on initiatives to reduce the use of plastic and other materials harmful to the environment, the role of individual actions in combating climate change, willingness to pay additional taxes or fees to reduce environmental impact, and the importance of international cooperation in addressing climate change issues.

The final section collects sociodemographic data on respondents' sex, age, educational level, and employment status.

To analyze Kazakhstan's climate policy, this study uses data from the Bureau of National Statistics (BNS) of the Agency of Strategic Planning and Reforms of Kazakhstan, statistics from the official websites of state bodies, media, reports from international development and financial institutions, and academic publications.

Climate Policy of Kazakhstan

Current situation

Climate change is among the most significant challenges facing Kazakhstan's population and economy. The floods of 2024 in northern, eastern, and western Kazakhstan brought substantial

costs for the population and agricultural businesses. Kazakhstan's agricultural sector also faces the challenge of regular droughts. Weather anomalies, temperature, and precipitation changes have been frequently discussed by the expert community. According to data from the BNS (2024), the average annual temperature in Kazakhstan increased from 6.5 ℃ in 1990 to 7.2 ℃ in 2022. In the same period, the indicator increased from 3.6 ℃ to 5 ℃ in Astana, and from 10.2 ℃ to 12 ℃ in Almaty. The average annual temperature in Kazakhstan peaked in 2013, reaching 8 ℃. Long-term average temperature in Kazakhstan also increased from 5.4 ℃ in 1961–1990 to 6.7 ℃ in 2000–2022. In the reported period, the indicator changed from 2.7 ℃ to 4.2 ℃ in Astana and from 9.1 ℃ to 10.8 ℃ in Almaty. The long-term average precipitation from 1961 to 1990 was 317.7 mm. In 2022, the average precipitation was 311.2 mm. The longest average annual deviation from the long-term average precipitation was observed in 2019–2022, varying from 85% in 2020–2021 to 98% in 2022.

The dissolution of the Soviet Union caused substantial shocks to Kazakhstan's economy, such as plummeted output, high unemployment rates, hyperinflation, and disruption of Soviet supply chains. These changes have resulted in a significant decline in GHG emissions (Table 2). Since the early 2000s, emissions have begun to increase owing to the recovery processes in Kazakhstan's economy and the subsequent oil boom. Kazakhstan's GHG emissions continue to grow at higher rates. Emissions declined in 2020–2021, mainly because of the economic consequences of the pandemic. Carbon dioxide (CO_2) accounts for 81.6% of national GHG emissions, while methane (CH_4) and nitrous oxide (N_2O) account for 12.4% and 5.6%, respectively.

Kazakhstan's energy sector is responsible for most of the country's GHG emissions. This sector's emissions share increased from 56% in 2000 to 77% in 2021. The shares of industrial processes, agriculture, land use, land use change, and forestry (LULUCF) showed insignificant growth. Kazakhstan's primary energy sources are coal, natural gas, and oil. These industries play key roles in Kazakhstan's economy in terms of production, exports, and employment. Coal production increased from 75 million tons in 2000 to 118 million tons in 2022 (Table 3). However, coal production was higher in 1990, at 131 million tons. During the same period, oil production increased by 2.4 times, while natural gas production surged by a factor of 4.5. Oil and natural gas production in 1990 was substantially lower than that in 2022.

Table 2. GHG emissions, total and by sector, million tons, in CO_2 equivalents

	1990	1995	2000	2005	2010	2015	2020	2021
Total GHG emissions considering LULUCF, out of which:	380.2	278.4	303.1	370.6	381.4	367.7	342.1	340.8
Energy sector	316.2	193.0	169.0	222.6	257.8	282.8	259.5	261.9
Share	*83%*	*69%*	*56%*	*60%*	*68%*	*77%*	*76%*	*77%*
Industrial processes	22.7	14.0	17.3	20.9	20.2	25.8	27.0	27.1
Share	*6%*	*5%*	*6%*	*6%*	*5%*	*7%*	*8%*	*8%*
Agriculture	43.9	50.1	70.6	40.3	33.4	33.3	41.4	42.8
Share	*12%*	*18%*	*23%*	*11%*	*9%*	*9%*	*12%*	*13%*
LULUCF	-6.5	17.8	42.7	83.2	65.6	20.9	8.1	2.7
Share	*-2%*	*6%*	*14%*	*22%*	*17%*	*6%*	*2%*	*1%*
Wastes	3.8	3.4	3.5	3.7	4.5	4.9	6.0	6.3
Share	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*2%*	*2%*

Source: Author's compilation and calculations based on data from the BNS

Table 3. Coal, oil, and natural gas production in Kazakhstan

	1990	1995	2000	2005	2010	2015	2020	2021	2022
Coal, million tons	131	83	75	87	111	107	113	116	118
Oil, including gas condensate, million tons	26	21	35	61	80	79	86	86	84
Natural gas, billion cubic meters	7	6	12	25	37	46	55	54	54

Source: Author's compilation and calculations based on data from the BNS

Coal remains a key energy source in several countries. According to the Global Energy Monitor's Boom and Bust Coal (2024) report, Kazakhstan proposed the third largest new coal capacity globally in 2023, behind only China and India. Kazakhstan's proposed projects included the expansion of the Ekibastuz-2 power station and an entirely new Ekibastuz-3 power station. Notably, the average degree of depreciation of Kazakhstan's thermal power stations is 66%, whereas some of the country's coal-fired power stations have depreciated by 80%, and no coal plants have an officially planned retirement date. Furthermore, the proposed capacity is nearly 4.5 times higher than that included in discussions on retirement.

Green Economy Indicators of Kazakhstan

Renewable energy development is a key priority for the global economy. Khitakhunov (2021b) showed the wide range of benefits renewable energy development offers, including economic, social, and environmental effects. Renewables positively contribute to job creation and economic growth, diversify energy sources, decrease the risk of price volatility, and create new markets.

Renewable energy development in Central Asia remains low. Kazakhstan began to develop a legal framework for renewable energy development in 2006. However, gaps in governance, insufficient accountability, and ineffective incentives for agencies remain obstacles that hinder the development of the industry. Moreover, the lack of opportunities for long-term borrowing to finance renewable energy projects (Mouraviev, 2021) and powerful lobbying by fossil-fuel producers restrict the development of renewable energy in Kazakhstan.

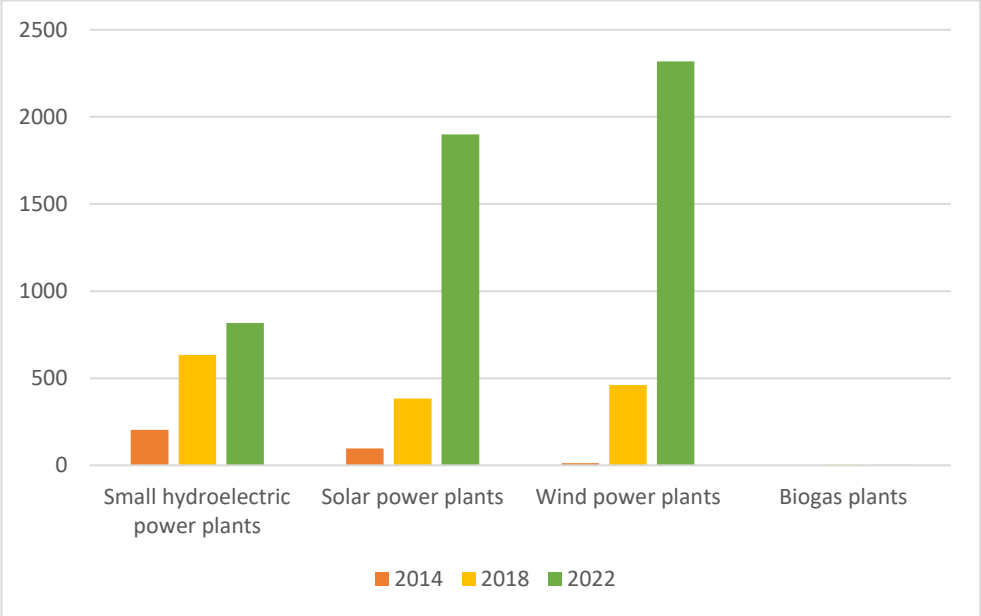
Kazakhstan began developing renewable energy sources (RES) in the early 2010s. Since then, the number of RES facilities and their electricity production have shown positive dynamics (Table 4 and Figure 1). In 2011, wind plants produced 0.1 million kWh, while in 2022, the production volume reached 2319 million kWh. In 2013, the electricity production of solar plants amounted to 0.8 million kWh, while in 2022, this indicator increased to 1900 million kWh. Kazakhstan began producing electricity from biogas plants in 2017, although the total volume of electricity produced from this source has remained modest. The volume of electricity production from solar and wind plants exceeds that of small hydroelectric power plants, the output of which increased from 180.4 million kWh in 2013 to 818 million kWh in 2022.

Table 4. Number of RES facilities in Kazakhstan, units

	2020	2021	2022	2023
Wind power plants	19	29	40	46
Hydroelectric power plants	37	38	40	37
Solar power plants	31	43	49	44
Biogas power plants	3	5	5	3
Total	90	115	134	130

Source: Author's compilation based on data from the BNS

Figure 1. Electricity production by RES, million kWh



Source: Author's compilation based on data from the BNS

A significant increase in production has led to higher RES shares in Kazakhstan's total electricity production (Table 5). Specifically, the share of solar power plants increased from 0.1% in 2014 to 1.7% in 2022. During the same period, the share of wind power plants surged from 0.014% to 2%. However, despite gradual increases, the share of biogas plants remains negligible.

Table 5. Shares of RES in total electricity production, %

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Share of RES in total electricity production, including large hydroelectric power plants	8.23	7.51	8.79	10.36	12.71	11.35	10.43	10.79	10.99	10.94	11.82
Share of RES in total electricity production, excluding large hydroelectric power plants	0.0	0.18	0.33	0.58	0.79	0.95	1.38	1.87	2.78	3.46	4.44
Electricity produced by small hydroelectric power plants	-	0.2	0.2	0.3	0.4	0.5	0.6	0.4	0.5	0.5	0.7
Electricity produced by solar power plants	0.0	0.0	0.1	0.1	0.1	0.2	0.4	0.8	1.3	1.4	1.7
Electricity produced by wind power plants	0.0	0.0	0.0	0.1	0.3	0.3	0.4	0.7	0.9	1.5	2.0
Electricity produced by biogas plants	-	-	-	-	-	0.000	0.003	0.005	0.006	0.002	0.003

Source: Author's compilation and calculations based on data from the BNS

The development of renewable energy can positively contribute to the growth of "green" jobs. As shown in Table 6, the number of workers in RES facilities increased from 955 in 2020 to 1660 in 2023.

Table 6. Number of workers in RES facilities

	2020	2021	2022	2023
Wind power plants	217	305	446	512
Hydroelectric power plants	534	691	758	696
Solar power plants	188	327	385	429
Biogas power plants	16	27	23	23
Total	955	1 350	1 612	1 660

Source: Author's compilation based on data from the BNS

BNS data indicate that, in 2022, almost 49,000 people worked in green jobs in large and medium-sized enterprises. Thus, in 2022, the share of green jobs in the total number of workers in large and medium-sized enterprises (2.8 million) amounted to 1.7%. Specifically, 390 workers (0.6% of total agricultural employment) were employed in agriculture, and 43.3 thousand workers (6.8% of total industrial employment) were employed in industry, of which 41.2 thousand workers were employed in the water supply, sewerage system, waste collection, and distribution control sectors. The total number of workers in the water supply, sewerage system, waste collection, and distribution control amounted to 41.3 thousand. Thus, almost all workers in this sector are considered to have green jobs. Almost 5.2 thousand green jobs (0.2% of 2.1 million jobs) have been created in other sectors. In 2022, the number of green jobs in Kazakhstan's small enterprises exceeded 8.6 thousand, or 0.5% of the total 1.6 million jobs.

Environmental regulation

Kazakhstan has adopted several important strategies to improve its environmental conditions and achieve carbon neutrality. The Strategy Kazakhstan-2050 (from December 2012) notes the need to increase organic production, provide the Kazakhstani market with fuels and lubricants per new environmental standards, and introduce environmentally friendly production among mining enterprises.

In May 2013, Kazakhstan adopted the Concept for transitioning to a "green economy." According to the UNDP (2023), Kazakhstan has developed an Action Plan for the implementation of the Concept for the transition of the Republic of Kazakhstan to a "green economy" during 2021–2030. Key goals of the Concept include reducing GHG emissions and the energy intensity of the gross domestic product (GDP), abandoning coal-fired power generation, and increasing the share of renewable and alternative energy sources (of total electricity generation) from 4.53% in 2022 to 50% by 2050.

The Concept pays particular attention to the formation of an environmental culture among the general population and businesses and the growth of "green" financing. According to the Concept, the share of "green" loans in the banking sector portfolio was 3.17% in 2023 and must increase to 20.5% by 2050. The priority tasks for the transition to a "green economy" are increasing resource use efficiency and both modernizing existing and constructing new infrastructure. On average, the implementation of the Concept will require an annual investment volume of 4.4% of the GDP. Private investors aimed at RES development were expected to provide the main share of investments as well as implement energy efficiency measures in transportation, industry, and construction. However, the volume of climate investment remains substantially below the

projected level (Table 7). In 2022, investments amounted to 347 million, which is lower than in 2019–2021.

Table 7. Environmental investments, million USD

	2016	2017	2018	2019	2020	2021	2022
Investments aimed at protecting the environment, out of which	128	267	322	519	420	402	347
Domestic investments	94	182	248	153	255	216	219
Share	*74%*	*68%*	*77%*	*30%*	*61%*	*54%*	*63%*
Foreign investments	34	85	75	366	166	186	127
Share	*26%*	*32%*	*23%*	*70%*	*39%*	*46%*	*37%*

Source: Author's calculations and compilation based on data from the BNS

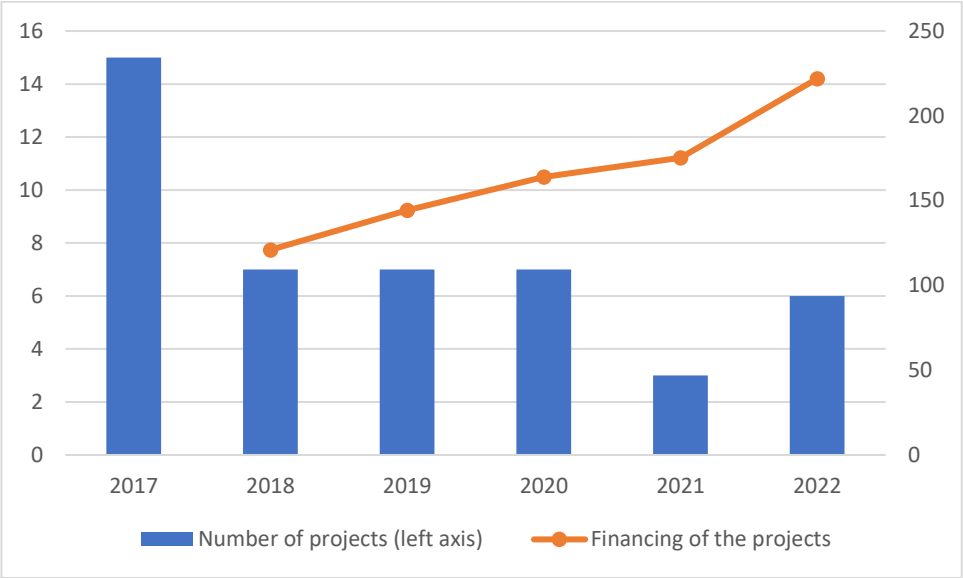
In January and February of 2024, capital investments aimed at environmental protection amounted to 11.3 billion tenge, a 45.7% decrease compared to the same period the previous year. Investments in environmental protection were allocated to only 8 of the country's 20 regions (Finprom, 2024).

In January 2021 Kazakhstan adopted a new Environmental Code, which set important objectives such as ensuring the environmental foundations of sustainable development and the contribution of Kazakhstan to strengthening the global response to the climate change threat, attraction of "green" investments, and widespread use of the best available techniques, ensuring transparency and full public participation in resolving issues of environmental protection and effective environmental monitoring and control, and the formation of environmental culture in society. The Environmental Code introduced the economic regulation of environmental protection using market mechanisms for managing environmental emissions, payments for negative environmental impact, economic incentives for activities aimed at environmental protection, and market mechanisms for reducing the emission and absorption of GHGs. The Environmental Code aims to develop and support ecological culture, education, and enlightenment. To form an environmental culture, the state has taken measures to ensure the dissemination of information that shapes people's connection with nature, the impact of their life activities on the environment, and the threat of global climate change. In particular, the government informs the public, business entities, and consumers and ensures public access to environmental information. Furthermore, the Environmental Code supports scientific research on climate change issues to ensure environmentally balanced development in Kazakhstan. Moreover, the government has implemented measures for climate change adaptation in priority areas, such as agriculture, water management, forestry, and civil protection. According to President Kassym-Jomart Tokayev, the adoption of a new Environmental Code was aimed at stimulating step-by-step preparatory work for a major energy transition (KazTAG, 2022).

In October 2021, the government approved the national project “Green Kazakhstan.” However, this project was abandoned and lost its force in September 2023. Then, in February 2023, Kazakhstan approved the Strategy for Achieving Carbon Neutrality by 2060, the main goal of which is to achieve sustainable economic development and carbon neutrality by 2060. The medium-term unconditional goal of the Strategy is to reduce GHG emissions by 15% by 2030 relative to 1990 emissions levels. Thus, GHG emissions must decrease from 381.7 million tons to 324.4 million tons. A conditional goal has also been outlined to provide for a 25% reduction in emissions, which is subject to international support for economic decarbonization. The Strategy provides measures to support research and development (R&D) for the transition to carbon neutrality and adaptation to the effects of climate change. These measures include reducing dependence on foreign technologies and utilizing the best available techniques by training domestic specialists in areas such as climate policy, green energy, environmental economics, sustainable design, digitalization, the growth of funding for environmental research, and the creation of links between research programs and the development of new industries. In particular, the Strategy pays attention to changing public consciousness by including climate change issues in the curricula of primary, secondary, and higher educational institutions. The government plans to launch information campaigns to raise climate change awareness, form and promote a low-carbon culture among government agencies, attract youth and volunteer organizations to participate in large-scale environmental projects, develop and disseminate digital tools that allow citizens to calculate their climate impact, and propose personalized actions to reduce emissions based on individual lifestyles. The state will organize sociological research on the development and implementation of state policies and regular public consultations at various dialogue and expert platforms. The Strategy also promotes measures for adapting to climate change and international cooperation.

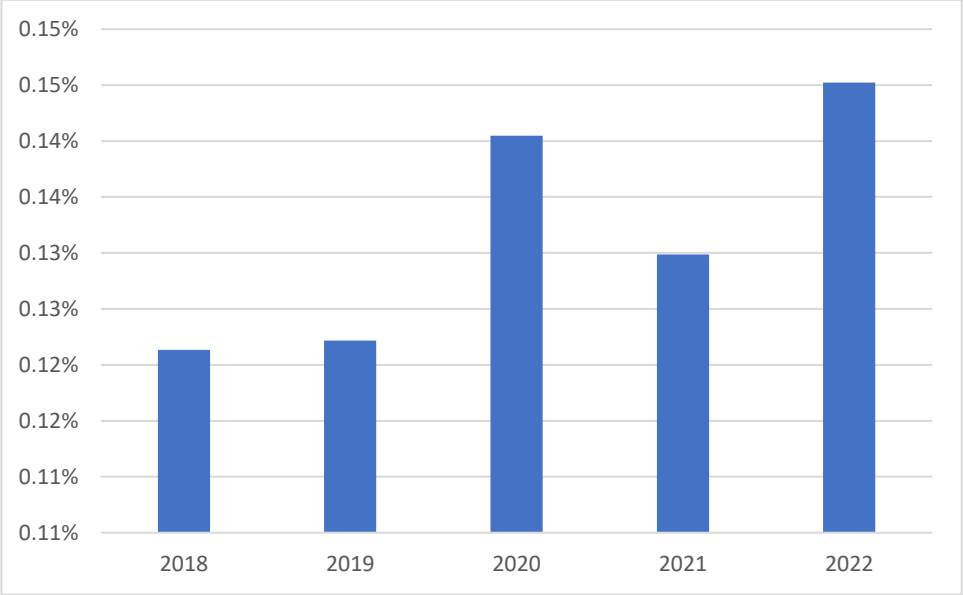
Despite the goals for scientific support outlined in both the Environmental Code and the Strategy for Achieving Carbon Neutrality, the number of scientific projects focusing on the green economy remains low, showing a decrease in 2022 compared to 2017 (Figure 2). Despite the growth of project financing from $351 thousand in 2018 to $482 thousand in 2022, the share of the expenditure on green economy projects in total R&D expenditure remains insignificant, accounting for 0.15% in 2022 (Figure 3). Furthermore, the level of environmental innovation has remained low (Tables 8–10).

Figure 2. Number of scientific and technical projects on the green economy and their financing, in million tenge



Source: Author's compilation based on data from the BNS

Figure 3. Share of expenditure on green economy projects in total R&D expenditure



Source: Author's calculations and compilation based on data from the BNS

Sabyrbekov and Overland (2023) measured the capacity of Central Asian countries to adapt to the impact of climate change and found that limited innovation capacity contributed to low adaptation scores in the region. Thus, the lack of investment in green projects and insignificant climate research financing are important obstacles to raising public awareness, given the positive attitude of the population towards climate scientists (see the survey results section).

In February 2024, the Ministry of Energy of Kazakhstan approved the "Action Plan for the Development of the Electric Power Industry until 2035," which includes modernization, expansion,

reconstruction of existing facilities, and construction of new energy facilities. By 2028, the Ministry plans to implement five large projects in renewables (solar and wind power plants), with a total power of 5000 MW (1000 MW each). These projects will be implemented through investment agreements with Masdar, Total Energies, AcwaPowerCompany, HEVEL, and CPIH. There are other smaller renewable energy projects in different regions of Kazakhstan (Ministry of Energy of Kazakhstan, 2024). The action plan aims to provide an additional 26 GW of new generating capacity, eliminate shortages in the energy system, and provide necessary reserve power. The expected volume of investments up to 2029 amounts to more than 18 trillion tenge for projects. By 2035, the successful implementation of the action plan will increase the share of RES to 24.4% and decrease the share of coal to 34.3% (Kursiv, 2024).

Despite changes in environmental regulations, Kazakhstan is ranked 60th (out of 67) in 2024 and remains among the low-performing countries on the Climate Change Performance Index (CCPI). Kazakhstan has received low ratings for GHG emissions, energy use, renewable energy, and climate policies. Weaknesses in Kazakhstan's system include the lack of a transparent GHG accounting system and sector-specific short-term targets. According to CCPI experts, regional and city-level authorities must introduce systems and plans to reduce local GHG emissions. Concrete action plans, such as a coal phase-out, plans for climate adaptation, and a green transition plan, are currently non-existent (Climate Change Performance Index, 2024).

Table 8. Number of patents issued in the environmental protection field

	2015	2016	2017	2018	2019	2020	2021	2022
Total number of patents issued	1 670	1 588	1 460	1 728	1 779	1 816	1 773	1 449
out of which								
number of patents issued in the field of environmental protection and energy efficiency	172	133	151	134	125	110	142	166
out of which								
patents on energy technologies	138	103	114	113	105	58	65	63
including those related to RES	62	61	46	42	32	13	19	28
on environmental technologies	34	30	37	21	20	52	77	103

Source: Author's calculations and compilation based on data from the BNS

Table 9. Number of enterprises with ecological innovations, units

	2014	2015	2016	2017	2018	2019	2020	2021	2022
Number of enterprises with ecological innovations, units	247	338	312	213	84	72	65	88	97
Level of activity in the field of environmental innovation, %	1	1.1	1	0.7	0.3	0.3	0.2	0.3	0.3
The share of ecological innovations in the total number of innovations, %	12.7	13.1	10.8	7.2	2.6	2.2	2.0	3.0	3.0

Source: Author's calculations and compilation based on data from the BNS

Table 10. Number of environmental innovations by type, units

	2015	2016	2017	2018	2019	2020	2021	2022
Product innovations	168	103	89	33	25	23	29	49
Business process innovations	181	154	108	48	54	47	58	61
Marketing innovations	33	23	12		2	3	5	...
Organizational innovations	64	104	43	18	4	11	20	...

Source: Author's calculations and compilation based on data from the BNS

Kazakhstan's experts and the business community have different assessments of changes in environmental regulations. According to Suleimenova (2023), Kazakhstan's national emissions trading system (ETS) is critical for reducing carbon emissions, which encompass 43% of the nation's GHG emissions. Authorities have made efforts to improve the measurement, reporting, and verification of the system, exploring the possibilities for its expansion and inclusion of new sectors, and have begun to work on aligning Kazakhstan's ETS with that of the European Union (EU). Yessekina (2022) noted that Kazakhstan's current carbon regulation system would not allow the country to achieve its goals. She proposed making climate targets legal acts, noting that the Strategy for achieving carbon neutrality is essentially a strategy for diversifying the economy and its technological breakthroughs. According to Yessekina et al. (2024), despite significant developments in Kazakhstan's climate legislation in recent years, significant potential remains to improve its effectiveness through alignment with legislation from the Organization for Economic Co-operation and Development (OECD) countries. The authors noted the limitations of the national ETS, which covers only six basic sectors (excluding agriculture, transportation, and construction) of the economy and the surplus in the issuance of the free quota in the agricultural sector. In addition, the principle of calculating quotas in Kazakhstan is not optimal compared to the practices of OECD countries. Moreover, the compensation for environmental damage is not optimal. According to the Environmental Code, each ton of emissions outside the established quota

standards carries a fine, regardless of the real negative consequences of violating the standards. The authors also recommend using the funds earned and saved through the ETS directly to combat and prevent emissions and include expanding the ETS with the inclusion of CH_4.

Forbes (2022) reported that some representatives of Kazakhstan's businesses criticize the country's environmental regulations for their inefficiency and lack of transparency. In their critique, they mainly focused on the Environmental Code's ETS, the best available techniques, and the installation of an automated monitoring system, which are costly and require significant investment. Business representatives have noted that because the number of free quotas decreases annually, the costs of purchasing additional CO_2 quotas are an irreversible loss for companies, as they are not included in production costs. According to their complaints, the ETS has thus far only reduced domestic production and the competitiveness of Kazakhstani enterprises and their investment programs, particularly in the electricity and heat fields. The risk of rising electricity prices in the event of a quota shortage also exists. Some energy companies already must pay for quotas based on their profits. As a result, Kazakhstan's level of production will decline, and customers will purchase the products they need from foreign countries that do not use an ETS. According to Kursiv (2021), reduced free GHG quotas allocated to large industrial polluters will increase their prices. The recommended price of a carbon unit should increase from $1.1 per ton of CO_2 equivalent in 2021 to $16.9 per ton in 2023–2025 and up to $50.8 per ton in 2026–2030. Such prices will make the ETS profitable for companies with new equipment that have excess allowances. However, producers of electricity, of which approximately 70% is generated by coal-fired thermal power plants, can increase electricity tariffs to cover their costs. The average price for one ton of CO_2 has not changed, and in 2022 amounted to $1.17 (Table 11). According to the ETS rules (Adilet, 2021), Kazakhstan's carbon unit trading system comprises primary and secondary markets. In the primary carbon market, the system operator (JSC "Zhasyl Damu") sells carbon quotas on auction terms. In the secondary market, companies buy and sell carbon units among themselves through direct transactions or a commodity exchange. "Zhasyl Damu" determines the minimum permissible price per carbon quota unit at the level of the weighted average price per carbon quota unit for the last five available trades on the commodity exchange, considering the current market situation.

Table 11. Trading quotas for GHG emissions in Kazakhstan

	2014	2015	2019	2020	2021	2022
Number of deals, units	35	40	3	6	39	46
Transaction volume, 1 ton of CO_2	1271289	1983922	1202209	1591000	4560397	2500559
Transaction volume, million tenge	182	755	519	811	2281	1348
Transaction volume, million USD	1.0	3.4	1.4	2.0	5.4	2.9
The average price per ton of CO_2, tenge	301	830	363	510	500,2	539
The average price per ton of CO_2, USD	1.68	3.74	0.95	1.24	1.17	1.17

Source: Author's calculations and compilation based on data from the BNS

Another important challenge for Kazakhstan's producers is the European Union's Carbon Border Adjustment Mechanism (CBAM). The EU uses this tool to tax carbon-intensive goods entering its market. The CBAM has a transition phase between 2023 and 2025 and will apply its definitive regime starting in 2026 (European Commission, 2024). Because the carbon border adjustment tax applies to Kazakhstan, the country's authorities have been conducting carbon tax awareness activities for export-oriented companies (Kazinform, 2024). Consequently, Kazakhstan's businesses have begun to adopt decarbonization policies. For example, one of the largest companies in Kazakhstan, the Eurasian Resource Group (ERG), considers the CBAM a transitional risk in its decarbonization strategy. In response, the company plans to reduce the carbon footprint of its major export products (ERG, 2024). Hence, the CBAM can also be considered an opportunity for Kazakhstan's businesses to improve their competitiveness. Thus, Kazakhstan's climate policy is experiencing a significant transformation, driven by domestic regulations and changes in the climate policies of its main trading partners.

Results and discussion: public awareness of climate change in Kazakhstan

A survey was conducted to assess climate change awareness among a sample of the population. The survey included 507 respondents, ensuring a diverse representation of the community. Participants were asked several questions with a primary focus on their climate change awareness.

The key question posed to respondents was, "Have you heard of climate change?" Out of the 507 respondents, 461 (90.9%) answered "Yes," 32 (6.3%) answered "No," and 14 (2.8%) answered "Don't know." Only the responses from those who answered "Yes" were included for further analysis. This subgroup of 461 respondents represents a population segment aware of climate change, providing a focused dataset for subsequent questions and insights into the depth of their knowledge and perceptions. The sample was stratified based on sex, age, educational level,

income, employment status, and marital status (Table 12). This approach ensured a well-rounded representation of the Almaty population, allowing for a thorough analysis of climate change awareness across various demographic segments.

Table 12. Sociodemographic characteristics of respondents

Strata	**Share (%)**
Sex	
Male	49.2
Female	50.8
Age, years	
18–25	29.7
26–35	19.5
36–45	20.6
46–55	14.5
55–65	8.5
66+	7.2
Marital Status	
Married	48.4
Single	51.6
Education	
Incomplete Secondary/Secondary education	34.3
College/Specialized secondary education	32.3
Bachelor's degree or equivalent	27.3
Master's/Doctoral degree or equivalent	6.1
Employment status	
Employed full-time	55.1
Employed part-time	12.1
Student	20.0
Unemployed/Retired	12.8
Monthly household income, tenge	
Up to 200,000	32.1
200,000 to 400,000	37.1
400,000 to 700,000	19.7
700,000 to 1,200,000	5.4
Over 1,200,000	5.6

Source: Author's data and calculations

Climate change awareness

Most respondents indicated that they regarded climate change as a significant issue, with 83.7% categorizing it as either "very significant" or "quite significant" (see figures in the Annex). Only 1.1% of respondents did not consider climate change to be important. More than 87.9% of respondents were familiar with the concept of the greenhouse effect, although only 28% possessed detailed knowledge. Approximately 76.1% of respondents had observed an increase in precipitation in recent years, indicating a significant impact of climate change on perceptions of weather conditions in the region. Only 5.4% noted a decrease in precipitation, and 7.8% were unsure.

Most respondents (33.4%) associated climate change with GHG emissions, followed by industrial activity (29.1%). A substantial proportion (24.7%) also identified the improper use of natural resources as an important factor.

Respondents considered flooding, flash floods (33.4%), and air pollution (32.8%) to be the most pressing climate issues in the region. This highlights the specific climate threats perceived as the most urgent for Almaty.

Respondents perceived the involvement of society, businesses, and the government in addressing climate issues as low; however, they expressed a positive attitude towards measures taken by the scientific community. In particular, 64.8% of respondents rated the involvement of ordinary citizens as low or nonexistent, indicating insufficient public engagement in climate issues. Over 64% of respondents believed that the business sector's involvement in combating climate change has also been low. Nearly 54.4% of respondents rated the involvement of government agencies as low or nonexistent, reflecting dissatisfaction with the effectiveness of government policies. The involvement of the scientific community was rated higher than that in other sectors, with 71.3% of respondents noting high or moderate activity.

Only 13% of respondents were fully informed about the Environmental Code of Kazakhstan, and approximately 47.3% had never heard of the "Strategy to Achieve Carbon Neutrality by 2060." Approximately 38% of respondents were unaware of the Paris Agreement, indicating a lack of awareness of key international climate initiatives. Possible reasons for the limited public awareness of government policies include a lack of climate education and information campaigns, inefficient government communication policies, and a general lack of interest in state policy.

Although 39.4% of respondents understood the concept of sustainable development and its connection to climate change, most (60.6%) acknowledged understanding the concept but did not see its direct link to climate issues. This underscores the need for educational initiatives to enhance public awareness of the relationship between sustainable development and climate change.

The most trusted sources of information were scientific research and publications (41%), whereas 24.1% of respondents trusted media and official statements from international organizations.

Climate change policy assessment

Most respondents (57.3%) believed that the government of Kazakhstan is making efforts to combat climate change; however, these efforts have been insufficient (39.3%) or could be improved (33.2%). Only 9.5% of respondents were fully satisfied with the government's actions,

whereas 18% expressed complete dissatisfaction. Most respondents (59.4%) rated the impact of climate change on Kazakhstan's economy as high, with an additional 20.6% considering it "very high." Only 16.7% viewed this impact as low, indicating widespread recognition of the significant economic consequences of climate change. This reflects the respondents' awareness of the links between environmental issues and national economic stability.

Respondents highlighted funding for research on green technologies (31.7%) and optimized water, agricultural, and grazing resource management (24.5%) as crucial policy actions. They also supported increasing investments in RES (16.9%), providing education, and raising public awareness of climate change (15.4%).

The largest proportion of respondents believed that the primary responsibility for addressing climate change lies with national governments (36.7%), whereas 21.7% believed that international organizations, such as the UN, should take on this role. Only 15.2% thought that businesses and industries should bear the main responsibility, with individual responsibility rated significantly lower (10.2%).

Readiness for change

Most respondents (57.7%) stated that they were willing to alter their consumer habits, albeit with some limitations. The results demonstrated a high level of environmental consciousness among part of the population, with 23.9% fully prepared to change their habits. However, 11.3% of respondents were unwilling to make such changes.

Nearly all respondents viewed education and information dissemination as important measures, with 46.6% considering it "very important" and 43% as "important." However, only 11.5% of respondents had actively participated in environmental initiatives, whereas 36% expressed a desire to become involved. More than 23.4% of respondents were not interested in participating, which may reflect insufficient motivation or a lack of information about such initiatives. Furthermore, 45.3% of respondents assessed youth engagement as moderate, noting active groups but acknowledging that not all young people were interested in the issue. Only 12.1% felt that activity among the youth was high, while 26.7% considered it low.

Most respondents (48.2%) fully supported initiatives to reduce plastics and other harmful materials. Approximately 30.2% approved of these initiatives but did not always adhere to them.

As key measures necessary to mitigate climate change, respondents identified improving public transportation (25.4%), transitioning to RES (24.9%), and implementing legislative measures for environmental protection (20%).

Perception and opinion on various initiatives and collaborations

Most respondents (53.4%) believed that everyone can help combat climate change. However, 34.1% felt that individual actions would be effective only with the support of the government and society. Only 6.3% of respondents believed that large companies and governments were solely responsible for addressing this issue. Although only 10.6% of respondents were unconditionally willing to pay additional taxes or fees to reduce environmental damage, 53.4% expressed a willingness to pay, provided that the funds were used effectively. Simultaneously, 30.8% of respondents were unwilling to accept additional tax obligations, indicating the need to strengthen trust in environmental management and funding systems.

The primary actions respondents considered important for reducing their carbon footprint were reducing the use of plastic products and packaging (33.8%) and implementing energy-efficient technologies in buildings and appliances (26%).

An overwhelming majority of respondents (57.3%) believed that international cooperation is crucial for addressing climate change because of its global nature. However, 34.1% highlighted the importance of national initiatives alongside international efforts. Only a small proportion of respondents (6.5%) thought that each country should address the issue independently.

The most popular measure for businesses was the implementation of a circular production cycle with material reuse to reduce waste (57%). A significant proportion of respondents (28.9%) also supported business involvement in environmental projects.

Respondents believed that the most important step for the scientific community was active participation in advising and developing governmental climate policies (40.3%). They also supported measures to strengthen cooperation with industry (19.1%) and educational programs and public lectures to raise climate change awareness (18.4%).

Respondents considered the most effective ways to raise public awareness to be introducing strict environmental laws and penalties for violations (33.8%) and providing educational campaigns and events (25.6%). Respondents also supported adaptation projects on changing climate conditions, media campaigns, and public speeches (17.8%). This suggests that the general population perceives the need for both stringent legal regulations and educational initiatives to increase public awareness and change behavior.

Data Analysis

The results of a chi-square test revealed no statistically significant differences in responses related to the specified sociodemographic strata. The absence of significant differences may indicate that respondents' sociodemographic characteristics did not have a substantial impact on their climate change awareness. This suggests that knowledge and awareness of climate issues

may not vary significantly according to sex, age, educational level, income, employment status, or marital status. Furthermore, respondents from different strata may have similar opinions and behavioral patterns concerning the topics covered by the survey, which could lead to a lack of significant differences. Thus, the results may reflect homogeneous perceptions of climate change across various sociodemographic groups.

The reliability of the survey instruments was assessed using Cronbach's Alpha coefficient. The results indicate sufficient reliability for most sections of the survey (Table 13). These high-reliability scores indicate that the items within these sections consistently measured their intended constructs.

Table 13. Cronbach's Alpha coefficients

Section	Cronbach's Alpha
Climate Change Awareness	0.876
Climate Change Policy Assessment	0.360
Readiness for Change	0.733
Perception and Opinion on Various Initiatives	0.723

Source: Author's calculations

Although the Climate Change Policy Assessment section produced a low Cronbach's Alpha of 0.360, it was retained for several reasons. First, this section was critical for evaluating public perceptions of government actions and responsibilities regarding climate change in this study. Excluding this section would limit the survey's ability to provide a comprehensive view of respondents' diverse perspectives on this significant issue. Second, the lower reliability score in this section may reflect varying opinions on government policies, indicating a spectrum of perspectives. This variability is an important insight, as it highlights the complexities and nuances of public attitudes towards climate change policies. Thus, retaining this section enhances the overall depth of the study and allows for a more robust analysis of public opinion.

Study limitations

The primary challenge in this study was conducting the survey exclusively online. Although this approach offers efficiency and cost reduction, it has several limitations. Internet access and digital literacy may vary among respondents, potentially limiting the survey's reach. Older individuals and those with lower incomes may have fewer opportunities to participate in online surveys. This creates a potential risk of systematic sampling bias towards younger and more socially active population groups. Moreover, the issue of non-participation is common in online research. Some potential respondents may have ignored the invitation to participate in the survey,

especially if they did not view climate change as a priority. This could have reduced the representativeness of the data because the views of the less active groups on environmental issues may not have been adequately captured. Furthermore, despite efforts to stratify by criteria such as age, sex, income, and educational level, some social groups may be underrepresented. For example, respondents with low incomes or insufficient education might have shown less interest in participating in the survey, leading to imbalances in the sample and potentially distorting the overall understanding of climate change perceptions in Almaty.

Another limitation was the potential difficulty that respondents might have faced in understanding the questionnaire. Although clarity and accessibility were considered in designing the questionnaire, some items involving specialized concepts, such as "carbon neutrality" or "sustainable development strategies," could have been challenging for respondents with low environmental or scientific literacy. This may have affected the accuracy of the data and reduced the validity of the responses.

The findings of this study are based on responses from residents of Almaty, which may not be representative of the entire country. Almaty is the largest city in Kazakhstan and has developed educational, technological, and financial systems. Conducting the same survey in other cities may yield different results. Moreover, the findings of similar studies conducted in rural areas would presumably differ substantially from those of this survey, and public awareness of climate change and state policies would likely be lower. Hence, extending this study to other regions of Kazakhstan is a possibility for future research.

This study was conducted per all ethical standards. Participation was voluntary, and respondents could withdraw from the study at any time. Respondents' identities were not disclosed, and their responses were handled anonymously and confidentially. This approach ensured robust protection of personal data and adhered to the principles of scientific ethics.

Policy recommendations

Kazakhstan has set ambitious climate goals and adopted several important documents, such as the Environmental Code and Carbon Neutrality Strategy. Achieving carbon neutrality requires substantial investment, competencies, and strong public support. The government should strengthen its efforts by involving businesses, academia, and civil society. Thus, the following recommendations can contribute to addressing climate issues in Kazakhstan:

1. Despite support for climate research being identified as a key priority in Kazakhstan's strategic documents, the share of climate research in total R&D expenditure remains

low. Moreover, the number of green research projects and amount of innovation activity are insufficient. Hence, addressing these issues should be a key priority for the government.

2. Because climate change is a permanent process, the authorities of Kazakhstan should focus on developing a persistent communication policy between the government and civil society regarding climate issues. This policy needs to clarify climate risks, state policies, potential benefits, and the implications of state measures for the public. Authorities must explain why the population should be involved in addressing climate change issues and show the potential benefits to create motivation. This communication can occur through the development of special apps that use the capacities of Kazakhstan's technology clusters, such as the Astana Hub.

3. The survey results revealed that while youth involvement in climate change initiatives is moderate, it remains insufficient. To address this issue, the government should develop programs and platforms that encourage both youth and the general public to participate in environmental issues through volunteering, educational events, and technological projects. This could involve creating volunteer environmental programs and supporting technology-driven initiatives to improve the environment. Such measures can enhance public engagement in environmental matters and foster greater environmental awareness.

4. Expanding access to environmental education is also vital. Given that most respondents considered education on climate change important, the government should implement more comprehensive environmental education programs at all levels, from primary schools to universities. This approach will help cultivate a new generation of citizens who are better informed and more prepared to address environmental challenges.

5. Given respondents' positive attitudes towards scholars and scientific publications, the government should promote climate scholars explaining climate change threats and popularizing mitigation policies.

6. The government should consider the willingness of the public to change their consumer habits and pay additional taxes if the funds are used effectively. The government must also ensure that future climate and communication policies are open and transparent.

7. Respondents distinguish the problem of plastic use. Hence, the authorities of Kazakhstan should start with specific projects, such as reducing the use of plastics. In the future, these measures can be extended to include nature-based solutions, such as promoting forest preservation and planting new trees.

8. The authorities must focus on not only disseminating knowledge and information among the public but also creating trusted knowledge and information for the business community. A three-way collaboration program involving the scientific community, businesses, and government authorities should be established to effectively address climate change. This program

will enable businesses to implement practical scientific advancements, which the government can support through grants and tax incentives.

Conclusion

Kazakhstan has made substantial efforts to change its environmental regulations and adopted several important concepts and strategies. These documents are expected to support Kazakhstan's accelerated transition towards a green economy and contribute to the country's sustainable development. However, important challenges may restrict the achievement of these ambitious climate goals, including a lack of finance and investments and insufficient support from scientists and training specialists who can develop climate innovations.

Despite the design of climate strategies, public awareness of state measures remains limited. The findings of the survey conducted in Kazakhstan's largest city, Almaty, show that the general public lacks knowledge of the country's internal regulations and international climate cooperation and commitments. However, the population considers climate change to be an important issue and is ready to address climate-related risks. Respondents mentioned a low level of involvement and insufficient measures from the government, businesses, and the public. However, their attitudes towards climate science were positive. The survey results revealed the population's willingness to change their consumer habits. Hence, the government must motivate people and show interest in addressing climate issues. The government should also use openness and transparency principles to provide the public with reliable and trustworthy information regarding state measures and encourage climate scholars to popularize mitigation policies.

Raising public awareness is a key priority in all of Kazakhstan's climate strategies. The state should begin the practical implementation of these measures. A better-informed population demands better policies, which, in turn, will improve government efficiency.

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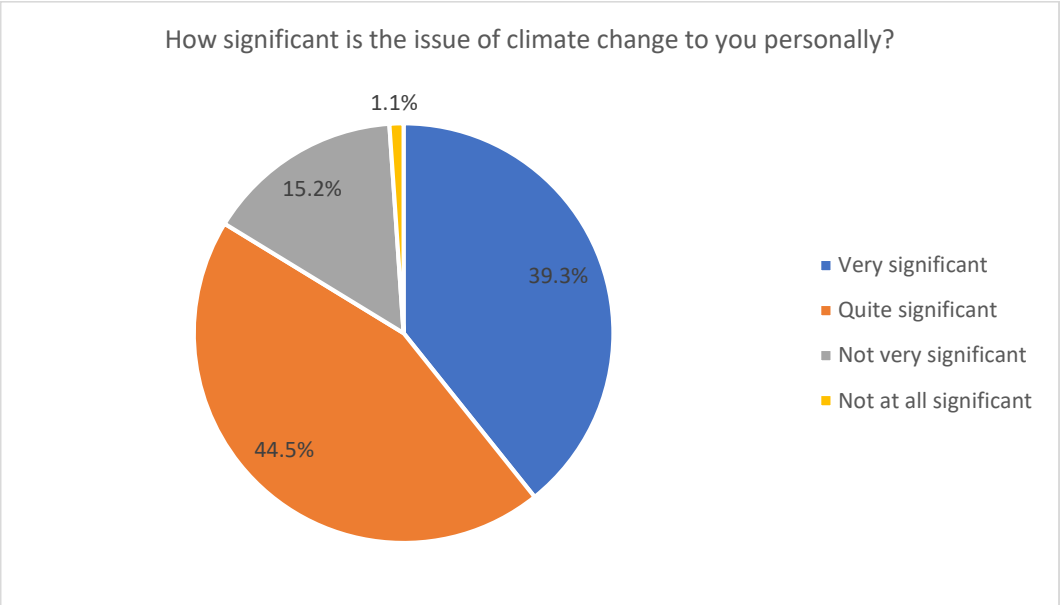
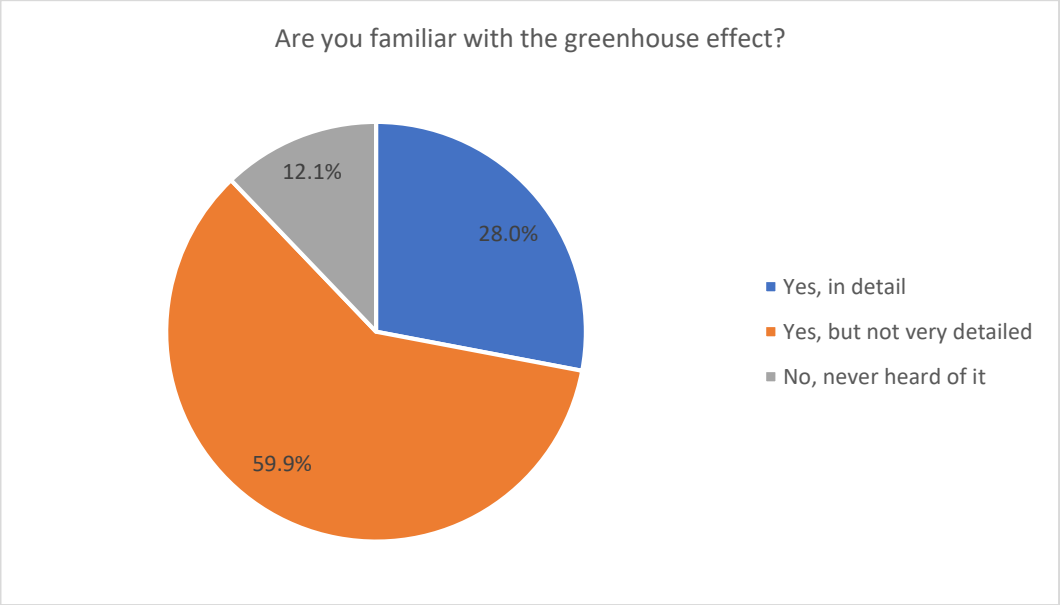
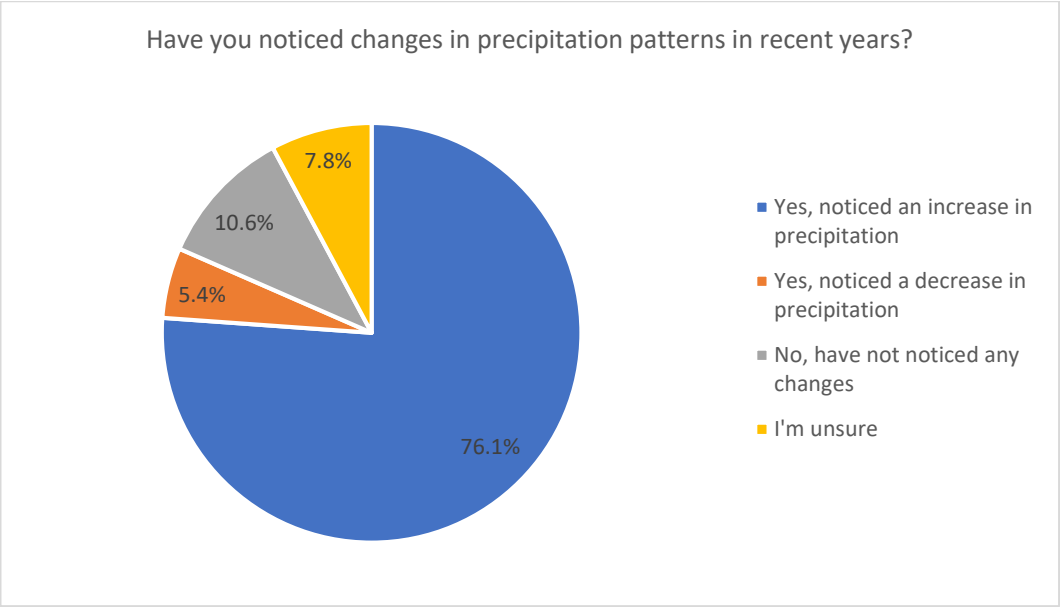
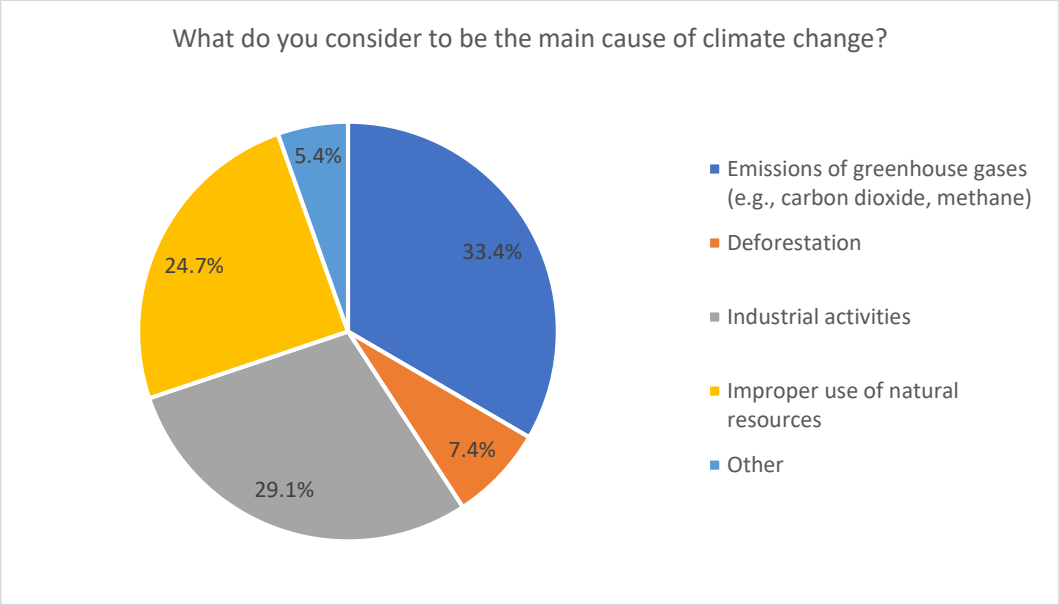
Annex

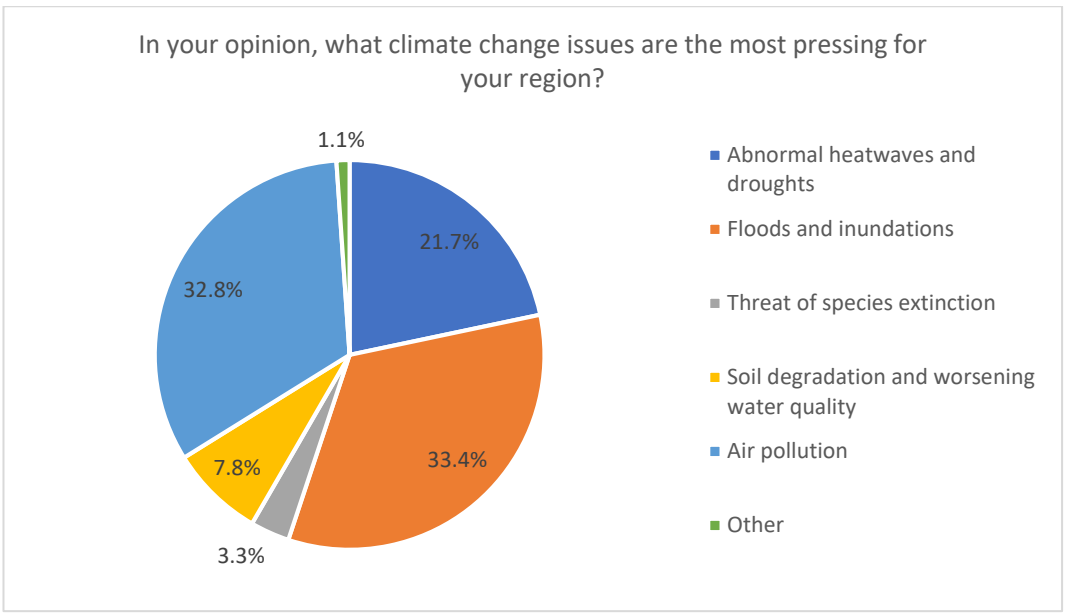
Climate change awareness

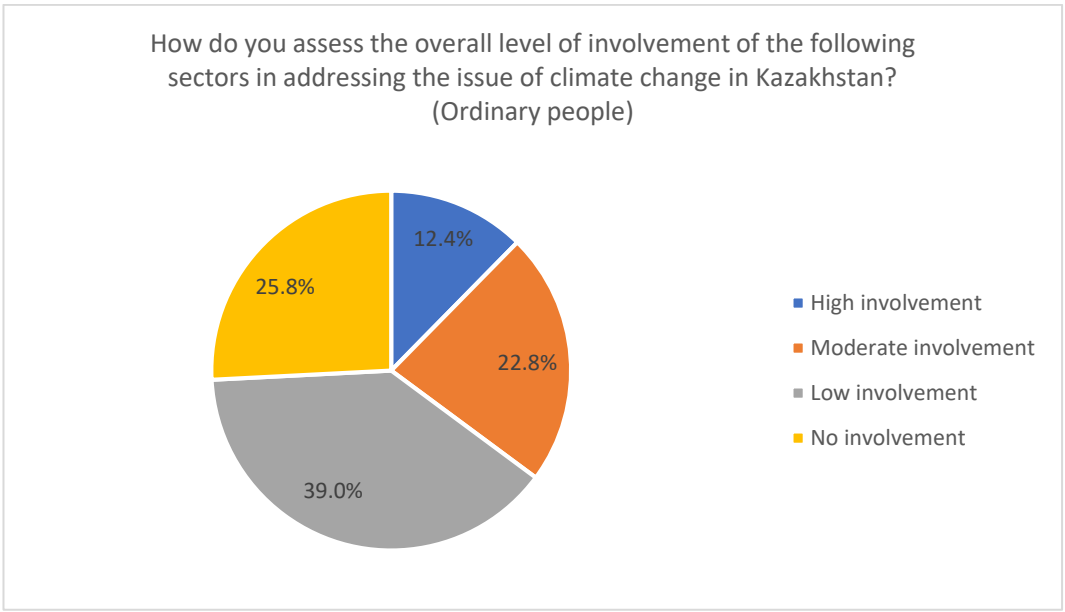


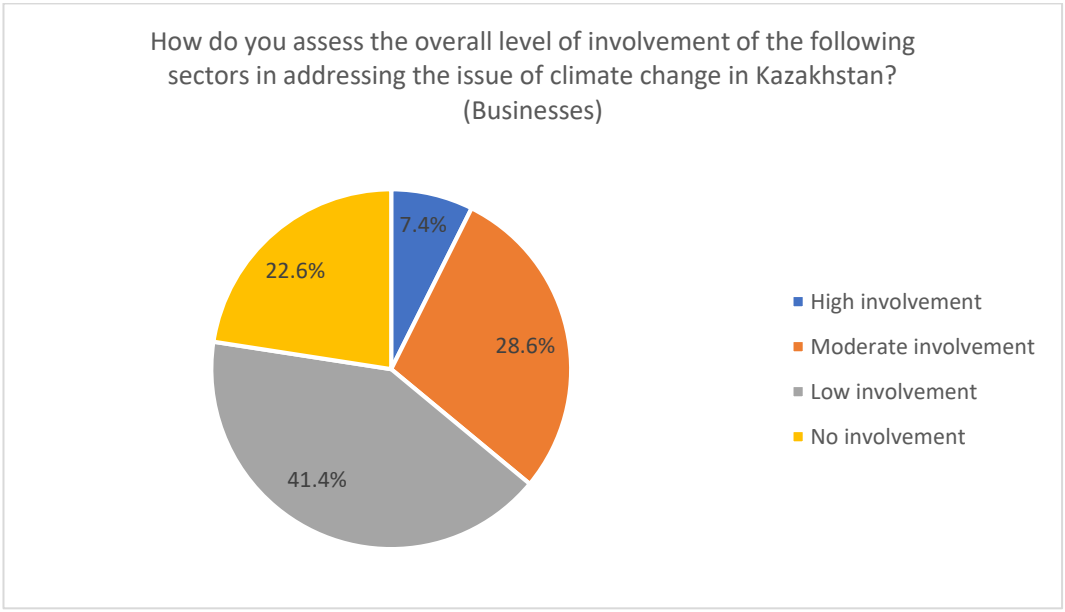


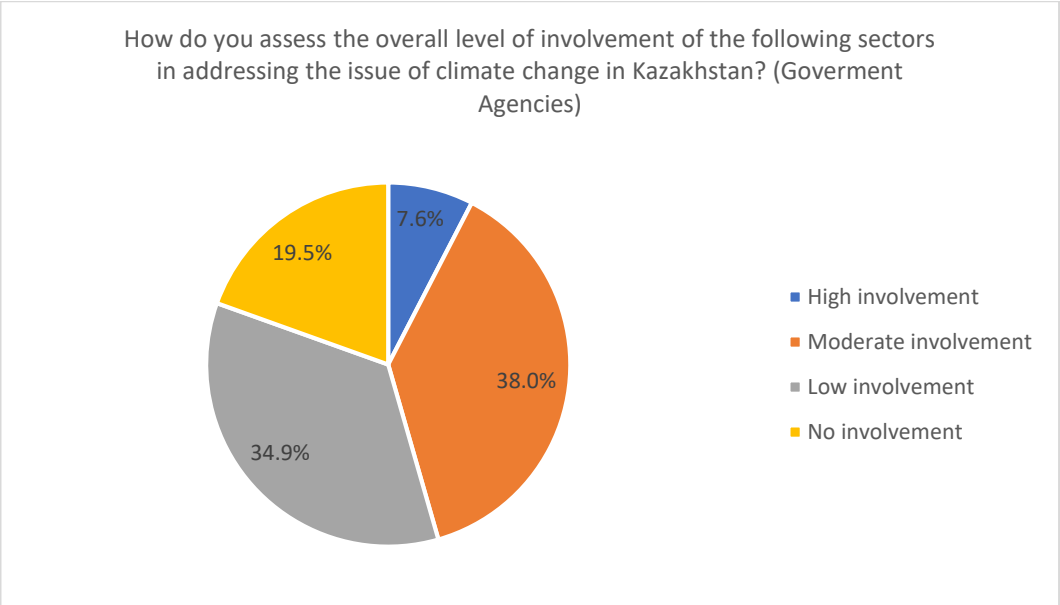

Have you noticed changes in precipitation patterns in recent years?
7.8%
10.6%
5.4%
76.1%
Yes, noticed an increase in precipitation
Yes, noticed a decrease in precipitation
No, have not noticed any changes
I'm unsure

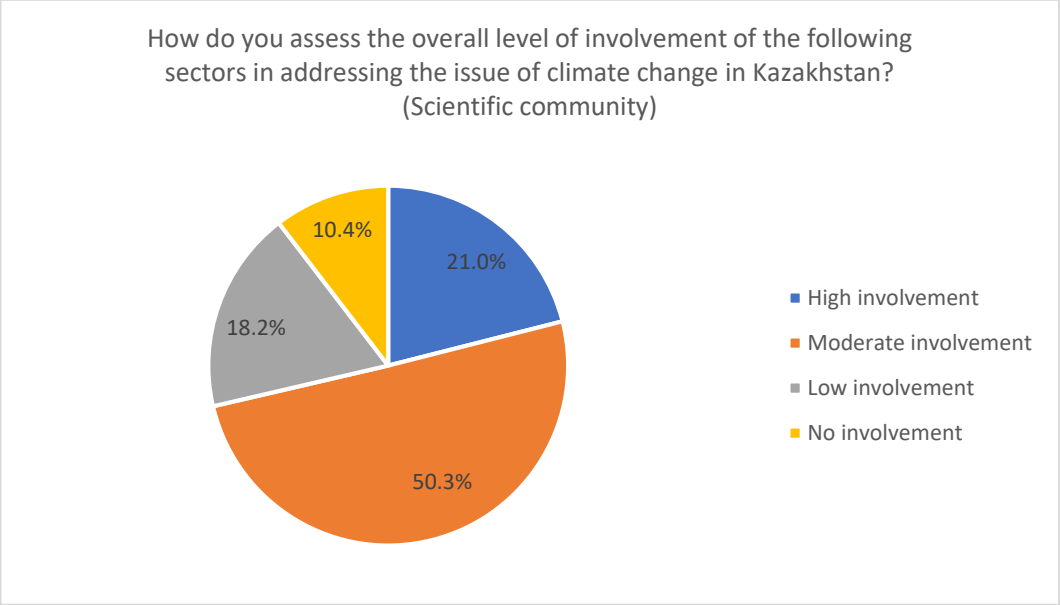

What do you consider to be the main cause of climate change?
5.4%
33.4%
24.7%
7.4%
29.1%
Emissions of greenhouse gases (e.g., carbon dioxide, methane)
Deforestation
Industrial activities
Improper use of natural resources
Other

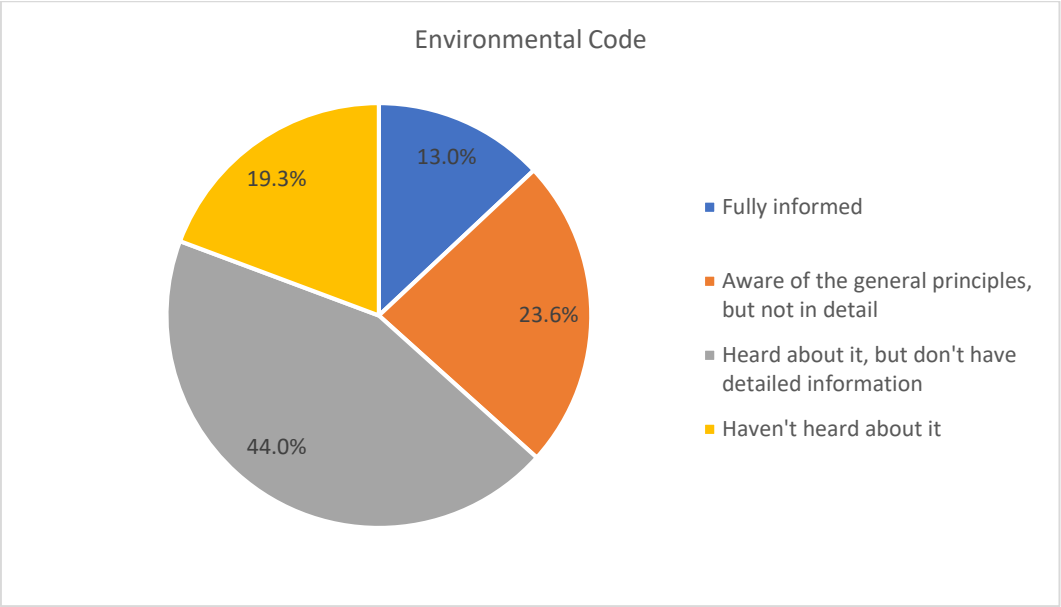

In your opinion, what climate change issues are the most pressing for your region?
1.1%
21.7%
32.8%
7.8%
33.4%
3.3%
Abnormal heatwaves and droughts
Floods and inundations
Threat of species extinction
Soil degradation and worsening water quality
Air pollution
Other

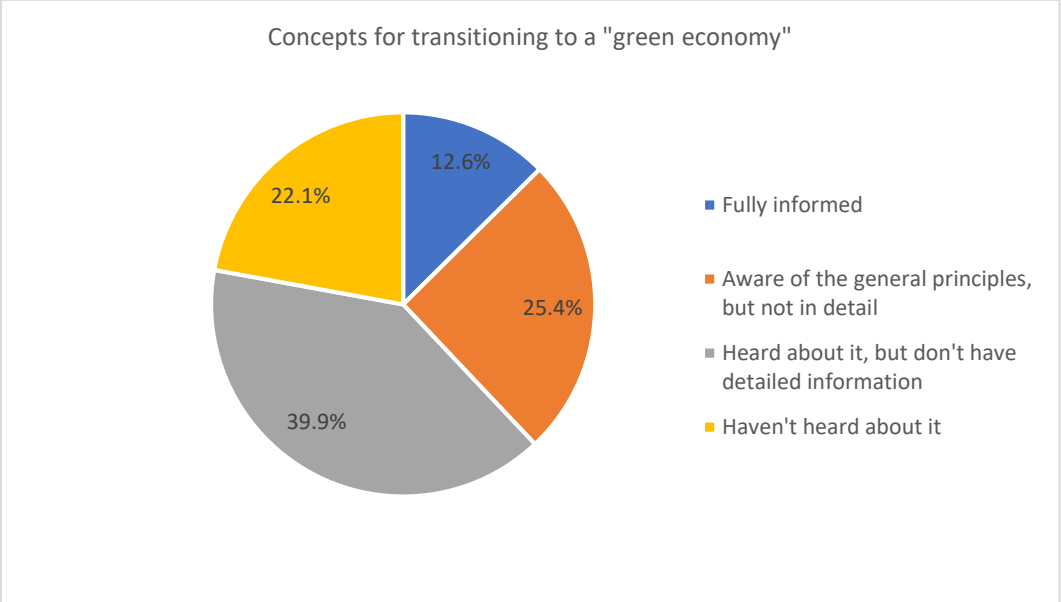

How do you assess the overall level of involvement of the following sectors in addressing the issue of climate change in Kazakhstan? (Ordinary people)
12.4%
22.8%
39.0%
25.8%
High involvement
Moderate involvement
Low involvement
No involvement

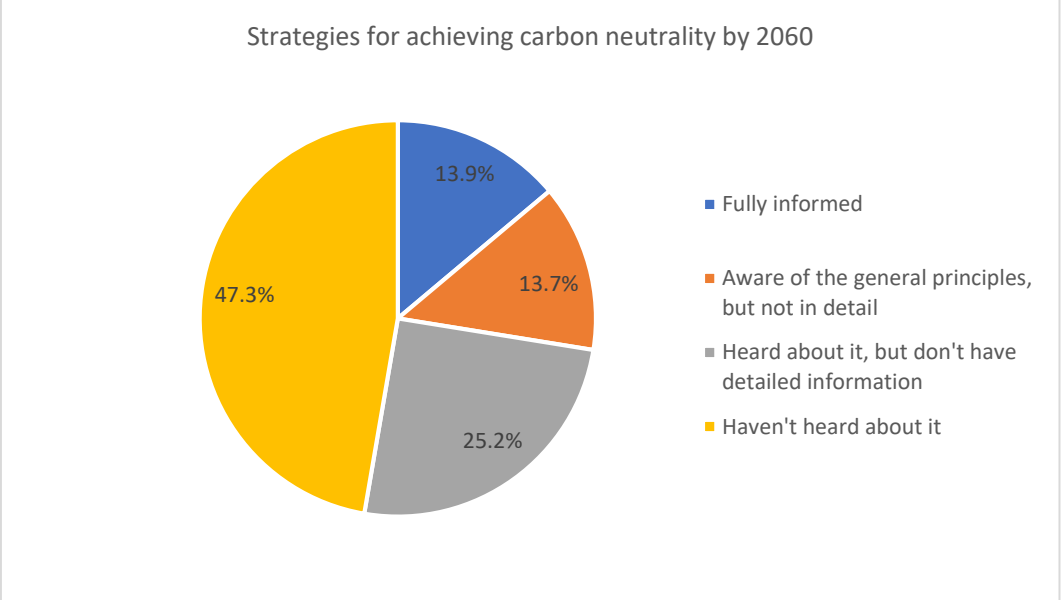

How do you assess the overall level of involvement of the following sectors in addressing the issue of climate change in Kazakhstan? (Businesses)
7.4%
28.6%
41.4%
22.6%
High involvement
Moderate involvement
Low involvement
No involvement


How do you assess the overall level of involvement of the following sectors in addressing the issue of climate change in Kazakhstan? (Goverment Agencies)
7.6%
38.0%
34.9%
19.5%
High involvement
Moderate involvement
Low involvement
No involvement


How do you assess the overall level of involvement of the following sectors in addressing the issue of climate change in Kazakhstan? (Scientific community)
21.0%
50.3%
18.2%
10.4%
High involvement
Moderate involvement
Low involvement
No involvement


Environmental Code
13.0%
23.6%
44.0%
19.3%
Fully informed
Aware of the general principles, but not in detail
Heard about it, but don't have detailed information
Haven't heard about it


Concepts for transitioning to a "green economy"
12.6%
25.4%
39.9%
22.1%
Fully informed
Aware of the general principles, but not in detail
Heard about it, but don't have detailed information
Haven't heard about it


Strategies for achieving carbon neutrality by 2060
13.9%
13.7%
25.2%
47.3%
Fully informed
Aware of the general principles, but not in detail
Heard about it, but don't have detailed information
Haven't heard about it

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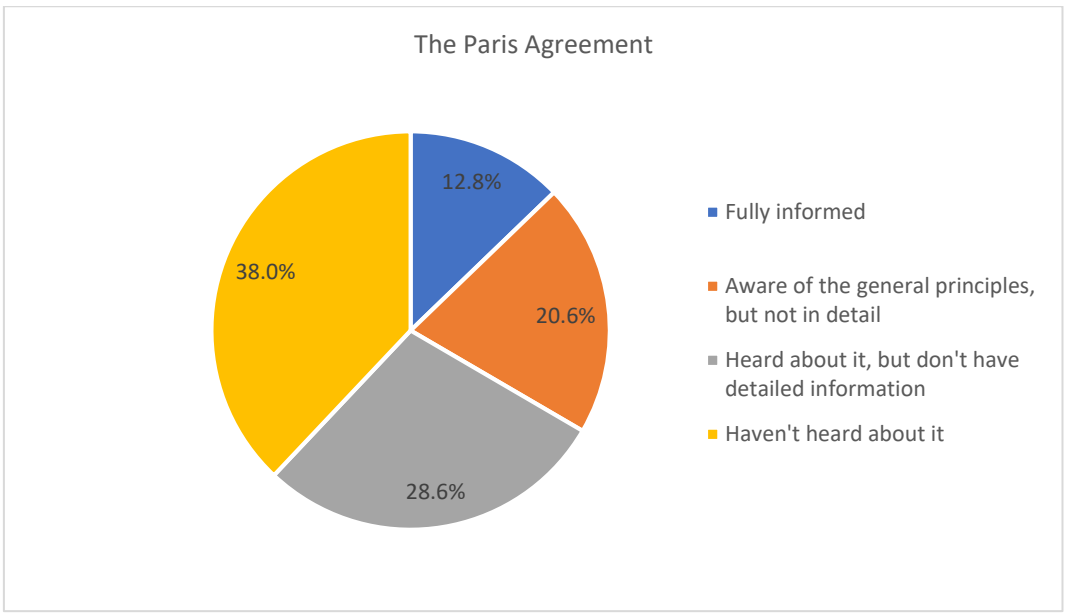
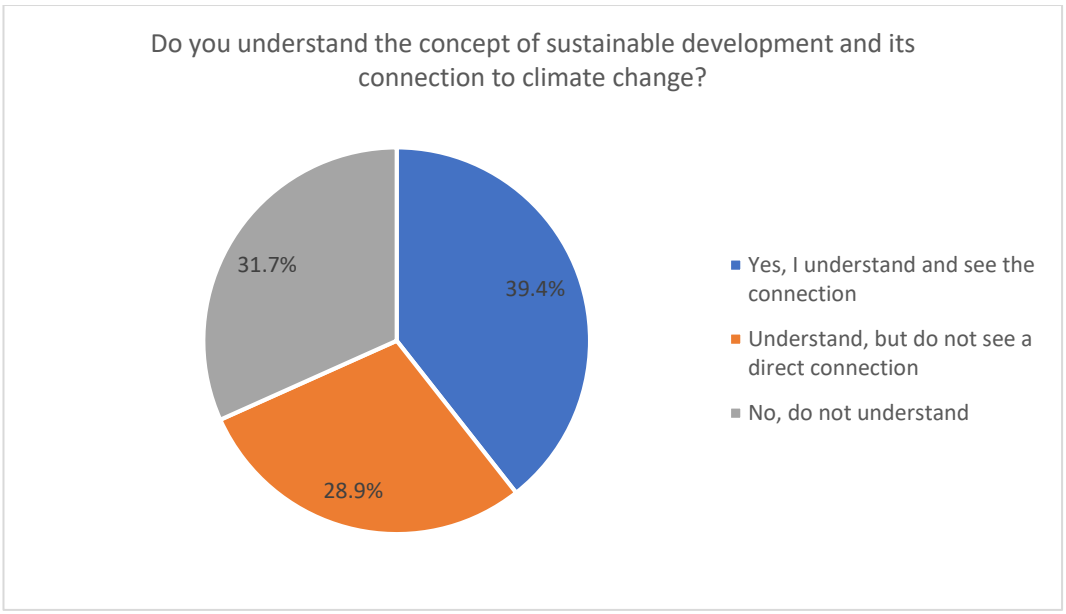
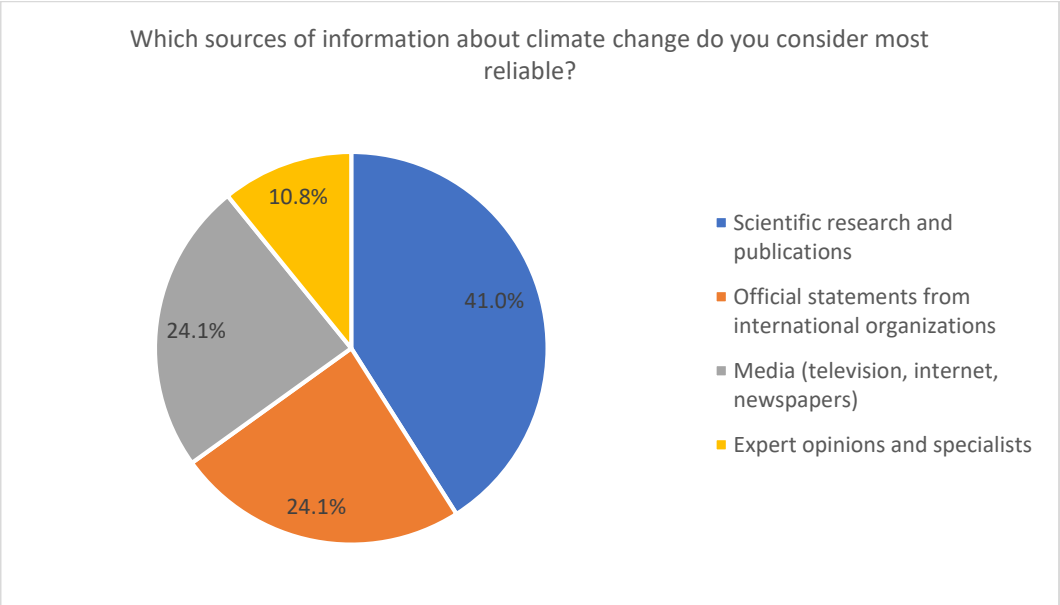
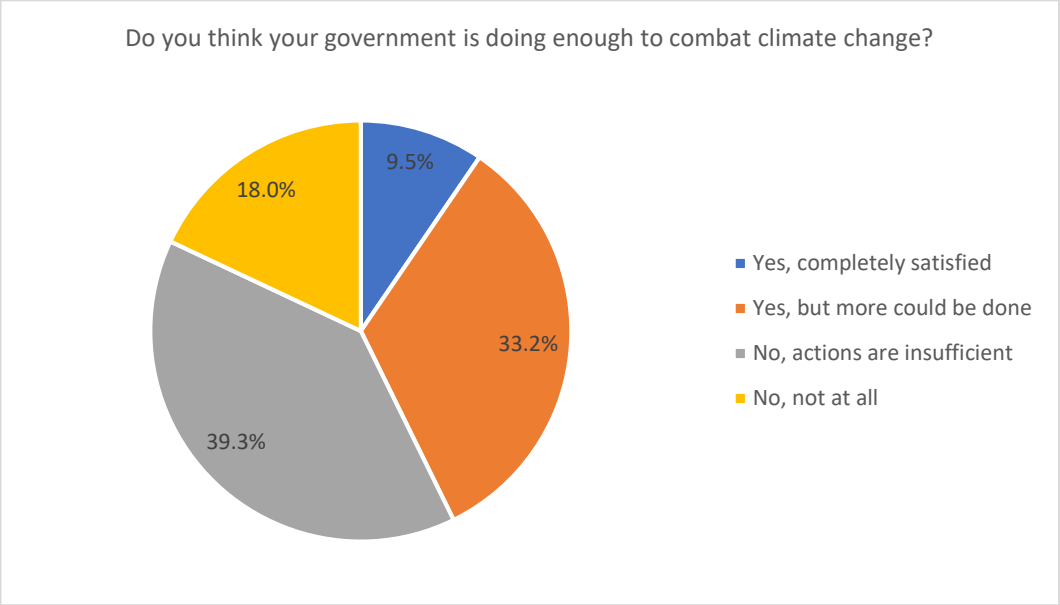
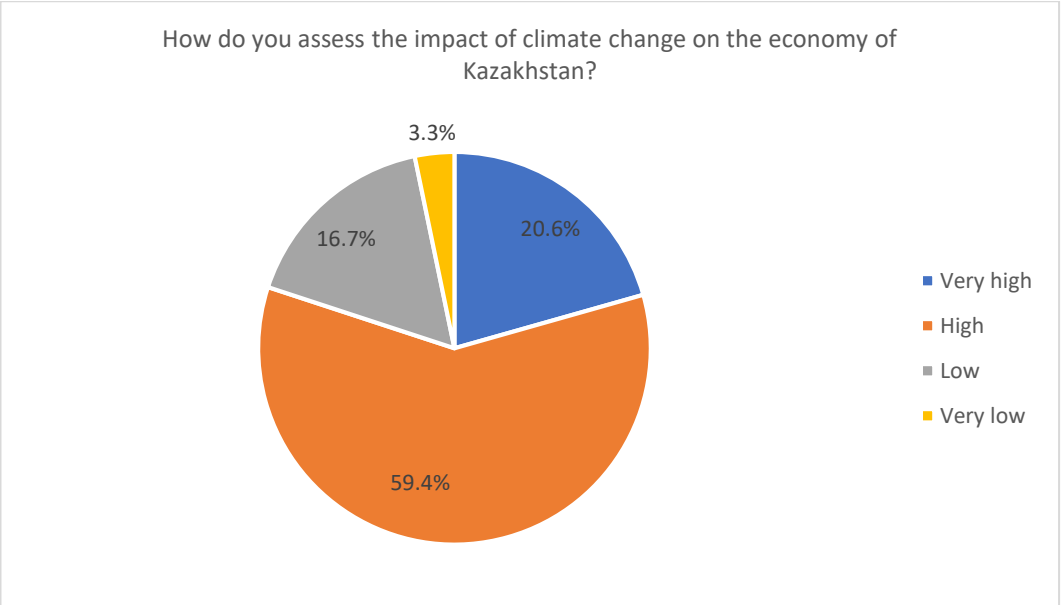

The Paris Agreement
12.8%
20.6%
28.6%
38.0%
Fully informed
Aware of the general principles, but not in detail
Heard about it, but don't have detailed information
Haven't heard about it

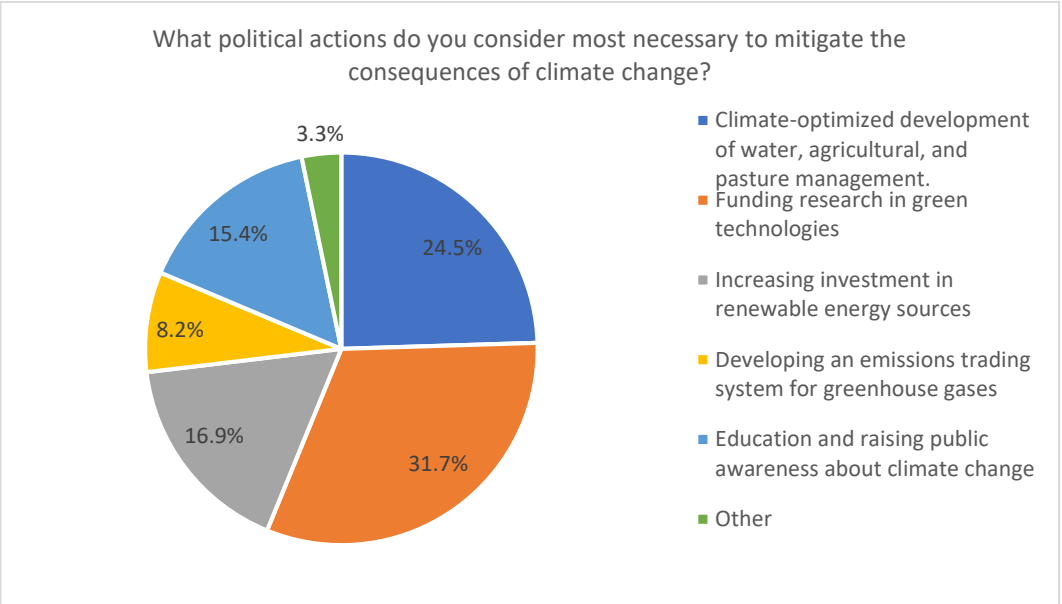

Do you understand the concept of sustainable development and its connection to climate change?
31.7%
39.4%
28.9%
Yes, I understand and see the connection
Understand, but do not see a direct connection
No, do not understand

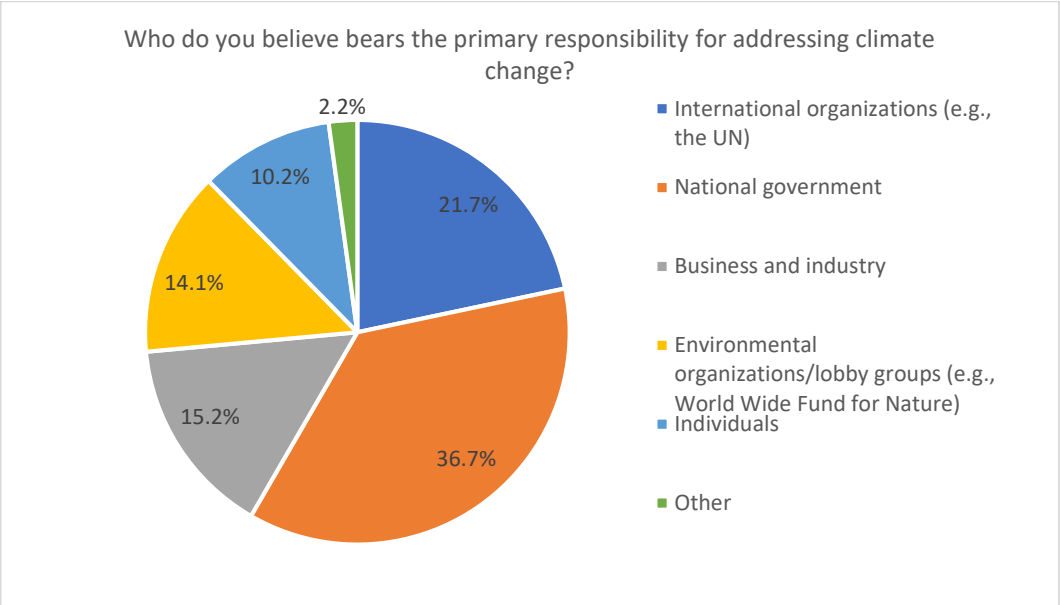


Climate change policy assessment

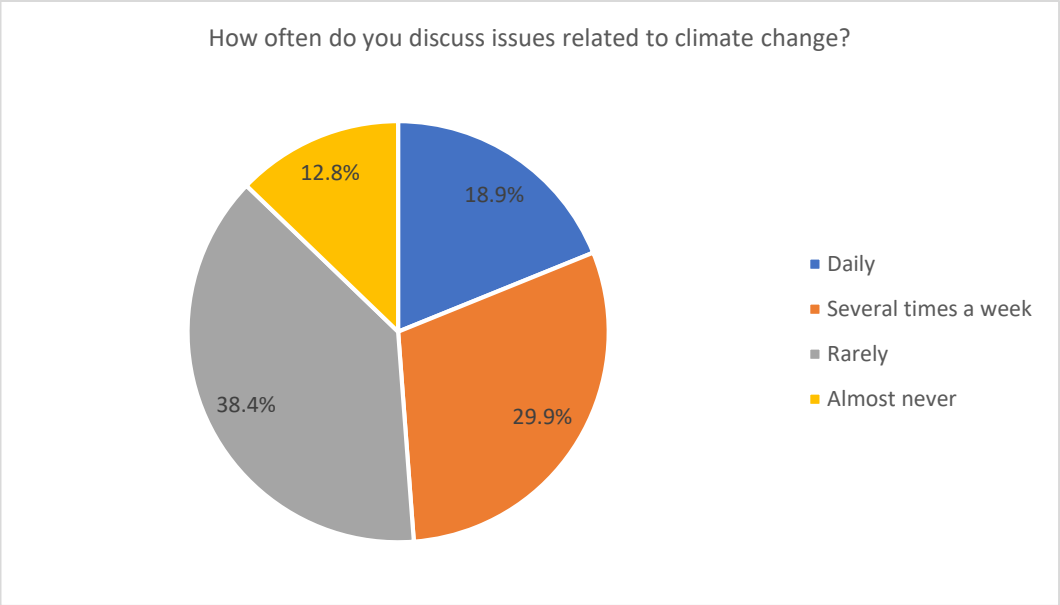


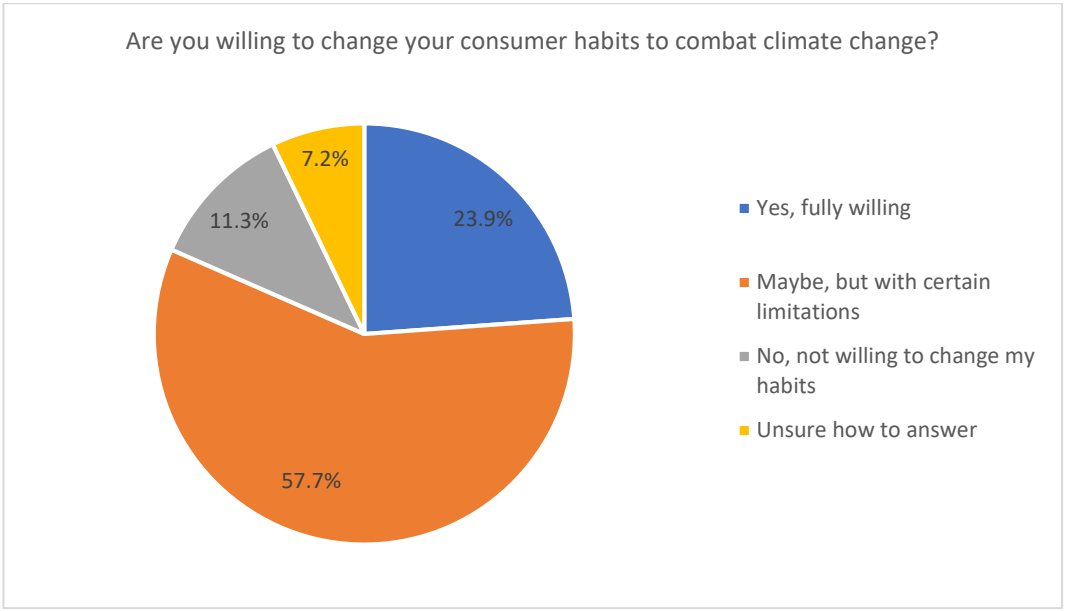

How do you assess the impact of climate change on the economy of Kazakhstan?
3.3%
20.6%
16.7%
59.4%
Very high
High
Low
Very low

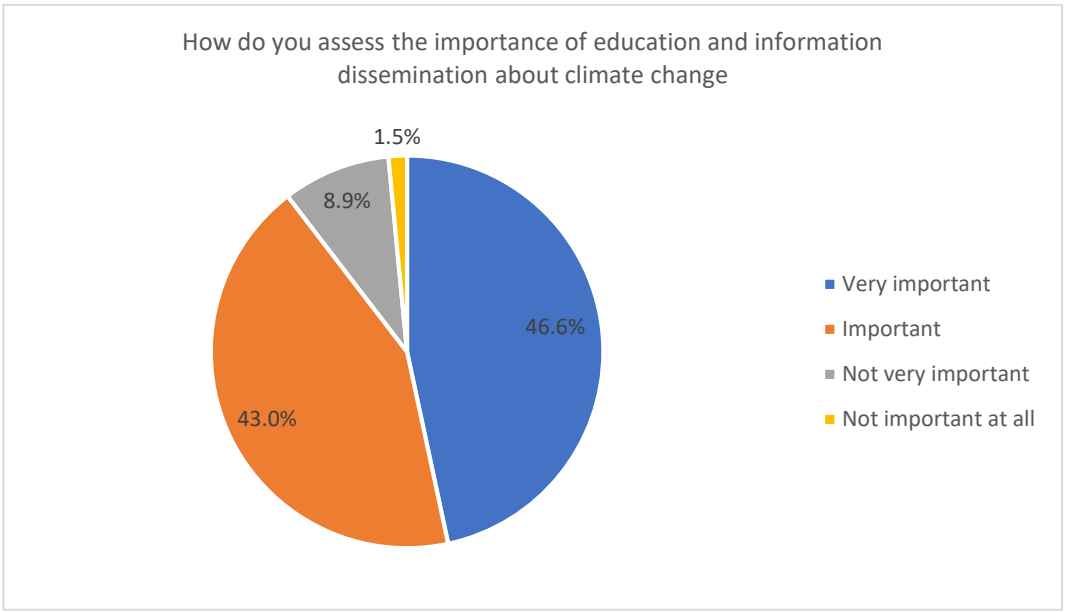

What political actions do you consider most necessary to mitigate the consequences of climate change?
3.3%
24.5%
15.4%
8.2%
16.9%
31.7%
Climate-optimized development of water, agricultural, and pasture management.
Funding research in green technologies
Increasing investment in renewable energy sources
Developing an emissions trading system for greenhouse gases
Education and raising public awareness about climate change
Other

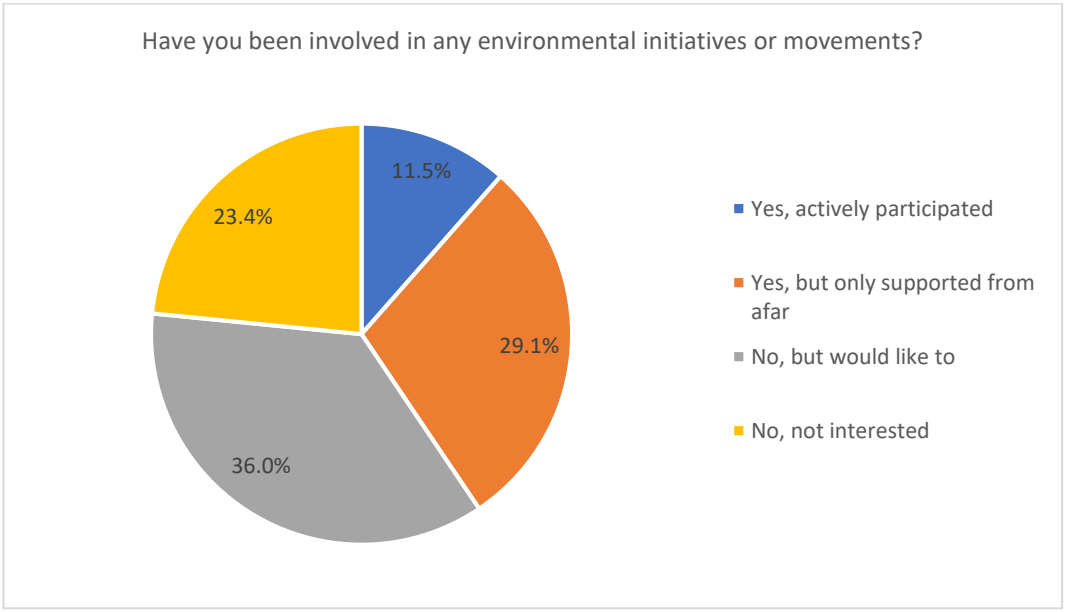


Readiness for change

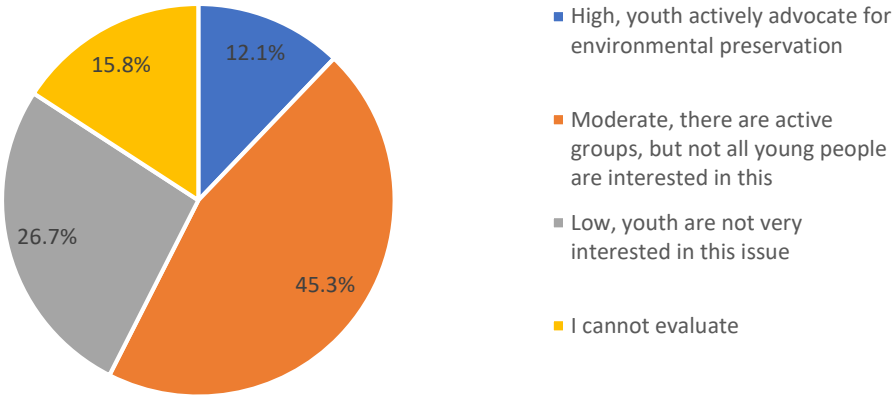



Are you willing to change your consumer habits to combat climate change?
7.2%
11.3%
23.9%
57.7%
Yes, fully willing
Maybe, but with certain limitations
No, not willing to change my habits
Unsure how to answer

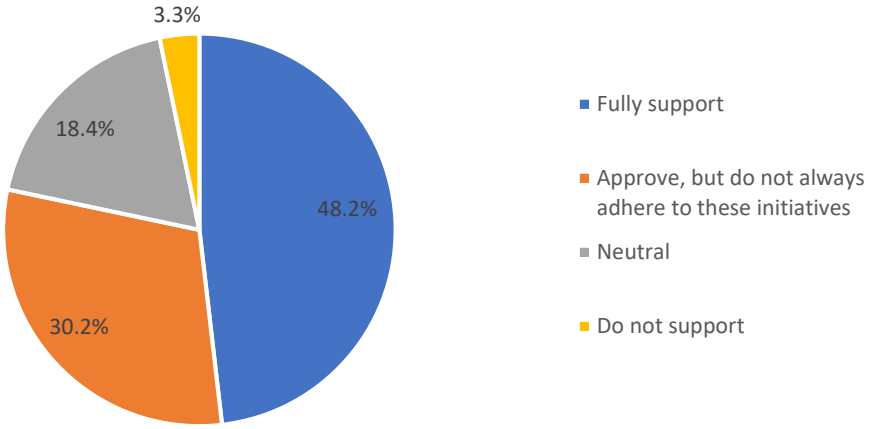

How do you assess the importance of education and information dissemination about climate change
1.5%
8.9%
46.6%
43.0%
Very important
Important
Not very important
Not important at all


Have you been involved in any environmental initiatives or movements?
11.5%
23.4%
29.1%
36.0%
Yes, actively participated
Yes, but only supported from afar
No, but would like to
No, not interested

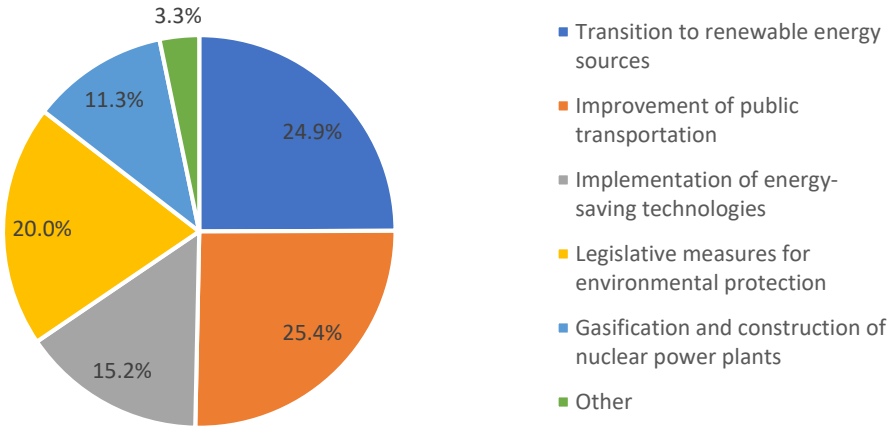
How do you assess the level of youth involvement in addressing the issue of climate change?



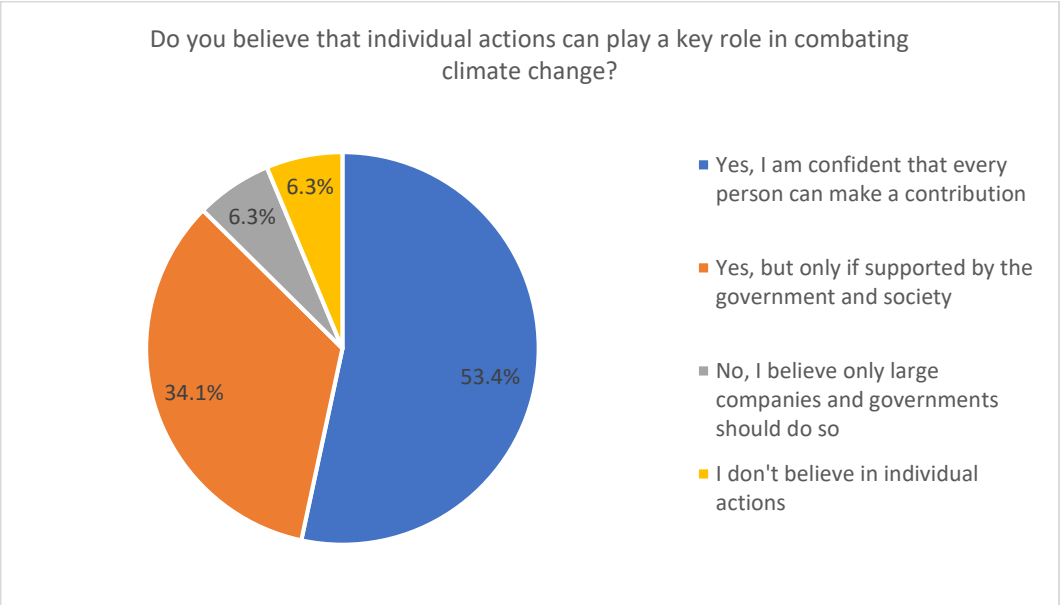
How do you feel about initiatives to reduce the use of plastic and other harmful materials for the environment?

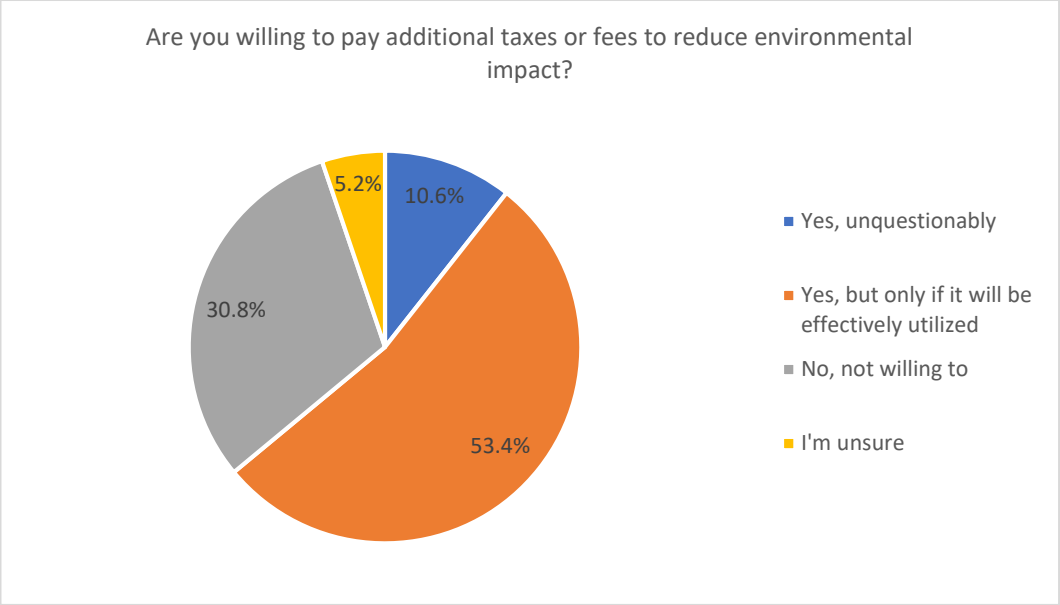


What steps do you think should be taken to mitigate the impact of climate change?

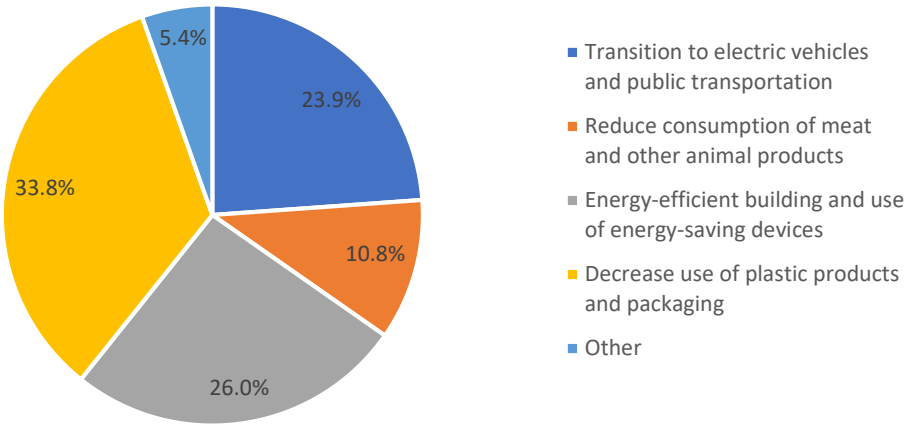


Perception and opinion on various initiatives and collaborations

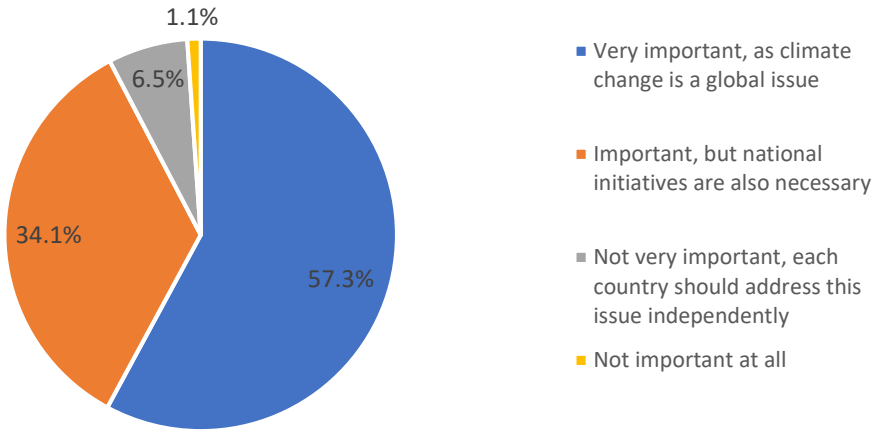




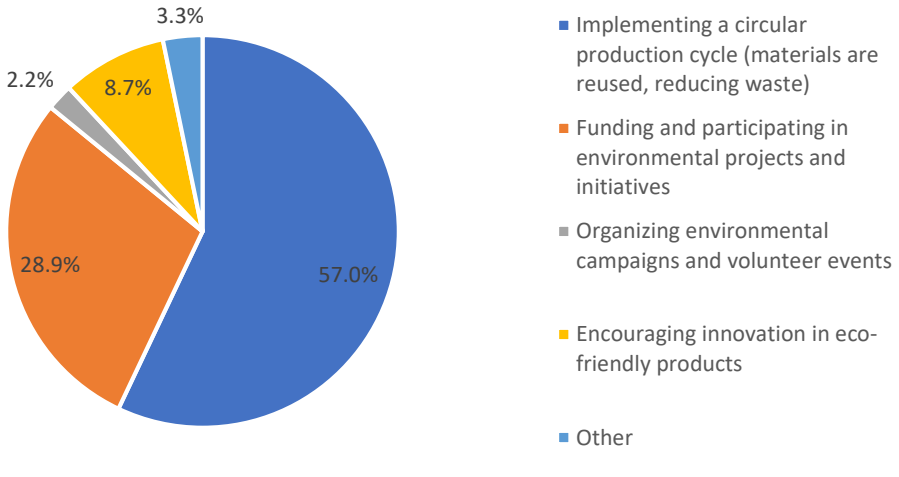
What do you think ordinary citizens can do to reduce their carbon footprint?

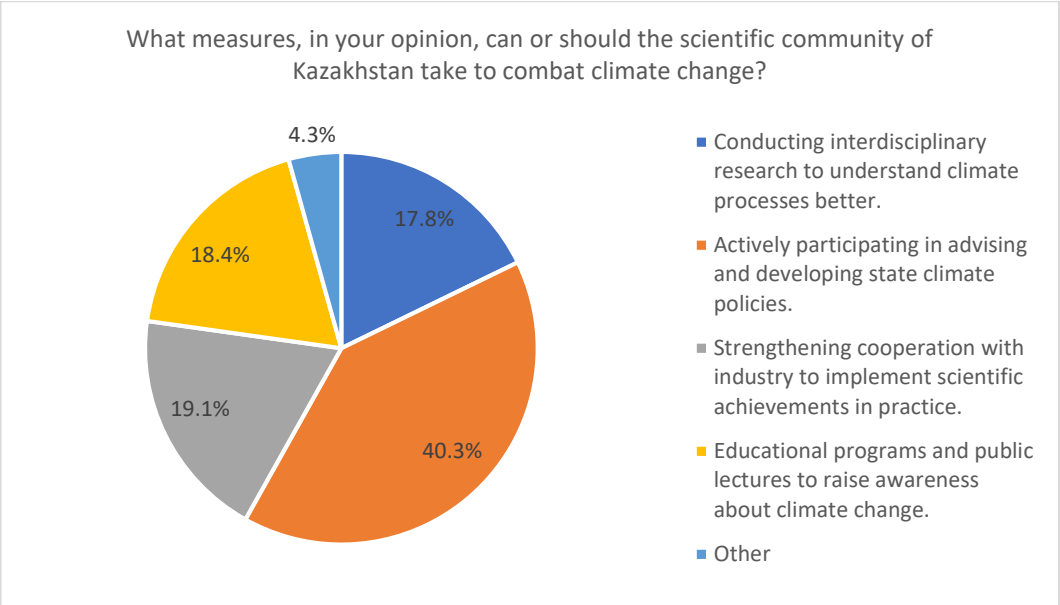


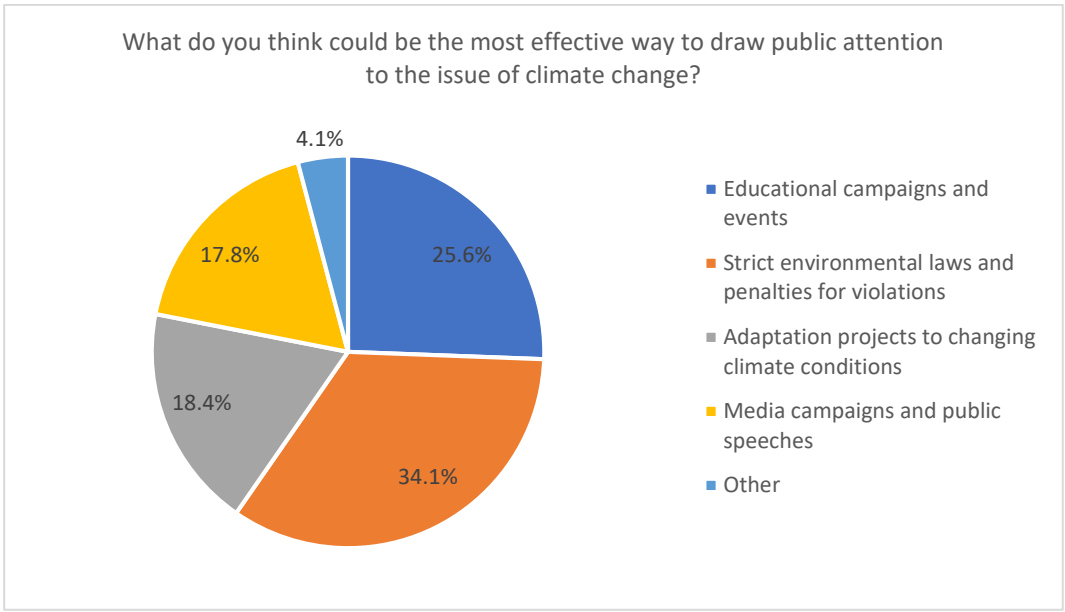
How do you assess the importance of international cooperation in addressing the issue of climate change?



What measures do you think businesses can or should take to combat climate change?




What measures, in your opinion, can or should the scientific community of Kazakhstan take to combat climate change?
4.3%
17.8%
18.4%
19.1%
40.3%
Conducting interdisciplinary research to understand climate processes better.
Actively participating in advising and developing state climate policies.
Strengthening cooperation with industry to implement scientific achievements in practice.
Educational programs and public lectures to raise awareness about climate change.
Other


What do you think could be the most effective way to draw public attention to the issue of climate change?
4.1%
25.6%
17.8%
18.4%
34.1%
Educational campaigns and events
Strict environmental laws and penalties for violations
Adaptation projects to changing climate conditions
Media campaigns and public speeches
Other

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