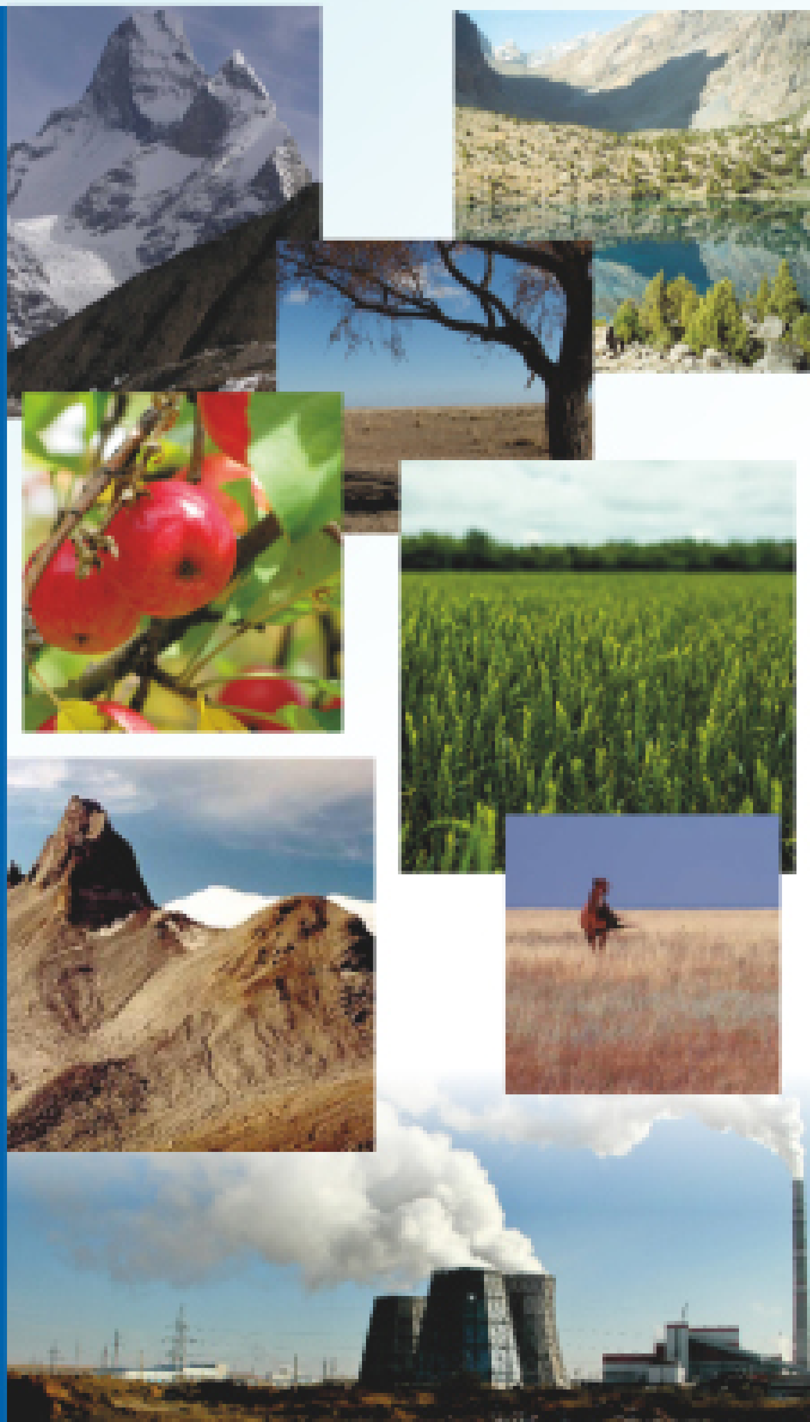
MINISTRY OF ENVIRONMENT
AND WATER PROTECTION OF THE REPUBLIC
OF KAZAKHSTAN

UNITED NATIONS DEVELOPMENT PROGRAM
IN KAZAKHSTAN

GLOBAL ENVIRONMENT FACILITY

III–VI NATIONAL COMMUNICATION OF THE REPUBLIC OF KAZAKHSTAN TO THE UN FRAMEWORK CONVENTION ON CLIMATE CHANGE



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The Third–Sixth National Communication of the Republic of Kazakhstan to the Conference of Parties of the United Nations Framework Convention on Climate Change (UN FCCC) has been prepared as a part of the joint project of the UN Development Program in Kazakhstan and the Ministry of Environment Protection of the Republic of Kazakhstan with the support of the Global Environment Facility. This National Communication (hereafter - NC) synchronizes the dates of the National Communications with other countries included to Appendix I to UN FCCC and contains the 3-d, the 4-th, the 5-th and the 6-th NC for the period to 2012. The document is intended for its submission to the UN FCCC Secretary, for government agencies, authorities of the Republic of Kazakhstan, science and public organizations.

ISBN

Ministry of Environment and water resources
of the Republic of Kazakhstan

United Nations Development Program in Kazakhstan

Global Environment Facility

The Third–Sixth National Communication of the Republic of Kazakhstan to the UN Framework Convention on Climate Change

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The team of authors and project implementation team notes the significant contributions of the following ministries, agencies and departments: the Ministry of Environment and water resources of the Republic of Kazakhstan, Ministry of Industry and New Technologies of the Republic of Kazakhstan, Ministry of Regional Development of the Republic of Kazakhstan, Ministry of Agriculture of the Republic of Kazakhstan, Ministry of Oil and Gas of the Republic of Kazakhstan, Ministry of Internal Affairs of the Republic of Kazakhstan, Ministry of Emergency Situations of the Republic of Kazakhstan, Ministry of Communications and Information of the Republic of Kazakhstan, Ministry of Transport and Communications of the Republic of Kazakhstan, Agency of Statistics of the Republic of Kazakhstan, «Zhasyl Damu» JSC, Nazarbayev University research and innovation systems.

The team of authors and project implementation team return thanks to all those who directly or indirectly participated in the preparation of the Third-Sixth National Communication of the Republic of Kazakhstan of the Conference of the Parties to the UN Framework Convention on Climate Change.

We also would like to express special gratitude to the Projects implemented by the UNDP in Kazakhstan, country office staff in particular that of Operations Department, Department of Environment and Energy, and Department of Government and Local Development.

We thank our partners at the Department of Low Carbon Development of the Ministry of Environment and water resources and its director Gulmira Sergazina.

We express gratitude to the Global Environment Fund, without its financial assistance the project would be much more complex.

The Ministry of Environment Protection of the Republic of Kazakhstan was reorganized into the Ministry of Environment and water resources of the Republic of Kazakhstan in accordance with the Decree of the President №677 signed 29 October 2013: “On Further Improvement of the Public Administration System of the Republic of Kazakhstan”.

Thus, the duties to protect and restore forest and water resources and specially protected natural areas were transferred from the Ministry of Agriculture (MA) to the Ministry of Environment and Water Resources (MEWR).

In this regard it should be taken into account that the section related to the issues on climate changes which lied in cognizance of the MA (section 4.1.2. and in other sections of the report) is currently the duty of the MEWR.

WELCOME ADDRESS OF THE MINISTER OF ENVIRONMENT AND WATER RESOURCES OF THE REPUBLIC OF KAZAKHSTAN NURLAN KAPPAROV

Dear colleagues,

The Republic of Kazakhstan as a Part to the UN Framework Convention on climate Change (UNFCCC), has taken clear and transparent position on combating global climate change. Undertaking voluntary commitments to reduce greenhouse gases emission to the atmosphere, our country pursues consistent policy on the carbon intensity of economy reduction, creation of conditions for the renewable energy sources participating in the energy balance of the Republic, and implementation of the national system of greenhouse gases emission quota sale, being developed on the «cap&trade» principle. The Law on the energy saving and energy use efficiency improvement was developed and passed in 2012; unprecedented measures are taken to reduce fuel consumption and update every sector of economy in terms of energy use. Particularly the program of energy use efficiency improvement and energy saving is being implemented with one of the most troubled sectors – housing and utility. Phased transition to newer, more demanding fuel standards of EURO-4 is being made, energy audit of large companies are being prepared and carried out.

By order of the Head of the State in 2013 the Ministry of Environment and water Resources has developed the Concept of the Republic of Kazakhstan's transfer to green economy. The Concept is supported by an action plan and will constitute a key instrument to provide sustainable development of the country. For these purposes the «Astana EXPO-2017» an International specialized exposition which will be hosted by Kazakhstan on the theme «Future Energy» will create additional incentives for the process of transfer to the «green» economy modernization. In its turn it will allow Kazakhstan to ensure the strategic goal achievement – to become one of the 30 most developed countries of the world by 2050.

In September 2013 Kazakhstan opened for signing the Green Bridge Partnership Programme – international cooperation to ensure «green» economic growth through technology transfer, knowledge exchange and provision of financial support to implement investment projects in Central Asian region. This program will act as a regional coordinator and international contributor to the development and adoption of clean technologies and will facilitate the development of innovative investment solutions for tangible and bankable projects within the number of key sectors for the sustainable green economy growth.

This National Communication was prepared by the Republic of Kazakhstan acting as a Party to the Appendix I to the UNFCCC. Third National communication (TNC) contains 3rd, 4th, 5th and 6th reports over the period from 2006 to 2012, and aligns the terms of National Communications submission with other countries included in the Exhibit I to the UNFCCC.

As estimated by experts there has been an annual average and seasonal temperature of the ground air rise observed throughout the entire territory of Kazakhstan within the recent 70 years, provided that 2007 and 2008 have become two of the ten warmest years in Kazakhstan. Although total emissions of Kazakhstan (excluding LULUCF) in 2011 amounted 76.7 % of the basic 1990 emissions, emissions per capita still remain high, in 2011 they exceeded 16.7 tons in CO_2 equivalent. Continuing economic growth where the primary source is the exploitation of resource potential promotes negative impact on the environment. According to the estimates available near 75% of the territory of the country is subject to an increased risk of environmental disruption. The water resources, waste management and agricultural sectors are the most vulnerable.

While preparing the TNC a vulnerability assessment of the climate change impact within the natural ecosystems and in the field of public health has been conducted for the first time for Kazakhstan, main areas of activity on the adaptation in the social and economic sector have been specified.

Understanding the importance of the climate change issues we take plenty of actions to reduce the impact of the climate change on our country and the whole planet. We will use our best endeavors to further enhance our participation in international and regional incentives to respond to new challenges.

MINISTER
Of Environment and Water Resources
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INTRODUCTION

This National Communication was prepared by the Republic of Kazakhstan acting as a Party to the Appendix I to the UNFCCC. Third National communication (TNC) contains 3rd, 4th, 5th and 6th reports over the period from 2006 to 2012, and aligns the terms of National Communications submission with other countries included in the Appendix I to the UNFCCC.

The Government of the Republic of Kazakhstan has taken critical and principled stand on the global climate change and pursues transparent and progressive policy on the mitigation of impact on the global climate. Kazakhstan feels acute effects of the climate change affecting the sectors of economy. Further such impact will grow and lead to forced adaptation.

Even now agriculture as the most vulnerable sector of economy experiences a lack of irrigation and drinking water; for the strategic cereal cropping industry it is expected a reduction in productivity in future.

Increase of the number of natural disasters heavily damaging the economy and public health is of great danger to the Republic. Over the period of 2002 to 2011 Kazakhstan has incurred damage resulting from emergency situations due to dangerous hydrometeorological phenomena (wind storms, blizzards, snowfalls, rapid thermal drop, freshets, floods, landslides and gale force wind) to the amount of USD68.6 mln. These and other factors make the Government and people of Kazakhstan to take actions to adapt to the climate change as well as to allocate funds from the country's budget to eliminate the effects of the climate change. Thus, the climate change withdraws from circulation the funds which could be otherwise assigned for the social programs' improvement, development of the infrastructure and creation process.

This National Communication contains the information about researches that have been carried out on the measures and policies implemented by Kazakhstan in order to reduce the greenhouse gases emission, information about the climate warming rates and future climate regime forecast. Additionally the activities have been carried out to analyze the climate change impact on the ecosystems, assessment of the regions' and public health vulnerability, etc.

The project team and partners who have prepared the report hope that this paper will be highly sought for the international institutions implementing projects and programs in Kazakhstan focused on the adaptation to the climate change. We suppose that Kazakhstan possesses every condition for the elaboration of a good base on the issues of the climate change effects mitigation through the Green Bridge Programs and The System of greenhouse gases emission quota sale.

I. EXECUTIVE SUMMARY

The Republic of Kazakhstan is located in the centre of the Eurasian continent and is a unitary state with the presidential system of government.

Population of the RK /Republic of Kazakhstan/ as of the end of 2012 was 16,912.3 thous. people. Population density amounts to 6.2 people per 1sq.km. Urban population share (54.9%) is higher than rural one (45.1%).

The area of the Republic is 2,724.9 thous. sq.km. Kazakhstan is the world's ninth largest and second among the CIS states by the territory. Kazakhstan extends 3 thous. km. west to east and 2 thous. km. north to south. Kazakhstan shares borders with: PRC, Kyrgyz Republic, Turkmenistan, Uzbekistan and Russian Federation. Total length of the land borders is 12,187km. The northernmost point of Kazakhstan – 55'26'N – corresponds to the southern latitude of the central part of the East European Plain and the south of the British Isles, the southernmost – 40'56'N – latitudes of South Caucasus and Southern European states of the Mediterranean basin.

Figure 1.1.

Republic of Kazakhstan

Kazakhstan terrains belong to four natural climate zones – forest-steppe, steppe, semi-arid and desert.

The distance from the ocean and vast territory determine sharply continental climate of Kazakhstan, its zoning and deficit of precipitation. Annual precipitation in the foothill and mountain regions is 500 to 1600mm, in steppe – 200-500 and in desert – 100-200mm. Average temperature in January ranges from 18 ºC below zero in the north to 3 ºC below zero in the south; Average temperature in July – from 19 ºC in the north to 29 ºC in the south. Winter in the north is long and cold. In certain years the temperatures were as low as 52 ºC below zero in the northern regions of the country, but there can be thaws up to 5 ºC as well. The highest temperature of the ground air in July in the north does not exceed 41 ºC, and in the south – 47 ºC (Kyzyl Kum desert). Daily temperature differences can reach 20-30 ºC.

There has been an annual average and seasonal temperature of the ground air rise observed throughout the entire territory of Kazakhstan within the recent 70 years. Particularly rapid rates of warming have started to occur since 1980-s, that caused higher frequency of warm years. Annual average temperatures of air in Kazakhstan during each year since 1997 till 2010 (14 consequent years) were higher at the mean than a climatic normal rate calculated over the period of 1971-2000, by 0.3 – 1.4 °C. Top ten warmest years in Kazakhstan are as follows: 1983, 2004, 2002, 2007, 1995, 2008, 1997, 2006, 2005, 1999 (ranked in decreasing order as to the value of the positive anomaly). Annual average in terms of the area of Kazakhstan amount of precipitation over the period since 1941 till 2011 virtually did not change.

Figure 1.2.

Time-series and linear trend of annual average air temperature (a) and annual amount of precipitation (b) anomalies over the period of 1941-2011, averaged in terms of the territory of Kazakhstan. The anomalies are calculated relative to basic period of 1971-2000. Smooth curve is obtained by 11 years smoothing averaging.

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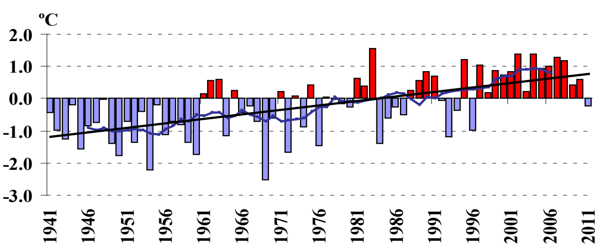

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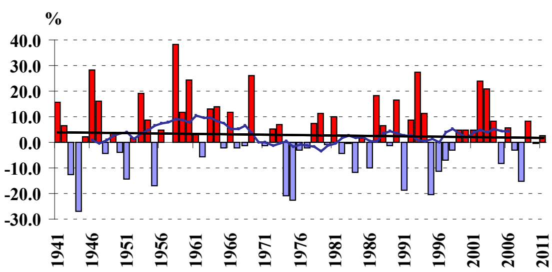


Annual average temperatures of air in Kazakhstan increased at the mean with the speed of 0.28 ºC every 10 years. Annual average temperatures increased more significantly in the north, west and south of Kazakhstan – by 0.30…0.37 ºC/10 years, в in the remaining regions – by 0.25…0.29 ºC/10 years. Some lower rates of the temperature increase observed in autumn and spring – at the mean by 0.32 и 0.27 ºC/10 years respectively throughout Kazakhstan. The lowest rate of the temperature increased was observed in summer within the range from 0.12 through 0.27 ºC/10 years. The summer temperatures in Kazakhstan increased at the mean with the speed of 0.18 ºC/10 years.

Precipitation regime has changed ambiguously throughout the territory of Kazakhstan. At the mean annual amounts of precipitation throughout Kazakhstan slightly decreased – by 0.5mm/10 years (0.3% of the normal rate/10 years), there also was observed a trend of decrease as to the seasonal amounts of precipitation – by 1mm/10 years (1% of the normal rate/10 years) in spring, summer and autumn. It is registered a trend of precipitation amount increase by 1.7mm/10 years (2.2% of the normal rate/10 years) in winter. Precipitation decreased by 1 to 5% of the normal rate/10 years throughout the major part of the territory of Kazakhstan except for the south-eastern mountainous regions in summer and autumn. On the contrary the amount of precipitation mostly increased in winter; persistent trends were observed in the northern and central regions as well as north-western, eastern, south-eastern mountainous and foothill regions of the Republic – by 1 to 10% of the normal rate/10 years. In spring period the positive trend as to precipitation was observed in the north-western half part of Kazakhstan while the negative trend – throughout the entire remaining territory. It should be mentioned that almost all the seasonal precipitation amount trends are insignificant in terms of statistics, except for the winter precipitation.

The main source of the economic growth is the exploitation of the resource potential of the country. In 2012 the oil production (including natural-gas condensate) was 79.2 mln. tons, (natural) gas extraction – 40.1 bln. cu.m.

Official export of goods increased by 5.3% in 2012 relative to 2011 and amounted to USD92.3 bln., of which USD56.4 bln. (or 61.2%) due to the oil and gas condensate export.[1]

According to the official statistical data, the mineral products' share in the total exports of Kazakhstan in 2012 was 77.8%.

Along with the industrial growth within the export-oriented industry sectors there was an increase in demand for the end products for consumption and production being the factor of expansion of production as well. Industrial production output in the Republic for the 2012 was 16,851.8 bln. tenge, that exceeds one of 2011 by 0.7%. 13 regions of the Republic showed industrial growth. Production in the manufacturing industry has increased by 1.2% when compared to 2011.

Kazakhstan continuously pursues the open foreign trade policy. High rates of growth within the real economy together with advantageous external conditions facilitated the growth of the external trade turnover by 6.5% that amounted to USD132,743.6 thous. as of the end of 2012.

The Republic concentrates about 0.5% of the world's mineral fuel balance reserves that amounts to 30 bln. toe /ton of oil equivalent/, of which the coal share is 80%, oil and gas condensate – 13%, natural and associated gas – 7%.

Proven electric capacity generated by Kazakhstan's power plants, is around 18GW (thermal power stations – 87.5%, hydraulic – 12.4%). Kazakhstan has a developed cogeneration system. Proven electric capacity of the CHPSs /combined heat and power station/ exceeds 6700MW (38% of the total capacity of all the country's power plants). Specifically they cover about 40% of heat and some 46% of electric energy consumption in Kazakhstan.

Kazakhstan's electric power industry is primarily oriented to the hydrocarbon fuel utilization. Only about as little as 12% of electric energy is generated by hydroelectric power stations and 88% – by thermal ones.

However, understanding the necessity of general technological shift towards high and innovative technologies, the state takes steps to strengthen the role of energy saving and efficient energy use, specifically the strategy for the industrial and innovative development by 2015 provides 2 times reduction of the energy consumption by the economy along with the 3.8 times GDP growth.

Geographical location of Kazakhstan in the centre of the Eurasian continent determines its substantial transport potential in the sphere of transit transportation. The bulk of land lines of communications' network are the roads and railways (around 88.4 and 14.0 thous. km respectively). The length of utilized waterways is 3.98 thous. km and airways – 61 thous. km. the network density is about 5.1km of railways, 32.4km of paved roads and 1.5km of inland waterways per 1000sq.km.

However such high economic and resource potential has a serious impact on the environment as well, specifically according to the estimates available near 75% of the territory of the country is subject to an increased risk of environmental disruption.

Municipal solid waste poses a serious problem to Kazakhstan. There was generated about 3,919.3 thous. tons of MSW in the country in 2011. Up to 400 mln. tons of industrial and up to 20 mln. cubic meters of household waste are generated each year. There have been more than 22 bln. tons of industrial and consumer waste accumulated throughout the territory of Kazakhstan. Great deal of waste is toxic one being the source of land, surface and underground water as well as air basin pollution. A bulk of hazardous wastes has been generated by the mining industry and through the surface mining – 30,334.1 thous. tons, with the electric energy, natural gas and water production and distribution in the amount of – 2,567 thous. tons, by the civil engineering – 165.1 thous. tons, by the agriculture, forestry and fishery – 143.9 thous. tons.

[1]www.zakon.kz/4550754-na-31-dekabrja-2012-goda-valovyjj.html

The agriculture is not one of those sectors of economy producing high environmental hazard as to its environmental impact. However, under current social and economic conditions being the reason of countrywide decline of farming, agriculture is one of the key factors of the adverse effect on the soil fertility throughout the vast area territories, and primarily at agricultural lands.

In terms of the fields and farms productivity Kazakhstan lags several times behind many countries of the world. Total investments made to Kazakhstan's agricultural sector in recent years do not go beyond 2% of the GDP. In 2012 the gross output volume index (VI) for agricultural products (services) was 82.2% relative to the preceding year, while in 2011 it was 126.8 and in 2010 – 88.3. The 2011 growth was due to returns from the crop production. Specifically agriculture is one of the most unstable sectors dependent on the climate change, as shown by variation of the output volume indexes.

According to the UN data 66% of the total area of Kazakhstan being 272.5 mln. hectares, are prone to desertification. Among all the environmental problems pertaining to the agricultural production of Kazakhstan the soil fertility and biological resources preserving and restoration, mitigation of the technogenic impact adverse effects on the agricultural lands and ensuring the sustainable production of green products challenges have come to the forefront during the current decade.

Total forest area of the Republic of Kazakhstan as of the end of 2012 was 28.8 mln. hectares covering 10.6 percent of the territory of the Republic. Woodlands cover the area of about 12.5 mln. hectares, that is 4.6% of the territory of the Republic.

According to Kazakhstan's cadastre the sources of GHG /greenhouse gases/ subject to the IPCC categories are the following sectors: Electric energy production activity; Industrial processes; Agriculture; Land use, land use change and forestry (LULUCF); Waste. Emissions from the international bunker and biomass combustion pursuant to the IPCC methodology are not included in the national emission.

The main greenhouse gases in Kazakhstan are carbon dioxide (CO_2), which portion in the total national greenhouse gases emission (excluding CO_2 net-sink from the LULUCF sector) in 2011 was 78.20%. Next are methane (CH_4) (17.82%) and nitrogen dioxide (N_2O) (3.21%). Parts of hydrofluoricarbons (HFC) and perfluorocarbons (PFC) in the total amount of GHG emissions are insignificant amounting to 0.30% and 0.48% respectively. There were no emissions of sulfur hexafluoride (SF_6). There were recorded 211.6 mln. tons of carbon dioxide (CO_2), 48.6 Gg of methane (CH_4) in CO_2-equiv. and 8.9 mln. tons of nitrogen dioxide (N_2O) in CO_2 equiv. in total national Kazakhstan's emissions in 2011 excluding LULUCF. HFC and PFC emissions were 0.8 and 1.3 mln. tons in CO_2 equiv.

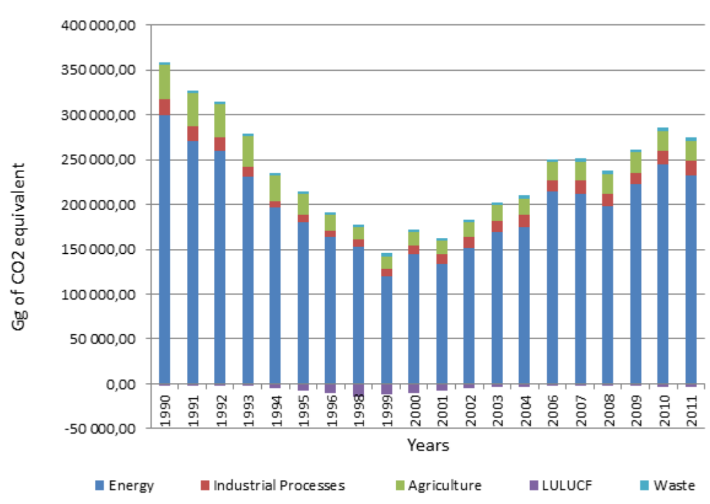
The most GHG emissions in 2011 including LULUCF were made from the Electric power industry – 85.4%. Provided that share of the Agriculture was 7.9%, Industrial processes – 6.3%, Waste – 1.5%. Absorption for the LULUCF sector was estimated as 1.1%.

Total national greenhouse gases emission in CO_2 equivalent in 2011 excluding LULUCF reached 274.46 mln. tons in CO_2-equiv. and decreased when compared to the basic 1990, when they were 358.38 mln. tons in CO_2-equiv., by 83.49 mln. tons in CO_2-equiv. or by 23.30%. They include, as estimated in CO_2-equiv., 231.8 mln. tons of emissions from Electric energy production activity, 17.16 mln. tons – from Industrial processes, 21.43 mln. tons – from Agriculture and 4.07 mln. tons – from Waste. Absorption within the LULUCF sector was 3.09 mln. tons of CO_2. Total emission in 2011 including CO_2 from the LULUCF absorption was estimated in the amount of 231.37 mln. tons in CO_2-equiv.

Excluding the CO_2 absorption by forests in 2011 emissions were 76.7% of the emission rate in 1990 and decreased by 3.87% when compared to 2010. Kazakhstan's per capita value in 2011 exceeded 16.7 tons in CO_2-equiv., including 13 tons of CO_2. These figures were higher in 1990 – 22 tons and 16 tons respectively.

Figure 1.3.

Dynamics of total national greenhouse gases emission and absorption in the Republic of Kazakhstan through the period 1990-2011, Gg of CO_2-equivalent



The Ministry of Environment Protection is the Republic of Kazakhstan's key government agency in the sphere of the state policy and measures development and implementation regarding the climate change. In general the MEP is the central executive body to govern and carry out cross-sector coordination on issues of the state policy implementation regarding the environment protection and natural resources management and ensuring environmentally sustainable development of society.

In reliance on the general expertise in improvement of the governmental administration and legislation in the field of the environmental protection, natural resources management and sustainable development, the MEP acts as a key initiator and developer of the policy and measures regarding the climate change. As of today its basic provisions are defined in Kazakhstan primarily in the strategic plans of this government agency for five years period as well as in the «Zhasyl damu» sector program for 2010-2014, of which the Ministry of Environment Protection is an administrator. Other governing documents are the Concept of the Republic of Kazakhstan's transfer to the green economy [2] and an action plan regarding the Concept of the Republic of Kazakhstan's transfer to the «green economy» implementation for 2013-2020 years. [3]

The main duty associated with the development of policy and legislation in the area of climate change is imposed on the Low Carbon Development Department within the named Ministry. These functions are performed by the Low Carbon Development Department with an active engagement of experts from the Zhasyl damu JSC and other entities. Additionally the MEP of the RK is an authorized government agency on the UN Framework Convention on Climate Change and Kyoto Protocol to it.

Strategic plan of the MEP for 2010-2014 includes a special goal 2.4 – reduction of the greenhouse gases emission. Its achievement is associated with the country's commitments' meeting as to the greenhouse gases emission reduction pursuant to the Kyoto Protocol and during the post-Kyoto period. For this purpose there have been defined actions on the development of legislative acts to implement provisions of the Kyoto Protocol, training on its flexible market mechanisms and implementation of projects on the joint implementation mechanism. Basic year regarding to the greenhouse gases emission reduction shall be 1990.

Strategic plan of the MEP for 2010-2014 determines the urgency for the country to develop and carry out adaptation measures designed to reduce the natural and social systems' vulnerability to the existing and future climate changes.

The MEP's special goals, tasks, measures, target indicators relating to the activities in the area of climate change have been integrated into the strategic course on the transfer to the low carbon development. In its turn it is focused on the achievement of goal to create conditions for the market selling quotas for the greenhouse gases operation that has started its work in Kazakhstan since 2013. Presently there is being developing a Quota distribution plan in Kazakhstan for the second commitment period of the trade system being of pilot nature as well.

Among the ongoing government programs directly associated with the reduction of anthropogenic impact on the climate system, the State program of forced industrial-innovative development of the Republic of Kazakhstan (FIID Program) for 2010-2014 should be primarily highlighted. [4] Its main tasks are defined as follows:

- development of priority sectors of economy, effecting its diversification and improvement of competitive ability;
- enhancement of the social efficiency for the priority sectors of economy development and investment projects implementation.
- creation of positive environment for industrial development;
- formation of economic growth centres on the basis of rational territorial organization of economic potential;
- guarantee of effective interaction between the Government and business actors in development of priority sectors of economy.

According to the Strategic plan of development of the Republic of Kazakhstan by 2020 the issues of the climate change have been displayed in the FIID Program, substantially in terms of direction on the economy diversification. Specifically with this direction the low carbon economy development, reduction of adverse effect of the anthropogenic load on the natural ecosystems and enhancement of the natural resources users' responsibility concerning reduction of emissions to the environment are associated.

As to the adaptation measures planning in the area of climate change at the government programs level it is necessary to mention the «Salamatty Kazakhstan» State public health development program of the Republic of Kazakhstan for 2011-2015. [5] This document mentions the influence of the factors of deteriorating state of environment on the increase of specific diseases (respiratory diseases, cancer diseases, allergic diseases, etc.).

The «Zhasyl damu» sector program for 2010-2014 is the basic ongoing sector program integrating the climate change issues. [6]

[2] Order of the President of the RK No.577 dated May 30, 2013.
[3] Decree of the Government of the Republic of Kazakhstan No. 750 dated July 31, 2013.
[4] Approved by the Order of the President of the Republic of Kazakhstan No. 958 dated March 19, 2010.
[5] Approved by the Order of the President of the Republic of Kazakhstan No. 1113 dated November 29, 2010.
[6] Approved by the Decree of the Government of the Republic of Kazakhstan No. 924 dated September 10, 2010.

In terms of the adaptation to the climate change issues integration to the national policy the Agro-industrial complex development of the Republic of Kazakhstan program for 2010-2014 [7] and the «Ak Bulak» Water resources program for 2011-2020 [8] are worth noticing among ongoing sector programs.

National legislation base regarding the greenhouse gases emission control has started to form in Kazakhstan with the Ecological code adoption on January 9, 2007. For the first time ever it integrated a special chapter on the emissions control and greenhouse gases absorption.

A number of legislative measures were taken with the ratification of the Kyoto Protocol in March 2009, which purpose was to implement the provisions of this international legal instrument and the UN Framework Convention on Climate Change.

In 2010-2011 the Government of Kazakhstan developed a National system of the greenhouse gases emission quota distribution and sale. New law was passes by the Parliament in November 2011 and signed by the President of the Republic of Kazakhstan.

The Ecological code also contains provisions determining the basis for the possible participation of Kazakhstan in either second commitment period of the Kyoto Protocol or post-Kyoto treaties. In particular this applies to the formation of national legislation regarding the implementation of various mechanisms of the Kyoto Protocol and other associated international treaties.

The Law On support of renewable energy sources was passed in Kazakhstan on July 4, 2009 and the Law On the energy saving and energy use efficiency improvement – on January 13, 2012. New law has introduced a number of new requirements as to the measures to strengthen the issues of energy saving and efficient energy use. Requirements of compulsory record and annual reporting as to the energy saving and efficient energy use measures implementation deserve to be particularly mentioned, being set for all the subjects consuming energy resources in the amount equivalent to 1500 or more toe/year, as well as public institutions, government-owned enterprises and national companies. [9]

Steady growth of the national economy being observed through the last 10-15 years is being accompanied by the corresponding increase of the energy consumption. Today the electric power industry satisfies the need of economy and people of the Republic in the electric energy. Forecast assessments show that the electric energy consumption in the country will reach a little more than 100 bln. kWh by 2015 as opposed to 82 bln. kWh in 2010.

Presently the Program of the electric power industry of the Republic of Kazakhstan development for 2010-2014 constitutes the primary policy document in effect.

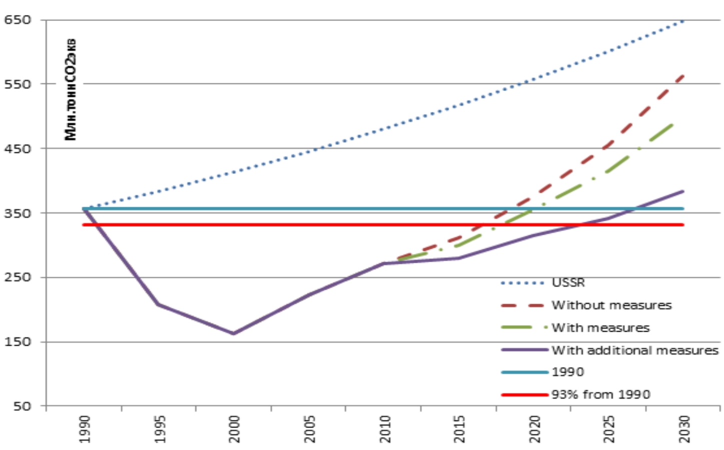
Main target indicators of the Program are:

- Achievement of the electric power production value of 97.9 bln. kWh by 2014, with the forecast consumption rate of 96.8 bln. kWh.
- Guarantee of the coal production output of 123 mln. tons by 2014.
- Achievement of the electric power production by the renewable energy sources at value of 1 bln. kWh per year by 2014.
- The renewable energy sources' share in the total amount of energy consumption exceeds 1% by 2015.

In order to evaluate the effect of all measures and policies there were developed four basic scenarios of the greenhouse gases emission growth. Each of them assumes a GDP annual growth at rate of 6% through 2020 and 5% after 2020.

Figure 1.4.

Greenhouse gases emission growth scenarios



[7]Approved by the Decree of the Government of the Republic of Kazakhstan No. 1052 dated October 12, 2010.

[8]Approved by the Decree of the Government of the Republic of Kazakhstan No. 1176 dated November 9, 2010.

[9]Article 9. The Law On the energy saving and energy use efficiency improvement.

The paper considered following scenarios of the electric energy production system of Kazakhstan development:

1. Emissions «no-change scenario» for Kazakhstan as a part of USSR since 1990 (USSR)
2. «no-change scenario» of Kazakhstan's emissions with the frozen technological state of the economy as of 2010. «Without measures» scenario (БМ).
3. scenario with current measures (СМ)
4. scenario with current and additional measures (СДМ)

In order to forecast the greenhouse gases emission associated with the fuel combustion, there was utilized a model of electric energy production system of the Republic of Kazakhstan based on the TIMES instrument (The Integrated MARKAL-EFOM System) for the scenarios with measures and additional measures.

First scenario was developed for the purpose of simple evaluation and to satisfy scientific interest as well as to estimate the state's «historical responsibility». The methods of calculation for the greenhouse gases emission forecast is based primarily on the calculation for the developed countries that were not exposed to the economic collapse and were able to build their basic line in accordance with their historical development. In case of the countries with transition economy the methodology can't give clear answer on what basic line shall be deemed to be «determinative» and could be adopted as a true one at the country level. Taking this into consideration the scenario was developed subject to such rate of possible emissions as if we have developed without any economic recession.

Three last scenarios of greenhouse gases emission forecast show the emission increase through the period from 2011 till 2030. Emissions have increased more than twice for the scenario without measures and less for the scenario with measures, while additional measures as to the emissions reduction can limit the emissions growth up to 40% of the emission rate in 2011.

In every scenario the GDP carbon intensity continues to reduce till 2020 with the same rate as during the preceding decade. Scenario with additional measures implementation will show significant decrease after 2020 as well. Total emissions of the greenhouse gases in CO_2 equivalent shall remain two times higher than average current emissions of the OECD countries while the GDP per capita forecast will be lower than present values for the OECD countries.

When no special measures are taken the greenhouse gases emission will reach 20 tons in CO_2 equivalent per capita by 2020. Additional measures will help to maintain the level of the greenhouse emission of 17-18 tons in CO_2 equivalent per capita that is close to 2011. Such values are less than actual ones of highly developed countries suppliers of energy resources (more than 20 tons in CO_2 equivalent have Australia, Canada and the USA). Kazakhstan must make hard technological and economic efforts to reduce current figures to the mean values of the OECD countries. This is due to sharply continental climate, prolonged heating season and low population density being 6 people per square kilometer.

During the development of scenarios for the possible climate change in Kazakhstan there was used in the National Communication a model ensemble (15 models) of the new generation CMIP3 project. Subject to the selected model ensemble there were achieved monthly, annual and season average spatial fields for the air temperature and amount of precipitation change. Changes were calculated relative to 1961 1990 period being used by the IPCC and the project team as a basic one.

Future climate changes have been estimated for three basic scenarios of the SRES [10] greenhouse gases concentration: A2, A1B and B1 as well as for three time periods: 2016-2045, 2036-2065 and 2071-2100 which display possible climate change in Kazakhstan by 2030, 2050 and 2085 years when compared to the basic period of 1961-1990.

All the CMIP3 models provide the climate warming within the territory of Kazakhstan in XXI century for every scenario in question. The least changes of the air temperature and amount of precipitation will occur by the B1 scenario among three of them, the biggest – according to the A1B scenario in the first half of the current century and A2 scenario in the second half of the XXI century.

According to the GHG emission A1B scenario change of the annual average ground air temperature in Kazakhstan will be 1.7 °C (within the range of 1.4-2.0 °C) by 2030, 2.9 °C (within the range of 2.0-3.0 °C) by 2050, and 4.1 °C (within the range of 2.9-4.8 °C) by 2085.

According to the B1 scenario, being the mildest scenario, change of the annual average ground air temperature in Kazakhstan will be 1.6 °C (within the range of 1.3-2.0 °C) by 2030, 2.1 °C (within the range of 1.4-2.9 °C) by 2050, and 2.7 °C (within the range of 2.1-3.2 °C) by 2085.

According to the A2 scenario, being the roughest scenario, change of the annual average ground air temperature in Kazakhstan will be 1.8 °C (within the range of 1.2-2.0 °C) by 2030, 2.6 °C (within the range of 2.0-3.0 °C) by 2050, and 4.7 °C (within the range of 3.5-5.6 °C) by 2085.

It is expected that the fastest rates of the ground air temperature increase average throughout the territory of Kazakhstan by 2030 will be the temperature of winter months: by 1.6-1.8 °C according to the B1 scenario; by 1.9-2.0 °C according to the A1B and A2 scenarios; and in August and September months: by 1.7-1.9 °C according to the B1 scenario; by 1.9-2.1 °C according to the A1B scenario; and by 1.8-2.0 °C according to the A2.

By 2050 the fastest rates of the temperature increase will be in January-February, and during the summer period according to the A2 scenario (by 2.6-2.9 °C); by 2.5-3.3 °C during the winter period and by 2.5-3.2 °C

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during the summer period according to the A1B scenario; by 2.1-2.3 °C during the winter period and by 2.1-2.2 °C during the summer period according to the B1 scenario.

By 2085 г. the fastest rates of the temperature increase will be in August (by 4.5 °C) and during winter period (by 4.2-4.4 °C) according to the A1B scenario, the same trend is expected for two other scenarios.

The simulation results show that in XXI century for all three scenarios in question there expected an average throughout the territory of Kazakhstan decrease of the precipitation amount from May to September, and forecast for the remaining months of the year will be increase of the precipitation amount with maximum during winter months.

Considering the expected changes of amount of precipitation it should be mentioned that they vary depending on period, season of the year or the emission scenario.

Under every emission scenario and in all the periods the increase of the precipitation amount during winter months is expected, by 14-28% according to the A1B scenario, by 11 22% according to the «mild» B1 scenario, by 15-31% according to the «rough» scenario. Spring and autumn periods show the amount of precipitation increase as well but with less increment than in winter period. The possible increase in the amount of precipitation during spring months according to the B1 scenario is 7.5-10.5%, according to the A2 scenario – 9.3-10.0% and according to the A1B scenario – 8.6-11.7%. There observed a gradual decrease of the amount of precipitation during the summer period with maximum by 2085, from 2.7% to minus 6.3% according to the A1B scenario, from minus 1.6% to minus 3.1% according to the «mild» B1 scenario and from 0.2% to minus 10.6% according to the «rough» scenario.

Subject to the derived correlation in the climate forecast it is assumed that the probability of abnormally cold weather in future will decrease year by year. But in certain years (especially till 2035) there can be air temperature decrease up to the currently existing absolute minimum values of temperature.

As calculated, the absolute maximum air temperatures in Kazakhstan should be overlapped at the average additionally by 1.2-1.5 °C by 2030, by 1.6-2.4 °C by 2050 and 2.1-2.3 °C (according to the mild scenario) to 3.7-4.2 °C by 2085. With this in view, in the northern oblasts of Kazakhstan where the maximum air temperature throughout the major territory today reaches 40-41 °C it can reach up to 44-45 °C by 2085 that is currently customary for Kazakhstan's western oblasts.

Thus the calculation results by either scenario show the increase of abnormally hot weather repetition in future.

Considering the Extreme meteorological phenomena (EMP) repetition during the global warming period (2000-2011) one may note that in future such EMPs as very heavy precipitation (rain, snow, rain and snow mixed), strong winds, strong blizzards, heavy (great) sleet, strong dust storms, heavy fogs and dangerous glaze ice and rime depositions will persist in Kazakhstan. Increase of such EMP as strong wind and heavy snow and sleet are observed now and probably will persist in future.

Heavy showery rains with storm winds, heavy snowfalls and blizzards as well as sleet processes will probably become more frequent in mountainous and foothill regions.

There is a high risk of strong blizzards covering vast territories in northern oblasts.

Table 1.1

Annual average air temperature change and corresponding standard deviations (°C) at the beginning (2016 2045), in the middle (2036 2065) and at the end (2071-2099) of the 21st century (B1, A1B, A2scenarios). Subscript shows standard deviation for the model ensemble specifying inter-model dispersion

Region	Period 2016 - 2045			2036 - 2065			2071 - 2099		
	B1	A1B	A2	B1	A1B	A2	B1	A1B	A2
Kazakhstan	**1,6**$_{\pm 0,4}$	**1,7**$_{\pm 0,4}$	**1,8**$_{\pm 0,3}$	**2,1**$_{\pm 0,5}$	**2,9**$_{\pm 0,6}$	**2,6**$_{\pm 0,5}$	**2,7**$_{\pm 0,7}$	**4,1**$_{\pm 0,9}$	**4,7**$_{\pm 0,8}$
Akmolinskaya	1,8	1,9	1,9	2,3	3,3	2,8	2,8	4,4	5,2
Aktyubinskaya	1,6	1,7	1,9	2,1	3,0	2,6	2,8	4,2	4,6
Almatinskaya	1,6	1,7	1,7	2,0	2,8	2,6	2,6	4,0	4,6
Atyrauskaya	1,6	1,7	1,7	2,0	2,7	2,5	2,7	3,8	4,4
East-Kazakhstanskaya	1,6	1,8	1,8	2,1	2,8	2,7	2,8	4,2	4,9
Zhambylskaya	1,5	1,7	1,7	1,9	2,7	2,6	2,5	3,,9	4,5
West-Kazakhstanskaya	1,7	1,8	1,8	2,1	2,9	2,6	2,9	4,0	4,7
Karagandinskaya	1,6	1,8	1,8	2,1	3,0	2,7	2,6	4,3	4,6
Kostanayskaya	1,8	1,8	1,9	2,3	3,2	2,8	2,9	4,5	5,1
Kyzylordinskaya	1,5	1,6	1,7	2,0	2,8	2,5	2,5	3,9	4,3
Mangystauskaya	1,4	1,6	1,5	1,9	2,5	2,2	2,4	3,5	4,0
Pavlodarskaya	1,9	1,9	1,9	2,3	3,3	2,9	2,9	4,4	5,3

Region	Period								
	2016 - 2045			2036 - 2065			2071 - 2099		
	B1	A1B	A2	B1	A1B	A2	B1	A1B	A2
North-Kazakhstanskaya	1,8	1,7	1,9	2,5	3,3	2,9	3,0	4,5	5,4
South-Kazakhstanskaya	1,5	1,6	1,7	1,9	2,7	2,5	2,4	3,8	4,4

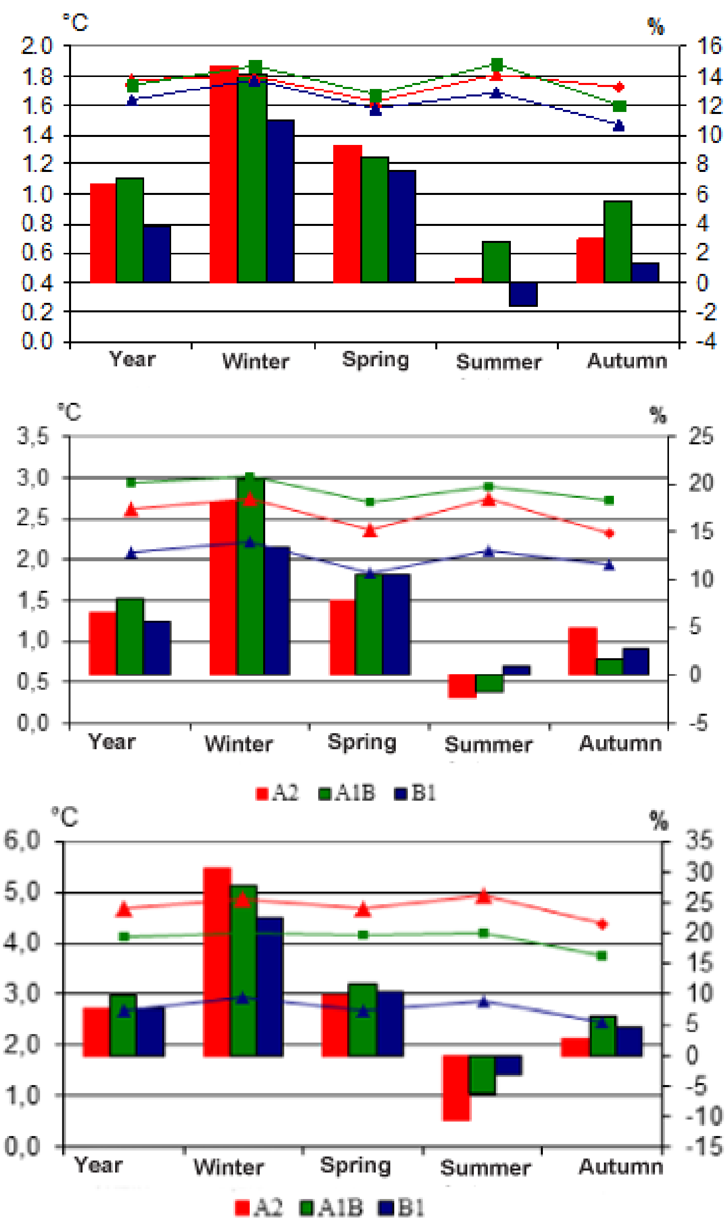
Figure 1.5

Annual and season average ground temperature (°C) and amount of atmospheric precipitation (%) change throughout the territory of Kazakhstan during the periods 2016-2045, 2036 2065 and 2071 2099 relative to basic period of 1961 1990, arrived from the ensemble of the global climate 15 models of the CMIP3 according to the B1, A1B and A2 greenhouse gases concentration in the atmosphere change scenarios

А)

Б)

В)



А) 2016-2045 (2030); **Б)** 2036-2065 (2050); **В)** 2071-2099 (2085)

Agriculture is one of the key sectors of the economy of Kazakhstan with crop production and livestock farming forming its core. These sectors of agriculture constituting the priority areas of the republican economy development possess potential for the development. However, further development of crop production and livestock farming depend on agricultural technologies and natural resources used including, inter alia, climatic changes.

Due to the moistening zones' shift some administrative regions of the cereal sowing oblasts will transfer to lower level of the territory moistening in 2050s. The areas of spring cereal cropping will shrink resulting from the mild arid zone shift northwards, and in some region such farming will turn of no potential.

Expected deterioration of the climatic conditions for the spring cereal cropping in northern oblasts of Kazakhstan could be compensated through the adaptive farming technologies' introduction.

The forecast estimates of the spring wheat productivity for 2050s conditions show that at the mean the yield by oblast will be 52-63% of its long-term annual average level (1971-2010), i.e. if the present farming level and cropping techniques persist in 2050s the productivity of cereals will decrease by 37-48%.

Table 1.2

The spring wheat productivity expected by 2030 (as a percentage of the current level (1971-2010)) according to the climate change A1B u A2 scenarios

Oblast / district	P, %	
	A1B	A2
North-Kazakhstanskaya oblast - 76 %		
Zhumabayevskiiy	72	73
Esilskiy	77	81
Zhambylskiy	73	74
Taiynshiskiy	76	77
Musrepovskiy	80	80
Aiyrtauskiy	70	71
Kostanayskaya oblast – 77%		
Karabalykskiy	79	81
Kostanayskiy	68	71
Karasuskiy	75	77
Auliekolskiy	63	64
Zhetigarinskiy	70	69
Zhangeldinskiy	93	95
Amangeldinskiy	84	84
Akmolinskaya oblast – 67%		
Zerendinskiy	68	77
Burabayskiy	69	69
Sandyktauskiy	84	83
Akkolskiy	56	55
Atbasarskiy	64	65
Esilskiy	61	62
Astrakhanskiy	61	60

Thus the climate changes expected will lead to reduction of the crops' moisture supply, increase of the climate aridity, moistening zones' shift towards the northern latitudes and the cereal yield reduction.

Productivity of the livestock farming depends on the animal feeds' reserves which in their turn depend on the weather conditions. Pastures, natural and artificial hayfields, plough lands for the forage crops farming constitute the base for the livestock farming forage resources. The area of pastures in the Republic is 187.5 mln. hectares of which 61.2 mln. hectares represent agricultural lands and 17.5 hectares of lands in municipal ownership, including irrigated pastures – 59.5 mln. hectares, plough land used to grow annual and perennial forage crops – 2.5 mln. hectares.

According to the estimates there is forecast for a slight reduction of the pastures' productivity at the lowland pastures of the southern oblasts by 2050 by 3-4%, i.e. it will be 96-97% of its current level, and in some oblasts – by 9-10%, i.e. will amount 90-91% of its current level. There is a forecast for the pastures' productivity reduction by 10-14%, which means that it will be 86-90% of its current level by 2050. Mountain pastures are more vulnerable to the climate change. Mountain pastures expect more significant reduction of the pasture plants productivity. For instance, at the Asa stow pasture the estimated pasture's productivity will reduce by 30% by 2030 and by 50% by 2050.

Table 1.3

The pasture plants productivity forecast for 2030 and 2050 years (P, as a percentage of the current level (1971-2010)), according to the climate change A1B u A2 scenarios, %

Terrain	2030		2050	
	A1B	A2	A1B	A2
Lowland pastures of the southern oblasts	97	96	90	88
Mangystau and Ust-Yurt Plateau Pastures	90	91	86	87
Mountain pastures of Trans-Ili Alatau (Asa)	69	73	46	51

According to the assessments the average number of non-grazing days (NND) throughout the south of Kazakhstan will decrease by 15% by 2030 and be 85% of the current NND (1971-2010), and by 2050 – by 72%. All these indicate the steady trend of winter conditions mitigation as to the livestock management. However, by reason of the weather conditions variability the repetition rate of abnormally cold winters will increase, i.e. against the general warming of the winter abnormally cold winters will occur more frequently. Such abnormally cold winters along with dry summers could cause severe damage to livestock farming.

Thus the results show that for the forecast 2030 and 2050 years regarding to the sheep farming winter will become warmer by 15-28%, summer – hotter by 18-31%, terms for the spring sheep shearing will occur 2-5 days earlier than the present day, the plant productivity at the lowland pastures of the southern half of the Republic will reduce by 4-14%, and at mountain pastures – by 30-50%. Such agricultural and zoo-climatic conditions setting in a junction will have an adverse effect on the sheep and cause their productivity reduction. Provided that the greatest reduction in the sheep productivity could be expected in the south of the South-Kazakhstanskaya oblast, in Kyzylordinskaya and Mangystauskaya oblasts and in the Southern Balkhash region.

Such climate parameters change will not lead to the fundamental changes of the livestock farming system of Kazakhstan, i.e. there will no changes take place as to the territory of the Republic division by regions subject to the livestock management system.

Assessment of the water resources vulnerability due to climate change has been carried out for 14 river basins within eight hydro-economic basins. Five of them are lowland basins – Tobol, Ishim, Nura, Sarisu and Ural rivers. Basins of Uba, Ulba, Ili, Karatal, Koksu, Arys, Shayan, Nura, Sarisu, Chu and Talas rivers are mountain. Ili, Karatal, Koksu, Chu and Talas rivers belong to glacier-fed rivers.

According to the long-term climate change forecasts till 2035 under the A2 scenario, total amount of water resources throughout the entire territory of the RK will increase. In the east of the RK such increase will be insignificant being about 2% (mountain basins of the Uba and Ulba rivers). There will be virtually no increase in the north of the RK within the Ishim river basin, but in the Tobol river basin it will be 7.1%. The water resources change will fluctuate within the range of 9-10.9% for the Ili, Koksu and Karatal river basins in the south-east of the RK. Changes will substantially take place within the limits of 6.2-12.5% for the Arys and Shayan river basins and 10.1%-14.9% – for the Talas and Chu river basins in the south of Kazakhstan. For the Nura and Sarisu river basins such increase will be 13.6% and 8.81% respectively. In the west of the RK the increase can reach 15% (Ural river basin).

Table 1.4

Correlation of annual simulated flow deviations (A2 and B1 scenarios) of its measured values (∆W, %) and precipitation values deviation (∆X, %) and the air temperature (∆T, (°C) during the period till 2035

River	∆W,%		∆X,%		∆T °C	
	A2	B1	A2	B1	A2	B1
Uba+Ulba	2,0	5,2	2,26	5,31	1,22	1,37
Tobol	7,1	5,4	3,35	4,74	1,31	1,64
Ishim	0,3	2,6	1,68	4,25	1,29	1,49
Ili	9,0	15,2	2,55	2,78	1,18	1,55
Karatal	10,9	11,3	1,9	2,36	1,17	1,55
Koksu	10,5	11,2	1,9	2,36	1,17	1,55
Arys	6,2	-7,3	5,41	3,77	1,29	1,65
Shayan	12,5	4,2	5,65	4,77	1,23	1,55
Ural	15,0	10,0	6,0	2,0	0,98	0,86
Chu	14,9	14,5	7,14	6,74	2,6	2,0
Talas	10,1	9,8	6,59	6,2	2,5	2,0
Nura	13,6	13,0	7,44	6,88	2,9	2,1
Sarisu	8,81	6,59	9,58	7,35	2,8	2,1

If the climate changes for a long-term period till 2035 occur according to the B1 scenario, then the total amount of water resources throughout the entire territory of the RK will increase too. In the east of the RK such increase will be about 5.2%. The increase in the north of the RK within the Ishim river basin will be around 2.6%, and in the Tobol river basin it will be 5.4%. The water resources change will fluctuate within the range of 15.2-11.3% for the Ili, Koksu and Karatal river basins in the south-east of the RK. In the south of the RK changes will substantially take place within the limits of 4.2% for the Shayan river basin and only in the Arys river basin the water resources might decrease by 7%. For the Chu and Talas river basins their amount can increase up to14.5-9.8%. For the Nura and Sarisu river basins there might be an increase by 13% and 6.59% respectively. In the west of the RK the increase in the amount of resources can be up to 10% (Ural river basin).

It should be noted that amount of precipitation and temperature increase in every version and every scenario. Due to increase of the amount of winter precipitation in mountainous regions (particularly within the main drainage forming zones of the basins) the values of snow storage will increase as well leading to the spring flow increase resulting from the air temperature rising. The air temperature increase is not sufficient to cause significantly more early soil melting and subsequent increase of the flow loss during spring flood. The situation is different in the lowland river basins. Increased amount of precipitation have less influence on the flow rate because of its greater loss at the watershed. Dependence upon the air temperature can be more clearly traced in the lowland basins. In the conditions of its increase it is observed a reduction of the autumn ground freezing and subsequent increase of the flow loss due to infiltration.

In different years subject to their water capacity the results of the water resources vulnerability assessments according to the A2 and B1 climate change scenarios show that: irrespective of the water capacity of the year the water resources change follows the same trend as during the entire long-term period.

With unfavorable implementation of climatic and transboundary hydrological threats there is a risk of future actual river flow resources reduction throughout the entire territory of the RK by 2020 up to 81.6km3/year, of which transboundary – up to 33.2km3/year, local – up to 48.3km3/year; and by 2030 – to 72.4; 22.2 and 50.2km3/year respectively. It is supposed that prerequisites specified should be taken as a basis for the RK water security strategy.

The RK economy in the whole and particularly agriculture will develop under the conditions of the lack of water resources in the years to come. Even today the water deficit is common to the Aral, Balkhash and Ural basins, endorheic basins of the Chu, Talas, Asa, Sarisu, Turgai and Nura rivers. For example, it is expected (according to pessimistic scenario) a surface water flow reduction by 15-18km3 within the short future (till 2020), of which by 10-12km3 due to the water intake increase beyond the territory of the RK, by 5-6km3 due to climate change.

Hydrological data show that by 2020 the flow will be 81km3/year, and by 2030 – 76.3km3/year, while the nationwide rate of water consumption amounts to 88-90km3/year.

Resulting from the «Impact, vulnerability and assessment of the public health system of the Republic of Kazakhstan adaptive capabilities regarding to the climate change» research carried out there have been groups defined vulnerable to the climate change; these are elderly people and rural areas' residents who have restricted access to the high quality drinking water.

Among the threats discovered by the research that has been carried out special attention is turned to:

- risk of spread of infectious and extremely dangerous diseases due to existence of widespread and active natural focuses of the extremely dangerous infections within the territory of Kazakhstan and risk of delivery from outside the country;
- risk of growth of dangerous natural phenomena and disasters because of the climate change.

Adaptation measures in the agriculture and water resources sector constitute the most vital pool of actions to be developed irrespective of the country's level of prosperity and access to the technologies. Kazakhstan pays much attention to such measures, but they more likely take place under the aegis of the increase of employment, enhancement of food and energy security and improvement of public health than with view to adapt to climate change. Although the climate aspect of this work is left apart and often unconsidered, nonetheless there is a trend to popularize such knowledge either at the scientific or at the household levels; and when the climate and environmental change issues have not been of high priority earlier, then now they enjoy widespread support of government and people. Adaptation is typical for agriculture and water resources sector, while the industrial sector works on an issue on the climate change mitigation.

The following basic adaptation measures are being implemented in the crop production and livestock farming of Kazakhstan in order to reduce the adverse effect of the climate change:

- No-Till zero technology
- Diversification of crop production
- Effective irrigation systems introduction
- Optimization (adaptation) of the terms for the land treatment measures to the weather regime
- Refurbishment of the agricultural machinery and equipment
- Training and professional development for the agriculture experts
- Improvement of the insurance system within the crop production sphere
- Restoration of the transhumant grazing system of the sheep farming at the southern half of Kazakhstan

- Development of the stall barn system for the industrial livestock management
- Selective breeding activities
- Pastures improvement
- Modification of the hydrometeorology system for the livestock security

There are generally 2 ways to eliminate the fresh water deficit in the water resources sector of the RK: reduction of load on the water resources and increase of the fresh water resources. First way contemplates implementation of measures to decrease the rates of development of water intensive industries and use more advanced technologies in order to reduce the water consumption in the industrial, agricultural and public service sectors. Second way contemplates the increase of available water resources on the account of long-term and seasonal control of the river flow, utilization of the fresh groundwater storage, desalination of seawater and brackish water, territorial including transboundary redistribution of the water resources.

Stimulating of the best green technologies introduction as defined in the Articles 6 and 7 of the Ecological code of the RK constitute a part of the government regulation in the field of the environmental protection. For this purpose the concepts of «best available technologies», «target indicators for the quality of environment», «environmentally dangerous machinery and equipment» and «environmentally dangerous technologies» were introduced in the Ecological code.

Today the «List of the best available technologies» approved by the Decree of the Government of the Republic of Kazakhstan No. 245 dated March 12, 2008 is in effect.[11]

«Green investments» in Kazakhstan are generated from the environmental charges (97 bln. tenge in 2009), environmental protection actions of the natural resources' users (124 bln. tenge in 2009) and grants from international organizations. It is necessary to note that charges for the emissions to the environment are received by local budgets with no designation and generally the major part of these funds is used at the discretion of the local executive bodies to solve current issues of vitality, social sector support, to solve the problems of infrastructure etc. Thus the environmental projects' implementation is often funded on a residual principle. For example, in 2009 the amount of money allocated for the environmental protection measures was 23.8 bln. tenge or 27.9% of the total amount of charges and penalties received. The MEP of the RK acting as a government agency takes actions aimed to increase the share of the environmental activities' funding standing for the 100% assignment of such assets to the «green» investments.

In the electric energy production sector 13 projects are being implemented with the power capacity increase by 3,186MW, including continuing modernization of the National electrical network of Kazakhstan, in order to achieve the indicators defined in the FIID State program and in the Strategic plan 2020. Projects envisage, inter alia, advancement of conventional electric energy production and transmission technologies which will have a positive effect on the GHG emission reduction.

The tariff policy measures as to the loss reduction being currently taken will have an effect as follows: during the period of 2010-2014 rated losses' reduction in the electrical networks will be 1.3% to 01.1%, extra-rated – 1.5% to 0; in the heating networks – 1.5% to 0.1%, extra-rated – 2% to 0; in the water supply networks – 2% to 1%, extra-rated – 2.5% to 0.

A large-scale policy to reduce the energy resources' loss is being pursued within the housing and budget sectors. To this effect there has been implemented a practice of energy audit with further modernization of houses and condominiums. Introduction of the energy management system as well as the complex energy saving plan pursuant to the Law On the energy saving and energy use efficiency improvement (No.541-IV dated January 13, 2012) have been contemplated in industrial sector in addition to the energy audit.

Today the Agency of the Republic of Kazakhstan for Construction Housing and Utilities in association with the Kazakhstan Housing and Utilities Reform Centre JSC implement the Program of housing and utilities sector modernization and development till 2020. This program contemplates taking complex actions subject to the modernization of infrastructure and utility networks in the housing and utilities sector, water supply and sewage, reconstruction of communication lines, introduction of the energy saving technologies, as well as thermal modernization of the housing stock with the allocation of funds to implement such program. Particularly there has been developed a repayment funding scheme for the overhaul and thermal modernization of the condominium objects. The mentioned program total funding for the entire term of its implementation in its every aspect amounts to 64.9 bln. tenge.

As part of the «Affordable housing 2020» program there will be commissioned 6 million square meters of new housing each year starting in 2013. New sites will have to satisfy requirements on energy efficiency pursuant to the law on energy saving.

Systematic monitoring of the climate is carried out within ongoing national programs of the Kazhydromet Republican State-Owned Enterprise (RSE) being the structural subdivision of the Ministry of Environment Protection of the Republic of Kazakhstan. Activities of the National hydrometeorology service (NHMS) of the Republic of Kazakhstan are focused on the information provision about climate, water resources and the state of

[11] «Kazakhstanskaya Pravda» dated April 15, 2008, No. 82 (25529);

the environment, warnings about dangerous and disastrous hydrometeorology phenomena and extremely high pollution of the environment.

National hydrometeorology service of Kazakhstan provides administration of the observation network, financial and maintenance support, planning and funding of the research and development work on the methods and means of measurement, monitoring techniques, data collecting and processing. The Global Climate Observing System (GCOS) consists of two subsystems: upper air and surface meteorological networks. The GCOS surface subsystem is based on land surface synoptic stations transmitting the «SYNOP» reports to the Global Telecommunication Network in four main periods, climatological stations providing «CLIMAT» reports and aerological stations transmitting «CLIMAT TEMP» reports.

The Kazhydromet Republican State-Owned Enterprise ensures free and open international data interchange with the following partners:

1. World Data Centre for Meteorology of the National Climatic Data Centre;
2. Global Precipitation Climatology Centre – meteorological data about daily amount of precipitation provided by 63 meteorological stations;
3. World data Centre of the All-Russian Research Institute of Hydrometeorology Information – meteorological data interchange on a regular basis following the current secure data processing from 22 international interchange stations.

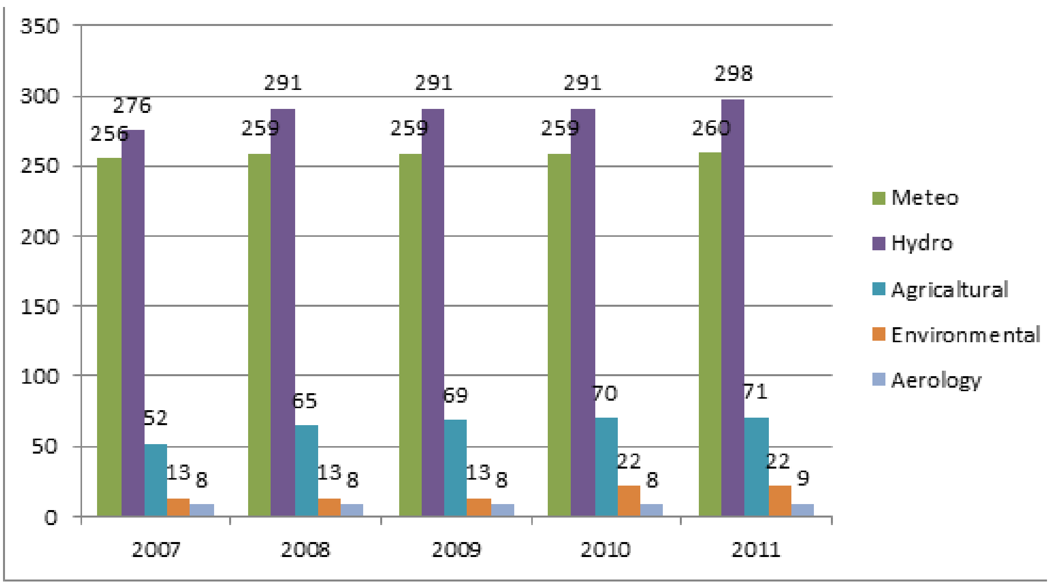
In its national programs for the systematic monitoring the Hydrometeorology service of Kazakhstan follows the principles and best practice of climate monitoring. GCOS of the World Weather Information Service, GCOS guidelines, Technical regulations of the World Meteorological Organization and the Instruments and means of measurement guidance constitute the basis of the programs of the Observation network of Kazakhstan.

The main and systematic problem of the NHMS of the Republic of Kazakhstan at the present stage is that NHMS is not able to meet the increasing demand of society for the hydrometeorology and other information concerning the environmental condition along with the serious lag in technical, technological and human resources when compared to the hydrometeorology services of the developed countries.

Today the territory of the Republic is provided with the meteorological monitoring at the level of 61%, agrometeorological – 67%, hydrological – 57%, ecological (atmosphere, soil, surface waters) – 58%. Therefore the NHMS modernization and development are a vital task involved in the development plans of the Ministry of Environment Protection of the Republic of Kazakhstan.

Figure 1.6

Dynamics of increase of the number of hydrometeorology stations and sites through the period 2007-2011



The education system in the Republic of Kazakhstan involves the notion of «environmental education» in which context the issues of climate change are considered. The National Communication considers aspects of environmental education in three levels: «preschool and secondary», «technical and vocational» and «higher and postgraduate».

The State compulsory standard does not require advanced study of the climate change issues at schools, however additional studies and elective courses on the subject in question are held in many schools being initiated by the teaching staff. Such initiatives are mainly implemented by the teachers who have finished their training or courses within the international projects.

Apart from the education approved by the state standards the Government carries out activities aimed to advance the environmental education of people, including the issues of the climate change, through the joint projects with international, non-governmental and business organizations.

As of today there has been created an academic and methodical framework to integrate the climate change issues into the general block subjects, which is being generally developed within international initiatives. According to the expert opinion, the most effective actions to inform people about the methods to mitigate the human impact on the climate change and adapt to its effect will be inclusion of courses in the comprehensive education programs.[12] Taking this fact into account, it is reasonable to work on the advancement and integration of the existing academic and methodical framework into natural science disciplines within the secondary education system, especially for the chemistry and biology or physics and geography majors.

In order to develop knowledge on the sustainable development issues for all professions and specializations within the system of technical and vocational education (TVE) there has been a basic discipline of «Environment protection» studying provided with the course duration of 32-36 hours. The model curriculum of such discipline does not assume the study of issues of the climate change.

In view of the national policy pursued in the area of the TVE development (State program of technical and vocational education development for 2008-2012), it is expected that such system will play stimulating role in solving urgent tasks of the electric power industry and water resources sustainability ensuring, mitigation of the climate change effects and adaptation to such conditions. With the growth of concern and need in the «green economy» creation, requirements to the expertise and skills level increase as well, i.e. there is a need for the modification of qualification and new specializations' development. To solve these problems it is necessary to integrate the climate change issues into the basic education programs for every specialization and also to advance the majors with due regard to current knowledge in the area of climate change and new technologies.

Since the time of the SNC /Second National Communication/ preparation the system of higher education of Kazakhstan has completely transferred to the three-level system of staff training as adopted in the European Area.

There are two directions of study the climate change issues in the higher school as is in TVE: general (basic) for the students of every specialization and major (advanced) for the students of natural geography, ecology, chemistry and biology, and technical specializations. The basic education considers the issues of climate change within the discipline of «Ecology and sustainable development» (90 hours). Taking into account the fact that the national policy transfers to the «green economy», demand for the specialists in legal, technical, economic, agricultural and other spheres with the specialization in ecology and climate change is increasing day by day. Therefore it is important to proceed further development of basic and special courses and introduce them at every faculty, as well as to prepare academic and methodical materials displaying the specific character of the sectors and the state in national including Russian languages.

There is established a research infrastructure in the country allowing candidates for master's and doctor's degrees to carry out their work. The research centres being opened with the leading universities, where the researches on the climate change mitigation are carried out, can serve as examples. Specifically, at the NURIS[13] there was built a Model of the electric energy production system of Kazakhstan development. It is expected that this model will allow to obtain quantitative estimates of the energetic and environmental policies impact, to simulate various scenarios within the context of the «green economy» development. The Centre of Environmental Safety and Use of Natural Resources Law was established with the Al-Farabi KazNU in 2011. The leading research area of the Centre is generalized legal analysis of the global climate change problems within the framework of sustainable development and use of natural resources law.

The Climate Change Coordination Centre NGF /Non-Governmental Foundation/ plays an active role in this process, carrying out workshops for the representatives of the ministries, companies and non-governmental organizations in cooperation with the international partners. The purpose of such workshops is to disseminate the knowledge of the UNFCCC and Kyoto Protocol international processes, mechanisms of Kyoto Protocol, system of emission quota selling and its elements in order to improve the energy use efficiency, etc.

In Kazakhstan the UNFCCC provisions are implemented by a number of institutional organizations. Kazhydromet RSE, Zhasyl damu JSC being on issues of the climate change prevention and adaptation. The expert evaluation is also conducted by the non-governmental organization named «Climate Change Coordination Centre». Such International non-governmental organizations as the Research and Data Centre of the Interstate Commission for Sustainable Development (RDC ICSD) and the Central Asian Regional Environmental Centre (CAREC) perform expert work on the issues of climate change and facilitate the growth of the civil society potential.

Kazakhstan has ratified more than 20 international environmental treaties (conventions and protocols). Ecological code has been aligned with the regulations of the International environment protecting conventions ratified by Kazakhstan. The «Zhasyl damu» sector program developed in 2010 provides mechanisms for the coordinated approach to the commitments' meeting under the following international treaties: Kyoto Protocol, Stockholm Convention on Persistent Organic Pollutants, Rotterdam Convention on the Prior Informed Consent

[12]Report on the «Public opinion sociological research to assess the basic level of public awareness on the climate change issues» UNDP project of the BISAM Central Asia LLP. Otenko T.V.

[13]Nazarbayev University Research and Innovations Systems www.nu.edu.kz

II. NATIONAL CIRCUMSTANCES RELATED TO THE GREENHOUSE GASES EMISSION AND ABSORPTION

2.1. General information about the Republic of Kazakhstan

2.1.1. Political structure of the Republic of Kazakhstan

The Republic of Kazakhstan is a unitary state with the presidential system of government. The President of the Republic of Kazakhstan as the Head of the State is its principal official and shall be elected by vote for a five-year term.

The state power in the Republic is unified and is exercised based on the Constitution of 1995 and the laws according to the principle of its division into legislative, executive and judicial branches and their interaction using the system of checks and balances.

The highest representative body of the Republic performing legislative functions is the Parliament of the Republic of Kazakhstan. The Parliament consists of two Chambers acting on a permanent basis – the Senate (term of office for the Senate deputies is six years) and Mazhlis (term of office for the Mazhlis deputies is five years).

The Senate is composed of the deputies representing each oblast, city of special republican status and the capital of the Republic of Kazakhstan, two persons from each, as provided by the constitutional law. One half of the elected deputies of the Senate are re-elected every three years.

The President appoints fifteen deputies of the Senate taking into account the necessity of ensuring national and cultural as well as other essential interests of the society representation in the Senate.

The Mazhlis consists of one hundred and seven deputies as provided by the constitutional law. Ninety eight deputies shall be elected from party lists of the political parties under a single national constituency through universal, equal and direct suffrage by secret ballot. Nine deputies of the Mazhlis shall be elected by the Assembly of the people of Kazakhstan.

The Government of Kazakhstan exercises executive power, leads the system of executive bodies and governs their activities. The Head of the Government shall be appointed by the President after the Prime Minister's candidacy approval by the majority of the Parliament of the RK. Members of the Government shall be appointed by the President with candidates being nominated by the Prime Minister.

The Prime Minister submits the Government structure for the approval by the President. The Government structure is as follows – The Prime Minister, 1 First Deputy Prime Minister, 3 Deputy Prime Ministers and the heads of the ministries.

Akimat is a regional executive body in Kazakhstan headed by an akim. Akims of oblasts, cities of special republican status and the capital city shall be appointed to the office by the President upon the recommendation of the Prime Minister of Kazakhstan. Akims of other administrative-territorial units shall be appointed or elected to the office according to the procedure provided by the President of Kazakhstan. The President of the Republic is entitled in his sole discretion to relieve akims from their offices. Kazakhstan is administratively divided into 14 oblasts. Astana is the capital city. Almaty City has special republican status.

The Supreme Court of the Republic of Kazakhstan is the highest judicial authority of the country for civil, criminal and other cases under the jurisdiction of local and other courts, supervising over their activities in procedural forms provided by law, and justifying the issues of judicial practice. Its status is registered in the Constitution of Kazakhstan and the Constitutional law On the Judicial System and the Status of Judges of the Republic of Kazakhstan. The Presiding Judge of the Supreme Court, chairmen of judicial panels and the judges of the Supreme Court shall be elected by the Senate upon the recommendation of the President of the Republic. The Justice in the Republic of Kazakhstan is administered exclusively by court.

The Constitutional Council of the Republic of Kazakhstan is a collective body for the constitutional control in Kazakhstan. It consists of 7 members. The Chairman and two members of the Constitutional Council shall be appointed by the President, two members – by each the Senate and Mazhlis for a term of 6 years. Only the President, the Chairman of the Senate, the Chairman of the Mazhlis, at least one fifth of the total number of deputies of the Parliament, the Prime Minister and a court may appeal to the Constitutional Council (only in case of the violation of human and resident's rights and freedoms guaranteed by the Constitution by the regulatory legal act).

2.1.2. Demographic situation

Population of the RK as of the end of 2012 was 16 909,8 thous. people. Population density amounts to 6.2 people per 1sq.km. Data on the population through the period of 1995-2011 are presented in the Table 1 of the Annex 1 and in the Figure 2.1. Urban population share (54.9%) is higher than rural one (45.1%).

Figure 2.1

Population of the Republic of Kazakhstan

Sources: «Kazakhstan over the years of independence, 1991-2010» The Agency of statistics of the RK, 2011; «Kazakhstan in figures, 2011» The Agency of statistics of the RK, 2012; Population dynamics, www.stat.kz.

Kazakhstan is a multinational state. There live people of more than a hundred nationalities and ethnic groups within the territory of the Republic. According to the 2009 census data the highest share in the total population have Kazakhs. Kazakhs represent – 8,011.4 thous. people; Russians – 3,793.7 thous. people; Uzbeks – 456.9 thous. people; Ukrainians – 333.0 thous. people; Uyghurs – 224.7 thous. people; Tatars -204.2 thous. people; Germans – 178.4 thous. people.

In 2012 the labor force population was 8,981,9 thous. people.

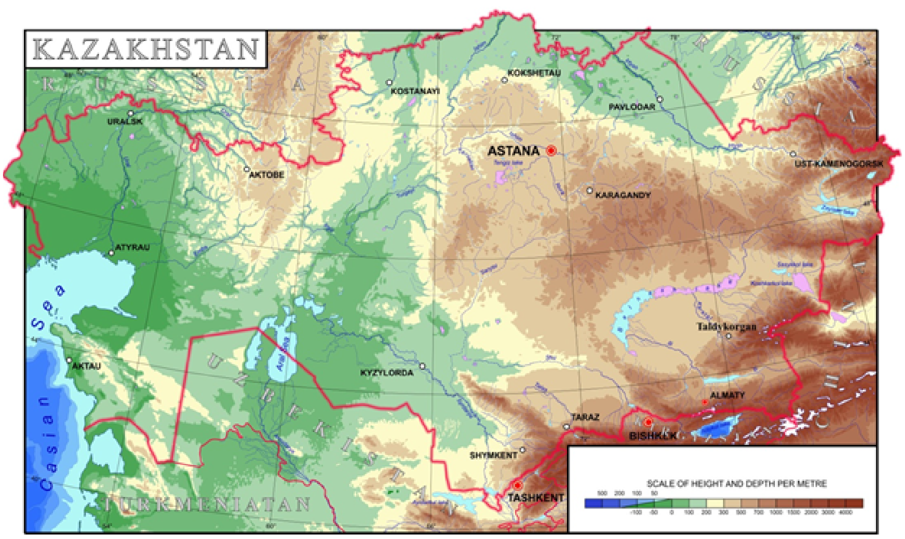
2.1.3. Geography and topography

The area of the Republic is 2 724, 9 thous. square kilometers. Kazakhstan is the world's ninth largest country by the territory. Kazakhstan shares borders with: PRC – 1,460km, Kyrgyzstan – 980km, Turkmenistan – 380km, Uzbekistan – 2,300km and Russian Federation – 6,467km. Total length of the land borders is 12,187km.

Topography of the country's territory is complex and diverse: high mountain regions occupy about 10 % of the territory, remaining part falls to the share of lowlands, plains, plateaus and highlands. The plain terrain with low heights within the range of 200-300m above mean sea level is typical for the south-western, northern and central regions (Figure 2.2).

Figure 2.2

Physical map of Kazakhstan



Sources: GisTerra company

2.1.4. Climate

The distance from the ocean and vast territory determine sharply continental climate of Kazakhstan, its zoning and deficit of precipitation. Annual precipitation in the foothill and mountain regions is 500 to 1600mm, in steppe – 200-500 and in desert – 100-200mm. Average temperature in January ranges from 18 ºC below zero in the north to 3 ºC below zero in the south; Average temperature in July – from 19 ºC in the north to 29 ºC in the south. Winter in the north is long and cold. In certain years the temperatures were as low as 52 ºC below zero in the northern regions of the country, but there can be thaws up to 5 ºC as well. The highest temperature of the ground air in July in the north does not exceed 41 ºC, and in the south – 47 ºC (Kyzyl Kum desert). Daily temperature differences can reach 20-30 ºC.

Kazakhstan terrains belong to four natural climate zones – forest-steppe, steppe, semi-arid and desert.

2.1.4.1.The climate changes observed in Kazakhstan

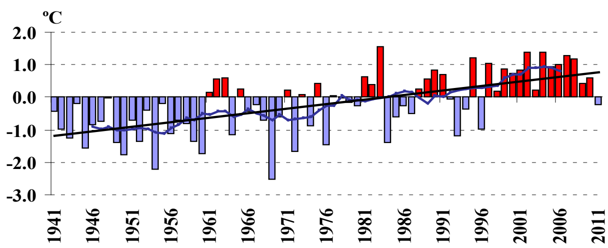
There has been an annual average and seasonal temperature of the ground air rise observed throughout the entire territory of Kazakhstan within the recent 70 years. To assess the trends the series of monthly average air temperatures and monthly amounts of precipitation obtained from 120 meteorological stations of Kazakhstan over the period of 1941-2011 were used as a basic data. The series of daily maximum and minimum air temperatures and daily amounts of precipitation obtained from 90 meteorological stations were used to calculate the climate change index, displaying the variation of values and extrema repetition in compliance with the recommendations of the WMO’s Commission for Climatology expert team.

Particularly rapid rates of warming have started to occur since 1980-s, that caused higher frequency of warm years. Annual average temperatures of air in Kazakhstan during each year since 1997 till 2010 (14 consequent years) were higher at the mean than a climatic normal rate calculated over the period of 1971-2000, by 0.3 – 1.4 °C (Figure 2.3.a). Top ten warmest years in Kazakhstan are as follows: 1983, 2004, 2002, 2007, 1995, 2008, 1997, 2006, 2005, 1999 (ranked in decreasing order as to the value of the positive anomaly). Annual average in terms of the area of Kazakhstan amount of precipitation over the period since 1941 till 2011 virtually did not change (Figure 2.3.b).

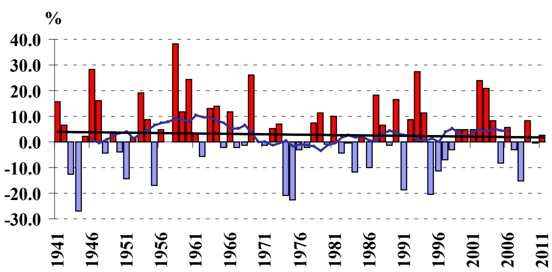
Figure 2.3

Time-series and linear trend of annual average air temperature (a) and annual amount of precipitation (b) anomalies over the period of 1941-2011, averaged in terms of the territory of Kazakhstan. The anomalies are calculated relative to basic period of 1971-2000. Smooth curve is obtained by 11 years smoothing averaging.

а)



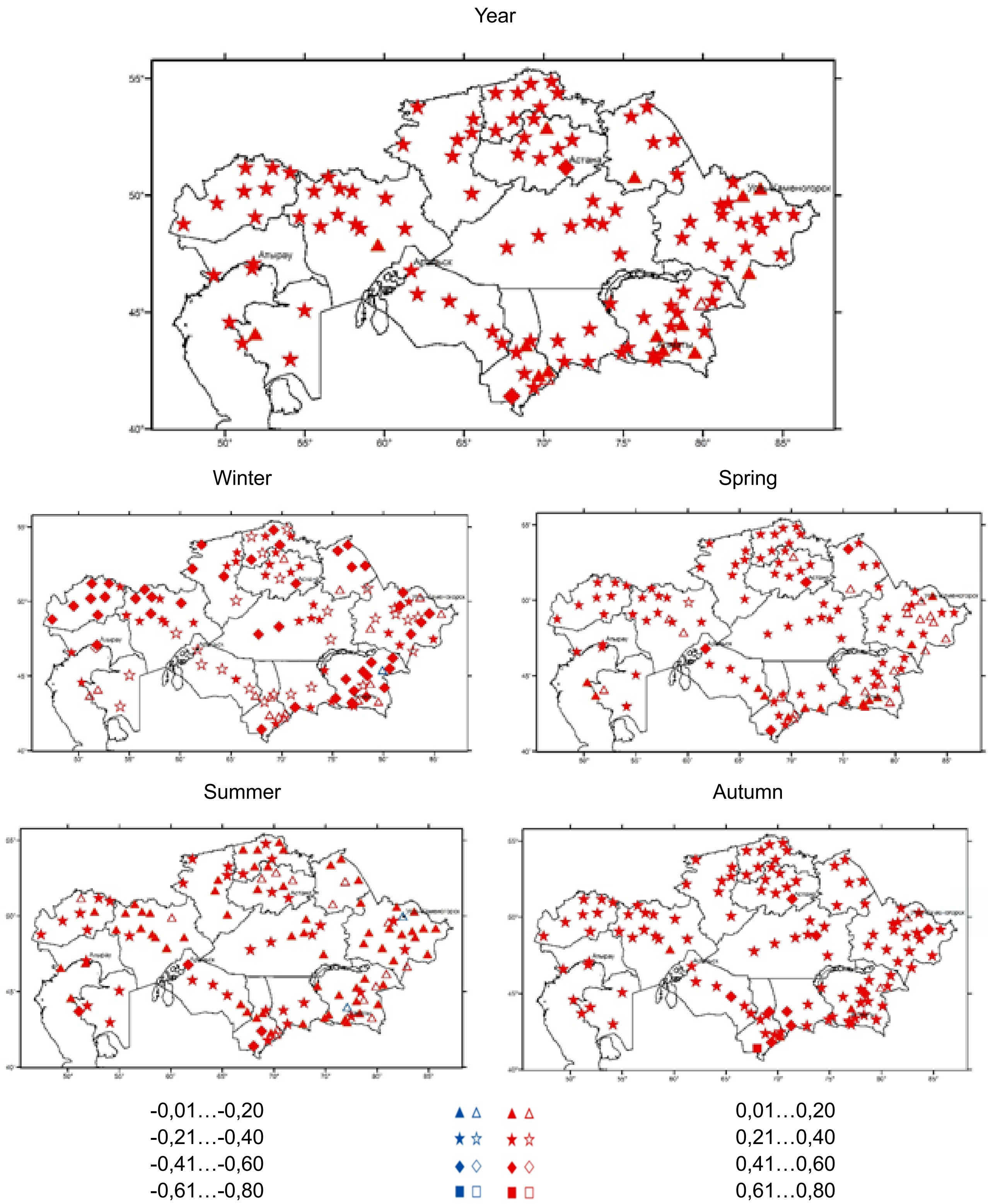
б)



Annual average temperatures of air in Kazakhstan increased with the speed of 0.28 ºC every 10 years at the mean. Annual average temperatures increased more significantly in the north, west and south of Kazakhstan – by 0.30…0.37 ºC/10 years, в in the remaining regions – by 0.25…0.29 ºC/10 years (Figure 2.5). The maximum warming occurred during winter – by 0.35 ºC/10 years at the mean. The temperature increase in winter in northern oblasts was 0.34…0.40 ºC/10 years, in western regions – 0.30…0.51 ºC/10 years, in central and eastern – 0.34…0.35 ºC/10 years, in the south – 0.22…0.36 ºC/10 years. Some lower rates of the temperature increase observed in autumn and spring – at the mean by 0.32 и 0.27 ºC/10 years respectively throughout Kazakhstan. The temperature increase by oblast during mid-seasons fluctuates within the range of 0.21…0.40 ºC/10 years. The lowest rate of the temperature increased was observed in summer within the range from 0.12 through 0.27 ºC/10 years. The summer temperatures in Kazakhstan increased at the mean with the speed of 0.18 ºC/10 years. In majority of cases trends were statistically significant with the confidence interval of 95%.

Figure 2.4

Spatial distribution for the coefficient values of the linear trend for the annual average and seasonal ground air temperature (°C/10 years), as estimated over the period of 1941…2011. Grading symbols are shaded where the trend is statistically significant.

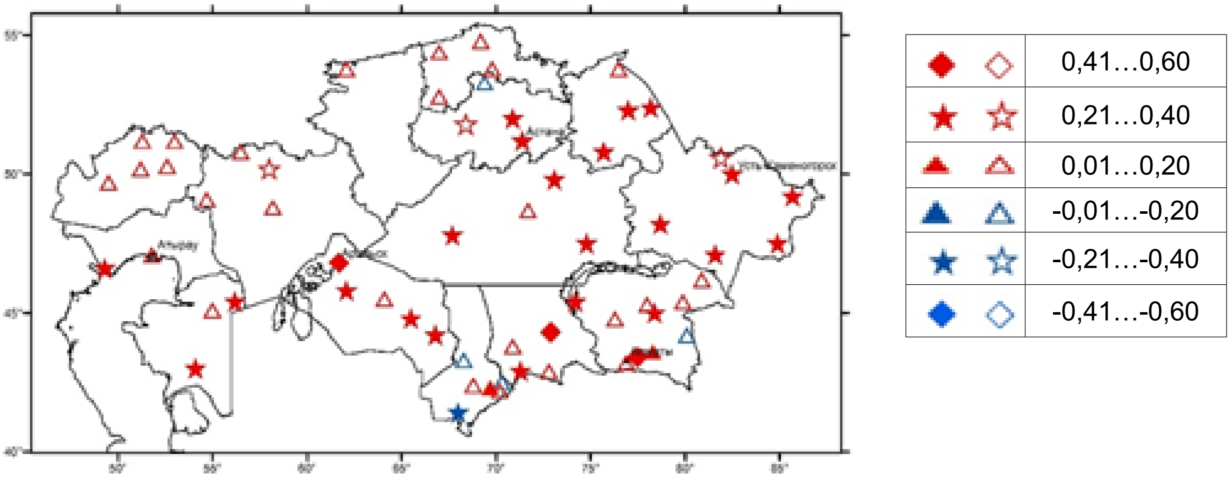


There were also observed variations in the air temperature regime, expressed by various extrema parameters' repetition increase:

- there was observed a trend of daily ground air temperature maximum values increase at most of the meteorological stations of Kazakhstan. Increase of daily temperature maximums was up to 0.40 ºC every 10 years, locally up to 0.60 °C/10 years. Statistically significant trends were generally common for north-east, east and south of the Republic (Figure 2.5).

Figure 2.5

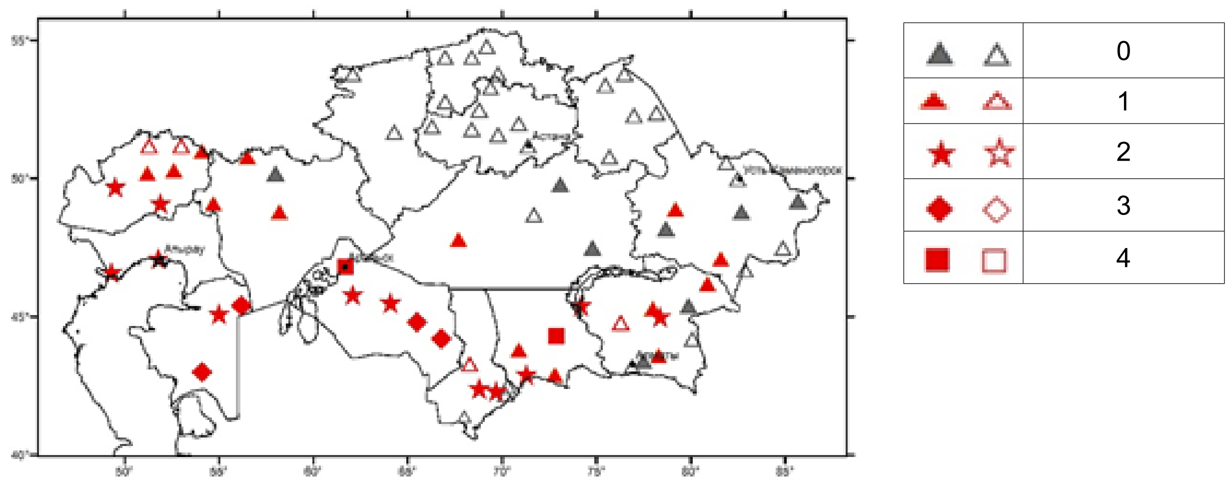
Spatial distribution for the coefficient of the linear trend for the daily air temperature maximum values (°C/10 years) over the period of 1941…2011. Grading symbols are shaded where the trend is statistically significant.



- everywhere within the Republic there was increase of the warm days repetition (when daily maximum temperature was higher than 90th percentile) – by 1-2 %/10 years, cold nights repetition (when daily minimum temperature is below 10th percentile) decreased by 1-3 %/10 years.
- the number of hot days increased (when the air temperature exceeds 35 ºC) within the territory of western and southern oblasts of Kazakhstan – by 1 to 3 days per every 10 years (Figure 2.6).

Figure 2.6

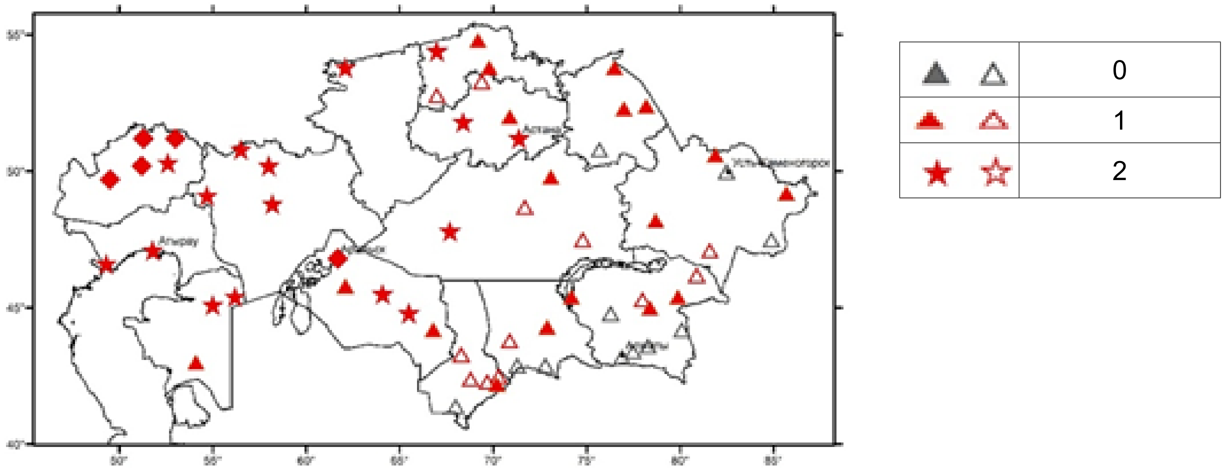
Spatial distribution for the coefficient of the linear trend for the number of days when air temperature exceeds 35 °C (days/10 years) over the period of 1941…2011. Grading symbols are shaded where the trend is statistically significant.



- general duration of the heat waves throughout the entire territory of the Republic increased (by 1…3 days/10 years, Figure 2.7). The heat wave is deemed to be a case when daily maximum air temperature for at least 6 subsequent days was higher than 90th percentile. Statistically significant trends were observed at more than 70 % of meteorological stations.
- duration of vegetation period (period between the first day when daily temperature of five-day term ≥5 °C, and the last day when daily temperature of five-day term ≤ 5 °C) increased. The vegetation period grew by 1-3 days/10 years at the mean throughout the territory of Kazakhstan, and by 4-5 days/10 years – in the south. Statistically significant trends were registered subject to the data of about70 % of meteorological stations.

Figure 2.7

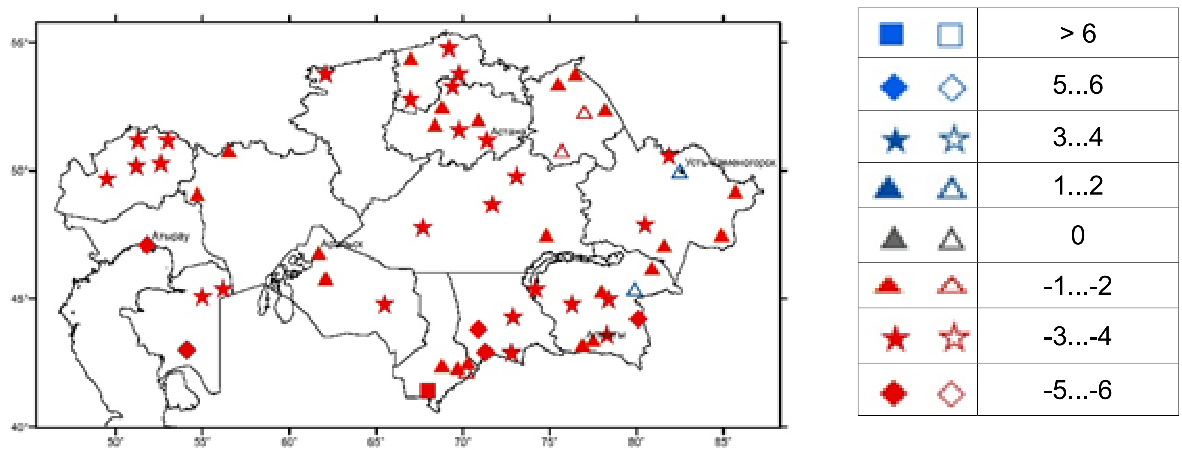
Spatial distribution for the coefficient of the linear trend for the aggregate duration of the heat waves (days/10 years) over the period of 1941…2011. Grading symbols are shaded where the trend is statistically significant.



- almost everywhere there was observed a trend of frost days repetition decrease when daily minimum temperature falls below 0 °C (Figure 2.8). Most significant rates of the frost day's repetition decrease were shown in mountainous and foothill regions of the south of Kazakhstan – by 5…6 days every 10 years. Decrease of such day's number at the rest territory 1…4 days every 10 years.

Figure 2.8

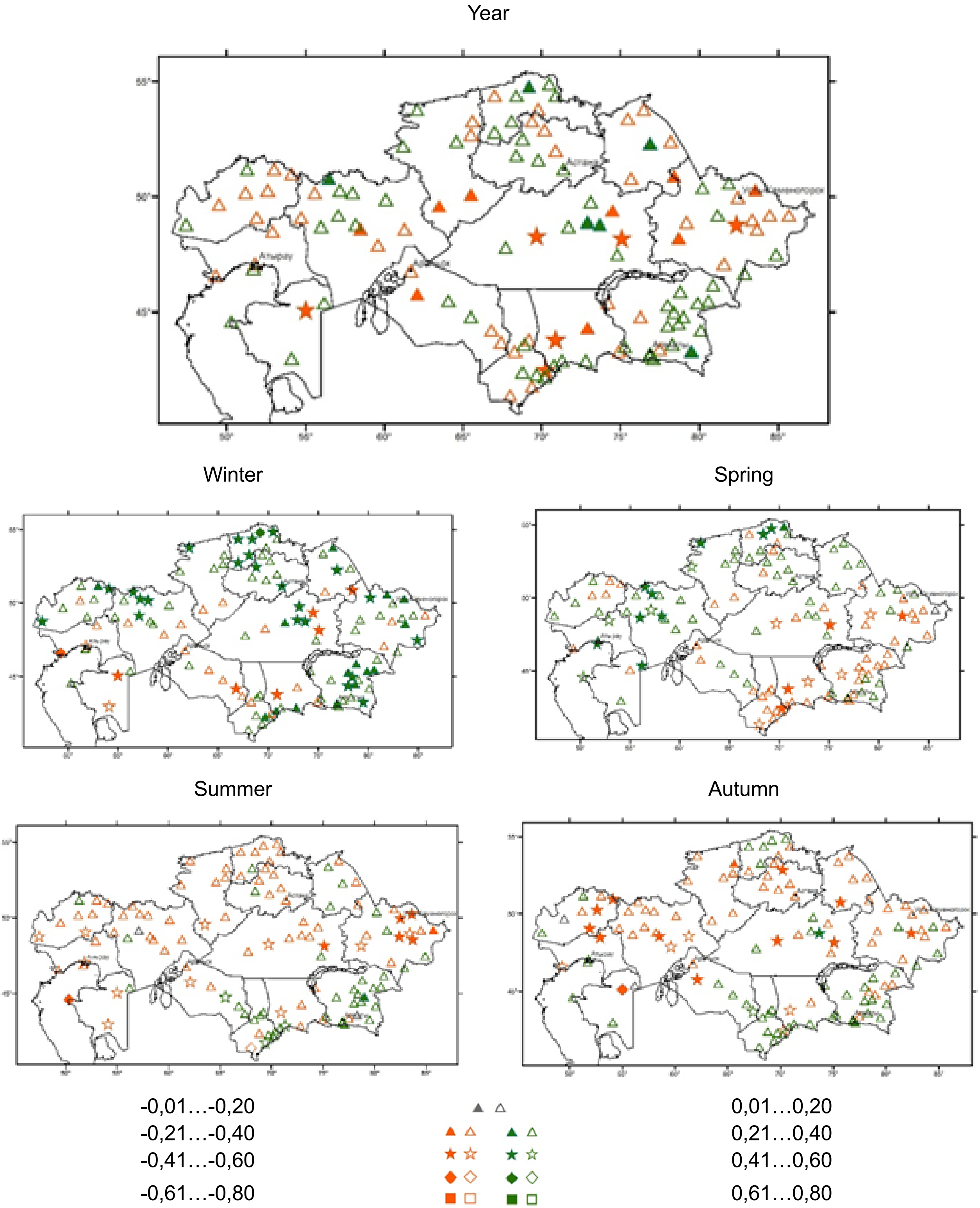
Spatial distribution for the coefficient of the linear trend for the number of days with the daily air temperature minimum below 0 °C (days/10 years) over the period of 1941…2011. Grading symbols are shaded where the trend is statistically significant.



Precipitation regime has changed ambiguously throughout the territory of Kazakhstan. At the mean annual amounts of precipitation throughout Kazakhstan slightly decreased – by 0.5mm/10 years (0.3% of the normal rate/10 years), there also was observed a trend of decrease as to the seasonal amounts of precipitation – by 1mm/10 years (1% of the normal rate/10 years) in spring, summer and autumn. It is registered a trend of precipitation amount increase by 1.7mm/10 years (2.2% of the normal rate/10 years) in winter. The maps (Figure 2.10) display variation of annual average and seasonal amount of precipitation (% of normal/10 years) throughout the territory of Kazakhstan over the period of 1941-2011. A patchiness of the seasonal amount of precipitation variation sign distribution was observed throughout the territory of the Republic. Precipitation decreased by 1 to 5% of the normal rate/10 years throughout the major part of the territory of Kazakhstan except for the south-eastern mountainous regions in summer and autumn. On the contrary the amount of precipitation mostly has increased in winter; persistent trends were observed in the northern and central regions as well as north-western, eastern, south-eastern mountainous and foothill regions of the Republic – by 1 to 10% of the normal rate/10 years. In spring period the positive trend as to precipitation was observed in the north-western half part of Kazakhstan while the negative trend – throughout the entire remaining territory. It should be mentioned that almost all the seasonal precipitation amount trends were insignificant in terms of statistics, except for the winter precipitation.

Figure 2.9

Spatial distribution for the coefficient of the linear trend for the abnormal seasonal and annual amount of precipitation (% of normal/10 years), as estimated over the period of 1941…2011 relative to basic period of 1971-2000. Grading symbols are shaded where the trend is statistically significant.



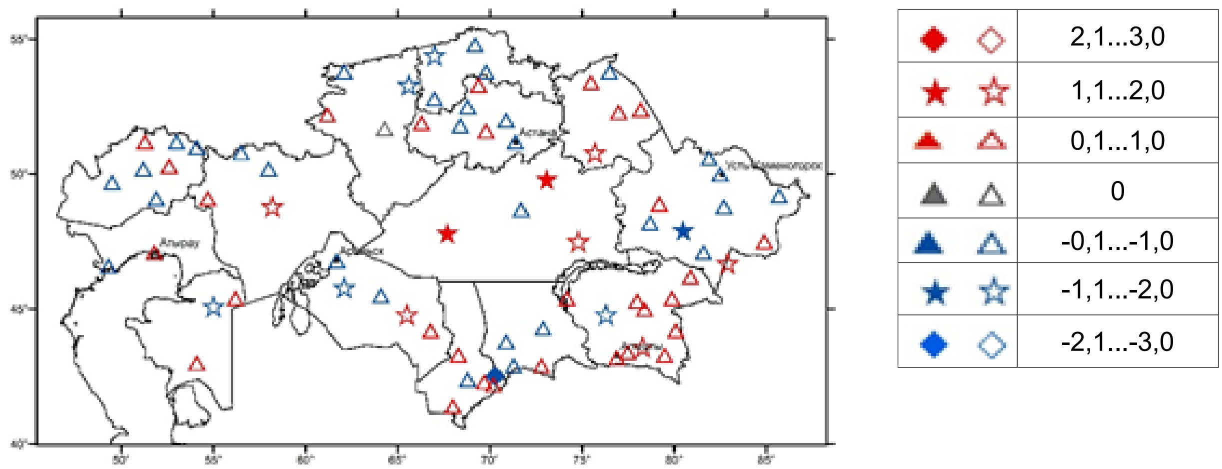
Some changes occurred as to the precipitation extrema:

- 58 % meteorological stations determined a weak trend of precipitation daily maximum values increase by 0.5-1.0mm/10 years.
- there was observed a slight increase of the share (%/10 years) of extreme amount of precipitation in the total annual amount of precipitation by 1…2 %/10 years in mountainous and foothill regions of the south-

eastern of Kazakhstan (Figure 2.10). Northern regions and the east of Kazakhstan more often showed a trend of decrease of extreme precipitations' share. Increase of extreme amount of precipitation during the summer period may lead to higher risks of erosion processes' occurrence, and in mountainous regions – to the rain originated mudslides.

Figure 2.10

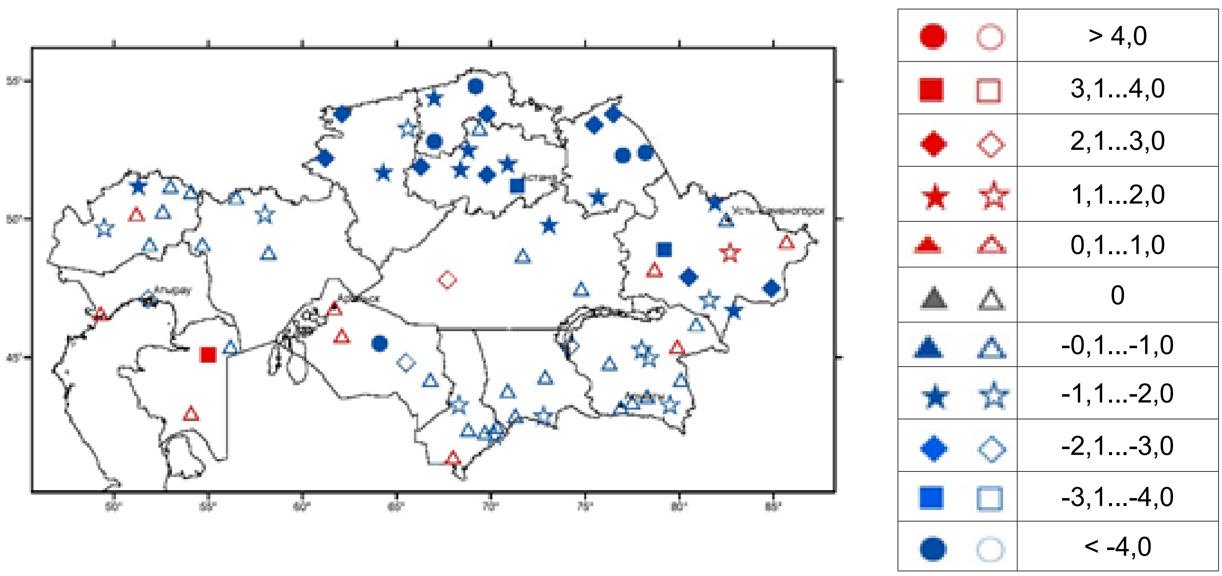
Spatial distribution for the coefficient of the linear trend for the share (%/10 years) of extreme amount of precipitation in the total annual amounts of precipitation, as estimated over the period of 1941…2011. Extreme amount of precipitation is calculated as a daily amount of precipitation higher than 95th percentile. Grading symbols are shaded where the trend is statistically significant.



- throughout the major territory of Kazakhstan there was shown a trend of the maximum duration of rainless period decrease. Statistically significant trends of decrease were observed in the north of the Republic – by 1…4 days every 10 years. The entire rest territory showed statistically insignificant trends (Figure 2.11)

Figure 2.11

Spatial distribution for the coefficient of the linear trend for the maximum duration of rainless period (days/10 years), as estimated over the period of 1941…2011. Grading symbols are shaded where the trend is statistically significant.



2.1.5. Economy

Gross export of Kazakhstan in 2012 was $92.3 billion and if compared to the corresponding period of 2011 it grew insignificantly by 5.3%. Provided that about $56,4 billion (61.2%) of the total amount was the share of oil and natural gas export.

The main export goods of Kazakhstan is the row material. In 2012 main oil extraction was 79,2 mln tones and extraction of natural gas was 40,1 billion of cubic m.

Potential threats to the country's economic stability pose its raw-material orientation, low level of readiness of particular sectors to the accession to the World Trade Organization (WTO), external debt increase and «black» market problems.

Along with the industrial growth within the export-oriented industry sectors there was an increase in demand for the end products for consumption and production being the factor of expansion of production as well. In 2012 the manufacturing industry produce goods 16 851.8 billion KZT and this amount is higher by 0,7% than in 2011. Increase of the production was occurred in 13 oblasts of Kazakhstan. Production in manufacturing industry increase by 1,2%

Inflation expressed in annual terms (December 2012 against December 2011) was 6%. Cost for the food commodities increase by 5,3% and nonfoods by 3,5%. Payment services increase by 9,3%. The country's international reserves including the money held by the National Fund increased by 17.9% over 2012 and amounted to USD 86 bln.

Kazakhstan continuously pursues the open foreign trade policy. High rates of growth within the real economy together with advantageous external conditions facilitated the growth of the external trade turnover by 6.5% over the period of 2012, amounting to USD132,743.6 thous.

2.2. Data by economic sectors

2.2.1. Energy production

The Republic, that occupies 1.8% of the total land area of the Earth, concentrates about 0.5% of the world's mineral fuel balance reserves that amounts to 30 bln. toe, of which the coal share is 80%, oil and gas condensate – 13%, natural and associated gas – 7%.

Proven electric capacity generated by Kazakhstan's power plants, is around 18GW (thermal power stations – 87.5%, hydraulic – 12.4%). Kazakhstan has a developed cogeneration system. Proven electric capacity of the CHPSs exceeds 6700MW (38% of the total capacity of all the country's power plants). Specifically they cover about 40% of heat and some 46% of electric energy consumption in Kazakhstan.

Our electric power industry is primarily oriented to the hydrocarbon fuel utilization. Only about as little as 12% of electric energy is generated by hydroelectric power stations and 87% – by thermal ones.

Table 2.1

Primary energy sources production (mln. tons of oil equivalent)

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011[1]
Oil, including natural-gas condensate	59,35	64,68	75,15	77,96	80,21	82,83	87,21	94,38	98,33	98,79
Natural gas	7,04	8,83	10,48	11,12	23,28	26,26	29,99	33,14	34,99	35,50
Coal (including lignite)	45,50	52,21	53,52	58,06	59,18	60,29	68,49	62,03	67,85	71,07

Sources : «Fuel and energy balance for 2000-2004» The Agency of Statistics of the RK, Astana, 2005; «Fuel and energy balance of Kazakhstan for 2006-2010» Statistical compendium, The Agency of Statistics of the RK, Astana, 2011; «Fuel and energy balance of Kazakhstan for 2007-2011» Statistical compendium, The Agency of Statistics of the RK, Astana, 2012.

Table 2.2

Primary energy sources consumption in Republic of Kazakhstan, 2012

Consumption	Primary energy sources consumption In the balance 2012 г., mln tones of oil eq.	Contribution to total, %	Primary energy sources consumption In the balance 2011 г., mln tones of oil eq.	Contribution to total, %
Coal consumption	38,9	50,4	37,5	50,5
Oil and oil products consumption	16,7	21,6	16,1	21,6
Gas consumption	20,5	26,6	19,8	26,6
consumption of oil, gas and coal total	76,1	98,7	73,4	98,8
Primary energy sources consumption	(2012) 77,06 mln tones of oil eq.		(2011) 74,22 mln tones of oil eq.	

Sources: «Energy Efficiency 2020 Program, Government Resolutions #904 from 29 August 2013

The heat balance data are given in the Table 2, Annex 1.

Hydropower potential of Kazakhstan is around 170 bln. kWh, provided that technically feasible for use are – 62, economically feasible – 27 bln. kWh, of which no more than 8 bln. kWh/year is used today.

Power potential of renewable sources of Kazakhstan is 2 trln. kWh/year. Power potential of alternative renewable sources of energy in Kazakhstan which is technically feasible for use in electric energy production much exceeds the energy consumption of the country and is about 337 bln. kWh/year. Provided that share of the wind energy is 322 bln. kWh/year, solar energy – 4 bln. kWh/year, small HPPs /hydraulic power plants/ – 11 bln. kWh/year

2.2.2. Industry

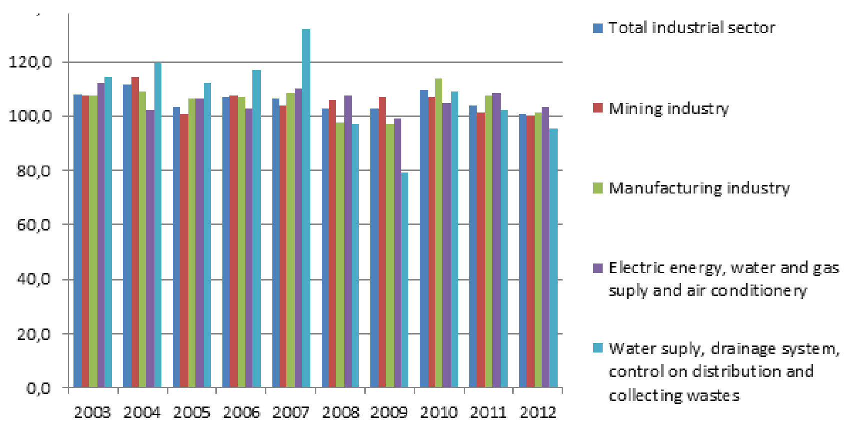
Industrial production makes up the base of the economy of the Republic of Kazakhstan. Mining industry is leading within the industrial sector being on the path of sustainable growth since 1999. Kazakhstan is second oil producer among the CIS countries after Russia. Over the recent years there has been observed a trend of its production increase. Particularly at the 2011 year end there were produced 80.1 mln. tons that is more than three times as much as the level of oil production in 1991. Manufacturing industry has a significant share within the industrial production sector (Table 3, Annex 1).

The output growth of 2011 in the mining industry was mainly due to increase of (natural) gas, natural-gas condensate, lignite, copper, chrome, non-agglomerated iron and lead-zinc ores and crude oil production. While production of gold, agglomerated iron and copper-zinc ores, iron ore pellets and coal decreased.

Dynamics of the industrial production is shown in the Figure 2.12. The coke production in manufacturing industry grows with fast rates. The industrial products' output growth within the mining industry and development of western regions of the country have significant effect on the cargo transportation volume increase.

Figure 2.12

Dynamics of the industrial sector's of the Republic of Kazakhstan growth rate in 2003-2012, in % to the preceding year



Sources: «Industrial sector of Kazakhstan and its regions» Statistical compendium, The Agency of Statistics of the RK, Astana, 2012.

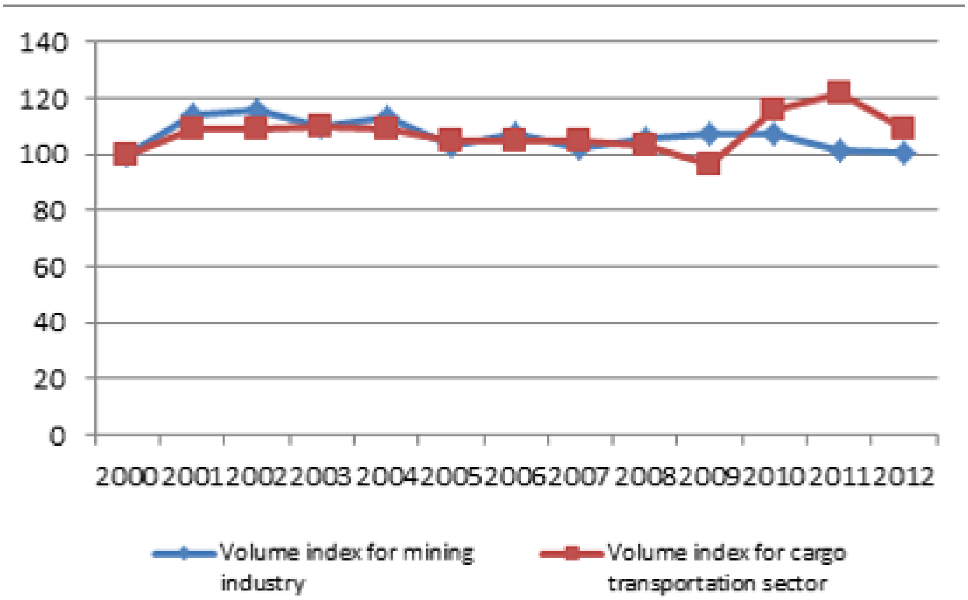
2.2.3. Transport

Geographical location of Kazakhstan in the centre of the Eurasian continent determines its substantial transport potential in the sphere of transit transportation. The bulk of land lines of communications' network are the roads and railways (around 88.4 and 14.0 thous. km respectively). The length of utilized waterways is 3.98 thous. km and airways – 61 thous. km. the network density is about 5.1km of railways, 32.4km of paved roads and 1.5km of inland waterways per 1000sq.km.

Data on transport vehicles in the Republic of Kazakhstan are given in the Table 4, Annex 1.

Figure 2.13

Dynamics of the mining industry and cargo transportation sector's output volume, as a percentage against the previous year.



Sources: «Industrial sector of Kazakhstan and its regions» Statistical compendium, Astana 2012.

The industrial products' output growth within the mining industry and development of western regions of the country have significant effect on the cargo transportation volume increase. Analysis of the cargo transportations over the period 2000 to 2011 shows that the cargo transportations growth rates increased during 2000-2002, reduced in 2004, grew in 2007 and reduced in 2008 increasing again by 2011 (Figure 2.14). Main cargos to be transported by the transport and communication industry's companies were coal, metal and petroleum products.

2.2.4. Housing stock

According to the housing stock registry total floor area of housing stock in the Republic of Kazakhstan by the end of 2011 was 283.9 mln. sq.meters. Of which 167.3 mln. sq.meters fall within urban settlements and 116.6 mln. sq.meters – rural ones. As a result of the housing and utilities sector reform the housing stock of the Republic of Kazakhstan in terms of ownership, pursuant to the applicable law, is comprised by 96.4 % of the private housing stock (273.6 mln. sq.m) and by 3.6 % – of the public housing stock (10.3 mln. sq.m). Information about the housing stock and its division in terms of ownership is presented in the Table 2.3.

Table 2.3

Housing stock (total floor area of houses: mln. sq.m)

Years	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total housing stock	238,3	243,0	252,7	254,6	256,1	260,6	267,8	270,9	271,7	283,9	304,6
including:											
Private	230,2	235,3	244,9	247,3	248,9	253,7	261,4	263,9	264,9	273,6	290,5
Public	8,1	7,7	7,8	7,3	7,2	6,9	6,4	7,0	6,8	10,3	14,1

Sources: «On the housing stock of the Republic of Kazakhstan» Statistical compendiums, The Agency of Statistics of the RK, Astana, 2011 and 2012.

Housing construction in the Republic is primarily carried out by privately owned entities essential part of which represent households.

In order to provide housing for every citizen the Government of the RK has approved a Program of the housing construction development for 2011-2014. It provides for three main directions of the government support for housing construction: utilization of the system of housing construction savings for the housing sales, second tier banks' funding to provide finance for the construction and construction of utility network. Level of provision of utilities within the housing stock (central heating, cold and hot water supply, central sewerage, gas supply, electricity supply) depends on the location of houses in urban or rural area, level of utility infrastructure provision to this settlement or its part (location of residential quarters, areas). Share of the housing stock provision with utilities is shown in the Table 2.4.

Table 2.4

Level of provision of utilities within the housing stock in 2011

Share of the floor area (%), provided with:	
water supply	64.6
sewerage	44.7
central heating	40.3
baths	40.3
gas	86.5
central hot water supply	34.8

Sources: "On the housing stock of the Republic of Kazakhstan" Statistical compendiums, The Agency of Statistics of the RK, Astana, 2012.

2.2.5. Waste and pollution emissions

Municipal solid waste (MSW) poses a serious problem for Kazakhstan. There was generated about 3,919.3 thous. tons of MSW in the country in 2011. Up to 400 mln. tons of industrial and up to 20 mln. cubic meters of household waste are generated each year. The cheapest and most acceptable way of long-term and safe waste storage is organized dumps (landfills).

Currently effective system of the MSW management does not meet today's requirements to the fullest extent as set to the public utilities:

- locations of the landfills intended for the waste storage are chosen without being based on any engineering or hydrological grounds;
- there is no separate waste collection, no companies to utilize or dispose the MSW components;
- there is no environmental monitoring carried out within the area of landfills;
- sanitary and environmental requirements as to the placement and equipment of the MSW temporary storages are not met;
- no activities are performed to reduce the amount of waste; process requirements as to the landfills and MSW dumps operation are mostly not met;
- not all the MSW produced reaches the permitted landfills that causes the non-permitted dumps creation.

There have been more than 22 bln. tons of industrial and consumer waste accumulated throughout the territory of Kazakhstan. Great deal of waste is toxic one being the source of land, surface and underground water as well as air basin pollution. A bulk of hazardous wastes has been generated by the mining industry and through the surface mining – 30,334.1 thous. tons, with the electric energy, natural gas and water production and distribution in the amount of – 2,567 thous. tons, by the civil engineering – 165.1 thous. tons, by the agriculture, forestry and fishery – 143.9 thous. tons.

Table 2.5

Key indicators of the economic activities' impact on the environment

Years	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Toxic waste generation, mln. tons	130,0	137,1	141,9	146,1	228,2	263,9	281,7	453,3	228,0	303,1	420,7

Sources: «Environment protection and sustainable development of Kazakhstan» Statistical compendiums, The Agency of Statistics of the RK, 2001 and 2011.

Table 2.6

Emission of harmful substances from the stationary air pollution sources

Years	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total, thous. tons	2582,7	2529,3	2884,3	3016,5	3968,8	2921,1	2915,0	2643,1	2320,0	2226,5	2346,2

including:											
solid substances	672,4	673,4	729,6	752,9	713,7	721,3	717,6	688,7	639,1	639,3	631,1
Gaseous and liquid substances	1910,3	1855,9	2154,7	2263,6	2255,1	2199,8	2197,4	1954,4	1680,9	1587,2	1715,2

Sources: «Environment protection and sustainable development of Kazakhstan» Statistical compendium, The Agency of Statistics of the RK, Astana, 2011; «Kazakhstan in 2011» Statistical yearbook, The Agency of Statistics of the RK, Astana, 2012.

Amount of accumulated industrial waste as of 01.01.2011 was 23,609,272.937 thous. tons. The greatest volume of accumulation had the following oblasts: Kostanayskaya – 44.9%, Karagandinskaya – 25.5%, Pavlodarskaya – 23.2%, East-Kazakhstanskaya – 3.37% and South-Kazakhstanskaya – 1.4% oblasts.

As to the industrial sectors, the greatest amount of industrial waste was produced by the following oblasts: Kostanayskaya (mining, CHP, housing and utility) – 359,860.73 thous. tons, Karagandinskaya (mining, CHP, coal production, non-ferrous and ferrous metallurgy) – 230,636.55 thous. tons, Pavlodarskaya (non-ferrous and ferrous metallurgy – 194,577 thous. tons, Aktyubinskaya (ferrous metallurgy, chemical industry, oil and gas production, electric power industry) – 44,344.094 thous. tons.

Constantly increasing stored amounts of waste create new technogenic landscapes adversely affecting the environment, polluting the atmosphere, soils, surface and underground water with toxic components (mercury, arsenic, antimony, etc.). With the height of tailings and spoil tips increase they become more and more intensive sources of dust formation.

The oil and gas production industry enjoying active development in the Republic today are a great anxiety.

2.2.6. Agriculture

The share of agricultural sector in the GDP in 2012 was 4.1%.

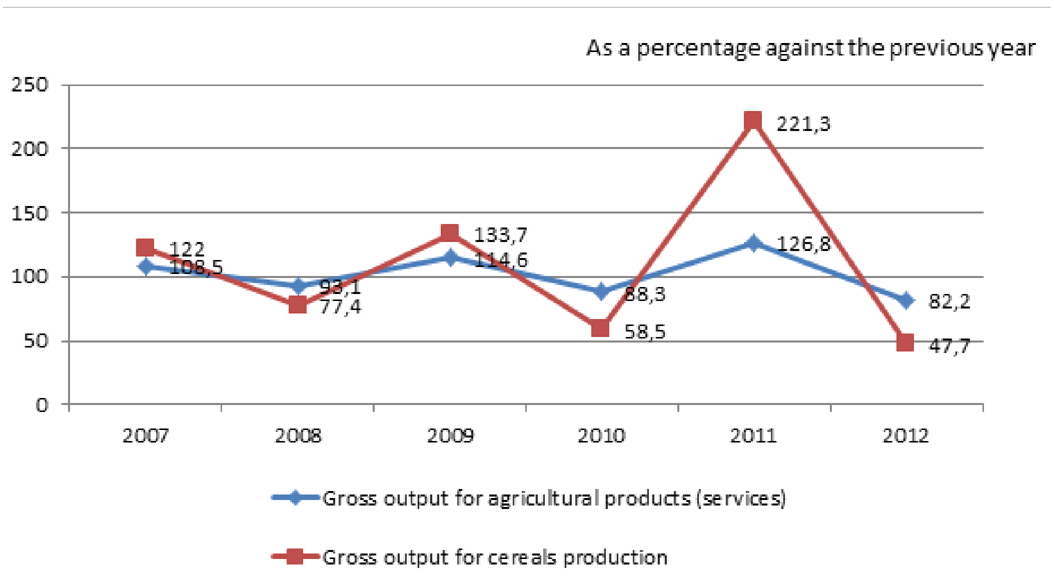
Dynamics (2001-2012) of total land areas and agricultural lands, including plough lands, hayfields and pastures, as distributed by land users is presented in the Table 5 of Annex 1. Croplands area distribution – in general and by major crops – over 2001-2011 is shown in the Table 6 of Annex 1.

In terms of the fields and farms productivity Kazakhstan lags several times behind developed countries of the world. Total investments made to Kazakhstan's agricultural sector in recent years do not go beyond 2%.

In 2012 the volume index of the gross output (services) of agriculture was 82.2% when compared to 2011.

Figure 2.14

Gross output volume index for agricultural products (services) shown in dynamics

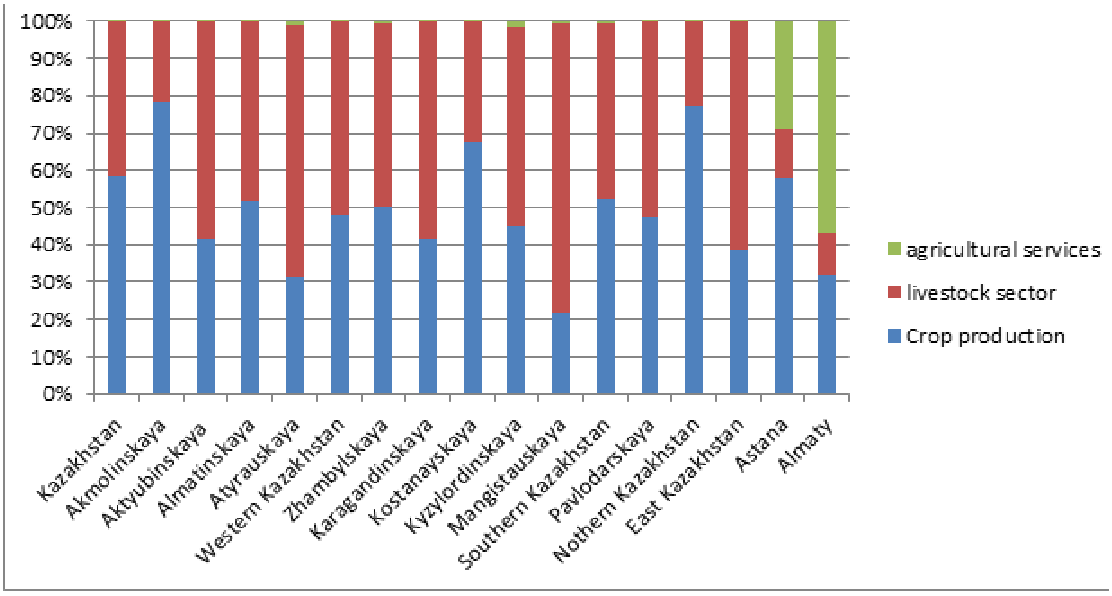


Sources: «Agriculture, forestry and fishery of Kazakhstan» Statistical compendium, 2006-2010, The Agency of Statistics of the RK, 2011.

Favorable weather conditions in 2011 had a positive effect on harvesting volumes of the oil-bearing crops (increase by 43.7% when compared to 2010), potatoes (by 20.4% respectively), vegetables and melons (by 11.7%), that also positively influenced the value index formation for the sector output.

Figure 2.15

Composition of gross output, livestock sector and agricultural products (services) of the Republic by regions



Sources: «Agriculture, forestry and fishery of Kazakhstan 2011», The Agency of Statistics of the RK, 2012.

Positive dynamics of the agricultural production was generally due to increase of revenues in crop production while the livestock farming sector's returns are still unstable.

According to the UN data, 66% of the total area of Kazakhstan being 272.5 mln. hectares, are prone to desertification. Among all the environmental problems pertaining to the agricultural production of Kazakhstan the soil fertility and biological resources preserving and restoration, mitigation of the technogenic impact adverse effects on the agricultural lands and ensuring the sustainable production of green products challenges have come to the forefront during the current decade.

High scale of ploughing, insufficient forest cover and water content of the plough lands, lack of haylands and pastures management, poor land economy management led to the loss of self regulating characteristics inherent to the soil and to the spread of wash-offs, washouts and blow-offs of fertile layer throughout vast territories as a result of water or wind erosion.

Fertilizing systems used are not balanced as to the basic nutrients. Doses of organic fertilizers are just pitiable and are not able to compensate the organic carbon losses.

2.2.7. Forestry

Total forest area of the Republic of Kazakhstan as of the end of 2011 was 28.8 mln. hectares covering 10.6 percent of the territory of the Republic. Woodlands cover the area of about 12.4 mln. hectares, that is 4.5% of the territory of the Republic (Table 7, Annex 2).

Forest cover of the territory of Kazakhstan including holoxylon forests and shrubs is 4.5 % (12.3 mln. hectares). Temperate coniferous forests cover about 1.6 mln. hectares. Forests of Kazakhstan have generally not the economic value but soil and water protective. Some factors threatening the biological diversity of forests are fires, unauthorized forest cutting, cattle grazing.

Annual range of reforestation as of the early last decade of past century average throughout the Republic was near 80 thous. hectares, but in 2011 the range of reforestation reduced much, more than 3 times (Figure 2.16).

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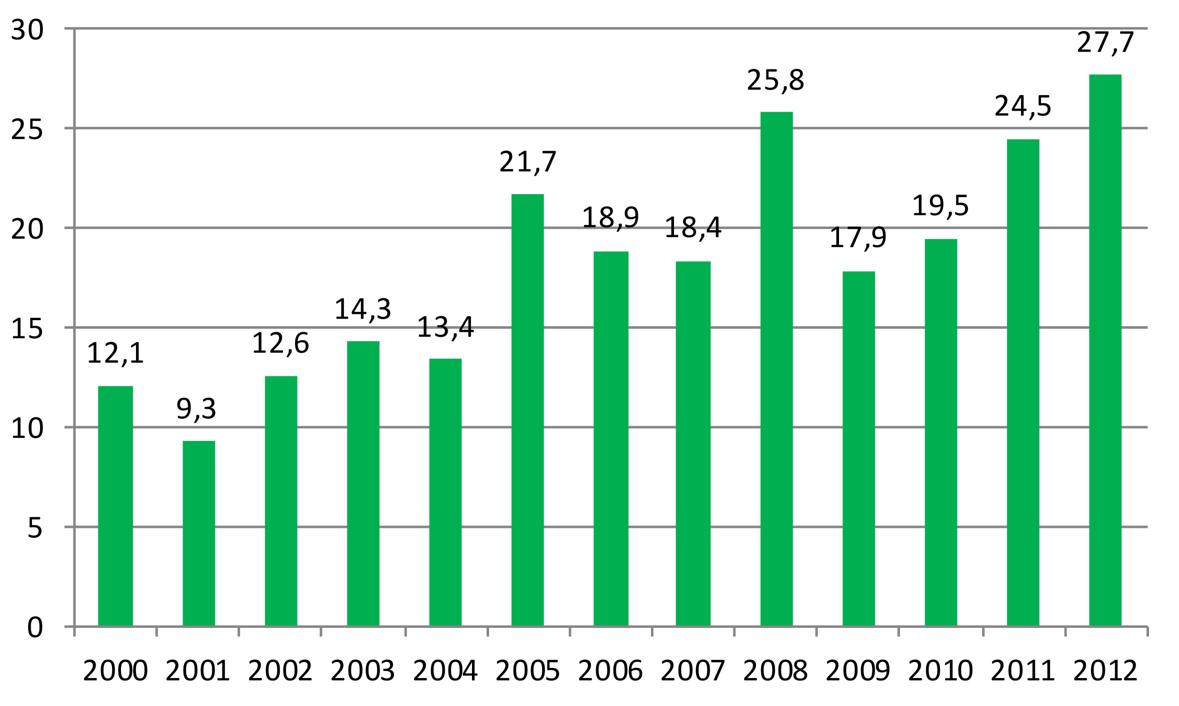
*Fig*ure 2.16

Range of reforestation in the Republic of Kazakhstan, thous. of hectars



Sources: «Environment protection and sustainable development of Kazakhstan» Statistical compendiums, The Agency of Statistics of the RK, Astana, 2011 and 2012.

Total average increment of forest stands reduced by 212.8 thous. m3, when compared to the previous year, due to reduction of total area of the most productive ripening and mature temperate coniferous and medium-return soft-leaved stands. Change of reserve per 1 hectare of land covered by forest was insignificant. In 2010 total stand reserve of the main forest-forming species increased by 4.95 mln. m3 when compared to the previous year. Areas of pine-tree stands and haloxylon reduced significantly by 48.5 thous. hectares and 48.9 thous. hectares respectively.

III. GREENHOUSE GAS INVENTORY IN THE REPUBLIC OF KAZAKHSTAN, NATIONAL SYSTEM AND NATIONAL REGISTER OF CARBON UNITS

3.1. General information on greenhouse gas emissions in the Republic of Kazakhstan

This section presents new and revised estimates of GHG emissions and removals in Kazakhstan in 1990-2011. According to the IPCC source categories, GHG sources in the Kazakh cadastre are the following sectors: Energy; Industrial processes; Agriculture; Land use, land-use change and forestry (LULUCF); and Waste. Emissions from the international bunker fuels and biomass burning according to the IPCC methodology are excluded from the national emissions.

Carbon dioxide (CO_2) is the main greenhouse gas in Kazakhstan; in 2011, it accounted for 78.23% of the total national GHG emissions (excluding net CO_2 removals from LULUCF); it is followed by methane (CH_4) (17,72%) and nitrous oxide (N_2O) (3.26). The contributions of HFCs and PFCs to the total GHG emissions are insignificant: 0.31% and 0.48% respectively. There were no SF6 emissions. In 2011, Kazakhstan was estimated to emit, excluding LULUCF, 214.72 mln t. carbon dioxide (CO_2), 48.63 Gg of CO_2 equivalent of methane (CH_4) and 8.94 Mt of CO_2 equivalent of nitrous oxide (N_2O). Emissions of HFCs and PFCs totalled 0.84 and 1.33 Mt of CO_2 equivalent.

The largest source of GHG emissions, with LULUCF taken into account, was Energy, at up to 85.4%. The contribution by agriculture was 7.9%, industrial processes contributed 6.3%, whereas waste contributed 1.5%. The removals in LULUCF were 1.1%.

In 2011, total national GHG emissions in CO_2 equivalent, excluding LULUCF, were 274.46 Mt of CO_2 equivalent and reduced, as compared to the base year of 1990 when they were 358.38 Mt of CO_2 equivalent, by 83.49 Mt of CO_2 equivalent, or 23.30% (Table 3.1). These include 231,23 Mt of CO_2 equivalent of emissions from energy sector, 17.16 Mt of CO_2 equivalent from Industrial processes, 21.43 Mt of CO_2 equivalent from agriculture, and 4.07 Mt of CO_2 equivalent from waste. Removals by LULUCF were 3.09 Mt of CO_2. Total emissions in 2011, minus CO_2 removals by LULUCF are estimated at 271.37 Mt of CO_2 equivalent.

Table 3.1 presents data on the structure of GHG emissions with direct greenhouse effect in Kazakhstan, in CO_2 equivalent.

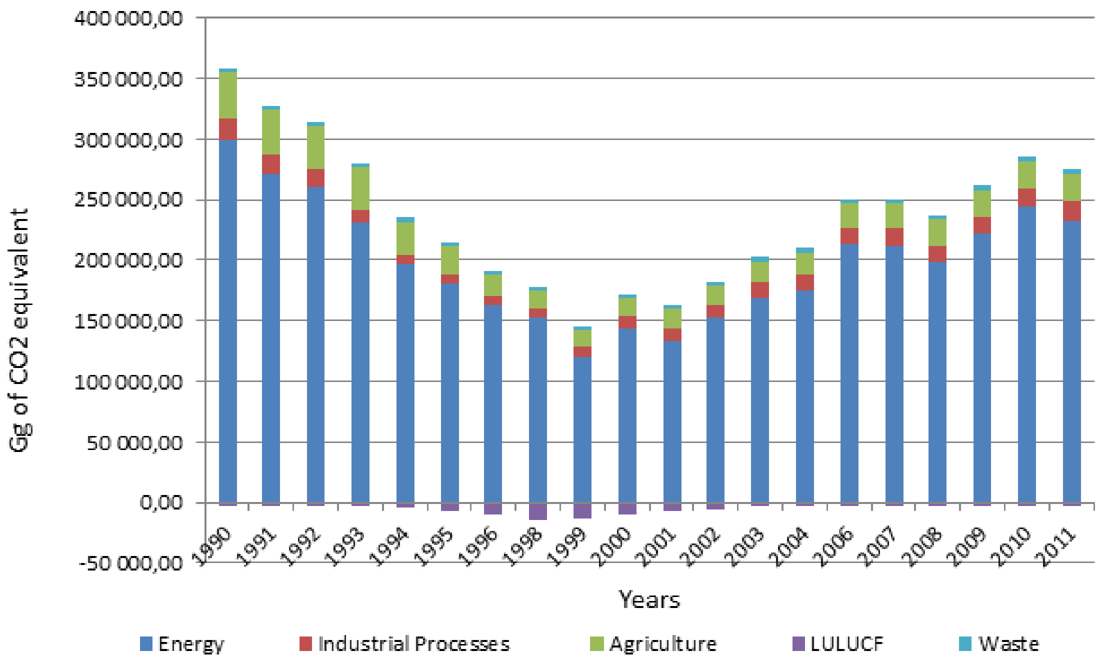
Table 3.1

GHG emissions in Kazakhstan, by sectors, Mt of CO_2 equivalent

Sectors	1990	1995	2000	2005	2008	2009	2010	2011	Difference between 2011 and 1990, %
Energy supply	299,58	180,55	144,11	190,45	198,08	222,22	244,61	231,80	-22,62
Industrial processes	17,92	8,14	10,23	13,26	14,38	13,60	15,11	17,16	-4,23
Agriculture	38,14	23,12	14,53	19,09	21,26	21,99	22,30	21,43	-43,81
LULUCF	-2,17	-7,29	-10,12	-2,86	-2,47	-2,48	-2,89	-3,09	42,79
Waste	2,74	3,11	3,09	3,47	3,74	3,84	3,95	4,07	48,37
Total emissions minus removals by LULUCF (net emissions)	356,21	207,63	161,85	223,41	235,00	259,17	283,08	271,37	-23,82
Total emissions, excluding removals by LULUCF	358,38	214,92	171,96	226,27	237,47	261,65	285,97	274,46	-23,42

Figure 3.1

Total national emissions and removals of greenhouse gases in the Republic of Kazakhstan, 1990-2011, Gg of CO_2 equivalent



3.1 Figure 3.1 shows changes in GHG emissions in Kazakhstan by economy sectors in 1990-2011. In 2011, emissions, excluding CO_2 removals by forests, were 76.58% of 1990 emissions and as compared to 2010 reduced by 4.02%. In 2011, emissions per capita were over 16 t of CO_2 equivalent, including 13 t of CO_2. In 1990, emissions per capita were higher: 22 t and 16 t respectively.

As the Figure shows, emissions were reducing from 1990 to 1999 due to the economic recession, and then, following the economic revival, emissions started increasing. Lower emissions in 2008 were driven by the global economic crisis after which industrial production started recovering and emissions again increased. A slight decrease in the total national emissions in 2011 was mainly due to increase in crude oil exports and the growth of its use as a raw material.

3.2. Trends of emissions by gases

Table 3.2 presents contributions by individual gases into total national emissions in Kazakhstan, in per cent, from 1990 to 2011.

Table 3.2

Greenhouse gas contributions into total national emissions, excluding removals by LULUCF, %

Greenhouse gas	1990	1995	2000	2002	2004	2006	2008	2009	2010	2011
CO_2	75	75	77	79	79	81	77	79	79	78
CH_4	20	21	19	17	18	16	19	17	17	18
N_2O	5	4	3	4	3	3	3	3	3	3
HFCs	0	0,00	0,01	0,10	0,11	0,15	0,25	0,20	0,30	0,30
PFCs	0	0	0	0	0	0	0,24	0,26	0,42	0,48
SF6	0	0	0	0	0	0	0	0	0	0

3.2.1. Carbon dioxide (CO_2)

Carbon dioxide makes major contribution into total national GHG emissions in Kazakhstan. CO_2 emissions, excluding removals in LULUCF, in 1990 were 266,563.18 Gg, and in 2011 reduced to the level of 212,048.16 Gg, which is 20.5 % less than in the base year (Table 8 of the Annex 2). Over the period from 1990 to 2011 the contribution of CO_2 into total national GHG emissions, excluding LULUCF, was in the range of 75 – 81% (Table 3.2).

The key source of CO_2 emissions in Kazakhstan is energy supply where emissions are due to fuel combustion. The share of this sector in total national emissions of carbon dioxide in 2011 was at the same level as in the base year of 1990, specifically 94%. Such category as fuel combustion in this sector makes major contribution into CO_2

emissions. In the base year of 1990 CO_2 emissions from fuel combustion were 250,860.74 Gg, and in 2011 such emissions were below the base level by almost 25% and were 200,179.55 Gg of CO_2.

In 2011, the subcategory of power industry where fossil fuel is combusted for generating heat and power was ranked first for the level of CO_2 emissions in Kazakhstan. The contribution of this subcategory into CO_2 emissions from fuel combustion in 2011 was about 47%, which is only 1% more than this source contributed in 1990, though the level of emissions in 2011, namely 93,657.17 Gg of CO_2, was below the level of emissions in the base year of 1990 (113,513.36 Gg of CO_2). In 1990-1999, CO_2 emissions in energy sector were reducing which was due to the overall decline in production in Kazakhstan. Then as economy started recovering, emissions increased, however, the level of 1990 was not yet achieved in 2011.

In 1990, Other sectors subcategory was second in this category, where CO_2 emissions were 51,747.99 Gg of CO_2, or 21%. In 2011, Other sources were ranked second with emissions of 40,936.17 Gg and the same level of contribution (21%). Other sectors subcategory includes emissions from combustion of fuel in 'Commercial/Institutions sector', 'Residential and utilities sector' and 'Agriculture/Forestry/Fisheries'. The subcategory of 'Other sources' includes all other sources, including 'Public administration and defence, compulsory social security', 'Losses' and 'Supplied to enterprises and organizations'. The move to the second place and increased, as compared to 1990, contribution by the subcategory of 'Other sources' in 2011 are due to the rise in fuel consumption in such Kazakhstan's Energy Balance item as 'Supplied to enterprises and organizations'. The percentage of CO_2 emissions from 'Processing industry and construction' subcategory was about 9% in 1990 and 13% in 2011. In 2011, emissions from 'Transport' subcategory were below the 1990 level, by 12%.

In 1990, in the category of 'Fugitive emissions' CO_2 emissions were due to gas flaring associated with oil production and reduced, as compared to the base year, by 57% due to the flaring ban.

The sector of Industrial processes is the second largest source of CO^2 emissions, which generated 17,869.44 Gg of CO_2 in 1990. The contribution of this sector into total CO_2 emissions in 1990 and in 2011 remained unchanged and was 7%. In 2011, emissions in this sector were below the base year by 16% and totalled 14,959.73 Gg. The major source of carbon dioxide emissions in this sector is Metal fabrication, which contributed 33% and 36% in 1990 and 2011, respectively.

3.2.2. Methane (CH_4)

Methane is the second largest greenhouse gas in Kazakhstan. In 2011, methane emissions from all categories of sources reduced, as compared to 1990, apart from the Waste sector. Emissions from this sector contributed 20% into total national emissions in 1990, and 18% in 2011 (Table 3.2). In 1990, total methane emissions were 73,328.12 Gg of CO_2 equivalent. Over this period, initially these were reducing, to the level of 30,175.45 Gg of CO_2 equivalent in 1999, after which emissions started rising gradually (Table 3.3).

Table 3.3

CH_4 emissions by sources, Kazakhstan, Gg of CO_2 equivalent

Sources	1990	1999	2005	2008	2009	2010	2011
Energy	47 844,31	18 029,99	22 126,27	27 540,81	27 004,37	30 286,65	31 375,21
A. Fuel combustion (sectoral approach)	1 299,29	328,51	492,23	606,20	652,70	700,17	849,90
1. Power sector	39,33	13,77	28,60	25,62	25,39	27,93	26,88
2. Processing sector and construction	33,09	31,57	39,32	47,33	47,20	45,43	47,39
3. Transport	125,55	37,43	79,83	129,09	123,92	126,46	121,81
4. Other sectors	1 036,62	224,89	306,03	378,07	384,05	410,72	581,21
5. Other sources	64,70	20,86	38,45	26,08	72,13	89,64	72,62
B. Fugitive emissions	46 545,03	17 701,47	21 634,04	26 934,61	26 351,67	29 586,48	30 525,30
1. Coal	Көмір	14 614,79	15 807,17	19 827,16	19 762,62	22 395,62	22 735,45
2. Oil and gas	Мұнай және газ	3 086,69	5 826,87	7 107,45	6 589,05	7 190,85	7 789,85
2. Industrial processes	47,39	26,15	28,66	30,89	26,80	26,53	27,96
B. Chemical industry	47,39	26,15	28,66	30,89	26,80	26,53	27,96
4. Agriculture	23 084,48	9 359,60	12 555,93	14 000,09	14 257,53	14 548,14	13 659,67
A. Enteric fermentation	21 372,36	8 643,13	11 614,41	12 990,75	13 221,02	13 487,79	12 668,89
B. Manure treatment	1 555,87	624,08	833,57	913,58	926,89	941,91	873,60
C. Rice cultivation	156,24	92,40	107,94	95,76	109,62	118,44	117,18
5. LULUCF	0,35	7,04	4,39	1,97	0,71	1,93	0,82
A. Forest land	0,35	7,04	4,39	1,97	0,71	1,93	0,82
6. Waste	2 351,60	2 752,67	3 037,81	3 278,46	3 365,34	3 465,16	3 572,44

Sources	1990	1999	2005	2008	2009	2010	2011
A. Waste landfills	2 351,60	2 752,67	3 037,81	3 278,46	3 365,34	3 465,16	3 572,44
International bunker	-	-	-	-	0,03	0,02	0,02
Aviation	-	-	-	-	0,03	0,02	0,02
Total methane emissions, excluding international bunker	73 328,12	30 175,45	37 753,05	44 852,23	44 654,75	48 328,40	48 636,09

By 2011, total methane emissions reached the level of 48,636.09 Gg of CO_2 equivalent but still were 32% below the base year level. Larger methane emissions are mainly associated with the increase in coal production which is still the easiest to produce and cheapest energy source in Kazakhstan; therefore its percentage in the energy balance remains high.

The key source of CH_4 in Kazakhstan's inventory is 'Energy' sector (47,844.31 Gg of CO_2 equivalent and 31,375.21 Gg of methane in 1990 and 2011 or 65% and 64% respectively), inside of which methane contribution is 97%-98%, due to activities associated with production, transportation, storage and processing of coal, oil and gas (Fugitive emissions). This source accounts for 62% of total national emissions of methane; about 80% of these emissions are due to coal-associated activities.

The sector of Agriculture is ranked second for methane emissions (23,084.48 Gg, or 31%, in 1990 and 13,659.67 Gg of CO_2 equivalent, or 28%, in 2011). In this sector over 92% of methane emissions come from the subcategory of Livestock enteric fermentation. In 1990-2011, methane emissions from this subcategory reduced by almost 40%, which was due to considerable reduction in livestock number in Kazakhstan over this period.

The sector of Waste has a relatively minor contribution into total methane emissions (3% in 1990 and 7% in 2011) and such emissions are entirely due to methane generation at waste landfills. Emissions from this sector increased from 2,351.60 Gg of CO_2 equivalent in 1990 to 3,572.44 Gg of CO_2 equivalent in 2011, or more than twofold. This was due to increased solid municipal waste and larger urban population.

3.2.3. Nitrous oxide (N_2O)

In 1990, N_2O emissions were 16,319.82 Gg of CO_2 equivalent, then those emissions reduced to a minimum in 2001, and subsequently started increasing, however, in 2011 emissions were still below the base year by 54%, and were 8,936.54 Gg of CO_2 equivalent (Table 3.4).

Table 3.4

N_2O emissions by sources, Kazakhstan, Gg of CO_2 equivalent

Sources	1990	1999	2005	2008	2009	2010	2011
Energy	871,07	357,11	573,17	572,89	672,70	731,50	676,70
A. Fuel combustion (sectoral approach)	871,07	357,11	573,17	572,89	672,70	731,50	676,70
1. Power sector	434,25	195,78	322,63	320,12	347,20	373,80	369,22
2. Processing industry and construction	63,75	76,81	96,81	109,09	107,84	103,22	108,32
3. Transport	35,04	7,50	19,48	35,62	34,19	33,97	32,91
4. Other sectors	211,21	30,80	40,41	48,64	48,52	51,08	63,36
5. Other sources	126,82	46,21	93,84	59,42	134,95	169,43	102,88
4. Agriculture	15 060,03	4 873,07	6 535,92	7 262,17	7 729,58	7 747,82	7 773,02
B. Manure treatment	5 678,23	2 222,65	2 978,85	3 311,97	3 384,95	3 448,59	3 256,10
D. Agricultural land	9 381,81	2 650,41	3 557,07	3 950,20	4 344,62	4 299,23	4 516,92
5. LULUCF	0,10	2,08	1,30	0,58	0,21	0,57	0,24
A. Forest land	0,10	2,08	1,30	0,58	0,21	0,57	0,24
6. Waste	388,62	305,66	435,14	464,99	470,81	482,73	489,57
B. Wastewater	388,62	305,66	435,14	464,99	470,81	482,73	489,57
International bunker	-	-	-	-	5,71	4,76	4,08
Aviation	-	-	-	-	5,71	4,76	4,08
Total nitrous oxide emissions excluding international bunker	16 319,82	5 537,91	7 545,53	8 300,63	8 873,30	8 962,61	8 939,54

The contribution of nitrous oxide into total national greenhouse gas emissions ranged from 3% to 5% in different years (Table 3.2). In 2011, the contribution of N_2O into total national GHG emissions in Kazakhstan was 3.2%. Since 1990, the level of nitrous oxide emissions has reduced by 45%.

Major source of nitrous oxide emissions is Agriculture (categories of Agricultural soil and Manure collection, storage and treatment systems). In 1990 and 2011, these two categories accounted for 92% and 87% of total emissions of nitrous oxide, respectively, and almost entirely determine their trends. In 1990, nitrous oxide emissions from category of Agricultural soil accounted for 62% of total N_2O emissions. In 2011, its percentage reduced to 58% due to the reduction in the use of mineral fertilizers. At the same time, emissions from Manure collection, storage and treatment systems increased due to expanded livestock, from 38% to 42%. The contribution of Waste sector into total national emissions of nitrous oxide, where N_2O emissions come entirely from sanitary wastewater, increased from 2% to 5% in 1990-2011, which is due to increased population and consumption of protein.

3.2.4. Fluorinated gases (HFCs, PFCs, SF_6)

Emissions of fluorinated gases in the Republic of Kazakhstan, as compared to emissions of major greenhouse gases, even though such gases have high potential global warming potential, are much less than emissions of CO_2, CH4 and N_2O in all years of inventory. In accordance with Article 3, Paragraph 3 of the Kyoto Protocol, the base year for HFCs, PFCs and SF6 is 1995. Since fluorinated gases are not produced in Kazakhstan but rather imported, emissions from such gases are estimated from consumption only.

In 1995, emissions of fluorinated gases were negligible, being only 0.21 Gg of CO_2 equivalent, and included HFCs only (HFC-134a). Its consumption has been considerably increasing since 1998 and in 2011 it was estimated at 843,000 tonnes of CO_2 equivalent. Major source of emissions here is HFC consumption in fixed refrigeration equipment. Its use in vehicle air conditioning is below 1 per cent.

Emissions of PFCs in Kazakhstan are due to anode effects in the electrolytic production of aluminium, starting from 2007, when such production was started in Kazakhstan. PFCs emissions were 87.17 Gg of CO_2 equivalent in 2007, and increased 15-fold in 2011, reaching the level of 1,328.41 Gg of CO_2 equivalent, which is due to increased aluminium production.

Major source of sulphur hexafluoride (SF6) in Kazakhstan is refilling of electrical equipment installed in 2004, after which SF6 emissions started rising sharply and in 2009 increased over 7-fold (from 0.45 to 3.31 Gg of CO_2 equivalent). In 2010 and 2011, no equipment was refilled, thus, there were no SF6 emissions.

3.3. Gas emission trends by gas and source

3.3.1. Energy

Energy sector makes the largest contribution into в total national GHG emissions in Kazakhstan: in 1990-2011 its contribution, excluding carbon removals by forests, ranges from 82% to 86%. In 1990, this sector contributed 83% into total national GHG emissions, excluding LULUCF, and 84% in 2011. GHG emissions from Energy sector come from two categories: Fuel combustion and Fugitive emissions. The contribution of Fugitive emissions is 18% and 14% in 1990 and 2011, respectively. The contribution of Fuel combustion is 82% and 86%, respectively. Major contribution into emissions by this sector is made by such subcategory as Power sector (46% in 1990 and 47% in 2011). Major contributor in the category of Fugitive emissions is coal (72% in 1990 and 69% in 2011), whereas oil and gas sector accounts for 28% and 31% in 1990 and 2011, respectively.

In 2011, emissions from Energy sector are still 22% below the base level (1990). Emissions in 2010 in the category of Fuel combustion, from three categories were below the 1990 level, with the exclusion of subcategory of Processing industry and construction, where in 2011 emissions increased by 20%, which is due to recent outstripping growth in these sectors of the national economy, as well as the subcategory of Other sources where emissions increased by 16% (Table 3.5). The downward difference between 2011 and 1990 in the category of Fugitive emissions is 37%.

Table 3.5

Changes in emissions from subcategories of sources, Fuel combustion category, Kazakhstan, Gg of CO_2 equivalent

Subcategories of sources	1990	2011	Difference, %
1. Power sector	113 986,95	94 053,28	-17
2. Processing industry and construction	21 988,24	26 448,25	20
3. Transport	22 651,50	20 065,11	-11
4. Other sectors	52 995,82	17 439,95	-67
5. Other sources	35 392,31	41 111,68	16

Figure 3.2

Contributions of subcategories into GHG emissions from Fuel combustion category

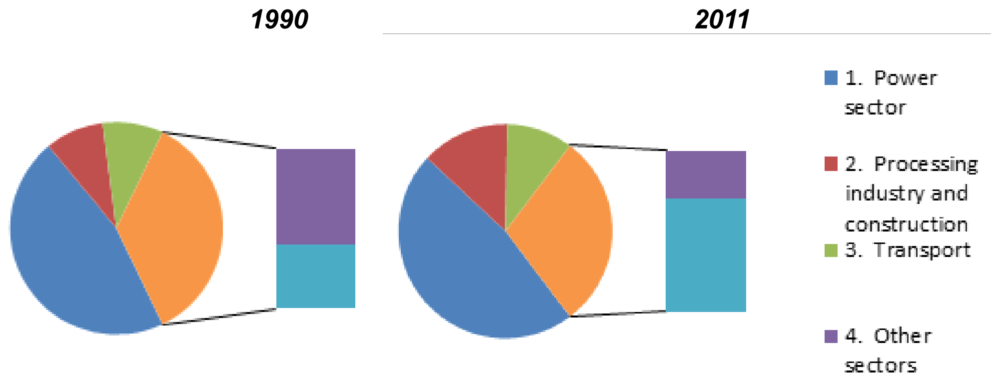
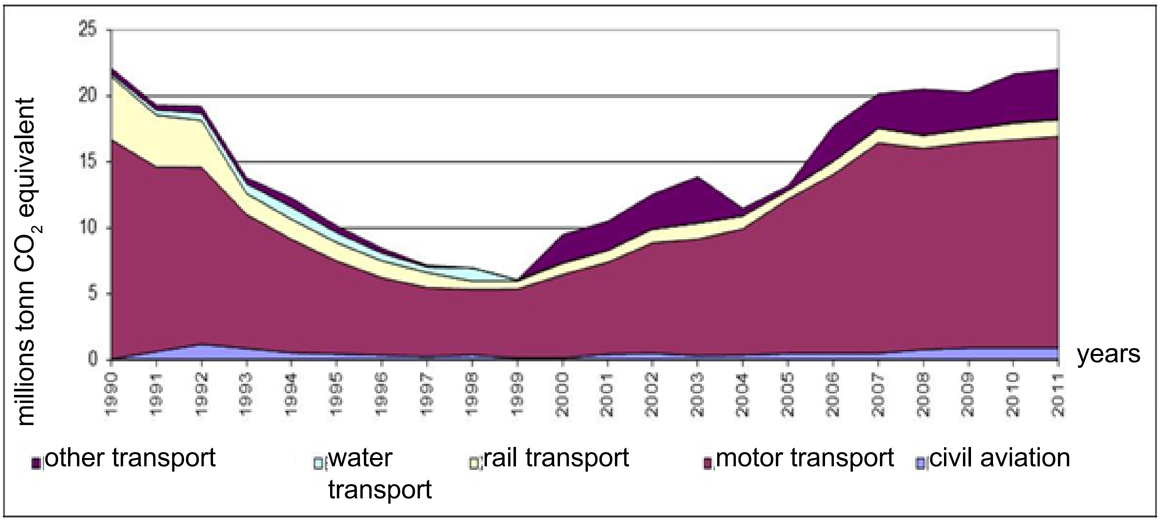


Figure 3.2 demonstrates changes in the distribution of emissions from Fuel combustion subcategories in 2011, as compared to 1990.

Figure 3.3

GHG emissions in Transport subcategory, Kazakhstan, Gg of CO_2 equivalent



Total greenhouse gas emissions from transport were reducing in 1990-1999 due to severe economic crisis in the country (Figure 3.3). Emissions have been increasing since 1999, mainly due to larger fleet of motor vehicles, however, such emissions are still 11% below the base level in 1990

3.3.2. Industrial processes

In 2011, emissions in the sector of Industrial processes were 14,565 Gg of CO_2 equivalent, which is 4.2% below than in 1990. The sector of Industrial processes in Kazakhstan includes four major subcategories of sources: Production and consumption of mineral products (soda, limestone, lime, and cement), Manufacture of chemicals (calcium carbide and ammonia), Metal fabrication (aluminium, ferroalloys, cast iron and steel) and Use of PFCs, HFCs and SF_6.

Figure 3.4

Greenhouse gas emissions from Industrial processes, Kazakhstan, 1990-2011

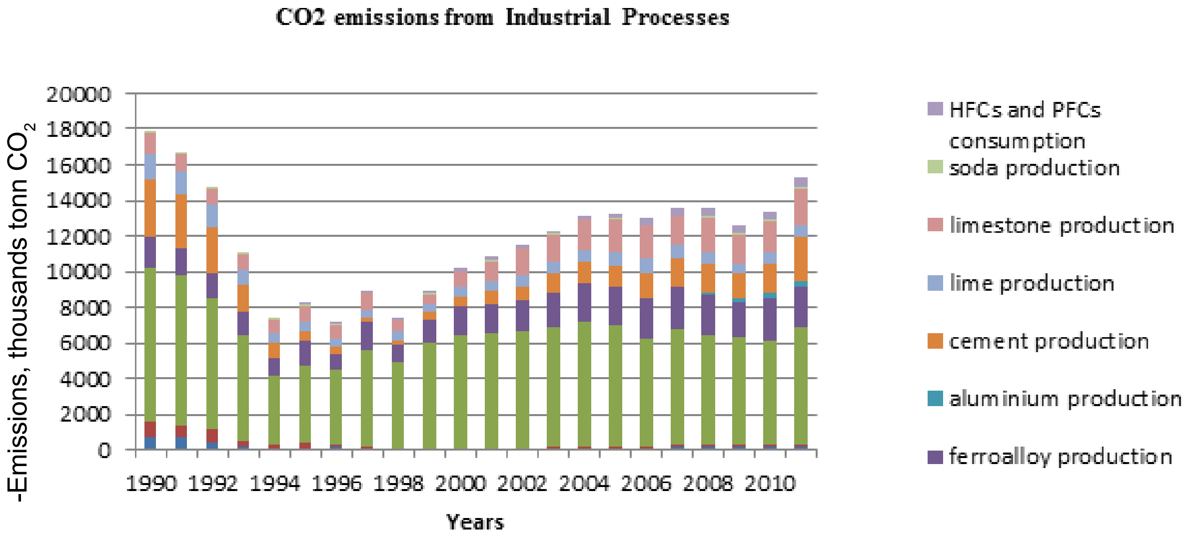


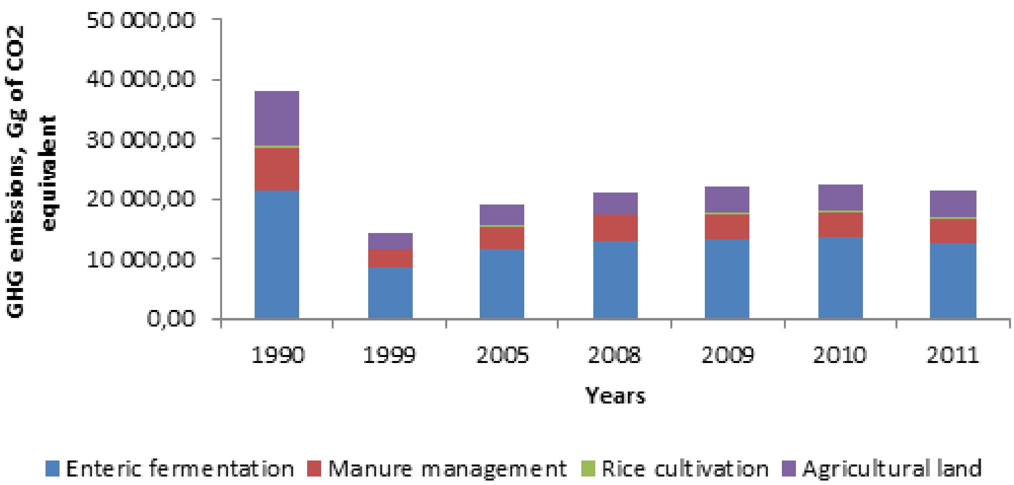
Figure 3.4 demonstrates that in 1990-1999 greenhouse gas emissions from this sector were steadily reducing due to the overall drop in industrial production in Kazakhstan, as well as due to the closure of many enterprises. From 2000 there was a growth in the output of key products associated with the economic recovery and growth in industrial production. Therefore emissions in industrial sector gradually started increasing from 2000 and reached maximum levels in 2007-2008. In 2009, there was again a decline in outputs and emissions, mainly in metal industry due to the global crisis and the decline in demand and prices for metals, which then again increased in 2010-2011.

3.3.3. Agriculture

Agricultural sector in Kazakhstan is the source of emissions of methane and nitrous oxide. Maximum level of nitrous oxide emissions from Agriculture was seen in 1993, specifically 20,543.7 Gg of CO_2 equivalent, mainly due to N-fertilization of arable land. Total emissions of methane and nitrous oxide from Agriculture in Kazakhstan were 27,258.54 Gg of CO_2 equivalent in 2010, which is 70% of the maximum level of 38,537.88 Gg of CO_2 equivalent in 1990.

Figure 3.5

GHG emissions in Agriculture



Changes in GHG emissions from Agriculture in Kazakhstan (Figure 3.5) are mainly driven by changes in methane emissions from livestock enteric fermentation and nitrous oxide emissions from agricultural land. In 1990, total GHG emissions from Agriculture were at the maximum level, specifically 38,144.51 Gg of CO_2 equivalent. Until 1998, such emissions were reducing due to severe livestock reduction and achieved minimum levels in 1998, comprising 35% of emissions in 1990 (13,507.3 Gg of CO_2 equivalent). In 2011, total emissions from the sector were 44% below the 1990 level. Emissions of nitrous oxide from agricultural land almost halved in 2001 due to the reduction in N-fertilization and then started to increase slowly. In 2011, total emissions of nitrous oxide from the sector were 21,432.69 Gg of CO_2 equivalent, which represents 56% of emissions in 1990.

3.3.4. Land use, land-use change and forestry

GHG emissions and removals in LULUCF in Kazakhstan calculated for natural pastures, forests, trees and shrubs, hayfields and perennial plantations over the period of 1990-2011 are characterized by negative values, i.e. these are sinks. In 1990-1998, carbon stocks in plant biomass demonstrate positive trends, along with negative trends for hayfields and perennial plantations. Total carbon stocks accumulated by plants in the process of photosynthesis in 'biomass' for these categories of land use increased from 2,470.88 Gg of CO_2 equivalent in 1990 up to 2,593.92 Gg of CO_2 equivalent in 2011. This is mainly due to the rehabilitation of natural vegetation and reduced anthropogenic load on pasture ecosystems since mid 1990s, increased areas of young forest plantations in the beginning of 1990s and afterwards as well as reforestation efforts.

Annual changes in carbon stocks in plant biomass in the period from 1990 to 2011 for land categories, including pastures and hayfields, forests, trees and shrubs as well as perennial plantations are negative (-), i.e. these categories represent net removals of carbon dioxide. Maximum removals (up to 14,667,000 tonnes per annum) were in 1995 – 2002.

Figure 3.6

Annual changes of carbons stocks in biomass (CO_2 net removals (-) / emissions (+)) for different categories of land use in Kazakhstan, 1990-2011

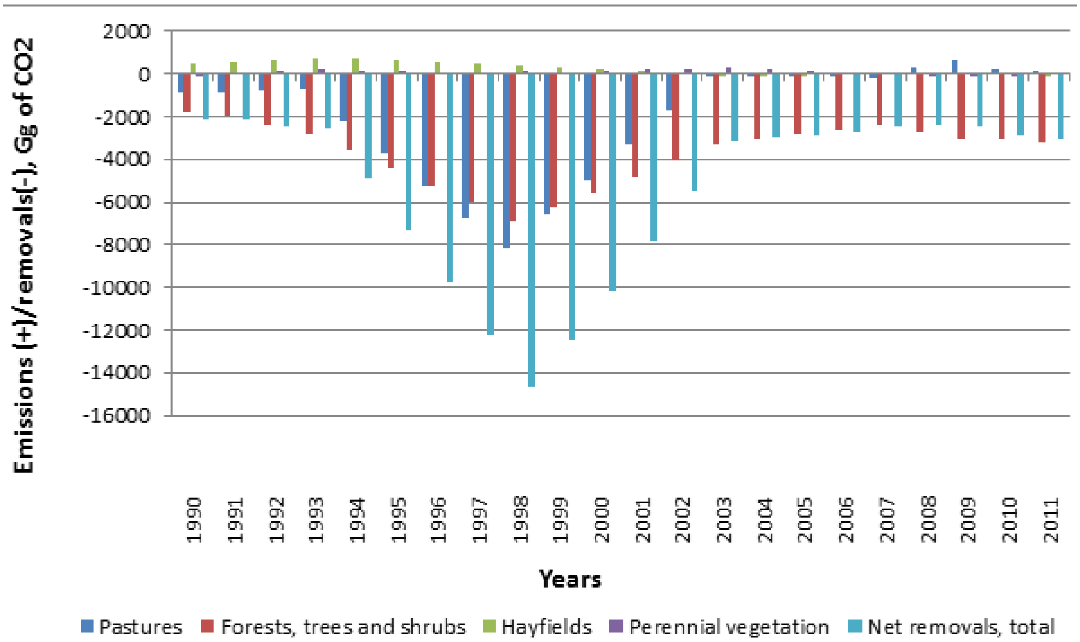


Table 3.6

CO_2 emissions (+) and removals (-) in LULUCF, Gg

Year	Pastures	Forests, trees and shrubs	Hayfields	Perennial plantations	Total, net removals
1990	-886	-1773	+504	-12	-2167
1991	-836	-1953	+589	+60	-2140
1992	-785	-2374	+674	+132	-2453
1993	-735	-2802	+759	+204	-2574
1994	-2231	-3563	+697	+166	-4931
1995	-3726	-4371	+631	+127	-7339
1996	-5221	-5242	+565	+88	-9810
1997	-6716	-6027	+500	+49	-12194
1998	-8211	-6959	+403	+100	-14667
1999	-6585	-6227	+311	+69	-12432
2000	-4959	-5567	+217	+129	-10180
2001	-3333	-4846	+123	+189	-7867

Year	Pastures	Forests, trees and shrubs	Hayfields	Perennial plantations	Total, net removals
2002	-1707	-4104	+29	+249	-5533
2003	-83	-3319	-65	+309	-3158
2004	-103	-3068	-36	+208	-2999
2005	-123	-2842	-7	+107	-2865
2006	-143	-2602	+22	+6	-2717
2007	-162	-2365	+51	+32	-2444
2008	+324	-2703	+25	-68	-2422
2009	+601	-3025	0,0	-58	-2482
2010	+224	-3058	0,0	-57	-2891
2011	+136	-3215	-15	0	-3094

3.3.5. Waste

Waste sector in Kazakhstan represents GHG emissions from the following sources: methane (waste landfills), nitrous oxide (sanitary wastewater) and carbon dioxide (medical waste incineration). In 2011, total GHG emissions from these activities in Waste sector were 4,066.96 Gg of CO_2 equivalent, which is 111.00 Gg of CO_2 equivalent, or 2.73%, more than in 2010. As compared to the base year of 1990, in 2011 emissions in the sector increased almost 1.5-fold, or by 48.41%, specifically 1,326.74 Gg of CO_2 equivalent, mainly due to increased generation of municipal solid waste. Population has also increased. In 1990, the population was 16,618,000, in 2001 it achieved the minimum of 14,851,000 and by 2011, for the first time it exceeded the level of 1990 and became 16,675,000. In 2011, urban population was 9,115,000, whereas in 1990, it was 9,523,000.

In 2011, emissions from Waste sector contributed 1.47% into total national net emissions, excluding removals by LULUCF. The increase in total emissions of greenhouse gases in Waste sector is mainly driven by disposal of municipal solid waste at managed landfills in Almaty and Astana due to considerable increase in the populations of these cities.

The largest contribution into total emission by Waste sector is made by disposal of municipal solid waste, ranging from 80% to 85% in all years of inventory, as for subcategories, the largest contribution is made by unmanaged landfills of municipal solid waste, from 65% to 68%.

The contribution of nitrous oxide emissions from wastewater due to increased protein consumption into total emissions by Waste sector ranges from 10% to 15% throughout the period; in the base year of 1990 these emissions contributed 14%, and in 2011 its contribution was 12%. In 2011, CO_2 emissions from medical waste incineration accounted for 5.8% of total emissions by Waste sector. However, in 2006-2006 when this practice was introduced in Kazakhstan not much medical waste was incinerated.

3.4. National greenhouse gas inventory system

3.4.1. National greenhouse gas inventory system, including institutional arrangements

The national GHG inventory system in Kazakhstan is set by the Rules of Maintaining State Cadastre of Sources of Greenhouse Gas Emissions and Removals (hereinafter, the Rules). These Rules were developed in accordance with Article 158-2 Para 3 of the Ecological Code of the Republic of Kazakhstan dated 9 January 2007 and set the procedures for maintaining the state cadastre of sources of greenhouse gas emissions and removals (hereinafter, state cadastre). The rules were approved by the RK Government Resolution No. 943 dated 17 July 2012. The authorized body responsible for environmental protection provides for the development and maintenance of the state cadastre. The state cadastre is maintained by a specialized entity conducting climate change and GHG emission related research (JSC Zhasyl Damu) as identified by the authorized body responsible for environmental protection.

Annual state cadastre is prepared within 12 months following a reporting year and such preparation starts on 15 April of the year following the reporting one. The authorized body responsible for environmental protection approves annual plans of the preparation of the state cadastre on an annual basis in the first half of the year following the reporting one. The preparation of the state cadastre involves the use of information and data on economic outputs and activities resulting in anthropogenic emissions from sources and removals by greenhouse gas sinks; such data are submitted by government authorities and the list can be found in Annex to the Rules.

Maintenance of annual state cadastre involves the collection of information containing primary data for estimating GHG emissions and removals, analysis and processing of collected data, calculations and the preparation of the state cadastre.

For the preparation of the state cadastre the authorized body responsible for environmental protection identifies a list of government authorities which have data required for preparing the state cadastre. Government authorities are to submit the requested data within a month after receiving such a request

3.4.2. Description of recalculations

In order to improve estimates of emissions and quality of information on GHG inventory in Kazakhstan as well as in response to the comments of the UNFCCC Secretariat's international expert group reviewing national inventories, recalculations of GHG emissions were made in such sectors as Energy, Industrial processes, Agriculture and Waste. As a result, total national GHG emissions without LULUCF were reduced by -0.48% in 1990 and increased by 8.85% in 2010

Energy

As the data on produced oil and gas were refined, GHG emissions were recalculated for all categories of the Energy sector. Therefore as compared to the 2012 inventory, estimates of CO2 emissions in 2010 from Energy sector increased by 16.77%, and in 1990 such emissions increased by 0.18%. As for emissions of methane and nitrous oxide, relative increase is insignificant. In Transport category fuel balance was refined and GHG emissions were also recalculated. As a result, the estimates of emissions for the base year of 1990 increased by 2% and the contribution of these changes into total national emissions was only 0.12%.

Industrial processes

Recalculations were made in the category of Mineral Products from calcium carbide in response to experts' comment to the 2012 inventory saying that estimates take into account production only and leave out its utilization. As a result, CO2 emissions from this subcategory were increased by 30%, and such change in the estimates corresponds to 0.02% only in total national emissions.

Metal fabrication. The data on the content of carbon in coke, cast iron and steel, as well as the data on cast iron consumption for manufacturing each type of steel (Martin steel, oxygen blown steel and electrical steel) were refined. These recalculations resulted in refined estimates of CO_2 emissions. As a result, CO_2 emissions from this source increased by 1.19% in 2010.

Agriculture

Enteric fermentation. As national emission ratios were set for cattle, methane emissions were calculated at Level 2 in 2009, and such emissions reduced by 0.27%.

LULUCF

Changes in the estimates of emissions and removals in the sector resulted from the rectification of methodological mistakes specified in the comments to the 2012 report. Therefore the estimation methodology was modified and all emissions and removals by all categories of LULUCF were recalculated. As a result, removals in 2010 almost halved, however, it had immaterial effect on the total national emissions (1.11%), whereas for 1990 such changes resulted in just 0.61% reduction of emissions.

Wastes

Recalculations were made for Waste landfills category because in accordance with review experts' recommendations for the first time calculations were made under Level 2 methodology, as for a key source. As a result, methane emissions reduced. In 2010, the reduction of emissions within the category was 12.88%, with a 0.18% reduction in total national emissions. In 1990, such reductions were 35% and 0.36 %. Recalculations were also made for methane emissions from wastewater, which are not estimated from 2011 because the applied wastewater treatment technology does not result in significant methane emissions. Recalculations of nitrous oxide emissions from wastewater were due to the usage of FAO data on protein consumption by people. This resulted in reduced estimates of nitrous oxide emissions from the source by 16.43% and total national emissions by 0.02% in 1990, whereas 2010 estimates were reduced by 7.39% and 0.01%, respectively

3.4.3. Overview of existing quality assurance/quality control system

In accordance with the RK Government Resolution No. 943 dated 17 July 2012, on Approval of the Rules of Maintaining State Cadastre of Sources of Greenhouse Gas Emissions and Removals, the maintenance of annual state cadastre includes quality assurance and quality control (QA/QC) of the state cadastre as well as submission of the state cadastre for evaluation of its compliance with the international treaty of the Republic of Kazakhstan on reduction of greenhouse gas emissions.

The state cadastre is submitted for evaluation of its compliance with the international treaty of the Republic of Kazakhstan on climate change by a specialized entity. Such specialized entity arranges activities. Quality assurance activities involve external institutions, specialists of sectoral government authorities and independent quality assurance experts prior to submission of the state cadastre to the authorized body responsible for environmental protection through cross validation and in accordance with QA/QC Schedule. QA/QC Schedule is presented in the table 21 of annex 3.

3.5. National Register of Carbon Units

Since Kazakhstan is not listed in Annex B of the Kyoto Protocol, it cannot utilize Kyoto Protocol's mechanisms. Nevertheless, after Kazakhstan ratified the Kyoto Protocol in 2009, it started activities to launch the National Register of Carbon Units based on Seringas software.

The following activities have been performed to ensure maintenance of the National Register of Carbon Units which enables the National GHG Emissions Quota Allocation Planning:

- quota registration module described;
- conditions created to enable quota auction trading, to put up quotas for tenders and to carry out pricing policies, to purchase quotas through auctions and out of auctions, transfer from user to user;
- system created to register quota units and history (assignment of unique numbers to quota units);
- conditions created to apply quota encryption schemes;
- materials reviewed to assess the possibility of linking SWIFT modules (bank codes);
- working meetings held with representatives of commodity exchanges. Meetings were to discuss the possibilities for exchanges to connect to the Register and to communicate data through VPN secure channel;
- register tested after new version was optimized and Patch ver. 5.0.0.0 update was installed;
- quota trading platform operability tested in new software similar to Seringas;
- activities ongoing to introduce the National Quota Allocation Plan to the Register of Carbon Units through operator assignment.

IV. POLICIES AND MEASURES, INCLUDING THOSE UNDER ARTICLE 2 OF THE KYOTO PROTOCOL AND NATIONAL AND REGIONAL PROGRAMS AND / OR LEGAL SECURITY, LAW ENFORCEMENT AND ADMINISTRATIVE PROCEDURES

4.1. Decision making process

Under the current system of state planning, formed in 2010, strategic directions of government agencies and organizations are defined as part of the five-year strategic plans. They are developed by public bodies - the administrators of budget programs and cover the entire scope of their activities, including the activities of subordinate organizations.

4.1.1. Ministry of Environment

4.1.1.1. Strategic areas of activity

Strategic areas of activity of the Ministry of Environment are defined in the plans for 2010-2014[1] and 2011-2015[2]. In the MoE Strategic Plan for 2010-2014 the MoE activity is integrated into area 2 «Creating mechanisms of transition for the Republic of Kazakhstan to the sustainable development» and aims to achieve the following objectives:

2.1. Forming tools of balanced development;

2.2. Deepening international environmental cooperation and formation of zones of sustainable development;

2.3. Targeting the economy and creating conditions for the effective use of renewable resources and energy;

2.4. Reducing greenhouse gas emissions.

In the scope of pursuing objective 2.1 to form tools for balanced development, energy consumption of the economy is planned to be reduced by 10% by 2014 as compared to 2008.Implementation of objective 2.3 will ensure creation of mechanisms to promote the use of renewable energy and the projects on the use of renewable energy, energy conservation and efficiency starting from 2011. Assessment of the implementation of the above measures defined the target indicator «the proportion of the use of alternative sources of energy to the total energy consumption» and an increase in its quantitative value from 0.03% in 2010 to 0.1% in 2014.

Specific goal of the MoE Strategic Plan for 2010-2014 is objective 2.4 - reducing greenhouse gas emissions. Its achievement is associated with the fulfillment of the country's commitments to reduce greenhouse gas emissions under the Kyoto Protocol and in the post-Kyoto period. For this purpose arrangements were defined to develop regulations to implement the Kyoto Protocol, provide training for its flexibility mechanisms and realize projects on the joint implementation mechanism. 4 training seminars (courses) are planned to conduct before 2014 to train on the mechanisms of the Kyoto Protocol, and, besides, it is planned to start implementation of 40 joint implementation projects and adopt 5 regulatory legal acts. Common target code for reducing the greenhouse gas emissions relative to 1992 is scheduled at the level of values shown below in table 4.1

Table 4.1

Values of the greenhouse gas emissions target code

Target code	Years				
	2010	2011	2012	2013	2014
Greenhouse gas emissions, % relative to 1992	82	87	90	92	94

Sources: MoE Strategic Plan for 2010-2014

As a preliminary assessment of the progress with the achievement of planned objectives it should be noted that strategic objective 2.4 to limit greenhouse gas emissions will be, apparently, implemented. According to the data of the national inventory of greenhouse gas emissions excluding CO_2 absorption by forests in 2011 emissions amounted to 76.7% of the level of emissions in 1990 and compared to 2010 decreased by 3.87%. in 2010 greenhouse gas emissions totaled 80.05 % relative to the level of 1992. Of course, this is due to the fact that the goal to limit emissions by 2014 was not ambitious. On the other hand a number of activities planned to achieve it were quite successfully implemented in practice. So every year since 2009 in

[1]Approved by Decree No 127of the Government of the Republic of Kazakhstan on February 25, 2010

[2]Approved by Decree No 98 of the Government of the Republic of Kazakhstan on February 8, 2011.

Kazakhstan, training events are held on the flexibility mechanisms of the Kyoto Protocol, including on the basis of JSC Zhasyl Damu on a sustained basis. In order to implement the Kyoto commitments in 2011-2012, a number of significant legislative amendments were applied to the Environmental Code and other laws and regulations package aimed at regulating greenhouse gas emissions.

At the same time strategic objective 2.3 to target the economy and create the conditions for the effective use of renewable resources and energy sources has not been achieved, although the main measures for it were planned to be taken in 2011. Mechanism to promote the use of renewable energy sources is not yet developed and the planned large-scale projects to build wind farm and solar installation is still under development.

The MoE Strategic Plan for 2011-2015 places more emphasis on the activity of this public authority in the sphere of climate change as compared to the Strategic Plan for 2010-2014. This document defines two strategic activity areas for the Ministry of Environment:

1. Stabilization and improvement of quality of the environment;
2. The transition of the Republic of Kazakhstan to the low-carbon development.

Specific goals, objectives, activities, target indicators relating to activities in the field of climate change, are integrated into the second strategic direction for the transition to a low-carbon development. It is, in turn, focused on achieving strategic objective 2.1. Creating the conditions for the functioning of the market for the trading of greenhouse gas emissions and strategic objective 2.2.Creating the conditions for the formation of the principles of «green» economy

In summary, the objectives and main activities according to the strategic objectives are presented in Table 4.2.

Table 4.2

The goals, objectives and activities for the transition to low-carbon development

Strategic goal and objective	Activity
Objective 2.1. Creating the conditions for the functioning of the market for the trading of greenhouse gas emissions Goal 2.1.1. Introduction of market mechanisms to reduce greenhouse gas emissions	Creation and maintenance of the public registry of carbon units
	Improved methods of the inventory of greenhouse gas emissions by sources of emissions
	Creation and maintenance of the public cadastre of greenhouse gas emissions
	Implementation of the projects to reduce greenhouse gas emissions and adapt to climate change
	Preparation of the Third National Communication to the UNFCCC
	Maintenance of the trading market for greenhouse gas emissions
Objective 2.2. Creating the conditions for the formation of the principles of "green economy" Goal 2.2.1. Introduction of "green" technologies and creation of a system of resource saving	Development of Program for the planning and development of sectors of the economy of the Republic of Kazakhstan in connection with the transition to a low-carbon development in 2011
	Improving the regulatory framework and its harmonization in accordance with the best international practices in relation to climate change in 2014
	Organization of public campaigns to promote energy efficiency, implement renewables
	Development of communication mechanisms for introducing and implementing the principles of "green growth"

Sources: MoE Strategic Plan for 2011-2015

Implementation of strategic objective 2.1 is expected by way of incremental steps in the implementation of the national market mechanism for reducing greenhouse gas emissions. These steps include:

1) carrying out of inventory of greenhouse gas emissions at the level of industrial plants of the enterprises, followed by the inclusion of relevant data to the state inventory of sources of greenhouse gas emissions;

2) establishment of the State registry of carbon units;

3) development and progressive extension of emissions trading market for greenhouse gas emissions;

4) achievement in the trading market for greenhouse gas emission reduction in the current level of greenhouse gas emissions.

As a first step, requirements are established for monitoring and evaluation of emissions of greenhouse gases at large industrial installations. They have been introduced in Kazakhstan since 2008 and in the MoE Strategic Plan in 2011 - 2015 it was planned to gradually increase the number of regulated facilities from 768 in 2010 to 1,600 in 2015. At the same time the necessary basis is envisaged for further operations with carbon units including their issuance, transfer, sale in certain cases - the removal from circulation and void conversion. This activity requires, above all, the creation of appropriate public registry of carbon units as information hardware system for carrying out various operations with carbon units (units of quotas and emission reduction units) in Kazakhstan. The Strategic Plan for 2011-2015, MoE plans to launch in 2013 a national cap-and-trade system of greenhouse gas emissions based on the limitation of emissions of greenhouse gases at a level of enterprises and their units to certain basic level (quota). The enterprises will be able to trade quotas with each other that will allow the enterprises, which have deficit of quota, purchase it from those having an excess of quotas. The ultimate goal of such a system of quotas and trade is to achieve a reduction of the total emissions from the sectors and installations with set quota.

The Strategic Plan of the MoE for 2011 - 2015 years, plans to reach by 2015 reduction of greenhouse gas emissions in the energy sector of the economy through market mechanisms to reduce greenhouse gas emissions by 3% compared to the emissions from this sector in 2012.Another important target indicator to assess the impact of steps to create the conditions for the functioning of the market for the trading of greenhouse gas emissions is the number of units covered by its requirements. It was originally planned that the number of industrial units should reach 180 in 2013, and in 2014 and 2015 it should be expanded by 10%, ie to about 200 units. In practice, a project of the National allocation plan for greenhouse gas emissions for 2013 posted on the web-site of MoE in July 2012 listed 177 plants. Along with the above mentioned measures, the achievement of the strategic goal of creating the conditions for the functioning of the market for the trading of greenhouse gas emissions was associated with the creation of an appropriate legal framework for this, enhancing the methods of inventory of greenhouse gas emissions by sources of emissions and implementation of projects to reduce greenhouse gas emissions.Legislative measures were scheduled for 2011-2012, the improvement of methods - by 2011, and work on projects for the entire period from 2011 to 2015.

Objective 2.1 of the MoE Strategic Plan for 2011 - 2015 also integrated activities to prepare the Third National Communication under the United Nations Framework Convention on Climate Change (UNFCCC) and to adapt to climate change. Works on the National Communication are scheduled for 2014, the implementation of adaptation measures - for the entire period from 2011 to 2015. It should be noted that adaptation aimed at reducing the vulnerability of natural and human systems to existing and expected climate changes were not elaborated under the MoE Strategic Plan for 2011-2015. They are only mentioned in the context of strategic objective 2.1 as projects on adaptation to climate change. However, the question remains open as to how and in which sectors they should be designed and implemented.

Achieving objective 2.2 of the MoE Strategic Plan for 2011-2015 to create the conditions for the formation of the principles of «green economy» includes the following activities that are directly related to the activities to mitigate climate change:

- Developing the Program for the planning and development of sectors of the economy of the Republic of Kazakhstan in connection with the transition to a low-carbon development in 2011;
- Improving the regulatory framework and its harmonization in accordance with the best international practices in relation to climate change in 2014;
- Conduct public campaigns to promote energy efficiency, introduce renewable energy sources in 2011;
- Development of communication mechanisms for introducing and implementing the principles of «green growth» in 2012.[3]

The following are the target indicators for evaluating the effectiveness of these measures: database availability and developed documents on best available techniques, a number of investment projects on clean technologies and a number of relevant social projects implemented by non-governmental organizations (NGOs).

As a preliminary assessment of the implementation of objectives 2.1 and 2.2 of the MoE Strategic Plan for 2011-2015 we should note substantial progress towards the achievement of the first of them. For the reporting 2010 inventory of greenhouse gas emissions covered more than 2,000 plants, exceeding the targets set for 2015 (1,600 plants). Another example - on December 3, 2011 a package of amendments was adopted to the Environmental Code, the Administrative Code and other applicable laws providing for the introduction of the quota system in the country and greenhouse gas emissions trading from 2013. In order to implement the new legal provisions in the May-July 2012 more than 30 regulations were adopted at the level of Government decisions and orders of the Ministry of Environment. In accordance with the MoE Strategic Plan measures were taken to improve the methodology for conducting the inventory of greenhouse gas emissions by sources of emissions and creation of a public registry of carbon units. In particular, on November 5, 2011 the Ministry of Environment approved a package of 19 procedures and guidelines for the calculation of greenhouse gas emissions from various activities.

The hardest bottleneck in terms of implementation in the case of objective 2.1 of the Strategic Plan for 2011-2015 MoE are projects to reduce greenhouse gas emissions and adapt to climate change. At present JSC Zhasyl Damu of the Ministry of Environment identified a list of potential projects to reduce greenhouse gas emissions and increase their absorption. However, up until recently, no mechanism has existed in the country to implement such projects in Kazakhstan since they can not be carried out either as the joint implementation mechanism or Clean Development Mechanism.[4] At present, they can be carried out as the internal mechanism to reduce emissions

[3] «Green» economic growth is defined in the Strategic Plan of the MoE for 2011-2015 as a low-carbon and reducing greenhouse gas emissions, along with the prevention and reduction of environmental pollution.

[4] Ni V.P., Sabitova S.N. «Kazakhstan's participation in the international legal regime for the Kyoto Protocol: Problems and Prospects,» Journal «Legal Reform in Kazakhstan», N 4, 2010.

and absorption of greenhouse gases. It became possible with the adoption in mid-2012 of package of bylaws on the procedure for the development, approval and implementation of projects aimed at reducing emissions and absorption of of greenhouse gases.At the same time efforts have not yet started for the development and implementation of projects on adaptation to climate change.

Activities in the area of climate change, provided under the MoE Strategic Plan for 2011-2015 within the framework of achieving objective 2.2 (creating the conditions for the formation of the principles of «green economy»), is still only at the planning stage. In particular it is expected during 2012 to develop a program of action for the transition to low-carbon economic development and long-term program on the green economy. It is expected that the final document, along with other elements of the communication mechanisms will include the introduction and implementation of the principles of «green growth.»

4.1.1.2. Institutional mandate

The Ministry of Environment is a key public authority in the Republic of Kazakhstan in the development and implementation of the country's policies and actions on climate change. The competence of the public authority is defined in Article 17 of the Environmental Code and the Regulations of the Ministry of Environment of the Republic of Kazakhstan[5]. In general, the MoE is a central executive body responsible for management and inter-sectoral coordination in the implementation of state policy in the field of environmental protection and natural resources and to ensure environmentally sustainable development of society.

Issues of state policy formation in the field of climate change and the organization of its implementation shall be the responsibility of the central apparatus of the Ministry of Environment, which acts as a «political» authority. Department of low-carbon development, the Department of Strategic Planning and Monitoring, Department of Environmental Legislation and Legal Support, Department of «green» technologies and investment generation are of main interest in terms of promotion of climate change in the structure of the central office. Activities for the implementation of measures to reduce emissions of greenhouse gases at different sectors of the economy, nature users, operators of certain industrial plants are within the mandate of the Committee for Environmental Regulation and Control, which is a department of the Ministry of Environment. All licensing and control functions in the area of environmental protection and natural resources are the responsibility of the agency. The Committee has the departments of ecology in all 14 regions of the country and Almaty and Astana. Expert and technical support of MoE activities in the area of climate change is carried out by its subordinate Joint Stock Company «Zhasyl Damu» (created in mid-2012 through the reorganization of RSE «Kazakh Research Institute of Ecology and Climate»). Some services and activities in this area are also implemented by RSE «Kazgidromet» - research, and by RSE «Information-Analytical Centre of of Environment» - development of of legislation and information support.

Based on the general competence to improve public administration and legislation in the sphere of environmental protection, environmental management and sustainable development MoE acts as a key initiator and developer of policies and measures to address climate change.To date, its main provisions are defined in Kazakhstan, primarily in the five-year strategic plans of this state agency and in sector program «Zhasyl Damu» for 2010-2014, which is administered by the Ministry of Environment. The main burden associated with the development of

[5]Approved by Decree No1201 of the Government of the Republic of Kazkakhstan dated December 8, 2007.

policy and legislation in the field of climate change lies in the structure of the Ministry on the Department of low-carbon development. These functions are implemented by the Department of low-carbon development with the active involvement of the expertise of JSC «Zhasyl Damu.» Services of the organization include the development of strategic projects, program, regulations and guidance documents. Part of the functions associated with the development of policies and measures to address climate change, are covered in the Ministry of Environment by the Department of «green» technologies and investment generation established in 2012. In particular, the competence of the department include the issues of promoting alternative energy sources. Further promotion and coordination of the developed projects of strategic documents is carried out with the active participation of the Department of Strategic Planning and monitoring, and legislation and regulations - Department of Environmental Legislation and Legal Support.

Another important competence of MoE in terms of the activity in the field of climate change is acting as the authorized state body for the UN Framework Convention on Climate Change and the Kyoto Protocol. After the ratification of the Kyoto Protocol by Kazakhstan in 2009, the functions of this ministry, associated with the implementation of international commitments on climate change have been greatly expanded. The statute of the Ministry of Environment includes additional functions related to:

- maintaining a national system for estimating anthropogenic emissions by sources and removals by sinks for greenhouse gases;
- organizing the annual national inventory of absorption and emission of greenhouse gases and maintenance of the public cadastre of greenhouse gases;
- maintaining public registry of carbon units;
- review, approval, registration and monitoring of projects to reduce greenhouse gas emissions.

Organization of corresponding works is the responsibility of the Department of low-carbon development, and the bulk of the work in this area is performed by JSC «Zhasyl Damu.» Since 2009, these activities are organized on the basis of the Technical Specification «Services to ensure the activities of the authorized body to regulate the activities of the Kyoto Protocol.» This allows for such arrangements for the implementation of the UN Framework Convention on Climate Change and the Kyoto Protocol, as the maintenance of the public cadastre of greenhouse gases, preparation of the national inventory of greenhouse gas emissions, update of forecasts for carbon dioxide emissions by sectors of the economy, providing the review and harmonization of regional programs for reduction and absorption of greenhouse gases. In addition, it ensures the participation of Kazakh delegation in the annual conferences of the Parties to the UN Framework Convention on Climate Change, meetings of the Parties to the Kyoto Protocol.

Of the Ministry of Environment was also significantly expanded with the adoption of new legislation on December 3, 2011 on cap-and-trade system of greenhouse gas emissions, with the expansion of respective functions of this public authority. On its basis, implementation of measures is provided to mitigate climate change by reducing greenhouse gas emissions in regulated sectors and industrial installations. More details about the main characteristics of the planned introduction of the cap-and-trade of greenhouse gas emissions in Kazakhstan are discussed in the Report on the Review of current strategic, program and legislative documents. It should be noted that the Ministry of Environment has the main functions related to the allocation of quotas for greenhouse gases, monitoring, reporting and verification of greenhouse gas emissions, accreditation of independent organizations carrying out professional verification and validation (determination) activity in the reduction of emissions and removals of greenhouse gases, as well as confirmation of the report on the inventory of greenhouse gas emissions. In essence, MoE is endowed with all the functions of the regulator of the national market in greenhouse gases, which are scheduled to run from January 1, 2013. They relate mainly to the Committee for Environmental Regulation and Control and partly JSC «Zhasyl Damu» in part of the functions of the Operator of public registry of carbon units.

4.1.2. Ministry of Agriculture[6]

The strategic framework of the Ministry of Agriculture is defined in the Strategic Plan for 2011-2015, approved by Decree of the Government of the Republic of Kazakhstan on February 19, 2011 No 158. In preparing the report the Strategic Plan of the Ministry of Agriculture was considered, mainly in two aspects: reducing human impact on the climate system, ensuring adaptation measures in the water sector and agriculture. They are reflected in the Strategic Plan for 2011-2015 of the Ministry of Agriculture in the scope of Strategic area 2 «conservation, sustainable use and restoration of fish, forests, wildlife resources, objects of natural reserve fund, as well as the creation of conditions for sustainable water supply and efficient level of water use» . Appropriate strategic goals, objectives and activities are presented in Table 4.3.

[6] Currently, the duties to protect forest lands and water resources are taken over by the Ministry of Environment Protection of the Republic of Kazakhstan

Table 4.3

Objectives, goals and activities related to climate change

Strategic objective and goal	Activity
Objective 2.1. Ensuring the survival, reproduction and rational use of fisheries, forests, wildlife resources, objects of nature reserve fund Goal 2.1.1. Increasing reforestation of the republic territory, forest fire prevention, timely detection and elimination, gardening of settlements, creating and expanding green zones around them, developing plantation cultivation of trees and private forest, forest resource management and conservation, reproduction and sustainable use of animal resources and the objects of natural reserve fund	Conducting forest management activities
	Obtaining planting material of improved hereditary qualities
	Aircraft patrolling of the state forest fund
	Arranging fire protection of the forest fund territory
Objective 2.2. Regulation of the use and protection of water resources Goal 2.2.1. Implementation of the principles of integrated water resources management and sustainable development of water supply and water management facilities	Carrying out compensatory augmentation
	Providing safe drinking water to rural communities
	Maintaining the level of the minor Aral Sea at around 42 m according to the Baltic system
	Maintaining the level of Lake Balkhash at the level of at least 341 m according to the Baltic system
	Provision of annual environmental flood discharge of the Irtysh River at the level of at least 4.55 km3

Sources: Ministry of Agriculture Strategic Plan for 2011-2015

The strategic framework of the Ministry of Agriculture, directly related to the reduction of anthropogenic interference with the climate system are associated with reforestation, afforestation and forest conservation. In this area, the Committee for Forestry and Hunting operating under the Ministry of Agriculture, takes measures to increase the forest cover, preventing and fighting forest fires. It should be noted that this Committee is currently implementing control and regulatory functions in relation to the protection and use of forest resources, the functions of aviation forest protection, as well as the organization of forest management, reforestation and afforestation, information and scientific support of forest fund. Direct works on reforestation and afforestation are carried out by state forestry agencies under the jurisdiction of local executive authorities. To evaluate the effectiveness of this activity as a target indicator the annual amount of forest plantations is determined, and it is scheduled to increase from 55,000 hectares in 2011 to 68,000 hectares in 2015.At the same time, increasing risks of forest fires due to climate change in this document are not reflected. In fact, the Strategic Plan of the Ministry of Agriculture provides maintaining the current level of activity to fight forest fires while maintaining current performance, that is, without taking into account the risk of increased frequency and area of forest fires due to global warming.

Adaptation measures to response to climate change were not developed directly in the Strategic Plan of the Ministry of Agriculture for 2011-2015. Earlier, the Ministry of Agriculture within the framework of the State program for development of rural areas in the Republic of Kazakhstan for 2004 - 2010 evaluated the capacity of rural communities taking into account the criterion of their water supply. In the case of rural settlements with a very low potential for development, resettlement of the rural population of these places was provided. However, at the end of 2010 activities associated with the assessment of ecological and demographic conditions of rural communities, have been transferred to the branch program «Zhasyl Damu», administrated by the Ministry of Environment. Obviously, as a result of this, issues of adaptation to climate change have not received the further development in the Strategic Plan for of the Ministry of Agriculture for 2011-2015. This also applies to adaptation measures with respect to the effects of climate change on agricultural production, the relevance of development of which is noted in the Strategic Plan for Development of Kazakhstan before 2020. In the Strategic Plan of the Ministry of Agriculture for 2011-2015, they were not developed in determining the goals, objectives, activities and indicators, including the strategic direction for the sustainable development of agriculture and rural areas.

Competence of the Ministry of Agriculture is defined by Decree No 310 approved by the Government of the Republic of Kazakhstan on April 6, 2005. This ministry is a central executive body in charge of leadership in areas such as agriculture and fisheries, use and protection of water resources, water supply and sanitation (excluding water and drainage systems located in populated areas), protected areas and the development of rural areas.

The ministry controls the Water Resources Committee, the Committee of Forestry and Hunting Committee of veterinary control and supervision, the State Inspection Committee in the agricultural sector, the Committee for Fisheries. In terms of the subject matter of this report the Water Resources Committee and the Committee of Forestry and Hunting are of the main interest.

Water Resources Committee provides regulatory, realizable and control functions in the use and conservation of natural resources. Its main objectives are defined as follows:

- ensuring the implementation of the state policy in the field of use and protection of water resources, programs, development of water sector and land reclamation;
- ensuring state control over the use and protection of water resources;
- regulating the use of water resources to meet the needs of the population and industries, to achieve and maintain an environmentally safe and economically optimal level of water use.

The structure of the central office of the Committee includes the Office of the use and protection of water resources, the Bureau of Reclamation and water-saving technology, the Office for operation and development of networks of water facilities, the Office of the organizational and legal work, the Office of financing, public procurement and summary analysis. CWR has 8 basin agencies with offices in Almaty, Astana, Atyrau, Karaganda, Kyzylorda, Kostanay, Semipalatinsk and Taraz.

The Committee on Forestry Hunting controls the main part of the specially protected natural territories of Kazakhstan (state nature reserves, national parks and national state natural reserves). Along with this its competence includes issues of conservation, protection, reforestation and afforestation, forest management in protected areas and areas of the state forest fund, used for scientific, research and industrial and educational purposes under its functional jurisdiction. A key tool for the implementation of this function is the public control of the state, security, protection and use of protected areas, objects of the state natural reserve fund, use of forest fund, reforestation, afforestation. The agency has 14 regional territorial inspections of forestry and hunting and it controls 10 state nature reserves, 10 national parks, 4 state nature reserves.

In the case of the Ministry of Agriculture the strategic planning and organization of implementation of strategic plans is carried out mainly at the level of its central office. Its structure, along with other units include the Department of Strategy and Corporate Development, and the Department of Natural Resources. The first of these includes the Department of Strategic Development in its structure, the second - Office for Strategic Planning of the development of natural resources. Thus, the institutional mandate of the Committee under the Ministry of Agriculture , in terms of developing independent strategies and policies is rather limited. In particular, the five-year strategic plans are developed at the level of ministries, but not their constituent committees. Thus the activities of the Water Resources Committee, the Committee of Forestry and Hunting and Committee of Fisheries are integrated into the Strategic Plan of the Ministry of Agriculture for 2011 - 2015 under Strategic area 2. Accordingly, their strategic goals, objectives, activities and target indicators are presented in a rather general form.

4.1.3. Ministry of Industry and New Technologies

Strategic areas of activity of the Ministry of Industry and New Technologies are defined in the Strategic Plan for 2011-2015.[7] In the aspect of mitigation, the main focus is on the planned strategic directions, goals, objectives, and activities relating to energy conservation and development of renewable energy sources. They are summarized in Table 4.4.

[7]Approved by Decree No102 of the Government dated February 8, 2011.

Table 4.4

Goals, objectives and activities related to energy efficiency, renewable energy

Strategic area, objective and goal	Activity
Strategic area 1. Creating the conditions for industrial-innovative development Objective 1.1. Development of the national innovation system Goal 1.1.1. Ensuring innovative development of the real sector of the economy	The development and adoption of by-laws in order to implement the Law «On energy conservation and energy efficiency»
	Forming and monitoring the public register of energy conservation
	Development of integrated regional energy conservation plans for 2010-2015. by akimats of regions, Astana and Almaty.
Strategic area 2. Development of industries Objective 2.1. Development of the manufacturing industry Goal 2.1.3. Development of the construction and building materials industry	Providing innovative grants in priority areas (energy-saving materials, exploring the use of waste related industries in the production of building materials, transfer of prefabricated technology, «green» and «energy-passive» houses).
Strategic area 3. Meeting the growing energy needs of the economy Objective 3.1. Development of the energy sector Goal 3.1.2. Development of renewable energy sources	Development and improvement of the regulatory legal documents in the field of renewable energy
	Implementation of the projects in the field of renewable energy sources

Sources: Strategic Plan ofMINTfor 2011-2015

To evaluate the effectiveness of efforts to increase energy efficiency and conservation, reduction in GDP energy intensity is defined as the target indicator. It is scheduled to eventually reduce it by 13% by 2015 to the level of 2008. It should be noted that the Strategic Development Plan of Kazakhstan provides for reducing GDP energy intensity by 2015, by at least 10%. The implementation of key activities under this strategic direction is expected in 2013 in accordance with the provisions of the Law «On energy conservation and energy efficiency», adopted in early 2013.[8] Providing innovative grants in areas such as the production of energy-saving materials, «green» and «energy-passive» homes, the use of waste for the production of building materials, was scheduled for 2011-2014. However, the necessary legal and regulatory basis for this was only adopted in June 2012.[9]

Implementation of the goal to develop renewable energy sources is defined in the scope of the strategic area of the Ministry of Industry and New Technologies activity to meet growing need of the economy in the energy. Arrangements were scheduled to develop and improve regulatory legal documentation in the sphere of the use of the renewable energy sources and realization of the projects in the sphere of the use of the renewable energy sources (in 2011-2013 – by 2, in 2014 – 1). Currently the MINT is developing more extensive plans to construct 10 wind farms, 6 hydroelectric plants and 1 solar power system.[10] The decision was made to finance the projects on construction of the two wind farms and one power plant based on the utilization of the solar power, financing to be provided by «Samruk-Energo» Joint-Stock Company.

Competence of the Ministry of Industry and Trade is defined in Decree No416 approved by the Government of the Republic of Kazakhstan on May 14, 2010. It is a central executive body governing in areas such as support for renewable energy and energy efficiency. In the structure of the central apparatus of the Ministry the important role in terms of development of these activities and organization of their implementation is performed by the Department of Strategic Planning and the Department of new technologies and energy efficiency. The Ministry supervises the Investment Committee , the Committee of the tourism industry , the Committee of Industry, the

[8]Law No 541-IV Law of the RK dated January 13, 2012.

[9]Decree No800 of the Government of the Republic of Kazakhstan dated June 18, 2012 «On the definition of the priority areas for the provision of innovation grants».

[10]Internet resource of the Ministry of Industry and New Technologies of the Republic of Kazakhstan, http://www.mint.gov.kz/index.php?id=212&lang=ru&lang=ru

Committee for Technical Regulation and Metrology, the Committee of state power supervision and control, the Committee of Atomic Energy, the Committee of Geology and Subsoil. At the level of subordinate organizations of the MINT, considering the subject of the report such Joint-Stock Companies as «National Innovation Fund» and «Kazahenergoekspertiza» may be highlighted.

4.1.4. Ministry of Health

Strategic areas of the Ministry of Health activity are defined in the Strategic Plan for 2011-2015. [11] This paper covers relation of climate change to human health in two aspects. In a broader context, the document notions the influence of environmental factors on the growth of certain diseases (respiratory diseases, cancer, allergic diseases, etc.). However, the Strategic Plan of the Ministry of Health stated that the lack of relevant research in this area does not allow for an objective assessment of the impact of environmental factors on the health of the population. Besides, such researches were not integrated into the strategic goals, objectives and activities of the document.

Issues of providing assistance in emergency conditions, climatic disasters were provided extensive coverage in the Strategic Plan of the Ministry of Health for 2011 - 2015. This aspect is integrated into the documentin question as objective 1.4 «Cross-sectoral cooperation in emergency medical and rescue assistance in emergency situations». The main tasks in such cases are as follows: increasing the efficiency of emergency medical and rescue assistance in natural and man-caused emergency situations, and improving the regulatory framework governing the joint activities of the State Institution «Centre for Disaster Medicine «, which is controlled by the Ministry of Emergency Situations and the Ministry of Health . In other words this issue is integrated into the strategic plan only in terms of improving interagency cooperation. It should be noted that the Service of the State Sanitary and Epidemiological Surveillance implement measures for the sanitary protection of the territory of the Republic of Kazakhstan against the introduction and spread of infectious, parasitic diseases , including the cases of climate-related natural disasters .

Competence of the Ministry of Health is defined in the in Decree No 944 approved by the Government of the Republic of Kazakhstan on October 12, 2007. The main tasks of the Ministry are as follows:

- implementation of the state policy in the field of health, medical and pharmaceutical science and education;
- arrangements to ensure citizens obtaining free medical care within the state-guaranteed scope;
- arrangements to provide the public and health-care organizations with safe, effective and quality medicines;
- international cooperation in the field of health care, including medical science and medical and pharmaceutical education.

In the context of the subject matter of this report the Strategic Development Department may be highlighted in the structure of the central apparatus of the Ministry of Health, and it includes the Office of Strategic Planning and the Department of medical care. Service of the State Sanitary and Epidemiological Surveillance in Kazakhstan includes the following organizations: the Committee of the State Sanitary and Epidemiological Surveillance and Republican Sanitary and Epidemiological Station (national level), the Department of the State Sanitary and Epidemiological Surveillance, at the level of regions, cities, districts and transportation, as well as laboratory sanitary and epidemiological expertise. However, as is mentioned above, organization, coordination and participation in the provision of emergency medical and psychological assistance in the event of natural disasters, including climate disasters, is the responsibility of State Institution «Centre for Disaster Medicine», which is currently under the supervision of the Ministry of Emergency Situations. The structure of the organization is comprised of 11 branches, namely in Astana, Almaty and Aktobe, Atyrau, East Kazakhstan, Karaganda, Kyzyl-Orda, Mangistau, Pavlodar, North Kazakhstan and South Kazakhstan regions.

4.1.5. Ministry of Emergency Situations

Strategic direction of the Ministry of Emergency Situations (hereinafter - the Ministry of Emergency Situations) are defined in the Strategic Plan of Ministry of Emergency Situations for 2011 - 2015.[12] The document is classified as «restricted» and access to it is restricted accordingly.

On the initiative of the Ministry of Emergency Situations, the issues of the prevention and elimination of emergency situations, the development of infrastructure to counter their negative effects are included in the basic documents of government planning at all levels. This Strategic Plan of the Republic of Kazakhstan and the Forecast scheme for spatial development of the country before 2020, the National Security Strategy of the Republic of

[11] Approved by Decree No183 of the Government of the Republic of Kazakhstan dated February 25, 2011.
[12] Approved by Decree No90 of the Government of the Republic of Kazakhstan dated February 13, 2010.

Kazakhstan for 2012 - 2016 and the plans and programs adopted by the Government for their implementation. At the local level, these issues are being addressed in the development programs in the 16 regions of the country and the strategic plans of local government offices.

In terms of adapting to the impacts of climate change it should be noted that the ministry estimates the highest risk associated with seasonal freshets and floods, with avalanching, mudslide, landsliding. At the management level it includes measures to equip organizations and institutions engaged in environmental monitoring and forecasting of natural and man-made emergency situations, with the modern technical equipment and software applications, the creation of a common information base about the sources of emergencies, the scale of natural and man-made disasters, the introduction of space monitoring of snow cover, turn water and floods, filling reservoirs, landscape fires.

Within the framework of the Ministry of Emergency Situations mountainous and submountain areas are monitored by State Institution «Kazselezaschita». The Ministry of Emergency Situations supervises «Centre for Disaster Medicine», whose jurisdiction includes issues of emergency medical and psychological assistance in the event of natural disasters. The Ministry of Emergency Situations also controls the Committee for State Control of Emergency Situations and Industrial Safety Committee and the fire service. However, both state agencies focus more on state control of the prescribed measures for the prevention and emergency response.

In general, the structure and activity plans of the Ministry of Emergency Situations are largely formulated for the solution of problems related to the prevention and elimination of emergency situations. Direction of activity of the Ministry of Emergency Situations related to informing the public does not include activities aimed at raising awareness on issues related to adaptation to climate change in the long run. In particular, it concerns the behavior change and the precautionary approach in the face of drought, as well as dangerous hydrological phenomena.

4.2. A review of current strategic, program and legal documents and analysis of changes in legislation relating to climate change

4.2.1. «Kazakhstan 2030» Strategy and the Stategic Development Plan before 2020

Overall long-term basis for the development of all the documents of the state planning system in the Republic of Kazakhstan, including strategic plans of the ministries and departments, programs, is the Development strategy of the Republic of Kazakhstan before 2050. The message of the President of Kazakhstan - the Leader of the Nation to the people of Kazakhstan «Strategy» Kazakhstan - 2050 « : a new policy of the established state» defines a strategic objective for the transition to a low carbon economy, as well as alternative and renewable forms of energy. The Strategic Development Plan of the country before 2020 includes the priority for the development of «green» low carbon economy policy, which provides for the use of modern technology with low power consumption, implementation of other measures aimed at energy conservation. Meantime, the task for the prevention of climate change and development of low-carbon economy is considered in the context of Kazakhstan's contribution to the global reduction of greenhouse gas emissions. Concept of the Republic of Kazakhstan for the transition to a «green economy», approved by Decree No577 of the President of the Republic of Kazakhstan on May 30, 2013, as one of the principles of transition to a «green» economy defines reduction in carbon intensity of GDP. According to this concept, one of the measures to reduce air pollution is implementation of continuous monitoring and control of emissions of greenhouse gases by an authorized body in the field of environmental protection. Development of low-carbon economy provides a significant reduction in greenhouse gas emissions in relation to gross domestic product, the transition of the power system from combustion of hydrocarbon energy resources to renewable energy sources (solar energy, wind energy, minihydro power plants), reduced energy consumption and, thus, reduced greenhouse gas emissions in the production and housing and utilities (energy conservation).

In order to implement the Development strategy before 2050 the Ministry of Economic Development and Trade is developing a strategic development plan for each ten-year period, specifying the goals, objectives, priority areas of socio-economic and socio-political development of the country for the relevant period. This document defines the expected results with their qualitative and quantitative indicators, including those defined for intermediate stages. Strategic development plans for the ten-year periods are approved by the President of the Republic of Kazakhstan. There is currently a Strategic Development Plan before 2020, approved by Decree No922 of the President of the Republic of Kazakhstan on February 1, 2010. It defines the climate change as one of the key factors determining current trends in the world economy. Meantime, it notes the urgent need for the implementation of measures such as reduction of anthropogenic emissions of greenhouse gases and addressing the regional issues growing due to global warming, including the availability and quality of water.

The Strategic Development Plan before 2020 provides for five key areas of development, namely:

1) Preparation for post-crisis development;
2) accelerating the diversification of the economy;
3) investment in the future;
4) services for citizens;
5) ensuring inter-ethnic harmony, security and stability in international relations.

Climate change issues are integrated into the document as part of the strategic direction to accelerate the diversification of the economy. This applies to both aspects of mitigation and adaptation to climate change.

The document in question defines the following priority sectors for development of the country in ten years term:

- agribusiness and agro-processing;
- construction industry and building materials;
- refining infrastructure and oil and gas sector;
- metals and fabricated metal products;
- chemical, pharmaceutical and defense industries;
- development of energy, including nuclear power and alternative energy sources;
- transportation and telecommunications.

The goal of climate change mitigation is considered in the context of Kazakhstan's contribution to the global reduction of greenhouse gas emissions. It is linked primarily to the future development of the energy sector, namely construction of a nuclear power plant, development of small hydro power plants, wind energy and increased use of solar energy.

With respect to the implementation of measures for development of alternative energy sources the following appropriate quantitative indicator is established - to increase their share in the total energy consumption by up to 3 % by 2020. As an interim measure it is planned to increase the share of alternative energy sources[13] to 1.5% by 2015. The Strategic Development Plan before 2020 also provides for the implementation of necessary measures to promote the development of wind, solar and geothermal energy.

Along with a reduction in the share of coal-fired power plants and increased use of renewable energy sources the country's contribution to the prevention of global warming will also be provided by means of technological modernization and development of energy conservation measures. As is noted above, this task is integrated into the strategic direction of diversification of the economy. The Strategic Development Plan before 2020 includes a priority for the development of «green» policy of low-carbon economy, which includes the use of modern technology with low power consumption, implementation of other measures aimed at energy conservation. The target indicator to assess progress with implementation of this priority is defined as the reduction in energy intensity of GDP. By 2020 it is planned to reduce it by at least 25% as compared to 2008. Interim rate established for the period before 2015 provides for a reduction in the energy intensity of GDP by at least 10%.

Issues of adaptation to climate change are expressly stated in the Strategic Development Plan before 2020 in the context of the priorities of development of agriculture sector and agro-processing. In this case, provisions are made for the implementation of measures to adapt crop growing to the possible consequences of global warming, as well as measures aimed at improving the efficiency of water use in agriculture. However, adaptation measures in the agricultural sector did not receive further elaboration in the document. It should be noted that the strategic objectives of priority «Agriculture and agro-processing» relate to the productivity in this area (a 4 times increase in 2020 and 2 times in 2015), increase in the export potential of the industry's total exports, increase in the share of processing of meat, milk , fruits and vegetables.

The Strategic Development Plan before 2020 currently recognizes only negative impact of climate change on the availability and quality of water as one of the key factors determining trends in the agricultural and water sectors. Indirectly, adaptation to climate change in the context of the given document touches upon priority sector «health care», included into strategic direction «investment in the future» and priority sector «housing and communal services» included in strategic direction «services for citizens». But as is noted above, adaptation measures did not receive elaboration in the Strategic Development Plan before 2020

4.2.2. Program documents and action plans

It should be noted that in 2008-2010 in Kazakhstan a new system of state planning was reformed. It highlights the following policy documents:

- state programs;
- industry programs;
- territorial development programs.

Currently, the programs has become less frequently used as a tool for planning the activities of state bodies. The main planning tools are now five-year strategic plans of the ministries and departments. Such tool as action plans are also widely used, as they can be both part of the program and taken as separate documents.

[13] Alternative energy sources in this case mean hydropower, geothermal, wind and solar power.

4.2.2.1. State programs

State programs are developed under a specific list and it is the responsibility of the designated state agency. Such a list of programs and those state bodies responsible for their development is determined by the President of the Republic of Kazakhstan. In other words the preparation and approval of state programs are initiated in a centralized manner, and not by the ministries and departments. Approval of state programs is also within the competence of the President of the Republic of Kazakhstan. At the same time, within a month after their approval by the authorized state body (bodies) action plans are developed for the implementation of government programs for further approval by the Government.

Of existing state programs directly related to the issues of reducing human impact on the climate system, emphasis should be given first of all to the state program of forced industrial-innovative development of Kazakhstan (FIIR) for 2010-2014.[14] The main tasks are defined in it as follows:

- development of priority sectors of the economy, ensuring its diversification and increased competitiveness;
- strengthening the social efficiency of development of priority sectors of the economy and the implementation of investment projects.
- creation of a favorable environment for industrialization;
- formation of centres of economic growth on the basis of rational territorial organization of economic potential;
- ensuring effective interaction between government and business in the development of priority sectors of the economy.

In accordance with the Strategic Development Plan of the Republic of Kazakhstan before 2020 the issues of the climate change were reflected in the FIIR Program, mainly in the aspect of diversification of the economy. It is with this area the development of low-carbon economy is associated along with reduction in the negative impact of human pressure on natural ecosystems, increased responsibility of nature users to reduce emissions into the environment.

As is the case with the Strategic Development Plan before 2020 the main focus is on reducing human impact on the climate system in the framework of the energy industry. In the FIIR Program alternative energy is treated as the priority sector of the economy. In general, it highlights the following:

- traditional, including oil and gas, mining and smelting complex, nuclear and chemical industry, machine building, construction, pharmaceuticals;
- non-commodity and export-oriented, including agriculture, light industry and tourism;
- sectors «economy of the future», including information and communication technology, biotechnology, alternative energy, space activities.

Meantime, the policy document in question integrates the intermediate target indicator, under which the increase in the share of renewable energy sources is scheduled before 2015. It should be noted that in the FIIR Program this number is somewhat reduced compared with the Strategic Development Plan of the Republic of Kazakhstan before 2020. Namely, the target is now one per cent instead of one and half a percent of share of alternative energy sources in the total energy consumption of the country. In general, the target volume of electricity generated by renewable energy sources in 2014 is 1 billion kWh per year.

Provisions are made that the scheduled increase in the share of renewable energy sources will be achieved through the construction and commissioning of the wind power plants and small hydroelectric plants. The priority places to accommodate wind farm are Astana, Akmola, Dzungarian gate and Shelek corridor - in the Almaty region. By 2015 it is planned to construct wind turbines with the design capacity of 125 MW and an electrical output of 400 million kWh of energy. During the same period it is planned to commission new mini hydropower stations with a total design capacity of over 100 MW with planned generation of electrical energy of 300 million kWh. Due to this it is planned to increase the total production of electricity from renewable energy sources up to 1 billion kWh per year. Besides, provisions are made for the implementation of measures aimed at promoting the use of renewable sources. Their development is expected in the scope of a package of regulations under the Act of 2009, «On support of the use of renewable energy sources.» In particular, within the framework of the new legislation the following incentives are scheduled:

- reservations and priority in the allocation of land for the construction of renewable energy sources;
- commitments of the energy transmission organizations to purchase electricity produced from renewable energy sources;
- exemption of energy from renewable sources of payment for transportation of electricity through the networks;
- provision of support when connecting facilities for renewable energy to power transmission networks of the organization.

Along with the development of renewable energy sources the FIIR Program identifies one of the key measures to support the development of priority sectors which is energy conservation. Among other such measures there

[14]Approved by Decree No958 of the President of the Republic of Kazakhstan dated March 19, 2010.

are provision of energy and transport infrastructure, information, communications, human resources, investment, reduction of administrative barriers, tariff policy etc. A respective target indicator in the FIIR Program coincides with the intermediate objective of the Strategic Development Plan of the Republic of Kazakhstan before 2020. In both cases, a 10 % reduction is provided in energy intensity of GDP, compared to 2008 levels. Provisions are made to achieve improvement of energy efficiency and energy conservation through the development and implementation of legal, administrative and economic measures to encourage the efficient use of energy. In this respect, the FIIR provides the following:

- changes to the rules, regulations and procedures that determine the consumption of fuel and energy;
- improving the tariff and tax policies;
- development of the system of accounting and control of energy consumption;
- regular energy audits of large companies ;
- ensuring the availability of data on energy-saving measures , technologies and equipment , specifications and technical documentation;
- providing energy labeling to energy-using products;
- promoting the exchange of experiences among professionals and promoting energy conservation among the public, including through the media .

However, the document in question is not a direct action program in the above areas, as it is primarily the basis for the economic development of the country. Although energy-saving measures are described in a special section of the FIIR Program, their practical implementation is associated with the adoption and implementation of the Act of 2012, «On energy conservation and energy efficiency» and a package of by-laws thereto, with the integration of related activities into regional plans and programs for socio-economic development, as well as development and implementation of special regional plans of energy conservation. In general, the issues related to energy efficiency and energy conservation are very poorly integrated into the section of the given document relating to the development of priority sectors of the economy. They are slightly mentioned in the context of addressing the issues related to the development of the mining industry, chemical industry, construction industry and building materials. In appropriate cases, there is the need to address energy intensity of the production, the use of energy-efficient materials. In this respect, the question remains on how measures to improve energy efficiency and conservation, provided by special sub-section 2.9 and to a large extent assigned the level of regional programs and plans, will be aligned and synchronized with the measures for the development of priority sectors of the economy under this government program. It should be noted that the FIIR Program recognizes that energy efficiency is one of the three main criteria for selection of projects that can be supported by it. The other two selection criteria are performance and export orientation. However, this aspect has not received further consideration as part of the document in question, which could significantly enhance its practical significance.

With respect to the planning of adaptation measures for climate change at the level of the state programs it is worth mentioning the State Program for Development of Health of the Republic of Kazakhstan «Kazakhstan Salamatty» for 2011-2015.[15] The document notes the influence of factors deteriorating environment on the growth of certain diseases (respiratory diseases, cancer, allergic diseases etc.). In this context, the accent is made on an increase in demand for health services for the diagnosis and treatment of diseases, but in the following text this aspect of public health has not received development. In the context of emergency medical and rescue assistance in emergency situations, including climate disasters, the given state program is limited to measures to equip the Disaster Medicine Service withairmobile hospital and the multipurpose mobile hospital unit, as well asto equip the medical and rescue structures of the emergency service with the sanitary helicopters and ambulances. To a greater extent, it is limited to issues of health- saving assistance in road accidents.

4.2.2.2. Industry programs

Industry programs are developed in the event that the solutions for the problems stated therein cannot be implemented at the national level within the framework of existing government programs, strategic plans of government agencies. They are adopted for a medium term (from one to five years) and for a long term (over 5 years) in accordance with the requirements established by Decree No218 of the Government dated 18 March 2010, and are approved by the Government. The action plan is an integral part of any industry program and organizational, economic, scientific, technical and other measures therein aimed at achieving its goals and objectives are determined by specifying the required resources, responsible contractors, completion forms and deadlines. The main current industry program that integrates climate change is industry program « Zhasyl Damu» for 2010-2014.[16]

The main purpose of the above industry program is to create conditions for the conservation and restoration of natural ecosystems. Its objectives are defined as follows:

- development of «green economy»;
- reducing human impact on the environment and health;
- preservation and restoration of natural ecosystems;

[15] ApprovedbyDecreeNo1113 of the President of the Republic of Kazakhstan dated November 29, 2010.
[16] Approved by Decree No924 of the Government of the Republic of Kazakhstan dated September 10, 2010.

- development and improvement of environmental quality control.

Activities and target indicators related to climate change, were elaborated in the context of the four above-mentioned goals. They are presented below in Table 4.5

Table 4.5

Areas, golas and activities of Idustry program «Zhasyl Damu», related to climate change

Area	Planned activity	Deadlines
Goal 1.Development of «green economy»		
1.1.Adoption of clean technologies and creation of a system of resource conservation	Development of a set of measures for low-carbon development in Kazakhstan, as well as the basic principles and mechanisms to ensure it	February 1, 2011
	Acquisition of software for keeping a register of carbon units and provision of support	February 1, 2011
1.2.Application of measures for energy efficiency and energy conservation	Preparation and submission of proposals to the Government on the implementation of effective management of public transport and traffic management in large communities	February 1, 2013
	Preparation and submission of proposals to the Government on recovery and utilization of landfill biogas in existing landfill disposal of solid waste	February 1, 2013
	Preparation and submission of proposals to the Government for disposal of incandescent lamps and stimulation of the production of energy-saving lighting devices	February 1, 2012
Goal 2.Reducing human impact on the environment and health		
2.1.Improving air quality	Preparation and submission of proposals to the Government on the development of measures to reduce the negative impact of vehicles, including the use of biofuels	February 1, 2012
Goal 3.Preservation and restoration of natural ecosystems		
3.2.Climate change mitigation and adaptation	Conducting an annual inventory of greenhouse gas emissions	July 15 and February 1 annually
	Establishment and operation of the centre on the preparation and implementation of projects to reduce greenhouse gas emissions	Since 2010
	Preparation of national communications to the UNFCCC	July 15 and February 1 annually
	Keeping the negotiation process under the UNFCCC and the Kyoto Protocol	annually
	Preparation and submission of proposals to the Government on the development of the legal framework for the implementation of the Kyoto Protocol, post-Kyoto agreement and domestic policies and measures to reduce greenhouse gas emissions	February 1, 2012
	Conducting training courses for controlling emissions and reducing greenhouse gas emissions	February 1, 2011
	Preparation and submission of proposals to the Government on the development of market mechanisms to approve the order of emission trading and commitments to reduce emissions of greenhouse gases into the environment	February 1, 2011
Goal 4.Development and improvement of environmental quality control		
Development of international cooperation	Adoption of measures to implement the requirements of the Kyoto Protocol	February 1, 2011

Area	Planned activity	Deadlines
Scientific support of the environmental protection and nature management	Conducting research on energy efficiency and renewable resources	July 15 and February 1 annually

Industry program «Zhasyl Damu» also includes a wide range of activities related to the absorption of greenhouse gas emissions in the land-use sector, change of land use and forestry. In Kazakhstan, the main interest in this case is measures to protect forests from fires, afforestation and reforestation activities, which are included in area of this program document «Conservation and regeneration of forests, their rational use, planting of settlements».

One of the target indicators specified to measure the progress in the implementation of industry program «Zhasyl Damu,» is the dynamics of greenhouse gas emissions. It is planned that as a result of its implementation, the annual reduction in emissions will make up 1 % compared to 1992. In terms of gross volume, this means an annual reduction in greenhouse gas emissions of about 31 million tonnes of carbon dioxide equivalent. This will be achieved by this program in 2013 and 2014. In addition, the policy document under consideration involves the use of a set of other objective indicators that are directly related to the limitation of emissions of anthropogenic greenhouse gas emissions and incase in absorption:

- the number of projects with other countries to reduce greenhouse gas emissions;
- the number of projects based on domestic carbon market;
- transition of unforested lands into the forested lands.

It should be noted that the descriptive part provides sufficient details on the issues related to adaptation to climate change and indicates that they are one of the key elements of the policy to combat climate change. Besides, attention is paid to the negative impact of climate change on biodiversity, land degradation and desertification, shrinking of glaciers, agriculture and water management. However, textual analysis of industry program «Zhasyl Damu» does not allow to highlight specific adaptation measures and related target indicators. So the action planting area 3.2 «Mitigation and Adaptation» shows only the activities related to the mitigation of climate change, but not to adaptation to climate change (see table 4.5 above).

Note that the Strategic Plan of the Ministry of Environment for 2011 - 2015 has provided for the development of the Action program for the planning and development of the sectors of economy of the Republic of Kazakhstan in connection with the transition to a low-carbon development in 2011. Currently there is no clear evidence of progress in the implementation of this action, because a developer of this document has not been identified yet and its name is still not clear. For example, during the Kazakh side events at the Conference of the Parties to the UNFCCC in Cancun in 2010 the idea of developing this document was presented under somewhat different name - Low Carbon Development Strategy .

In terms of integrating the issues of climate change adaptation into the national policies along with existing sectoral programs consideration may be given to the Program for the development of agriculture in the Republic of Kazakhstan for 2010 - 2014[17], and program «Ak Bulak» for 2011 - 2020 [18]. Program «Ak Bulak» for 2011 - 2020 adopted for the purpose of providing the potable water to the people in the required quantity and with guaranteed quality, the issues of global warming and its effects will not be considered. Of course, the second of the above programs, takes into account the dependence of agricultural production on the climatic conditions, but without taking into account the current trends of climate variability and its impacts on agriculture. Overview of the planned activities under this document also does not allow to identify the intentions of developers with respect to their adaptation to global warming. In particular, this applies to the support of a mandatory system of crop insurance, which does not take into account the increasing factor of extreme natural phenomenon such as drought. Similar amounts of annual expenses are scheduled for financing the support of the current insurance program in the period from 2010 to 2014. It should be noted that currently Program for the development of agribusiness for 2013-2020 is under development. The draft of this document in the version of July 13, 2012 [19] contains specific provisions relating to the adaptation of agriculture to climate change. In particular, it points to the need for cultivating drought-resistant varieties and breeding adapted breeds of cattle.

In accordance with the Law of 2012 «On energy conservation and energy efficiency» [20] provisions are made for the adoption by the Government of industry programs in the field of energy conservation and energy efficiency.

[17]Approved by Decree No1052 of the Government of the Republic of Kazakhstan dated October 12, 2010.
[18]Approved by Decree No1176 of the Government of the Republic of Kazakhstan dated November 9, 2010.
[19]Available from the internet resources of the Ministry of Agriculture of the Republic of Kazakhstan, www.minagri.kz.
[20]Subparagraph 16) of paragraph 4.

Its development is within the competence of the Ministry of industry and new technologies, but at the moment this activity is not even integrated into the Strategic plan of the agency for 2011-2015. In the meantime the Comprehensive plan to improve the energy efficiency of the Republic of Kazakhstan for 2012 - 2015 [21] has been adopted. This document defines a list of energy efficiency measures by industry sectors, production of electricity and thermal energy, housing and communal services and the budget sector, specifying their contractors, deadlines, estimated costs for them and sources of funding. As part of the Comprehensive Plan the relationship of the planned activities with the reduction of the greenhouse gas emissions is not considered, but as it is noted above, it is found at the level of the Strategic Development Plan of the Republic of Kazakhstan before 2020.

4.2.2.3. Territorial development programs and regional plans

The territorial development programs feature two levels: 1) provinces, cities of republican status and capitals, and 2) regions (cities of regional status). In both cases they are developed by the divisions for the state planning of respective akimats with their subsequent approval by the local representative bodies. The program for development of territories is accompanied by the plan of measures specifying their indicators, expected results, deadlines, people responsible for implementing the government and funding for each activity by years with the indication of its sources. Such plan is approved by akim of a respective territory. Measures to mitigate climate change and adapt to its effects at the regional and local levels should be integrated into the programs for development of territories. However, so far there is no progress in the implementation of this task, and some local agencies noted the main reason which is the lack of necessary methodological framework for the development and integration of relevant activities into the program for development of territories.

Earlier, at the level of regions, Almaty and Astana the so -called targeted regional programs were actively implemented as a planning tool. Thus in 2007-2008 a number of regional programs for energy efficiency was developed and approved, in particular in Almaty and Astana. First steps were even taken to implement them and in the first place in the housing and fiscal sectors. Instead of «targeted» regional programs «targeted» regional action plans can now be adopted, for example, in the near future it is expected to adopt comprehensive plans for energy conservation in regions, Almaty and Astana. Their development is planned for November 2012 in accordance with the Comprehensive Plan to improve the energy efficiency of the Republic of Kazakhstan for 2012 - 2015. Adaptation measures have not been yet developed at the regional level in Kazakhstan.

4.2.3. Laws relating to the issues of climate change

4.2.3.1. Laws regulating greenhouse gases

National legislation to regulate greenhouse gas emissions began to emerge in Kazakhstan with the adoption on January 9, 2007 of the Environmental Code. It was first to include a special chapter on the regulation of emissions and removals of greenhouse gases. Originally, it was associated with the regulation of ozone-depleting substances. This chapter consists of nine articles, specifying the regulatory principles and legislative framework for the implementation of measures aimed at keeping and reducing greenhouse gas emissions at the level of industrial plants. Along with it the legal framework was established for the annual national inventory of emissions and removals of greenhouse gases, with the appropriate data included into the state inventory of greenhouse gas emissions[22]. The general principles of the climate and ozone layer protection are defined as follows:

- preventing, mitigating the irreversible effects of climate change (including global) and the degradation of the ozone layer;
- mandatory character of the state regulation of greenhouse gases and ozone-depleting substances in the atmosphere;
- transparency, completeness and accuracy of information on climate change and the degradation of the ozone layer;
- scientific validity, systematic and integrated approach to the protection of the climate and the ozone layer.

The Ministry of Environment is a body responsible for public administration in the field of climate protection in the Republic of Kazakhstan[23].

The development and implementation of measures to reduce greenhouse gas emissions and consumption of ozone-depleting substances at the time was planned to be based on the development and implementation of state, industry and regional target programs for the protection of the climate and the ozone layer[24]. Under the current system of state planning that was formed in the country since 2010, the adoption of such targeted programs is unlikely. Also, the legislation established a requirement with respect to the procedure for the planning and implementation of measures to prevent and mitigate the effects of climate change and the degradation of the ozone layer. Provisions were made for the obligatory participation of citizens and public associations in their discussion.

[21] Approved by Decree No1404 of the Government of the Republic of Kazakhstan dated November 30, 2011.
[22] Article 317 of the Environmental Code of the Republic of Kazakhstan.
[23] Aricles 310 and 311 of the Environmental Code of the Republic of Kazakhstan.
[24] Article 312 of the Environmental Code of the Republic of Kazakhstan.

Another innovation in the Environmental Code in 2007 was a requirement to hold annual inventory of greenhouse gas emissions by legal entities having certain sources of emissions. Provisions were made to establish the obligation to provide annual reports on the results to the Committee for Environmental Regulation and Control of the Ministry of Environment at the end of the second quarter of the year following the reporting year. Later, in order to implement the above-mentioned legislative requirement, Decree No124of the Government dated February 8, 2008 approved the rules of public accounting of sources of greenhouse gas emissions and consumption of ozone-depleting substances. Certain provisions of this Decree of the Government were detailed within the Regulation for the inventory of greenhouse gas emissions and consumption of ozone-depleting substances, approved by Order No348-p of the Minister of Environment on 13 December 2007. In particular, it approved the form of passport for inventory of greenhouse gas emissions. These regulations made it possible to gather information on greenhouse gas emissions at the plant level for the period of 2008 - 2010. As a methodological framework for the greenhouse gas inventory of natural resources, Methods for calculating emissions of greenhouse gases dated November 29, 2009 were used along with a set of methods for certain types of activities approved by the Ministry of Environment on December 5, 2010 .

The organization of the system of accounting of greenhouse gas emissions at the level of individual industrial units was based on the intention to establish a national cap-and-trade market for greenhouse gas emissions in the country[25]. This market-based mechanism was seen as a key tool to limit and reduce greenhouse gas emissions. According to Decree No128[26] of the Government dated 11 February 2008 creation of the cap-and-trade system was expected in Kazakhstan since 2008. In this case, it was provided that the quotas for greenhouse gas emissions were to be defined in relation to the level of emissions in 2008. They had to apply to specific installations for the production and processing of ferrous and non-ferrous metals, in the energy, mining industry, manufacturing, and agriculture. However, this attempt was clearly not elaborated well and the above Decree was composed of 13 very brief provisions and two annexes (the list of regulated facilities and an application for a quota) . In fact, the provisions of the above-mentioned Decree of the Government were limited to the demand for the operators of regulated facilities to file applications for quotas for greenhouse gas emissions and there view thereof by the Ministry of Environment.

With the ratification of the Kyoto Protocol in March 2009 a number of legislative measures were adopted to implement the provisions of international legal instruments and the UN Framework Convention on Climate Change. First of all, it should be noted that Decree No1205 of the Government dated August 6, 2009 the Ministry of the Environment was appointed as the authorized body for the coordination of the implementation of the Kyoto Protocol to the United Nations Framework Convention on Climate Change. These functions are implemented by it, first of all , within the Department of low-carbon development established in the structure of that body (before 2012 it was the Department of the Kyoto Protocol). In addition, Joint-Stock Company «Zhasyl Damu» was defined as a working body to ensure the activities of the authorized body for the coordination of the implementation of the Kyoto Protocol to the UN Framework Convention on Climate Change.

The above mentioned institutional appointments allowed organizing regular work on the development of the legislative framework for the implementation of international commitments on climate change. In particular, regulations were prepared and approved at the level of orders of the Ministry of Environment on a national inventory of emissions by sources and removals by sinks of greenhouse gases. Order No194-p of the Ministry of Environment dated July 23, 2010 defined the objective and main goals, procedure for the organization and ensuring the functioning of the national system for the estimation of anthropogenic emissions by sources and absorption by sinks of greenhouse gases not regulated by the Montreal Protocol on Substances that Deplete the Ozone Layer. It established the necessary institutional and legal arrangements for the organization of work and coordination of activity of various public agencies and other organizations involved in the preparation of the public cadastre of emissions and removals of greenhouse gases. This regulatory act also defined basic provisions to ensure the collection of information, quality control and quality assurance of the public cadastre for sources of emissions and removals of greenhouse gases. In particular, it defined a list of public bodies obliged to provide data for its preparation, and the time frame for the performance of these duties. Certain aspects of the public cadastre for sources of emissions and removals of greenhouse gases became regulated under Order No193-p of the Ministry of Environment dated July 23, 2010. First of all, it concerns the content of the cadastre and the procedure for granting access to its data. The adoption of the above two regulations in 2011 provided timely and better availability of data necessary for the preparation of the public cadastre for sources of emissions and removals of greenhouse gases.

In 2010-2011, the Government of Kazakhstan again returned to the issue of establishing a national cap-and-trade system. To this end, the bill was submitted to the Parliament on amendments and supplements to a number of laws, including the Environmental Code and the Code of Administrative Offences and the Law «On Bankruptcy». The new bill was passed by the Parliament in November 2011 and signed by the President of the Republic of Kazakhstan on December 3, 2011[27]. The main part of the legislative amendments relating to the

[25]Article 313 of the Environmental Code of the Republic of Kazakhstan.

[26]Cancelled by Decree No584 of the Government of the Republic of Kazakhstan dated May 7, 2012.

[27]Law No505-IV of the Republic of Kazakhstan dated December 3, 2011 «On the introduction of modifications and amendments to the legislative acts of the Republic of Kazakhstan on environmental issues».

management of climate change issues was related to the provisions of the Environmental Code and the Code of Administrative Offences and was formalized by including new sections and provisions described in Table 4.6.

Table 4.6

New sections of the legislation on greenhouse gases effected by the Law dated December 3, 2011

Purpose of a new section	Method of introduction	References to the new provisions
Introduction of the conceptual apparatus for cap-and-trad system and the flexibility mechanisms of the Kyoto Protocol	Definitions of the 24 new terms	Addition to paragraph 1 of Article 1 of the Environmental Code
The definition of new competencies of government bodies associated with the regulation of cap-and-trade system	Giving the additional functions of the Government and the authorized body in the field of Environmental Protection (MoE), local representative and executive bodies	Modifications and additions to Articles 16 and 17, 19 and 20, and Article 34-1 of the Environmental Code
Introduction of the basic requirements for greenhouse gas emission quotas, projects to reduce emissions and enhance the removals of greenhouse gases	Inclusion in the Environmental Code of a new chapter for state regulation in the field of emissions and removals of greenhouse gases, according to the provisions of the cap-and-trade system	Chapter 9-1, Article 94-1 - 94-12 of the Environmental Code, amendments to Articles 6, 95-96 of the Environmental Code
Defining the system requirements for the estimation of emissions and removals of greenhouse gases at the national level	Inclusion in the Environmental Code of a new chapter on the public system for estimating emissions and removals of greenhouse gases	Chapter 20-1, Article 158-1 - 158-4 of the Environmental Code
Expansion of requirements for monitoring, recording and reporting of the operators of plants for greenhouse gases	Inclusion of a new article, and modifications to the previously adopted articles of the Environmental Code	Article 314-1, amendments to articles 315, 317 and 318 of the Environmental Code
Establishment of liability for the excess of quotas for greenhouse gas emissions and for the accuracy of reporting for greenhouse gases	Inclusion of new articles in the Code of Administrative Offences	Articles 243-1 and 243-2 of the Code of Administrative Offences
Establishing the schedule of cap-and-trade system launch	Determination of the period of the first national plan for the allocation of greenhouse gas quotas and timing of the introduction of the provisions of the Act of December 3, 2011	Addition to Article 324 of the Environmental Code, Article 2 of Law No505-IV of the Republic of Kazakhstan dated December 3, 2011
Adjustment of certain provisions of the legislation, unrelated to the regulation of greenhouse gases, taking into account the introduction of the cap-and-trade system	Delineating the application requirements to regulate greenhouse gases	Additions to subparagraph 1) of paragraph 2 of Article 39, paragraph 1 of Article 47, paragraph 2 of Article 60, Article 68, paragraph 2 of Article 80 of the Environmental Code, paragraph 4 of Article 74 of the Bankruptcy Act.

Through modifications and amendments to the Environmental Code dated December 3, 2011 concerning the regulation of greenhouse gases, a legislative framework was created for:

- launching a national cap-and-trade system in 2013;
- the introduction of project-based mechanisms and the implementation of projects aimed at reducing emissions and removals of greenhouse gases;
- implementation of the Kyoto Protocol to the UN Framework Convention on Climate Change and the post-Kyoto agreement.

The cap-and-trade system under formation will cover the major sources of greenhouse gas emissions and it is expected that it will apply to about 200 companies operating in Kazakhstan, covering more than half of national emissions of greenhouse gases. Kazakhstan's cap-and-trade system created by analogy with the European cap-and-trade system.The new legislation provides for quotas of greenhouse gas emissions by plants with the annual emissions of greenhouse gases over twenty thousand tons of carbon dioxide equivalent. Requirements for the quotas apply only to such major plants of theenergy, oil and gas, mining and smelting, chemical industry, transport and agriculture[28]. Companies will be able to repay those quotas due to the implementation of measures to reduce greenhouse gas emissions at their own facilities or by using the opportunities of the market trading the quotas.

The key elements of the cap-and-trade system that became subject to the regulation at the level of provisions in the Environmental Code,are as follows:

- quotas for greenhouse gas emissions on the basis of national plans for the allocation of quotas of gases through the issuance of certificates for greenhouse gas emissions;[29]
- monitoring, reporting and verification of greenhouse gas emissions by regulated companies and plants; [30]
- the internal mechanism of the implementation of projects aimed at reducing emissions and increasing the absorption of greenhouse gases, including quota-free plants;[31]
- monitoring, reporting and verification of reduced emissions and increased removals of greenhouse gases in the internal projects; [32]
- operations with carbon units, including units of quotas and project units;
- trading quota units and units derived from the internal projects. [33]

In addition, the new provisions of the Environmental Code also provide for the implementation of internal projects aimed at reducing emissions and increasing removals of greenhouse gases. Relevant projects are not subject to the requirements of the clean development mechanism and joint implementation of the Kyoto Protocol to the UN Framework Convention on Climate Change. This is due to the uncertain status of the country on this international legal instrument. Kazakhstan is a Party to Annex I, but it has no definite quantitative obligations under Annex B of the Kyoto Protocol and, therefore, does not have any rights to participate in the joint implementation projects or in projects under the clean development mechanism. Therefore, Article 94-10 of the Environmental Code sets an internal mechanism for the implementation of the reduction projects, by analogy with the flexibility mechanisms of the Kyoto Protocol. Their implementation is provided in the following sectors of the economy:

- mining and smelting (in terms of utilization of coal mine methane projects);
- agriculture;
- housing and utilities;
- planting of forest and grassland areas;
- prevention of land degradation;
- renewable energy sources;
- recycling of municipal and industrial waste;
- transport;
- energy-efficient construction.

Economic incentive to promote such projects will be an opportunity to use reduction units obtained through their implementation, for the redemption of quotas for greenhouse gas emissions.

Along with the metioned above, the Environmental Code contains provisions that lay the groundwork for a possible participation of Kazakhstan in the second crediting period of the Kyoto Protocol or the post-Kyoto agreement. This primarily concerns the formation of the national legislation for the implementation of mechanisms for joint implementation and emissions trading based on the mechanism of green investments [34] in the country and the treatment of various carbon units provided under the international legal regime for the Kyoto Protocol. This applies to such international carbon units, as the assigned amount, units of absorption, emission reduction units and certified emission reduction units. Naturally, the relevant provisions of the national law will take effect only after the acquisition by Kazakhstan of the rights to issue relevant international carbon units in the scope of the second crediting period of the Kyoto Protocol or a new international agreement that establishes quantitative commitments

[28] Article 94-2 of the Environmental Code of the Republic of Kazakhstan.
[29] Articles 94-3 – 94-5 of the Environmental Code of the Republic of Kazakhstan.
[30] Articles 94-11, 158-4 and 314-1 of the Environmental Code of the Republic of Kazakhstan.
[31] Articles 94-6, 94-8, 94-10 of the Environmental Code of the Republic of Kazakhstan
[32] Articles 94-9 and 158-3 of the Environmental Code of the Republic of Kazakhstan.
[33] Articles 94-7, 94-9 of the Environmental Code of the Republic of Kazakhstan.
[34] Article 94-12 of the Environmental Code of the Republic of Kazakhstan.

to reduce greenhouse gas emissions. The presence of these provisions in the Environmental Code is due to the fact that at the time of its development the legislator expected that the country would have opportunities to participate fully in the first crediting period of the Kyoto Protocol (2008-2012). Accordingly, Kazakhstan would be able to participate in the joint implementation projects or in the international emissions trading under the mechanism of environmental (green) investments. However, at the suggestion of Kazakhstan [35] for the inclusion of country's quantitative commitment to reduce greenhouse gas emissions in the Annex at the Meeting of the Parties on December 7, 2011 in Durban no decision was made, while the new law in Kazakhstan was signed by the President of Kazakhstan before the completion of the international climate negotiations .

In general, the Act of December 3, 2011 established only common and fairly brief provisions necessary for the development and adoption of more detailed regulatory provisions and procedures at the level of secondary legislation. Many aspects of the introduced national cap-and-trade system received more detailed regulation in May and August 2012 at the level of the Government decrees and orders of the Ministry of Environment. Total of approximately 30 by-laws were adopted in accordance with Order No14 of the Prime Minister of the Republic of Kazakhstan dated January 27, 2012 and those by-laws cover the following aspects of the regulation of emissions and removals of greenhouse gases:

- quotas for greenhouse gas emissions;
- monitoring, reporting and verification of greenhouse gas emissions;
- projects to reduce emissions and removals of of greenhouse gases;
- trade and other operations with carbon credits;
- implementation of the Kyoto Protocol to the UN Framework Convention on Climate Change.

Table 4.7 summarizes the content of by-laws regulating greenhouse gases adopted in May and August 2012. Completion of the development and adoption of laws aimed at creating a national cap-and-trade system in accordance with the Act of December 3, 2012, will be performed by the adoption of the National plan for allocation of quotasfor greenhouse gases for the first reporting periodat the level of the Government's decree. It will defineplants with quotas set for them, quota reserve for new plants etc. It is envisaged that the first National plan for allocation of quotas for greenhouse gases will come into force on January 1, 2013 and will be adopted before December 1,2012

Table 4.7

New by-laws regulating greenhouse gases

Regulated aspect	Description of the new by-laws	Object of the new by-laws' regulation
Quotas for greenhouse gases	Terms of issuing quotas for greenhouse gases, approved by Decree No584 of the Government on May 7, 2012	Determine the procedure for registration of the certificate for greenhouse gases and obtaining quotas for greenhouse gases at the expense of the plant operator in the State register of carbon units.
	Terms of quota changes, and re-registration of the certificate for greenhouse gases, approved by Decree No585 of the Government on May 7, 2012	Determine the procedures for changing the quota in the case of expanding and increasing the power of the quota covered plant, and the renewal of the certificate in case of change of the operator or its name.

[35]Article 94-9 of the Environmental Code of the Republic of Kazakhstan.

Regulated aspect	Description of the new by-laws	Object of the new by-laws' regulation
Quotas for greenhouse gases	Rules for distribution of quotas for greenhouse gases approved by Decree No586of the Government dated May 7, 2012	Establish the basic regulatory approaches and requirements for the allocation of quotas for greenhouse gas emissions. Determine the procedure for the development and approval of national plans for the allocation of quotas for greenhouse gas emissions.
	The list of of greenhouse gases, which are subject to government regulation approved by Decree No655 of the Government on May 22, 2012	Defines the greenhouse gases that are subject to the requirements for quotas of greenhouse gases, and carbon dioxide and methane are listed in that group.
	Government Decree No685dated May 25, 2012 "On the definition of priority sectors for reserve of quotas needed for the allocation of quotas for greenhouse gases"	Defines the sectors of the economy in which the new plants, unspecified in the National Plan for allocation of quotas for greenhouse gases, can receive quotas from the reserve of quotas.
	Rules for the formation of the reserve of the established volume, and the reserve of quotas of the national plan for allocation of quotas for greenhouse gasesapproved by Decree No716of the Government dated 31 May 2012	Determine the procedure and establish requirements for the formation of the reserve of quotas for new plants that do not have a quota in accordance with the National plan for the allocation of quotas for greenhouse gases.
	Rules for converting the units of project-based mechanisms in the regulation of emissions and removals of greenhouse gases into the units of quotas approved by Decree No148-p of the Minister of Environment of Kazakhstan dated May 10, 2012	Define the procedure by which the design carbon units can be converted into the units of quotas for the operators of quota covered plants to meet their future commitments. This operation can be performed in case the operator has insufficient units of quotas.
Monitoring, reporting and verification of greenhouse gas emissions	Order of the Minister of Environment of the Republic of Kazakhstan dated May 25, 2012 No 170-p «On Amendments to Decree of the Minister of Environment of the Republic of Kazakhstan dated December 13, 2007 № 348-p» On Approval of the Rules of the inventory of greenhouse gases and ozone-depleting substances "	Sets a new date and format of reporting of greenhouse gases for the operators of plants that are not subject to the requirements for quotas of greenhouse gases. Annual reports are submitted by them before 1 April of the following year and are prepared in the same form as in the case of operators of quota covered plants.
	Rules for monitoring and controlling inventory of greenhouse gases, approved by Decree of the Government on June 26, 2012 No 840	Establish the basic requirements for monitoring greenhouse gas emissions for the operators of quota systems, their preparation of reporting on greenhouse gases, confirmation of the prepared reports by the verifiers and their subsequent submission to the regulator.
	Rules of accreditation of independent organizations conducting verification, validation (determination) and confirmation of the report on the greenhouse gas inventory, approved by Decree of the Government dated June 30, 2012 No 895	Establish eligibility requirements and determine the procedure for accreditation of validators and verifiers performing verification of emission volumes of greenhouse gases, or in the case of projects - reduction thereof.

Regulated aspect	Description of the new by-laws	Object of the new by-laws' regulation
Monitoring, reporting and verification of greenhouse gas emissions	Methods for the development of monitoring plans by entities in the allocation of quotas for greenhouse gases, approved by Order of the Minister of Environment dated May 10, 2012 No 143-p	Provides guidance and clarification for the operators of quota systems for preparing plans for monitoring of emissions of greenhouse gases for subsequent submission to the regulator.
	Terms of standardization for measurement and accounting of greenhouse gasesapproved by Order of the Minister of Environment dated May 10, 2012 No 144-p	Establishes requirements for the standardization of requirements in the case of measuring devices for monitoring greenhouse gas emissions and the organization of accounting of greenhouse gas emissions.
	Form of report on the inventory of greenhouse gases, approved by Order of the Minister of Environment dated May 10, 2012 No 145-p	Defines the format in which the operators of quota covered plants should develop an annual inventory report on their emissions of greenhouse gases for submission to the regulator.
	Form of the passport for the plant, approved by Order of the Minister of Environment dated May 10, 2012 No146-p	Defines the format of the document in which operators must provide information and data on the quota covered plants to the regulator.
	Methods and criteria for the preparation of reports on greenhouse gas inventory, approved by Order of the Minister of Environment dated May 10, 2012 No149-p	Provides guidance and clarification for the operators of quota covered plants on the preparation of their annual reports on the greenhouse gas emissions inventory for submission to the regulator.
Projects to reduce emissions and removals of of greenhouse gases	Terms of participation of subjects of administration in the implementation of project-based mechanisms in the regulation of emissions and removals of greenhouse gasesapproved by Decree of the Government dated May 8, 2012 No 594	Define the procedure and establish the requirements for participation in the implementation of projects to reduce greenhouse gases of the operators of plants, who may, under certain circumstances, be subject to the requirements for quota of greenhouse gases.
	Terms of review, approval and implementation of projects aimed at reducing emissions and removals of greenhouse gasesapproved by Decree of the Government dated June 26, 2012 No 841	Define procedure for the implementation of projects to reduce emissions and removals of of greenhouse gases from the the stage of formation of the project idea to the completion of the issuance of project units under the respective projects.
	Terms of of the project-based mechanisms in the regulation of emissions and removals of greenhouse gasesapproved by Decree of the Government June 30, 2012 No 897	Set the basic requirements for the implementation of projects to reduce emissions and removals of of greenhouse gases through a variety of mechanisms. Distinguish between projects on flexibility mechanisms of the Kyoto Protocol (Joint Implementation, the Clean Development) and the internal mechanism established by Article 94-10 of the Environmental Code.
	Rules for the preparation of review and approval, registration, reporting and monitoring of internal projects to reduce greenhouse gasesapproved by Order of the Minister of Environment dated May 11, 2012 No 150-p	Define the procedures for the implementation of projects to reduce greenhouse gases by internal mechanism after the projects are submitted to the Ministry of Environment. Govern the relationship between the applicants of such projects and the Ministry of Environment.
	Rules for the development of internal projects to reduce greenhouse gases and the list of industries and sectors of the economy in which they can be implemented, approved by Order of the Minister of Environment dated May 14, 2012 No 156-p	Define procedure for initiating projects to reduce greenhouse gases by an internal mechanism to the stage of submission of the project documentation on them to the Ministry of Environment. Establish the form of project documentation and project ideas submitted for approval to the Ministry of Environment.

Regulated aspect	Description of the new by-laws	Object of the new by-laws' regulation
Trade and other operations with carbon credits	Rules of conducting the state registry of carbon units, approved by Order of of the Minister of Environment dated May 10, 2012 No147-p	Define the procedures for opening accounts in the State Register of carbon units for the operators of quota covered subjects, applicants of the projects to reduce emissions and removals of greenhouse gases, subjects of the market for trading carbon units. Establish the basic requirements for carrying out various operations with carbon units from their issuance to their cancellation.
	Terms of trading quotas for greenhouse gas emissions and carbon unitsapproved by Decree of the Minister of Environment dated May 11, 2012 No 151-p	Establish the basic requirements and determine the procedures for trading of units of quotas and project carbon units trading at stock exchanges. Regulate issues related to holding the auctions for the sale of units of quotas.
	Rules of mutual recognition of the quota units and other units of carbon credits on the basis of international treaties of the Republic of Kazakhstanapproved by Order of the Minister of Environment dated May 11, 2012 No 153-p	Establish the basic requirements and determine the procedure in respect of the negotiations on association of the national carbon market with foreign and international markets, such as the market of the European Union. The regulations apply to the case where the association is carried out by means of mutual recognition of units of quotas or other internal carbon units between different markets.
	Rules of monitoring, recording and reporting of carbon units of greenhouse gases for the purposes of trade, approved by Order of the Minister of Environment dated May 14, 2012 No 157-p	State register of carbon units of the Republic of Kazakhstan can not yet be included in the international or independent system of registration of the performed transactions with carbon units and authentication operations. With this in mind, special requirements are established for monitoring, recording and reporting of transactions with carbon units, conducted on the basis of Kazakhstan's registry of carbon units.
Implementation of the Kyoto Protocol to the UN Framework Convention on Climate Change	Rules for creating and handling parts of the assigned amount of emission reduction units, units of the certified emission reduction, units of removals of greenhouse gases and other derivatives provided by international treaties of the Republic of Kazakhstan, approved by Decree of the Government on May 25, 2012 No 684	Establish the basic requirements and procedures for operations with international carbon units, introduced into circulation in accordance with the Kyoto Protocol to the UN Framework Convention on Climate Change. Cover the cycle starting from the moment they are put into circulation in the territory of the Republic of Kazakhstan to the full withdrawal and cancellation.
	Rules for the control of completeness, transparency and reliability of the state inventory of emissions and removals of greenhouse gasesapproved by Decree of the Government dated June 18, 2012 No 798	Establish the basic requirements and define procedures to ensure compliance with the annual national inventory of emissions and removals of greenhouse gases with the criteria of completeness, transparency and credibility, established under the Kyoto Protocol and the UNFCCC.
	Rules of maintenance and keeping of the state cadastre of emissions and removals of greenhouse gasesapproved by Decree of the Government dated July 17, 2012 No 943	Define procedure for the annual preparation of the state cadastre of emissions and removals of greenhouse gases for subsequent submission to the UNFCCC Secretariat. The document establishes the list of information and data included in the state register.
	Rules of implementation of environmental (green) investments approved by Decree of the Government dated August 8, 2012 No 1032	Establish the basic requirements and determine the procedure for the implementation in Kazakhstan emissions trading mechanism provided by the Kyoto Protocol. Provide for the sale of assigned amount of units by Kazakhstan only on terms of proper use of funds for projects that reduce greenhouse gas emissions.

4.2.3.2. Legislation in support of renewable energy sources

On July 4, 2009 Kazakhstan adopted the Law «On support of renewable energy». This law provides support for the use of renewable energy sources as a tool to carry out international commitments to reduce greenhouse gas emissions. It introduced the basic concepts of national legislation relating to renewable energy, defined approaches, the shape and direction for their governmental support, established competence of the government, authorized body, local executive bodiesin the field. The competence of the government covers a wide range of functions, including:

- implementation of public policies in support of renewable energy, including through the adoption of industry-specific and regional programs;
- development of legislative framework and technical regulations to support renewable energy sources;
- adoption of a plan of accommodation of facilities for the use of renewable energy sources;
- providing connection of renewable energy sources to the electrical or thermal networks;
- supporting the system of compulsory purchase of electricity produced from renewable energy sources;
- regulation and support of construction projects that use renewable energy with capacity of up to twenty five megawatts, as well as construction projects that use renewable energy to generate heat;
- monitoring of the use of renewable energy sources.

At the same time, while the majority of these functions are not implemented in practice, one of the few implemented competencies, which may be specified, is the definition by the Ministry of Industry and New Technologies of the plan for accomodation of the objects for the use of renewable energy sources. [36]

The second regulatory approach of the given law is defined in chapter «Supporting the use of renewable energy,» and it is based on the compulsory purchase of energy produced by renewable energy sources. It ensures, among other support measures, the obligations of the regional power grid companies to purchase the full electric power produced from renewable energy sources. In general, it provides for the imposition of administrative burden for the development of renewable energy on the power generating companies. It should be noted that admittedly the provisions of this part of the law has also not been realized in practice. As long as there are no objects that could qualify for the mandatory purchase of electricity they produce using renewables.

One of the weak points of the Law «On support of renewable energy», is admittedly the lack of established procedures and clearly defined responsibilities for the application of its provisions. Its provisions are formulated in a rather general way and are considered as a «declaration» to support the use of renewable sources, and no law has been adopted for the purpose of their implementation. This is regarded as one of the main reasons that the law has not yet been implemented in practice. On the other hand the necessary institutional framework for its implementation has long been absent, although the law contains an article on the competence of the authorized body. The Ministry of Energy and Mineral Resources was first considered as such, but it did not show a significant interest in the development of renewable energy sources because of the need to revise the tariffs for consumers in the event of extensive development. Then, the Ministry in March 2010, was transformed, and now the functions of the authorized body to support the use of renewable energy sources are executed by the Ministry of Industry and New Technologies.

4.2.3.3. Legislation on energy efficiency and conservation

Admittedly, the Act of December 25, 1997 «On Energy» was declarativelike the Act of 2009 «On support of renewable energy», and its provisions were not applied in practice. With this in mind, on January 13, 2012 in lieu thereof the new Law «On energy saving and energy efficiency» was adopted. The new law, along with a glossary of terms, competence of the Government, the authorized body and other state authorities introduced a number of new requirements in respect of:

- implementation of the policy on energy saving and energy efficiency of the state bodies and public organizations;
- ensuring compliance with the requirements of energy efficiency of the designed, constructed buildings, constructions and structures;
- mandatory use of the utility meters for consumed hot and cold water, electricity and heat in the designed and built residential apartment buildings;
- special regime of regulating the subjects consuming energy above certain levels;
- mandatory labeling of electrical energy consuming devices

The new legislation is aimed at the active implementation of the country's energy management tools, examination of energy saving and energy efficiency, energy regulation, energy audits, and monitoring and evaluation of the requirements of energy saving and energy efficiency by the government agencies and organizations.

Special attention should be given to the requirements for mandatory registration and annual reporting on the implementation of energy conservation and energy efficiency arrangements, established for all entities involved

[36]See the internent resource of the Ministry of Industry and New Technologies of the Republic of Kazakhstan, www.mint.gov.kz

in the consumption of energy resources in the amount equivalent to fifteen hundred or more tons of fuel per year, as well as for public institutions, state enterprises, national companies.[37] This requirement is implemented on the basis of the establishment of the State Energy registry on January 1, 2013. Subjects included in this registry, will have to develop and implement action plans for energy conservation and efficiency. The form and content of such action plans are determined by Decree of the Government dated August 31, 2012 No1118. All subjects of the National Energy registry, except for public institutions should at least once every five years have the energy audit with its mandatory performance during the first three years of the new law. In addition, for subjects consuming energy resources in the amount of one hundred thousand or more tons of fuel a year, mandatory standards will be established to reduce the consumption of energy (at least 25% reduction in 5 years).[38]

Another important regulatory tool is a mandatory energy conservation expertise on the pre-project and project documentation for the construction of new or expansion of existing buildings and structures with the volume of consumption of energy resources, equivalent to five hundred or more tons of reference fuel per year[39]. Although it was first introduced in 2000, only now it will be applied as a mandatory one. Energy audit and examination of energy conservation will be conducted by legal entities accredited by the permanent commission on accreditation in the field of energy conservation and energy efficiency under the Ministry of Industry and New Technologies.[40] In addition, the new law places great emphasis on the introduction of the assessment mechanism for central and local executive bodies on energy conservation and energy efficiency based on the consideration of the annual reports, as well as on the issues of raising awareness, training and skills development in this area.

4.2.3.4. Legislation relating to adaptation to climate change

As it is stated above, when considering the Strategic Development Plan before 2020 adaptation to climate change in the case of Kazakhstan is associated primarily with the sectors of agriculture and water management. Note, that according to the Report of Working Group II of the Intergovernmental Panel on Climate Change, «Climate Change, 2001. Impacts, Adaptation and Vulnerability» Central Asia has the potential to become one of the most affected regions as a result of the reduction of the annual river flow because of climate change. In these circumstances, implementation of the country's adaptation measures in the areas of health, emergency management, management of forests and protected areas, compulsory insurance, management of water resources is getting of significant importance. However, as is noted above, measures of adaptation to climate change and its effects have not yet received the full development in the national policy of Kazakhstan. Accordingly, there is often no basic conditions to develop appropriate legislative framework for the implementation of measures to adapt to climate change.

However, in separate sectors legislative frameworks were developed for the implementation of adaptation measures. First of all, it should be noted that the Act of July 7, 2006 «On Specially Protected Areas» provides for the establishment of ecological corridors and ecological networks that ensure maintaining of the integrity of natural ecosystems due to the formation of ecological corridors and networks of the specially protected areas . This allows to respond to threats to the ecosystems associated with the movement of the desert areas to the north in latitude zoning, increased fragmentation of ecosystems in the transition zones.

Ecological Corridor - part of the ecological network represented by protected areas of land and water bodies, connecting the specially protected natural sites with each other and with other types of protected natural sites to ensure natural migration (distribution) of the objects of wildlife and preservation of biodiversity (paragraph 22 of Article 1 of the Law «On Specially Protected Areas»).

Ecological network - a set of specially protected natural sites of various categories and types associated with each other and with other types of protected natural sites of ecological corridors, organized with the natural, historical, cultural and socio-economic characteristics of the region (sub-paragraph 1 of Article 23 of the Law «On Specially Protected Areas»)

Establishment of ecological corridors and development of ecological networks is enshrined in the competence of the authorized state body (Committee for Forestry and Hunting), and local agencies. Law «On Specially Protected Areas» regulates the procedure for their creation and development, use and protection of the relevant natural areas. At the same time, opportunities for the implementation of these legislative requirements in practice

[37] Article 9.
[38] Articles 16 and 18
[39] Paragraph 1 of article 15.
[40] Paragraph 3 of article 14.

are associated primarily with the programs for development of the system of the specially protected natural sites and ecological networks, which have largely lost their importance since the formation of a new system of state planning in Kazakhstan in 2008-2010. It should be noted that so far no bases have received regulatory framework in national legislation for the implementation of such adaptation actions on ecosystems, as the creation of transboundary biosphere reserves, inclusion of the conservation of landscape and biological diversity into the process of spatial planning by local executive bodies.

With respect to the sector of emergency mitigation the respective framework Law of July 5, 1996 has not undergone significant changes in terms of the basis for the implementation of adaptation measures. At the same time the Order of the Minister of Emergency Situations of December 1, 2008 approved the catalog of natural and man-made disasters. Among other things, it defines dangerous hydrological phenomena associated with climate change (floods, high water, freshets, ice jams, congestion, drying up of rivers), debris flows, landslides , hazardous weather events (heavy rainfall, droughts), epidemics, epizootic diseases. The Catalogue defines the threats associated with the above extreme natural events, the supposed areas and objects that are particularly susceptible to their impact, quantitative risk assessment and provides data on trends in their frequency and magnitude in recent years. Respective catalogues are also being developed in certain territories, for instance, in the Almaty region it has been approved by Order of the Chief of the Department of Emergency for the Almaty region on December 15, 2008 No40 .

In addition, the order of the Ministry of Emergency Situations of March 24, 2011 approved the Model passport for the water areas of the region (city), which is used as a tool to assess the possible effects of emergencies on the water bodies and the development of measures to reduce, eliminate, mitigate the effects of emergencies. The introduction of such passports is the responsibility of the staff of the Ministry of Emergency Situations and its subordinate organizations, and currently such catalogs are already being developed. However, it is unclear how they will be used for the design and planning of adaptation measures in the water sector, which could be carried out, including at the level of the Water Resources Committee, Ministry of Agriculture and local executive bodies.

In general, in terms of future development and inclusion of legal instruments for the implementation of measures to adapt to climate change is of interest to a number of existing laws. Among them are the Environmental Code, the Water Code, Land Code, Forest Code, the Code of health of people and the health care system, the Law on Protected Areas, the Law on Mandatory Environmental Insurance and the Law on Compulsory Insurance in plant breeding. A review of the legislative texts of the documents does not allow to identify any provisions or regulations therein which would initially be suitable for the implementation of measures to adapt to climate change. In general, they do not contain any link of the provisions for the protection of natural ecosystems, human health and safety to changing climate conditions and associated impacts.

In general, the Strategic Development Plan of the Republic of Kazakhstan before 2020 created a good basis for the development of measures in Kazakhstan to mitigate climate change and reduce greenhouse gas emissions. It identifies the appropriate strategic direction and objectives, sets target indicators to assess progress. The strategic objectives defined by the plan are the reduction of greenhouse gas emissions, reducing energy intensity and increasing the share of renewable energy in total energy consumption. They are associated with actions to diversify the economy and future development of the energy industry. Taking action on climate change adaptation in the agricultural sector and the water sector is also recognized in the Strategic Development Plan of the Republic of Kazakhstan before 2020, as a priority, but appropriate measures have not yet received further development in this strategic document, and in the current program.

Provisions of the Strategic Plan of Development of Kazakhstan before 2020 have laid a good foundation for the inclusion of objectives, activities and targets to reduce greenhouse gas emissions, improve energy efficiency and development of renewable energy sources in the strategic plans of separatestate bodies (the Ministry of Environment and the Ministry of Industry and New Technologies) and in Industry program for 2010-2014 «Zhasyl Damu.» To a much lesser extent, the program frameworks and plans for the implementation of the activities in the above mentioned strategic areas are defined at the local government level.

At the legislative level, the main interest is the new provisions of the Environmental Code, adopted on December 3, 2012 and the Act of January 13, 2012 «On energy conservation and energy efficiency.» The first law provides for the launch of the national cap-and-trade system in the country in 2013by analogy with the European cap-and-trade scheme. The new system will cover the major plants in the energy production and transportation of oil and gas, chemical manufacturing, mining and metallurgical industry. The second law introduces a package of binding measures to save energy and improve energy efficiency for use at the level of public authorities, public organizations, large energy users, designers and constructors of buildings, structures and facilities, manufacturers and suppliers of energy-consuming devices. The provisions of both laws have already received further implementation through the adoption of a package of by-laws to them, defining procedures and specifying the conditions and procedures for their application in practice.

The legislative framework for adaptation to climate change in Kazakhstan is not yet developed, insomuch as the adaptation measures themselves have not been yet developed and defined. Separate tools that can be used for planning and implementation of adaptation measures are envisaged in the law on protected areas, natural emergencies. Review of legislative acts regulating social relations in such potentially vulnerable to the impacts of climate change sectors, such as agriculture , water, health, forest, insurance, revealed no elements that could serve as a basis for adaptation measures.

4.3. Analysis of program documents for the development of the electricity sector of the Republic of Kazakhstan and their focus on the prevention of climate change

The steady growth of the economy observed over the last 10-15 years is accompanied by a corresponding increase in power consumption. To date, the electric power industry meets the needs of the economy and the population of the Republic in the electricity.

The development of electric power industry in Kazakhstan is focused on the appropriate development of the country, suggesting the accelerated implementation of social and economic reforms, with the growth rate of the gross domestic product of 7.5 - 8%. Meantime, in the last few years, GDP growth is accompanied by a steady growth of power consumption by the amount of 4 - 6% each year. Projected estimates indicate that by 2015, electricity consumption in the country will be just over 100 billion kWh, against 82 billion kWh in 2010.

As of 01.01.2011 (01.01.2012) design capacity of power plants in Kazakhstan amounted to 19,440.5 MW (19,798 MW), with available capacity, respectively – 15,765 MW (15,765)

The design capacity of power plants by type as of January 1, 2011 was as follows:

- CPP – 9,618 MW (49.5% of the total design capacity of Kazakhstan);
- CHP – 6,391 MW (32.8%);
- GTPP – 1,166.9 MW (6.0%);
- HPP – 2,267.1 MW (11.7%).

The structure of generating capacities in Kazakhstan in fuel:

- coal-fired thermal power plants - 12,607.5 MW, or 64.8% of the total generating capacity of the Republic of Kazakhstan;
- Oil-gas stations - 4,565.9 MW (including gas turbine - 1,166.9 MW), or 23.5%;
- hydropower plants - 2,267.1 MW, or 11.7%.

In 2010, the structure of the use of fossil fuels in power plants in Kazakhstan was as follows:

- coal - 28.0 mln tons of reference fuel
- oil - 0.48 mln tons of reference fuel
- gas - 4.81 million tons of reference fuel

Electricity production in 2010 by UES power plants in Kazakhstan amounted to 82.3 billion kWh, including:

a) By zones:

- North Zone - 65.2 billion kWh. h (79.2%);
- West Zone - 8.9 billion kWh. h (10.8%);
- South Zone - 8.2 billion kWh. h (10%).

b) By types of power plants:

- CHP CPP - 69.5 billion kWh. h (84.4%);
- HPP - 8.0 billion kWh. h (9.7%);
- GTPP - 4.8 billion kWh. h (5.8%).

c) By type of used primary energy resources:

- coal-fired thermal power plants - 60.0 billion kWh, or 72.9% of the total electricity generated in the Republic of Kazakhstan;
- oil-gas stations - 14.28 billion kWh (including gas turbine - 4.84 billion kWh), or 17.35%;
- hydropower plants - 7.99 billion kWh, or 9.75%.

Thus, most of the electricity - 73% is produced in thermal coal fired power plants, so the development of these power plants will determine the contribution of electricity in total greenhouse gas emissions in Kazakhstan.

As noted above, the growth of the economy of Kazakhstan is accompanied by a corresponding increase in energy consumption, which leads to the necessity in developing the generating sector of the industry. The analysis shows that the current state of the electricity sector, the power plants in the country can provide electricity production in the volume of no more than 90 billion kWh / year. Given the ever-increasing output of the current economic life of the generation equipment, in order to ensure coverage of the growing electricity consumption in the electric power sector in the country it is necessary to carry out the modernization of existing plants and construction of new generating capacity.

The prospect of the development of electric power industry in Kazakhstan in general is determined subject to general trends in the development of the economy of the Republic of Kazakhstan, taking into account the adopted program documents of the Government of the Republic of Kazakhstan, as well as the regional development programs.

Currently, the main applicable program document in the electricity sector in Kazakhstan is the Program for development of the power industry of the Republic of Kazakhstan for 2010 - 2014 years. This program document was approved by Decree of the Government of the Republic of Kazakhstan on October 29, 2010 No1129. In the framework of the Program the forecast balance of electricity in Kazakhstan was developed for 2010 - 2014 years. (Table 4.8).

Main target indicators of the Program:

- Bringing electricity generation in 2014 to 97.9 billion kWh, with consumption forecast of 96.8 billion kWh.
- Ensuring coal production by 2014 up to 123 million tons.
- Achieving volume of electricity generation in 2014, by renewable sources of energy - 1 billion kWh per year (Table 4.9).
- The share of renewable energy in the total energy consumption more than 1% in 2015.

Table 4.8

Forecast balance of electricity to Kazakhstan in 2014

billion kWh.

Description	2009 fact	Forecast				
		2010	2011	2012	2013	2014
Power consumption	77,96	82,20	85,86	89,52	93,18	96,84
Power generation	78,43	84,70	87,61	90,27	93,76	97,91
Providing electricity by own sources,%	98,20	99,10	99,88	99,87	99,92	99,85

Sources: Program for development of power industry for 2010-2014

Table 4.9

Production of electricity by renewable sources of energy

billion kWh.

Description	2009 fact	Forecast				
		2010	2011	2012	2013	2014
Electric power generation	0,37	0,38	0,45	0,60	0,80	1,00

Sources: Program for development of power industry for 2010-2014

4.3.1. Analysis of the projects implemented under the Programme aimed at reducing emissions of greenhouse gases

In line with the developed industry «Program for development of the power industry of the Republic of Kazakhstan for 2010-2014», the development of generating sources in Kazakhstan (the main producers of greenhouse gases in the electricity generating sector) was provided as follows:

Table 4.10

Development of generating sources in Kazakhstan

Projects scheduled by the Program	Scheduled implementation term	Current state
A) Modernization and reconstruction of existing facilities 2010 - 2014		
Expansion of the Atyrau CHP	2006 - 2010	Installation of three turbines of 25 MW each
Restoration of block No 8 of Ekibastuz GRES-1	2010 - 2012	Block restored and running at full capacity
Construction of power block No 3 of Ekibastuz GRES-2	2009 - 2013	Block construction began in 2012, the estimated completion date - 2015
Restoration of block No 2 Aksu GRES	2011	Block restored and running at full capacity
Modernization of the Shardarinisk HPP	2009 - 2015	
Renovation and expansion of Almaty CHP-2 (3rd line, boiler No 8and boiler room)	2009 - 2013	Boiler is installed, completion of construction of boiler No 8 - not earlier than 2015

The analysis of the proposed measures shows that the implementation of these projects will not affect the reduction of CO_2 emissions, with the exception of the project on modernization of Shardarinisk plant, as a result of which the installed capacity of the plant after its complete modernization will increase by 16 MW with the output of about 60 million kWh / year, which will lead to a corresponding reduction in the production of the same amount of electricity at large condensing thermal power plants in northern Kazakhstan. Meantime, reduction of CO_2 emissions due to such substitution will be about 60 thousand tons per year.

The implementation of all other planned measures to modernize stations, including modernization of Atyrau CHP running on oil-gas fuels, will lead to an increase in CO2 emissions.

Table 4.11

Planed actions on modernization of power plants

Projects scheduled by the Program	Scheduled implementation term	Current state
B) Construction of new generating capacities		
Construction of the Moinak HPP	2006 - 2011	Construction of the station is completed, the annual electricity production is about 1 billion kWh a year
Construction of GTPP "Akshabulak"	2010 - 2012	Construction in Kyzyl-Orda region of gas turbine power plant for 87MW working on the passing gas oil, consisting of three units by 29 MW ended in 2012, the annual power generation will be 600 million kWh / year
Construction of the Ural GTPP	2010 - 2012	Construction of the plant with capacity of 54 MW is finished, the annual electricity production will reach 360 million kWh / year
Construction of the Balkhash TPP	2010 - 2015	Construction of the plant began in 2012, the completion of construction of the first module consisting of two power units of 660 MW each - 2017-2018
Construction of the Kerbulak HPP	2012 - 2016	Construction of hydropower plant started - HPP construction period is not defined, roughly after 2020

Analysis of the proposed measures shows that the implementation of these projects will not affect the reduction of CO_2 emissions in Kazakhstan, with the exception of the project for the construction of the Kerbulak distribution reservoir hydropower plants with capacity of 40 MW and output of about 200 million kWh / year, which will result in a corresponding reduction of the production of the same volume of electricity at large condensing thermal power plants in northern Kazakhstan. In this case, reduction of CO_2 emissions due to such substitution will be about 200 thousand tons per year.

Construction of the Ural GTPP with capacity of 54 MW and an annual production of 360 million kWh / year will not reduce CO_2 emissions in the WKO, because the electricity generated by the plant will replace electricity imported from Russia. Estimated additional CO_2 emissions will be about 200 tons / year .

GTPP «Akshabulak» in Kyzyl-Orda region with capacity of 87MW with the annual production, will ensure reduction of the supply of electricity to energy-deficient South Kazakhstan from Northern Kazakhstan in the amount of 600 million kWh / year. In this case , reduction of CO_2 emissions in general for Kazakhstan will be about 240 thousand tons / year (600 tons - 360 tons) .

Construction of Balkhash coal plant with a total capacity of the first module of 1320 MW and an annual production of electricity at least 9 billion kWh / year, taking into account a more efficient power generation technology will lead to an increase in CO_2 emissions of at least 7 million tons / year.

Table 4.12

Planed actions on RES

Projects scheduled by the Program	Scheduled implementation term	Current state
C) Development of renewable energy sources		
Almaty Region		
WPP in Sheleksky corridor with design capacity of 51 MW	*2011*	The project was not carried out
WPP in the vicinity of Dzhungar gates with design capacity of 50 MW at the first stage	2012	The project was not carried out

Projects scheduled by the Program	Scheduled implementation term	Current state
The cascade of small hydropower plants on river Cox with total capacity of 42 MW	2012	The project was not carried out
Small hydropower plants on river Baskan with design capacity of 4.37 MW	2011	The project was not carried out
Small hydro power plants on river Issyk with total capacity of 5 MW	2011-2012	The project was not carried out
Small hydro power plants on river Shelek with total capacity of over 30 MW	2014-2015	The project was not carried out
Small hydropower plant on river Lepsy with design capacity of 4.8 MW	2012	The project was not carried out
Solar plants with a capacity of 6 MW at the first stage	2014	The project was not carried out
East Kazakhstan Region		
WPP in the vicinity of Ulan district with design capacity of 24 MW	2011	The project was not carried out
Mangystau Region		
WPP in the Tubkaragan area with design capacity of 40 MW	2012	The project was not carried out
Aqmola Region		
WPP in the Ermentau area with design capacity of 35 MW	2013	The project was not carried out
Karaganda Region		
WPP in the Karkarala area with design capacity of 10 - 15 MW	2013	The project was not carried out
South Kazakhstan Region		
WPP in the Baydybek area with design capacity of 40 MW	2014	The project was not carried out
Small hydro power plants on river Keles with total capacity of 10 MW	2011-2014	The project was not carried out
Kostanay Region		
WPP in the vicinity of Arkalyk with design capacity of 41 MW	2014	The project was not carried out

The most effective measure to reduce CO_2 emissions in the electricity sector can give the development of power generation capacity on the basis of renewable energy sources (RES). Of the above mentioned projects to develop renewable energy sources in Kazakhstan with the aggregate capacity of 400 MW with the annual electricity production of more than 1 billion kWh, only the project for the construction of a small hydropower plant on river Issyk in Almaty region was completed to date. Implementation of these projects will lead to a decline in the construction of new generating capacity with the use of coal power with capacity of about 200 MW, and, thus, to the reduction of CO_2 emissions in the long term by the value of at least 1 million tons / year .

It should be noted that in 2011Institute of JSC « KazNIPIITES «Institute for Energy» (hereinafter Institute «Energy») at the request of JSC»KEGOC» performed the work on the creation of the «Master plan for development of the electric power industry of the Republic of Kazakhstan before 2030»(hereinafter the Master plan). This work is the basis for the «Concept of power industry development in Kazakhstan before 2030»currently being developed by the Ministry of Industry and New Technologies of the Republic of Kazakhstan. In this regard, it is advisable to consider the main provisions of the Master Plan with respect to the long-term development of generating sources, as some of them may be included into the «Concept ... « developed by MINT of the RK. Below are the key proposals of LLP «KazNIPIEnergoprom» for reconstruction and expansion of existing thermal power station, as well as the construction of new thermal power plants.

To improve fuel efficiency in the context of ever increasing cost and shortage of electricity co-production of heat and electricity becomes most efficient.

Great attention to the development of TPP in Kazakhstan is explained by the following main advantages of high-efficiency cogeneration:

- increasing the efficiency of using main types of fuels by 35-40 % compared with condensing thermal power plants (TPP) due to the higher key performance indicator (KPI);
- reducing emissions compared to the separate production of heat and electricity;

- increasing the efficiency of power transmission, which is associated with a decrease in the cost of electricity transmission, as CHP are placed in areas of thermal and electrical load consumption, they are free of all restrictions on power transmission, there are virtually no losses in electric networks.

4.3.1.1. Renovation and expansion of existing TPP

The main volume of electric power and steam capacities of TPP in the RK was commissioned in 60-80 years of the last century and requires immediate action to replace obsolete equipment.

The main task of reconstruction and modernization is the selection of optimal progressive technical solutions based on advanced technologies for the generation of heat and power, with the maximum use of existing infrastructure that will ensure manufacture of competitive products and conditions for long-term, reliable and safe operation of the power plant as part of the environmental legislation of Kazakhstan.

The purpose of the reconstruction of the existing thermal power plant is improving the efficiency through the replacement of obsolete equipment with modern one with higher KPI, increasing generation of power on heat consumption, which will allow to increase the efficiency of using the fuel heat, to provide reliable and high quality heat supply to the cities.

The volumes of reconstruction and replacement of TPP capacities in the RK are defined by disposal of equipment with expired life, deadlines of introducing the basic electrical and steam power capacities.

The costs of operating the worn-out and obsolete equipment (additional repair costs and fuel burnout), if the renewal of the equipment at the TPP is not performed, are comparable to the annual investment required for the modernization of power plants, according to the estimates held in CIS countries.

To eliminate negative aspects of thermal energy and ensure its development, it is necessary to focus not only on the extension of the life of the equipment of the TPP through the repair and replacement of individual components of steam turbines and boilers (low cost measures), but also on the upgrade of the equipment with the use of advanced technologies .

Selecting the option for reconstruction should be determined by the owner, based on the actual conditions, fuel prices, the cost of the project, accepted funding conditions and tariff policy.

To replace old equipment and expand the TPP equipment from leading manufacturers may be used as well as from the leading suppliers of boilers and steam turbines, gas turbines, steam and hot-water heat-recovery boilers from the CIS countries.

To replace the gas fired equipment it is requires the use modern steam and gas technology with the use of combined-cycle steam turbine plants (STP) according to the utilization scheme to ensure the KPI of fuel use in heating mode - more than 80 %, in condensing mode - more than 50 %.

In Kazakhstan, the TPP have the equipment from mainly Russian factories, the reconstruction and new construction in recent years use power equipment, both of manufacturers in Russia and foreign countries. Table 13 shows the comparative energy efficiency of the equipment manufactured currently in other countries.

Table 4.13

The efficiency of power equipment in Russia compared to the foreign equipment

	Russia		World class	
	Average value	Advanced versions	Average value	Advanced versions
KPI of gas TPP,% CCGT	38,5%	51-52%	44-45%	58-60%
KPI of coal TPP, %	34,2%	38-44%	37-40%	45-47%
Losses in heat networks, %	13,2%		7,5%	

Sources: Master plan for development of the electric power industry of the Republic of Kazakhstan before 2030

The use of reclaimed areas with established infrastructure allows to reduce the cost of construction, gradually replace the exhausted equipment, defective communications, buildings and structures, ensures continuous heating of the TPP zone during the reconstruction of the plants.

Selected best available technologies for a particular business entity must meet the following basic requirements:

- matching the latest technology developments in this industry;
- justification for the application of this technology in terms of environmental protection, that is, to minimize the human impact on the environment;
- economic and practical acceptability of this technology for the enterprise.

Replacement of existing equipment at the TPP with the expired life for modern equipment with the use of highly advanced technologies will allow to improve the reliability of heat supply, improve fuel efficiency in the face of ever-rising gas prices, save the existing heating system, further develop the heat source due to the dismantling of decommissioned equipment, buildings and facilities to cover the increase in heat loads. Table 4.14

presents proposals of the Master Plan for the reconstruction and expansion of a number of thermal power plants in Kazakhstan.

Table 4.14

List of reconstructed and expanding TPP

City	Name of the plant	Power capacity, MW	Fuel	Scheduled term of the equipment commissioning
Almaty	TPP-2 JSC «AlES»	240	coal	2021 -2025
Astana	TPP-2 JSC «Astana Energia»	240	coal	2012-2015
Ust-Kamenogorsk	JSC "AES Ust-Kamenogorsk TPP"	80	coal	before 2015
Karaganda	TPP-3 LLP "Karaganda Energocentre"	240	coal	120-2012 120- 2016
Temirtau	LLP "Ba3e1 Group" (Karaganda GRES-1)	50	coal	2016-2020
Ridder	JSC "Ridder TPP"	12	coal	2012
Semey	Municipal Utility Service "Teplokommunenergo" (Semipalatinsk TPP-1)	12	coal	2012
Taraz	TPP-4 JSC «Tarazenergocentre»	125	Gas, fuel oil	2015
Shymkent	JSC "Z-Energoortalyk" (Shymkent TPP-3)	50	Gas, fuel oil	2021-2025
Atyrau	JSC "Atyrau TPP"	109	Gas, fuel oil	24 MW-2015 25 MW-2018 60 MW-2020
TOTAL:		**1158**		

Sources: Master plan for development of the electric power industry of the Republic of Kazakhstan before 2030

4.3.1.2. Construction of new TPP

Further development of the electric power industry of the Republic of Kazakhstan is impossible without modernization of existing and construction of new thermal power plant. Thus, in addition to technical and technological requirements necessary to ensure the following:

- energy efficiency equipment stations by increasing the efficiency of conventional coal-fired steam-turbine power efficiency up to 45-47%, increasing the efficiency of gas turbines (CCGT) to 45 (60)%;
- reducing the impact on the environment.
- Technological priorities for the introduction of new facilities are to:
- transition to combined cycle with the introduction of new and modernization of existing gas-fired power plants;
- the transition to clean coal technology at coal-fired plants.

Clean coal technology is one of the directions of the future of energy, along with renewable energy sources (RES), and nuclear power. But in this case , the choice of the main production technology for new thermal power station in Kazakhstan preference is usually given to the industrial development of the resource-saving technologies and meet the environmental requirements. Table 4.15 shows the values of the level of efficiency of the combustion of coal ,which is regulated by Directive 96/61/EC the use of best available technologies for coal combustion technologies and systems.

Table 4.15

The achieved efficiency of clean coal energy technologies

Combined technology	Efficiency of the plant (net), best available technology	
	New installations	Installations in use
Cogeneration - TPP	75-90%	75-90%
Dust and coal burning	43-47%	36-40%
CCS	>41%	
Pressurized CS	>42%	

Sources: Master plan for development of the electric power industry of the Republic of Kazakhstan before 2030

In Kazakhstan, the use of modern technologies by industry, including thermal power, regulated by Government Decree number 245 of 12.03.2008g.»The list of the best available technology.»

To improve the efficiency of thermal power plants and reduce emissions in the list of the best available technologies RK includes the following key recommendations:

- the use of pulverized coal combustion;
- installation of electrostatic precipitators, bag filters and emulsifiers with 99,4-99,8% efficiency to reduce emissions of ash;
- wet, dry and semi-dry method to reduce emissions S0h for new boilers;
- staged combustion, low-emission burners, SNCR, SCR to capture 80-95% of oxides of nitrogen.

Analysis of the proposed BAT (best available technology) indicates the absence of some of the most important energy efficient emerging technologies for use in the coal power industry in Kazakhstan , which include fluidized and circulating fluidized bed at atmospheric or elevated pressure , the more so in the world there is a very considerable experience in the use of these technologies in commercial power plants bolshoy1 , as well as using supercritical steam parameters.

The construction of new thermal power station (Table 4.16) is offered during the 2011 2030gg .at new sites in the eight existing towns in energy-deficient areas to cover the increase in heat loads , replacement exhaust the life of equipment in existing energy sources , the closure of boilers.

Table 4.16

The list of new TPP plants proposed for construction

New TPP	Capacity, MW	Fuel	Expected commissioning term
TPP-3 Astana	240/120	Coal	2017-2018,2020
Karaganda TPP-4	360	Coal	2021 - 2025
Ust-Kamenogorsk TPP-2	240	Coal	2026 - 2030
Semipalatinsk TPP-3	180/195	Coal	2021 - 2025
Kostanay TPP-2	240	Coal (gas)	2021 - 2025
Uralsk TPP-2	120	Gas	2026 - 2030
Zhezkazgan TPP-2	220	Coal	2021 - 2025
Taldykorgan TPP-2	240	Coal	2021 - 2025
TOTAL CAPACITY:	1975		

Sources: Master plan for development of the electric power industry of the Republic of Kazakhstan before 2030

Performing the analysis of projects submitted for implementation in the Master Plan, with a view to the consideration of the subject focus on the prevention of climate change is not advisable since the failure of these materials as the program for the industry. In 2013, Min to SC will be made and published the concept of power development until 2030, which should be a policy document for the industry in the short and medium term.

4.3.2. The current status of the implementation of development projects in the electricity sector in Kazakhstan, used for the preparation of RK SNC

At the time of the development of the Second National Communication (SNC) in the electricity industry to ensure its long-term development, by providing self balancing power and capacity of Kazakhstan as a whole, as well as the establishment of the export potential have been developed and approved the following policy documents:

- Budgeted balance sheet electricity until 2015 , approved by the Decree of the Minister of Energy and Mineral Resources on 26 June 2007 number 154;
- Action Plan for the development of power industry of the Republic of Kazakhstan for 2007-2015 , approved by order of the Prime Minister of the Republic of Kazakhstan on May 31, 2007 № 147- p (repealed in 2008) ;
- List of electric power facilities undergoing renovation , modernization, and expansion and the construction of new power plants for 2007-2015 , approved by the Decree of the Minister of Energy and Mineral Resources on June 26, 2007 № 163 (repealed in 2008) .

The following table 4.17 presents the current status of the projects presented in the «List of electric power facilities, subject to reconstruction, modernization and expansion, as well as the construction of new power plants for 2007 - 2015.» In this case, only the projects are affecting the change in greenhouse gas emissions, and the current status of these projects

Table 4.17

Projects «List of electric power facilities, subject to reconstruction, modernization and expansion, as well as construction of new facilities for 2007 - 2015 years.» Affecting the emission of greenhouse gases

№ Item No	Description of the power facility	Description of works,No - MW	Assumed project implementation term, years	Current project status	Notes
1	Ekibastuz GRES-1	Reconstruction of power blocks No4, 5, 6, 7, restoration of non-operating power blocks No1, 2, 8	2007-2015	Partially complete	Reconstruction complete. In 2012power block No8 restored. Implementation of the projects will lead to the increase of greenhouse gas emissions
2	Ekibastuz GRES-2	Construction of power blocks No3 and No4 by 500 MW	2008-2015	Not completed.	Construction of block No3 started in 2012. Completion of the construction - 2014. Implementation of the project will lead to the increase of greenhouse gas emissions
3	Aksu GRES	Reconstruction of five power blocks	2007-2015	Complete	The performed reconstruction will virtually have no impact on the greenhouse gas emissions
4	TPP-2 Astana	Expansion, No5 and No6 by 240 MW	2007-2015	Partially complete.	In 2007 the power block with capacity of 120 MW was introduced. Greenhouse gas emissions of the plant increased.
5	TPP-3 Astana	Expansion, No1 and No2 by 240 MW	2007-2015	Not completed.	Construction of the new plant did not start. Implementation of the project will lead to the increase of greenhouse gas emissions
6	Stepnogorsk TPP in Aqmola region	Expansion for 200 MW	2007-2015	Not completed.	Plant expansion did not start. Implementation of the project will lead to the increase of greenhouse gas emissions
7	Rudnensk TPP	Commissioning of the turbine with capacity of 63 MW	2007-2010	Complete	Greenhouse gas emissions increased
8	Ust-Kamenogorsk TPP	Turbine commissioning	2007-2009	Not completed.	Implementation of the project will lead to the increase of greenhouse gas emissions
9	Semipalatinsk TPP-1	Expansion -12 MW	2007-2009	Not completed.	Implementation of the project will lead to the increase of greenhouse gas emissions
10	Semipalatinsk TPP-3	Construction - 195 MW	2007-2015	Not completed.	Implementation of the project will lead to the increase of greenhouse gas emissions

№ Item No	Description of the power facility	Description of works,No - MW	Assumed project implementation term, years	Current project status	Notes
11	Bulak HPP	Construction (capacity of 80 MW)	2007-2013	Not completed.	Implementation of the project will lead to decrease of greenhouse gas emissions due to the under output of such power at the northern plants by 350 thousand tons of CO_2/year
12	Chain of HPP at Kurchum	Construction (capacity of 106 MW)	2008-2015	Not completed.	Implementation of the project will lead to decrease of greenhouse gas emissions approximately by 300-350 thousand tons of CO_2/year
13	Almaty TPP-2	Reconstruction of the power boilers, ventilation cooling towers, expansion with the installation of boiler and turbine units 2x120 MW and construction of the combined ashes and slag disposal system	2008-2020	Not completed.	Implementation of the project will lead to the generation of the power at the TPP by 1.3 billion kW/year and, respectively, to the increase of CO_2 emissions by 0.8 mln tons/year
14	Gas turbine power plant in Almaty	Construction of GTPP in Almaty with the power capacity of 180 MW and heat capacity of 300 MW	2007-2009	Not completed.	Implementation of the project in general across Kazakhstan will lead to decrease of greenhouse gas emissions at the coal plants of the Northern Kazakhstan approximately by 400-450 tons of CO_2/year
15	Construction of Balkhash TPP	Construction 1-st stage (1000-1300 MW)	2007-2015	Not completed.	Plant construction started in 2012, completion - 2017-2018 Capacity - 1320 MW Implementation of the project will lead to increase of CO_2 emissions by at least 7 mln tons/year
16	Construction of Moynak HPP	Construction (capacity of 300 MW)	2007-2015	Complete	Construction of HPP with the generation of 1 billion kWh/year has led to decrease of CO_2 emissions by 1 mln tons/year
17	Construction of Kerbulak HPP	Construction of HPP (capacity of 50 MW, with release capacity at Kapchagay HPP up to 120 MW)	2007-2015	Not completed.	Construction of HPP with capacity of 40 MW with the output of 200 mln kWh/year will lead to decrease of CO_2 emissions by 200 thousand tons/year
18	Construction of Shelek, Horgos and Kosu chains of HPP	Construction of HPP in the Almaty region (with total capacity of 750 MW)	2007-2015	Not completed.	Construction of HPP with total capacity of 750 MW with the output of over 3.5 mln kWh/year will lead to decrease of CO_2 emissions by 3 thousand tons/year

№ Item No	Description of the power facility	Description of works,No - MW	Assumed project implementation term, years	Current project status	Notes
19	Zhambyl TPP-4	*Expansion with the construction of cogeneration GTPP (capacity of GTPP-100 MW)*	2008-2012	Not completed.	Construction of the cogeneration GTPP with capacity of 100 MW with the output of about 500 mln kWh/year will lead to decrease of CO_2 emissions by 300 thousand tons/year
20	District boiler room No4 Taraz	Construction of GTPP with power capacity of 50 MW and heat capacity of 46 Gcal/h	2007-2008	Not completed.	Construction of the GTPP with capacity of 50 MW with the output of about 300 mln kWh/year will lead to decrease of CO_2 emissions by 180 thousand tons/year
21	Gas turbine power plant in Karatau	Construction of gas turbine power plant with capacity of 50 MW	2010-2015	Not completed.	Construction of the GTPP with capacity of 50 MW with the output of about 300 mln kWh/year will lead to decrease of CO_2 emissions by 180 thousand tons/year
22	Shymkent TPP-3	Expansion for 100 MW	2007-2015	Not completed.	Expansion for 100 MW with the output of about 600 mln kWh/year will lead to decrease of CO_2 emissions by 360 thousand tons/year
23	chain of HPP on Maydantal river	Construction - 50 MW	2009-2015	Not completed.	Construction of the HPP with capacity of 50 MW and output of 250 mln kWh/year will lead to decrease of CO_2 emissions by 150 thousand tons/year due to decrease of the power generation at the gas plants of Southern Kazakhstan.
24	chain of HPP on Ugam river	Construction - 51.7 MW	2008-2015	Not completed.	Construction of the HPP with capacity of 51.7 MW and output of 250 mln kWh/year will lead to decrease of CO_2 emissions by 150 thousand tons/year due to decrease of the power generation at the gas plants of Southern Kazakhstan.
25	Kyzylorda TPP	Expansion with the construction of cogeneration GTPP (expansion for 100 MW)	2008-2015	Not completed.	Expansion for 100 MW will lead to increase of power generation by 550 mln kWh/year and, respectively, to increase of CO_2 emissions by 330 thousand tons/year
26	Atyrau TPP	Reconstruction of TPP (expansion 3X25 MW)	2007-2015	Complete	Has lead to increase of power generation by 450 mln kWh/year and, respectively, to increase of CO_2 emissions by 270 thousand tons/year

№ Item No	Description of the power facility	Description of works,No - MW	Assumed project implementation term, years	Current project status	Notes
27	Agip KCO GTPP onshore complex(capacity of 230 MW)	Construction of Agip KCO GTPP onshore complex(capacity of 230 MW)	2010	Partially complete.	Commissioning of the capacity in the volume of 163 MW, further increase is not required, because currently there are no power consumers for this plant
28	Agip KCO GTPP offshore complex(capacity of 120 MW)	Construction of Agip KCO GTPP offshore complex (capacity of 120 MW)	2010	Not completed.	Construction of the GTPP 120 MW and increase of the power generation by 600 mln kWh/year will lead to increase of CO_2 emissions by 360 thousand tons/year
29	GTPP to provide power to the designed cement plant and International centre for near-border partnership "Taskala-Ozinki" in West Kazakhstan Region	Construction of GTPP with power capacity of 2x30 MW	2009-2012	Not completed.	Construction of GTPP 60 MW and increase of power generation by 18 thousand tons/year
30	Kandyagash GTPP	*Construction (GTPP capacity of -100 MW)*	2007-2010	Not completed.	Construction of the GTPP 100 MW and increase of the power generation by 600 mln kWh/year will lead to increase of CO_2 emissions by 360 thousand tons/year
31	GTPP CNPC "Aktobemunaigas"	Construction of intermediate station, power line and GTPP - 45 MW	2007	Complete	Construction of the GTPP with capacity of 45 MW will lead to increase of the power generation by 250 mln kWh/year and, respectively, to increase of CO_2 emissions by 150 thousand tons/year
32	Aktobe TPP	Reconstruction and expansion (expansion 3X70 MW)	2007-2015	Not completed.	Will lead to increase of power generation by 350 mln kWh/year and, respectively, to increase of CO_2 emissions by 200 thousand tons/year
33	GTPP of the metallurgical complex for the processing of iron-and-steel scrap inAktobe	Construction - 240 MW	2007-2015	Not completed.	Construction of the GTPP with capacity of 240 MW will lead to increase of the power generation by 1.3 billion kWh/year and, respectively, to increase of CO_2 emissions by 800 thousand tons/year
34	Aktobe GTPP	Construction of GTPP in Aktobe with power capacity of 40 MW	2007-2010	Not completed.	Construction of the GTPP with capacity of 40 MW will lead to increase of the power generation by 230 mln kWh/year and, respectively, to increase of CO_2 emissions by 140 thousand tons/year

Table 4.18 presents implemented projects to increase the generating capacity of the electricity sector of Kazakhstan and their impact on the reduction of CO_2 emissions. In this case, reduction of CO_2 emission calculations are made only with the substitution of similar capacity coal-fired power plants

Table 4.18

presents implemented projects to increase the generating capacity of the electricity sector of Kazakhstan and their impact on the reduction of CO_2 emissions. In this case, reduction of CO_2 emission calculations are made only with the substitution of similar capacity coal-fired power plants

Power plant	Commissioning of the generating capacities	Capacities commis-sioning terms	Expected decrease of CO_2 emission, mln tons						Notes
			2005	2010	2015	2020	2025	2030	
Kukol GTPP (Karaganda region)	1 stage -3 gas turbine plant x 18 = 54 MW (350 mln kWh/year) 2 stage 2 gas turbine plant x 18.3 = 36.6 MW (240 mln kWh/ year)	1 stage - 2004; 2 stage - 2011	0,175	0,175	0,295	0,295	0,295	0,295	Replacement of the power generation at the coal TPP of the Karaganda region
Zhanazhol GTPP-56 "CNPC-Aktobemunaigas: (Aktobe region)	1 stage-2 gas turbine plant x 16 = 32 MW (220 kWh/year) 2 stage-3 gas turbine plant x 16 = 48 MW (330 kWh/year)	1 stage -2005; 2 stage – 2010	0,11	0,11	0,275	0,275	0,275	0,275	Replacement of the power generation at the coal TPP of Northern Kazakhstan
Issyk HPP, Karatal HPPAksu HPP-1 (Almaty region)	5.1+4.4+1.0= 10.5 MW (42 mln kWh/ year)	2008.	-	0,45	0,45	0,45	0,45	0,45	Replacement of the power generation at the coal TPP of Southern and Northern Kazakhstan
Zhanazhol GTPP-45 JSC "CNPC-Aktobemunaigas: (Aktobe region)	3 gas turbine plant x 11.25 = 33.8 MW (230 mln kWh/ year)	2009	-	0,057	0,11	0,11	0,11	0,11	Replacement of the power generation at the coal TPP of Northern Kazakhstan
Gas engine generator plant South Karatobe (Aktobe region)	4 gas-processing plant x 1.54 = 6.2 MW (30 mln kWh/ year)	2010	-	-	0,015	0,015	0,015	0,015	Replacement of the power generation at the coal TPP of Northern Kazakhstan

Power plant	Commissioning of the generating capacities	Capacities commis-sioning terms	Expected decrease of CO_2 emission, mln tons						Notes
			2005	2010	2015	2020	2025	2030	
Karatal HPP (Almaty region)	2x1.25+1x0.6 = 3.1 MW (12.4 mlnkWh/year)	2010	-	-	0,014	0,014	0,014	0,014	Replacement of the power generation at the coal TPP of Southern and Northern Kazakhstan
Moynak HPP (Almaty region)	2 x 150 = 300 MW (1 billion kWh/year)	2012	-	-	1,1	1,1	1,1	1,1	
GTPP Akshabulak (Karaganda region)	3gas turbine plant x 29 = 87 MW (570 mln kWh/year)	2012	-	-	0,3	0,3	0,3	0,3	
Merkent HPP (Zham region)	3 x 0.5 = 1.5 MW (6 mln kWh/year)	2012	-	-	0,007	0,007	0,007	0,007	
TOTAL:			0,285	0,79	2,57	2,57	2,57	2,57	

Note: Production of 1 kWh for coal thermal power plants - 1.1 kg CO_2 for gas turbine stations - 0.6 kg of CO2.
Sources: Expert assessment of K.Suleimenov

4.4. Cost-competitive measures to reduce emissions associated with the burning of fuel

4.4.1. Reducing the demand for energy

The introduction of EURO 4 for cars

Resolution of the Government of the Republic of Kazakhstan № 97 dated February 6, 2013 EURO 4 is a restriction on imported cars (from July 1, 2013) and produced in the Republic of Kazakhstan cars (from 1 January 2014) . In order to comply with environmental standard , Euro 4 standard machines must use high-quality fuel . Therefore, this measure will lead to lower emissions only in the case of the other measures , which involves improving the quality of produced light oil (particularly gasoline) refineries (see http://iacng.kz/eng/?q=node/2663). According to the « State Program of Forced Industrial -Innovative Development» for these purposes in the period 2011 to 2015 will be allocated more than U.S. $ 3 billion . Emission reductions achievable combined effect of these two policies and measures evaluated , provided that Kazakhstan will continue to apply the mandatory environmental standards Euro . In addition , taking into account the assumption of increasing the fleet from the current 2 million to 6 million by the year 2030 , most of the fleet will be replaced , which would increase the average efficiency of the fleet twice over that span.

The use of compressed natural gas (CNG) as a fuel for motor vehicles

According to research by Centre for Climate and Energy Solutions , USA (Centre for Climate and Energy Solutions. US natural gas overview of markets and uses: Natural gas use in the transportation sector. - 2012) the use of CNG as fuel compared to gasoline results in lower emissions greenhouse gas emissions by 29%.

At this point in Almaty greenhouse gas emissions from transport are significant. As a result , we assume that in this city of national importance replacement of gasoline and diesel to CNG will be the most relevant.

Assumptions : 5% goes to CNG vehicles by 2020 , 10% by 2025 and 30 % by 2030 . The share of Almaty in the sector « Transport « - 13.8%.

Improving energy efficiency in housing and communal services

Resolution of the Government of the Republic of Kazakhstan from September 11, 2012 № 1181 introduces a requirement for energy efficiency of buildings and building envelopes. Given the rapid pace of construction of new buildings, as well as reducing the requirements for space heating (high-rise buildings more energy efficient than homes) , this measure can lead to a reduction of emissions associated with the housing and communal services by 10% by the year 2030 . Since most of the new buildings being built in cities with central heating, share of central heating and central hot water supply will increase, which will reduce the final energy consumption,

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since individual heating systems are much less effective . This measure can reduce emissions by 2 million tonnes of CO_2 equivalent by 2030 year.

In the « Comprehensive Plan of the Republic of Kazakhstan energy efficiency for 2012 - 2015 years» , special attention is paid to the industry. This document sets out measures for the development of technology reporting of greenhouse gas emissions and measures to support energy audits . In the context of a general improvement in the economic situation , the replacement of equipment coming from businesses will use more energy-efficient solutions . Estimating conservatively, such measures could lead to a reduction of greenhouse gas emissions in CO_2 equivalent to 10-15 % by the year 2030 .

Table 4.19

Reduction of CO_2 emissions associated with the burning of fuel from the use of cost-competitive actions on the side of power

№	Description	Target sector	Type of tool	Status	Responsible body	Emissions decrease (mln tons of CO_2) 2020	2025	2030
1	* New car standard EPBO 4	Transport	Law	Implemented	Ministry of Transport and Communications	2	5	8
2	* Producing petroleum of standard EBPO 4	Transport	Direct investments	Adopted	Ministry of Oil and Gas			
3	* Transition of cars and buses to compressed natural gas	Transport	Direct investments, grants	Planned	Almaty akimat	0	0,1	0,5
4	* Improved standards of building heat insulation	housing and public utilities	Law	Adopted	Ministry of Regional Development, city akimats	2	3,5	5
5	* Urbanization, distribution of central heating	housing and public utilities	Capital investments	Planned	City akimats	1	1,5	2
6	* Power audit, report on emissions etc.	Industry	Law, information distribution	Adopted	MINT	4	7	9
7	* Revamp/ restoration/ repair of the key assets	Industry	Direct investments	Implemented	Industrial enterprises			

4.5. Policies and measures in the field of energy supply

4.5.1. Measures to reduce greenhouse gas emissions from the energy supply sector

Measures to reduce emissions of the power supply are shown in Table 4.20 . The first two measures are related to the field of renewable generation for which data are available. The calculations in this table by hydroelectric plants , involves the implementation of only half of the power provided for in the Government's plans (Master Plan for the electricity industry of the Republic of Kazakhstan till 2030) (0.5 GW instead of 1 GW in 2015) . Applying the capacity factor (load factor) of 30 % , additional hydroelectric power should produce about 1.3 TWh per year. The additional capacity of 0.3 GW of wind power will be able to produce about 0.7 TWh per year. Emissions that can be prevented in this way , are calculated based on the average annual emission coal-fired plants (HPP and TPP on average produce 1 tone of CO_2 per 1 MWh of electricity).

Commissioning of the Balkhash thermal power plant is scheduled for the year 2020 . Evaluation was done to reduce emissions on the basis of the difference calculation of efficiency of modern coal-fired plants and the average efficiency of existing plants , the conservative assumption of equal capacity factor of 65%. Paragraphs 4 and 5 of Table 4.20 were calculated in a similar manner .

The final steps are cross-cutting and are based on repeatedly stated commitment of Kazakhstan to improve the technical, economic and environmental performance of energy management and mining industry . These items also include social, technical and economic measures aimed at reducing the so-called non-normative losses. The calculation is based on the analysis provided in the study, «Electricity and heating system in Kazakhstan: Exploring energy efficiency improvement paths», which was published in Energy Policy (Volume 60) in September 2013 (Sarbasov , etc.)

Table 4.20

Reduction of CO_2 emissions associated with the burning of fuel from the use of cost-competitive energy supply-side measures

N	Description	Target sector	Type of tool	Status	Responsible body	Decrease of emissions (mln tons of CO_2)		
						2020	2025	2030
1	* HPP. Moynak 0.3 GW; Shardarin 0.1 GW; Small HPP 0.1 GW	Energy conservation	Direct investment	Adopted	MINT	1,3	1,3	1,3
2	* Wind power plants 0.3 GW	Energy conservation	Direct investment	Adopted	MINT	0,7	0,7	0,7
3	* Balkhash TPP, 1.3 + 1.3 GW	Energy conservation	Direct investment	Adopted	MINT	5	5	5
4	* Replacement of the old coal plants with more efficient ones	Energy conservation	Direct investment	Adopted	MINT	3	10	10
5	* Preferrable use of gas generation instead of the outgoing coal generation	Energy conservation	Direct investment	Adopted	MINT	2	2,5	3
6	* Replacement of the power lines	Power distribution	Direct investment	Adopted	KEGOC, MINT	0,1	0,3	0,5
7	* Reduction of non-normative losses	Intersectoral	Law, information distribution, grants for calibration equipment	Planned	MINT	4	8	12
8	* Further distribution of market-based mechanisms in the economy	Intersectoral	Various	Planned	Government	3	6	9

4.6. Additional policies and measures

Additional measures included the establishment of a system, which introduced the market value of a unit volume of greenhouse gas emissions, which is equal to U.S. $ 10 per tonne of CO_2 equivalent emissions in the period from 2020 to 2025 , 15 U.S. dollars from 2025 to 2030 -th - th year and U.S. $ 20 from 2030 till 2030. In response to such measures of the enterprise will soon take action to reduce emissions of modernization of production and thereby increase the overall efficiency of the system as a whole

In other areas , for example in the area of final consumption in the residential sector or in the field of passenger transport includes the following tools to achieve emission reductions :

- Economic measures such as subsidies to accelerate fleet replacement devices emitting greenhouse gases or carbon taxes on fuel for transport.
- Legal measures such as the introduction of standards for building insulation or the requirements for the compliance with certain end-use efficiency values.
- The dissemination of information, including the use of monitoring and implementation of energy efficiency classes end-use devices.
- Direct Investment.

In this phase, when defined sectoral goals, it is very difficult to assign specific amounts of emissions reduction to a particular policy or measure, or even a combination of policies and measures. For this reason, further assessments are indicative.

4.6.1. Lower consumption associated with an increase in energy prices

Table 4.21

Reducing CO_2 emissions from fuel combustion. Additional policies and measures. Lower consumption associated with an increase in energy prices

N	Description	Target sector	Type of tool	Status	Responsible body	Decrease of emissions (mln tons of CO_2)		
						2020	2025	2030
1	Partial liberalization of the price policy	Transport	Law	Planned	APEM, MINT, Ministry of Regional Development	0	0.5	1

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2	Partial liberalization of the price policy	Industry	Law	Planned	APEM, MINT, Ministry of Regional Development	0	3	6
3	Partial liberalization of the price policy	housing and public utilities	Law	Planned	APEM, MINT, Ministry of Regional Development	0	2	4

Given that entered the market value of the unit of greenhouse gas emissions , the cost of production of secondary energy resources will rise in proportion to the associated greenhouse gas emissions. In a perfect market of secondary energy sources with lower associated greenhouse gas emissions will have additional benefits that will help to increase their share in the structure of generation. However, relying solely on market mechanisms is difficult in a country in transition, which is Kazakhstan. In this vein, the strategic document «Concept of the Republic of Kazakhstan for the transition to a «green economy» approved by Decree of the President of the Republic of Kazakhstan on the 30th of May 2013 number 577 proposes to revise the tariff policy vacations energy end-users , namely tariffs for electricity and heat. The document also proposes measures to protect the most vulnerable people in the course of such reforms. The data in Table 4.21 are calculated on the basis of the elasticity of energy demand to price in some sectors.

4.7. Policies and measures in the field of end-use

Policies and measures listed in the table, with the exception of last resort , are priority objectives of the state to a more efficient use of energy. They are mentioned in the « Energy saving and energy efficiency « strategic document «Concept of the Republic of Kazakhstan for the transition to a» green economy « approved by the Decree of the President of the Republic of Kazakhstan on the 30th of May 2013 number 577. These policies and measures are in addition to those given in the previous section , and can be achieved only when taken into account additional benefits of reducing emissions of CO_2. These measures help to reduce greenhouse gas emissions in sectors such as transport , housing and services by about 20-25 %.

Table 4.22

Reducing CO_2 emissions from fuel combustion. Additional policies and measures in the energy sector

N	Description	Target sector	Type of tool	Status	Responsible body	Decrease of emissions (mln tons of CO_2)		
						2020	2025	2030
1	EURO standard for trucks	Transport	Law	Planned	Ministry of Transport and Communications	3	6	9
2	Production of high quality petroleum	Transport	Direct investment	Planned	Ministry of Transport and Communications			
3	calorimeter	housing and public utilities	Law, information distribution	Planned	Ministry of Regional Development, MINT	2	5	9
4	Improved heat insulation	housing and public utilities	Law, information distribution	Planned	Ministry of Regional Development, MINT	2	5	9
5	Improved standards for heaters	housing and public utilities	Law, information distribution	Planned	Ministry of Regional Development, MINT	2	5	9
6	Marking of devices by energy efficiency classes	housing and public utilities	Law, information distribution	Planned	Ministry of Regional Development, MINT	2	5	9
7	Grants for replacement of devices	Intersectoral	Direct investment	Planned	Government	*	*	*

N	Description	Target sector	Type of tool	Status	Responsible body	Decrease of emissions (mln tons of CO_2) 2020	2025	2030
8	Additional volume of the natural gas 5 billion m3	housing and public utilities, industry	Direct investment	Planned	Ministry of Oil and Gas	6	6	6

4.8. Policies and measures in the energy supply

In 2013, Kazakhstan has begun a pilot year of a trading system for greenhouse gases. Enterprises with annual CO_2 emissions above 20,000 tons / year (hereinafter referred to as «operators») are included in the emissions trading system (ETS) in Kazakhstan. At present, on the basis not of verified data on greenhouse gas emissions provided by operators in 2010 , identified 178 operators PTS. The overall distribution of their emissions will be reduced in the coming years. In the case of a favorable external environment and national scope of permitted emissions in 2030 could reach 70 % of the base value.

The strategy document «Concept of the Republic of Kazakhstan for the transition to a green economy» , aims to achieve a level of 3% of wind and solar energy in the structure of the generated electricity by 2020 and 10 % by 2030, equivalent to almost 12TVt * bounds.

This document provides a strategic diversification of electricity through nuclear energy development with a total installed capacity equal 1.5GVt in 2030.

According to the fuel and energy balance of the Republic of Kazakhstan, the mining sector has a greater energy intensity per unit of gross added value in comparison with other major countries supplying energy. The potential for energy efficiency in primary energy consumption reaches nearly 10 million tons of oil equivalent (see «Concept of Kazakhstan's transition to a green economy» , illustration 10). According to the same document, the technical and financial support to improve the policies and measures needed for a successful transition to a more energy- efficient production . The table shows the quantitative values decrease from the use of such policies and measures , taking into account half of the reduced potential decline.

4.8.1. Description of policies and measures to reduce greenhouse gas emissions and assessment of their effect

Table 4.23

Reducing CO_2 emissions from fuel combustion. Additional policies and measures in the energy supply sector.

N	Description	Target sector	Type of tool	Status	Responsible body	Decrease of emissions (mln tons of CO_2) 2020	2025	2030
1	Cap-and-trade system	Major power nad industrial enterprises	Law	Adopted	MoE	20	25	30
2	Wind power	Power enterprises	Law, grants	Planned	MoE, MINT, Ministry of Economics and Budget Planning	2	5	10
3	Solar panels	Power enterprises	Law, grants	Planned	MoE, MINT, Ministry of Economics and Budget Planning	0.2	0.5	1
4	Nuclear power plants	Power enterprises	Direct investment	Planned	MINT, Ministry of Economics and Budget Planning	0	0	9
5	Decrease of losses on own needs	Mineral production	Law	Planned	Ministry of Oil and Gas	5	10	15
8	Additional volume of the natural gas 5 billion m3	housing and public utilities, industry	Direct investment	Planned	Ministry of Oil and Gas	6	6	6

V. FORECASTS AND GENERAL EFFECT OF POLICIES AND MEASURES, MECHANISMS OF KYOTO PROTOCOL FLEXIBILITY

This section demonstrates the possible forecasts of greenhouse gas emissions. Categories of emissions, which are related to fuel combustion, and also not related to fuel combustion, such as fugitive emission, greenhouse gases coming from industrial processes, land use, forestry and waste. Hereafter it is explained how the emissions are in keeping with the common effect of taken policies and measures. The section ends with the chapter of the detailed explanation of the calculation methodology, which is the basis of the forecast.

Supplementarity relating to mechanisms under Article 6, 12 and 17, of the Kyoto Protocol"

Kazakhstan is a Party to Annex I, but it has no definite quantitative obligations under Annex B of the Kyoto Protocol and, therefore, does not have any rights to participate in the joint implementation projects or in projects under the clean development mechanism." Although "the new provisions of the Environmental Code also provide for the implementation of internal projects aimed at reducing emissions and increasing removals of greenhouse gases, relevant projects are not subject to the requirements of the clean development mechanism and joint implementation of the Kyoto Protocol to the UN Framework Convention on Climate Change." (the sentences in quote are copied from the same NC3-6 of KZK, para 4.2.3.1, page 73).

Trading of emission permits with other Parties are not yet possible either. A domestic Emission Trading Scheme started in 2013 with a pilot phase. Several provisions of the scheme have to be improved before making it compatible with similar schemes of other Parties and enable Kazakhstan to supplement domestic Policies and Measure with emission permits trade."

5.1. Forecasts of greenhouse gas emissions

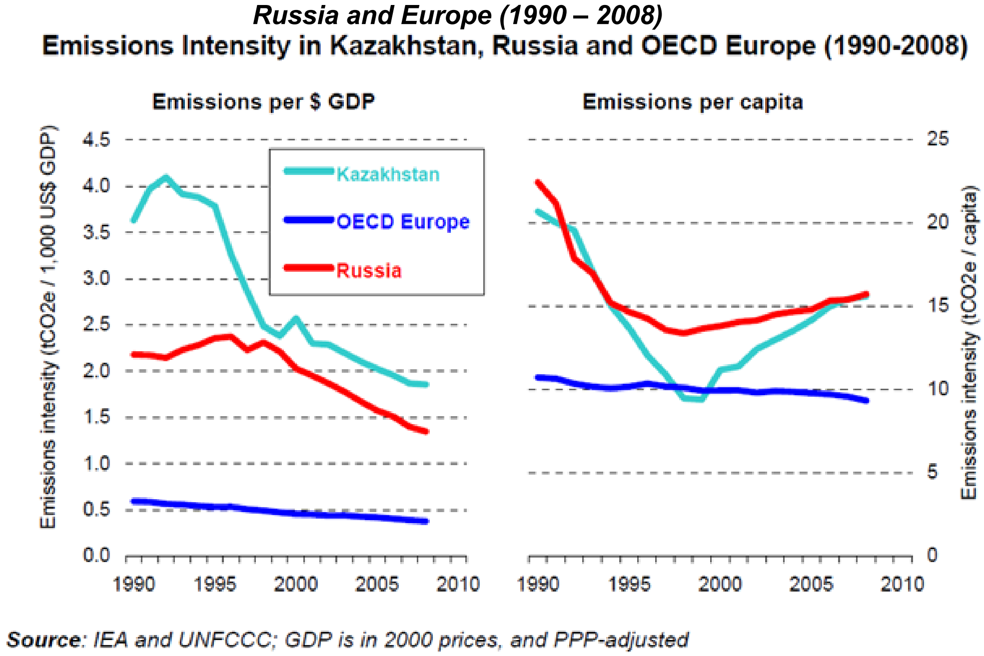
5.1.1. Total greenhouse gas emissions

5.1.1.1. Four scenarios of development

In Kazakhstan greenhouse gas emissions are determined by the history of the country more than by the influence of taken policies and measures. Kazakhstan had emerged as a state already in modern times, and the economy of the country was transmitted from the planned economy to the market one due to the USSR breakup. The extent of the crisis influence on greenhouse gas emissions is represented by the specific greenhouse gas emission per GDP and specific greenhouse gas emissions per capita in Figure 5.1.

Figure 5.1

Specific values of greenhouse gas emissions in Kazakhstan, Russia and Europe (1990 – 2008)



Specific greenhouse gas emissions per GDP (Figure 5.1, from the left) have been reduced for more than twice since 1992 - from 4 to less than 2 tons of CO_2 equivalent per 1,000 US dollars (hereinafter US dollars are specified in prices of 2,000 at par value of purchasing power). This reduction can be explained by the shift to less energy intensive sectors of economy, and also transmission to less carbon intensive energy system. Supposing that the theoretic increase of the gross domestic product (GDP) of the KazSSR is equal to 3% in 1990 (102.18 billionUS dollars) [6] [27], and having carried out the inertial forecasting of greenhouse gas emissions with regard to the GDP historical data of the USSR and when the elasticity of the greenhouse gas emission level for GDP is equal to 0.5, we obtain that the emissions of Kazakhstan would be approximately equal to 480 million tons of CO_2 equivalent instead the real 271 million tons of CO_2 equivalent by 2010, which are averaged over last three years (from 2009 to 2011) according to the GHG inventory of «Zhasyl Damu», JSC.

Four new scenarios of the development of greenhouse gas emissions were developed in order to assess the influence of all policies and measures, which was mentioned earlier. All scenarios propose low increase of GDP at the level of 6% annually by 2020 and of 5% after 2020.

Possible variants of future development of the energy system and levels of greenhouse gas emissions are very difficult to foresee on the basis of historical data of still unstable economic system of Kazakhstan. Forecasted emissions for 2030, calculated with different methods, were equal from 250 to 550 million tons of CO_2 equivalent. Diagrams of averaged values of emissions, which are indicated in this section, should be used as the instrument for assessment of the policies and measures effect, but not as a forecast of the future emission level.

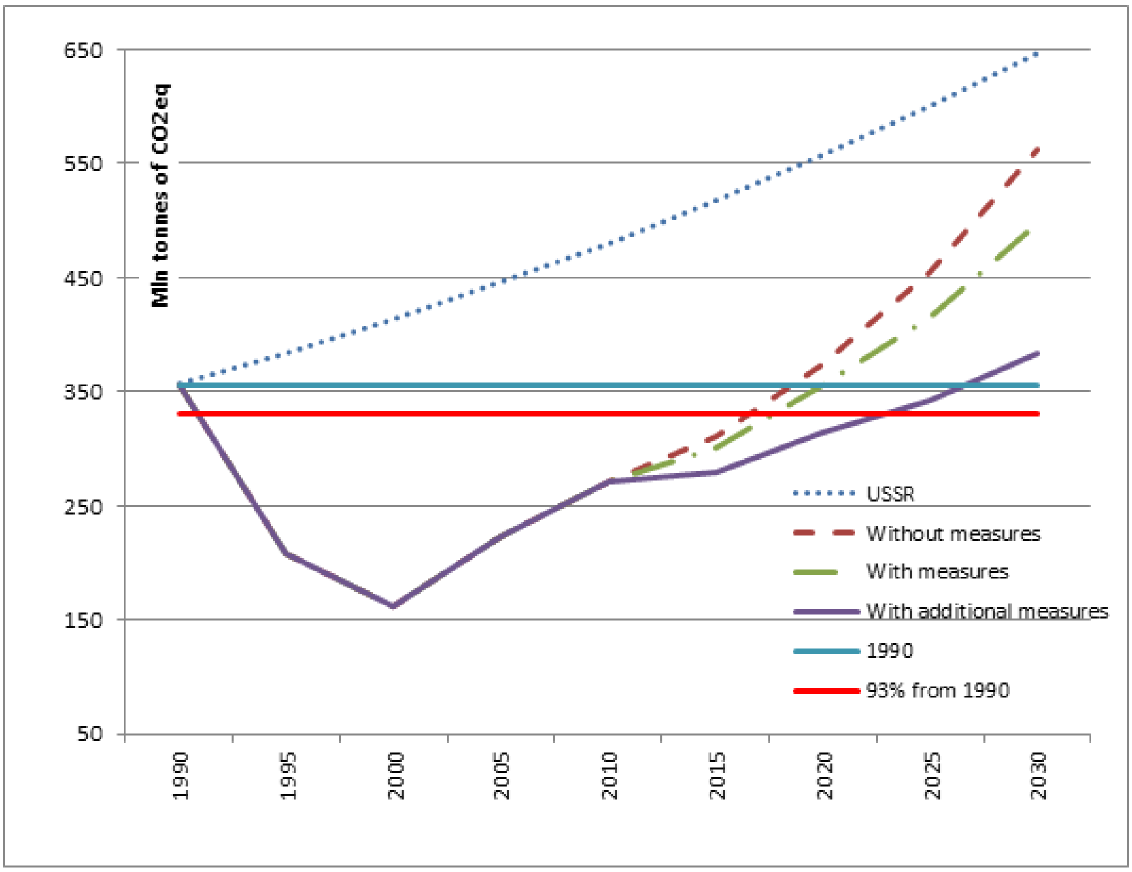
The following development scenarios of the energy system of Kazakhstan were considered in the work:

1) business as usual emissions scenario in Kazakhstan as a part of the USSR upward 1990 (USSR);
2) business as usual emissions scenario in Kazakhstan with a frozen technological economy condition as of 2010. Scenario without measures (WOM);
3) scenario with current measures (WM);
4) scenario with current and additional measures (WAM).

The model of the Republic of Kazakhstan energy system on the basis of TIMES instrument (The Integrated MARKAL-EFOM System), which is the solution of the last-generation MARKAL family and involves the approach of detailed technical and economical process description of power industry («bottom-up»), was used in the scenario with measures and scenario with additional measures for forecasting greenhouse gas emissions related to fuel combustion. TIMES is a tool for technical and economic model engineering of energy systems, which allows carrying out the scenario analysis of energy system development dynamics for a long-time period. Emissions from sectors, which are not related to fuel combustion, were assessed by experts. Methodology of assessment is mentioned in Annexes.

Figure 5.2

Scenarios of greenhouse gas emissions development



Business as usual emissions scenario in Kazakhstan as a part of the USSR upward 1990 (USSR)

This scenario is hypothetic, because it describes supposed greenhouse gas emissions as if the USSR breakup did not happen, and dynamics of emission increase remains at the same level, i.e. without adverse effects of Kazakhstan transition to the market economy. Dynamics of greenhouse gas emissions is calculated by the business as usual method on the basis of the KazSSR GNP change and level of greenhouse gas emissions in 1990.

Business as usual emissions scenario in Kazakhstan with a frozen technological condition of economy for 2010. Scenario without measures (WOM)

This scenario represents the possible variants of changes of greenhouse gas emission volumes in cases when no measures are taken to reduce it and the main task is to reduce costs. Further economy growth derives from using cheap coal as fuel for energy generation.

The scenario without measures was prepared on the basis of the simplified analysis of emission categories. This scenario supposes that greenhouse gas emissions depend on overall GDP growth rate and current dynamics of transition to less energy intensive sectors of economy. Elasticity of greenhouse gas emission values for GDP was calculated on the basis of data on the latest modifications in sectors and subsectors of economy, which impact on the greenhouse gas emission volume, and it is equal to 0.825. It is supposed that this scenario includes several policies and measures, which have already been exercised in the country over the last years, as indicated in Section 4. According to these assumptions, the amount of annual greenhouse gas emissions of Kazakhstan will be equal to 562 million tons of CO_2 equivalent in the scenario without measures.

Scenario with current measures (WM)

This scenario includes measures and policies on reduction of greenhouse gas emissions, which have been adopted and are planned to be adopted in coming years, in contrast with the scenario without measures. The scenario does not include policies and measures related to the tax on greenhouse gas emissions, and also to the increase in the share of alternative and renewable energy resources such as solar, wind and nuclear energy in the structure of energy industry (Section 4).

This scenario consists only of those policies and measures, which are sound both for energy supply and energy consumption in economic terms; herewith the reduction of greenhouse gas emissions is not the top task for this scenario.

Reduction of greenhouse gas emissions is a second-order effect of policies and measures on introduction of more energy-efficient technologies and energy supply in the energy generation and consumption sectors and in the transport sector.

Scenario with current and additional measures (WAM)

This scenario takes into accounts not only policies and measures of the scenario with current measures, but also introduction of the tax on greenhouse gas emissions in the amount of 10 US dollars for 1 ton of greenhouse gas emissions of CO_2 equivalent from 2020 to 2025, 15 US dollars for 1 ton of greenhouse gas emissions of CO_2 equivalent from 2025 to 2030 and 20 US dollars for 1 ton of greenhouse gas emissions of CO_2 equivalent from 2030 with the result that the energy demand decreases, the energy efficiency increases and a partial transition to the use of less carbon intensive types of fuel is carried out, as well as policies and measures, which are included to the conception on the transition of the Republic of Kazakhstan to «green economy», including:

- increase in energy generating from renewable and alternative energy resources, especially wind, solar and nuclear energy - to 3% by 2030 and to 30% by 2030.
- As opposed to the scenario with current measures, the main tasks of the scenario with additional measures are:
- reduction of greenhouse gas emissions;
- increase in energy generation powers of renewable energy resources;
- increase in energy efficiency and energy savings in all economy sectors.

The scenario with measures and scenario with current and additional measures are based on the technical and economic model engineering in the processes, which are related to fuel combustion, and on more traditional extrapolation method for other processes (subsection 5.5). All four scenarios are indicated in Figure 5.2. Results of scenarios without measures, with current and with current and additional measures for processes, which are related to fuel combustion, as well as results of inventory (for types of greenhouse gases) are indicated in Table 5.1. The blue line in the diagram represents the level of greenhouse gas emissions in 1990, and the red line represents 93% of the emission level in 1990 and illustrates the obligations of Kazakhstan under the Kyoto Protocol by 2020.

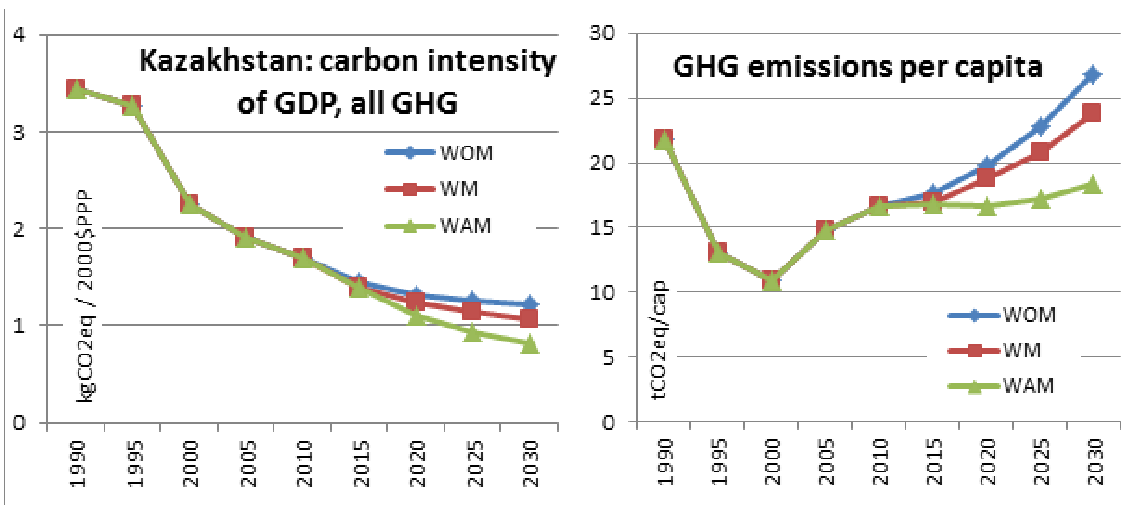
Table 5.1

Historical data and forecasts of general emissions by types of greenhouse gases

Million tons of CO_2 equivalent	Historical data, Inventory					Scenario with measures				Scenario with additional measures			
Types of gases	1990	1995	2000	2005	2011	2015	2020	2025	2030	2015	2020	2025	2030
CO_2	266,5	154,2	123,0	177,9	212,1	236,7	284,0	333,2	401,1	234,6	247,8	265,6	292,3
CH_4	73,3	44,5	33,0	37,8	48,6	51,4	58,4	65,2	73,9	47,4	53,7	59,8	68,1
N_2O	16,3	9,0	5,6	7,6	9,0	10,7	12,4	14,1	15,9	10,6	12,2	13,8	15,5
CF_4 (CFs)	0,0	0,0	0,0	0,0	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1
C_2F_6 (CFs)	0,0	0,0	0,0	0,0	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2
HFCs	0,0	0,0	0,2	0,2	0,8	0,9	1,5	2,1	2,7	0,9	1,4	2,0	2,5
Total	**356,2**	**207,7**	**161,8**	**223,5**	**271,8**	**301,0**	**357,6**	**415,8**	**494,9**	**294,8**	**316,4**	**342,5**	**379,7**

Figure 5.3

Forecast of specific values of greenhouse gas emissions in Kazakhstan



The growth of emissions is observed in all three scenarios of greenhouse gas emission forecasts during the period from 2010 to 2030. Emissions increase for more than twice in the scenario without measures and less in the scenario with measures, while additional measures on emission reduction can limit the emission growth up to 40% of the level for 2010.

In all scenarios the carbon intensity of GDP continues to reduce with the same rate as for previous decade by 2020 (Figure 5.3, from the left). In the scenario with additional measures the reduction will be observed also after 2020. The total green gas emissions of CO_2 equivalent will become twice higher than values of current average emissions of OECD countries, while GDP per capita is lower than current values of OECD countries.

Greenhouse gas emissions will achieve 20 tons of CO_2 equivalent per capita in 2020 without taking special measures (Figure 5.3, from the right). Additional measures will help to keep greenhouse gas emission at the level from 17 to 18 tons of CO_2 equivalent per capita, which is proximal to the level of 2010. These indexes are lower than the actual values of high-developed energy supplying countries (more than 20 tons of CO_2 equivalent in Australia, Canada and the USA). In order to reduce these values to average values of OECD countries, Kazakhstan shall make big technological and economic efforts. It is related to the sharp continental climate, long heating season and underpopulation, which is equal to 6 persons per one square kilometer.

5.1.1.2. Total emissions by types of greenhouse gases

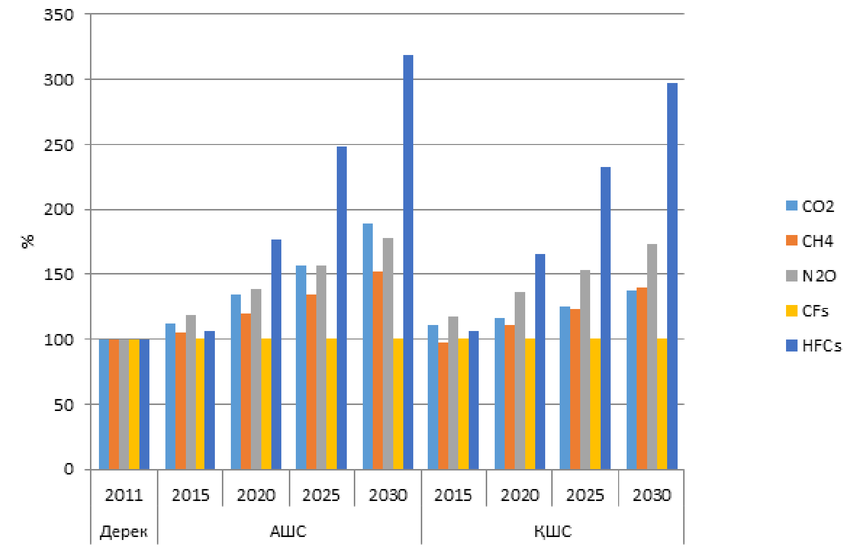
According to forecasts, the level of greenhouse gas emissions of 1990 will be exceeded in the scenario with current measures by 2020 and in the scenario with additional measures by 2030.

As can be seen from the diagram (figure 5.4), in spite of the high level of greenhouse effect of CF_4, C_2F_6, HFCs gases, their share in total emissions is not essential, and the main part consists of CO_2, CH_4 and N_2O.

Emission growth by types of greenhouse gases and by sectors is unbalanced. For example, emissions of PCFs (CF4, C_2F_6) will remain at the same level, while HFCs increase in three times in comparison with emissions of 2011. It is related to accretion of demand for refrigerators and air conditioners.

Figure 5.4

Percentge of greenhouse gasesin CO_2 equivalentfrom all processes by 2011

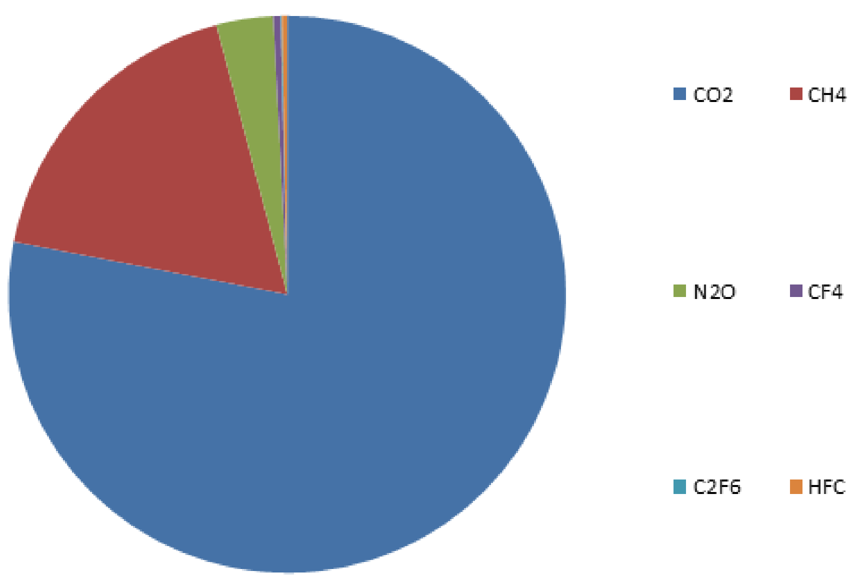


Increase in CO_2, CH_4, N_2O emissions relates to the economic growth, as well as to accretion of demand for energy carriers in all sectors.

As it is indicated in figure 5.3, influence of the additional polices and measures are also unbalanced by sectors.Share of the service sector was subject to the biggest change, while the biggest reduction was observed in absolute values of energy industry.

Figure 5.5

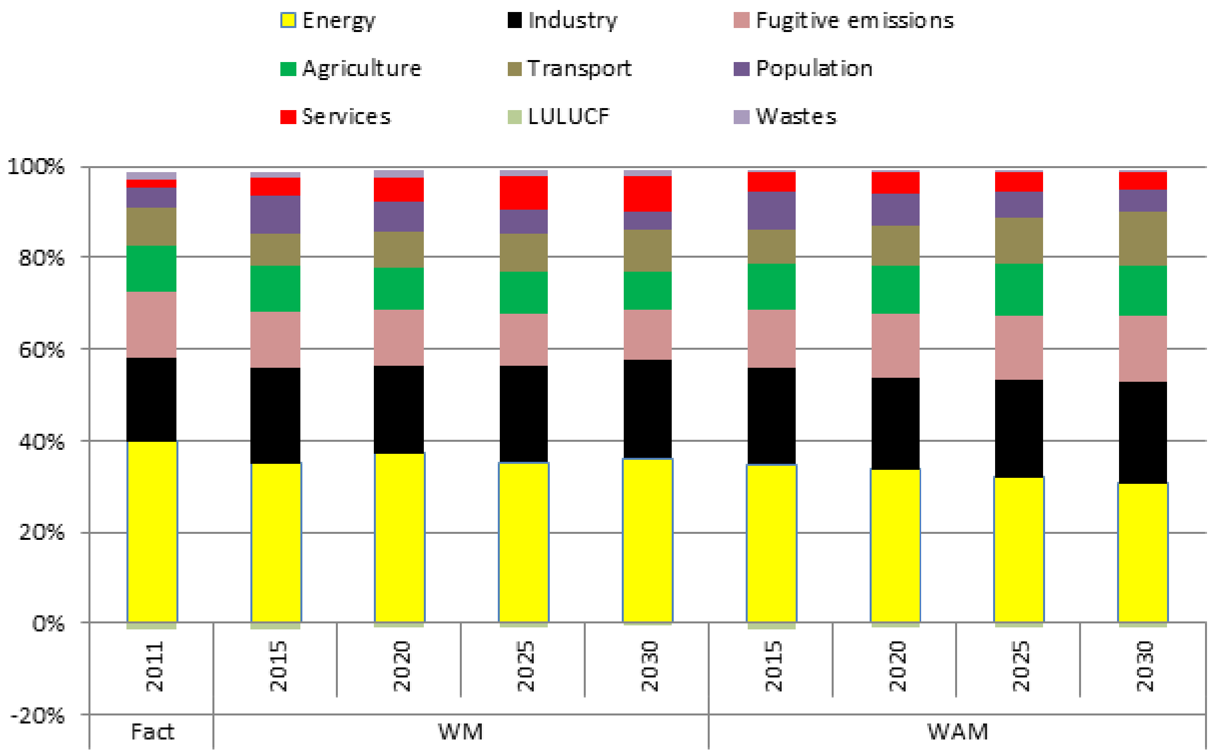
Share of total emissions by types of greenhouse gases in 2011, in CO_2 equivalent



5.1.1.3. Total greenhouse gas emissions by sectors

Figure 5.6

Shares of total emissions by sectors, in CO_2 equivalent



The observed dynamics demonstrates that service and waste utilization sectors are most sensitive to the increase in energy sources cost. Housing and utilities sector reduces the consumption share in both scenarios that is related to the renewal of fund for housing with increase in the rental apartment share and with growth of building energy efficiency. Besides we see that energy industry share decreases in the scenario with additional measures. It is related to the fact that the reduction per emission unit is more available in the energy industry. Due to the essential reduction of emission in the energy industry, the share of transport and fugitive emissions increases in the scenario with additional measures faster than in the scenario with current measures. Transport sector emission growth in absolute terms is caused by improvement of the quality of population life and increase of vehicle fleet. Growth of fugitive emissions is associated with the increase of oil and gas exploitation. Greenhouse gas emissions from industry increase in absolute terms in both scenarios, while percentage of total emissions remains at the same level. The aggregated effect of additional measures application is mentioned in table 5.2.

5.1.2. Greenhouse gas emissions related to fuel combustion

Fuel combustion is one of the most important greenhouse gas emission sources in Kazakhstan (figure 5.7). As greenhouse gas emissions per unit of GDP, greenhouse gas emissions related to fuel combustion had reduced approximately in twice within the period from 1990 to 2000 [1]. The reason was a deep recession of production and drop in the living standards of Kazakhstan population [2].

Table 5.2

Aggregated effect of additional measures application

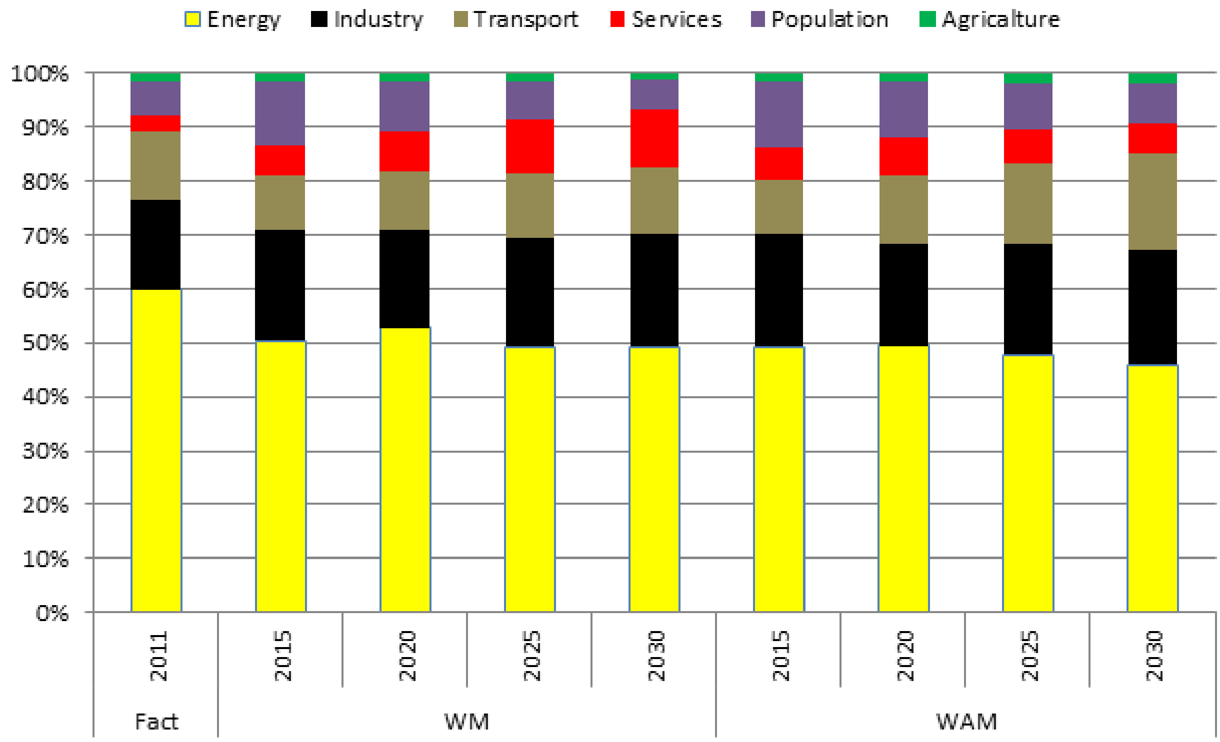
	Emission values. Million tons of CO_2 equivalent			
Types of gases	2015	2020	2025	2030
Scenario with measures	301,0	357,6	415,8	494,9
Scenario with additional measures	294,8	316,4	342,5	379,7
Effect of additional measures application	6.2	41.2	73.3	115.2

As of 2000 the stable growth of greenhouse gas emission has been observed in proportion to recovery and further growth of economy. It is expected that in the scenario with current measures greenhouse gas emissions, which are related to fuel combustion, will exceed the level of 1990 by 2020.

Forecasts of emissions in both scenarios with measures and without measures are represented consequently and on methodological reasonable basis (Annex 3). The diagram of CO_2 emissions by sectors, which are related to fuel combustion, is represented in figure 5.7.

Figure 5.7

Share of CO_2 emissions related to fuel combustion, by sectors



5.1.2.1. Total CO_2 emissions related to combustion, by types of fuel

Nowadays the main fuel of energy generation is coal. In all considered scenarios and in future coal will remain the leading fuel, but its share in general consumption will essentially reduce in the scenario with additional measures (figure 5.8.).

Additional policies and measures will lead to the event when the use of gas and oil products will increase, but as the share of natural gas is low in total volume, the main growth of CO_2 emissions in absolute values will happen by means of oil products use.

5.1.3. CO_2 emissions by sectors

According to table 5.3., containing historical and forecasting data of CO_2 emissions related to fuel combustion, the main reduction of emissions will happen by means of additional measures in energy, industry and service sector.

Table 5.3

Emissions related to fuel combustion, by types of greenhouse gases

Million tons of CO_2 equivalent	Historical data, Inventory					Scenario with measures				Scenario with additional measures			
	1990	1995	2000	2005	2011	2015	2020	2025	2030	2015	2020	2025	2030
CO_2	244,8	148,6	116,7	162,6	197,6	219,1	263,2	309,7	374,0	217,5	227,5	242,7	265,8
CH_4	1,3	0,8	0,3	0,5	0,8	0,6	0,6	0,7	0,7	0,6	0,5	0,5	0,6
N_2O	0,9	0,6	0,4	0,6	0,7	1,3	1,6	1,9	2,3	1,2	1,4	1,6	1,9

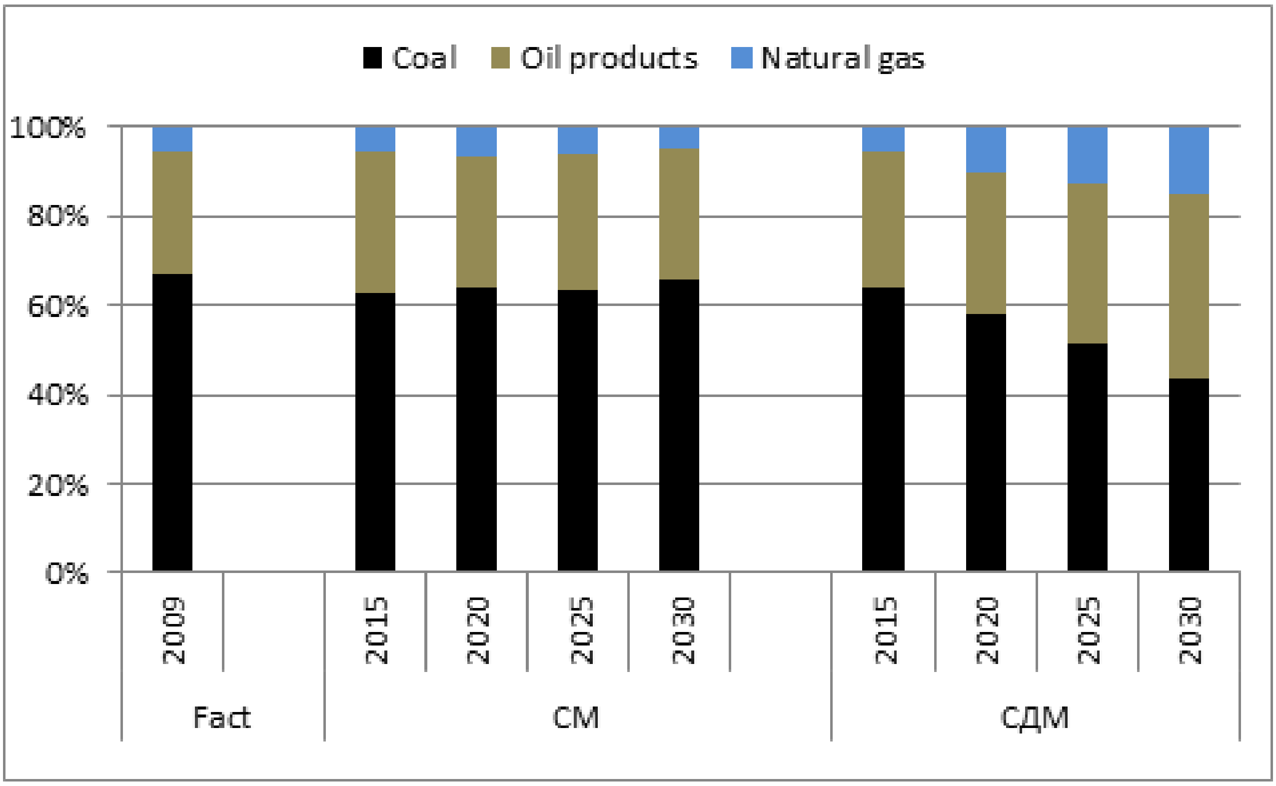
Total	**247,0**	**149,9**	**117,5**	**163,6**	**199,1**	**221,0**	**265,4**	**312,3**	**377,1**	**219,3**	**229,4**	**244,9**	**268,3**

5.1.3.1. Agriculture

CO_2 emissions from the agriculture sector are not essential in comparison with emissions from other sectors. According to forecasts of the scenario with measures, CO_2 emissions in the agriculture sector will be equal to 3.4 million tons of CO_2 by 2020 and 4.4 million tons of CO_2 by2030 that is slower than the supposed GDP growth. In the scenario with additional measures CO_2 gasemission growth is lower than in the scenario with current measuresin 2025 and 2030. Thus,it will be equal to 3.7 million tons of CO_2 by 2025 that is less by 200 thousand tons of CO_2, and 4.1 million tons of CO_2 in 2030 that is less by 300 thousand tons of CO_2 than the level of the same year in the scenario with current measures.

Figure 5.8

CO_2 emissions related to combustion, by types of fuel



5.1.3.2. Industry

Table 5.4 represents the data on inventory for the period from 1990 till 2011, as well as forecasts for the period from 2015 to 2030 according to the scenario with current measures and scenario with additional measures. Growth of emission volume will depend on the modification of technologies, which are applied in the industry sector. Emission measurement will be unbalanced by the branches of industry.

According to the forecast, the application of additional measures will also lead to the essential reduction of CO_2 emissions in comparison with the scenario with current measures, and will be approximately equal to 21.4 million tons of CO_2.

Table 5.4

Total CO_2 emissions from industry by emission categories, by years, forecasts according to scenarios

Million tons of CO_2 Emission categories	Historical data, Inventory					Scenario with current measures				Scenario with current and additional measures			
	1990	**1995**	**2000**	**2005**	**2011**	**2015**	**2020**	**2025**	**2030**	**2015**	**2020**	**2025**	**2030**
Ferrous industry	11,3	8,6	8,9	9,3	5,6	6.9	7.3	7.7	8.3	**6.5**	6.7	6.8	6.9
Non-ferrous industry	2,4	3,9	6,9	7,4	10,8	13.3	13.2	13.0	13.5	13.3	13.0	12.6	12.0
Non-metallic minerals	N/A	N/A	N/A	N/A	N/A	3.4	6.0	9.5	14.5	3.4	5.4	8.3	12.3
Other	8,2	5,4	5,7	8,7	9,9	5.1	6.4	14.0	23.0	5.2	3.1	3.5	6.7
Total	**21,9**	**17,8**	**21,5**	**25,4**	**26,3**	28.7	32.9	44.3	59.3	28.4	28.2	31.2	37.9

N/A – not applicable, due to the absence of this category in GHG inventory of Zhasyl Damu JSC [1]

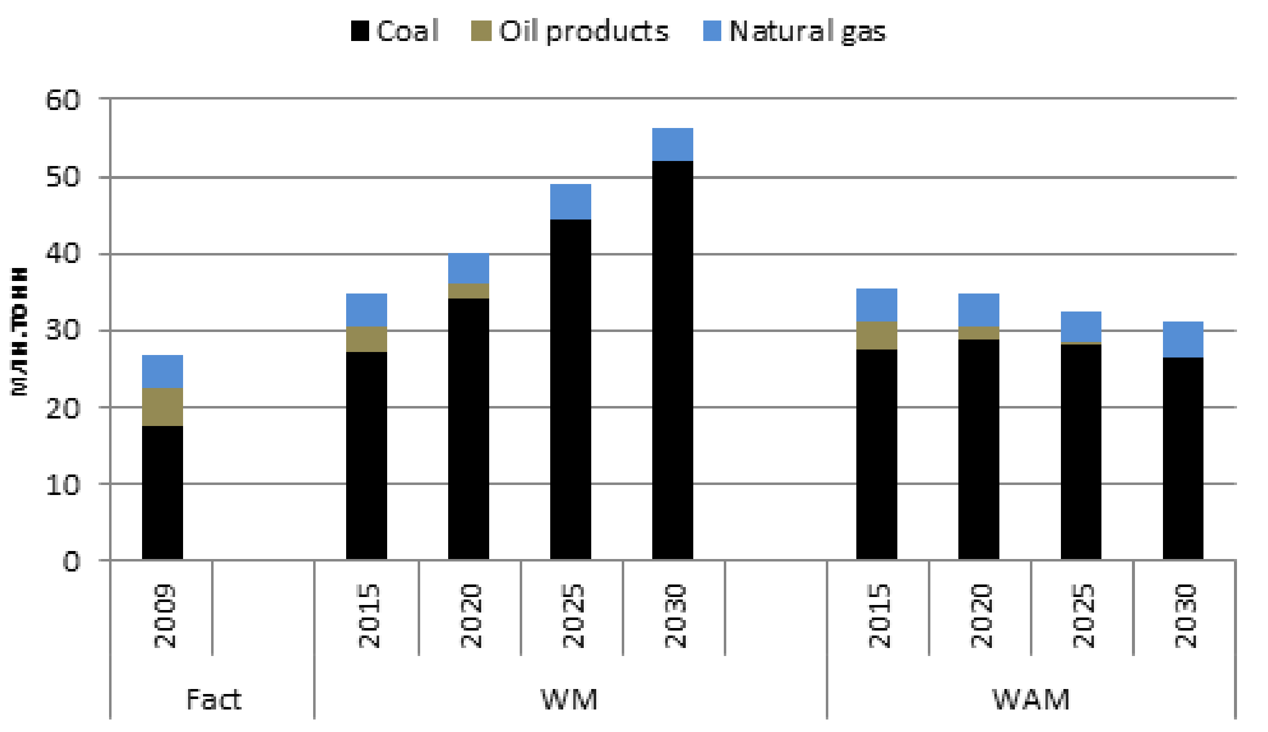
Sources: NURIS

5.1.3.3. Population and services

Double growth of CO_2 emissions related to fuel combustion is possible in service and housing and utilities sectors in future. Coal was and will remain the main fuel leading to CO_2 emissions. Emission growth is observed in the scenario with current measures, while emissions are reducing in the scenario with additional measures. These sectors are the most sensitive to changes of price for energy carriers, which are proved by this dynamics.

Figure 5.9

CO_2 emissions related to fuel combustion in service and population sectors



5.1.3.4. Emissions from electric and thermal power plants

Emissions from electric and thermal power plants are equal to the range from 30 to 35% of the total volume of emissions and from 45 to 50% of emissions related to fuel combustion. Although the emission volume and its shares are changed, figure 5.9 shows that the main fuel of electric and thermal energy is coal in spite of the chosen scenario.

Table 5.5

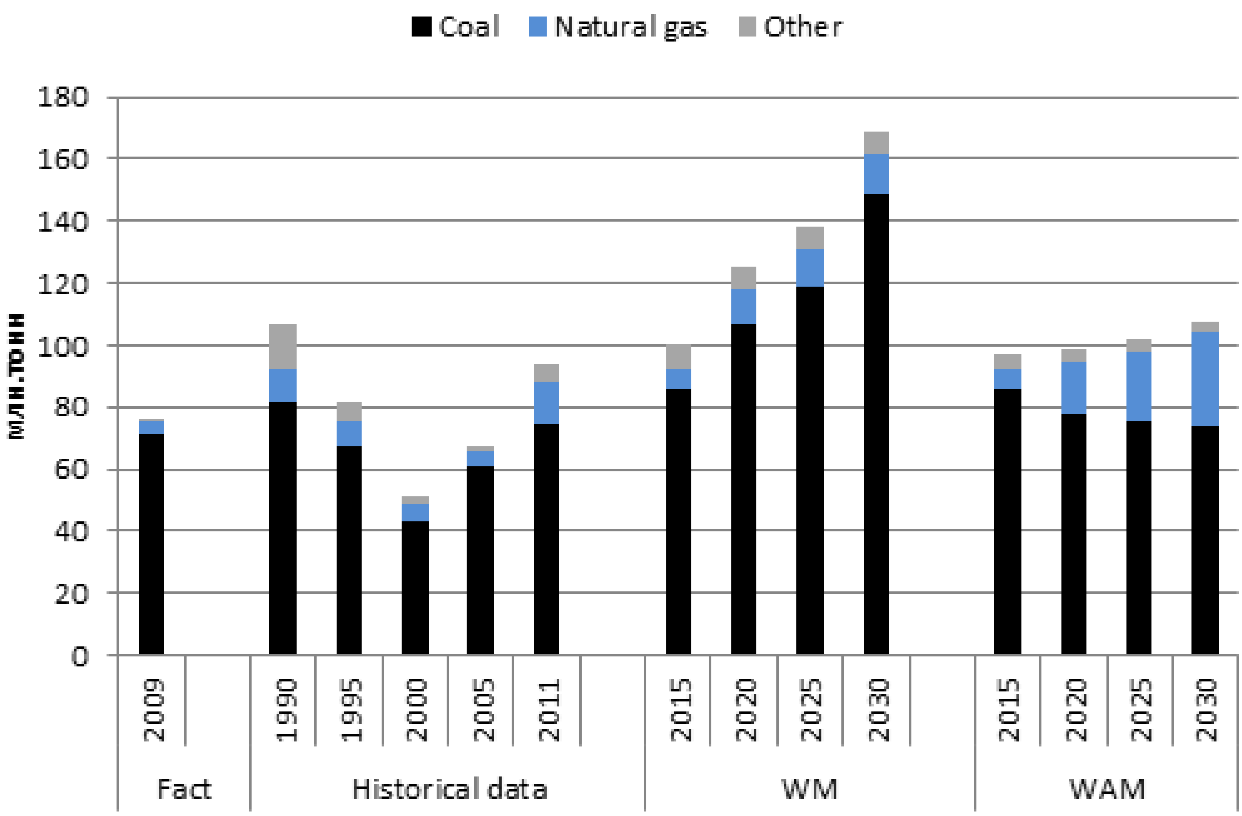
Total CO_2 emissions related to fuel combustion at theelectric and thermal power plnatsby years, forecasts according to scenarios

Million tons of CO_2 equivalent	Historical data, inventory					Scenario with current measures				Scenario with current and additional measures			
Sector	**1990**	**1995**	**2000**	**2005**	**2011**	**2015**	**2020**	**2025**	**2030**	**2015**	**2020**	**2025**	**2030**
Electric power plants	N/A	N/A	N/A	N/A	N/A	40,4	34,3	8,8	10,7	39,3	13,8	2,6	2,6
CHP plants	N/A	N/A	N/A	N/A	N/A	37,8	68,8	107,0	140,7	37,8	69,6	81,7	83,3
Thermal power plants	N/A	N/A	N/A	N/A	N/A	21,2	21,2	21,2	16,7	18,8	15,0	16,7	21,
Total	**107,1**	**81,9**	**51,0**	**67,6**	**83,5**	**99,5**	**124,3**	**137,0**	**168,0**	**95,9**	**98,4**	**101,0**	**107,0**

N/A – not applicable due to the fact that there is no station type separation in inventory of Zhasyl Damu JSC

Figure 5.10

CO_2 emissions related to fuel combustion, at the electric and thermal power plants by fuel types



5.1.3.5. «Other» category of emissions

The «Other» category which includes processes unaccounted by statistics, as well as which allows balancing the incorrectness of reporting in sectors covered by statistics is introduced for preparation of the fuel and energy balance plan during the calculation of the statistical difference. TIMES-Kazakhstan model, which is based on the fuel and energy balance plan, also includes the «Other» category.

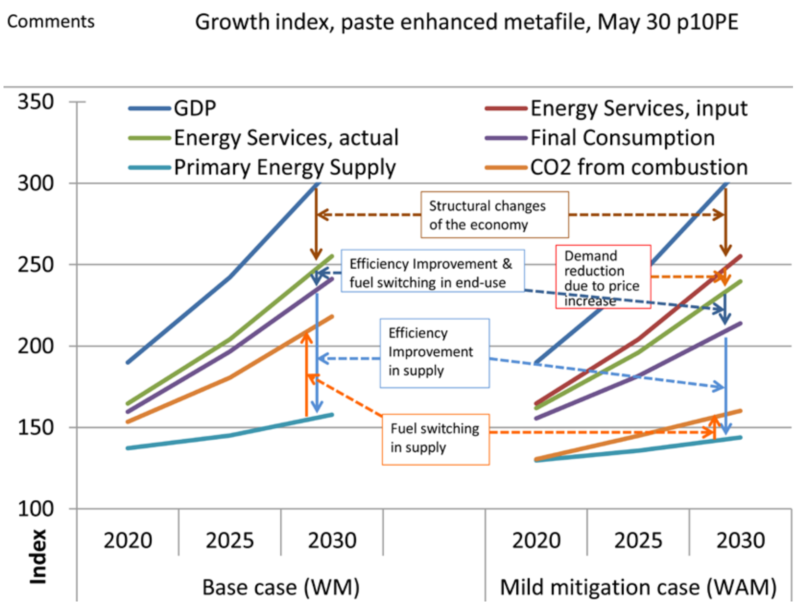
Also the «Other» category is in the inventory of Zhasyl Damu JSC for last years.

5.1.4. Explanation of results

It is expected that growth of greenhouse gas emissions from combustion in both scenarios will be lower than in domestic economic forecasts. Analysis of growth of the main macroeconomic and energy indexes was performed to understand differences between two emission scenarios with measures and additional measures. Such analysis allows determining the quality change of economics, such as transition to the low-carbon development, and importance of measures for energy efficiency.

Figure 5.11

Comparison of effect of the policies and measures of scenario with measures and scenario with additional measures



In figure5.11growth indexes of values are indicated in relation to 2011 as follows:

1. GDP – Index of GDP growth, same in both scenarios, is to be exogenously designated as a base assumption.
2. Demand WM – Index of increase in demand for energy services in the scenario with measures, which is calculated by demand elasticity for GDP in the period from 2011 to 2030.
3. Demand WAM – Index of increase in demand for energy services, which is calculated by the model with account of increase in prices as a result of application of additional policies and measures.
4. Consumed energy – Index of growth of final energy consumption, which is equal to the total consumption of final consumers, excluding energy, which have been consumed for transformation processes and energy supply, as well as excluding own consumption of energy producers.
5. Primary energy supply – Index of growth of the primary energy supply, which represents the amount of extracted energy resources in the country, including import and excluding export.
6. CO_2 from combustion –Index of growth of carbon dioxide emission from the processes related to fuel combustion

Technical and economic model engineering of energy industry supposes the energy system division into supply and consumption. Initial values for model engineering are demand values on the part of consumption. The model allows calculating energy industry structure for satisfaction of demand, predetermined from outside as an assumption.

Diagrams of relative indexes of different values, which are calculated in different units, are presented in figure 5.11. Application of growth indexes allows giving different indexes in one diagram for comparison of index change rate. Explanation of differences of index growth rates are mentioned below

5.1.4.1. Difference of GDP growth and increase in demand for energy services due to the economy structure

The demand for energy services forecasted exogenously depending on changes of the main macroeconomic indexes, was calculated in the assumption that elasticity of demand drivers in relation to GDP was generally lower than one (ratios are mentioned in subsection 5.5). Generally it is expected that the f demand for energy services will growth by 2.5 times during the period from 2011 to 2030, while GDP will increase in three times during the same period. The average demand elasticity in relation to GDP is equal to 0.83 for this period. Difference between rates of GDP growth and increase in demand for energy resources is the economy characteristic and determined by the retrospective analysis.

Scenario with additional measures provides a small increase in prices for energy due to application of measures and policies on reduction of greenhouse gas emissions. The increase in prices for energy resources leads to the reduction of energy consumption (energy consumption – violet curve in figure 5.11). The reduction is related to two main factors: decrease in demand for energy services and increase of energy efficiency.

5.1.4.2. Decrease in demand by means of increase in prices for energy resources

The decrease in demand for energy resources, related to increase in prices, can be allocated to fall of population living standards. For example, enterprises and population can reduce use of air conditioners in responding to increase in prices for electricity in the service and housing and utilities sector, and transportation of cargo and number of travels will be reduced in responding to increase in price of engine fuel in the transport sector. Examples of the decrease in industry demand can be also considered. Some production capacities can become uncompetitive as a result of increase in price for electric energy that will lead to the reduction of production and thus to decrease in demand for electric energy on the part of industry.

The decrease in demand for energy services of the whole economy of Kazakhstan can be reduced by 2% in 2020, 4% in 2025 and 6% in 2030in the scenario with additional measures (WAM) in comparison with scenario with current measures (WM). In 2030 such reduction can be observed in the industry (8.6%), service (7.5%), housing and utilities (5.7%) and transport (2%) sectors.

If it is assumed that Kazakhstan economy sensitivity to increase in price for energy does not differ from similar countries, then the decrease in demand for energy can be reduced by 2% in 2020, 4% in 2025 and 6% in 2030 in the scenario with additional measures (WAD) in comparison with scenario with current measures (WM).

If the increase in price for transport fuel by the range from 5 to 10% by 2030, we will get decrease in demand for transportation of passengers and cargo in 2%. If the price for electric energy increases by the range from 5 to 6% and for district heating and natural gas - by the range from 20 to 40%, the demand for energy services will reduce by 7% in housing and utilities and service sector, by the range from 8 to 9 % in industry sector.

5.1.4.3. Raising of energy efficiency and transition to another type of fuel in sectors of final use

The next constituent of reduction of energy consumption is related to repowering on the part of consumption. If we go back to the abovementioned examples it can mean the use of more energy efficient air conditioners, transition from use of petrol to natural gases, as well as transition to new generation of vehicles and industrial technologies.

The effect of raising energy efficiency is observed in both scenarios, but it is substantially more expressed and equal to 1% in 2020, 3% in 2025 and 5% in 2030. All main economy sectors consuming energy give the substantial potential of energy efficiency rising. In the scenario with additional measures the reduction of energy consumption can be equal to 23%, 12%, 6% and 2 % for service, industry, housing and utilities and transport sectors by 2030 respectively.

5.1.4.4. Raising of energy efficiency in the supply sector

Another variant, which reduces greenhouse gas emissions in relation to the economic growth, is a use of more efficient energy supply system. Primarily it means the increase in efficiency of electric and thermal energy supply system in Kazakhstan: production, transfer and distribution. It is related to a big distance between the energy resource and consumer, physically and technologically old-fashioned energy supply system, high level of lost business.

In the scenario with current measures several more efficient technologies will be used in the electric energy sector, because it is economically competitive. For the purposes of satisfaction of final consumption annual growth (demand) in the amount from4.0 to 4.3% during the period from 2020 to 2030 the volume of initial energy increases slowly during the same period - only by the range from 1.1 to 2.9% annually. In 2030 the efficiency growth gain reaches approximately 35% between initial and final energy.

The efficiency growth has the same total effect (35%) in the scenario with additional measures

5.1.4.5. Transition to another type of fuel in the supply sector

As used herein it means that transition to another type of fuel includes also transition from fossil-based energy resources to carbon-free types of energy, such as wind, sun and nuclear energy.

Some incomes of previous effects are lost in the basic scenario as a result of fuel replacement with more carbon intensive types of energy (figure 5.11).

In the scenario with additional measures the substantial part of electric energy is generated by wind, solar and nuclear power stations in 2030 that is provided for by the Concept on the transition of the Republic of Kazakhstan to «green economy». This effect compensates the growth of generating capacities on the basis of the cheapest type of fuel (coal) (figure 5.10).

Comparison of scenarios provides a possibility to disaggregate the emission reduction among the scenarios by main indexes.

5.2. Emissions not related to fuel combustion

Greenhouse gas emissions from processes not related to fuel combustion are mentioned in table 5.6 and 5.7 below.

Table 5.6

Historical data and forecast of greenhouse gas emissions from processesnot related to fuel combustion, by gas types

Million tons of CO_2 equivalent	Historical data, inventory					Scenario with measures				Scenario with additional measures			
	1990	1995	2000	2005	2011	2015	2020	2025	2030	2015	2020	2025	2030
CO_2	21,7	5,6	6,3	15,3	14,5	17,6	20,8	23,5	27,1	17,1	20,3	22,9	26,5
CH_4	72,0	43,7	32,7	37,3	47,8	50,8	57,8	64,5	73,2	46,8	53,2	59,3	67,5
N_2O	15,4	8,4	5,2	7,0	8,3	9,4	10,8	12,2	13,6	9,4	10,8	12,2	13,6
CF_4 (PCFs)	0,0	0,0	0,0	0,0	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1
$C2F_6$ (PCFs)	0,0	0,0	0,0	0,0	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2
HFCs (hydrofluo-rocarbon)	0,0	0,0	0,2	0,2	0,8	0,9	1,5	2,1	2,7	0,9	1,4	2,0	2,5
Total	**109,2**	**57,7**	**44,4**	**59,8**	**72,7**	**80,0**	**92,2**	**103,5**	**117,9**	**75,5**	**87,0**	**97,7**	**111,4**

Table 5.7

Historical data and forecast of greenhouse gas emissions from processes not related to combustion, by sectors

Million tons of CO_2 equivalent	Historical data, inventory					Scenario with measures				Scenario with additional measures			
Sector	1990	1995	2000	2005	2011	2015	2020	2025	2030	2015	2020	2025	2030
Agriculture	38,1	23,1	14,5	19,1	21,4	24,9	28,5	31,8	35,5	24,9	28,5	31,8	35,5
Industry	17,9	8,1	10,2	13,3	17,2	18,7	21,6	24,7	28,5	18,2	21,0	24,1	27,7
Fugitive emissions	52,6	30,6	26,6	26,8	33,1	35,1	40,2	44,3	50,7	35,1	40,2	44,3	50,7
LULUCF	-2,2	-7,3	-10,1	-2,9	-3,1	-3,3	-3,2	-3,2	-3,2	-3,3	-3,2	-3,2	-3,2
Waste	2,7	3,1	3,1	3,5	4,1	4,6	5,2	5,8	6,4	0,6	0,6	0,6	0,7
Total	**109,2**	**57,7**	**44,4**	**59,8**	**72,7**	**80,0**	**92,2**	**103,5**	**117,9**	**75,5**	**87,0**	**97,7**	**111,4**

5.2.1. Fugitive emissions

The forecast of greenhouse gas emission in the fugitive emission sector due to coal mining, oil extraction, processing and transportation, gas condensate and natural gas by the following gases: CO_2, CH_4 is indicated below.

Table 5.8

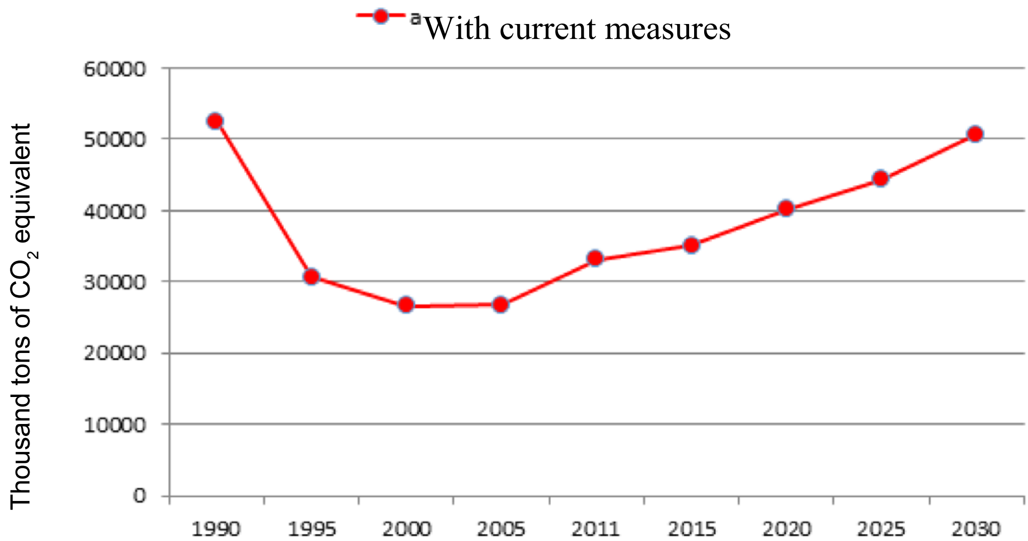
Historical data and forecast of fugitive emissions, thousand tons of CO_2 equivalent

	Historical data					WM				WAM			
	1990	**1995**	**2000**	**2005**	**2011**	**2015**	**2020**	**2025**	**2030**	**2015**	**2020**	**2025**	**2030**
CO_2	6016,3	4779,8	6367,6	5195,3	2587,9	4445	5264	5426	5902	4445	5264	5426	5902
CH_4	46545	25864,4	20265,7	21634	30525,3	30669	34921	38902	44845	30669	34921	38902	44845
Total	**52561,3**	**30644,2**	**26633,3**	**26829,3**	**33113,2**	**35114**	**40185**	**44328**	**50747**	**35114**	**40185**	**44328**	**50747**

Sources: NURIS

Figure 5.12

Forecast of greenhouse gas emissions in the fugitive emission sector



Sources: NURIS

Greenhouse gas equivalent of fugitive emissions is presented in figure 5.12 (scenario with current measures). Scenarios without measures and with additional measures are not presented, because the analysis of previous and future policies and measures in the fugitive emission was not performed. In the scenario with current measures a gradual increase in emissions of this sector and reaching the level of 1990 approximately are expected in 2030 due to increase in extraction of coal, oil and gas.

5.2.2. Emissions due to the processes

Mineral products

Generally emissions of carbon dioxide (CO_2) during the mineral material production are formed from tree categories of sources; they are concrete, lime and glass production. All mentioned categories are related to the processes of carbonate material calcination. According to IPCC Guidelines for national greenhouse gas inventories (2006) [17], other greenhouse gases are not taken into account in these categories.

Concrete production

During the concrete production processes CO_2 is generated on the stage of clinker production –an intermediate product, which is used for concrete production. According to the data of the Agency of Statistics of the Republic of Kazakhstan (ASof the RK), eight concrete factories are functioning in five regions of Kazakhstan, but clinker is produced only in two regions.

Data on clinker have been collected by the AS of the RK since 2004 (table 5.9).

Table 5.9

Clinker production (thousand tons)

Region	2004	2005	2006	2007	2008	2009	2010	2011
East Kazakhstan region	657,4	675	903,8	1 134,3	1 234,9	1 030,2	1 014,5	1 072,4
Karaganda region	-	-	-	-	635,4	742,2	933,8	954
Total for the Republic of Kazakhstan	**657,4**	**675**	**903,8**	**1 134,3**	**1 870,3**	**1 772,4**	**1 948,3**	**2 026,4**

Sources: Data of AS of the RK

Lime production

Calcium oxide or quicklime is produced by heating high lime rock (calcite).This process is accomplished with CO_2 emission.

According to the data of AS of the RK, lime is produced in eleven regions and in Almaty city. Dynamics of lime production of the country is indicated in table 5.10. Period of economic growth has been taken into account since 2000.

Table 5.10

Dynamics of lime production

Index	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total lime production of the Republic of Kazakhstan, thousand tons	622,9	689,3	710,7	786,1	859,0	993,5	988,1	1023,2	905,9	798,2	886,6	959,8

Sources: AS OF THE RK

Glass production

The Agency of Statistics of the Republic of Kazakhstan [2] does not keep records of production volumes of glass and glass products. Kazakhstan imports 100% of plate glass consumption. Nowadays the construction of factory for glass production is held in Aktobe region near the Alazharskoe mine. The first output is planned for 2014; estimated capacity is equal to 600 tons of glass per day or about 200 thousand tons of glass per year.

According to the data of the Industry Committee of the Ministry of Industry and New Technology of the Republic of Kazakhstan,12.4 and 14.4 million square meters of glass will be produced in 2015 and in 2020 respectively that is approximately equal to 125 and 145 thousand tons of glass. Further, the linear growth is supposed with the projected rate operation by 2030.

Results of calculations on glass production forecasts up to 2030 are presented in table 5.11. A single weight rate of CO_2 emissions for glass production was used for calculation of the forecast on carbon dioxide emissions during the glass production, which is equal to 0.2 (IPCC Guidelines for national greenhouse gas inventories, 2006 [17])

Table 5.11

Forecast of glass production

Index	2011	2015	2020	2025	2030
Glass production, thousand tons	0	125,0	145,0	172,5	200,0

Sources: NURIS

Other processes using carbonates

Carbonates, namely dolomite, are used as flux in the metal industry, except the processes of concrete, lime and glass production

Inventory data for the period from 2000 to 2011, which is prepared by the Zhasyl Damu JSC [1], was used for projection of emissions of this category.

Table 5.12

Dynamics of CO_2 emissions due to dolomite use in the metal industry

Index	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
CO_2 emissions from dolomite use, thousand tons.	834	1074	1515	1550	1650	1836	1817	1565	1975	1619	1726	1997

Sources: Zhasyl Damu JSC

5.2.3. Chemical industry

Ammonia production

In Kazakhstan the sole producer of ammonia is «Kazazot», LLP, which also produces ammonia nitrate. The company was established on the 16th of November, 2005 on the basis of the chemical complex of Pre-Caspian Mining and Metallurgical Integrated Plant (PMMIP) ofthe former Ministry of Medium Machine-Building Industry of the USSR. According to Zhasyl Damu JSC [1], emissions of the category 2.B.1 Ammonia production were equal to 192.2 Gg of CO_2 in 2011, which is equal to 0.5% of national emissions.

According to the data of the Agency of Statistics of the Republic of Kazakhstan, the ammonia production was equal to 128.1 thousand tons of ammoniain 2011, which is almost in 4 times less than in 1990. According to the data of «Kazazot», LLP, liquid ammonia was equal to 200,433 tons in 2012, and natural gas consumption was equal to 199,629 thousand cubic meters. The main raw material of ammonia production is natural gas, which is supplied to «Kazazot», LLP by the «Kazakh Gas Refinery», LLP.

The main activities of «Kazazot», LLP are related to the following productions:

- ammonia production
- 46% weak nitric acid production
- ammonia nitrate production
- Ammonia production technology consists of several stages:
- Natural gas (NG) and air compression
- NG stripping from sulphur compounds.
- Initial steam reforming of methane with catalyst.
- Secondary air reforming with catalyst.
- Conversion of carbon oxide into carbon dioxide with catalyst.
- Stripping of converted gas from carbon dioxide using monoethanolamine solution and methanation with catalyst.
- Compression of synthesis gas to 300 kgf/cm2
- Synthesis of ammonia in synthesis column with catalyst and its further condensation.
- Transfer of final products to the storage.

Calculation of Zhasyl Damu JSC was executed by the method of TIER 1 level [6].

Table 5.13

GHG emissions from ammonia production during 1990, the period from 2008 to 2011 (thousand tons)

Activity type	Year					Change in relation to 1990
	1990	2008	2009	2010	2011	
Ammonia production	455,9	127,8	101,2	91,9	128,1	Reduction for more than in3.5 times
CO_2 emissions from ammonia production, thousand tons	683,9	191,7	151,8	137,9	192,2	Reduction for more than in 3.5 times

Sources: Zhasyl Damu JSC

Forecast in relation to ammonia production

It is supposed (according to historical data) that production growth of chemical industry will be equal to 8% per year. Thus, ammonia production will reach the level of 1990 by the period from 2022 to 2025 approximately.

Data on ammonia production and dry natural gas consumption was obtained for the production of 2012. On the average 1 thousand cubic meters of natural gas is used for one ton of ammonia. Also data on calorific efficiency, equaling to 31.8 MJ / cubic meter (7600 ccal), of used gas according to GOST 5542-87 was obtained. According to the data obtained, a calculation according to TIER 2 level was made, because IPCC Guidelines for national greenhouse gas inventories, 2006 [17] will be used since 2015.

In view of aggregated CO_2 emission rate per ton of produced ammonia, the forecast of CO_2 emissions from ammonia was obtained (table 5.14).

Table 5.14

Forecast of ammonia production during 2012-2030

Activity type	Year							
	2012	2014	2016	2018	2020	2022	2025	2030
Ammonia production, thousand tons	200,4	233,4	272,1	317,1	369,5	421,4	513,4	711,2

Sources: NURIS

CHAPTER V

Calcium carbide production

Greenhouse gas emissions occur during calcium carbide production. Calcium carbide is produced by the reduction method of quicklime (CaO) with carbon (anthracite, coke) in special carbide electrical arc furnace at the temperature from 2000 to 2300ºC according to endothermic reaction. During CaC_2 production CO_2 emissions generate from lime rock, and also from the process of lime reduction and carbide use. Commercial calcium carbide is widely used in engineering, mainly for industrial production of acetylene and its processing products, and also of calcium Cyanamid, which is used for fertilizers, nitriles production. Moreover, commercial calcium carbide is used for recovery of metals, reduction of oxygen (deoxidation) and sulphur (desulphuration) contentin the steel in order to obtain carbide and caramide phytohormone, produce powdery carbide reagent, silicon carbide SiC is produced from silica sand or silica and coke. CO_2 and methane emissions generate during SiC production.

The data on calcium carbide production in Kazakhstan is provided for by the Agency of Statistics of the Republic of Kazakhstan. The production is executed at the «Temirtau Electro Metallurgical Plant», JSC. Data on calcium carbide production for the period from 1990 to 2011, its export and import was obtained by the Agency of Statistics of the Republic of Kazakhstan. Values of lime specific consumption for production of 1 ton of calcium carbide, of CO_2 emission rates during lime use and of reducing agent for calcium carbide production and of its application were defaulted (table 2.8 of part 2 of the Revised Guidelines of IPCC).

General modification of calcium carbide production and its emissions are presented in table 5.15. Source – Zhasyl Damu JSC, the calculation was made according to TIER 1, Revised IPCC Guidelines for national greenhouse gas inventory, 1996 [14].

Table 5.15

GHG emissions from calcium carbide production during 1990, the period from 2008 to 2011 (thousand tons)

Activity type	Year					Change in relation to 1990
	1990	2008	2009	2010	2011	
Calcium carbide production, thousand tons	306,720	31,787	34,196	35,690	27,570	Reduction for more than in 10 times
CO_2 emissions from calcium carbide production, thousand tons	904,810	93,77	100,870	105,270	81,330	Reduction for more than in 10 times

Sources: Zhasyl Damu JSC

As it seen from the table, the total GHG emissions from calcium carbide production have reduced by more than 10 times in relation to 1990. Growth of calcium carbide production is supposed at the level of 8% per year. Thus, CaC_2 production will reach 105.33 thousand tons per year by 2030. In the Republic of Kazakhstan the produced calcium carbide is fully used at the domestic market. It is primarily connected with the fact that calcium carbide is fully used in the metal industry sector.

Forecast for calcium carbide production

According to the calculation of Zhasyl Damu JSC [1], 2.95 tons of CO_2 equivalent fall within the ton of produced calcium carbide.

Table 5.16

Forecast for calcium carbide production during the period from 2012 to 2030

Activity type	Year							
	2012	2014	2016	2018	2020	2022	2025	2030
Production, thousand tons	29,68	34,57	40,3	46,95	54,72	62,41	76,02	105,33

Sources: NURIS

By-product coke industry

By-product coke industry provides valuable raw material for ferrous and non-ferrous metal industry, and for chemical industry. A big part of coke, which is produced in Kazakhstan, is metallurgical coke for iron smelting or special coke for ferrous alloys. Pitch coke is mainly imported and used for production of anode paste, graphite electrodes, and different carbon construction materials. According to the IPCC Guidelines of national greenhouse gas inventory, 2006 [17],the most part of coke production was allocated to the energy industry section. But due to the fact that coke is used in chemical industry, coke chemistry is also valuable source of chemicals. The part of coke production is allocated to the chemical industry.

Table 5.17

GHG emissions from coke production during the period from 1990 to 2011, thousand tons of CO_2 equivalent

Activity type	Year					Change in relation to1990
	1990	2008	2009	2010	2011	
Coke production, thousand tons	4 513,3	2 942,1	2 552,0	2 526,9	2 663,3	Reduction almost in 2 times
CH4emissions to atmosphere, thousand tons of CO_2 equivalent	47,5	30,9	26,9	26,5	27,9	Reduction almost in 2 times

Sources: Zhasyl Damu JSC

5.2.4. Metal industry

Iron and steel production

In Kazakhstan iron and steel are produced at Arcelor Mittal steelmaking plant in Temirtau. The main data on production capacities of the plant for the time being:

- 6 coke oven with total capacity up to 3.5 million tons per year;
- 3 sintering machines with capacity up to 6.5 million tons per year with direct feed to blast furnaces;
- 4 blast furnaces with capacity up to 5.00 million tons of iron per year;
- 3 converters with capacity up to 6 million tons per year;
- hot dip galvanizing shop (mill 1,700) with capacity up to 5.2 million tons per year;
- strip cold rolling shop (mill 1,400) with capacity up to 0.8 million tons per year;
- electrolytic tinplate production shop (three coating lines) with capacity of 375 thousand tons per year;
- two zincalume coating lines and contouring unit with capacity of 320 thousand tons for each one per year.

Ferrous alloys production

In Kazakhstan the main producers of ferrous alloys is «Transnational Company «Kazchrome», JSC, which includes producers - Aktobe Ferroalloys Plant and Aksu Ferroalloys Plant, and the main products are ferrochrome, ferrosilicon, ferrochrome silicon and ferrosilicon manganese.

Aluminum production

In Kazakhstan the sole producer of aluminum is «Kazakhstan Electrolysis Plant», JSC. The plant capacity is 250 thousand tons per year. Centre-worked prebake (CWPB) technology is used at the plant. Electrolysis cells with anode prebaking are used in this technology.

Aluminum production is a key-note in the Republic of Kazakhstan. In this regard it is recommended to apply calculation formula of carbon dioxide emission according to Tier 3 method (2006 IPCC Guideline for national greenhouse gas inventories) for aluminum production.

The data on production indexes of «Kazakhstan Electrolysis Plant», JSC were taken from the report of Zhasyl Damu JSC [1] for the period from 2010 to 2011. Rates of conversion into CO_2 equivalent were taken from IPCC Fourth Assessment Report.

At this moment Pavlodar Alumina Plant operates with established capacity of 250 thousand tons of aluminum per year. In the near future production increase is not expected.

Zinc production

The main zinc producer is «Kazzinc», JSC. Hydrometallurgical technology is used at the «Kazzinc», JSC zinc plant, which does not emit greenhouse gases to atmosphere according to 2006 IPCC Guidelines (Metal Industry Emissions).

Forecast of greenhouse gases emissions in «Industrial processes» sector, «Metal industry» subsector.

Production volume of metallurgical products for 2013 was forecasted using the arithmetical average for last 4 years at the level of 2,934.8 thousand tons of iron, 3,224.4 thousand tons of steel, 5,247.5 thousand tons of sinter, 1,787.6 thousand tons of ferrous alloys (by 4 types).

A stable level of aluminum production is supposed according to the maximum capacity of 250 thousand tons per year.

Production elasticity, which is based on GDP of ferrous and non-ferrous metal industry, is taken from the NURIS report [9] and equal to 0.5 and 0.13 relatively.

During the forecasting of metal industry production the authors of this work did not focus on target values of the State Program of Accelerated Industrial and Innovative Development of the Republic of Kazakhstan for the period from 2010 to 2014. In particular, it was found out that initial plans on achievement of production volume of 6 million tons by 2014 were impossible. According to statistics, Kazakhstan steel production does not exceed approximately 3-3.5 million tons per year after the program adoption. Reasons of failure to execute the program are discussed in articles of A. Amalbaev (10) and «ZONA.KZ» online newspaper (11).

Table 5.18

Predicted assumptions on iron, steel, sinter and non-ferrous metals production (2013 = 1)

Index	2015	2020	2025	2030
GDP	1,14	1,61	2,17	2,9
Ferrous metal industry	1,02	1,08	1,13	1,18
Non-ferrous metal industry	1,02	1,07	1,11	1,15

Sources: NURIS

Table 5.19

Forecast of iron and steel making production for 2011-2030

Metal	2011	2015	2020	2025	2030
Steel	3 699 300	3 288 863	3 482 325	3 643 544	3 804 763
Iron	3 141 100	2 993 471	3 169 557	3 316 296	3 463 035
Sinter	6 024 900	5 325 399	5 667 246	5 929 619	6 191 991

Sources: NURIS

Table 5.20

Forecast of greenhouse gas emissions from ferroalloy industry during the period from 2011 to 2030

	2011	2015	2020	2025	2030
Ferrochrome, tons	1 289 917	1 738 946	1 738 946	1 738 946	1 738 946
Ferrosilicon, tons	1 683	2 817	2 983	3 121	3 259
Ferrosilicon manganese, tons	232 039	296 839	293 839	293 839	293 839
Ferrochrome silicon, tons	143 296	156 682	165 899	173579	181 260

Sources: NURIS

5.2.5. HFCs consumption

Table 5.21

Forecast of greenhouse gas emissions from aluminum industry duringthe period from 2011 to 2030

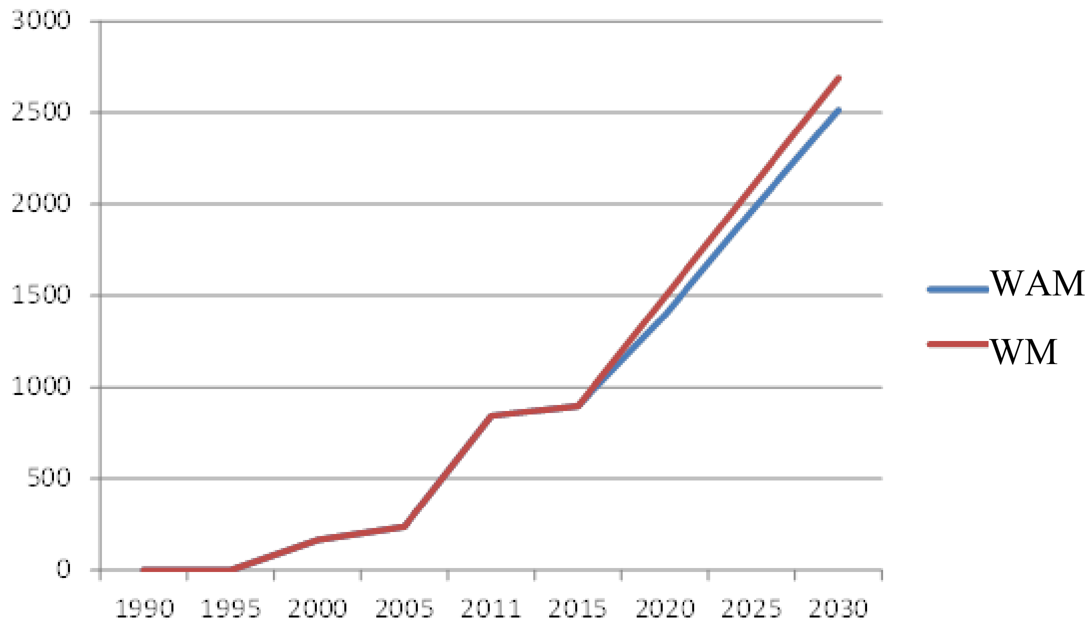
	2011	2015	2020	2025	2030
Aluminum, tons	248 767	250 000	250 000	250 000	250 000

Sources: NURIS

The following approach is used for forecasting emissions of this sector: on the basis of historical data of the period from 2000 to 2011 a functional relationship between demand for refrigerators and air conditioners and HFCs emissions [1] was evaluated, and then future HFCs emissions in CO_2 equivalent were also evaluated.

Figure 5.13

Historical data and forecast of HFCs emissions during the period from 1990 to 2030



Sources: NURIS

Table 5.22

Forecast of greenhouse gas emissions from aluminum industry during the period from 2011 to 2030.

Emission type	Fact	WM				WAM			
	2011	2015	2020	2025	2030	2015	2020	2025	2030
HFCs emissions, thousand tons of CO_2 equivalent.	843,6	896,4	1493,9	2091,5	2689,1	896,4	1392,9	1964,8	2513,7

Sources: NURIS

5.2.6. Agriculture

Greenhouse gas emissions from the agriculture sector are limited to methane, dinitrogen monoxide. In 2011 share of agriculture in the total volume of emissions was equal to 7.9%. In 2011 emissions from agriculture were equal to 56.2% of values of basis 1990.

Emission forecast for the period from 2015 to 2030 is presented in table 5.24.

Table 5.23

Historical data on GHG emissions from the agriculture sector during the period from 1990 to 2011.

	Historical data				
	1990	1995	2000	2005	2011
Agriculture (CH_4)	23084,5	15161,1	9612,6	12555,9	13659,7
Enteric fermentation	21372,4	13991,0	8867,1	11614,4	12668,9
Cleaning, storage and use of dung	1555,9	1049,2	647,9	833,6	873,6
Rise cultivation	156,2	121,0	97,7	107,9	117,2
Agriculture (N_2O)	15060,0	7960,0	4916,9	6535,9	7773,0
Cleaning, storage and use of dung	5678,2	3741,1	2307,1	2978,9	3256,1
Agricultural lands	9381,8	4218,9	2609,8	3557,1	4516,9
Total	38144,5	23121,1	14529,4	19091,8	21432,7

Sources: NURIS

Table 5.24

Historical data on greenhouse gas emissions from agriculture sector during the period from 2011 to 2030.

	WM				WAM			
	2015	**2020**	**2025**	**2030**	**2015**	**2020**	**2025**	**2030**
Agriculture (CH_4)	16048,6	18257,6	20299,4	22515,6	16048,6	18257,6	20299,4	22515,6
Enteric fermentation	14899,1	16956,7	18854,4	20925,0	14899,1	16956,7	18854,4	20925,0
Cleaning, storage and use of dung	1023,5	1163,2	1295,7	1439,3	1023,5	1163,2	1295,7	1439,3
Rise cultivation	126,0	137,8	149,3	151,2	126,0	137,8	149,3	151,2
Agriculture (N_2O)	8831,9	10205,2	11525,8	12939,4	8831,9	10205,2	11525,8	12939,4
Cleaning, storage and use of dung	3704,5	4178,8	4625,2	5090,2	3704,5	4178,8	4625,2	5090,2
Agricultural lands	5127,4	6026,4	6900,6	7849,2	5127,4	6026,4	6900,6	7849,2
Total	24880,5	28462,8	31825,2	35455,0	24880,5	28462,8	31825,2	35455,0

Sources: NURIS

The main emission source is cattle breeding subsector, generally by enteric fermentation.

Whereas policies, aimed at reduction of emissions in agriculture, were not applied, and the only measures of agriculture emission taxation has negligibly low effect, the scenario «without measures» in emission forecasting of the agriculture sector was not calculated. Greenhouse gas emission assessment is based on the scenario assumptions.

Special assumptions were made in assessment of forecast of cattle breeding products, as mentioned in table below in addition to general scenario assumptions, which are related to basic indexes of Kazakhstan economy development.

Table 5.25

Special assumptions in relation to individual goods markets

Product	Assumptions
Milk	Kazakhstan is among ten leading countries on milk consumption, in this regard the further growth of consumption per capita will be locked. It is suspected that level of milk of 320 kg per capita per year will remain stable during the forecasting period.
Beef	Beef import is limited to 10 thousand tons annualy according to beef quata regime, while there is no export. Meat market is relatively focused on the domestic production, because main meat volume is realized as fresh and cold meat that limits the abilities of external suppliers.
Pork	Pork import will be equal to 10% of consumtion volumes, there is no pork export.
Horse meat	Horse meat is a bonus product, demand for which increases with growth in prosperity. In this regard the outlined growth trend of this product import is given in the forecasting calculations at the level of 10% of general consumption.
Mutton	Mutton market remains closed, there is practically no external trade of this meat type, which is extrapolated for the whole forecasting period.
Poultry meat	It is suspected that poultry meat import will reduce from current 60% to 30% according to target indicators of this sector at the rate of 3% per year.
Eggs	Market egg import will be equal to 5% of the general consumption at the level of average consumption for the period from 2001 to 2011.

Sources: NURIS

As for the scenario «with additional measures», practical policies and measures are not planned nowadays in relation to greenhouse gases in the agriculture sector. Government attempts to force the production industrialization in the cattle breeding subsector can potentially lead to increase in use of high-yield cattle, which reduces specific emissions per production unit. Nevertheless, there are no quantitative reference points of structural transformation of the cattle breeding sector in policy documents, and historical data do not help to determine any certain trends in this regard.

Enteric fermentation of farm livestock

Calculation scheme of emission from the cattle breeding sector supposes the assessment of greenhouse gas emission according to the chain «future consumption of food products» – «assessment of necessary animal livestock» – «emission assessment» in assumption on relative privacy of markets (milk, beef, mutton, eggs) or on supply structure in section of import – domestic production (pork, poultry meat, horse meat) on the basis of historical data, official documents and expert evaluations (refer to Methodology). Domestic consumption was assessed by regression method due to GDP level per capita, because the most products of cattle breeding show positive correlation with this index. Such an approximation is seen as reasonable, in spite of that this approach does not take into account elasticity of mutual replacement, which can lead to change in the consumption structure.

Due to the consumption of main products, including assumptions about market structure, production forecast is formed, that is the basis for the needed cattle stock calculation. The last index is the base for further calculations of greenhouse gas emissions from the enteric fermentation and systems of cleaning, storage and use of dung on the basis of average ratios of CH_4 and N_2O emissions for latest years according to the latest National Report [1].

Table 5.26

CH_4 emissions due to the enteric fermentation

CH_4 emissions due to enteric fermentation, thousand tons	2011	2015	2020	2025	2030
Cattle	462,0	568,1	653,7	732,7	819,0
Dairy cattle	276,1	312,0	332,4	350,0	368,6
Non-dairy cattle	183,2	240,3	290,1	336,9	388,3
Seep and goats	103,1	114,9	133,0	150,1	169,0
Camels	8,1	9,1	11,0	12,7	14,7
Horses	30,4	31,6	39,1	46,1	53,8
Swines	1,5	1,6	1,7	1,9	2,1
Total	**603,3**	**709,5**	**807,5**	**897,8**	**996,4**

Sources: NURIS

Cleaning, storage and use of dung

Calculation of emissions from systems of cleaning, storage and use of dung according to IPCC Guidelines [16] was made on the basis of stock calculation (refer to subsection 5.5).

Table 5.27

CH_4 emissions from systems of storage and use of dung

CH_4 emissions from systems of storage and use of dung, thousand tons	2011	2015	2020	2025	2030
Cattle	30,87	37,46	42,57	47,26	52,37
Dairy cattle	16,67	18,78	20,01	21,07	22,18
Non-dairy cattle	14,21	18,68	22,56	26,20	30,19
Seep and goats	2,09	2,30	2,66	3,00	3,38
Camels	0,23	0,25	0,31	0,35	0,41
Horses	1,84	1,91	2,37	2,79	3,26
Swines	6,12	6,36	6,96	7,68	8,49
Poultry	0,40	0,44	0,52	0,60	0,64
Total	**41,60**	**48,74**	**55,39**	**61,70**	**68,54**

Sources: NURIS

Table 5.28

N_2O emissions from systems of storage and use of dung

Direct N_2O emissions from systems of storage and use of dung, thousand tons	2011	2015	2020	2025	2030
Cattle	5,95	7,02	7,79	8,49	9,25
Dairy cattle	4,28	4,82	5,14	5,41	5,69
Non-dairy cattle	1,67	2,20	2,66	3,09	3,56
Seep and goats	2,59	2,89	3,34	3,78	4,25
Camels	0,00	0,00	0,00	0,00	0,00
Horses	0,33	0,35	0,43	0,50	0,59
Swines	0,96	1,00	1,09	1,21	1,33
Poultry	0,63	0,70	0,82	0,94	1,00
Total	**10,50**	**11,95**	**13,48**	**14,92**	**16,42**

Sources: NURIS

Rise cultivation

In regard to rise cultivated areas, it is supposed that in spite of population growth and, consequently, demand for this product, due to the irrigation water deficit, and also competition on the part of most profitable cultures, the extension of rise cultivation areas will be limited. In this regard the current growth rates are extrapolated quantitative in BAU scenario by 2026, when the total cultivation area of this culture is approximately fixed at the level of 1990. After this period it is supposed that rise area will remain constant at the level of 120 thousand hectares

Table 5.29

Rise cultivation area

Index	1995	2011	2015	2020	2025	2030
Rise cultivation area, thousand ha	96,0	93,0	100,0	109,3	118,6	120,0

Sources: NURIS

Agricultural lands

Emissions from agricultural tillage, including nitrogen compounds emissions from additional feeds of nitrogen into the ground, were calculated in assumptions, mentioned in table 5.30.

Table 5.30

Key assumptions in calculations of emissions from agricultural lands

Indicator	Assumptions
Synthetic mineral fertilizers	Specific volumes of synthetic fertilizers apllication have been increasing on the average for all cultivated area according to the current historical trend since 2001.
Organic fertilizers	Organic fertilizers do not show any expressed dynamics. As the contribution of organic fertilizers to N_2O emissions is not sustainable, fixed average value of organic fertilizers application per 1 ha of cultivated grounds for 10 years were used as a basis of calculations.
Crop and root residues	Forecast of crop residue volumes was made on the basis of crop residues per 1 ha of area, because it was impossible to forecast the structure of the area under crop. Such an approach indirectly supposes that: • structure of the area under crop will remain at the level of averaged area for last ten years; • yielding capacity of main cultivated cultures will remain the growth trend according to dynamics of the historical period under consideration.

Sources: NURIS

Results of made calculation of predicted emission values are presented in table below.

Table 5.31

Nitrogen emissions from agricultural lands

N_2O emssions from cultivated lands, thousand tons	1995	2011	2015	2020	2025	2030
Direct emissions	1,94	4,28	4,35	5,20	6,11	7,08
Synthetic nitrogen fertilizers	0,31	0,34	0,55	0,67	0,81	0,95
Organic fertilizers	0,06	0,06	0,01	0,01	0,01	0,01
Crop residues	1,56	3,89	3,79	4,51	5,29	6,12
Emissions of dung, left on pastures and grazing lands	11,63	10,20	12,13	14,16	16,05	18,12
Indirect emissions	0,04	0,05	0,07	0,08	0,10	0,11
Total	**13,61**	**14,57**	**16,54**	**19,44**	**22,26**	**25,32**

Sources: NURIS

Generally by 2030 dinitrogen monoxide emission volume will increase by 68% due to areas growth (39%) and cattle stock growth, including grazed cattle.

Calculation of specific emissions from nitrogen fixing crops is not produced according to the remark 2 in the Chapter «11.2.1 N_2O direct emissions» of the IPCC Guidelines [16].

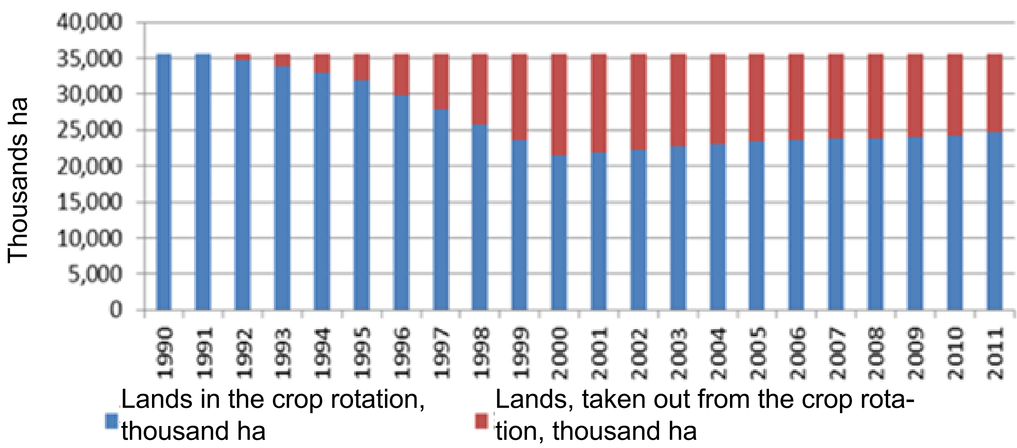
Particularly, biological nitrogen fixation is not considered as the direct source of N_2O in consequence of absence of substantial emissions evidence, which generate as a result of fixing itself. According to the greenhouse gas inventory data for the period from 1990 to 2011, nitrogen contribution of biological fixation is equal to 0.3% of total direct nitrogen emission from agricultural lands.

As for crop residues, then due to failure to make accurate forecast of the structure of land under crop for agricultural plants, this structure is supposed to be fixed.

In 90s of the last century substantial land areas were introduced to land reserves without conversion. Further, these lands were again introduced to crop rotation, in this regard it is supposed in calculations that increase in lands under crop takes place generally by means of repeat introduction to land reserve rotation according to the historical trends of the period from 2001 to 2011. According to these calculations the area under crop of agricultural plants will increase by 39% by 2030.

Figure 5.14

Dynamics of introduction to land reserve rotation. Lands, which are taken out the crop rotation during 90s of XX century



Sources: NURIS

The average yielding capacity of agricultural crops have been increasing gradually for last 10 years, which is related to more and more wide introduction of saving technologies, although it is difficult to make accurate assessment of such a growth due to the strong influence of weather conditions on yielding capacity values. As the structure of lands in section of crops is supposed to be fixed, and crop yielding capacity is extrapolated linearly during the period from 2012 to 2030, «nitrogen yielding capacity» can also be represented by the linear function of time $N_{(T)}$ (t)=$K_{(T)}$·Yielding capacity$_{(T)}$ (t)=a $_{(T)}$·t+$b_{(T)}$. The average «nitrogen yielding capacity» from crop residues is also the linear function of time that is easy to prove by the following transformations:

Regressive estimations of A and B parameters gives the values:A= 0.257379, B= -509.217838 with determination coefficient R^2=0.43, that reflects the volatility of yielding capacity values due to dependence of yields on weather conditions.

5.2.7. Land use, land-use change and forestry (LULUCF)

Table 5.32

Historical data on emissions from land use, land-use change and forestry sectors

	Historical data				
	1990	1995	2000	2005	2011
LULUCF (CO_2)	-2167,0	-7300,3	-10123,7	-2863,7	-3094,7
Forestry	-1774,7	-4374,3	-5569,7	-2845,3	-3215,7
Plough lands	-11,0	128,3	128,3	106,3	0,0
Pasture lands	-381,3	-3054,3	-4682,3	-124,7	121,0
LULUCF (CH_4)	0,3	7,0	4,4	4,4	0,8
Forestry	0,3	7,0	4,4	4,4	0,8
LULUCF (N_2O)	0,1	2,1	1,3	1,3	0,2
Forestry	0,1	2,1	1,3	1,3	0,2
Total	-2166,6	-7291,3	-10118,0	-2858,0	-3093,6

Sources: NURIS

Area of Kazakhstan lands is equal to 272,490.2 thousand hectares, whereof 70% is used generally as forage reserve for cattle breeding.

The most important changes of land use of last half a century occurred in 50-60s of XX century during the mass reclamation of virgin lands, when the area of tilled lands increased in more than 2.5 times in short terms. Further by 90s there were no substantial changes in land use.

Economy crisis of 90s after the USSR breakup was accompanied by substantial reduction of cultivated areas, haloxylon deserts, and perennial plantings, degradation of hayfields and pastures, which was attended by substantial changes in carbon reserves.

According to the data of National Report [1], the main key categories of quantitative assessment of carbon reserves are:

- pastures (natural and improved) – 182,070 thousand hectares,
- plough, fallow and perennial plantings –35,771.8 thousand hectares,
- forest and tree and shrubbery plantings – 14,333.3 thousand hectares,
- hayfields (natural and improved) – 5,172 thousand hectares.

Calculated forecasting values of emissions from LULUCF sectors are represented in table below:

Table 5.33

Forecasts for emissions from land use, land-use change and forestry sectors

	Scenario with measures				Scenatio with additional measures			
	2015	2020	2025	2030	2015	2020	2025	2030
LULUCF (CO_2)	-3256,8	-3231,3	-3205,,8	-3180,3	-3256,8	-3231,3	-3205,8	-3180,3
Forestry	-3557,2	-3576,6	-3595,9	-3615,3	-3557,2	-3576,6	-3595,9	-3615,3
Plough lands	-30,7	-30,7	-30,7	-30,7	-30,7	-30,7	-30,7	-30,7
Pasture lands	331,0	375,9	420,8	465,7	331,0	375,9	420,8	465,7
LULUCF (CH_4)	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3
Forestry	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3
LULUCF (N_2O)	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3
Forestry	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3
Total	-3255,3	-3229,7	-3204,2	-3178,7	-3255,3	- 3229,7	- 3204,2	- 3178,7

Sources: NURIS

Forestry

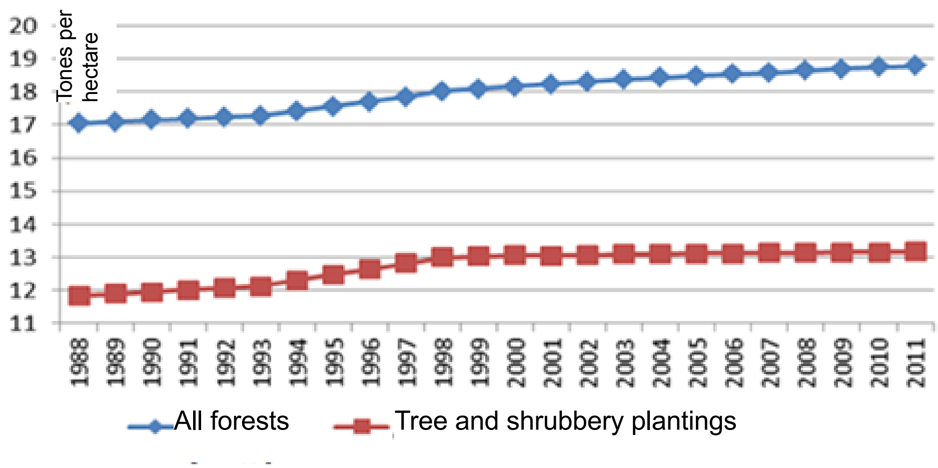
For last 25 year the forest areas of Kazakhstan have not substantially changed in terms of increase. Reduction by 7% for soft-wood forest was observed in the structure of forest areas, while forest areas of other type have increased. The most rates of growth gain were in haloxylon desert areas – its area has been increased from 4.8 million hectares to 6.1 million hectares for 25 years.

Generally the total area of forests has been increased by 75 thousand hectares or 2% for the mentioned period, while afforestation area remains stable over last years.

Calculation of carbon pickup forecast is based on the assessment of forest area and specific carbon reserves in term of area unit. The biggest growth of carbon reserves was observed during the period from 1995 to 1998 that is related to the growth of timber reserves in young forests, which maximum planted areas were observed in the end of 80s at the beginning of 90s.

Figure 5.15

Specific carbon content



Sources: NURIS

During the last decade the rates of carbon reserve increment have slowed down that is related to finishing ripeness of young forest. The current rates of specific carbon content increment have remained for last 13 years, and, probably, will remain in future both by means of growth of current timber biomass and new plantings.

Table 5.34

Carbon pickup by forests and tree and shrubbery plantings

Charaterictic of forest areas	1995	2011	2015	2020	2025	2030
Forest area, thousand ha	13 993	14 139	14 176	14 224	14 271	14 318
Carbon content in forest areas, tons / ha	18	19	19	19	20	20
Carbon reserves in forest areas, thousand tons	245 722	265 679	269 736	274 617	279 524	284 457
Area of tree and shrubbery plantings, thousand ha	239	211	211	211	211	211
Carbon content in tree and shrubbery plantings, tons / ha	12	13	13	13	13	13
Carbon reserve in content in tree and shrubbery plantings, thousand tons	2 982	2 775	2 785	2 796	2 807	2 819
Gross carbon pickup in CO_2 equivalent, thousand tons	4 374	3 228	3 576	3 595	3 615	3 634

Sources: NURIS

It is rather difficult to forecast greenhouse gas emissions during forest fires, because they depend strongly on weather conditions and other factor of each certain year, except taken measures on fire liquidation.

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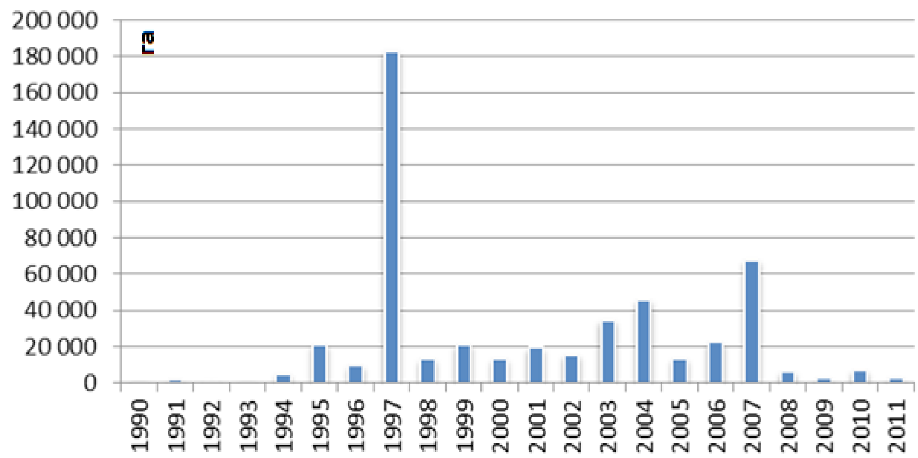
Figure 5.16

Area of forest fires, hectares



Sources: NURIS

Table 5.35

Emissions from forest fires

Forest fires	1995	2011	2015	2020	2025	2030
Fire area, ha	20500,000	2400,000	4225,000	4225,000	4225,000	4225,000
CO_2 emissions, thousand tons	96,500	11,300	18,800	18,800	18,800	18,800
CH4 emissions, thousand tons	0,330	0,040	0,060	0,060	0,060	0,060
CH4 emissions in CO_2 equivalent, thousand tons	6,930	0,840	1,310	1,310	1,310	1,310
N_2O emissions, thousand tons	0,007	0,001	0,001	0,001	0,001	0,001
N_2O emissions in CO_2 equivalent, thousand tons	2,058	0,241	0,273	0,273	0,273	0,273
Total emissionsin CO_2 equivalent, thousand tons	**105,5**	**12,4**	**20,4**	**20,4**	**20,4**	**20,4**

Sources: NURIS

Table 5.36

Forecast of greenhouse gas emission (pickup)from the forestry sector (scenario with current measures)

Gases	1990	2000	2005	2011	2015	2020	2025	2030
CO_2, thousand tons	-1 774,67	-5 569,67	-2 845,33	-3 215,67	-3 557,18	-3 576,55	-3 595,91	-3 615,28
CH_4, thousand tons of CO_2 equivalent	0,35	4,39	4,39	0,82	1,31	1,31	1,31	1,31
N_2O, thousand tons of CO_2 equivalent	0,10	1,30	1,30	0,24	0,27	0,27	0,27	0,27
Total	**-1 774,22**	**-5 563,98**	**-2 839,64**	**-3 214,61**	**-3 555,59**	**-3 574,96**	**-3 594,33**	**-3 613,70**

Sources: NURIS

Plough

According to FAO [18], the area of saving technologies application has been increased in 3 times for the last 5 years. During detailed consideration of zero technology expansion in Canada [19] the researchers point out an «explosive» territory growth of technological expansion after the certain accumulation of knowledge about it and its practical application. Maybe, this effect will take place in Kazakhstan, because adoption of these technologies allows increasing the yielding capacity of crops by the range from 25 to 30%. But this will take some time, because transition from traditional to zero technology is rather difficult and requires vast investments.

According to the chapter 5.2 of IPCC Guidelines [16], carbon dioxide emissions due to carbon losses from the category of plough lands are to be calculated only for areas with perennial plants, including single crops. Growth in biomass reserve of annual crops only per one year is taken to be equal to biomass losses from provisions and death in the same year. Thus, there is no resulting accumulation of biomass carbon.

Area of perennial plantings began to reduce intensively in virtue of own inertia in comparison with annual crops at the beginning of 2000s. According to the current information, the fastest rates of area reduction and its formal conversion into fallow lands took place during the period from 2000 to 2005. During this period the used area as intended has reduced almost in three times, whereupon some recovery outlines.

Quality of data about this land category does not allow making any assessments of area recovery rates with certainty. Area expansion for perennial plantings is seen more probable, but it is difficult to assess it quantitatively at this moment. In this regard the average rates for the period from 2005 to 2011 were saved as assumptions in relation to possible expansion of these areas.

Carbon reserves in biomass were calculated using data on biomass (carbon) content for other threes on the basis of these assumptions by analogy with these calculations within the National Report [1]. Results of calculations, provided in table below, demonstrated the annual average carbon absorption in biomass reserves of perennial plantings by means of its area expansions in the amount of 30.7 thousand tons of CO2 equivalent per year

Table 5.37

Carbon emissions from plough lands

Carbon emissions from plough lands	1995	2011	2015	2020	2025	2030
Area of perennial plantings, thousand ha	144,2	54,5	60,3	67,6	74,9	82,2
Carbon amount in biomass of perennial plantings, thousand tons	1 037,4	660,2	693,7	735,6	777,4	819,3
Carbon emissions in CO_2 equivalent, thousand tons	-128,3	0,0	-30,7	-30,7	-30,7	-30,7

Sources: NURIS

Table 5.38

Forecast of CO_2 emissions from the plough land sector (scenario with current measures)

Gases	1990	2000	2005	2011	2015	2020	2025	2030
CO_2, thousand tons	-11,00	128,33	106,33	0,00	-30,70	-30,70	-30,70	-30,70

Sources: NURIS

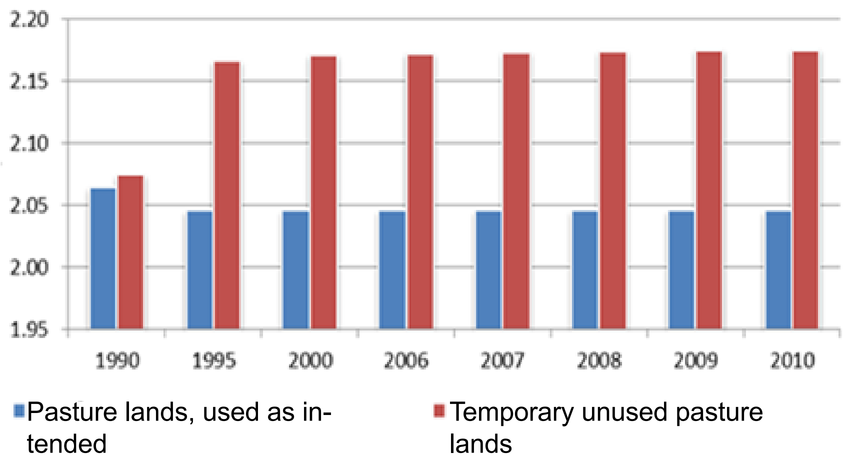
Pasture lands

Total area of all (including temporary unused) pasture lands has been changed slightly since 90s of previous century. According to the National Report [1] in 90s of XX century,the substantial number of pasture lands was put on the reserve category of temporary unused or other lands, which part was returned to the initial category later during the period from 2000 to 2010.

Decrease in anthropogenic load on ranchlands, which is related to the crisis of 90s, promoted the recovery and preservation of pasture land biomass, and as consequence 12 million tons of carbon were absorbed by pasture lands during the period from 1990 to 2000.

Figure 5.17

Biomass carbon content per 1 ha of pasture lands, Tons / ha



Sources: NURIS

Since the beginning of 2000s the recovery of livestock has led to the renewal of anthropogenic load in pasture lands and gradual return of temporary unused ranchlands, put on the reserve. Since 2008 biomass losses of pasture land had renewed and were equal to 121 thousand tons of CO_2 equivalent.

Table 5.39

Change of biomass carbon reserves of pasture lands

Change of biomass carbon reserves of pasture lands, thousand tons C	1995	2011	2015	2020	2025	2030
Pasture lands, used as intended, thousand tons of C	-	582	2 920	2 920	2 920	2 920
Temporary unused pasture lands, thousand tons of C	-	- 615	-3 010	-3 023	-3 035	-3 047
Total change of biomass carbon reserves, thousand tons of C	833	- 33	- 90	- 103	- 115	- 127
Total in CO_2 equivalent, thousand tons	**-3 054**	**121**	**331**	**376**	**421**	**466**

Sources: NURIS

The extrapolation of the following trends is the basis of assessment of emissions from pasture land category:

- return of temporary unused pasture lands, which are put on reserves, takes place with stable rates at the level of 1,428 thousand ha per year for 2006–2011;
- carbon content in biomass per 1 ha of pasture lands, used as intended, remains stable at the level of average values for the period from 2000 to 2011 (2.045 tons / ha);
- carbon content in biomass per 1 ha of temporary unused pasture lands will increase by 0.77% by 2030 according to the current trends.

Table 5.40

Forecast of CO^2 emissions from pasture land sector (scenario with current measures)

Gases	1990	2000	2005	2011	2015	2020	2025	2030
CO_2, thousand tons	-381,33	-4 682,33	-124,67	121,00	331,04	375,93	420,81	465,70

Sources: NURIS

5.2.8. Wastes

Table 5.41.

Historical data of greenhouse gas emissions from the waste sector

	Historical data				
	1990	**1995**	**2000**	**2005**	**2011**
Waste (CO_2)	0,0	0,0	0,0	0,0	5,0

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	Historical data				
	1990	**1995**	**2000**	**2005**	**2011**
CO_2 emissions, related to combustion of medical waste	0,0	0,0	0,0	0,0	5,0
Waste (CH_4)	2351,6	2675,2	2774,9	3037,8	3572,4
Methane emissions from domestic solid waste dumping	2351,6	2675,2	2774,9	3037,8	3572,4
Waste (N_2O)	388,6	431,7	319,7	435,1	489,6
N_2O emissions from sewage of human life and activities	388,6	431,7	319,7	435,1	489,6
Total	**2740,2**	**3106,9**	**3094,6**	**3473,0**	**4067,0**

Sources: NURIS

Table 5.42

Forecast of greenhouse gas emissions from the waste sector

	АШС				ҚШС			
	2015	**2020**	**2025**	**2030**	**2015**	**2020**	**2025**	**2030**
Waste (CO_2)	5,8	7,0	8,2	9,6	5,8	7,0	8,2	9,6
CO_2 emissions, related to combustion of medical waste	5,8	7,0	8,2	9,6	5,8	7,0	8,2	9,6
Waste (CH_4)	4004,0	4574,0	5182,0	5727,0	0,0	0,0	0,0	0,0
Methane emissions from domestic solid waste dumping	4004,0	4574,0	5182,0	5727,0	0,0	0,0	0,0	0,0
Waste (N_2O)	550,9	591,2	631,5	671,8	550,9	591,2	631,5	671,8
N_2O emissions from sewage of human life and activities	550,9	591,2	631,5	671,8	550,9	591,2	631,5	671,8
Total	**4560,7**	**5172,1**	**5821,6**	**6408,4**	**556,7**	**598,1**	**639,6**	**681,4**

Sources: NURIS

Methane emissions due to domestic solid waste dumping

The forecast of methane emissions due to domestic solid waste dumping is represented here.

Product of urban population number by annual average municipal waste generation per capita was used for the calculation of total amount of generated annual SMW (solid municipal waste).

Population number for the period from 2008 to 2012 was taken from the web-site of Agency of Statistics of the Republic of Kazakhstan [2].

Forecast of urban population number was got by the extension of the linear trend up to 2030 (refer to table below).

Historical data on average municipal waste generation per capita per day (year) and MSWf, MCF, DOC, DOCf, F and OX parameters were taken from the report of Zhasyl Damu JSC [1].

Table 5.43

Forecast of methane emissions from SMW dumping

Name of index	2011	2015	2020	2025	2030
Urban population, at the year-end, million people.	9,115	9,729	10,498	11,267	12,036
Waste / citizen, kg per day	0,81	0,85	0,9	0,95	1
Total waste, million tons per year	2,695	3,018	3,448	3,907	4,393
Methane emissions, million tons	0,17	0,191	0,218	0,247	0,277
CO_2 equivalent, million tons	3,575	4,004	4,574	5,182	5,727
CO_2 equivalent, acccording to Zhasyl Damu JSC	3,572	-	-	-	-

Sources: NURIS

N_2O emissions from sewage of human life and activities

Sewage of human life and activities are the emission category with low-level control. In this regard the number of emission from this waste category can be essentially reduced by sewage clearing and increase in control over compliance with rules of run-off arrangement.

Estimations of N_2O emissions are given in table below.

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Table 5.44

Forecast of N_2O emissions from sewage of human life and activities

Index	2011	2015	2020	2025	2030
Average annual number of population, million people	16,559	17,604	18,891	20,179	21,466
Protein, kg / person / year	37,96	40,15	40,15	40,15	40,15
Nitrogen share in protein	0,16	0,16	0,16	0,16	0,16
Emission ratio	0,01	0,01	0,01	0,01	0,01
Ratio of N_2O-N convertion into N_2O	1,571	1,571	1,571	1,571	1,571
N_2O, tons	1 580	1 777	1 907	2 037	2 167
EGR	310	310	310	310	310
Tons of CO_2 equivalent.	489 918	550 904	591 187	631 470	671 754
Tons of CO_2 equivalent, Zhasyl Damu JSC	489 570	-	-	-	-

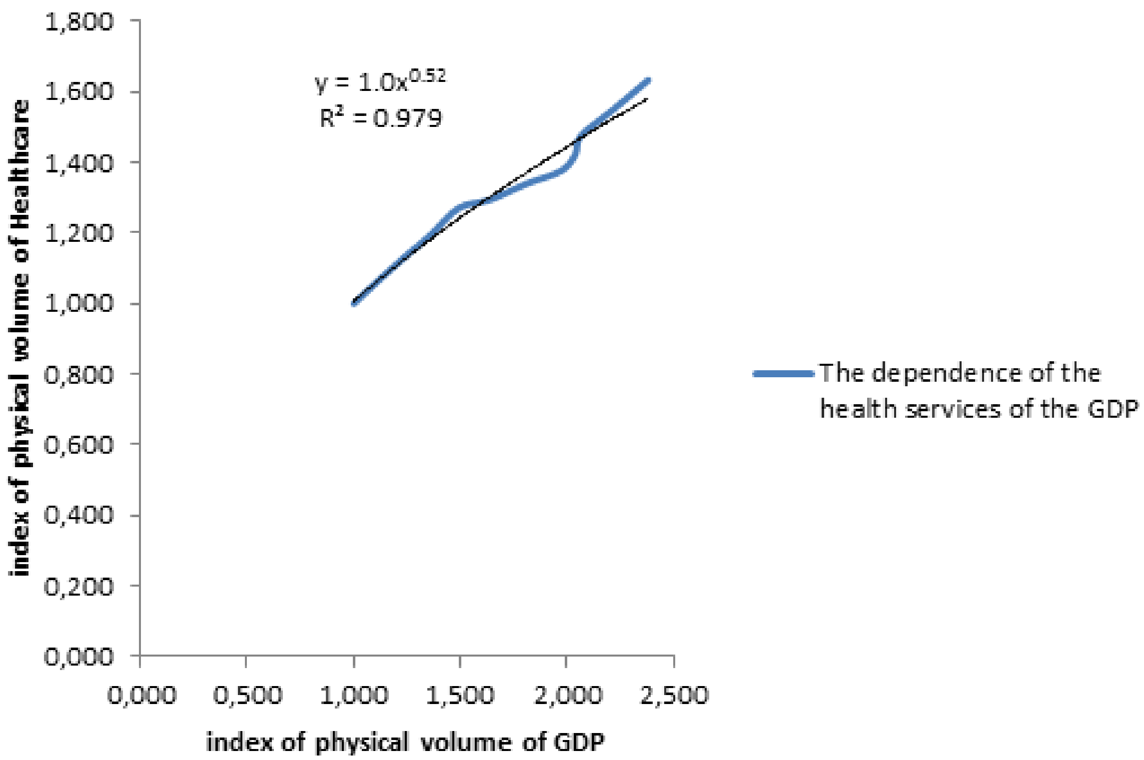
Sources: NURIS

CO_2 emissions, which are related to combustion of medical waste

Data on combustion of medical waste for 2011 was taken from Zhasyl Damu JSC report [1] and it was extrapolated by2030 using elasticity of the index of actual volume (IAV) of gross healthcare value added in relation to GDP of the Republic of Kazakhstan. The elasticity for 2000-2011 was calculated on the basis of the statistics data of the Agency of Statistics of the Republic of Kazakhstan and equal to 0.52.

Figure 5.18

Dependence of healthcare services on GDP



Sources: NURIS

Table 5.45

Forecast of medical waste generation

	2011	2015	2020	2025	2030
Index of physical volume of GDP	1	1,311	1,838	2,46	3,292

Sources: NURIS

According to the scenario with current measures the level of emissions of 1990 will be reached in 2020, but if to take additional measures, which are predicated in the present work (including Emission Trading Scheme with a price of 10 $ per ton of CO_2 and measures on development of nuclear, wind and solar energy industry), then the level of 1990 will be reached later – in 2030.

5.3. Estimation of total effect of policies and measures on greenhouse gas emission reduction

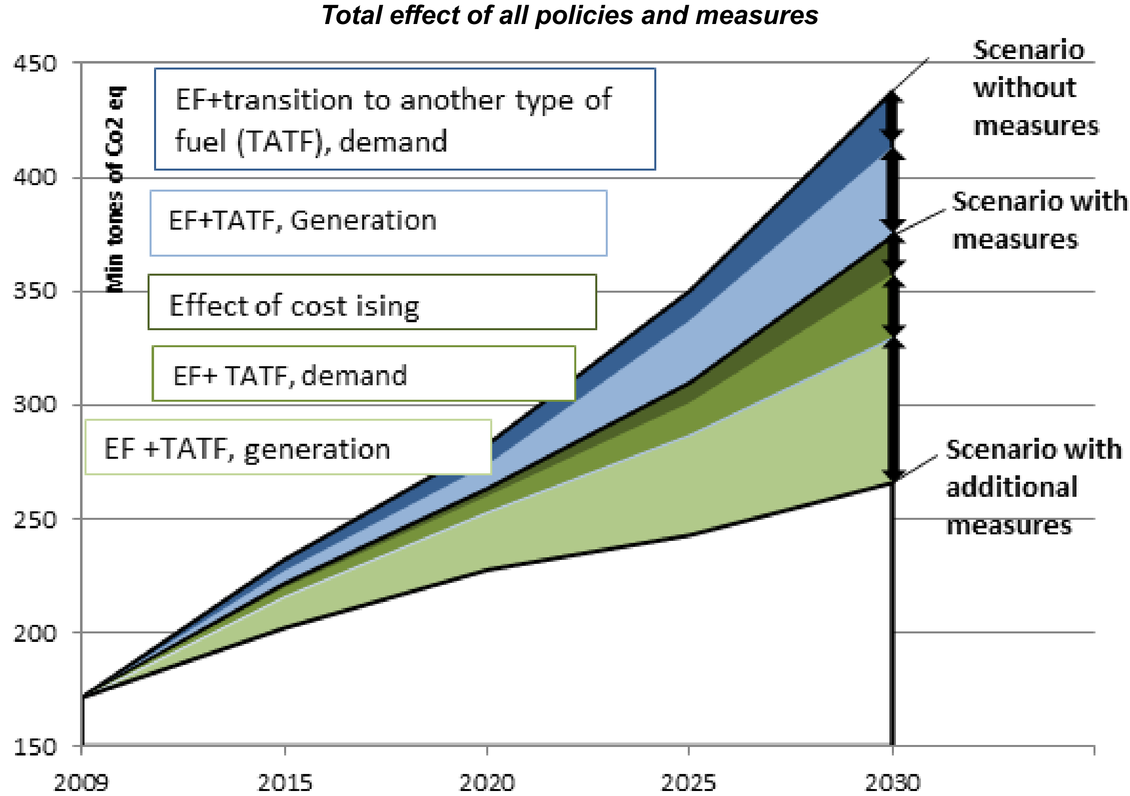
The accordance of two components of currently provided emission reduction strategy is considered in this section, which are: three scenarios of greenhouse gas emissions and list of policies and measures. The both components were developed according to the basic elements of the reduction strategy:

- Adoption of more efficient technologies; in the energy sector it is related to all generating technologies, and also to all energy consuming equipment, which transforms energy into final forms of energy;
- Transition from fuel and energy resources with high or average carbon content to resources with low or zero content in the energy system;
- Transition of private consumer from more energy intensive services to less energy intensive services without decrease in service quality.

On the basis of these strategy elements the potential influence of each policy and measure was estimated using simple methods with detailed «bottom-up» approach, as it has been explained in Section IV.C. Complex technical and economic model of energy system was calculated basing on the same elements for calculation of three scenarios of greenhouse gas emissions. Emission difference between the scenario without measures (WOM) and scenario with measures (WM) shows the full effect of the current (and economically efficient) policies and measures. Difference of greenhouse gas emissions between the scenario with measures (WM) and scenario with additional measures (WAM) shows the full effect of additional policies and measures.

Figure 5.19

Total effect of all policies and measures



Sources: NURIS

Effect of policies and measures of both sectors of consumption and supply is divided depending on the influence of different factors (figure 5.19). Method provides the theoretical and numerical conformance between technical and economic aspects of three scenarios and all policies and measures.

According to figure 5.19 the economically efficient technological measures can reduce greenhouse gas emissions by 65 million tons of CO_2 equivalent, 25 million tons of CO_2 equivalent with measures in the consumption sector and 40 million tons of CO_2 equivalent in the energy generation sector. Additional policies and measures, which become economically efficient in adoption of tax in amount of 10 US dollars per one ton of CO_2 equivalent as of 2020, can potentially reduce emissions almost by 110 million tons of CO_2 equivalent. Growth of prices for fuel and energy resources according to the estimated price for CO_2 will directly influence on the reduction of the final energy consumption and can reduce emissions by more than 15 million of CO_2 equivalent. Other policies and measures of the consumption sector can potentially reduce emissions almost by 30 million tons of CO_2 equivalent; the most influence of policies and measures will appear in the energy generation sector, and can be equal to more than 60 million tons of CO_2 equivalent.

It is noteworthy that the aggregated effect of policies and measures, as it was indicated in figure 5.19 earlier, is slightly smaller than the whole amount of influence, estimated in the subsection 4.5. It is caused by the difference of applied methodology. Potential of certain measures on emission reduction does not take into account combinations of different measures and policies. For example, potential of greenhouse gas emission reduction will be lower during simultaneous use of more efficient boilers for heating of premises with the measure on energy efficiency improvement of inhabited buildings than during its consideration as a separate measure. At another point the method, which is used for assessment of the aggregated policies and measures, takes into account the system effect and excludes interference and double accounting, and it is a theoretical assessment. Although methodology on the technical and economic basis provides the logical coherence, we can observe results differing from provided forecasts in practice after years.

If key initiative variables change after years otherwise as it has been supposed, then scenarios of greenhouse gas emissions and influence of policies and measures will also change. Although some policies and measures are mandatory by virtue of law, its execution can be problematic. Efficiency of each policy and measure in real achievement of target technological and goods changes can differ from the expected one. Moreover, the social and political development of the country towards stable market-based economy can continue more than it is expected. In accounting of systemic effect the total effect of policies and measures can be lower than total effect of certain policies and measures. That’s why it is recommended to make revision of scenarios, policies, measures and its compatibility against each other.

According to the Kyoto Protocol, Kazakhstan has obligations not to exceed the quantity of greenhouse gas emissions to atmosphere - 7% level of 1990 by 2020.

If to look at the diagrams of scenarios (figure 5.2), we can see that only one scenario with additional measures of all four scenarios fits in the requirements of the Kyoto Protocol.

VI. ASSESSMENT OF VULNERABILITY, CLIMATE CHANGE IMPACT AND ADAPTIVE MEASURES

6.1. Scenarios of climate change and expected impact

Results of coupled atmosphere-ocean general circulation models (CAOGCM), which were used for the preparation of the Third Assessment Report of the Intergovernmental Panel on Climate Change (AR3, IPCC, 2001), were also used for vulnerability assessment in the Second National Communication during the development of scenarios of climate changes (SNC of the Republic of Kazakhstan, 2009). An essential improvement of CAOGCM as a model class has taken place after AS3 publication. Spatial resolution of CAOGCM has substantially increased that allows reproducing small scale events more accurate. At this moment the increase of spatial resolution has changed from 5° to 0.5°.

A model ensemble (15 models) of the new generation CMIP3project, which was used during the preparation of the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (AR4, IPCC, 2007), was also used in this research in development of scenarios of possible climate change in Kazakhstan. Average monthly, average annual and average seasonal three-dimensional fields of change of air temperature and precipitation amount were obtained according to the chosen ensemble of models. Changes are calculated in relation to the period from 1961 to 1990,which are used by IPCC as a basis. Average areal assessments of temperature and precipitation amount change were made both for all the territory of Kazakhstan and its 14 regions.

Possible future climate changes were calculated for three main scenarios of increase in greenhouse gas concentration - SRES (IPCC Special report on emission scenarios):A2, A1B and B1 and for three temporary periods: from 2016 to 2045, from 2036 to 2065, from 2071 to 2100 – years characterizing possible climate changes in Kazakhstan by 2030, 2050 and 2085 in relation to the basis period from 1961 to 1990.

All CMIP3 models predicate climate warming for all scenarios under consideration in the territory of Kazakhstan in XXI century, as indicated in table 6.1 and in figure 6.1. The smallest changes of air temperature and precipitation amount will take place according to B1 scenario, the biggest – according to A1B scenario of three considered scenarios in the first half of current century; the biggest changes will take place according to A2 scenario in the second half of XXI century.

Table 6.1

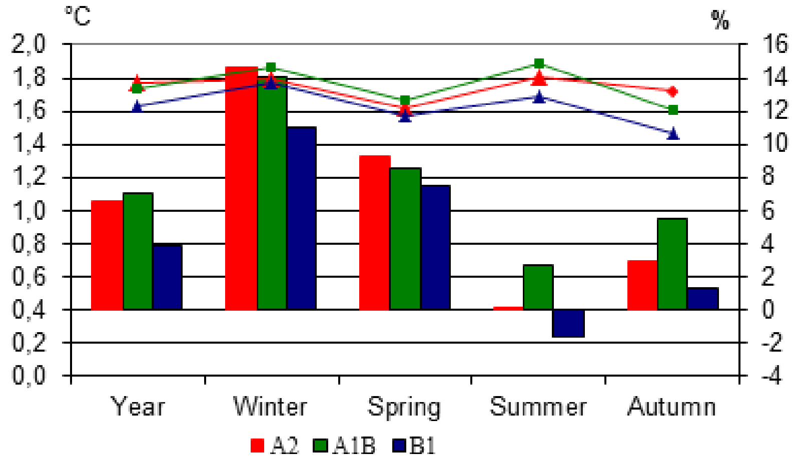
Changes of average annual temperature of ground air and relative standard deviations (°C) at the beginning (from 2016 to 2045), in the middle (from 2036 to 2065) and at the end (from 2071 to 2099) of 21st century (B1, A1B, A2 scenarios). The sub-index shows the standard deviation for model ensembles characterizing the inter-model scatter

Region	Period								
	From 2016 to 2045			From 2036 to 2065			From 2071 to 2099		
	B1	A1B	A2	B1	A1B	A2	B1	A1B	A2
Kazakhstan	$1,6_{\pm}$	$1,7_{0,4}$	$1,8_{\pm}$	$2,1_{\pm}$	$2,9_{\pm}$	$2,6_{0,5}$	$2,7_{\pm}$	$4,1_{\pm}$	$4,7_{\pm}$
Akmola	1,8	1,9	1,9	2,3	3,3	2,8	2,8	4,4	5,2
Aktobe	1,6	1,7	1,9	2,1	3,0	2,6	2,8	4,2	4,6
Almaty	1,6	1,7	1,7	2,0	2,8	2,6	2,6	4,0	4,6
Atyrau	1,6	1,7	1,7	2,0	2,7	2,5	2,7	3,8	4,4
East Kazakhstan	1,6	1,8	1,8	2,1	2,8	2,7	2,8	4,2	4,9
Zhambyl	1,5	1,7	1,7	1,9	2,7	2,6	2,5	3,,9	4,5
West Kazakhstan	1,7	1,8	1,8	2,1	2,9	2,6	2,9	4,0	4,7
Karaganda	1,6	1,8	1,8	2,1	3,0	2,7	2,6	4,3	4,6
Kostanay	1,8	1,8	1,9	2,3	3,2	2,8	2,9	4,5	5,1
Kyzylorda	1,5	1,6	1,7	2,0	2,8	2,5	2,5	3,9	4,3
Mangistau	1,4	1,6	1,5	1,9	2,5	2,2	2,4	3,5	4,0
Pavlodar	1,9	1,9	1,9	2,3	3,3	2,9	2,9	4,4	5,3
North Kazakhstan	1,8	1,7	1,9	2,5	3,3	2,9	3,0	4,5	5,4
South Kazakhstan	1,5	1,6	1,7	1,9	2,7	2,5	2,4	3,8	4,4

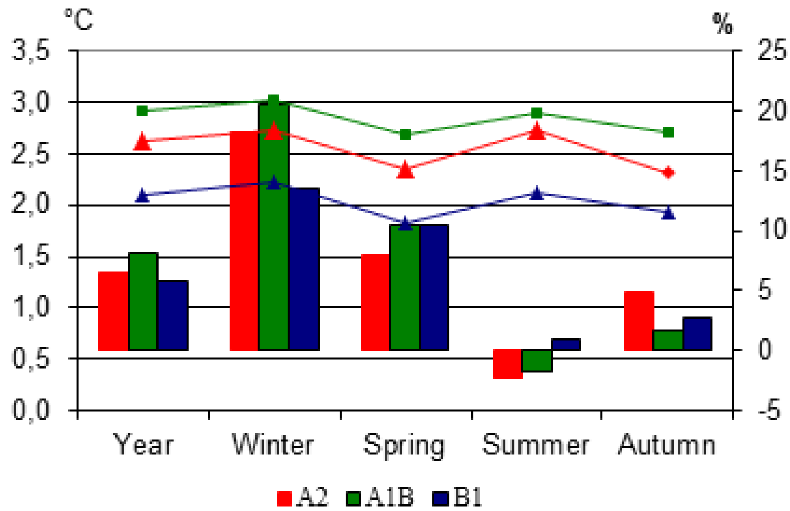
Figure 6.1

Change of average annual and average seasonal temperature of ground air (°C)and preciptiation amount (%) in the territory of Kazakhstan during the periods from 2016 to 2045, from 2036 to 065 andfrom 2071 to 2099 in relation to the basic period from 1961 to1990, obtained upon the enseble of 15 models of CMIP3 global climate project according to B1, A1B and A2 scenarios of change of greenhouse gas concentration in atmosphere

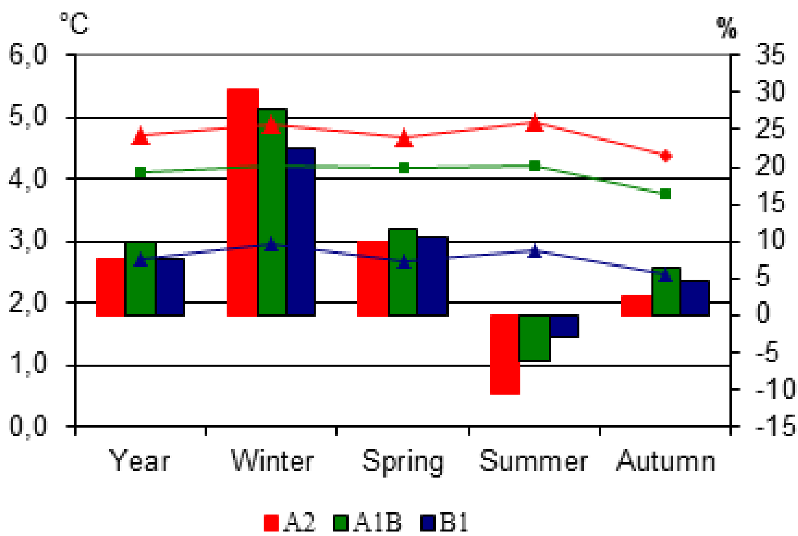
A)



B)



C)



A) from 2016 to 2045 (2030); B)from 2036 to 2065 (2050); C) from 2071 to 2099 (2085)

CHAPTER VI

Table 6.1 and figure 6.1 demonstrate that change of average annual air temperature is increasing in all scenarios of climate change and during all periods under investigation. The biggest increase in the average annual air temperature is expected in North Kazakhstan, Pavlograd, Kostanay, Amola regions. The smallest increase of average annual air temperature is expected in Mangistrau, Kyzylorda, South Kazakhstan and Zhambyl regions. According to A1B scenario of greenhouse gas emissions change of average annual ground air temperature will be equal to 1.7˚C (with range from 1.4 to 2.0 C) by 2030, to 2.9˚C (with range from 2.0 to 3.0˚C) by 2050, and to 4.1˚C (with range from 2.9 to 4.8 C) by 2085 in Kazakhstan.

According to B1scenario, which is the mildest scenario, change of average annual ground air temperature will be equal to 1.6˚C (with range from 1.3 to 2.0˚C) by 2030, to 2.1˚C (with range of from 1.4 to 2.9˚C) by 2050, and to 2.7˚C (with range from 2.1 to 3.2˚C) by 2085 in Kazakhstan.

According to A2 scenario, which is the hardest scenario, change of average annual ground air temperature will be equal to 1.8˚C (with range of from 1.2 to 2.0˚C) by 2030, to 2.6˚C (with range from 2.0 to 3.0˚C) by 2050, and to 4.7˚C (with range from 3.5 to 5.6˚C) by 2085 in Kazakhstan.

Results of the model engineering demonstrate that the trend of increasing in temperature of the ground air will remain the same in the XXI century for all three scenarios under consideration. It is expected that ground air temperature of winter months will increase with the fastest rate in the territory of Kazakhstan by 2030: according to B1 scenario by the range from 1.6 to 1.8˚C, according to A1B and A2 scenarios by the range from 1.9 to 2.0˚C, and also in August and September: according to B1 scenario by the range from 1.7 to 1.9˚C, according to A1B and A2 scenario by the range from 1.9 to 2.1˚C and from 1.8 to 2.0˚C respectively.

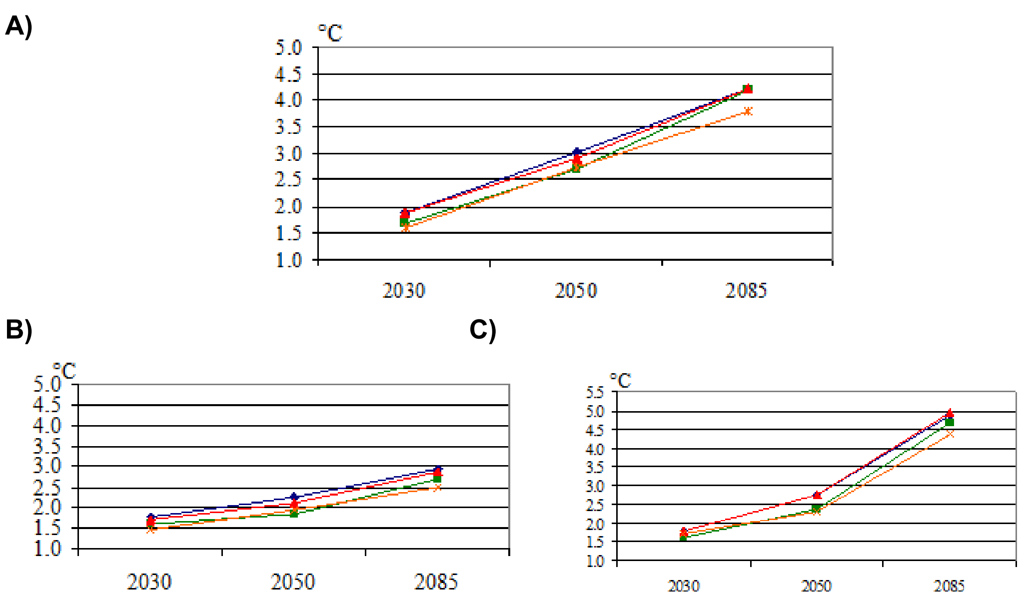
By 2050 the temperature will increase with the fastest rates in January and February, and also in summer time according to A2 scenario (by the range from 2.6 to 2.9˚C), according to A1B scenario in winter time by the range from 2.5 to 3.3˚C and in summer time by the range from 2.5 to 3.2˚C, according to the scenario B1 in winter time by the range from 2.1 to 2.3˚C and in summer time by the range from 2.1 to 2.2˚C.

By 2085 according to A1B scenario the temperature will increase with fastest rates by 4.5˚C in August and by the range from 4.2 to 4.4˚C in winter time, the same trend is expected for two other scenarios.

Expected temperature changes in the seasonal trend are represented in figures 6.1, 6.2 and in table 6.1 as follows. Analysis of obtained scenarios of grid point air temperature changes for different seasons shows balanced temperature increase according to the increase in greenhouse gas concentration, prescribed by the emission scenario. Mean values of expected seasonable air temperature change according to the emission scenarios are presented in figures 6.1 and 6.2. In the territory of Kazakhstan the biggest air temperature increase is expected for winter and summer, and the increase in spring temperatures exceeds summer temperatures in north cropping districts of Kazakhstan – North Kazakhstan, Pavlodar, Kostanay and Akmola regions. The minimal increase in ground air temperature is expected in autumn on all scenarios and during all periods of time.

Figure 6.2

Possible changes of average seasonal air temperature (˚C) in the territory of Kazakhstan for different periods of time according to A2, A1B, B1 scenarios of change of greenhouse gas concentration in atmosphere



A) A1B; B) B1; C) A2

According to A2, B1 and A1B scenarios by 2030 the forecasted change of average annual ground air temperature in the territory of Kazakhstan falls within the range from 1.6 to 1.8˚C.

Decided difference between scenarios has already been marked by 2050. Essential changes are expected in the values of average annual air temperatures during situation development according to A2 scenario. The average annual air temperatures will increase by the range from 3.0 to 3.5˚C in relation to the basis period (from 1961 to 1990) in the most territory of Kazakhstan.

A very big increase in air temperature is forecasted by 2085. The expected change of average annual air temperature in the territory of Kazakhstan will be equal to the range from 2.5 to 3.0˚C according to B1 scenario, to the range from 3.5 to 5.6˚C according to A2 scenario. The biggest warming is forecasted for winter time, in this case, the northern part is, the bigger increase will be.

There is no decisive trend in precipitation amount change in comparison with assessments of possible changes of ground air temperature.

During XXI century the average annual precipitation amounts are mainly increasing, first of all by means of precipitations growth in Pavlodar, East Kazakhstan, Almaty, Zhambyl and Aktobe regions.

Change of annual amount of precipitation, which is averaged in the territory of Kazakhstan, increases in all scenarios of climate change in all periods under consideration.

According toA1B scenario of GHG emissions, change of the average annual amount of precipitation will be equal to 7.0% (with range from 0.1 to 12.0%) by 2030, to 8.1% (with range from 2.6 to 15.1%) by 2050, and to 9.9% (with range from 4.1 to 18.3%) by 2085in Kazakhstan.

According to B1 scenario, which is the mildest scenario, change of average annual precipitation will be equal to 3.9% (with range from 3.8 to 7.4%) by 2030, to 5.7% (with range from 0.8 to 12.7%) by 2050, and to 7.6% (with range from 2.6 to 16.2%) by 2085 in Kazakhstan.

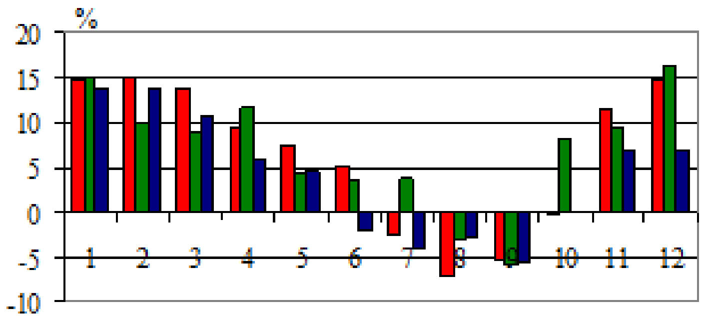
According to A2 scenario, which is the hardest scenario, change of average annual precipitation amount will be equal to 6.6% (with range from minus 0.4 to 13.3%) by 2030, to 6.6% (with range from minus 2.8 to 13.8%) by 2050, and to 7.6% (with range from minus 6.8 to 17.9%) by 2085 in Kazakhstan.

Three-dimensional fields of changes of precipitation amount were obtained according to the chosen model ensemble for the whole territory of Kazakhstan by 2030, 2050, 2085. Possible changes of monthly precipitation amount (%) averaged in the territory of Kazakhstan are presented in figure 6.3 according to A1B, A2, B1 scenarios of change of greenhouse gas concentrations in atmosphere.

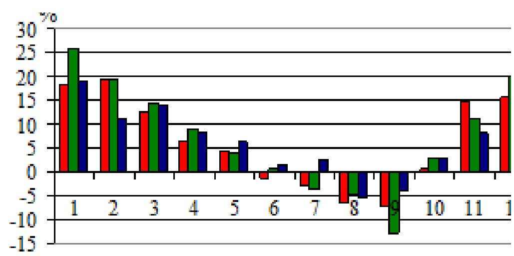
Figure 6.3

Changes of three dimentially averaged annual amounts of precipitations (%) in the territory of Kazakhstan during the periods from 2016 to 2045, from 2036 to 2065 andfrom 2071 to 2099 in relation to the basic periodsfrom 1961 to 1990, obtained by the ensemble of 15 models of CMIP3 global climate project according to B1, A1B and A2 scenariosof changes of the greenhouse gas consentrations in atmosphere

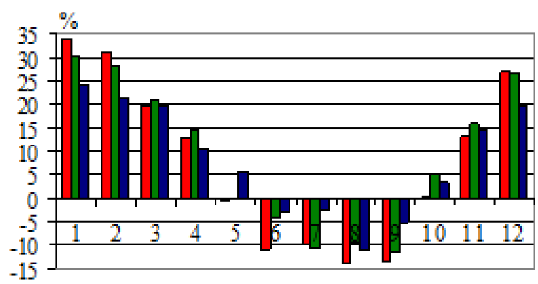
A)



B)



C)



A) from 2016 to 2045 (2030); B)from 2036 to 2065 (2050); C) from 2071 to 2099 (2085)

Results of model engineering demonstrate that it is expected a decrease in precipitation amount for all scenarios under consideration from May to September on the average in the territory of Kazakhstan in XXI century, and it is expected an increase in precipitation amount with a maximum value in winter month for all other months.

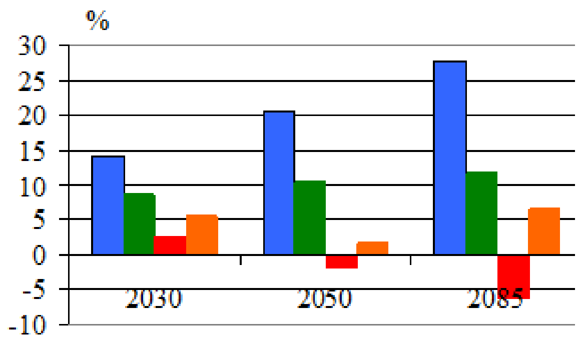
It should be noted the variations by its periods, year seasons and emission scenarios during the consideration of expected changes in the precipitation amount.

According to all emission scenarios and during all periods it is expected an increase of precipitation in winter months by the range from 14 to 28 % according to A1B scenario, by the range from 11 to 22% according to the «mild» B1 scenario, and by 15–31% according to the «hard» scenario. Increase in precipitation amount is also observed in spring and autumn period, but with less increment in comparison with the winter period. In spring months possible increase in precipitation amount is equal to the range from 7.5 to 10.5 % according to B1scenario, to the range from 9.3 to 10.0% according to A2 scenario, to the range from 8.6 to 11.7% according to A1B scenario. In the summer period a gradual decrease in the maximum precipitation amount is observed from 2.7% to minus 6.3% according to A1B scenario by 2085, from minus 1.6% to minus 3.1% according to the «mild» B1 scenario, from 0.2% to 10.6% according to the «hard» scenario.

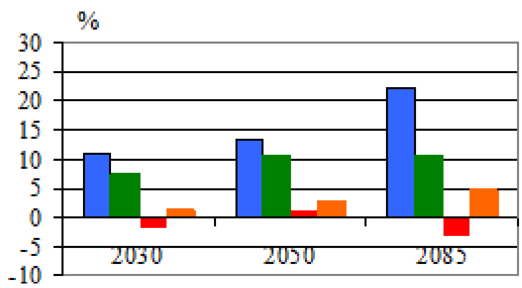
Figure 6.4

Possible changes of average seasonal precipitation amount (%) in the territory of Kazakhstan for different periods of time according to A2, A1B, B1 scenarioof change of greenhouse gas concentration in atmosphere

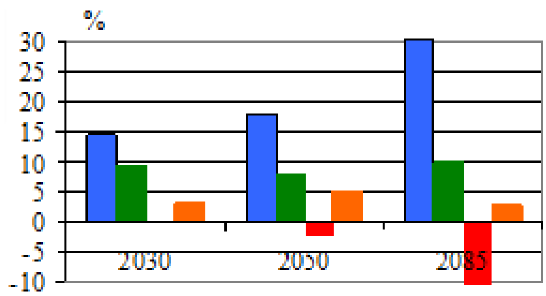
A)



B)



C)



A) A1B; B) B1; C) A2

6.1.1. Extreme events and climate changes

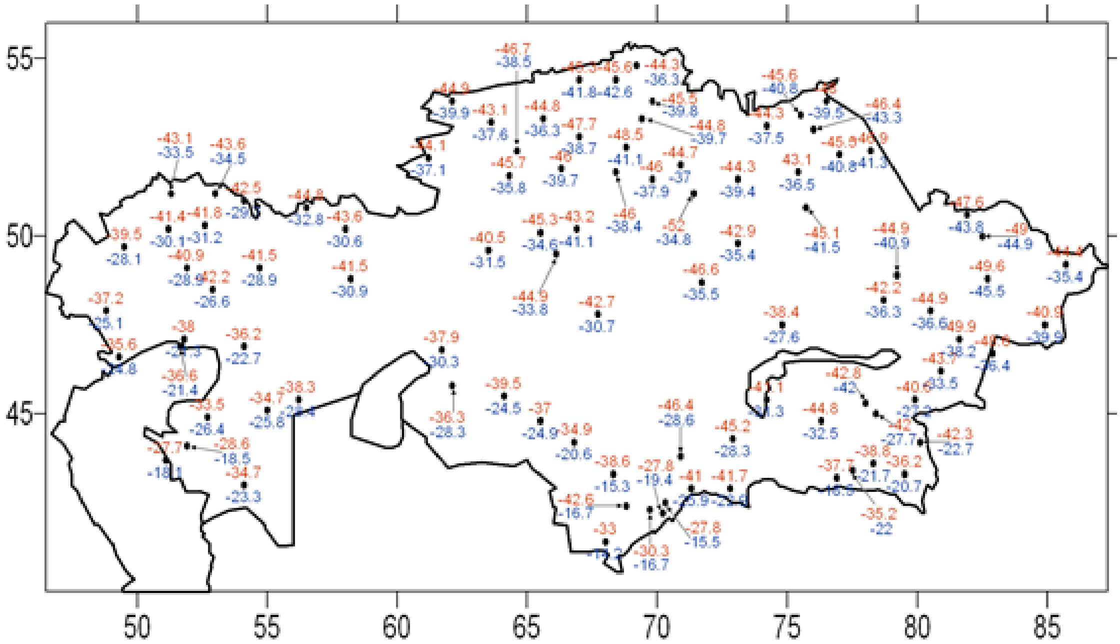
An attempt to assess the future development of extreme weather events (EWEs) was made in this section. The calculation results of future climate were used for this purpose (air temperature change and precipitation amount).

As mentioned in the analysis of model engineering results in figure 6.3, expected change of precipitation amount is ambiguous in comparison with air temperature in XXI century, i.e. its change is marked both for increase and decrease. At that, these changes do not exceed 10–15% of the rated value in most cases. In view of precipitation insignificance and its big mobility in space and time it was approved in Kazakhstan that change of precipitation amount can be neglected in future, wherefore its current climate rated values can be applied in calculations.

In view of obtained dependence it is possible to suppose that probability of anomalous cold weather will decrease from year to year in future. But in certain years (especially by 2035) falls of air temperature are possible up to current values of absolute minimums of air temperature (figure 6.5).

Figure 6.5

Values of absolute minimums of air temperature (˚C), which were registered as of the meteorological station opening and by 2009 (marked with red color), and values of daily minimums (˚C), which were observed in 2010 (marked with blue color).



In relation to the expected temperature increase the frequency change of anomalous hot weather is of big interest in Kazakhstan. We have observed the absolute minimums of air temperature for estimation, which one correlates with middle air temperatures in July well (figure 6.6)

Using the obtained dependence, it can be marked on the average that increase in the average monthly air temperature by each 1˚C leads to the increase in the absolute maximum of the air temperature by 0.8˚C.

Calculation results of future changes of absolute maximum values of air temperature are given in table 6.2.

Table 6.2

(°C) Expected change of absolute maximums of air temperature in Kazakhstan (˚C)

Scenarios	Years		
	2030	2050	2085
A2	1,4–1,5	2,1–2,3	3,7*–4,2**
A1B	1,3–1,4	2,2–2,4	3,4–3,6
B1	1,2–1,3	1,6–1,8	2,1–2,3

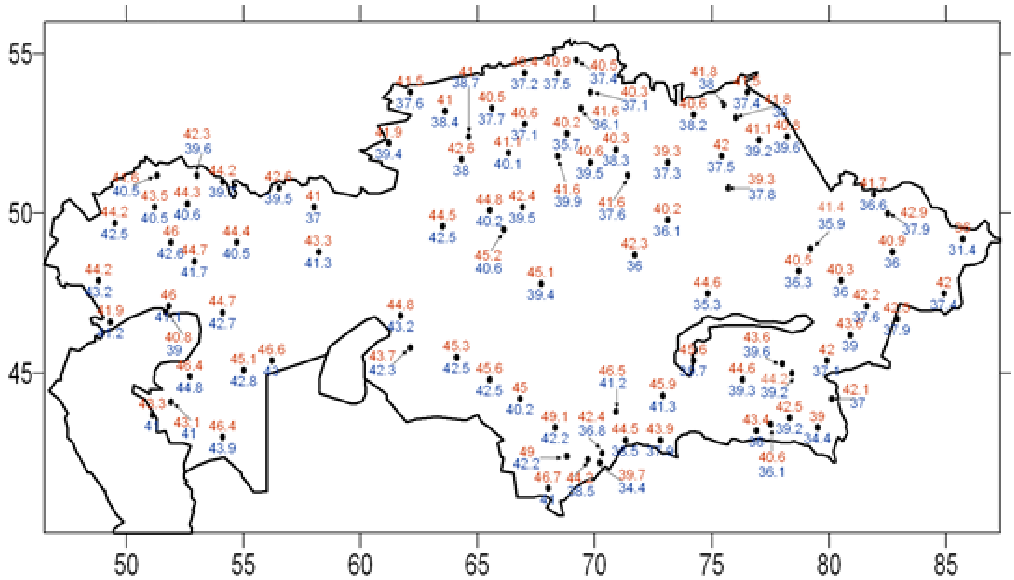
Note. *- in the west and north of the republic, **- in the south of the republic

According to the calculations, the absolute maximums of air temperature shall be covered by the range from1.2 to 1.5˚C by 2030, by the range from 1.6 to 2.4˚C by 2050, and from the range from 2.1 to 2.3˚C (according to the mild scenario) to the range from 3.7 to 4.2˚C by 2085 in Kazakhstan. In this basis in north regions of Kazakhstan, where absolute maximums of air temperature are equal to the range from 40 to 41˚C mostly, they can reach up to the range from 44 to 45˚C by 2085 that is a distinctive feature of the north regions of Kazakhstan nowadays.

Actual values of absolute maximums of air temperature in the territory of Kazakhstan are presented in the picture 6.6.

Figure 6.6

Values of absolute maximums of air temperature (˚C), which were registered as of the meteorological station opening and by 2009 (marked with red color), and values of daily maximums of air temperature (˚C), which were observed in 2010 (marked with blue color).



The South Kazakhstan region is related to the hottest territory of Kazakhstan. Here the absolute maximums of the most part of even lands vary within the range from 46 to 50˚C. And during the instrumental observation period in Kazakhstan the highest air temperature was equal to 51˚C and fixed in the south of the region – in the Kyzylkum desert (at the Kyzylkum weather station, it is not presented in figure6.8). On the basis of the forecast the absolute maximums of the air temperature can raise up to the range from 50 to 55˚C by 2085.

All these results of calculations point us at the increase in frequency of anomalous hot weather in future.

In the regard of other EWEs, the quantitative estimation of its future change is not possible, because they depend on many meteorological parameters besides air temperature, for which there are no results of climatologists' forecast.

In view of EWEs frequency during global warming (from 2000 to 2011) it can be noticed that such EWEs will remain in future in Kazakhstan as very heavy precipitation (rain, snow, melted snow), strong winds, strong blizzards, heavy (giant) hail, heavy dust devils, heavy fogs and dangerous glaze-ice and rime deposition. An increase in frequency of such EWEs as strong wind, heave snow and hail is observed and, maybe, will be observed in future.

In mountain and piedmont regions heavy rain showers with squally winds, heavy snows with snowstorms, and also hail will probably become more frequent.

In north regions there is a major risk of heavy snowstorms in big territories.

Expected intensive air temperature increase can lead to increase in frequency of aridities in main cropping regions of Kazakhstan (Aktobe, Kostanay, North Kazakhstan, Akmola, Pavlodar, East Kazakhstan, Karaganda regions).

Strong squally winds (with a velocity of 30 m / sec and more) will be also observed in the even lands of Kazakhstan. Although such events have little frequency due to its suddenness, they constitute the most danger for economy and life activities of population.

In works [4, 5] it was indicated that a big number of days of dust devils was noticed in the Aral Sea region over the last years. In view of climate aridity increasing in future, it is possible to suggest that dust devils will probably become more frequent not only in the above mentioned regions, but also in other regions of Kazakhstan.

6.2. Assessment of climate change impact, vulnerability of natural ecosystems and sectors of economy and climate risks

6.2.1. Agriculture

Agriculture is one of the key braches of Kazakhstan economy, where plant growing and cattle breeding are the basis. These sectors of agriculture, being the priority guidelines of economy development, have a potential for development. Further development of plant growing and cattle breeding depends on applied agricultural technologies and natural resources, including on climate changes.

Results of calculation of ground air temperature and precipitation amount for two time periods of 30 years– from 2015 to2045 with a midpoint in 2030 and from 2035 to 2065 with a midpoint in 2050 for two A1B and A2 scenariosof climate change, which correspondingly assume fast and slow economic growth, were chosen for research of forecasted climate change impact on agriculture of Kazakhstan.

6.2.2. Plant growing (grain production)

Agro-climatic resources of the territory are characterized by the indexes of thermal regime and moisture regime of vegetation period. Predicted values of some indexes of heat- and moisture assistance of the territory for climate conditions of 2030 and 2050 were calculated for trending performance of agro-climatic resources changes according to A1B and A2 scenarios of climate change.

Predicted values of amounts of average daily air temperatures for May–August (∑T5-8) were calculated for assessment of thermal resources change. The calculations demonstrated that heat- assistance of agricultural crops will increase by the range from 2 to 9% for the expected climate of 2030 in comparison with the current climate (from 1971 to 2010). In this case the biggest changes are expected in north regions (North Kazakhstan, Akmola, Pavlodar), and the smallest ones – in Atyrau region.

Amounts of precipitations for the active vegetation period (May–August) and generally for the year, precipitation ratio K, and also Selyaninov Hydrothermal Coefficient - hydrothermal index were analyzed for discovering change of moisture assistance of agricultural crops.

The calculations demonstrated that precipitations will decrease by the range from 1 to 10% for the warm period on the prevailing territory of the republic with the most adverse changes in Atyrau, Mangystau and South Kazakhstan regions (from minus 6 to 10%),and the precipitations will increase slightly (by the range from plus 3 to 8%) in the north and south regions of the country.

Total annual precipitations are forecasted with positive changes for both scenarios (up to 12%), except Atyrau region, where decrease by 2% is expected.

Thus, a slight increase in total annual precipitations can be expected in the territory of Kazakhstan by 2030 in case of slight decrease in precipitation during summer time in comparison with the current climate, i.e. precipitation will increase due to the cold period.

Analysis of calculation results of precipitation ratio K demonstrated that moisture assistance of agricultural crops will slightly decline by 2030. In this case the most adverse changes (from minus 5 to 11%) are expected in the south and south-east of the republic, and also in Pavlodar region. An insignificant positive change (plus 1%) is possible in Kostanay region due to precipitation increase during the cold period of the year (table 6.3).

Analysis of expected hydrothermal index change (for May–August) points at the expected climate aridity increasing by 2030. The biggest adverse changes (from minus 8 to 17%), i.e. summer aridity increasing is expected in the south part of the republic and in Pavlodar region (table 6.3). The smallest adverse change (less than minus 5%) is expected in the north and central regions (Kostanay, North Kazakhstan, Akmola, Karaganda) and also in the east of the republic.

Table 6.3

Expected change of K and hydrothermal index values by 2030 according to A1B and A2 scenarios of climate change

Region	∆K,%		∆ hydrothermal index, %	
	A1B	A2	A1B	A2
Akmola	-3	-4	-4	-6
Aktobe	-5	-3	-10	-8
Almaty	-8	-7	-11	-10
Atyrau	-5	-5	-8	-8
East Kazakhstan	-1	-1	-2	-3
Zhambyl	-4	-5	-8	-8
West Kazakhstan	-1	0	-7	-7
Karaganda	1	-1	0	-5
Kostanay	1	1	-2	-2
Kyzylorda	0	-1	-8	-11
Mangistau	-5	-4	-10	-11
Pavlodar	-8	-11	-10	-14
North Kazakhstan	-3	-3	-3	-3
South Kazakhstan	-3	-5	-13	-17

Sources: Expert finding of S.S. Baisholanov using data, calculated according to «Climate Wizard» CAOGCM and SW models

Trend calculations of 2050 demonstrated that heat-assistance of agricultural crops will note worthily increase (by the range from 4 to 15%) in comparison with the current climate (from 1971 to 2010). In this case the biggest changes are expected in the north regions, the smallest – in south regions.

Forecast calculations of the total precipitation demonstrated that precipitation of warm period of the year will decrease by the range from 2 to 14% in the prevailing territory of the republic in the climate condition of 2050, with biggest adverse changes in Mangistau and South Kazakhstan regions(from 11 to 14%). Precipitation of the warm period will slightly increase in the north and east part of the country (by the range from 2 to 8%).

Total annual precipitation has positive changes in all regions (up to 20%), except Atyrau and Mangistau regions with probability of slight adverse change (minus 2%).

The result is that a slight increase in precipitation can be expected generally per year in the territory of Kazakhstan by 2050 in case of slight decrease in precipitation in summer period that can lead to decline of moisture conditions of the vegetation period.

Analysis of calculation results of precipitation ratio K demonstrated that moisture assistance of agricultural crops will slightly decline according to both scenarios of climate change by 2050. The biggest adverse changes (from minus 9 to 16%) are expected in the south and south-east of the republic, and also in Pavlodar region (table 6.4). The smallest adverse changes (from minus 9 to 16%) are expected in the west part of the republic (north-west, west, south-west and centre).

Calculations of hydrothermal index confirm the expected climate aridity increasing by 2050. The biggest adverse changes of hydrothermal index (from minus 17 to 22%) are expected in the south part of the republic and in Pavlodar region (table 6.4). The smallest adverse changes (less than minus 10%) are expected in the north regions and in the east of the republic.

Table 6.4

Expected change of K and hydrothermal index values by 2050 according to the A1B and A2 scenarios of climate change

Region	∆K,%		∆ hydrothermal index, %	
	A1B	A2	A1B	A2
Akmola	-5	-9	-8	-11
Aktobe	-6	-8	-14	-12
Almaty	-16	-14	-22	-19
Atyrau	0	-7	-11	-10
East Kazakhstan	-5	-6	-9	-9
Zhambyl	-9	-9	-13	-13
West Kazakhstan	-4	-4	-14	-12
Karaganda	-3	-5	-10	-8
Kostanay	-1	-4	-6	-8
Kyzylorda	0	-7	-17	-17
Mangistau	-2	-11	-21	-19
Pavlodar	-11	-14	-17	-19
North Kazakhstan	-5	-8	-6	-10
South Kazakhstan	-15	-10	-21	-23

Sources: Expert finding of S.S. Baisholanov using data, calculated according to «Climate Wizard» CAOGCM and SW models

Expected change of indexes of heat- and moisture assistance will lead to the shift of thermal zones and moisture zones sideward the north latitudes.

Space distribution of precipitation ratio K in the north part of Kazakhstan under conditions of current (from 1971 to 2010) and forecasted climates of 2050 is presented in figure 6.9. Isolines K have some shift to the north in 2050 in comparison with the current distribution of ratio K.

Well moistened zone (K = 1.0–1.2) with stable moisture assistance of spring crops, located in the north outskirts of North Kazakhstan region, will transmit to the low moistened category (unstable moisture assistance), i.e. there will be no well-moistened zone in the north part of the republic (figure 6.7)

Low moistened zone (K = 0.8–1.0) with unstable moisture assistance of spring crops will decrease in Kostanay, Akmola and Karaganda regions, and disappear in the north part of Pavlodar region in full. An islet of «Korneevka – Karkaly – Bayanaul» low moistened zone will become separated from the main zone in Karaganda region.

Low arid zone (K = 0.6–0.8) with a low deficit of moisture assistance of spring crops will also shift to the north, especially in West Kazakhstan and Aktobe regions, and a low shift of this zone is expected in Kostanay and Karaganda regions.

Middle arid zone (K = 0.4–0.6) with a temperate deficit of moisture assistance of spring crops is also expected to have a shift to the north, but with smaller amplitude.

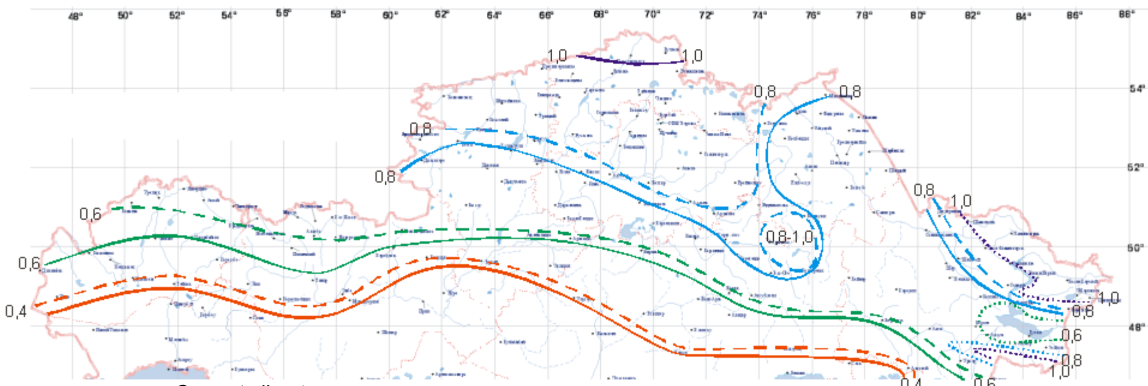
There is also a shift of moisture zones to the north-west in the East Kazakhstan region (prevailing of altitudinal shift). Any essential changes of moisture are not expected in the mountainous areas of the region.

As a result of the shift of moisture zones, some administrative districts of cropping regions will transmit to the lower level of territory moisture in 2050s. As a result of the shift of low arid zone to the north, the growing areas of spring crops will reduce, and their growing will become unpromising in some districts. For example, climate conditions of the West Kazakhstan region, offering the possibility of spring cereal crops, will remain unchanged only in Zelenovsk, Taskala, Burlin and Terektin districts. Grain production will be possible to remain in Martuk, Kargaly, Hobda, Chromtau and in the north of Alga and Aitekebiskiy districts of Aktobe region. The climate of Karaganda region will allow growing cereal crops only in Osakarovka, Buhar-Zhyrau, Abay, Karkaraly districts and also in the north-east of the Nura district. There will be unprofitable growing of cereal crops in Zhangeldi, Amangeldinsk and Arkalyk districts of Kostanay region.

An expected decline of climate conditions of spring crops growing can be compensated by introduction of adaptive growing technologies in the north regions of Kazakhstan.

Figure 6.7

Spatial distribution of precipitation ratio K in the north part of Kazakhstan



Current climate

Forecast for 2050 according to A1B scenario

Current climate and forecast for 2050 according to A1B scenario

Sources: Expert finding of S.S. Baisholanov using data, calculated according to «Climate Wizard» CAOGCM and SW models

North Kazakhstan, Kostanay and Akmola regions were chosen for the research of dependence of yielding capacity from expected climate change, i.e. territories, where 76% of all cereal and pulse crops, 80% of spring wheat are grown.

Dynamic model of agricultural crops formation of the professor A.N. Polevoy (Ukraine) was used for forecasting spring wheat yield capacity. The model was adopted for Kazakhstan conditions in «Kazhydromet» Republic State Enterprise in 2010.

Calculations were made for administrative districts of above mentioned regions for current climate conditions (average for the period from 1971 to 2010), for conditions of 2030 and 2050 according to A1B and A2 scenarios.

Calculations demonstrated that yielding capacity of spring wheat would be equal to 67–77% of its long-term average annual level (from 1971 to 2010) for regions under conditions of the expected climate of 2030s. It means that yielding capacity of cereal crops will decrease by 23–33% during maintenance of current level of the farming standards (average for the period from 1971 to 2010) under the influence of climate changes by 2030.

Table 6.5

Expected yielding capacity of spring wheat by 2030 (as a percentage of the current level (from 1971 to 2010)) according to A1B and A2 scenarios of climate change

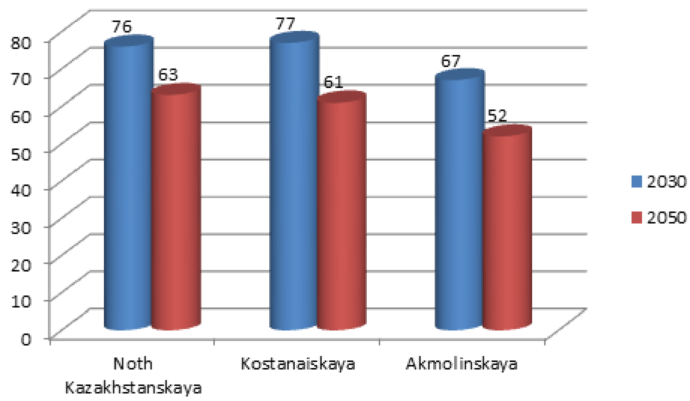
Region / district	Yielding capacity, %	
	A1B	A2
North Kazakhstan region - 76 %		
Zhymabaev	72	73
Esil	77	81
Zhambyl	73	74
Tajynsha	76	77
Musirepov	80	80
Aiyrtau	70	71
Kostanay region – 77%		
Karabalyk	79	81
Kostanay	68	71
Karasu	75	77
Auliekol	63	64
Zhetikara	70	69
Zhangeldi	93	95
Amangeldi	84	84
Akmola region – 67%		
Zerendi	68	77
Burabay	69	69
Sandyktau	84	83
Akkol	56	55
Atbasar	64	65
Esil	61	62
Astrakhan	61	60

Sources: Expert finding of S.S. Baisholanov using data, calculated by the model of A.N. Polevoy according to "Climate Wizard" CAOGCM and SW models

Trend calculations of spring wheat yielding capacity under the conditions of 2050s demonstrated that yielding capacity of regions will be equal to the range from 52 to 63% of its long-term average annual level (from 1971 to 2010) (table 6.6, figure 6.8), i.e. yielding capacity of cereal crops will decrease by the range from 37 to 48% during maintenance of the current level of farming and growing technology in 2050s.

Figure 6.8

Forecasted average yielding capacity of spring wheat for regions in 2030 and 2050 (as a percentage of the current level)



Thus, expected climate changes will lead to decrease in moisture assistance of agricultural crops, increase in climate aridity, shift of moisture zones to the north latitudes and decrease in the yielding capacity of cereal crops.

Table 6.6

SExpected yielding capacity of spring wheat by 2050 (as a percentage of the current level (from 1971 to 2010)) according to A1B and A2 scenariosof climate change

Region / district	Yielding capacity, %	
	A1B	A2
North Kazakhstan region – 63%		
Zhymabaev	63	63
Esil	64	64
Zhambyl	63	63
Tajynsha	52	51
Musirepov	70	71
Aiyrtau	66	66
Kostanay region – 61%		
Karabalyk	52	52
Kostanay	57	57
Karasu	52	55
Auliekol	49	48
Zhetikara	63	62
Zhangeldi	80	80
Amangeldi	79	70
Akmola region – 52%		
Zerendi	52	51
Burabay	56	56
Sandyktau	55	59
Akkol	46	46
Atbasar	54	54
Esil	48	48
Astrakhan	49	49

Sources: Expert finding of S.S. Baisholanov using data, calculated by the model of A.N. Polevoy according to "Climate Wizard" CAOGCM and SW models

6.2.3. Cattle breeding (sheep breeding)

Capacity of cattle breeding depends on its forage provision and weather conditions. The basis of cattle breeding forage potential consists of: pastures, natural and artificial hay fields, plough for forage crops cultivation. The area of the republic pastures is equal to 187.5 million ha. Hereof the following is used: 61.2 million ha of lands of agricultural designation, 17.5 million ha of settlements, including 59.5 million ha of waterlogged pastures, 2.5 million ha of plough, used for growing annual and perennial forage crops.

But still the yielding capacity of forage crops remains at the low level, and harvesting of forage units does not exceed the range from 2.5 to 6.0 dt / ha from 1 ha nowadays. Area of degraded natural foraging sites have increased in 2 times, have been equal to 48 million ha, including degradated – 26 million ha (especially near settlements within a radius from 5 to 6 km). Specific weight of forage crops have reduced from 32.5% (11 million ha in 1991) to 11.8% (2.5 million ha by 2011), of fodder-grain crops – from 30.7 to 8.6 % within the area under crops.

The average yielding capacity of seeded annual grasses for hay making was varying from 5.0 to 11.2 dt / ha during the period from 1996 to 2010 and was equal to 7.2 dt / ha in the republic for last 15 years. The biggest average yielding capacity of annual grasses for hay making has been formed in North Kazakhstan (20.9 dt / ha), Almaty (14.1 dt /ha), Zhambyl (13.9 dt / ha), East Kazakhstan (13.6 dt / ha) regions in respect of the republic regions for 15 years, and the smallest yielding capacity was in Karaganda, Kostanay, Aktobe, Akmola regions (from 3.1 to 6.6 dt / ha).

The average yielding capacity of perennial grasses for hay making was equal to 11.5 dt / ha for last 15 years. The biggest yielding capacity of perennial grasses for hay making has been formed in the South Kazakhstan (35.4 dt / ha), Almaty (30.5 dt / ha), Zhambyl (29.4 dt / ha), Kyzylorda (19.9 dt / ha), Atyrau (17.5 dt / ha) regions, that is primarily related to the cultivation of main perennial grasses (bean – Lucerne) under the conditions of irrigation.

The main recourse of forage for livestock animals is still natural foraging sites (hay fields and pastures). Capacity of natural foraging sites as well as its species composition is different by the natural and climatic zones. Capacity of natural hay fields was varying from 3.8 to 7.3 dt / ha and was equal to 5.3 dt / ha on the average during 1996–2010 in the republic.

Capacity of natural pastures are varying from 1.5 to 8.0 dt / ha of dry weight in respect of different natural and climatic zones. Steppe cereal pastures with mixed herbs have a capacity from3 to 8 dt / ha in the north, centre and west regions. Desert steppe pastures, moderatedry steppe pastures, dry steppe sheep's fescue and needle grass pastures, and arid needle grass pastures with mixed herbs have a yielding capacity from 2.5 to 7 dt / ha of grass stand dry weight in the central and west part. In the south regions white land and vermouth pastures, white salsola and vermouth anabasis-salsa pastures have a yielding capacity from 1.5 to 6 dt / ha.

Condition of pasture plants and hay fields, and also conditions of animal management are in the direct dependence on the temperature regime and resources of the territory moisture. Predicted changes of agro-climatic indexes for 2030 and 2050 are indicated in the section of plant growing above (total air temperature, total precipitation, precipitation ratio K and hydrothermal index). All these changes and shift of thermal zones and moisture assistance zones to the north will naturally influence on the condition and yielding capacity of pasture plants and hay fields, and, maybe, on animal productivity further on.

Calculations [6] demonstrate that the spring vegetation of pasture plants will begin from 1 to 2 days earlier and finish from 1 to 2 days later in autumn in regard to the current conditions by 2030, and also in spring – from 2 to 3 days earlier and in autumn – from 2 to 3 days later. Thus, it is expected that duration of the vegetation period will increase by the range from 2 to 4 days under climate conditions of 2030, and by the range from 4 to 6 days – under climate conditions of 2050.

According to our calculations, a slight decrease in yielding capacity of plain pastures of the south regions (Almaty, Zhambyl, South Kazakhstan, Kyzylorda) by the range from 3 to 4%, i.e. it will be equal to the range from 96 to 97% of its current level, and also of pastures of Mangystau region – by the range from 9 to 10%, i.e. it will be equal to the range from 90 to 91% of the current level by 2030. Decrease in yielding capacity from 10 to 14% is forecasted for pastures of the mentioned regions, i.e. it will be equal to the range from 86 to 90% of the current level (table 6.7). Mountain pastures are vulnerable to the climate changes. More essential decrease in yielding capacity of pasture plants are supposed for mountain pastures. For example, decrease in pasture yielding capacity is supposed by 30% by 2030, by 50% by 2050 on the pasture of Assy mountain area (plateau).

Table 6.7

Forecasted yielding capacity of pasture plants for 2030 and 2050 (Yielding capacity, as a percentage of the current level (from 1971 to 2010)) according to A1B and A2 scenarios of climate change, %

Territory	2030		2050	
	A1B	A2	A1B	A2
Plain pastures of the south regions	97	96	90	88
Mangystau pasturesand Ustyurt	90	91	86	87
Mountain pastures of Zailiyski Alatau (Assy)	69	73	46	51

Sources: Expert finding of S.S. Baisholanov using data, calculated according to «Climate Wizard» CAOGCM and SW models

Assessment of the climate change impact on animals is very important for Kazakhstan conditions for all seasons of the year, but winter is more responsible period for sheep breeders. The main zoo-climatic index of the cold period is number of days without sheep pasturingfor November–March.

Number of days without pasturing is varying within the period from 5 to12 days for the winter pastures of Almaty region. Number of days without pasturing is equal to 10 days approximately for pastures of Moinkum desert, where sheep of Zhambyl and South Kazakhstan region are kept in winter. The mildest and most favorable winters for sheep pasturing are observed in sand massifs of Kyzylkum (South Kazakhstan region). In this case the average number of winter days without pasturing does not exceed two days. Average number of days without pasturing is equal to 6 days for the south sand pastures of Kyzylorda region, and it reaches 17 days for the north part of the region.

In inclement winters the number of days without pasturing can reach up to 30 days in the south (Kyzylkum), and up to 115 days in Betpak-Dala. 70% of all cases of days without pasturing are accounted for January and February. Negative integrated effect on sheep pasturing is done by low air temperature, wind, high and dense snow cover.

Probability analysis of number of days without pasturing with different provision demonstrated that number of days without pasturing of more than 10 days had 5% provision in the south of South Kazakhstan region, from 15 to 25% in the territory of Almaty region and in the south part of Zhambyl region, from 30 to 60% in the north of South Kazakhstan, Kyzylorda and Zhambyl regions. Favorable warm winters can be in the south of South Kazakhstan region – 60%, in the south of Zhambyl region – 50%, in the north of Zhambyl and Kyzylorda regions – 10%. Probability of warm winters varies from 30% to 50% in Almaty region.

According to calculations [10], the average number of days without pasturing will decrease by 15% and will be equal to 85% of the current number of days without pasturing (from 1971 to 2010) by 2030, and to 72% - in 2050s in the south of Kazakhstan (table 6.8). The biggest changes will be observed in the south of South

Kazakhstan region. All of these points at the stable trend of winter condition moderation for animal management. But as indicated in [10, 20], frequency of anomalous cold winters will increase due to the instability of winter conditions, i.e. anomalous cold winters will be more often observed on a ground of the general winter warming. Such anomalous cold winters together with arid summer can bring essential losses of cattle breeding.

Table 6.8

Forecasted number of days without sheep pasturing for 2030 and 2050 over a cold period of the year (number of days without pasturing, as a percentage of the current level (from 1971 to 2010) according to A1B and A2 scenarios of climate change, %

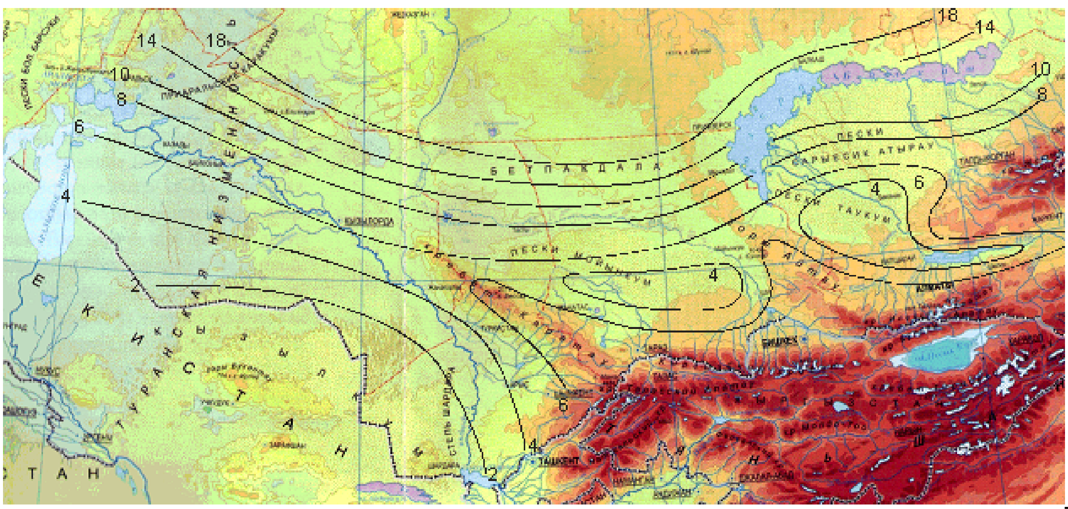
Region	2030		2050	
	A1B	A2	A1B	A2
North of Kyzylorda region	87	85	72	77
South of Kyzylorda region	85	83	70	76
Mangistau region	83	82	68	72
North of South Kazakhstan region	85	82	69	72
South of South Kazakhstan region	72	81	63	54
North of Zhambyl region	85	83	72	73
South of Zhambyl region	87	88	72	74
North of Almaty region	87	86	75	77
Foothill of Almaty region	90	86	77	81
Average for the south of the republic	**85**	**84**	**71**	**73**

Sources: Expert finding of S.S. Baisholanov using data, calculated according to «Climate Wizard» CAOGCM and SW models

Figure 6.7 shows the spatial distribution of the number of days without sheep pasturing of the south of the republic, which is forecasted for 2050 according to A1B scenario. The average number of days without pasturing will be equal to the range from 4 to 6 days for winter pasture of Almaty region in 2050s. The average number of days without pasturing will be equal to 6 days for pastures of Moinkum desert, where sheep of Zhambyl and South Kazakhstan region are kept in winter. The average number of days without pasturing will not exceed 1 day for the most favorable sand massif of Kyzylkum for winter sheep pasture. The average number of winter days without pasturing will be equal to 4 days for the winter sand pastures of Kyzylorda region and it will reach up to 12 days in the north of the region. But number of days without pasturing can reach higher values in increment winters - for Kyzylkum – up to 30 days, for Betpak Dala – up to 110 days.

Figure 6.9

Spatial distribution of the number of days without pasturing, which is forecasted for 2050 according to A1B scenario



——- isolines of the number of days without pasturing (days)

Sources: Expert finding of S.S. Baisholanov using data, calculated according to «Climate Wizard» CAOGCM and SW models

Pasturing during warm period of the yeas has a particular importance for formation of sheep productivity. Before the beginning of summer heat, sheep are fleeced before the drift to the summer pastures. Spring crutching is carried out during the period of cold weather end and beginning of warm weather. Premature crutching leads to production of low grade wool, increasing of decease probability and shorn sheep mortality because of influence of cold weather conditions. Sheep are at grass less time and lose weight due to the crutching on later term under the conditions of hot weather. In this regard it is necessary and important to determine the optimal term of crutching in advance.

The mean date of crutching beginning changes from the middle of the third decade of April (south of South Kazakhstan region) to the middle of May on the south of the republic (north of Almaty region). Moreover, early or late dates of crutching beginning deviate from the mean date by 10–15 days. These deviations are related to early or late incoming of spring in these districts.

According to our calculations the optimal term of spring crutching (days of crutching - Dcr) will be 2 days earlier of the current term in 2030s, and 4–5 days earlier in 2050s (table 6.9).

Table 6.9

Forecasted deviation of the optimal date of the spring crutching (∆Dcr) from the current term (from 1971 to 2010) according to A1B and A2climate scenarios

Region	2030		2050	
	A1B	A2	A1B	A2
South of Karaganda region	-2	-3	-5	-5
North of Kyzylorda region.	-3	-2	-5	-4
South of Kyzylorda region	-2	-2	-4	-3
Mangistau region	-2	-2	-4	-3
North of South Kazakhstan region	-3	-2	-5	-4
South of South Kazakhstan region	-2	-2	-4	-4
North of Zhambyl region	-2	-2	-4	-4
South of Zhambyl region	-2	-2	-5	-4
North of Almaty region	-3	-2	-5	-4
Foothill of Almaty region	-3	-3	-6	-5
Average for the south of the republic	**-2**	**-2**	**-5**	**-4**

Sources: Expert finding of S.S. Baisholanov using data, calculated according to «Climate Wizard» CAOGCM and SW models

The main zoo-climatic index of the warm period is duration of the stable hot period (SHP) for sheep. Hot weather, relevant to this year season in desert pastures, gets down animals as well as leads to its weight reduction. The fittest animals to hot weather conditions are karakuls.

More often beginning of the stable hot period falls with the end of May and beginning of June for fine wool sheep in the semi desert districts of Almaty region, and this period continues from 85 to 97 days, i.e. till the end of August and beginning of September. The stable hot period begins a little bit later and finishes earlier in the piedmont regions with a district height increase and air temperature depression. Hot days are rarely observed in the high mountain pastures. Unfavorable conditions for sheep pasture are mainly generated by means of cold weather in the mountain pastures. Duration of the stable hot period varies within the period from 33 to 59 days for karakuls in the plain pastures of Almaty region.

Duration of the stable hot period varies within the period from 83 to 98 days for fine wool sheep, and from 40 to 63 days for karakuls in Zhambyl region.

Duration of the stable hot period increases from 97 days (in the north) to 124 days (in the south of the region) for fine wool sheep in the plain pastures of South Kazakhstan region. The stable hot period continues from 53 to 56 days for karakuls in the north of the region and from 80 to 85 days - in the south.

Duration of the stable hot period changes from the south to the north from 69 to 62 days for karakuls in Kyzylorda region.

Duration of the stable hot period reduces incrementally to the north, because the stable hot period of steppe pastures is equal to the range from 42 to 53 days for fine wool sheep, for karakuls – 14 days in the south of

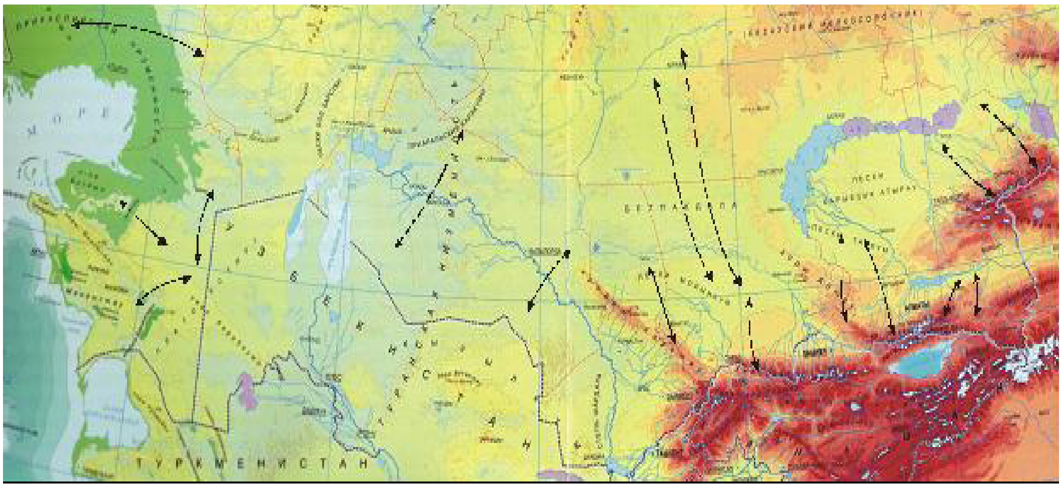
Saryarka. Karakuls are stronger for heat. That is the reason why their duration of the stable hot period is much less than for fine wool sheep.

When the stable hot period has come, it is necessary to take animals to pastures with more comfortable weather conditions, to the north districts or mountain pastures. Drift of fine wool sheep shall be started on the 15–20th of May for Kyzylkum, 25th of May – for the south foothill of Karatau and Karakum desert, 30th of May – for Moinkum and Taukum desert, 5th of June – for the north foothills of Karatau, in Saryesik Atyrau and Betpak-Dala desert, 10th of June –for the foothill of Kyrgyz Ala-Too, 15th of June – for the foothill of Ile-Alatau. At the end of June hot weather comes also to the south of Saryarka steppe.

Transhumant system of animal management, which preexisted earlier, before 1990s, allowed bounding together natural economic complex and different seasonal pastures. The south of Kazakhstan represents primarily complexes of altitudinal zoning, in central and west regions – of latitudinal zoning (figure 6.8). Nowadays only large scale enterprises have a possibility to comply to some extent with the generally accepted economic scheme of sheep management in Kazakhstan – namely with transhumant system.

Figure 6.10

Main livestock routes (winter - summerpastures) [35]



During many years (from 1964 to 2010) the average duration of the stable hot period has a stable trend of growth both for fine wool sheep and karakuls. In this regard a frequency of anomalous hot years with a high value of the stable hot period (more than 120 days) has increased for last ten years and its interannual changeability has also increased.

Table 6.10 shows durations of the stable hot period, which is calculated for fine wool sheep and expected for 2030 and 2050 as a percentage of its current level (from 1971 to 2010) according to A1B and A2 scenarios of climate change. The average duration of the stable hot period for sheep will increase by 19% by 2030 and by 30% by 2050 in the south of the republic, i.e. a severization of summer conditions of pasturing is observed due to high air temperature.

Table 6.10

Forecasted duration of the stable hot period for sheep for 2030 and 2050 (stable hot period, as a percentage of the current level (from 1971 to 2010)) according to A1B and A2 scenarios of climate change, %

Region	2030		2050	
	A1B	A2	A1B	A2
South of Karaganda region	123	125	137	135
North of Kyzylorda region	116	117	128	126
South of Kyzylorda region	114	115	125	124
Mangistau region	114	114	125	122
North of South Kazakhstan region	117	118	129	128
South of South Kazakhstan region	113	114	124	123
North of Zhambyl region	116	118	129	127
South of Zhambyl region	122	122	137	135
North of Almaty region	120	121	134	132

Region	2030		2050	
	A1B	A2	A1B	A2
Foothill of Almaty region	124	123	140	136
Average for the south of the republic	**118**	**119**	**131**	**129**

Sources: Expert finding of S.S. Baisholanov using data, calculated according to «Climate Wizard» CAOGCM and SW models

Figure 6.9 presents the spatial distribution of the duration of the stable hot period for fine wool sheep (karakuls), forecasted for 2050 according to A1B scenario.

In semi desert districts of Almaty region the stable hot period is expected within the period from 110 to 120 days for fine wool sheep. In piedmont districts with height increase the stable hot period reduces. On the plain pastures of Almaty region the stable hot period will be equal to 60–80 days for karakuls in 2050s.

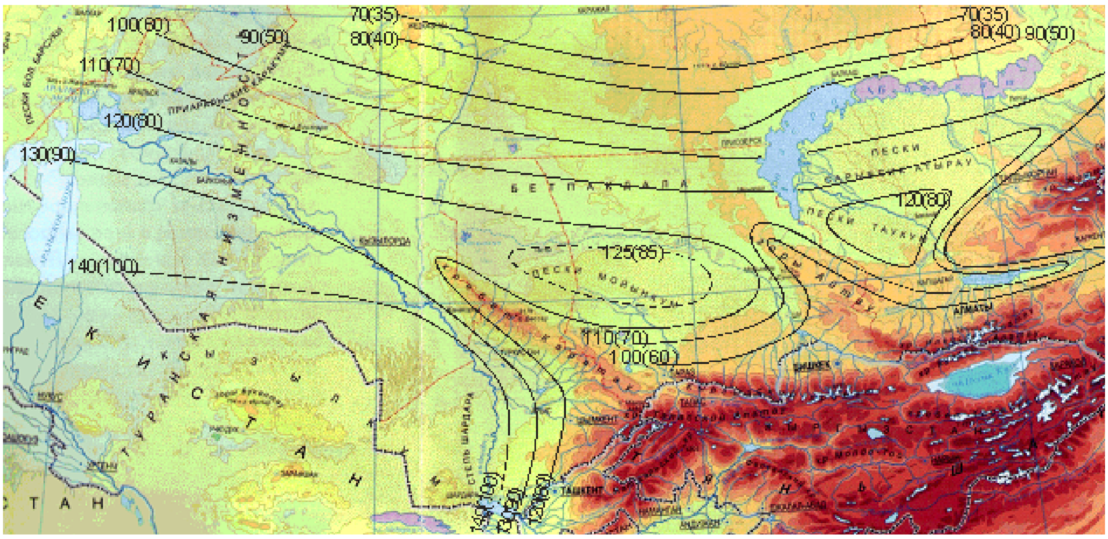
In Zhambyl region on the plain pastures the term of beginning and completion of the stable hot period coincide approximately with terms of Almaty region. In this case duration of the stable hot period varies within the period from 110 to 125 days for fine wool sheep, from 70 to 85 days for karakuls.

Hair sheep and karakuls, resistant to heat, are kept in South Kazakhstan region. The stable hot period are forecasted for them within 80 days in the north, from 90 to 100 days in the south.

Karakuls are kept also in Kyzylorda region. Their duration of the stable hot period will change from the south to the north from 100 to 80 days (figure 6.11).

Figure 6.11

Spatial distribution of the stable hot period duration for fine wool sheep (karakul), forecasted for 2050 according to A1B scenario



Sources: Expert finding of S.S. Baisholanov using data, calculated according to “Climate Wizard” CAOGCM and SW models

Thus, results of our researches demonstrated that winter will be warmer by the range from 15 to 28% for sheep management in forecasted 2030 and 2050, summer will be hotter by the range from 18 to 31%, term of the spring crutching will come from 2 to 5 days earlier of the current term, yielding capacity of plants will decrease by the range from 4 to 14% in the plain pastures of the south part of the republic, and by the range from 30 to 50% in the mountain pastures. Establishment of such agro– and zoo-climatic conditions as a whole will impact on sheep and can lead to decrease in its productivity. In this case the biggest decrease in sheep productivity can be expected in the south of South Kazakhstan region, in Kyzylorda and Mangistau regions, and also in South-Pribalkhash.

Such changes of climate parameters will not lead to the radical changes in the system of the animal management of Kazakhstan, i.e. there will be no changes in the regional assignment of the republic territory according to the system of animal management. In 2030 and 2050 the spatial distribution of areas according to the system of sheep management will remain within the current border, i.e. it is distributed from the south to the north from the prevailing pasture management (south of Kazakhstan) to the stall and pasture management (north of Kazakhstan). The most sheep vulnerability will be observed in the south part of the republic. Adoptive measures, including adjustment of regional assignment of sheep breeds, are necessary for reduction of heating load on animals and forage provision in the south of the republic.

6.2.4. Water resources

Researches with respect to variations of natural river runoff in basins of 30 rivers of different water basins in 41 gauging stations are conducted in order to assess impact of anthropogenic climate changes on water resources. Residual-mass curves are used to assess runoff rate on the basis of data of the first half – beginning of the second half of the XX century and second half of the XX century – beginning of the XXI century. Such analysis is conducted with account for cyclical variations of river runoff. Periods, which include not less than two closed cycles of water content change, such as low-water and high-water phases of different duration, are chosen in order to assess the rate of annual runoff. Duration of periods usually amounted to the range from 40 to 45 years, maximum duration - 64 years for the Arys River, minimum duration – 29 years for the Karakengir River. Daily precipitation and average daily air temperatures on meteorological stations, located within the boundaries of basin or near it, are main input data for runoff hydrograph simulation.

Researches, conducted within the framework of Second National Communication [1], are continued in this work and other global climate models with higher resolution are used, adaptation of runoff hydrograph formation model is conducted, using new scenarios of potential anthropogenic climate change, in order to assess vulnerability of water resources.

Anthropogenic climate changes were investigated under A2 and B1 scenarios. Output data from the new-generation global AOGCM (CMIP3 – Coupled model inter-comparison project (global atmosphere-ocean circulation) is used as input data in order to assess future changes in the amount of precipitation.

Calculations were conducted using software system MAGICC/SCENGEN (Model for the Assessment of Greenhouse-gas Induced Climate Change/SCENario GENerator, version 5.3.v2) according to the data of group comprised of 9 models. These are models, developed in Canada (CGCMA3.1 (T47), Australia (CSIRO-Mk3.0), Germany (ECHAM5 /MPI-OM), USA (GFDL-CM2.0 and GFDL-CM2.1), Japan (MIROC3.2med and MRI-CGCM2.3.2), Great Britain (UKMO-HadCM3) and Germany/North Korea joint model (ECHO-G).

Future changes in precipitation and air temperature are considered for two scenarios of SRES («Special report on emission scenarios» – Special report of IPCC on emission scenarios): A2 and B1 (Nakicenovic et al., 2000) and for three time periods: from 2006 to 2035, from 2016 to 2045, from 2036 to 2065 of the 21st century, averaged for 30 years with respect to base climate period 1980-1999. Output data of models are given to the uniform longitude-latitude grid, spatial resolution of which amounts to 2.5x2.5. Selection of models is conducted according to the value of spatial correlation coefficient between the observed and simulated temperature values of ground air and precipitation amount.

Change in ground air temperature and precipitation by 2035 is calculated with respect to two scenarios of greenhouse gas concentration change A2 and B1.

Vulnerability assessment of water resources due to anthropogenic climate change is conducted for 14 river basins, related to eight water basins. Five of them are plain – basins of the Tobol, Ishim, Nura, Sarysu and Ural Rivers. Basins of the Uba, Ulba, Ili, Karatal, Koksu, Arys, Shayan, Nura, Sarysu, Shu and Talas Rivers are mountain. The Ili, Karatal, Koksu, Shu and Talas Rivers are referred to glacier-fed rivers. It should be noted that runoff simulation of the Ural, Shu, Talas, Nura, Sarysu Rivers is conducted in another way. Average annual runoff coefficient and average annual precipitation on meteorological stations, located in basins of such rivers, are used for calculation according to such method.

Departures of resources in the process of anthropogenic climate change and of values of natural resources in river basins and for the long term until 2035 are presented in table 6.11.

Table 6.11

Comparison of departures of annual simulated runoff (A2 and B1 scenarios) from its measured values (ΔW, %) and departures of precipitation (ΔX, %) and air temperature (ΔT, °C) for the period until 2035.

River	ΔW,%		ΔX,%		ΔT °C	
	A2	B1	A2	B1	A2	B1
Uba+Ulba	2,0	5,2	2,26	5,31	1,22	1,37
Tobol	7,1	5,4	3,35	4,74	1,31	1,64
Ishim	0,3	2,6	1,68	4,25	1,29	1,49
Ili	9,0	15,2	2,55	2,78	1,18	1,55
Karatal	10,9	11,3	1,9	2,36	1,17	1,55
Koksu	10,5	11,2	1,9	2,36	1,17	1,55
Arys	6,2	-7,3	5,41	3,77	1,29	1,65
Shayan	12,5	4,2	5,65	4,77	1,23	1,55
Ural	15,0	10,0	6,0	2,0	0,98	0,86
Shu	14,9	14,5	7,14	6,74	2,6	2,0
Talas	10,1	9,8	6,59	6,2	2,5	2,0
Nura	13,6	13,0	7,44	6,88	2,9	2,1
Sarysu	8,81	6,59	9,58	7,35	2,8	2,1

Sources: Li. V. I., Domran A. O., Lineytseva A. V. Vulnerability assessment of Kazakhstan water resources in case of anthropogenic climate change for the long term until 2035. – Hydro-meteorology and environment, No. 2. 2022, p. 37-44.

Data from the table shows that if climate changes for the perspective until 2035 occur according to the A2 scenario, then water resources will increase within the Republic of Kazakhstan. Such increase is insignificant on the east of the Republic of Kazakhstan and will amount to about 2% (mountain basins of the Uba and Ulba Rivers). Increase will barely occur on the north of the Republic of Kazakhstan in basin of the Ishim River, but it will amount to 7.1% in basin of Tobol river (basins of the Ishim and Tobol Rivers are plain). Changes in water resources on the south-east of the Republic of Kazakhstan will vary from 9 to 10.9% for basins of the Ili, Koksu and Karatal Rivers (mountain glacier-fed basins). Changes will occur in general within the range from 6.2 to 12.5% on the south of the Republic of Kazakhstan for basins of the Arys and Shayan Rivers (mountain basins) and from 14.9 to 10.1% for basins of the Shu and Talas Rivers (mountain glacier-fed basins). Increase will amount to 13.6% and 8.81% in basins of the Nura and Sarysu Rivers respectively (Kazakh Hummocks). Increase may reach 15% on the west of the Republic of Kazakhstan (basin of the Ural River).

If climate changes for the perspective until 2035 occur according to the B1 scenario, then water resources will increase within the Republic of Kazakhstan. Such increase will amount to about 5.2% on the east of the Republic of Kazakhstan (mountain basins of the Uba and Ulba Rivers). Increase will amount to about 2.6% on the north of the Republic of Kazakhstan in basin of the Ishim River and it will amount to 5.4% in basin of the Tobol River. Changes in water resources on the south-east of the Republic of Kazakhstan will vary from 15.2 to 11.3% for basins of the Ili, Koksu and Karatal Rivers (mountain glacier-fed basins). Changes on the south of the Republic of Kazakhstan will occur in general within the range of 4.2% in basin of the Shayan River and resources may be reduced by 7% only in basin of the Arys River. Changes may increase up to 14.5-9.8% in basins of the Shu and Talas Rivers. Increase may be up to 13% and 6.59% in basins of the Nura and Sarysu Rivers respectively. Increase of water resources may amount to 10% on the west of the Republic of Kazakhstan (basin of the Ural River).

It should be noted that precipitation and temperature increase in all variants and scenarios as seen in Table 6.11. Total amount of snow increases in mountain areas due to increase in winter precipitation (especially in main runoff-producing areas of basins), that results in increase of runoff in spring in conditions of air temperature increase. Increase in air temperature is not so significant to cause the earlier thawing of soil and increase in loss of runoff in the period of spring flood. Pattern has another view in plain basins. Increased precipitation influences on the runoff rate less due to its larger losses in water catchment. Dependence on air temperature is clearly observed in plain basins. Reduce in depth of autumn freezing is observed in conditions of temperature increase and as a result increase in runoff losses on infiltration.

Assessment results of water resource vulnerability with respect to A2 and B1 climate change scenarios in years, which are different in terms of dryness, show: change in water resources has the same trend as on the average for a long-term period, without regard to dryness of year.

According to the opinion of climatologists of «Kazhydromet» Republican State-owned Enterprise (RSE), it is necessary to focus on both climate change scenarios for conditions of the Republic of Kazakhstan. Thus it is probably believed that increase will occur in water resources of south-eastern and south mountain areas of the country, as well as in western plain areas and their insignificant increase in eastern (mountain) and plain areas of north Kazakhstan under the influence of anthropogenic climate change.

In the assessment process of possible resources in river runoff of the Republic of Kazakhstan it is necessary to take into account the existence of 2 types of uncertainties. First uncertainty is related to the climate-dependent variability of river runoff, forming in the basin and having stochastic nature. Second uncertainty is conditioned upon economic activity in basins of bordering countries, range of which is impossible to predict. Strategy of sustainable country water supply, taking into account for high-rate vulnerability of natural environment and economic sectors of the Republic of Kazakhstan to possible changes in river runoff, shall be focused on unfavorable combination of two destabilizing factors: climate-dependent changes in local runoff (from 10 to 20%) and anthropogenic reduction of trans-boundary runoff (up to 50%).

According to the data of Institute of Geography, in case of unfavorable realization of climate and trans-boundary hydrological dangers the decrease in resources of river runoff is possible to occur in the Republic of Kazakhstan by 2020 up to 81.6 km3/year, including trans-boundary – up to 33.2 km3/year, local – up to 48.3 km3/year, by 2030 – 72.4; 22.2 and 50.2 km3/year respectively. It is expected that specified prerequisites shall be taken as a basis of water safety provision strategy of the Republic of Kazakhstan.

Consolidated water-resource balance of the Republic of Kazakhstan in 2008 and for the perspective till 2020 (Table 6.12) is presented in General multipurpose water resources utilization and conservation scheme of the Republic of Kazakhstan, developed in 2010 by «Institute Kazhyprovodhoz» Production Cooperative.

Table 6.12

Consolidated water-resource balance on the Republic of Kazakhstan in 2008 and 2020, km3

N	Components of balance	2008	2020 50%	2020 75%	2020 95%
	I. Balance input				
1	Surface runoff of rivers with account for management, water apportioning, outcrop, return waters, diversion of runoff, sea and lake waters	88,059*	108,089	84,678	64,424
2	Utilization of ground, mining, waste and collector and drainage waters	1,373	2,173	2,173	2,173
	TOTAL	**89,432**	**110,262**	**86,851**	**66,597**
	II. Balance output				
1	Withdrawal of water by economic sectors* *	17,040	20,479	20,265	18,482
2	Additional water withdrawal in People's Republic of China	0	6,450	6,450	6,450
3	Damage to river runoff as a result of ground water withdrawal	0	0,389	0,389	0,389
4	Losses of runoff, environment	13,844	29,389	21,759	14,597
5	Discharge into Arnasay	1,000	1,000	0	0
6	Residues of runoff – intake to lower reaches, lakes and seas (Caspian Sea, North Aral Sea, Balkhash, Alakol and Sasykol lakes and etc.)	30,312	29,182	21,341	15,821
7	Supply to the Russian Federation	27,236	23,373	16,647	10,858
	TOTAL	**89,432**	**110,262**	**86,851**	**66,597**
	III. Balance	**0**	**0**	**0**	**0**

*Without regard to discharge of the Ugam and Maydantal Rivers in Uzbekistan
* * satisfied requirements for water are indicated on the level of 2020.

Sources: Summary of General multipurpose water resources utilization and conservation scheme of the Republic of Kazakhstan. Production Cooperative «Institute Kazhyprovodhoz». Almaty. 2010

Economy of the Republic of Kazakhstan and agriculture will develop in coming years in conditions of shortage of water resources. Water deficit is now characteristic of Aral, Balkhash, Ural basins, closed drainage basins of Shu, Talas, Asu, Sarysu, Turgay, Nury rivers. For instance, the runoff of surface waters is assumed (according to the pessimistic scenario) to be reduced in the near term (until 2020) by the range from 15 to 18 km3, including from 10 to 12 km3 – as a result of increase of water withdrawal beyond the borders of the Republic of Kazakhstan and from 5 to 6 km3 – as a result of climate change. Kazakh Scientific Research Institute of Water Economy gave a preliminary estimate and scheme for possible runoff utilization of river basins of the Republic of Kazakhstan (table 6.13) as on 2007 /19/ on the basis of analysis and forecast of water resources state.

Table 6.13

Runoff distribution under the principle of conservation of natural ecosystems (km3/year)

Basins	Average annual runoff		Runoff distribution, including:						Available runoff
	total	including from the outside	environ-mental release	releases in RF	for evaporative and filtration	irregular runoff	transfer to another basins	total consum-ption	
Aral-Syrdarya	17,9	14,6	7,8	-	2,8	-	2,0**	12,6	5,3
Balkhash-Alakol	27,8	11,4	14,6	-	1,1	1,8	3,0***	20,5	7,3
Irtysh	33,5	9,8	5,5	12,8	4,9	0,8	0,9****	24,0	9,5
Ishim	2,6		0,3	-	0,5	0,7	-	1,5	1,1
Nura-Sarysu	1,3	-	0,8	-	0,4	0,1	-	1,3	0
Tobol-Torgay	2,0	-	0,3	-	0,1	1,0	-	1,4	0,6
Shu-Talas	4,2	3,1	1,4	-	0,2	0,1	-	1,7	2,5
Ural-Caspian	11,2	5,1	4,0	-	2,2	0,4	-	6,6	4,6
Total In Kazakhstan	100,5	44,0	34,7	12,8	12,2	4,9	5,9	69,6	30,9

Notes: * discharge into Arsanay; ** increase in water withdrawal in the People's Republic of China; *** discharge into channel named after K.I. Satpaev.

Sources: Ibatullin S. R. Participation of Basin Councils in fair and equal runoff distribution of trans-boundary rivers. Journal «Water economy of Kazakhstan», No. 3 (15), 2007

In March, 2012 it was reported that the total water runoff in Kazakhstan has amounted to 126 km3/year according to 50-years old data on the meeting of the Security Council with the participation of the President of the Republic of Kazakhstan. It decreased to 115 km3/year in 1970s and reduced to 100.5 km3/year in the years of independence. Having analyzed secular changes of runoff, the researchers came to a conclusion that annual runoff amounts to 91.3 km3/year, of which 44.3 km3/year – resources, which are formed within the territory of our country, residual water is trans-boundary in other words it comes to us from neighboring countries.

Hydrologists have determined: runoff will amount to 81 km3/year in 2020 and 76.3 km3/year in 2030, while the rate of national consumption amounts to 88 – 90 km3/year. In other words in the present time water is enough in the country, but water level will be insufficient in 20 years. But apart from coming water crisis the country is in for unfavorable change in natural environment.

Researches show that, for instance, the range from 11.5 to 11.9 km3/year of water flow in the Ili River. People's Republic of China, from where the Ili River flows, actively develops the industry and agriculture in its western areas and already realizes projects with respect to transfer of water from the Ili River to the centre of the country. If idea of the People's Republic of China is realized and water withdrawal amounts to at least from 7 to 9 km3/year, then the Balkhash Lake will be divided into 4 parts and delta of the Ili River will be changed. Desertification process will begin and natural zone will be transferred to the north. It means that this territory will become the zone of environmental instability and inadequate for agriculture.

The Institute of Geography gave an estimate and forecast of water resources with account for climate change and economic activity and developed the forecasting water supply scenarios of the Republic of Kazakhstan. It was shown that further increase in ground air temperature and increase in annual average precipitation amount are expected on the territory of the Republic of Kazakhstan. Scientific hypothesizes with respect to water consumption development and dynamics of existing water resources by particular basins are taken as a basis of forecasting scenarios on water supply of the Republic of Kazakhstan.

Key indices of strategy in mid-term (2020) and long-term (2030) are based on comparison of alternative water supply scenarios of the Republic of Kazakhstan (inertial, water saving, innovative) with the use of water security criteria system, taking into account the existence of multidimensionality, uncertainty, conflict factors, pertaining to complicated systems. Use of proposed criteria system is necessary, but insufficient for making managerial decisions. In this regard the received results shall be considered as interim results, which require further grounds on the basis of use of more voluminous information and modern methods of its processing. Inertial scenario provides for realization of trends existing in the Republic of Kazakhstan with respect to water utilization and factors, determining them. Provision of developing need in water in the realization process of such scenario may be performed by increasing the use of local surface and ground waters. Domestic water consumption will increase by 15% each 10 years in perspective according to such scenario, if environment norms on water are stable. Development of water utilization according to the inertial scenario can cause the deep deficit of fresh water and difficult economic damages and disturbance of natural environment.

Materials of General multipurpose water resources utilization and conservation scheme with respect to main basins of the Republic of Kazakhstan until 2020 with conditional trend extrapolation are taken as a basis of water saving scenario. It provides for performance of complex reconstruction and modernization of irrigation and collector networks and hydraulic facilities; creation of optimum reclamation mode, increase in technical level of hydro-reclamation systems and its performance coefficient up to 0.75, providing the saving of water resources; implementation of modern Automated management system of water metering, water distribution and irrigation. Total domestic water consumption, as well as environment and obligatory costs of runoff will be stabilized by 2020, and domestic water consumption will be reduced on 10% until 2030 due to implementation of advanced technologies. Scenario does not exclude the possibility for formation of deficit of fresh water in the long-term, and thus it is necessary to realize the program with respect to territorial redistribution of water resources after 2020.

Innovative scenario provides for realization of strategy with respect to innovative transformation of water economic sector in the Republic of Kazakhstan on the principles of sustainable development, including formation of Unified water supply system in the Republic of Kazakhstan. Total water consumption will stabilize and will not exceed the level of 2010 in the longer term according to the scenario. Water-retaining sectors will develop due to intensive utilization of water resources. Expected reduce in existing water resources in the Republic of Kazakhstan will be compensated by trans-boundary and inter-basin transfers of river runoff. Common use of modern water-saving technologies in economic sectors, improvement of inter-state water relations and inter-basin and trans-boundary transfers of river runoff may become the basis for provision of water security in the Republic of Kazakhstan. This scenario provides the balance of water utilization in all eight basin natural and domestic systems of the Republic of Kazakhstan.

According to the calculations of United Nations Development Program, the satisfaction of demand for water will be impossible by 2050. According to estimates of Water Resources Committee of the Ministry of Environment Protection of the Republic of Kazakhstan, the reduce in existing resources of surface waters is expected from 100 to 70 km3/year by 2020, and reduce in trans-boundary runoff – from 44 to 18.5 km3/year. Our local water runoff will reduce by the range from 10 to 20% by the period from 2010 to 2030 due to intensive thawing of glaciers. According to estimates of UN, water consumption in the Republic of Kazakhstan will be almost equal to volume of water runoff by 2020. There is a risk of the most rigorous water deficit and according to the estimate of foreign researchers the Republic of Kazakhstan may occur in the list of states of catastrophic water stress by 2050.

6.2.5. Heath of population

Research on the topic «Influence, vulnerability and assessment of adaptive possibilities of healthcare system of the Republic of Kazakhstan to climate change» was conducted by the Ministry of Public Health of the Republic of Kazakhstan with support of World Health Organization (WHO) and German Federal Ministry for Environment, Nature Conservation and Nuclear Safety (BMU) within the periodfrom 2010 to 2012. Methodology proposed by WHO in publications «Assessment methods of vulnerability of human health and adaptation of public healthcare to climate change» and «WHO Guide to disease severity, conditioned upon environment state, for assessment of influence of climate change on human health on national and local levels» was used in order to study connection between meteorological parameters and health indices. Relevance of problem for current healthcare system is taken into account for study in the selection process of nosology. These are circulatory diseases, respiratory diseases, infectious diseases as well as problems in mental health. Historical data of daily accidents related to mortality, emergency medical aid appealability for six years, monthly accidents of salmonellosis and «A» hepatitis for eleven years were collected and studied for determination of association with climatic variables. Main conclusions with respect to influence of climate change on health state of population of Kazakhstan in terms of priority disease groups are presented below.

Circulatory diseases

Decrease in amount of deaths by arterial hypertension, absence of growth in deaths by ischemic heart disease are observed in warm season at increased air temperature, and increase in deaths by cerebrovascular diseases from 1.2% to 2.7% is observed if air temperature is increased by 1 ˚C. Women, suffering from cerebrovascular diseases, especially in age group older than 60 years are the most sensitive to increase of air temperature in warm season. Dependence between decrease in air temperature and increase in amount of deaths by arterial hypertension and ischemic heart disease is not observed in cold season, contrary to all expectations. Results of analysis with respect to cerebrovascular diseases makes possible to suggest a hypothesis about increase in amount of deaths as a result of decrease in air temperature. It is necessary to conduct research with bigger sample size in order to verify such suggestion.

Respiratory diseases

Dependence between increase in temperature by 1˚C and decrease in emergency medical aid appealability in connection with bronchial asthma from 0.5% to 3.6% in different age-sex groups is observed in warm season. Dependence between decrease in air temperature by 1˚C and increase in emergency medical aid appealability in connection with bronchial asthma from 1.7% to 2.0% in different age-sex groups is observed in cold season.

Infectious diseases

Conclusions with respect to influence of climate change on salmonellosis morbidity were made for two regions. In the Astana the increase in average monthly air temperature by 1˚C is associated with increase in accidents of salmonellosis by 5.5% (95% CI: 2.2-8.8) in the same month; increase in average monthly precipitation amount by 1 mm is associated with increase in accidents of salmonellosis by 0.5% (95% CI: 0.1-1.0) after two months. In South-Kazakhstan region the increase in average monthly precipitation amount on 1 mm is associated with increase in accidents of salmonellosis by 0.6% (95% CI: 0.1-1.1) in the same month.

Dependence between «A» hepatitis morbidity and climate change was analyzed in four regions of the country. In Almaty the increase in average monthly air temperature by 1˚C is associated with decrease in accidents of «A» hepatitis by 3.3% (95% CI: -6.5; -0.2) after 1 month. In the North-Kazakhstan region the increase in average monthly precipitation amount by 1 mm is associated with decrease in accidents of «A» hepatitis by 1% (95% CI: -1.7; -0.2) after 2 months. In the South-Kazakhstan region the increase in average monthly air temperature by 1˚C is associated with decrease in accidents of «A» hepatitis by 2.4% (95% CI: -4.8; -0.1) in the same month and by 2.3% (95% CI: -4.4; -0.3) in the following month. In the South-Kazakhstan region the increase in average monthly precipitation amount by 1 mm is associated with decrease in accidents of «A» hepatitis by 0.1% (95% CI: -0.3;

-0.01) after 2 months In Astana no dependence between average monthly climate variables and «A» hepatitis morbidity is observed.

Mental health

Results of conducted research make possible to assume the availability of dependence between climate variables and daily indices of fatal cases from external causes. Thus increase in average daily effective air temperature on 1˚C is associated with increase in amount of deaths by intentional self-injuries (X60-84) by 2% (95% ci: 0.39-3.62), by accidental drowning and water immersion (W65-W74) by 9.55% (95% CI: 2.08-17.0). Increase in relative air humidity by 1% is associated with increase in drowning (W65-W74) by 4.87% (95% CI: 2.16-7.58). Further study of reasons and development of measures for decrease of suicides in the country are directly related to improvement of registration of such cases in the country.

The following groups, which are vulnerable to climate change, were determined as a result of research work:

- Habitants of rural regions, 40% of which have the limited access both to safe fresh water and healthcare system;
- Habitants of metropolises and cities, population of which amounts to more than 55% of country population, with the risk of heat island and tense environmental situation in large cities;
- Old people, population of which in Kazakhstan grows and according to the forecasts will amount to more than 11% of population until 2030, and due to such fact the medical and social services are to be required to be provided and loading on healthcare sector with account for background of diseases is to be required to be increased.

It is necessary to give special attention to the following dangers, detected by the conducted research:

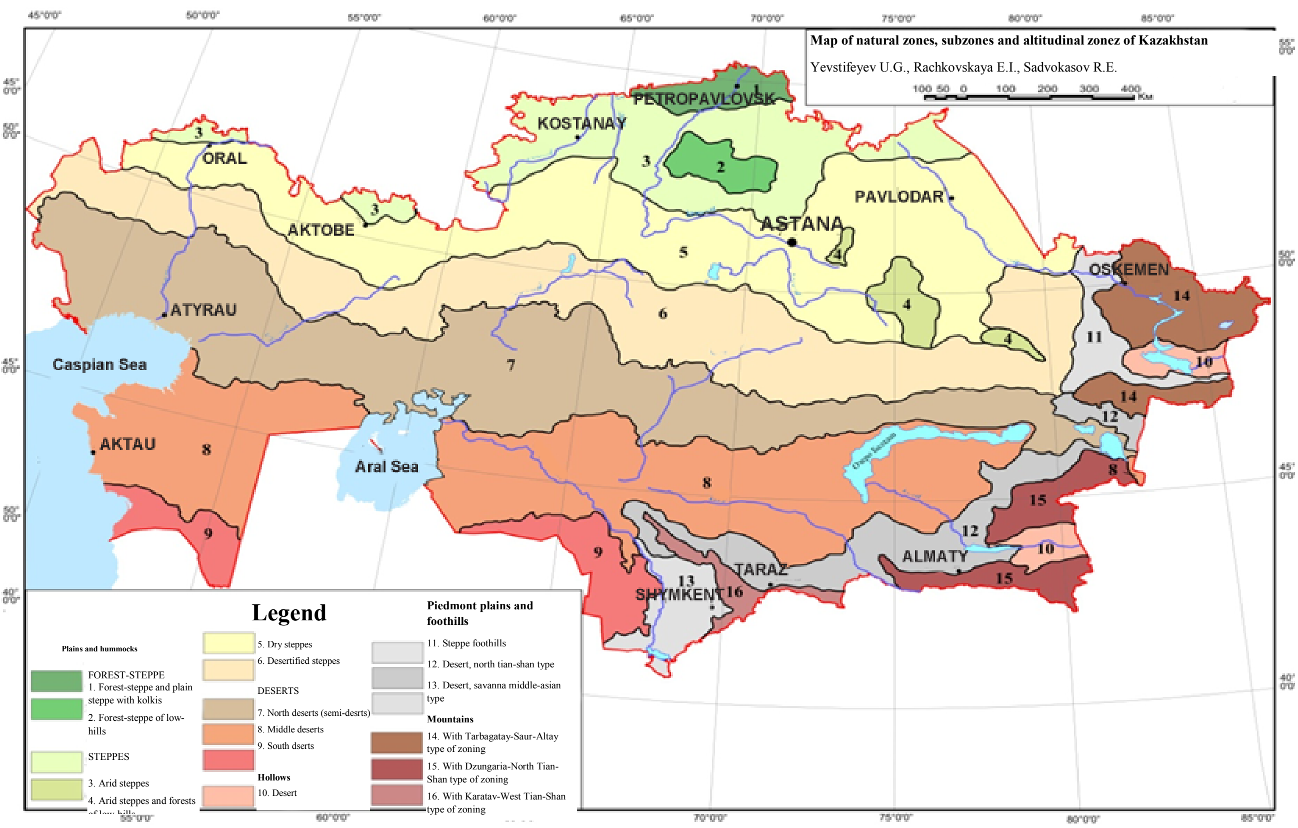
- Risk for distribution of infectious and highly dangerous infections due to presence of broad and active natural focuses of highly dangerous infections on the territory of Kazakhstan and risk of transfer from the outside;
- Risk for growth of dangerous natural disasters, emergency events, conditioned upon climate change.

6.2.6. Natural ecosystems

Territory of the Republic of Kazakhstan is characterized by the biggest diversity of types of ecosystems in the Central Asia due to unique combination of natural complexes of steppes, deserts, mountains, large intra-continental water bodies with rivers falling into them and well-developed deltas.

Figure 6.12

Map of natural zones, subzones and altitudinal zonez of Kazakhstan



Sources: National strategy and plan of actions with respect to conservation and balanced utilization of biological diversity of the Republic of Kazakhstan, 1999, p. 34

Climate is the most important factor of spatial biodiversity distribution and it followed by relief and mode of surface runoff. All together they determine diversity of types of ecosystems, soil and vegetation in various natural and climatic zones.

Each ecosystem supports the particular set of types of flora and fauna in the range of cyclic changes (fluctuations), conditioned mainly upon climatic factors. It is especially related to vegetation because the drought-resistant plants dominate in dry years and some species are in the state of anabiosis (dormancy) and do not sprout, and the water-resistant plants dominate in in wet years and biodiversity and productivity increase.

Regularities of spatial structure of ecosystems are subordinated to change of latitudinal zoning and altitudinal zoning. Vegetative-ground cover is an indicator of all these changes. Zonal ecosystems formed on watersheds in conditions of automorphic moisture regime (atmosphere precipitation) are markers of ecosystem belonging to particular latitudinal zone, subzone or altitutidial zone.

Geographic location of Kazakhstan in the centre of Eurasia continent and big area of territory determine the wide range of climatic changes. The regular change-over of climatic types or latitudinal climatic natural zones and relative subzones (Figure 6.9) occurs in direction from north to south within the republic according to the change of hydrothermal indices:

- Forest-steppe zone - subzone of south forest-steppe.
- Steppe zone with subzones of semi-arid, arid, dry and desert steppes.
- Desert zone with subzones of north, middle (true) and south deserts.

Also biodiversity especially floristic biodiversity in direction from forest-steppe to deserts is regularly decreased together with change of zoning.

Vertical zoning, where together with altitude gain the rapid change of climatic parameters, which is expressed in decrease of temperature and increase of precipitation amount, takes place in the central part of the country, on south and south-east as a result of mountain lifting (Central-Kazakhstan hummocks, Altay, Saur, Tarbagatay, Dzungarian Alatau, North, West and Central Tian-Shan mountains).

Reverse climatic inversion takes place in intermountain hollows (Zaisan, Alakol, Ili), while in direction to the centre of hollow the temperature increase and precipitation decrease are observed, and such events are accompanied with gradual transition from steppe to desert, but in the narrower spatial line than in the change process of latitudinal zoning.

Spatial climatic gradients are extended on plains and rapid change of altitudinal zones is observed in mountains with gain of altitude and change of environment factors.

If climate is changed on plains (forest-steppe, steppe, desert), then ecosystems coincided with increased relief elements are the most vulnerable and their moisture regime depends only on atmosphere precipitation of deserts.

Altitudinal zoning in mountains may be considered as another «model» of spatial change of ecosystems on climatic gradient. In altitudinal gradient the diversity of ecosystem types and biodiversity increase and reach the maximum in middle zones. Lower and upper zones of mountains are characterized by contraction of environmental conditions and biodiversity.

In mountains the ecosystems of lower zone (steppe and desert foothills) and upper zone, especially nival zones, are the most vulnerable as a result of thawing of glaciers and permanent snow. Ecosystems, coincided with these zones, will be transformed quicker than middle types (forest, meadow, forest-steppe and forest-meadow) in case of scenario of climate warming. Orientation of slopes has the great importance; north and the wetter forest slopes will be transformed quicker than south steppe slopes because the range of environmental conditions, which is favorable for forest ecosystems, is narrower than for steppe ecosystems.

In general the structure of latitudinal zoning on plains (forest-steppe, steppe and desert) and of altitudinal zoning in mountains is natural model of ecosystem reaction on climate change, but for the long period of evolution. Data on change of upper and lower forest line, thawing of glaciers and snow patches as a result of secular variations of climatic parameters are available. Replace processes of ecosystems from high-mountain tundra to alpine and subalpine meadows, environmental niche of which is lower with respect to altitudinal zone, are activated in the last 20 years in Altay Mountains. It is accompanied with reduction in area of tundra and other types of ecosystems and full loss of some species of flora and fauna, which are typical for them.

Advance of south flora elements to the north is observed on plains and it reflects on change in floristic composition of communities. On the territory of Kazakhstan some species of plants, related to Mediterranean area type, actively moved to the north; they may be considered as indicators of climate warming. The most indicative trees are Elaeagnus oxycarpa and Asiatic poplar (Popular diversifolia), which were formerly observed in river valleys of desert zone but now dominate also in steppe zone. There are a lot of such examples, especially with cultivated plants, delivered from the warmer climate and successfully sprouting in middle latitudes. At the same time in steppe zone of West Kazakhstan the droughts and their duration have become more frequent, cycling of precipitation fallout is changing. Vegetation is an indicator of such processes. Events when there is almost no precipitation in spring and in the first half of summer, and abundant rain fall in August have become more frequent in particular regions of steppe zone and especially in West Kazakhstan. In September the air temperature is high, all steppe shrubs (pea shrub, spiraea, almond, briar) as well as dandelion and other annual plants effloresce after rain, and feather grass gains phytomass and blossoms. Migration of precipitation abundance to summer (July, beginning of August) is observed in particular years in desert zone and duration of period with maximum high temperature increases. It results in destruction of plants, containing a lot of water in vegetative organs (succulent saltwart and etc.). Frequent periodicity of such event has a negative impact on floristic diversity, and it reflects on forage quality and pasture productivity. The most noticeable changes are observed in ecosystems, coincided with transitional lines between latitudinal zones and subzones, which are called as ecotones.

On the basis of this data and structure of distribution of vegetative-ground cover on plains it may be assumed that it is necessary to wait for change, which is similar to state of further south subzone, and in mountains – for lower zone in case of climate warming, but to the contrary in case of climate cooling. In other words the replace with mixed forest with domination of deciduous forest will occur in Altay Mountains in zone of dark coniferous taiga in case of warming and with domination of subalpine meadows - in case of cooling. Subzone of desertificated steppes will be replaced with subzone of steppe deserts on the border of steppe and desert zones.

Specific parameter set of environment and ecosystems is characteristic of each latitudinal zone and altitudinal zone. Typical (zonal) indigenous ecosystems occupy the middle position within its limits. They constitute the standard of structure, floristic and phyto-coenotic diversity; they may be determined by the following criteria:

- Typical soil belonging to one of main sequences of soil formation (sod, forest, meadow and etc.);
- Relation of dominated and main types of grass and shrub layer to the same ecotype (mezophyte, xerophyte and etc.);
- Resistance of dominated life forms of plants (trees, shrubs, grass and etc.);
- Uniform horizontal structure of communities and equal spatial distribution of species in them;
- Small range of cyclic changes in hydrothermal parameters of habitats (ecotopic fluctuations).

Border areas (transitional zones or ecotones) from one subzone/altitudinal zone to another one are distinguished by non-uniform spatial structure and «flashing» of floristic diversity as a result of flora interpenetration, multiple-factor influence of environmental conditions and non-uniformity of their distribution in the space. They are not resistant to impact of both natural and anthropogenic factors as a result of non-uniformity and instability of environmental conditions, composition and structure of vegetative-ground cover.

If external factors, mainly climate (droughts, frosts and etc.) prevail in ecosystems of transitional zones, then they weaken the internal connections of biotic communities and its components and cause the rapid change of ecosystems and even landscapes. Changes within one type of ecosystems may have the cyclic nature, when their return to initial state occurs in specific conditions. In case of significant trends, these changes take directional nature and full replace of one ecosystem type with another one occurs, for instance, replace of steppe ecosystems with desert ecosystems, but this process requires longer time.

Thus even insignificant changes in environmental conditions in ecosystems of transition line appear in change of biodiversity, but the same cannot be said of standard and middle ecosystems. That is why ecosystems of transitional zones/belts may be indicators of change in climatic parameters, especially in temperature and humidity. Ecosystems in transition line between steppe and desert zones are the most indicative in this context in plain territory of Kazakhstan. In mountains the transitional zones of lower forest line (from deciduous forests to steppes) and upper line (from mountain taiga or mixed forest to subalpine meadows) will be the most informative in case of climate change.

Climatic and even meteorological factors does not influence separately on particular belt or ecosystem, and have almost general nature, enclosing certain location or even region at the same time. Rapid repetition of abnormal situations makes possible to talk about directional changes or trends.

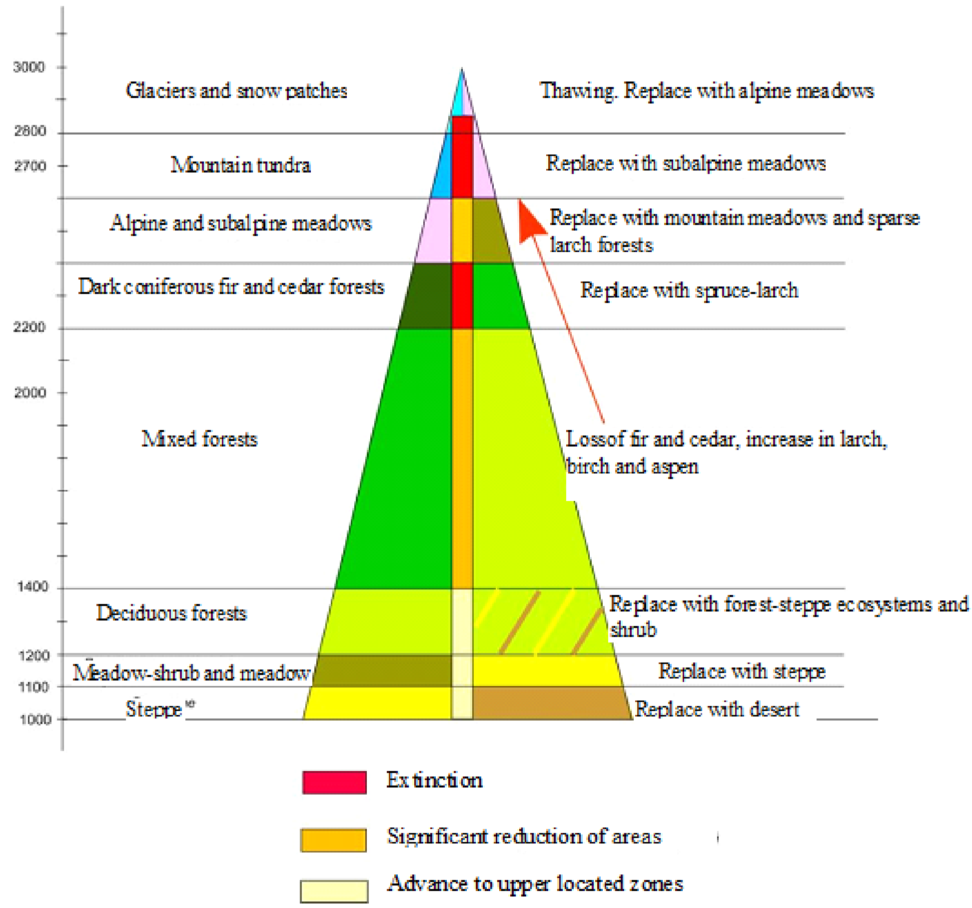
If ecosystems are in natural state, in other words do not suffer from anthropogenic influence or it is insignificant, then speed of successions is slowed due to large biodiversity, providing the compensation mechanisms. For instance, some species of plants dominate in wet and cold years, and another species – in dry and warm years. Thus the composition and structure of communities modestly change, especially in forests.

In case of anthropogenic influence the composition and structure of communities are simplified, loss of biodiversity occurs, compensation mechanisms are lost. If upper soil horizons are disturbed as a result of anthropogenic influence, then projective soil cover with plants is reduced. The result is that any insignificant changes have a negative impact on state of ecosystems. As a rule, the aridization of ecosystems intensifies in case of anthropogenic influence. That is why anthropogenically-disturbed ecosystems desertify quickly as a result of change in climatic parameters towards temperature increase and humidity decrease. If anthropogenic influence has local nature and in the environment there are a lot of undisturbed ecosystems, then degradation rates are reduced due to restoration of biodiversity with the help of seed material and diaspore from the outside. If anthropogenic influence has frontal long-term nature, then vegetation convergence, which is expressed in absence of differentiation of species and communities with respect to relief elements and soil types, occurs as a result of «diaspore hunger». In such conditions in case of climate warming the degradation rates will be significantly accelerated and areal coverage will be increased. Neighborhoods of settlements, where cattle are grazed, especially in steppe belt are good example of rapid transformation of ecosystems. They are fully degraded in case of droughts and high temperatures in spring and summer periods. Thus resistance to climate change (warming) is reduced in transfer processes from standard (not disturbed) ecosystems to not disturbed transitional zones, from subzone/altitudinal zone to further south latitudinal subzone on plains or to lower altitudinal belt in mountains to belt of standard disturbed and transitional disturbed ecosystems. Anthropogenic factors together with climate change accelerate the aridization processes both on plains and in mountains.

Forecasted changes in distribution of ecosystems with respect to altitudinal zones in Altay Mountains in conditions of climate warming are presented on Figure 6.10.

Figure 6.13

Change in zoning structure of ecosystems in case of climate warming



Sources: *Source: Ogar N.P. «Vulnerability assessment of specially protected areas of Kazakhstan part of Altay-Sayan ecoregion (KASE) in case of climate changes». Project of UNDP 00052843 «Conservation and sustainable utilization of biodiversity of the Kazakh part of Altai-Sayan Ecoregion».*

As a result of climate warming the biodiversity will be changed, in vegetation cover the boreal species will disappear, including many uncommon plants as well as some species of animals (snow leopard, stone marten, brown bear and etc.). Possible scenarios of ecosystem change as a result of climate warming in Altay Mountains are presented in table 6.14

Table 6.14

Possible ecosystem changes in Altay Mountains in short term, middle term and long term

Ecosystems	Short-term changes	Middle-term changes	Long-term changes
Nival (glaciers and permanent snow)	Thawing of glaciers and permanent snow, insignificant reduction of areas are observed in the present time. Snow will remain for a longer time due to increase in winter precipitation.	Gradual replace of nival ecosystems with ecosystems of mountain tundra and alpine meadows, process intensity will be increased in the course of time.	It threatened with full disappearance; maybe, permafrost areas will remain locally. Mountain peaks of Western and Southern Altay will be meadow-steppe, as peaks of Tarbagatay Range in the present time.
Mountain tundra	Here areas of marsh ecosystems may be increased in case of forecasted increase of precipitation in winter period. Such ecosystems are threatened with full disappearance in long term.	These ecosystems will be slowly replaced with subalpine and alpine meadows, except for stony and crushed stony tundra, where habitation of high-mountain petrophyte shrubs is possible.	Such ecosystems are threatened with full disappearance by the end of this century; maybe, areas, coincided with relict permafrost will remain locally.
Alpine and subalpine meadows	March of upper forest line in this zone, natural restoration of larch (Larix sibirica) and cedar (Pinus sibirica) are observed in the present time.	Gradual march of forest upwards, replace of alpine meadows with subalpine meadows.	Disappearance of alpine meadows. Replace of subalpine meadows with forest and meadow ecosystems.
Dark coniferous forests (Abies sibirica, (Pinus sibirica, Picea obovata)	Shrinkage of fir forests and more intensive attack of diseases and insects are observed in dry years. Natural restoration of cedar is almost stopped and old trees died in Markakol Reserve in last 10 years.	Gradual replace of dark coniferous forests with deciduous forests (Larix sibirica) will be observed and participation share of deciduous trees (Betula pendula, Populus tremula) will be increased.	At first meadow-steppe deciduous sparse forests together with deciduous forests according to the negative relief form will be developed instead of dark coniferous forests. Ecosystem of black taiga will disappear in lower zones of mountains.
Mixed deciduous-coniferous forests	Abundance of coniferous trees is reduced; they are often attacked with diseases and insects and burned out as a result of fires.	March of forests to upper zones. Dark coniferous trees (fir, cedar, spruce) will die gradually and be replaced with larch (Larix sibirica).	These forests will be replaced with deciduous trees (birch, aspen) and shrubs. Meadows of this zone will be gradually replaced with steppes.
Deciduous forests(birch, aspen)	These forests are suffered from anthropogenic influence near settlements in lower zones of mountains, and this process is accompanied with degradation of grass layer.	Share of aspen will be increased. Aspen will be moved gradually from watersheds to river valleys and floodplains. Aspen forests may remain on lower sides of north slopes in narrow gorges.	Further south flora elements such as crab apple, hawthorn, various types of briar, honeysuckle and other shrubs may be implemented into composition of these forests.
Shrub thickets	They are resistant in the present time; often in the lower layer they are suffered from influence of anthropogenic factors and fires.	Replace of mezophytic types with xerophytic types will be observed, abundance of juniper, pea shrub, cotoneaster and etc. in middle and lower zones of south slopes is to be increased.	Meadow plant species will disappear in grass layer and they will be replaced with steppe plants.

Ecosystems	Short-term changes	Middle-term changes	Long-term changes
Mountain meadows	They are resistant in the present time; often in the lower layer they are suffered from influence of anthropogenic factors, including haying and this process is accompanied with loss of floristic biodiversity.	These meadows will be replaced with steppes in different zones of mountains on watersheds.	They will remain only in high mountains and river floodplains. Thus replace of species composition of grass and forbs with further south elements will occur.
Steppe ecosystems of dark coniferous forests	They are resistant in the present time; often in the lower layer they are suffered from influence of anthropogenic factors, including cattle pasturing.	Areas of arid and dry steppes will be increased.	These ecosystems will be gradually desertified; abundance of wormwoods and drought-resistance herbs will be increased in them.

6.2.7. Social and economic development

Four groups of indicators were selected in order to assess vulnerability of Kazakhstan regions to climate changes and their consequences: economic potential of regions to adaptation to climate change, sensitivity of regions to climate change, features of climate change in regions and exposure of regions to risk of emergency situations. Analysis is oriented on vulnerability assessment of rural population.

Indicators are selected with account for social and development situation in regions, as well as accessibility and quality of statistic data on regions of Kazakhstan, including climatic information. Thus indicators include the following parameters:

Economic potential of regions to adaptation to climate change:

- Share of population, having income below poverty line;
- Gini coefficient;
- Gross Regional Product per capita;
- Population coverage by education system (it is used in calculation of human development index);

Sensitivity of regions to climate change:

- Share of hydro-power plants (HPP), located in regions, in satisfaction of regional demand on electrical power;
- Share of produced agricultural products in Gross Regional Product;
- Share of people, involved in agriculture, in total amount of workers in region;
- Share of population, having stable access to quality drinking water;

Features of climate change in regions:

- Change in average annual air temperature, °C;
- Change in amount of precipitation in summer, %;
- Number of days per year, when daily maximum of temperature exceeds 25°C;
- Change in duration of heat waves.

Exposure to risk of emergency situations:

- Mudflow and landslide hazards;
- High water and flood;
- Fire hazard of forest territories;
- Repetition of severe droughts;
- Change in duration of heat waves per year, when during at least 6 consecutive days the daily maximum of ground air temperature was extremely high (it exceeded the value of 90th percentile);
- Average number of days with dangerous and highly dangerous dust storms;
- Maximum wind speed;
- Number of days with heavy precipitation (more than 20 mm);
- number of days with snowstorm.

Normalized regional factors (table 6.15) were used for aggregated vulnerability assessment of Kazakhstan regions to climate change. They characterize:

- economic potential of regions to adaptation;
- sensitivity of regions to climate change;
- features of climate change in regions.

Table 6.15

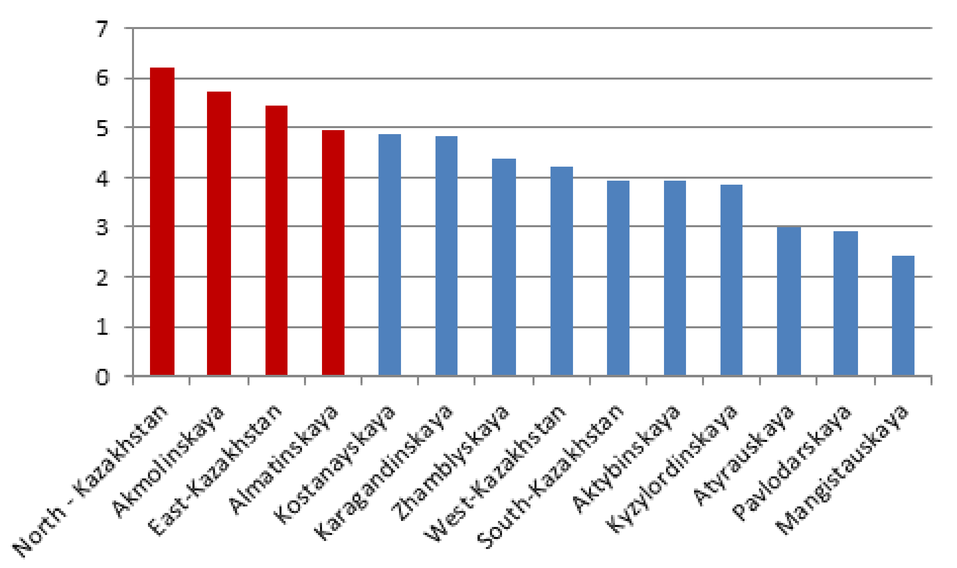
Values of indicators with respect to groups and Kazakhstan regions

Region	Economic potential of regions to adaptation	Sensitivity of regions to climate change	Features of climate change in regions
Akmola	9,9	7,386	3,88
Aktobe	5,3	4,995	3,47
Almaty	9,1	8,658	1,34
Atyrau	2,3	2,886	4,2
West-Kazakhstan	6	4,803	3,94
Zhambyl	10,1	5,76	1,61
Karaganda	7,4	4,053	5,35
Kostanay	8,9	6,123	3,11
Kyzylorda	7,6	5,235	1,92
Mangystau	3,4	2,469	2,51
South-Kazakhstan	10,5	6,3	-0,1
Pavlodar	5,1	4,365	1,44

Region	Economic potential of regions to adaptation	Sensitivity of regions to climate change	Features of climate change in regions
North-Kazakhstan	10,7	9,102	3,35
East-Kazakhstan	8,7	5,25	5,27

Figure 6.14

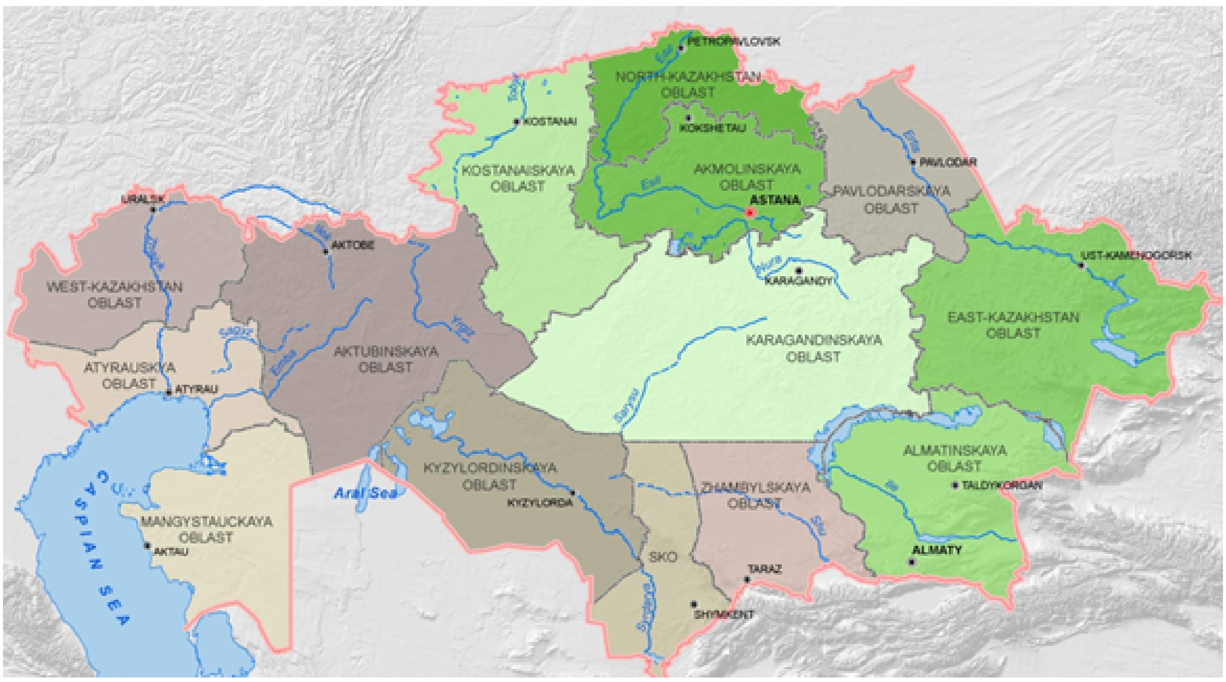
Ranking of Kazakhstan regions with respect to level of their vulnerability to climate change



Rural territories of North-Kazakhstan, Akmola, East-Kazakhstan, Almaty and Kostanay regions are the most vulnerable according to the summation of considered factors.

Figure 6.15

Vulnerability map of Kazakhstan regions to climate change



Note: if region is more vulnerable to climate change, then green color is more intensive.

Agriculture dominates in economic structure of Kazakhstan regions, which are determined as the most vulnerable. Climatic regime of these regions is characterized by the most significant changes, which are expressed in reduction of precipitation amount, increase of average annual air temperature and change of soil humidity. Thus vulnerability of agriculture in the face of climatic changes predetermined sensitivity of these regions to climate change.

Indicator of exposure to risk of natural emergency situations was not considered in aggregated vulnerability assessment of Kazakhstan regions to climate change because due to latitude and diversity of geography and natural and climatic conditions of Kazakhstan regions the various natural emergency situations are characteristic of different regions.

Nevertheless, if proceed from ranking of regions with respect to risk factor of emergency situations, then specified regions are also characterized by increased level of this risk. So, for example, Almaty, East-Kazakhstan, Kostanay regions are related to the most vulnerable regions with respect to risks of natural emergency situations.

Domination of rural population, low efficiency of agriculture, insufficient availability of water resources make specified regions sensitive to climatic changes.

Climate change complicates agricultural production, reduces its efficiency, has a negative impact on food security and reduces social and economic conditions and life level of population of regions, which are the most vulnerable to risks of climate change

6.3. Activities on adaptation to climate change

6.3.1. Extreme meteorological events

Project on assessment of economic efficiency of development of National Hydro-meteorological Service of the Republic of Kazakhstan [4] was performed by the National Hydro-meteorological Service (NHMS), represented by «Kazhydromet» RSE, under order of the Ministry of Environment Protection of the Republic of Kazakhstan and with financial support from the World Bank in 2006.

First of all the assessment showed that economy of the Republic of Kazakhstan is characterized by «average» general weather dependence: total share of weather-dependent sectors amounted to 42.7% of GDP (gross domestic product) in 2004 and 45.3% of GDP in 2005. Agriculture is the most weather-dependent sector (6.4% of GDP in 2005), openness of which to influences of weather events determines the level of total damages to economy of countries. Preliminary estimates of efficiency of hydro-meteorological support, provided by the NHMS, which are received according to the analogue method, showed that economy of the republic loses at the average more than 140 million US dollars (in prices of 2005) due to losses from dangerous hydro-meteorological events and unfavorable conditions (see table 6.16). Estimated value of average annual economic effect of current NHMS activity amounted to about 16 million dollar and this fact indicates that economic effect (benefits) from prevention of losses through the use of available hydro-meteorological support potential is double the volume of current annual financing of national hydro-meteorological service.

Table 6.16

Main assessment results of economic efficiency of hydro-meteorological support of NHMS of Kazakhstan (as on 2005) [4]

	In prices of 2000	In prices of 2005
Total volume of incurred losses from unfavorable weather conditions (million US dollar)	77,9	146,4
Share of incurred losses, in % of GDP	0.32	0.32
Potential losses, which could be avoided (minimum effect), million US dollar/year	39.0	73,3
including due to available hydro-meteorological support in the country	8,3	15,6
Coefficient of prevented losses	0,333	0,333
Marginal efficiency of hydro-meteorological support (%)	198	198

Estimating the efficiency of available hydro-meteorological support (in this case the relation of prevented losses to financing volume of NHMS), it is necessary to consider only estimates «below». Actual efficiency may be higher, if the indirect costs and benefits such as retained supplies (in the form of retained electric and heat power, fuel and etc.) or additional benefit, gained from the use of hydro-meteorological information in the form of increased yield capacity in agriculture are considered in the process of its assessment.

Activities which are oriented on reduce in risks of extreme weather events and realized for reporting period and in the present time or planned to be realized in Kazakhstan are presented in table 6.17. Modernization of National hydro-meteorological service, started in 2009, is one of these activities, as table shows. Notwithstanding that allocated financing volumes are increased from year to year, but still they are insufficient for achievement of desired objective – to achieve the level of developed countries in the hydro-meteorological service.

Table 6.17

Activities oriented on reduce in risks of extreme weather events (EWE) and realized in the Republic of Kazakhstan

№	Activity	Duration	Objective	Executive
1.	Reconstruction of «Western Europe – Western China» International Transit Corridor	2008 – 2019	Road traffic accidents related to such extreme weather events as glaze, heavy precipitation, fog, snowdrifts and etc. will be reduced as a result of realization of this investment project.	Asian Development Bank (ADB)
2.	Realization of republican budget program 025 «Zoning of Kazakhstan territories in terms of climatic features»	2013-2015	To renew the available Construction standards and rules with due regard to requirements of Eurocode. Construction standards establish extreme climatic parameters, which are used in design of building and structures, heating, ventilation, conditioning, water supply systems, and in planning and development of urban and rural settlements.	«Kazhydromet» RSE
3.	Realization of proposes, stated in Research work «Research and forecast of drought in Kazakhstan»	2010	To perform wide-scale complex research of drought in the vital natural environments: in atmosphere, on soil, in water bodies, in agricultural vegetation and fauna. Results are implemented into production activity of «Kazhydromet» RSE.	«Kazhydromet» RSE
4.	Development and publication of «Atlas of natural and man-made hazards and risks of emergency situation in the Republic of Kazakhstan»	2010	Cartographic generalization of data on natural and man-made hazards and creation of scientific and information base for development of strategy for protection of territories from natural and man-made disasters.	Institute of Geography of the Republic of Kazakhstan

№	Activity	Duration	Objective	Executive
5.	Realization of republican budget program 014 «Modernization of National hydro-meteorological service»	2009 – till present	Achievement of high level hydro-meteorological service of population and economic sectors.	«Kazhydromet» RSE

Necessity of effective risk reduction of disasters for life saving and protection of subsistence is widely supported in the countries of Central Asia and Caucasus region (CAC)[1] [56, 57].

Central Asia and Caucasus Disaster Risk Management Initiative (CAC DRMI), which is realized according to the Hyogo Framework for Action on 2005 – 2015, aims at reducing CAC region's vulnerability to the risk of natural disasters [56]. CAC DRMI incorporates three focus areas with the possibility of inclusion of additional activities:

- coordination of disaster mitigation, preparedness and response;
- financing of disaster losses, reconstruction and recovery and disaster risk transfer instruments such as catastrophe insurance and weather derivatives;
- hydro-meteorological forecasting, data sharing and early warning about natural disasters.

This initiative will constitute a ground for determination of (on the level of certain countries and regions) investment priorities in such areas as early warning, disaster risk reduction and financing of relative activities. This initiative is based on sustainable cooperation in the region. It shall complete and enhance activity of relative institutions in order to promote more effective disaster mitigation, preparedness and response.

This initiative is coordinated by the World Bank, United Nations International Strategy for Disaster Reduction (UNISDR) and World Meteorological Organization (WMO). Initiative is financed by the Global Facility for Disaster Reduction and Recovery (GFDRR) and other donors.

6.3.2. Agriculture

6.3.2.1. Measures on adaptation of plant-growing to expected climatic changes

Climate change contemplates both positive and negative consequences for plant-growing of the Republic of Kazakhstan. The following main negative consequences of expected climate changes were determined on the basis of conducted researches:

- increase in number of days with high air temperature;
- enhancement of climate dryness and increase in drought repetition;
- increase in share of rain-shower precipitation;
- increase in cases of hail fallout;
- reduction in period with snow cover;
- increase in inter-annual and intra-seasonal variability of weather pattern;
- increase in repetition of anomalous cold winters and hot summers;
- dislocation of agro-climatic wetting zones to the north;
- decrease in yield capacity of cereal crops;
- development of infectious diseases and insects of agricultural crops, distribution of weed vegetation.

The following main adaptation measures are implemented in the Republic of Kazakhstan in order to reduce negative consequences of climate change.

No-Till farming

According to the terminology of FAO, the No-till farming (No-Till) is a direct seeding by sowing machine with minimum soil destruction, in other words by disk or narrow chisel plow. In No-till farming the weed control is performed by herbicides.

In 2000 the International Maize and Wheat Improvement Centre (CIMMYT) together with scientists and farmers of Kazakhstan began work with respect to implementation of zero/minimum tillage and direct seeding system (with reservation of stubble, disintegration and spreading of straw on fields).

In conditions of unwatered farming the No-till technology increases significantly the soil fertility due to higher control over wind and water erosion, improvement of water-holding soil capability and increase of organic substances in its content. High stubble on fields retains and accumulates more snow and shredded and spread straw due to biological destruction improves soil structure and quality. Decrease in dependence of crop capacity from weather conditions as a result of No-till technology implementation is an adaptation measure to climate change.

Zh.A. Kaskarbayev, Director of Scientific Production Centre of Grain Farming (SPCGF), notes in own report [17] that mulching of soil surface by shredded straw on the background of minimization of tillage contributes to conservation and increase of moisture storage in soil, increase of organic substance in soil in 1.5 times, as

[1] Caucasus: Armenia, Azerbaijan and Georgia; Central Asia: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan.

well as contributes to increase in erosion resistance of soil surface. It is established in SPCGF that reduction in mechanical tillage in autumn, spring until full failure, use of disk and chisel-plow tools in crop seeding [18] are the basis for development of resource-saving technologies for cultivation of pulse and oil crops in steppe regions of North Kazakhstan.

Academician of National Academy of Sciences of the Republic of Kazakhstan M.K. Suleymenov thinks that it is possible to expect at the average the yield capacity of cereal crops in Akmola region – 11.0 centner/ha, in Kostanay region – 15.0 centner/ha, in North-Kazakhstan region – 16.0 centner/ha as a result of assimilation of resource-saving technologies.

As a result of no-tillage the sufficient amount of plant residues comes in, frequency of humus mineralization decreases on the annual basis, and this helps to increase soil fertility. As a result of no-tillage application the yield capacity is increased due to use of biological products and favorable soil density is formed.

Application of No-till technology on slope grounds for cultivation of agricultural crops in previous stubbles may cause the flow of melt waters due to the fact that infiltration is delayed in tight soil. About 33% of plough in North-Kazakhstan is located on slopes of more than 0.5°, and from 12 to 14% on slopes of the range from 1 to 3°. Hazard of erosion processes as a result of use of No-till technology in relation to landscape [9] is poorly known.

No-till technology is actively implemented in Kazakhstan in three north regions (North-Kazakhstan, Kostanay, and Akmola regions). According to Academician M.K. Suleymenov, the share of use of resource-saving technologies in areas for seeding of cereal crops in these regions amounts to the range from 40 to 70% and about 55% - at the average in the Republic.

Plant-growing diversification

Implementation of new and improved crop varieties is technology which is oriented on increase of plant productivity and quality, resistance to environmental stresses.

Diversification objective is to increase crop species in such a way to allow farmers not to depend on one crop species. Agricultural scientific organizations determine varieties, which are better adapted to climatic conditions.

If new crop species are implemented in order to diversify plant-growing system, it is necessary to take into account the great number of questions: accessibility and quality of natural resources, accessibility of technology for cultivation, storage and reprocessing; investment possibilities; market factors; institution and infrastructure factors and etc.

Plantings of sun flower, rape, flax, soybean and pea are increased in last years in Kazakhstan. Large crop variety provides big profitability with respect to plant-growing diversification in conditions of North Kazakhstan. From cereal crops – spring barley, millet, oat and buckwheat, from pulse crops – pea, chick-pea and lentil, from oil crops - sun flower, rape, flax and mustard [16].

Diversification makes possible to evade one-crop and become more independent in food production. Crop diversification creates conditions for provision of food security and allows farmers to get additional income. In comparison with one-crop production the plant-growing diversification makes possible to use natural resources consistently and effectively. Selection of new and improved crop varieties increases plant resistance to various stresses, occurring as a result of climate change. With various scheme the farmer increases own chances to get through conditions, occurred as a result of climate change.

Analysis of economic efficiency showed that plant-growing diversification in Kazakhstan by implementation of such crops as pea and rape in crop rotation increases profitability on 32% and 10% more than at traditional plough structure [13].

Implementation of effective irrigation systems

On the south of republic the farmers began to use drop irrigation. Drop irrigation is irrigation method, when water is supplied directly into root area of cultivated plants by controlled small portions through the dosing drippers. Drop irrigation has a lot of advantages and is adaptation measure to climate warming: water is drained uniformly and economically, fertilizers can also be directly supplied together with water to plant roots, growing of weed is minimized, salts are always washed from the root system, high yield is guaranteed. Irrigation with the use of plastic pipes and mixed use of drainage and irrigation water showed increase in water productivity on 15-25% in Kyrgyzstan, Turkmenistan and Uzbekistan.

Optimization (adjustment) of terms for performance of agro-technical activities to weather pattern

This measure provides for improvement of agro-meteorological monitoring and forecasting system, provision of agriculture with information. Works on modernization of hydro-meteorological survey system, on improvement and development of forecast methods of dangerous natural events, forecast methods of optimal terms for performance of agro-technical activities, forecast methods of agricultural crop state, as well as on improvement of operative information distribution to final consumer (farmer) are began in Kazhydromet. For instance, in 2011 Kazhydromet was provided with technical assistance in the form of modernization of agro-meteorological stations within the framework of «Second Agricultural Post-privatization Assistance Project» of World Bank and Ministry of Agriculture of the Republic of Kazakhstan. Project UNDP/USAID «Increase in resistance of wheat sector in

Kazakhstan to climate change for provision of food security in the Central Asia» (from 2012 to 2014) provides for intellectual assistance to Kazhydromet in the form of improvement of agro-forecasting methods.

These measures as a whole will help to use climatic and soil resources effectively, in the optimal terms perform seeding, agro-technical activities and yield harvesting, and this will significantly decrease the risk of influence of unfavorable weather events. For example, in North Kazakhstan the timely seeding of cereal crops is performed only in 45% of enterprises, and harvesting – in 38% of enterprises. Failure to comply with terms for performance of technological operations causes the loss of 40% of yield [28].

Re-equipment of agricultural vehicle and equipment fleet

Use of modern high-productive tractors and combine harvesters, various other machines and equipment makes possible to perform agro-technical activities, yield seeding and harvesting on timely basis, to a good quality and without losses and this use significantly reduces risk of exposure to unfavorable weather events.

Preparation and professional improvement of agricultural specialists

There is a shortage of well-qualified specialists, having complete knowledge about modern agricultural techniques, modern resource-saving and adaptive farming technology, about features of crop varieties, plant and soil protection methods and means, effective irrigation methods and means, as well as soil and climatic properties of Kazakhstan territory. Specialist of region and district agriculture department or agriculturer with such qualification could help farmers to adopt a right strategy in selection of crop and its varieties, production volumes, terms and methods for performance of agro-technical activities and this would make possible to get high yields, but avoid big losses in case of unfavorable weather conditions.

Improvement of plant-growing insurance system

Within the framework of «Second Agricultural Post-privatization Assistance Project» (from 2010 to 2012) of World Bank and Ministry of Agriculture of the Republic of Kazakhstan the experts of World Bank and Kazakhstan scientists in the field of agricultural insurance proposed to improve plant-growing insurance system by transferring it to the market system and transforming to commercial pool [15]. Thus it is proposed to transfer to voluntary insurance, implement insurance from many risks and new insurance products, implement reinsurance security on the excess of loss basis, as well as rationale the agricultural loss (death) assessment procedures and system. Effective plant-growing insurance system will make possible to minimize financial losses of agricultural product manufacturers as a result of unfavorable weather conditions.

6.3.2.2. Measures on adaptation of cattle breeding to expected climatic changes

Climate change contemplates both positive and negative consequences for cattle breeding of the Republic of Kazakhstan. The following main negative consequences from expected climate changes were determined on the basis of conducted researches:

- increase in number of days with high air temperature;
- increase in share of rain-shower precipitation;
- increase in cases of hail fallout;
- increase in inter-annual and intra-seasonal variability of weather pattern;
- increase in repetition of anomalous cold winters and hot summers;
- enhancement of climate dryness and increase in drought repetition;
- dislocation of agro-climatic wetting zones to the north;
- exaggeration of conditions of summer sheep pasturing on plain pastures;
- decrease in yield capacity and early wilting of vegetation on pastures;

Review of various sources [35, 36, 46], as well as results of our researches made possible to select main activities, which are implemented in Kazakhstan, for adaptation of cattle breeding to climate change.

Recovery of transhumant system of sheep management in the south part of Kazakhstan

Natural and climatic and pasture conditions of south part of republic make possible to keep sheep on pastures during the whole year. This technology was commonly used in Kazakhstan before breakup of institution of collective farms and state farms. Sheep drift from spring pastures to summer pastures makes possible to avoid the reduction of sheep productivity due to influence of high temperature on animal organism and transfer from burnt pastures to green pastures. Over pasturing and degradation of pastures are also avoided.

Cattle are drifted from one pasture to another pasture (winter, summer, spring and autumn pastures, and also year-round pastures) in certain seasons at transhumant system. Thus it is necessary to implement the cattle pasturing control system with account for pasturing capacity of pastures and climatic conditions, recover wells and watering points on pastures and regularize pasture lands for users. It is also necessary to arrange effective veterinary and sanitation supervision, protective-quarantine and other activities. Transhumant system of cattle managementis adaptation measure to climate change. It makes possible to unite various seasonal pastures, reduce exogenous loading on animals, effectively use pasture resources and finally makes possible to increase productivity of cattle breeding.

Torehanov A. and Alimayev I. [49] propose the reasonable pasture utilization system in 8 main pasture complexes. For instance, in Zhetysu-Pribalkhash pasture complex it is proposed to carry out the winter sheep pasturing (January-March) in Saryesik-Atyrau Desert. In unfavorable days the straw feeding is carried out. Saty-bulak mountain area, where brood and crutching of ewes are performed, is used in spring and at the beginning of summer (April – June). In summer and early autumn (July- September 15) the pasturing is carried out in Zhetysu Alatau middle mountains on Satyly mountain areas. At the same time the cattle are drifted to Matay mountain area. In autumn the sheep are again grazed in pre-desert of Churuk mountain area in 20-30 km from the place of spring pasturing. In the end of December the cattle are transferred to winter pasturing in Saryesik-Atyrau Desert. All cattle drift on seasonal pastures amounts to 180 -200 km per year. Sheep travel this route approximately for the period from 20 to 25 days by the range from 8 to 9 km per day.

Absence of water bodies and basins for cattle watering is one the factors, hindering the development of transhumant cattle breeding. Utilities, providing the cattle with water (more than 60 thousand of dug and pipe wells) became useless due to long-term inactivity.

Head of state has directed to fill up pastures with water in order to involve the distant pasture lands into use and develop pasture infrastructures for development of transhumant cattle breeding in Kazakhstan. Ministry of Agriculture of the Republic of Kazakhstan plans to fill up more than 8.0 million ha of pasture lands by constructing 4 thousand of wells in the period from 2013 to 2020 [www.minagri.kz].

Development of stall and pasture system of industrial animal management

In Kazakhstan this technology did not become a frequent practice, but particular elements have been already implemented. It is possible to transfer animal (sheep and cattle) on industrial stall and pasture management in the north part of republic in zone of high-intensive farming, where natural pastures are insufficient or even absent. Here it is possible to make animals be on pasture forage from May until October, and in cold half of year – on stall regime. Animal feeding depends on climatic conditions and arable fodder cropping [7]. Such animal management reduces dependence of animal productivity on external weather conditions.

Transfer to industrial management provides for construction of mechanized farms, implementation of new technologies, providing the full mechanization of production processes. Mechanized farms may be breeding, feeding, for young-stock breeding and with final production cycle, where various sex-age animal groups are kept. Optimal dimensions of these farms depend on specialization of zone and enterprise, management system, mechanization level and state of forage resources [45].

Mechanized farms may be used during summer for intensive animal feeding, which are subject to be slaughtered for meat. It makes possible to feed beef-cattle to stock and significantly reduce labor costs on production. For instance, increase in weaning lamb bodyweight by the range from 5 to 8 kg makes possible to get additional income from 1500to 2400 tenge more per each sheep [32].

Stock selection and breeding

Share of breeding cattle stock in republic amounted to 8.2% of total stock, sheep – 13.8%, swine – 19%, horse – 7%, camel – 10% and poultry – 11.7% as on January 1, 2013 [www.minagri.kz].

Master-plans on development of each cattle breeding sector are prepared in addition to program on development of agricultural sector in the Republic of Kazakhstan as of the period from 2013 to 2020 in the Ministry of Agriculture of the Republic of Kazakhstan. Master-plan on development of sheep breeding provides for subsidization of breeding stock, participating in stock selection and breeding, subsidization for purchase of breeding ewe and ram hogs [www.minagri.kz].

It is also necessary to perform zoo-climatic zoning of sheep breeds with account for climate change, determine the sheep adaptation rate and detect the most stress-resistant and adaptive sheep breeds for each natural and climatic zone of Kazakhstan and its subzones. Such activity will allow animals to adapt quickly to changes of climatic conditions. Similar research works were conducted on Australian Merinos and its reproductions in the experimental farm named after Mynbayev of Kazakh Scientific Research Technological Institute of Sheep Breeding (KazSRTI). Questions of acclimatization and adaptation of Australian Merinos in conditions of south-east of Kazakhstan are considered and its adaptive properties are studied in the works of Karabayev Zh.A [38,39].

Pasture improvement

It contemplates root and surface improvement of vegetation cover on degraded pastures. Natural umbrellas from saxaul forest trees are required to be planted in desert and semi-desert pastures. Production of rough forages by recovering the plantings of perennial grass on fallow lands is also provided for. Such activities will make possible not only to increase animal providing with forages but also reduce heat loading on animals.

Authors [48] think that grounds, which are withdrawn from 8 to 12 years ago from the use, are one of reserves for forage receipt. They can be used as pastures and hayfields. For instance, in the north regions of Kazakhstan such grounds amount to the range from 10 to 12 million and most of them are located near settlements. Such fallow grounds have good humus content, but high alkalinity (pH = 8.0-9.0), however they are appropriate for cultivation of forage grasses. Development and grassing on less than half of fallow grounds will make possible to provide about 2.0 million of cow heads with forages during the whole year.

Improvement of cattle breeding hydro-meteorological support system

It contemplates the modernization of hydro-meteorological survey system, improvement of forecast methods of weather events which are dangerous for cattle breeding and control methods, forecast methods of optimal terms for insemination, lambing, crutching, prophylactic sheep dipping and drift on pastures, calculation methods of pasture pasturing capacity and procurement volumes of reserve forage stocks for winter, as well as improvement of system of operative information distribution to final consumer (farmer). At the present time the works related to such processes have been already begun in Kazhydromet. These measures as a whole will help to use climatic and pasture resources effectively, in the optimal terms perform zoo-technical activities and this will significantly decrease the risk of exposure to unfavorable weather events on animals.

6.3.3. Water resources

There are 2 ways for fresh water deficit control in the Republic of Kazakhstan, which are determined in the Institute of Geography: decrease in loading on water resources and increase in fresh water resources. The first way provides for realization of activities on reduction of development rates of water-retaining productions and utilization of more advanced technologies for fresh water consumption reduction in industry, agriculture and municipal services. The second way provides for increase in water resources which are available for utilization at the account of over-year and seasonal storage river runoff, utilization of fresh ground water storage, demineralization of salt and brackish waters, territorial and trans-boundary redistribution of water resources.

Main activities on adaptation to climate change are determined:

- Construction of seasonal storage reservoir, implementation of drop irrigation system, performance of soil-protection activities, development of Law «On pastures», reinforcement of mudflow-protective facilities, increase of Specially Protected Natural Areas, increase in amount of modern meteorological stations and etc.
- It is also necessary to improve the climatic change forecast and warning system. Thus it is necessary to make the value of human life is the most important thing in the adaptation projects. Projects shall be assessed in the context of mortality prevention, related to climate change. Main steps to adaptation shall be: provision of cross-departmental integration, improvement of regulatory basis, arrangement of cross-border cooperation with respect to climate change. Performance of activities, determination of concepts will make it possible for Kazakhstan to transfer from mainly responsive adaptation type to preventive type and indemnify itself against losses, related to climate change.

Drinking water deficit may become one of consequences of climate change in Kazakhstan.

Development of water legislation of Kazakhstan with account for climate change

Many countries develop and implement own adaptation strategy to climate change for vulnerability reduction of population, economy and natural ecosystems to predictive negative consequences.

The following shall be focus areas of adaptation activity:

- involvement of society into adaptation process to climate change;
- provision of cross-departmental integration with respect to adaptation to climate change;
- improvement of regulatory basis of adaptation to climate change;
- arrangement of cross-border cooperation with respect to climate change.

Thus in the «Water resources» sector the reasonable utilization of water resources and increase in water utilization efficiency in agriculture are the focus areas of adaptation activity. For this it is necessary to perform the following main activities:

- Improvement of water utilization control system, including drought and flood risk prevention, construction of seasonal storage reservoirs for improvement of water supply of irrigated plant-growing in conditions of climate dryness enhancement in vegetation period and on the background of increase in water withdrawal higher up the trans-boundary rivers;
- Integration of questions of adaptation to climate change into ground and water resource utilization planning, including:

  - implementation of innovative methods of effective water utilization in agriculture, including drop irrigation systems;
  - selective recovery of destroyed areas of irrigation systems, where it is cost effectively;
  - optimization of structure of irrigated areas for cultivated plants, implementation of crops, which are the most valuable and adapted to new climatic conditions;
- Increase in awareness of population, farmers, entrepreneurs, specialists and persons making decisions with respect to social and economic consequences of climate change, including problem of increased water deficit.

Main principles of water resource quality depletion prevention, which come from the logic understanding of water resource formation in the process of natural water circulation, are:

- Refuse to present information about unlimited self-purification capacity of water and infinite of water resources; development of economic stimulation system of productions to waste and emission reduction without loss for development of social programs.
- Water resource protection in the process of their utilization: reduce in water-retaining capacity of productions up to transfer to low-water and dry technologies; local treatment of industrial wastes, closed reverse water supply, base of which is separate treatment of waste water of production lines, workshops and etc., containing one or group of similar pollutions; change of technologies, making possible to receive waste water, which are ready to be clean or regenerate waste recycling and etc.
- Remove of reasons, causing pollution, instead of pollution consequence control (principle of preventive measures instead of consequence control; removal of toxic substance discharge in the content of industrial waste water).
- Isolation of household water circulation from river, lake and ground circulation, division of two waste water disposal groups – municipal and industrial.

- Emergency situation warning by the system of advanced arrangement of extraction and transporting of mineral resources, waste disposal, excluding massive oil spillages, emission of radioactive wastes, area pollution washout from the sites for mineral resources development and waste storage.
- Prediction and prevention of disturbance of natural element circulation in nature under influence of activity in water catchment, global air pollution and climate warming (disturbance of ionic balance and water acidification; change in regime of biogenic substances and eutrophication, release of ionic toxic metal forms and etc.).
- Differential approach to water protection depending on natural conditions of water body and region, as well as specifics and manner of pollution agents, combination of contributing factors in specific situations, determination of regional ecologically-permissible loading norms.
- Advancement of disturbed water body recovery technology on the basis of knowledge of natural ecosystem successions: from developing to stable stage, having structure and functions, which are similar to natural state.
- In the adaptation sector of coastal territories of the Aral and Caspian Seas, the Balkhash Lake:
- Activation of problem solving with respect to trans-boundary river runoffs (their quality and volume), including harmonization of river water quality standards, including runoffs, replenishing the Balkhash Lake;
- Creation of mechanism for integrated water resources management (IWRM) with the use of funds from International Fund for Saving the Aral Sea (IFSA) and International Fund for Protection of the Caspian Sea for adaptation activities.

The following is required for reduction in negative influence consequences of water resource vulnerability on economic sector:

- Reconstruction of irrigation systems and water supply systems for water loss reduction;
- Replacement of water-loving agricultural crops on irrigated grounds with less water-loving crops;
- Integration of advanced technologies into irrigated farming;
- Integration of low-water technologies and reverse water utilization system on available industrial enterprises and municipal services;
- Waste water utilization;

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- Revision of operation modes of hydro-power plants;
- Performance of dredging works, reconstruction of quays, berths on navigable rivers:
- Replacement of available vessels of river transport and fishing fleet with shallow-draft vessels.

Measures on optimization of water ecosystem state and environment protection
- Creation of conditions for transfer to production with the use of water saving, cultivation of low-cost (in relation to water consumption) crops in the low-water regions and its transfer to another territories;
- Enhancement of legislation related to environmental requirements for sanitary-protection zones of facilities, having stationary emission sources, and for state environmental expertise of new projects, which provides for water resource utilization;
- All-round application of chemical and biological treatment of waste waters;
- Development and realization of additional reclamation, agro-forest reclamation and agro-technical activities for provision of environmental water resource safety;
- Creation of favorable water-heat regime for habitation and reproduction of fish and other living organisms, control of their number.

Measures of social loss reduction
- Allocation of funds for population as compensation for involuntary resettlement from desertification regions and for development of infrastructure in new settlements;
- Import of missing food products and manufactured goods due to its unprofitable production in conditions of possible reduction in water resources.

Measures on increase in decision-making promptness
- Development of intergovernmental control of water resource relations with account for prospective water resource change;
- Increase in earliness and correctness of hydrological forecasts;
- Development of models and scientifically-based recommendations, making possible to correctly and quickly assess situations, occurring as a result of water resource formation and utilization;
- Preparation of necessary services for immediate realization of possible decisions;
- Development of multipurpose water resources utilization and conservation schemes with account for climate change and adaptation to it;
- It is necessary to create simulation system, which would make it possible to simulate various situations and select the most acceptable variants of water resource management, in order to assess adaptation measures in detail.

Main activities, which are developed and applied in the present time for problem-solving in water economic sector of the Republic of Kazakhstan, are presented below.

Project of Water resource development and modernization program for the period from 2014 to 2020, containing analysis of country water resources, problems in water resources, ways of their solving and arguments for necessity of sector reform is developed in the Water Resources Committee of the Ministry of Environment Protection of the Republic of Kazakhstan. Realization of Program provides for step-by-step solving of available problems in water resource sector of the Republic of Kazakhstan, as well as number of transformations in water economic sector.

Funds in the amount of 1,518,707 million tenge are required for realization of this Program.

«Ak Bulak» Program for the period from 2011 to 2020 and Realization activity plan are approved by the Resolution of the Government of the Republic of Kazakhstan dated May 24, 2011. The main difference of this Program from previous «Drinking water» Program for the period from 2002 to 2010 is more than 11-fold increase in funds, planned for its realization. If funds in the amount of 115.2 billion tenge are planned for realization of «Drinking water» Program, then for realization of «Ak Bulak» Program - 1273.859 billion tenge.

It should be noted that in contrast to «Drinking water» Program the «Ak Bulak» Program covers firstly not only rural settlements, but also cities, and secondly not only water supply systems, but also water disposal systems (sewer systems).

Approximate capital investments for water resource and environmental protection activities were estimated at the development process of «General multipurpose water resources utilization and conservation scheme of the Republic of Kazakhstan», performed by the «Institute Kazhyprovodhoz» Production Cooperative in 2010.

Water metering and water saving

Notwithstanding that main amount of water resources withdrew for consumption in the Republic of Kazakhstan is used in agriculture for irrigation, exactly in this sub-sector their use is organized in the worst way. It is related to metering of water resources, which are used in agriculture.

If almost 100% water metering is established in industrial water supply sub-sector in the Republic of Kazakhstan, and in drinking (municipal) water supply sub-sector it amounts to 76% in cities and 28% in rural settlements, but in agricultural sub-sector the metering of irrigation water is not established. And in those areas, where water metering is somehow established, the long-outdated methods, technologies and tools for water metering are used. Even antediluvian scales for measurement of water level in aryks (irrigation ditchs), rivers, lakes and water reservoirs, which are used for irrigation, are insufficient, not to speak of modern methods and technologies of automated water metering. According to the «Ak Bulak» Program 100% population coverage by drinking water metering devices in the cities is scheduled on 2013 and in rural settlements – only 55% coverage in 2015 and 80% coverage in 2020.

Apart from almost complete absence of water metering in agricultural irrigation, the irrigation water is used in the Republic of Kazakhstan in irrational way without application of modern water saving technologies. Unit water costs on 1 kg of cultivated yield are too high in the Republic of Kazakhstan. They amount to the range from 0.15 to 0.6 m3 per 1 kg of yield in the countries with high irrigation technology, but in our country they are higher in 10 times. Consequently the irrigation water productivity in developed countries amounts to the range from 2.5 to 6 kg of agricultural products per 1 m3 of irrigation water, but in the Republic of Kazakhstan – from 0.4 to 0.8 kg.

It is recommended to perform the renovation of irrigated grounds with implementation of mechanized irrigation and micro-irrigation by 2020, having provided the increase in performance coefficient of irrigation systems up to 0.75, economy of water resources on 30%, increase in yield capacity in 1.5-2 times, improvement of available water supply of pasture lands of the Republic of Kazakhstan by constructing the non-natural water sources, including dug wells and water wells. It is planned to implement reverse and closed water supply systems in water-retaining industrial sectors and provide the priority sustainable water supply of municipal facilities, including at the account of ground waters. In the present time from the whole resource of withdrawn surface and ground waters the population consumes 51% of approved stocks at the account of ground waters and 49% at the account of surface waters.

In the Republic of Kazakhstan it is planned to reequip 108 gauging stations, renew 50 early functional gauging stations, open not less than 58 new stations, having achieved its number to 399 by 2020.

According to the data of Institute of Geography the long-term expected intensive production growth in the Republic of Kazakhstan shall be maximally provided with intensive water resources utilization, not with the growth of drinking water consumption. Household water withdrawals shall not exceed the actual volumes at the level of 2010 (23.3 km3/year, including irretrievable water consumption – 15.3 km3/year and water disposal – 8 km3/year) with a breakdown by sectors: agriculture – 15.3 km3/year; industry – 4.0 km3/year; municipal services - 2.2 km3/year; other sectors – 1.8 km3/year.

Creation of additional water stocks by constructing new water reservoirs and HPP

Intergovernmental water relations

In the present time problems of trans-boundary waters are topical because river systems, forming the regional and global hydrological cycles, do not have borders. 261 water basins in the world are trans-boundary; they cover 45% of land surface, where about 40% of world population lives. Water problems in trans-boundary basins become the factor of international policy. More than 500 conflicts related to trans-boundary waters have arisen and about 200 contracts have been discussed and signed in last half of century.

More frequent situation is when the countries located downstream may face the water deficit and other consequences due to un-agreed regulation of water runoff by the countries, located upstream. In general the presence (and possibility of construction on new facilities) of large hydro-power facilities in the upper reaches and big areas of irrigated plough and potential possibilities for development of new areas in the lower reaches of river basins give rise to necessity of compromise search between interests of hydro-power and irrigation sectors. Problem is complicated by necessity of contemporary compliance with the requirements of natural complexes in water. Problem may be solved with the help of analysis of advantages of one or another type of water utilization (hydropower industry, irrigated farming, recreation and etc.) and correct distribution of benefits and it is directly related to problems of regional integration and cooperation.

According to the proposition of Institute of Geography, the fundamental principle of equal use of general water resources by various countries and mutual responsibility for their protection shall become conceptual framework on trans-boundary waters. Regional restrictions on water resource activity in trans-boundary basins, providing the regeneration of water resources and environmental safety of region shall be determined.

Principles and norms of water apportioning in trans-boundary basins, taking into account the geographic location, social and economic and environmental features of Kazakhstan are proposed.

Integrated water resources management (IWRM)

In the present time the IWRM is the most progressive management system and one of priorities of International Decade for Action «Water for life» (from 2005 to 2015). Global Water Partnership determines the IWRM as process, contributing to coordinated development and management of water, ground and relative resources in order to maximize indices of social and economic development on equal basis without disturbance of sustainability of vital ecosystems.

In the Republic of Kazakhstan the water resource management is performed by some ministries and departments. It results in inconsistency of actions on water resource management and construction and operation of water facilities, as well as that none of organizations do bear the full responsibility for water sector management. Many state bodies, engaged in protection of environment, subsurface resources, fish stocks, flora and fauna, performing hydro-meteorological control and forecasting, sanitation and veterinary supervision, are also liable within own competence for water use and protection. Water resources are natural monopolist due to natural and environmental conditions, and principle of creation of competitive environment in this field may not be always used.

Despite the performed organizational and structural reorganization, the cross-departmental nature in solution of tasks related to water resource management remains. Often water resource management does not take into account the specific features of these resources, to which it is necessary to refer their spatial mutual influence, absence of local borders and time-to-time variability of runoff. Their disregard leads to interest infringement of downstream water users by water users, located upstream, in all river basins. As a result water is supplied to downstream water users in limited amount and as a rule of low quality.

In general the available organizational structure of water sector management in the Republic of Kazakhstan still does not solve problems of water source conservation, regional use and renovation of water resources. Cross-departmental nature in solution of tasks of water resource management does not contribute to economic responsibility for water utilization results.

All components in the IWRM system shall be coordinated by the respective governing structure. Main objective of management is provision of democratic conditions to all parties, engaged in the process of water resource management.

Practical realization of IWRM in water resource sector had been begun in Kazakhstan before its independence. During the long period of time this process had been realizing without general adaptation strategy of such approach to local conditions at spontaneous practical performance of only some elements and principles of IWRM.

Water resource policy of Kazakhstan shall be based on the following principles in order to eliminate possible water deficit:

- Water basin shall be considered as single ecosystem, water resource management and surface water protection shall be built under basin principle.
- Water supply and disposal systems (WSDS) shall be based on application of modern water treatment technologies, multipurpose water resource utilization, and provide the water loss reduction.
- Priority of drinking water supply and environmental protection releases against production and agricultural water consumption.
- Participation of water consumers in compensation for costs on utilization and maintenance of water facilities shall become the base of sustainable water sector development.
- Implementation of water metering system in all sub-sectors.

Thus, the available water reserves are enough only for several tens (20, 30, 40) of coming years even in case of compliance with all required measures with respect to metering and reasonable and economic utilization of water with account for IWRM. Water will be not enough after this term at available growth rates of country economy and growth in number of its population. And in this case probably it will be necessary to return to the project on possible transfer of part of water runoff from Siberian rivers to the Republic of Kazakhstan and also introduce measures on strict water consumption control.

6.3.4. Human health

It is commonly known that the stronger system, which is provided with sufficient resources and possesses organizational, material, technical potential, the more it resistant to influences of adverse external factors, including climate change.

Mitigation of possible unfavorable and application of possible favorable external influences on health and adaptation to them shall become perspective directions of healthcare service for sustainable development of economy and increase in quality of population life in conditions of changing climate, reduction in additional mortality and amount and severity of diseases, conditioned upon influence of environment.

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Researchers tried to take into account all available departmental and strategic plans, related to this topic, and recommend enhancement of mechanisms and platforms already created in Kazakhstan instead of creation of new ones.

The following is required for adaptation of population health:

- implement daily registration of amount of diseases, deaths and emergency aid appeal ability and introduction of this information into electronic registers;
- enhance monitoring, analysis and prediction of possible complex influence of both negative and positive environmental factors on health;
- take early diagnostics and prophylactic measures of diseases, which are oriented on mobilization of reserve and compensation organism abilities;
- increase awareness of population and medical workers about influence of climate change on health and response measures.

Certainly even now it is necessary to initiate work with all possible departments and determine leading sector or body, which would coordinate work in this direction for more complete list of recommendations and realizations, wide measures on health protection of country population.

Good example of cross-departmental cooperation for the benefit of health of country population may be experience of state program «Salamatty Kazakhstan» (healthy Kazakhstan), where first aid measures in case of emergency situations and traffic accidents are realized with the help of budget of the Ministry of Public Health by such department as: Ministry of Internal Affairs, Ministry of Emergency Situations, Ministry of Culture and Information, as well as Non-governmental sector.

In this regard it is proposed to consider the possibility to include new and complete available paragraphs of strategic plan of the Ministry of Public Heath, which are related to climate change.

1. Creation of mechanisms of cross-departmental coordination with respect to population health protection from unfavorable influence of environment and climate change

This mechanism will be efficient in case of assignment or creation of responsible body under the Ministry of Public Health with determination of its powers and interconnect with other departments. Taking into account the cross-departmental nature of topic, the effective solving of presented problems is possible only by creation of cross-departmental working group constituting representatives of central state bodies, nongovernmental organizations, scientific institutes and private sector.

For this it is necessary to introduce required amendments into available regulatory and program documents, which will make possible to monitor and assess situation on regular basis in order to develop prompt and reasonable preventive and response measures.

It is possible only upon condition of free presentation of key data on state of health, environment and meteorological indicators.

2. Creation of environmentally-safe healthcare system, provision of resistance to external influences

It is reasonable to determine and reduce environmental pollution, related to functioning of sector with account for its scope (management of biological and laboratory wastes, practice of its disposal and etc.).

In this regard it is proposed to perform pilot initiatives with their economical assessment in order to make decision with respect to wide application of experience.

3. Building of human-resource and scientific capacity with respect to influence of environment and climate change on population health and adaptation measures

Study of influence of environment and climate change on health is possible upon presence of prepared human-resource and scientific capacity, training methodology according to the international standards.

In this regard it is reasonable to implement questions of environmental and climatic influence on health into system of pre- and post-graduate studying in medical universities and colleges.

4. Increase in awareness level and provision of commitment to environmental principles and behavior skills

It is necessary to form environmentally-conscious thinking and behavior of population and medical workers, refuse from stereotype of consumer attitude to environmental resources for efficiency of specified initiatives. It is possible in case of performance of regular work in mass media and on all stages of training of medical workers, including pre- and post-graduate levels.

5. Enhancement of epidemiological supervision system of climate-dependent infections, transmitted by pests

Taking into account the potential risk for change of distribution area of infection carriers, related to change in conditions of environment and climate, the regular monitoring, epidemiological supervision, performance of preventive and response measures are of great importance. Methodology for performance of anti-mite treatment on republican territories, which are endemic with respect to Congo-Crimea hemorrhagic fever, shall be unified; it is also necessary to perform regular training and raising of medical workers awareness.

In the long term in addition to specified recommendations it is possible to consider possibility for introduction of additions to the Code of the Republic of Kazakhstan «On public health and healthcare system» dated September 18, 2009 No. 193-IV with respect to adaptation to climate change and creation of environmentally-safe healthcare system, which is resistant to external influences. It may be reasonable to introduce additions into the Decree of the Ministry of Public Health of the Republic of Kazakhstan dated September 22, 2010 No. 742 «On approval of forms of report documentation of healthcare subjects», report form on daily monitoring of mortality by circulatory diseases and other climate-sensitive diseases.

It is necessary to put forward a proposal to the Ministry of Education and Science of the Republic of Kazakhstan to include researches on climate change in Kazakhstan to the List of scientific research works, financed from the Fund of Science.

6.3.5. Natural ecosystems

Climate is a main differentiating factor of spatial distribution of wildlife elements. Adaptation features to certain climatic parameters are developed at species of flora and fauna during millenniums. In the present time the rates of changes are accelerated, that is why natural adaptation is almost impossible. Contribution to species and ecosystems in rearrangement to new conditions of habitat is the main task for ecosystem conservation.

The following activities shall be realized in public and economic aspects:

1. Review of available land and environment management system
2. Arrangement and creation of model testing areas with account for latitudinal zoning on plains and altitudinal zoning in mountains for regular monitoring of biodiversity in conditions of climate change.
3. Creation of conserved corridors between specially protected natural areas.
4. Monitoring of dynamics of standard ecosystem types on specially protected natural areas with the use of data on remote sensing, including:
   - monitoring of forest fires
   - monitoring of forest state at upper and lower line
   - monitoring of glacier, mountain tundra and lake states.

Adaptation variants for ecosystems are limited and their efficiency is questionable. Respective contribution variants include creation of corridors for contribution to ecosystem «migration», land use management, active contribution to natural renovation, forest plantations and artificial regeneration of degraded territories.

Predicted speed of climate change according to all scenarios will be higher than speed, with which various types may adapt to occurring changes.

As a result of these features the replace of one ecosystem with another one with set of types, which are peculiar to them, will likely be observed in certain environmental and climatic conditions.

In this regard the questions on necessity for acquiring of knowledge about possible rearrangement of content, structure and biodiversity in various ecosystem types, which will cause the replace of one ecosystem type with another one, are more topical than questions on adaptation.

It is necessary to realize the following activities in order to mitigate consequences of climate change.

Activities in conservation of species and populations (population-species approach)

- Activities on conservation and rehabilitation of habitat areas of rare species;
- Activities on maintenance of natural populations of rare species with the help of artificial reproduction
- Implementation of sustainable biodiversity use and conservation principles into arrangement of biological resource trade, regulation and control of trade and other types of biological resource use.
- Activities on inter-regional and international coordination on of species conservation on all stages of lifecycle.

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Activities in the field of ecosystem conservation (ecosystem approach)

- Activities on conservation of standard and unique ecosystem areas;
- Development of state forest policy and forest management strategy, oriented on biodiversity conservation;
- Activities on rehabilitation of disturbed natural ecosystems;
- Activities on optimization of combination of natural and anthropogenic elements;
- Activities on control of number of stress tolerant species of animals and plants, as well as on prevention from distribution of alien species, which are aggressive for local species;
- Development of mechanisms of operative decision making on the basis of monitoring data and its inclusion into management cycle;
- Detection of climate change influence mechanisms on ecosystems with account for microclimatic parameters;
- Development of short-term and long-term dynamics forecasts of vulnerable ecosystems and indicative species of flora and fauna;
- Assessment of risk level for existence of populations, species and communities, threatened with extinction;
- Development of reasonable sustainable use schemes of certain resource types and ecosystems;
- Adjustment of traditional metering systems of biological resources and biodiversity with account for change in climatic parameters.

Activities in the field of social and economic mechanisms

- Development and realization of international adaptation mechanisms;
- Development and realization of integrated regional and basin programs on conservation and sustainable use of biodiversity;
- Detection of influence mechanisms of natural and anthropogenic factors on biodiversity dynamics in various habitats, climatic zones and natural-landscape complexes;
- Analysis of alien species influence on biodiversity, role of invasions in biodiversity dynamics;
- Studying of cyclic processes, first of all ecosystem development processes; assessment of ecosystem capacity to self-regeneration;
- Development of scientific protection basis of the most vulnerable biomes and ecosystems;
- Development of biodiversity indicator system, territorial location scheme of supervision, methods of use of modern technical means;
- Development of uniform standards of collection, storage and presentation of information on biodiversity;
- Adjustment of traditional biodiversity metering system according to the objectives of biodiversity conservation:
- forest resource metering system;
- fish stocks metering systems;
- metering system of number of game animals;
- metering system of animal species, which are responsible for conservation of feral-herd infections;
- agricultural pest metering system
- development of biodiversity in reserves and other specially protected natural areas;

Special forest functions and activities on its conservation

Natural forest due to transpiration streams (evaporation from leaf surface), big area of leaf apparatus injects moist air, coming from oceans, and increases precipitation until level which is required for ecosystem. In other words, forest plays a role of biotic pump of atmospheric moisture.

In case of forest destruction, the precipitation is decreased with remoteness from ocean to the land centre. Water collected in soil, ground reservoirs, lakes, rivers and glaciers flows into ocean. That is why forest devastation and extinction exacerbate a problem of moisture conservation on land.

Forests (as biotic pumps) increase precipitation on land and decrease it above oceans and seas therefore they provide soil humidity and biota productivity. Thus undisturbed natural forest of any river basin creates autonomous water circulation, not depending on external influences.

Biotic pump works only in natural undisturbed forests, where trees of natural flora are connected with other biological species in ecosystem.

Homogeneous stands with genetic programs, which are not peculiar for this area, are not able to self-support on alien territory for a long time, not causing the degradation of stands and environmental conditions. It is seen on forest stands of arid zone of Kazakhstan, which are dried for more than on 50%.

Secondary forests, regenerated after anthropogenic disturbances or natural disasters such as fires and windfalls, are in the regeneration process of all their functions, have weakened function of biotic pump. Full destruction of natural forests causes territory desertification and water resource loss. Economic losses will exceed economic benefits from forest devastation and wood harvesting and other forms of practical forest use in many orders. That is why modern forest policy shall be based on the following principles:

1. Immediately stop the degradation and destruction of natural aboriginal forests and forests on the territories of all river basins, especially floodplain forests and forests, coincided with shores of lakes, seas and oceans, as well as forests of arid zone;

2. Begin the planned regeneration of aboriginal forest cover of disturbed territories, because only they could sustainably support the river basin and extend it in future;

3. Destruction areas of natural forests as a result of economic activity shall not exceed 10% of total area;

4. Maximally direct the material and labor resources on conservation and regeneration of natural forests, but not on creation of homogeneous stands, except for planting of settlements and creation of forest shelterbelts if appropriate;

5. Use the ecosystem approach in forest protection, in other words support natural balance and preservation of soil cover, grass and shrub layers and all other biotic (mushrooms, seaweed, fauna) and abiotic (level of ground waters, physical and chemical soil properties) components;

6. Maintain biological diversity of forest ecosystems on all stages of arrangement;

7. Everyway preserve forest from fires, soil drying, disease and insect attach, as well as intensive economic and recreation loadings;

8. Pay greater attention to preservation of channel floodplain forests, performing water-regulating functions.

Currently the objective for the whole world including Kazakhstan is to consider data on greenhouse gas sources and absorbers, their influence on global warming processes in order to prevent negative consequences of climate change influence. Collection and acquisition of data on changes in carbon stocks in ecosystems under influence of economic activity are provided for.

Absorption of CO_2 greenhouse gas is the most important role of forest ecosystems in prevention of dangerous climate changes due to biologic properties of forest capacity.

6.3.6. Social and economic influence

Adaptation to climate change in this sector shall combine all early proposed measures, because climate change influence will eventually influence on society development.

Realization of Adaptation program in social and economic sector will make it possible to prevent expected loss, related to climate change risk, at the realization process of middle-term and long-term development programs on national level and on the level of certain regions, first of all, of the most vulnerable regions, where risks of such losses are especially high.

The following shall be focus areas of adaptation activity:

- Involvement of society into adaptation process to climate change, including the most vulnerable population and public organizations;
- Provision of cross-departmental integration and harmonization in questions of adaptation to climate change and economic growth;
- Improvement of regulatory basis for adaptation to climate change;
- Arrangement of cross-border cooperation in questions of adaptation to climate change;
- Mobilization of financing on priority adaptation measures.
- Taking into account the possible climate change in sector programs and preparation of conditions for creation of resistance of economic sectors.

Including with respect to certain sectors:

- **Reasonable water resource utilization together with increase in water utilization efficiency in agriculture**

Improvement of water use control system, including decrease in risks of floods and droughts, construction of seasonal storage reservoirs for improvement of water supply of irrigated plant-growing in conditions of climate dryness enhancement in vegetation period and on the background of increase in water withdrawal higher up the trans-boundary rivers;

Increase in awareness of population, farmers, entrepreneurs, specialists and persons, making decisions on social and economic consequences of climate change, including on problem of increased water deficit.

- **Increase in land resource utilization efficiency**

Development or adjustment of development strategies of agro-industrial production and food market for the period until 2020 (and further), which are oriented on provision of food safety of Kazakhstan in conditions of climate change;

Use of sustainable land cultivation and cattle pasturing technologies, taking into account the necessity for performance of soil-protective activities and restoration of sustainable local centuries-old land use practices and implementation of new adaptation technologies with performance of regular monitoring over state of pastures and soil fertility;

Increase awareness and possibilities of adaptation in this sector, including training of farmers and other agricultural workers.

- **Adaptation of rural population to climate change**

State support in development of waste pasture lands with reclamation of degraded areas, forest reclamation by planting saxaul and further exploitation of saxaul forests in the system of pasture rotation, in water supply of pasturing lands for arrangement of pasture rotations, regulation and provision equal cattle loading on pastures for conservation of natural vegetation cover, in implementation and replication of new development technologies of «waste» and saline lands;

Replication of sustainable pasture use technologies, mastered within pilot projects, which are based on traditional methods: use of transhumant cattle breeding, seasonal pastures, pasture rotations, watering of pastures and etc., which may be used by rural population in steppe and desert zones of Kazakhstan;

Further development and wide application of water- and soil-saving tillage technologies for restoration of soil fertility and provision of state food safety, including by implementation and replication of modern methods of forest belt planting for control of dry winds, wind erosions and snow retention with account for increase in agricultural productivity.

Continuing the programs on resettlement of population from small unpromising settlements;

- **Disaster risk reduction by improvement of early warning and response system on emergency situations**

Provision of monitoring over climate change due to necessity of warning about land-slide hazards, avalanche- and mudflow-disaster in conditions of increase in frequency of rain-shower precipitation and rain fallout in mountain areas;

Enhancement of mudflow-protective technical constructions, dams and quays for protection of settlements from floods (resettlement of small settlements, which are located in dangerous regions);

Improvement of population and organization warning system about imminent danger in order to minimize human and economic losses;

Development of preventive activities on preparation of public, medical and social institutions to work in extreme and emergency regime in order to help population, got in distress due to floods, natural fires, severe frosts and heat waves, as well as in other emergency situations, related to climate change.

- **Forest management and biodiversity**

Improvement of regulatory control over forest protection and increase of territory forest-cover, including according to the receipt of new knowledge about forest vulnerability to climate change, first of all in North Kazakhstan;

Provision of further increase in territory forest-cover in forest-steppe and mountain zones, increase in areas of specially protected natural areas for risk reduction and increase in carbon potential of republic;

Increase in awareness of population about forest vulnerability and consequences for types of economic activities, which are dependent on forest preservation, and population groups, involvement of people into development and realization of certain activities on adaptation of forest ecosystems.

- **Health**

Identification of main risks, related to climate change, for population health in the cities and rural area;

Development of activities on reduction of risks for health of urban population with income below poverty line and separately for health of rural population, which is suffered from shortage of acceptable-quality drinking water;

Strengthening of healthcare system by increasing the investment volumes in development of its infrastructure in vulnerable regions, improvement of medicine provision, enhancement of scope of free high-qualified medical services to vulnerable population, as well as by increasing the awareness about prophylactic measures and development of disease detection systems in early stages.

- **Cities**

Integration of methods for solving of climate change problems into municipal planning and budgetary policy for provision of realization of cost-efficient activities on loss prevention and minimization, including development of regulatory basis of city development in conditions of climatic changes and risks;

Strengthening of potential of local institutes and training of representatives of local bodies in methods, tools and mechanisms of increase in adaptation potential of managed economy and local community to climate change.

- **Insurance**

Scope extension of insurance tools of legal and private entities (especially vulnerable economic sectors and population groups) from unfavorable consequences of climate change;

Testing and development of institutional basis for implementation of index-insurance from risks of climate change in Kazakhstan.

- **Energy, industry, transport**

Decrease in loading on environment (air, water, soil pollution) in order to reduce influence on population health and ecosystems is main channel for reduction of their vulnerability to climate change;

Increase in reliability of infrastructure functioning of economic sectors (transport and communications, electrical networks, heat pipelines, water pipelines, gas and oil pipelines);

Improvement of regulatory basis of municipal and traffic construction and increase in access of population from small distant settlements to electric power with account for negative consequences of climate change;

Increase in awareness and ability to adaptation of such sectors, including training of specialists and heads of enterprises.

- **Education and science**

Development continuing and provision of accessibility of quality maps of natural-climatic and soil-climatic zoning, map of dangers and risks of hydro-meteorological events in modern Geographic Information System programs;

Provision of coherence of state policy on enhancement of monitoring and forecasting of climate change on the basis of modern scientific and technical achievements in this sector;

Increase in number of modern meteorological stations;

Development of educating courses on climate change, its influence on life areas and introduction of adaptation methods and mechanisms for various educational levels and age groups;

Formation of joint data base for Central Asia countries with respect to methods, technologies and projects, which will contribute to decrease in population vulnerability to climate change risks;

Creation of climatic Kazakhstan model, which is integrated with model of economic development and influence blocks in terms of sectors with a breakdown of regions.

VII. FINANCIAL RESOURCES AND TECHNOLOGY TRANSFER, INCLUDING INFORMATION OF ARTICLES 10 AND 11 OF THE KYOTO PROTOCOL

7.1. The analysis of national policy aimed at encouragement, promotion, and financing of the transfer of or access to environmentally friendly technologies

Stimulation of integration of best environmentally friendly technologies is a constituent of the state control in the field of the environmental protection as defined in Articles 6 and 7 of the Environmental Code of the Republic of Kazakhstan (hereinafter EC).

For this purpose the concepts of «best available technologies», «environmental quality objectives», «environmentally hazardous machinery and equipment», and «environmentally unsound technologies» were introduced into the Environmental Code.

The powers[2] of the Government of the Republic of Kazakhstan (Article 16 EC), in the field of environmental protection and use of natural resources along with the functions of implementation of the national environmental policy, management of the programs in the field of environmental protection, development of environmental quality objectives programs also include the following provisions:

- approval of the list of best available technologies and organization of maintenance of their register;
- maintenance of the register of environmentally unsound technologies, machinery and equipment[3];
- approval of the norms of generation and accumulation of municipal waste[4], organization of the development of the waste management programs, provision of their implementation, provision of the construction of waste disposal facilities;
- development of investment projects and submitting them to the authorized body;
- creation of awareness among population about the state of natural objects.[5]

Furthermore, since 2011 the EC has been supplemented by Article 17-1[6] relating to the powers of the authorized body in the field of public utilities[7] which is involved in the development and implementation of the state policy in the field of management of municipal waste and which is subsequently involved in matters of encouragement, promotion, financing of the transfer of or access to environmentally friendly technologies.

In accordance with Article 32 of the Environmental Code, there is a norm of «eco-labeling»; its objectives are to ensure the environmental safety of the equipment, technological processes, production works and products, integrate environmentally friendly technological processes, equipment and production works; prevent the import of environmentally hazardous products and technologies; promote the export and raise the competitive capacity of domestic products.

The Environmental Code introduced the concept of the integrated environmental permit (Article 79) which is a single document certifying the right of a nature user to carry out emissions into the environment on the condition of integration of best available technologies and compliance with the technical specific emission standards established by the national environmental legislation. Integrated environmental permits are issued by the authorized body in the field of environmental protection. The list of types of industrial facilities for which it is possible to obtain the integrated environmental permits instead of permits for emissions into the environment, and the procedure of their issuance shall be established by the Government of the Republic of Kazakhstan. The integrated environmental permit is valid up to the date of change of application of technologies and conditions of use of natural resources specified in the permit.

Currently the «List of best available technologies» approved by the Regulation of the Government of the Republic of Kazakhstan No. 245[8] dated March12, 2008 is effective. It contains eight sections:

1. Industrial wastewater treatment
2. Heat power industry

[2]Changes under the Law of the Republic of Kazakhstan dated December 10, 2008, Law of the Republic of Kazakhstan No. 479-IV dated July 22, 2011, Law of the Republic of Kazakhstan No. 505-IV dated December 3, 2011

[3]The Article is supplemented by sub-clause 24-1 in accordance with the Law of the Republic of Kazakhstan No. 164-IV dated June 23, 2009

[4] The Article is supplemented by sub-clause 6-1 in accordance with the Law of the Republic of Kazakhstan No. 479-IV dated July 22, 2011

[5]The Article is supplemented by sub-clause 3-1 in accordance with the Law of the Republic of Kazakhstan No. 505-IV dated December 3, 2011

[6]In accordance with the Law of the Republic of Kazakhstan No. 479-IV dated July 22, 2011

[7] Nowadays it is Agency for Construction, Housing and Utilities (ACHU)

[8]«Kazakhstanskaya Pravda» («Kazakhstani Truth») dated 15 April, 2008, No. 82 (25529); Official newspaper dated 14 June, 2008, No. 24 (390)

3. Offshore and inland oil and gas production
4. Refining and storage of oil, oil products and hydrocarbon gases
5. Ferrous metal engineering
6. Non-ferrous metal engineering
7. Tailings ponds and dumps
8. Chemical industries

The analysis of the measures mentioned in the list is given below.

Investment in the environmentally friendly technologies can take place as a part of the mechanism of environmental (green) investments (Art. 94-12 EC), for which on August 8, 2012 the Government Resolution No. 1032 approved the Rules for realization of environmental (green) investments.

The application of technologies, machinery, except for vehicles, and equipment in the Republic of Kazakhstan is carried if there is a national environmental seal of approval. If the technologies are recognized as environmentally unsound, they do not apply to business or other activities, and they are to be included in the register of environmentally unsound technologies, machinery and equipment, the use of which is prohibited. In practice, however, this register has not been developed and approved yet.

Operation of industry facilities, electric power facilities, transport and communication facilities as well as operation of facilities of an agricultural applications and reclamation should be carried out taking into account the established environmental requirements and use of environmentally friendly technologies, necessary treatment facilities and protective sanitary zones preventing pollution of the environment. During the use of these facilities (Article 203) low-waste and non-waste technologies ensuring environmental safety should be integrated.

Integration of new technologies, implementation of programs of land reclamation and soil fertility raise are prohibited in the event of non-compliance with the environmental, sanitary, and epidemiological rules and regulations and other requirements stipulated by the legislation of the Republic of Kazakhstan (Article 217 EC). Environmental requirements for the use of subsurface resources (Article 219 EC), discharge of wastewater (Article 225 EC), location, design and construction of settlements, companies, pipelines etc. (Article 237 EC) also provide the prohibition of the use of technologies without providing them with the means of protection of animals and their habitats.

7.1.1. Integration of environmentally friendly technologies directly related to the innovation development policy

A number of program documents relating to the issues of development of Kazakhstan cover the issues of integration of innovative projects that can lead to the reduction of greenhouse gas emissions. These issues are reflected in the energy-saving policy pursued by the state in the energy sector, as well as in industry, housing and utilities, oil and gas and transport sectors.

Alongside administrative and trade barriers on the way to the transfer of the technology from industrialized countries to developing ones, there is an acute problem of their inaccessibility due to their high cost. It is also necessary to work on the simplification of the global extension of environmentally friendly or «green» technologies. Measures for implementation of the relative policy may include changes in the regulatory and tax base as well as stiffening of rules for the use of natural resources.

In the medium term (from 2012 to 2017) the innovation development policy will be aimed at construction of a national innovation system ensuring the growth of the competitive capacity of the economy. For this purpose it is supposed to provide for a system of management of innovation and technological development of industries and regions of the country including the creation of conditions for the high-tech development of small and medium-sized businesses and for improvement of the scientific and engineering skills of specialists, as well as a system of the development of the innovation clusters infrastructure.

The achievement of the assigned objectives will be carried out through the implementation of the Program for innovation development and promotion of technological modernization in the Republic of Kazakhstan from 2010 to 2014, and further in accordance with the directions for the development which are specified in the «Strategic Plan 2020» (No. 922 dated February 1, 2010).

The basis for the energy-saving policy is an effective legal framework: the laws of the Republic of Kazakhstan «On Energy Saving and Energy Efficiency» (No. 541-IV Law of the Republic of Kazakhstan dated January 13, 2012) and «On Amendments and Supplements into some Legislative Acts relating to Energy Saving and Energy Efficiency» (542-IV Law of the Republic of Kazakhstan dated January 13, 2012) and «Kazakhstan Comprehensive Energy Efficiency Improvement Plan for the Period from 2012 to 2015» (No. 1404 dated November 30, 2011).

In the field of energy saving it is necessary to ensure the reduction of energy intensity of the gross domestic product by at least 10% by 2015 and by 25% by 2020, which is impossible without the use of innovation technologies aimed at the reduction of greenhouse gas emissions.

In addition, comprehensive measures are worked out as a part of the Comprehensive Plan in order to reduce the energy intensity of the industry including electric-power supply industry.

The main tasks in the field of energy saving are:

1) development of delegated acts to the Law of the Republic of Kazakhstan «On Energy Saving and Energy Efficiency» and «On State Support of Industrial and Innovative Activity»;
2) development of the Rules for innovation grants;
3) attachment of the Intersectoral Plan for Scientific and Technological Development of the country 2020 according to the results of the foresight studies;
4) study of the issue of creation of the instrument design bureau;
5) establishment of technology commercialization offices.

Carrying out of energy saving measures is included in the rate policy. The rate policy is aimed at the implementation of the following tasks:

- energy saving by means of reducing the levels of excessive and normative losses, as well as introduction of differential rates for electric power, heat and water;
- resource saving by means of optimization of norms for consumption of raw materials, fuel and energy, administrative expenses.

Modernization of the economy with the use of innovation technologies and integration of environmentally friendly technologies is implemented by means of its industrialization. The industrialization program remains a major orienting point for economic modernization. Under this program the priority in financing is given to the activities of the programs «Performance 2020», «Business Road Map 2020» as well as other sector programs adopted for the implementation of the «State Program for Accelerated Industrial and Innovative Development for the period from 2010 to 2014» (SPIIAD) (No. 958, March 19, 2010) including energy and transport sectors.

Efficient energy use is a necessary condition for the diversification of electric power supply allowing raising the competitive capacity of the economy. Investments in energy efficiency and development of the renewable sources of energy as the whole are economically and financially viable; the support at the national level provides the highest investment efficiency as a whole.

The target indicator of the electric-power supply industry development in 2014 according to the SPIIAD is to bring electric-power generation in 2014 to 97.9 billion kW / h along with the projected consumption of 96.8 billion kW / h. Due to the introduction of new capacities and modernization of the existing ones the total volume of electric power produced in the country will exceed projected levels of consumption specified in the Program.

Provision of the population with quality drinking water and services of the water disposal system will be continued through the implementation of «Ak Bulak» Program for the period from 2011 to 2020, the key objectives of which are: construction and reconstruction of water supply and water disposal systems in urban and rural areas, its efficient and profitable operation.

Under the Program for the development of the oil and gas sector in the Republic of Kazakhstan for the period from 2010 to 2014 there is a provision for the increase of the level of gasification of the Republic to 64%, notably in Southern regions – to 46%, in Western regions – to 85%, in Kostanay region – to 60%.

The strategic objectives of the «Strategic Plan 2020» (No. 922 dated February 1, 2010) for the diversification of economy include the increase of the part of manufacturing sector in the GDP by 2015 – not less than to 12.5%, by 2020 – not less than to 13%, the part of innovation active enterprises – to 10%. In the construction sector the increase of the production of construction materials is expected to be brought to 80% inside the country in order to meet the demand, in particular, the growth of cement production will be accompanied by the use of more environmentally friendly technologies.

The doubling of the production of metal engineering products where it is necessary to take into account the environmental load is expected to take place in the field of metal engineering by 2015. Chemical production will increase by 3 times by 2020, which would require the integration of environmentally friendly technologies.

The rate of economic growth and diversification of the economy will have a significant pressure on the energy sector. The domestic industries are relatively energy-intensive and have significant potential for energy saving. Along with the implementation of measures for the improvement of energy efficiency, the increase of its production is required to meet domestic needs, especially in western and southern regions. In this regard, the work on the expansion and reconstruction of the operational capacities and construction of new ones at the energy sources and power supply network enterprises will be carried out.

Kazakhstan will contribute to the achievement of global objective – reduction of greenhouse gas emissions – as a part of the energy sector development. Development of nuclear power energy and so-called renewable energy is one of the ways to get more environmentally friendly energy.

The part of the alternative energy sources in the total energy consumption is less than 1%. Given the need to solve environmental problems, one of the priority directions of the electric-power supply industry development will be the use of renewable energy sources (hydro, wind and solar energy), the untapped potential of which is rather significant in Kazakhstan.

Nowadays the most promising directions for the development of renewable energy technologies for the conditions of Kazakhstan are: small hydropower industry, wind power industry and use of biomass energy.

Hydropower industry development in Kazakhstan will be mainly based on small and medium-sized hydro power plants in accordance with the Law of the Republic of Kazakhstan «On Support of Usage of Renewable Energy Sources» adopted on July 4, 2009. Thus, 15 new small hydro power plants with a gross installed capacity of about 170 MW are planned to be in operation in South Kazakhstan.

The wind consumption potential is estimated up to 10 billion kWh / year, while electric power generated at wind power plants will for the most part replace the electric power generated by large coal condensing plants of national importance.

According to the SPIIAD and Strategic Plan 2020 electric power generation from renewable and alternative sources is expected to be up to 1 billion kWh / year in 2014, the increase of the part of renewable energy in the total energy consumption in its turn will be more than 1% by 2015 and more than 3% by 2020.

The increase of transportation by all means of transport, with a complete integration of European aviation standards, environmental standards «Euro-3» in the area of the road sector and road transport is expected to take place in the area of transport infrastructure development by 2015. In the field of water transport national merchant marine is expected to provide two thirds of the volume of oil transportation and half the volume of dry cargo shipments from the ports of the Republic of Kazakhstan in the Caspian Sea by 2016.

The policy of the increase in the Kazakhstani content and domestic support throughout all sectors of the economy is also associated with the increase in the part of innovative environmentally friendly technologies integration.

7.2. The analysis of programs and activities implemented for the transfer of or access to environmentally friendly technologies, know-how, practices and processes

An important element in the choice of technologies is their compliance with strategies and programs of country development. Technology transfer and use of scare resources will be unsustainable without taking into account the priorities of national development in strategies and national programs.

A key document defining the priorities of the country is Strategic Plan for the Development of the Republic of Kazakhstan until the year 2020. This document provides optimization of sustainable development management system and integration of a «green» policy of low-carbon economy, including attracting investment, reducing the negative impact of anthropogenic load.

The sector program «Zhasyl Damu» for the period from 2010 to 2014 which is approved on September 10, 2010, by the Regulation No. 924 for the purposes of the Strategic Plan for Development of the Republic of Kazakhstan until the year 2020 is focused on the application of the progressive principle of «green economy» which provides the elimination of dependence between resource use and ecological effects of economic growth. The program promotes an integrated solution of many issues, including: greenhouse gas emissions, air pollution, environmental disaster zones, specially protected natural areas, production and consumption waste, water resources, planting, integration of new technologies and resource saving.

The State Program for Accelerated Industrial and Innovative Development of Kazakhstan for the period from 2010 to 2014 (SPIIAD) provides for the development of all sectors of the economy, including electric-power supply industry and transport. The program provides support for the development of mechanical engineering, including energy-saving construction materials, introduction of the policy of «green» economy, support for projects aimed at the improvement of energy efficiency in all sectors of the economy. The Program provides innovation grants in such priority fields as energy-saving materials, transfer of technologies of rapidly erected «green» and «energy-passive» houses.

Sector development programs designed for the purpose of the implementation of the SPIIAD consider measures for extension of international cooperation in order to improve energy efficiency, measures for improvement of the rate policy on energy services, stiffening of existing norms, rules and technical regulations that define the consumption of fuel and energy, measures for the improvement of the rules of accounting and energy consumption control, measures for the setting energy consumption standards, measures for mandatory certification of energy consuming appliances and mass consumption equipment and their compliance with the standards of energy consumption, and measures for performance of regular energy audits of enterprises.

The main directions of the Program for Technological Development of the Republic of Kazakhstan 2015 (dated November 25, 2007, No. 1131) are:

- increase of the extent of involvement and integration of innovative technological solutions;

- provision of infrastructure and engineering conditions for the integration of obtained scientific results into the industry;
- capital renewals and technical re-equipping;
- integration of modern management technologies;
- required resources and sources of financing.

Expected results of the Program implementation:

- establishment of the effective system of integration of scientific results into the industry;
- development of the engineering infrastructure;
- improvement of the technical and technological level of enterprises through modernization of production facilities;
- not less than threefold increase in labor performance by 2015 compared with 2000 and twofold reduction of energy intensity of the GDP;
- involvement in innovation activities of enterprises and companies connected with the improvement and development of technologies;
- increase in the share of research and innovation activities in the GDP from 0.9% in 2000 to the range from 1.5 to 1.7% in 2015;
- technical re-equipping of 25% of small and medium-sized enterprises of the manufacturing sector;
- improvement of the efficiency of domestic enterprises activity through the integration of modern management technologies.

Provision of infrastructure and engineering conditions for the integration of the obtained scientific results into the industry is based on the international experience and efficiency of the activities of the engineering organizations, design bureaus and rapid prototyping system. Thus, design bureaus have been already established in four regions of Kazakhstan (North, East, South and West) and in the city of Astana. Design bureaus will be established in the large industrial enterprises working closely with universities and research institutes in order to strengthen the links between science and industry, bring research works to the industrial design and carry out pilot testing.

The integration of modern management technologies is an essential solution for the effective systematic operation of enterprises and optimization of the manufacturing process. Operational management involves formalizing business processes and developing enterprise standards, strict compliance with which leads to optimal results.

The objective of the Program «Performance 2020» approved on March 14, 2011, by the Government Regulation No. 254 is to increase the competitive capacity of industrial enterprises in the priority sectors of the economy by means of increasing labor performance.

Program objectives:

- improvement of management and production technologies applied by enterprises;
- modernization (technical re-equipping) of existing and development of new competitive industries.

The following is provided as a result of Program implementation:

- raise of the availability of financial resources for enterprises of the private sector in order to implement new investment projects aimed at the industrial and innovative development;
- attraction of funds from the private sector, primarily from financial organizations in order to implement investment projects in the non-resource sectors of the economy;
- improvement of financial and economic stability of industrial enterprises, primarily of medium and large business.

Government support for the development or expertise of a comprehensive plan by the consulting company provides the coverage of the expenses in the amount of 50%, but not more than 7.5 million tenge for the development or expertise of a comprehensive plan of the investment project by the consulting company.

Long-term lease financing is provided to the party by the operator of the instrument -joint-stock company «DBK – Leasing» - a subsidiary of «Development Bank of Kazakhstan» JSC. The applicant must ensure the participation in the implementation of the project by means of money in the amount of not less than 15% of the total cost of leasing subjects in long-term use of the instrument of lease financing. The cost of the leasing subject should be at least 150 million tenge (for light industry - not less than 75 million tenge.) Long-term lease financing is available for up to 10 years. Rate of remuneration under financial leasing contracts for the participant shall not exceed 7.5%.

Innovation grants are presented for the implementation of new industrial and innovative projects, as well as for industrial and innovative projects being implemented aimed at modernization and expansion of the production in the following directions:

- advanced training of the engineering staff abroad;
- involvement of highly qualified foreign specialists;
- involvement of consulting, design and engineering organizations;
- integration of management and production technologies.

Operator of the instrument is national institute of development in the field of technological development.

Innovation grants are presented in accordance with the procedure of providing grants for advanced training of engineering staff abroad, involvement of highly qualified foreign specialists, involvement of consulting, design and engineering organizations, integration of management and production technologies; this procedure is prescribed by the legislation of the Republic of Kazakhstan.

Implementation of the programs resulted in the creation of «Centre for Engineering and Technology Transfer» JSC which is approved as the Institute for Innovation Development by the Regulation of the Government of the Republic of Kazakhstan No. 1201 dated August 6, 2009.

7.3. The analysis of information on assistance provided to Kazakhstan in order to cover the expenses for adaptation, mitigation, capacity building, vulnerability assessment, or other measures taken to implement the Convention

The Republic of Kazakhstan takes an active part in the processes of international cooperation on environmental issues. One of these processes is a program «Environment for Europe» (EfE). «Greening» of the economy and provision of the access to «green» technologies became one of the main subjects of the Seventh Ministerial Conference «Environment for Europe» which took place in Astana in September, 2011. In the course of this conference the Astana Initiative «Green Bridge» was supported, this initiative was proposed by Kazakhstan to promote partnerships between Europe and the Asia-Pacific region in the development of policies and instruments to support green investments and green technologies. From May 2012 to December 2013, the UNDP in cooperation with the Ministry of Environmental Protection has been implementing the project «Assistance to Kazakhstan in Improving Interregional Cooperation for the Green Growth Promotion and Astana Initiative Implementation» aimed at improvement of institutional capacity. A working document titled «The Concept of Transition to Low-Carbon Development» was developed in 2012 as part of this cooperation. The document became one of the materials that formed the basis of the Concept of Kazakhstan's Transition to Green Economy. Also the capacity for sustainable development is built through the integration of climate change issues in strategic planning in the Republic of Kazakhstan. With reference to the initiative of the economy «greening» a nationwide plan of measures to implement the President's Address for people of Kazakhstan on December 14, 2012 «Strategy» Kazakhstan-2050» contains measures to develop the concept of Kazakhstan joining the number of 30 most developed countries of the world. One of the measures that should be provided by the concept is development of production of alternative and renewable forms of energy that should constitute at least half of the total energy consumption by 2050. Under the plan, the respective decree of the President is expected in September 2013.

The Regional Environmental Centre for Central Asia (CAREC) the office of which is located in Almaty «promotes cross-sector dialogue in Central Asia at the national and regional levels to solve environmental problems». The activity of the CAREC is aimed to carry out the following tasks:

- establishment of cross-sector dialogue in Central Asia with the participation of the donor community;
- promoting involvement of advanced knowledge, best international practices and technologies in the field of environmental management and sustainable development to Asia;
- Strengthening of the civil society's role in the field of environmental protection and sustainable development in Central Asia.

One of the operational programs of the CAREC is «Climate Change and Sustainable Energy» (CCSD) which has been implemented since 2010 in order to improve energy efficiency and reduce greenhouse gas emissions in the region of Central Asia. The main activities under this program: promoting transition of the countries of Central Asia to the low carbon development through a comprehensive approach: study of the current situation, offer of international experience and new instruments, holding workshops and trainings for specialists, conducting awareness campaigns and public dialogues. For example, at the present moment, the program CCSD participates in the implementation of the projects that help countries to develop national policies for the promotion of renewable energy and energy efficiency in countries of Central Asia (EU «Sustainable Energy Program for Central Asia»). These projects also help the countries of Central Asia to develop comprehensive sector approaches to the mitigation of the impact on climate change and transition to the climate friendly development path «Integrated Approaches to the Development of Climate Friendly Economies in Central Asia». A detailed list of projects of the program «Climate Change and Sustainable Energy» of the CAREC is presented in Table 22, Annex 4.

Kazakhstan is also a member of the Central Asian Initiative on Sustainable Development (CAI) which was announced by the countries of sub-region of Central Asia during the preparation for the World Summit on Sustainable Development in Johannesburg in 2002. The document «An Invitation to Partnership on Implementation of the Central Asian Initiative on Sustainable Development» was adopted in 2003 in the framework of the 5th Europe-wide Ministerial Conference of the United Nations Economic Commission for Europe (UNECE) region. To achieve the objectives of sustainable development in Central Asia the Initiative seeks to strengthen the mechanisms of cooperation and establish partnership relations between the states, private sector, international and non-governmental organizations. CAI priorities include enhancement of environmental management, strengthening of the civil society's role, promotion of education for sustainable development, coordinated approach to the water resources management, sustainable energy development and promotion of environmentally sustainable livelihood.

Kazakhstan rapidly develops bilateral and regional cooperation in the field of environmental protection which indirectly affects the issues of adaptation to climate change. The Republic signed the bilateral agreements for environmental protection with more than ten countries such as the United States, Switzerland and Azerbaijan, including some of the neighboring countries (Russia, China and Kyrgyzstan). Three agreements with the Russian Federation cover issues of ecology and natural resources in Baikonur (2005), co-operation in the field of environmental protection (2004) and joint use and protection of transboundary water bodies (1992). The agreement with China provides the exchange of hydrological and hydro-chemical information and data on the main transboundary rivers (2006). The agreement with Kyrgyzstan (2000) for the use of hydrological facilities of the interstate use on the Chu and Talas Rivers entered into effect after the establishment of the Commission on the two rivers. Kazakhstan is a party to the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) (2001) and its Annex A (concerning dangerous substances and articles) and B (concerning transport equipment and transport operations).

In 2008, Kazakhstan sent an offer for consideration by the Parties of the UNFCCC to assume a voluntary obligation by the country for annual reduction of emissions in the period of 2008-2012 to the base level of 1992. In October 2010, the Ministry of Environmental Protection signed a Memorandum of Understanding with the Verified Carbon Standard (VCS) for the development of national control and accounting of GHG emissions.

7.4. Evaluation of financial resources aimed at the implementation of the Convention through bilateral, regional or multilateral channels.

Payments related to the implementation of the Convention

Kazakhstan receives considerable international assistance in the field of environmental protection. Examples of such cooperation have been mentioned above. The structures that provide technical and financial assistance to Kazakhstan through bilateral, regional and multilateral channels are: European Commission, Organization for Security and Cooperation in Europe, United Nations Development Program, World Bank, Asian Development Bank, European Bank for Reconstruction and Development, as well as governments of Canada, Germany, United Kingdom and United States, and others. However, there is no single database for sources, purposes and sizes of international assistance; therefore it is difficult to analyze the efficiency of its use.

According to the document A/AC.237/79/Add.2 (p. 20), the annual payment associated with the implementation of the Convention was set for Kazakhstan in the amount of 0.19% of the national budget according to the scale of UNO.

7.5. Measures for implementation of the policy and barriers, recommendations

Creation of the conditions for the formation of the principles of «green» economy is a medium-term objective of the Ministry of Environmental Protection (MEP) established in the Strategic Plan of the Ministry of Environmental Protection of the Republic of Kazakhstan for 2011-2015.[9] Achievement of this objective is planned by means of the performance of the following tasks:

- Development of the Action Program on planning and development of economic sectors of the Republic of Kazakhstan due to the transition to a low-carbon development (2011-2012)
- Improvement of the regulatory and legal framework and its harmonization in accordance with the best international practices in relation to climate change (2014);
- Carrying out public campaigns for promotion of energy efficiency, integration of renewable energy sources (in cooperation with the Ministry of Industry and New Technologies of the Republic of Kazakhstan (MINT) and Agency for Construction; Housing and Utilities of the Republic of Kazakhstan (ACHU)), for promotion of green technologies recommended by the Partnership Program «Green Bridge» at the national and international levels (2011-2014);
- Creation and maintenance of the electronic portal «Green Bridge» in the framework of the Uniform Information System of Environment Protection, making an annual information review on the initiative of «Green Bridge» (2011-2013);
- Development of communication mechanisms for integration and implementation of the principles of «green growth» (2011-2012).

The process of attracting investments for implementation of some «green» projects in the cities of Pavlodar, Petropavlovsk and Atyrau has already started.

One of the indicators for achieving objective 2.2. «Creation of the conditions for the formation of the «green «economy» principles of the Strategic Plan of the Ministry of Kazakhstan for the period from 2011 to 2015» is a database on the best available technologies which is planned to be completed up to 2015; it will be open for use by business structures and individuals. Funds for achieving this indicator are expected to be obtained due to the implementation of task 2.2.1, «The integration of «green» technologies and the creation of a system of resource supply». At the same time three priority indicators of the expected outcome are allotted, namely:

[9] Approved by the Regulation of the Government No. 98 dated February 8, 2011, supplement to the Regulation of the Government of the Republic of Kazakhstan No. 1741 dated 31 December, 2011. It is developed in accordance with the Strategic Plan for Development of the Republic of Kazakhstan until the year 2020 approved by the Decree of the President of the Republic of Kazakhstan No. 922 dated February 1, 2010.

- the number of industries for which the reference documents on best available technologies are developed – 4 in 2013;
- the increase of the number of investment projects on clean technologies – from 4 in 2012 to 11 in 2015;
- the number of the social projects in the field of environmental protection among non-governmental organizations (NGOs) – from 4 in 2012 to 6 in 2015.

«Green Investments» in Kazakhstan are formed by means of environmental payments (97 billion tenge in 2009), environmental protection measures of users of natural resources (124 billion tenge in 2009), and grants of international organizations. It should be noted that payments for environmental emissions go to the local budget without intended purpose and as a rule most of this money is used at the discretion of the local executive bodies on the current issues of livelihood, social support, solution of problems of infrastructure etc. Therefore implementation of environmental projects is often funded on leftovers. For example in 2009, the amount of money allocated for environmental protection was 23.8 billion or 27.9% of the total amount of payments and penalties received.

The attempted measures include «The list of best available technologies» designed by the Ministry of Environmental Protection (Regulation of the Government No. 245 dated March 12, 2008) which was developed in accordance with Article 16 of the Environmental Code of the Republic of Kazakhstan.

In the first section «Industrial wastewater treatment», the best available technologies are divided into three stages depending on the degree of eventual purification and include the following industries:

- irrigated farming
- municipal wastewater treatment
- light industry
- food industry
- oil refining
- coal mining
- electroplating
- non-ferrous metal engineering (in the production of zinc, copper, nickel, cobalt, aluminum, titanium, magnesium, mining and processing of gold ores).
- Selection of technologies is carried out on the basis of the assessment of the following factors:
- presence or absence of centralized wastewater sewerage systems; list and level of concentrations of pollutants in wastewater which was pre-treated at the local sewage plant founded for release to the off-site sewage plants;
- threshold values of the generated wastewater volume set by the authorized bodies taking into account economic and technological capabilities of enterprises estimated at the design stage and / or at the stage of the draft of the environment impact assessment (EIA);
- standards for water quality and / or water quality target in the river basin which are set by the authorized bodies.

The second section «Heat power industry» divides emissions according to the type and respective effectiveness indexes of the treatment achieved and contains measures to prevent water pollution, methods of burning solid fuel, but unfortunately does not contain preferential characteristics of a technology which requires study and development and there are no technologies to reduce losses in heat power industry and electric-power supply industry. Peculiarities of technology application in the off-shore heat energized facilities are not improved.

The third section, «Offshore and inland oil and gas production» gives the list of available technologies and does not contain any additional information on their distinctive characteristics and advantages; therefore it is impossible to judge their competitiveness, so there is a need in improvement. Almost the same can be said about the next section, «Refining and storage of oil, oil products and hydrocarbon gases».

The section on «Ferrous metal engineering» discloses to the full extent the technology according to the categories of operations but does not contain measures / technologies for energy saving and energy efficiency and it is very important in connection with the law adopted in January 2012 «On Energy Saving and Energy Efficiency» (No. 541-IV Law of the Republic of Kazakhstan). Moreover, according to the national statistics the part of the industry of Kazakhstan constitutes 72% of the total GDP energy intensity, while the strategic objective indicated in the Strategic Development Plan 2020 and State Program for Accelerated Industrial and Innovative Development (2010-2014) is to reduce the GDP energy intensity by 10% with reference to 2008. These issues are recommended to be worked over together with the MINT.

The last three sections relating to non-ferrous metal engineering, tailings ponds and dumps and chemical industries contain a list of best available technologies depending on the categories of the applied operations without additional characteristics of these technologies, potential advantages and period of limitation / availability, which is recommended to be improved by means of interagency coordination and involvement of suitably qualified professionals. In this regard, there is an acute question of the availability of environmentally-friendly technologies, the study of their possible adaptation to applied technological processes and national conditions.

The list of industries for environmentally-friendly technologies can be expanded or supplemented, for example, in measures / technologies in agriculture, electric-power supply industry, transport sector, construction; housing and utilities sector, waste sector. The waste sector is not exposed at all, except for pollution of industries by wastewater. At the same time, the involvement of the relevant ministries and departments, as well as local agencies, scientific and public organizations, enterprises, foreign sources is required. Most likely this will require an increase in financing from both national / local sources and financial institutions.

In the area of improving policy and methods to promote the growth of the Kazakhstani content the following measures are implemented:

- service support of national producers of competitive products, works and services of high quality in the domestic market;
- maintenance and further development of information systems «Register of goods, works and services used in subsurface resources management», «Internet resource «Kazakhstani Content» in order to raise awareness of entrepreneurs about products and services which are in demand;
- improvement of the efficiency of exhibitions, forums, conferences, meetings, round tables held with the participation of national producers and potential customers, the publication of reference literature and pamphlets of educational and enlightening character.

In the electric-power supply industry sector in order to achieve the indicators identified in the State Program for Accelerated Industrial and Innovative Development and Strategic Plan 2020 13 projects with the increase of capacity to 3,186 MW are being implemented, among which the modernization of Kazakhstan's national power network will be continued and transformer stations have been already built in the city of Almaty and Almaty region. The projects provide improvement of traditional technologies of power generation and transmission, which will have a positive effect on the reduction of losses and greenhouse gases emissions.

Excess production value of the electric power in the North energy zone through modernized Ekibastuz and Aksu GRES will be reallocated to the South and West energy zones suffering from power shortages by means of interregional power transmission lines North Kazakhstan – Aktobe region and North – South.

To take the issue of energy shortage in Western Kazakhstan off the table the origin of the Uralsk gas turbine power plant (GTPP) and the expansion of Atyrau combined heat and power plant (CHP plant) are expected; as to the southern regions of the country – the construction of the Moinak hydro power plant (HPP) and Akshabulak GTPP by 2012, and by 2015 – two power-generating units of the Balkhash thermal power plant (TPP), construction of a number of power supply network facilities including substations «Alma» and power transmission lines with power generation of Moinak HPP, reconstruction of existing power supply network and step-down substations will take place.

In order to implement the rate policy for energy saving, resource saving, there is a provision of optimization of norms for consumption of raw materials, fuel and energy, administrative expenses, decrease of the levels of excessive and normative losses as well as introduction of differential rates for electric power and water. For example, in the field of transmission and distribution of electric power since 2013 for the regional power supply network companies there is a provision for the transition to the new method of calculating the rate on the basis of comparative analysis (benchmarking) and work on the introduction of third level of differentiation of the electric power rates according to the consumption. In the area of water supply the work on the introduction of differential rates according to consumer groups and depending on the water consumption will be continued. In order to standardize rates for transportation of goods by rail within the Customs Union the annual rate increase by 15% is planned. In telecommunications where there is the highest competition development potential, in the period of 2012-2017 the transition to the methodology for rate calculation for joining and transmission of traffic based on the long-term average differential costs of the dominant operators is expected to take place as well as completion of rebalancing of rates for universal telecommunications services, and achievement of the break-even point of public postal services.

The Ministry of Industry and New Technologies and the energy-producing organizations are bound by 36 agreements on the implementation of investment obligations in the framework of limit rates for 2010 in the amount of more than 84.2 billion tenge. In cases of large-scale investments as the construction of new power plants, investors can work according to the settlement rate or individual rate. The integration of a new mechanism of rate setting has been carried out since 2009, which will increase the investment attractiveness of the industry, create conditions for attracting investment to the industry and allow for all opportunities of the energy-producing organizations for assurance of the investment recovery.

The applied measures of the rate policy for reduction of losses will have the following effect: in power supply networks in the period of 2010 2014 the reduction of normative losses will make from 1.3% to 01.1%, of the excessive losses – from 1.5% to 0, in heat networks – from 1, 5% to 0.1%, excessive losses – from 2% to 0, reduction of water losses – from 2% to 1%, excessive losses – from 2.5% to 0.

The introduction of electric meters in order to make differential payment possible, the change of accuracy class of these devices (which was introduced in legislation in 2012 by the law «On Amendment and Supplements into some Legislative Acts of the Republic of Kazakhstan» No. 542-IV dated January 13, 2012), automated systems of heat consumption control makes it possible to control the demand and it is one of the ways to reduce the growth rate of energy consumption (subsequently and GHG emissions) along with market instruments of influence on the behavior of energy consumers.

The large-scale policy of energy losses reduction is carried out in the residential and budgetary sectors. For this purpose, the practice of conducting the audit is introduced. In industry, in addition to the energy audit, the integration of the energy management system is planned as well as Comprehensive Energy Saving Plan according to the Law «On Energy Saving and Energy Efficiency» (No. 541-IV dated January 13, 2012).

Nowadays the Agency for Construction, Housing and Utilities of the Republic of Kazakhstan with the participation of «Kazakhstan Centre for Modernization and Development of Housing and Utilities» is implementing a program of modernization and development of housing and utilities up to 2020. The program provides comprehensive measures for modernization of infrastructure and utility networks of housing and utilities, water supply and water disposal, rehabilitation of communication, integration of energy saving technologies and thermal modernization of the residential areas with the allocation of financial resources for the implementation of this program.

In order to finance the above mentioned measures there is a scheme of repayment financing of general repair and thermal modernization of condominium objects. Due to the establishment of a new model of housing relations and special mechanisms of consolidated financing 11,624 houses will be repaired. The categories of financially disadvantaged citizens will be provided with housing assistance to cover the expenses for general repair of the common property of the object of condominium and / or contributions to the accumulation of funds for the general repair (according to the supplements to the Law «On Housing Relations» made in 2011). In general, the implementation of the program will modernize more than 81 thousand km of heat, power and gas supply networks. The total amount of financing of the program for the entire period of its implementation in all areas is 64.9 billion tenge.

From 2013 onwards, in the framework of the program «Affordable Housing 2020» 6 million square meters of new housing will be introduced annually. New facilities will meet the requirements of energy efficiency in accordance with the new Law on Energy Efficiency (Article 11).

The country is implementing a number of projects aimed at reducing GHG emissions. One of the projects of energy efficiency has been completed with the participation of the Japanese public company NEDO which invested 15 million U.S. dollars. The result of the project was the installation for generation of heat and electric power with two gas turbines with a capacity of 130 MW and 120 Gcal / h. The installation also includes a demineralized water generator with the performance of up to 50,000 tons of fresh water per day. There is an annual planned reduction of emissions of carbon dioxide (CO_2) in the amount of 800 kg.

VIII. RESEARCH AND CONTINUOUS OBSERVATIONS

Continuous climate observations are carried out in the framework of national programs of the Republican State Enterprise «Kazhydromet», which is a structural subdivision of the Ministry of Environmental Protection of the Republic of Kazakhstan. The activity of the National Hydrometeorology Service of the Republic of Kazakhstan is aimed at provision with information on weather, climate, water resources and state of environment, reports of dangerous and natural hydrometeorology phenomena and extremely high levels of environmental pollution.

8.1. National programs in the field of continuous observations of the climate system on the territory of Kazakhstan

8.1.1. Continuous observations:

The program provides:

a) Monitoring, network development and technological re-equipping of the stations, metrological provision of hydrometeorology and heliogeophysical observations, development of technology of acquisition, processing and dissemination of data of operating and monitoring observation, maintenance and development of the Republican base of hydrometeorology and environmental pollution data.

b) Preservation and management of climate data. Generation of monitoring and reference information as well as the provision of population and various sectors of the economy of Kazakhstan with climate information for forecasting purposes.

8.1.2 Research activities

1. Research in the study of the state dynamics of the ozone layer over Kazakhstan and the development of measures to prevent the negative effects of the ozone layer state;
2. Study and forecast of droughts in Kazakhstan;
3. Development of the system of climate change monitoring;
4. Methodological works for scenario forecast of climate change of Kazakhstan on the basis of regional climate models and methods of statistical regionalization.

National hydrometeorology service of Kazakhstan provides control over observation network (Table 8.1), financial and logistical support, planning and financing of research and development (R & D) according to the methods and means of measurement, observational methods, data acquisition and processing. The Global Climate Observing System (GOS) includes two subsystems: upper-air and ground-based meteorological networks. Ground-based subsystem of the GOS is based on on-shore surface synoptic stations which transmit reports «SYNOP» to the Global Telecommunications Network (GTS) in four main terms, on climate stations transmitting reports «CLIMAT» and upper-air stations which transmit reports «CLIMAT TEMP», and the list of stations on the territory of the Republic of Kazakhstan involved in the provision of the Global Telecommunications Network with information is shown in Table 8.1

Table 8.1

The observation network of RSE «Kazhydromet»[10]

№	Type of observation	Number of observation points	Global Network
I.	Ground-based meteorological network:		
1	Stations	260	65 (SYNOP), 44(CLIMAT)
	Upper-air observations	9	9 (CLIMATTEMP)
	Integration station of environmental background monitoring	1	(SFM Borovoe)
	Actinometrical observations	13	
	Ozone measuring observations	5	
	Meteorological posts	13	
II.	Agro meteorological observations:		
1	Agro meteorological stations	87	
III.	Hydrological observations:		
	on rivers	254	
	on lakes	35	
	on the sea	9	

[10]The station is established by the decision of the WMO

CHAPTER VIII

№	Type of observation	Number of observation points	Global Network
III.	Network of environmental monitoring:		
1	Air pollution observation points	78	
2	Water pollution observations:		
	River	70	
	Lakes	15	
	Channel	3	
	Artificially impounded water body	14	
	Sea	1	
3	Soil pollution observations:		
	City / settlement	39	
IV.	Radiation monitoring		
	Gamma background	80 stations	
	Beta-particle activity	43 stations	

Sources: Technical specifications for national programs 006 – «Conducting hydrometeorology monitoring,» 008 – «Observations of the state of the environment

8.2. International data exchange

Kazhydromet provides free and open international exchange of data with the following partners:

1. World Data Centre for Meteorology (Vol. A) of the National Climatic Data Centre (U.S.);
2. Global Precipitation Climatology Centre – meteorological information from 63 meteorological stations relating to daily precipitation;
3. World Data Centre of the All-Russian Research Institute of Hydrometeorology Information (RIHMI) – the exchange of meteorological data on a regular basis according to the processing of current performance information covering 22 stations of the international exchange.

According to the plan of joint action aimed at the implementation of the Concept of Hydrometeorology Safety of the States-Members of Commonwealth of Independent States RSE «Kazhydromet» supports bilateral cooperation in the exchange of information on dangerous phenomena (DP), and natural hydrometeorology phenomena (NHMP). In case of threat of a natural hydrometeorology phenomenon on the territory of Kazakhstan, Kazhydromet transmits storm warnings to Hydrometeorology Services of Russia, Uzbekistan and Kyrgyzstan.

8.3. Training of RSE «Kazhydromet» employees.

National Hydrometeorology Service participates in regional educational seminars organized by the World Meteorological Organization. The main subject-matters of the seminars and training courses are automatic observation systems, meteorological data, analysis of the information quality, climate data management, long-term climate forecasting. Below there is information about the seminars which were attended by the members of the National Hydrometeorology Service for the reporting period:

- The use of the Doppler meteorological radars (Marmaris, Turkey, 2012);
- Exchange of experience between the countries of Central Asia and Finnish Meteorological Institute (Helsinki, Finland, 2012);
- International Training Course for forecasters (Nanjing, China, 2012);
- Satellite Meteorology (Dehradun, India, 2011);
- Long-term climatic forecasting (Nanjing, China, 2011);
- Teaching of skills of the processing of performance meteorological information according to the software package «PERSONA MIS» and climate data management according to the software package of the access control system (ACS) «CliWare» (Obninsk, Russia, 2011);
- The use of satellite data in climate monitoring (Rostock, Germany, 2010);
- The work of networks of meteorological and agro meteorological conventional and automatic stations (Shefayim, Israel, 2010)

[6] станция ҒБЖ шешімімен ұйымдастырылған.

8.4. Climate monitoring principles of Global Climate Observing System (GCOS) / Global Ocean Observing System (GOOS) / Global Land Surface Observing System (GLSOS).

The Hydrometeorology Service of Kazakhstan sticks to the principles and best practices of climate monitoring in their national programs for continuous observations. The basis of systems and programs of observation network in Kazakhstan is Global Observing System (GOS) of the World Weather Watch (WWW), Global Observing System Guidebook, WMO Technical Regulations, Guidebook of Instruments and Methods of Measurements.

On January 1, 2012, compared to 2007, there were 33 automatic stations with meteorological observations in operation on the territory of Kazakhstan. In 2011, the meteorological station Stepniak (Akmola region) was established. In 2012, 35 automatic stations were acquired and installed. Rates of growth of the number of hydrometeorology stations and posts are shown in Fig. 8.1.

There is a network of meteorological posts at the National Hydrometeorology Service (NHMS) – 13 meteorological posts, one post more was founded in Petropavlovsk in 2012.

Actinometrical observations of the intensity of the direct, scattered, total solar radiation, as well as of the effective radiation, radiation balance and albedo are carried out at 13 meteorological stations. Observations of total ozone content in the atmosphere are carried out at 5 stations – Almaty, Aral Sea, Atyrau, Karaganda, Semipalatinsk. The obtained data are sent to the main geographical observatory in St. Petersburg every month.

One of the most important areas of the NHMS is upper-air observations at standard and special levels up to heights from 30 to 40 km. Nowadays upper-air observations are carried out at 9 upper-air stations. In 2011, the upper-air station Kyzylorda was restored. In the period from 2009 to 2012 modernization of upper-air observation network took place, 4 new upper-air complexes of MARL-A were acquired.

Control and archiving of ground station network observations on the territory of Kazakhstan are carried out using the software package «PERSONA-MIS» (Automated System for meteorological information processing, developers RIHMI-WDC, Obninsk, Russian Federation). The control over representativeness of the location of the station is performed by the software package «Inter-station Control», developers of the Voeikov Main Geographical Observatory, St. Petersburg, Russian Federation. Later performing climatological data processing for the historical period, the analysis of homogeneity is carried out with the use of a variety of methods aimed at detection and elimination of the climate heterogeneity.

An important element of the monitoring system is a system of climate data management. In the first ten days of June 2009, the hardware-software package «System of integrated database management» CliWare (ACS CliWare) was restored. Nowadays works on restoration of the databases for all meteorological stations of Kazakhstan are carried out.

8.5. Provision of the Republic of Kazakhstan with the observation network.

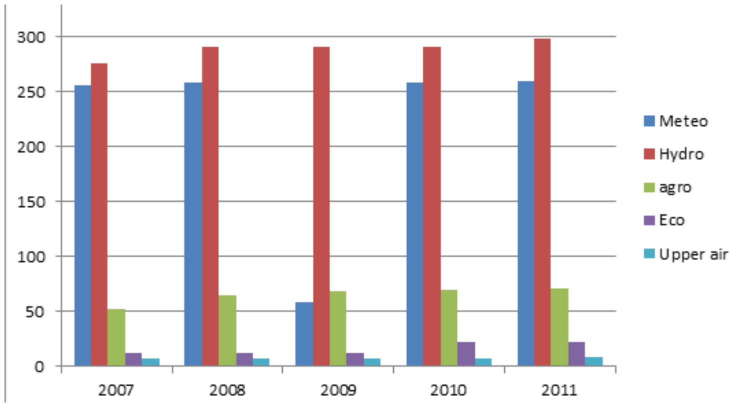
The main and constant problem of the National Hydrometeorology Service of Kazakhstan at the present stage is inconsistency between the capabilities of the National Hydrometeorology Services and the increasing demand of society for hydrometeorology and other information about the state of the environment as well as a serious lag of technical, processing and human resource base behind the level of the Hydrometeorology Service of the developed countries.

After the collapse of the Soviet Union, the national observation network had been steadily declining up to 1999. The number of meteorological stations (MS) decreased from 361 to 244, stations performing agro meteorological observations – from 246 to 111, upper-air stations (UAS) – from 15 to 8, hydrological posts (HP) – from 457 to 159 [5].

Rates of growth in the number of hydrometeorology and ecological stations and posts are shown in Fig. 8.1.

Figure 8.1

Rates of growth in the number of hydrometeorology and ecological stations and posts.



Sources: Technical specifications of state programs: 006 – «Conducting the hydrometeorology monitoring» and 008 – «Observations of the state of the environment»

Nowadays despite the efforts applied to expand the national observation network in the level of coverage of the territory, the national observation network does not meet the requirements of representativeness of the stations even now. For example, the minimum number of observation points should be:

- 700 meteorological stations;
- 15 upper-air stations;
- 507 hydro posts;
- upper-air observations are to be carried out at 280 points.

Consequently, the national observation network of the National Hydrometeorology Service is insufficient for high-quality regional and global assessment of the state of the environment and climate change. The strengthening of the technological and human capacity is required.

As a result, today the provision of the Republic with meteorological monitoring constitutes 61%, agro meteorological – 67%, hydrological – 57%, ecological (air, soil, surface water) – 58%. According to this fact modernization and development of the National Hydrometeorology Service is a vital task included in the development plans of the Ministry of Environmental Protection of the Republic of Kazakhstan [3].

8.6. Meteorological and atmospheric observations

Nowadays ground-based meteorological network of Kazakhstan, the area of which is 2,756 thousand square kilometers, includes 260 stations performing regular monitoring observations in 8 synchronous periods of time: 00, 03, 06, 09, 12, 15, 18 and 21 o'clock of the Coordinated Universal Time. This allows describing the diurnal variation of the basic meteorological parameters (temperature, humidity, wind speed and direction, atmospheric pressure, soil temperature, visibility, number and shapes of clouds, the height of their lower boundary) with the required accuracy [4].

At the same time measurements of precipitation are performed in the periods of time of 9 and 15 o'clock of the Coordinated Universal Time.

Observations of the intensity and development of atmospheric processes and phenomena are conducted continuously.

Sounding of the atmosphere is carried out at 9 upper-air stations, 9 upper-air stations are GCOS (GCOS Upper Air Network – GUAN).

The reports «SYNOP» in GST (GSN-Global Surface Network) from the Republic of Kazakhstan gives information from 65 stations: region of RA-2 – sixty two (62) stations, region of RA-4 – three (3) stations in four basic periods of time: 00, 06, 12 and 18 o'clock of the Coordinated Universal Time. 44 in 65 stations monthly present reports «CLIMAT», 9 upper-air stations present reports «CLIMAT TEMP».

Table 8.2

Participation in global atmosphere observing systems[11]

Stations	GSN	GUAN	WMO Global Atmosphere Watch	Other
The number of stations the party is responsible for	65	9		
How many of them are functioning	65	9		

[11] On a regular basis

Stations	GSN	GUAN	WMO Global Atmosphere Watch	Other
How many stations are expected to function				
How many stations are providing international data centres with information				RIHMI – WDC 22 stations

Sources: RSE Kazhydromet

Table 8.3

List of stations on the territory of the Republic of Kazakhstan involved in reporting information to the Global Telecommunications Network[12]

№	Code	Station name	Observation mode	Latitude	Longitude	Altitude
1	28679	PETROPAVLOVSK	CLIMAT(C)	54,7	69,09	142
2	28766	BLAGOVESCHENKA	CLIMAT(C)	54,22	66,58	151
3	28867	URITSKY	-	53,19	65,33	216
4	28879	KOKSHETAU	CLIMAT(C)	53,17	69,23	229
5	28952	KOSTANAY	CLIMAT(CT)	53,13	63,37	170
6	28966	RUZAYEVKA	CLIMAT(C)	52,49	66,58	227
7	28978	BALKASHINO	CLIMAT(C)	52,32	68,45	398
8	28984	SCHUCHINSK	-	52,57	70,13	395
9	29802	MIKHAILOVKA	-	53,49	76,32	114
10	29807	YERTIS	CLIMAT(C)	53,21	75,27	94
11	34398	ZHALPAKTAL	CLIMAT(C)	49,4	49,29	10
12	34691	NOVYJ USHTOGAN	CLIMAT(C)	47,54	48,48	-10
13	34798	GANYUSHKINO	-	46,36	49,16	-23
14	35067	ESIL	CLIMAT(C)	51,53	66,2	221
15	35078	ATBASAR	CLIMAT(C)	51,49	68,22	304
16	35085	AKKOL	-	52,0	70,57	384
17	35108	URALSK	CLIMAT(C)	51,15	51,17	37
18	35173	ZHALTYR	-	51,37	69,48	305
19	35188	ASTANA	CLIMAT(C)	51,08	71,22	350
20	35217	DZHAMBEYTY	CLIMAT(C)	50,15	52,34	32
21	35229	AKTOBE	CLIMAT(CT)	50,17	57,09	219
22	35302	CHAPAEVO	-	50,12	51,1	17
23	35358	TORGAY	-	49,38	63,3	-
24	35357	BARSHINO	CLIMAT(C)	49,7	69,5	356
25	35394	KARAGANDA	CLIMAT(CT)	49,48	73,09	553
26	35406	TAIPAK	CLIMAT(C)	49,03	51,52	2
27	35416	UIL	CLIMAT(C)	49,04	54,41	128
28	35426	TEMIR	CLIMAT(C)	49,09	57,07	234
29	35497	ZHARYK	-	48,51	72,52	656
30	35532	MUGODZHAR	CLIMAT(C)	48,38	58,3	398
31	35576	KZYLZHAR	CLIMAT(C)	48,18	69,39	-
32	35671	JEZKAZGAN	CLIMAT(CT)	47,48	67,43	346
33	35699	BEKTAUATA	-	47,27	74,49	620
34	35700	ATYRAU	CLIMAT(CT)	47,07	51,55	-22
35	35746	ARAL SEA	CLIMAT(C)	46,47	61,39	62
36	35796	BALKHASH	CLIMAT(C)	46,48	75,05	350
37	35849	KAZALINSK	CLIMAT(C)	45,46	62,07	68
38	35925	SAM	CLIMAT(C)	45,24	56,07	88
39	35953	DZHUSALY	CLIMAT(C)	45,3	64,05	103
40	35969	ZLIKHA	-	45,15	67,04	138
41	36003	PAVLODAR	CLIMAT(CT)	52,18	76,56	122
42	36152	SEMIYARKA	-	50,52	78,21	149
43	36177	SEMIPALATINSK	CLIMAT(C)	50,25	80,18	196
44	36208	LENINOGORSK	CLIMAT(C)	50,2	83,33	811
45	36397	ZHALGYZTOBE	-	49,13	81,13	455
46	36428	ULKEN NARYN	CLIMAT(C)	49,12	84,31	401
47	36535	KOKPEKTY	CLIMAT(C)	48,45	82,22	512

[12] CLIMAT(C) – stations presenting reports CLIMAT, CLIMAT (CT) – stations presenting reposts CLIMAT and CLIMAT TEMP

№	Code	Station name	Observation mode	Latitude	Longitude	Altitude
48	36639	URZHAR	-	47,07	81,37	491
49	36686	ALGAZY OSTROV	-	46,33	76,52	349
50	36821	BAKANAS	-	44,5	76,16	396
51	36859	ZHARKENT	CLIMAT(C)	44,1	80,04	645
52	36864	OTAR	-	43,32	75,15	743
53	36870	ALMATY	CLIMAT(CT)	43,14	76,56	851
54	38001	FORT SHEVCHENKO	CLIMAT(C)	44,33	50,15	-25
55	38062	KYZYLORDA	CLIMAT(C)	44,51	65,3	130
56	38069	CHIILI	CLIMAT(C)	44,1	66,45	153
57	38196	ACHISAY	-	43,33	68,54	822
58	38198	TURKESTAN	CLIMAT(C)	43,16	68,13	207
59	38222	TOLE BI	-	43,42	73,47	456
60	38232	AKKUDUK	CLIMAT(C)	42,58	54,07	78
61	38328	SHYMKENT	CLIMAT(C)	42,19	69,42	604
62	38334	AUL TURARA RYSKULOVA	CLIMAT(C)	42,29	70,18	808
63	38341	TARAZ	CLIMAT(CT)	42,51	71,23	655
64	38343	KULAN	CLIMAT(C)	42,57	72,45	683
65	38439	CHARDARA	CLIMAT(C)	41,22	68	275

8.7. Scientific research and projects in the field of environmental protection.

Studies on climate change are performed by the Republican State Enterprise «Kazhydromet»(hereinafter RSE «Kazhydromet»).

National Hydrometeorology Service of Kazakhstan during the implementation of national programs shall perform the following tasks:

- assessment and forecasting of climate;
- hydrometeorology mechanisms and study of climate change;
- development of methods for long-term and short-term weather forecasting and their improvement;
- study of climatological, hydrological, meteorological, agricultural potentials and their changes under the influence of natural and anthropogenic factors;
- comprehensive study of natural meteorological phenomena and meteorological conditions of the Caspian Sea, Aral and Balkhash Lakes, Baikonur and the surrounding areas.

The studies carried out according to the budget programs 006 «Conducting the hydrometeorology monitoring» and 003 «Scientific research in the field of environmental protection» are aimed at the creation of information systems on current and projected climate changes and its effects. Below there are subjects matters of research activities performed by RSE «Kazhydromet» for the reporting period as well as the duration and results of these activities:

1. Subject matter:»Conducting a study of dynamics of the ozone layer state over Kazakhstan and development of measures to prevent the negative effects of the impact on it».

Period of implementation: 2005-2007

Objective:the study of dynamics of the ozone layer state over Kazakhstan and development of measures to prevent the negative effects of the impact on it.

Result: Statistical description of the condition of total content of ozone over Kazakhstan for the available period of observations 1974-2003 is received. At most stations there is a trend to decrease in average monthly values of the total ozone content which is strongly marked during the autumn and winter periods. The maps of the distribution over the territory of Kazakhstan of the long-term average annual monthly amount of the incoming erythemal ultraviolet radiation, minimal erythemal doses (MED) in 1 hour and 1 MED accumulation time, maximum doses of erythemal ultraviolet radiation income are generated. Empirical method for forecasting the index of ultraviolet radiation for the territory of Kazakhstan is developed and introduced in operational practice of RSE «Kazhydromet». A weekly bulletin with the forecast of ultraviolet radiation index for the territory of Kazakhstan is published. Period of publication is from May to September. The bulletin is posted on the website of RSE «Kazhydromet».

2. Subject matter:«Creation of a catalogue of wind effected phenomena».

Period of implementation: From2011 to 2012

Objective – the study of wind effected phenomena in the north-eastern part of the Caspian Sea and the creation of a reference book including the characteristics of the wind effected phenomena for various areas of the Kazakhstan coast.

Result: Catalogue of wind effected fluctuations of water level in the Kazakhstani sector of the Caspian Sea which consists of two sections. Each section contains the following characteristics of a wind effected phenomenon: start date and date of the upsurge (downsurge) peak, values of initial (background) sea level preceding the phenomenon, and value of the level at the upsurge (downsurge) peak in meters of the absolute Baltic elevation system, rate of rise (fall) of sea level in cm, duration of the period of rise (fall) of sea level in hours, as well as the characteristics of the wind that caused this phenomena: wind direction in rhumbs and the highest wind speed in m / s.

3. Subject matter: «Study and forecast of droughts in Kazakhstan»

Period of implementation: From 2011 to 2012

Objective: Forecast of droughts in Kazakhstan and integration of a developed drought monitoring system into the operational practices of RSE «Kazhydromet»

Result: The effect of different types of atmospheric circulation on the occurring of the drought in the space of the first natural synoptic region and in Kazakhstan is studied. The system of representative indexes for the drought monitoring is suggested. It is shown that during the last 40 years, the most severe droughts became more frequent, but there were no such droughts on the territory of Kazakhstan in the period from 1998 to 2008. In 2009, strong atmospheric and soil droughts occurred in the western regions of Kazakhstan. An electronic catalogue of droughts for the period from 1971 to 2009 was made. Predictors for the forecast of atmospheric and soil droughts are determined. A method for long-term forecast of drought with the use of models of global and regional climate was suggested.

4. Subject matter: «Development of the climate change monitoring system»

Period of implementation: From 2008 to 2010

Objective: Development of the climate change monitoring system.

Result: The development of the system of climate change monitoring of Kazakhstan with respect to the recommendations of the World Meteorological Organization took place. Since 2008, RSE «Kazhydromet» has been annually publishing a bulletin of climate monitoring in Kazakhstan. The main purpose of the bulletin is providing reliable scientific information on climate, its variability and changes. Bulletin describes the climatic conditions observed in a particular year, including the assessment of extremeness of ground air temperature and precipitation. It also provides information on trends in the average values and extreme values that have taken place since the forties of the previous century. The bulletin is posted on the website of Kazhydromet.

5. Subject matter: «Methodological works for scenario forecast of climate change of Kazakhstan on the basis of regional climate models and methods of statistical regionalization».

Period of implementation: 2012

Objective: Methodological works for scenario forecast of climate change of Kazakhstan on the basis of regional climate models and methods of statistical regionalization

Result: Scenarios recommended by the Intergovernmental Panel on Climate Change relating to the increase of the A1B, A2, B1 greenhouse gases concentration in the atmosphere as well as global climate models developed in Canada, USA and Germany are chosen for the development of regional climate scenarios. Regionalization of the results of these global models is performed in the grid of latitude 0.5^{o} in order to assess changes in air temperature.

6. Subject matter: «Assessment of ice conditions in the Kazakhstani sector of the Caspian Sea».

Period of implementation: 2011-2012

Objective: The study of ice conditions of the Caspian Sea and its various phases: ice formation, growth and destruction of the ice cover.

Result: The work was carried out in two stages. The report of the first phase which was finished in 2011 presents the analysis of climatic factors that are crucial in the study of the characteristics of ice conditions, pays particular attention to the current climate of the region, and presents the studies of the initial phase of ice conditions (ice formation) and the phase of the ice cover growth.

The study of the ice cover of the Caspian Sea in winters with different thermal conditions was made in the framework of the second stage.

The winters were analyzed according to the degree of ice cover, and this analysis revealed cases with an unstable state of the ice cover. Abnormally warm half-year periods from 1980 to 1981, from 1982 to 1983, from 2006 to 2007 can serve as an example of ice seasons with an unstable state of the ice cover. As a rule, in such years the area of drifting ice is larger than the area of the fast ice throughout the whole ice season. The unstable state of the ice cover may have adverse effects on the population of Caspian seals. The work gives actual examples and analysis of ice conditions contributing to the development of stress among animals, infections, and their mass mortality.

An important characteristic of ice conditions is duration of the ice cover. The work presents an assessment of ice conditions off the coast of the sea according to the duration of ice cover, number of days with ice and fast ice in normal (ice cover average) and severe winters. A special emphasis in the work is put on the ice formation in the areas of reclamation of the Caspian Sea shelf and marine operations. It is shown that the active economic activities in the area contribute to the ice cover disturbance and periodic human-caused fracturing. This leads to the strengthening of processes of ice compression which are followed by the formation of zones of rafting near the boundary of the fast ice in floes and formation of extended zone of pile-ups of ice blocks. Repeated fracturing of the fast ice, its shearing, hummocking and the subsequent congelation cause the formation of heavy hummocks. After coming off the edge of the floe, under the influence of wind currents, blocks of ice strip away the bottom surface layer making «exaration marks» the length of which can reach from 2 to 3 km, i.e. exaration processes are getting stronger.

7. Subject matter: «Zoning of the territory of Kazakhstan according to the climatic characteristics».

Expected results: Updating the climatic parameters in the building code for more effective accounting of the current climatic conditions and provision of the national security in the field of construction activities in the Republic of Kazakhstan. As part of this work, the country will assess climatic resources and study the connection of the environment with modern social and economic systems depending on climate.

Period of implementation: From 2013 to 2015

Objective: Assessment of the climatic variables and their mapping in order to update the building code of the Republic of Kazakhstan «Affecting load bearing constructions»

8. Subject matter: Well-timed climate conditions and scenario forecasts of climate change in this century on the t**erritory of the Kazakhstani sector of the Altai-Sayan eco-region (as a part of the MEP / UNDP Kazakhstan on «Conservation and Sustainable Use of Biodiversity in the Kazakhstani Sector of the Altai-Sayan Eco-region»).**

Objective: Estimation of the future climate changes by means of physical and mathematical modeling.

Result: Probabilistic changes in the average values of air temperature and precipitation for the Kazakhstani sector of the Altai-Sayan eco-region are obtained on the basis of the coupled atmosphere-ocean general circulation model.

RSE «Kazhydromet» is working on the publication of climate data reference books of Kazakhstan. In particular, the following reference books were prepared for the reporting period:

- Sunshine –contains characteristics of duration and diurnal variation of sunshine from 46 meteorological stations in the period from 1971 to 2006, year of publication – 2009;

- Snow cover – contains climatological materials of observations carried out at the meteorological stations from 234 meteorological stations in the period from 1977 to 2008, year of publication – 2011;

In accordance with the Development Strategy of the National Hydrometeorology Services of Kazakhstan up to 2020 the following areas are included in the number of priority areas of activity [5]:

- development of the observation network up to the parameters recommended by the WMO and development of the related infrastructure of the GOS. Figure 9.2. shows the minimum number of meteorological observation points in Kazakhstan with regard to the heterogeneity of the relief and economic development of the territory [2];
- development of an integrated system of hydrometeorology and ecological monitoring using geographic information systems including the Caspian Sea basin;
- improvement of the automation of distribution and collection of necessary information, its centralized processing and further storage;
- creation of the Electronic Forecasting Information Fund;
- introduction and development of numerical techniques for weather and climate forecasting and automation of RSE «Kazhydromet» as a result of it;
- creation of a situation centre to monitor hydrometeorology and environmental situations, forecast dangerous natural weather phenomena and emergencies caused by unfavorable weather conditions and sudden emissions of polluting ingredients;
- quality improvement of RSE «Kazhydromet» forecasting activity products for end-consumers (forecasts, recommendations, storm warnings etc.);
- improvement of lead time indexes and accuracy of forecast of RSE «Kazhydromet»;
- creation of an instrument of continuous hydrological monitoring, advance warning of potential dangerous natural phenomenon.

Figure 8.2

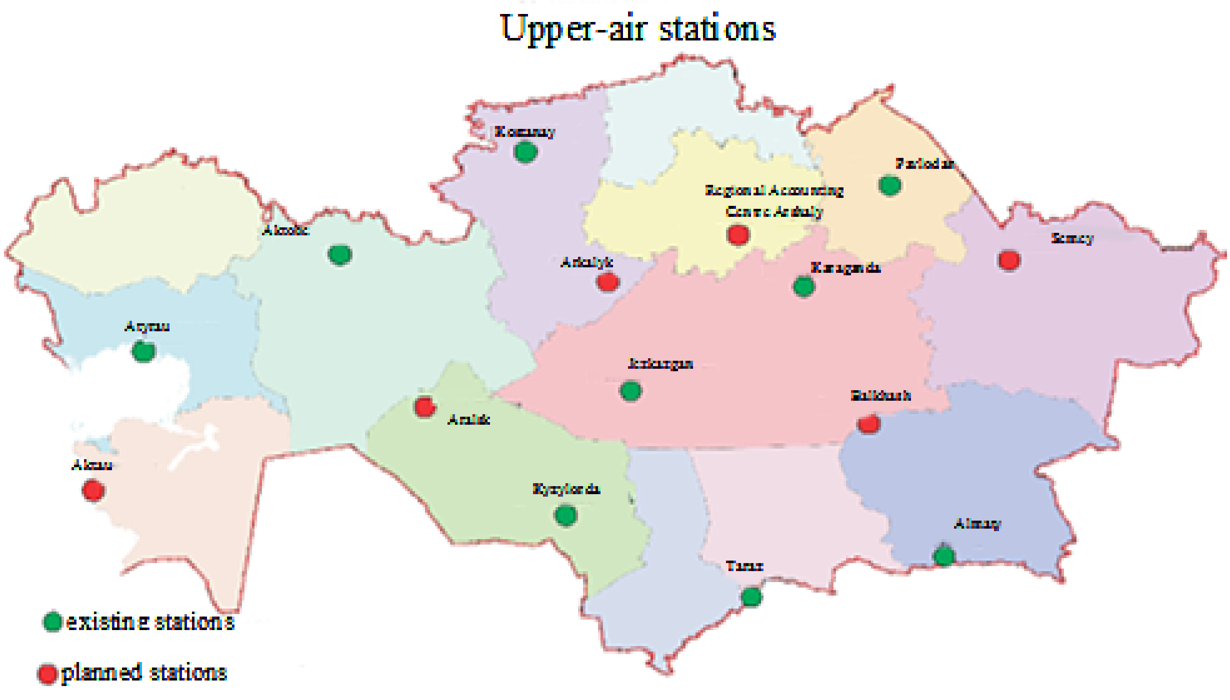
Development of meteorological observation points in the Republic of Kazakhstan

Sources: Development Strategy of the National Hydrometeorology Services of Kazakhstan up to 2020.

Nowadays the network of upper-air observations constitutes about 67% (9 upper-air stations) of the number recommended by the WMO. Dangerous weather phenomenon forecasting of and aviation safety provision as well as monitoring of the state of the atmosphere require more complete coverage of the territory of the Republic – 15 upper-air stations [5]. Figure 8.3 shows the development of upper-air stations of RSE «Kazhydromet».

Figure 8.3

Development of upper-air stations of Kazakhstan



Sources: Development Strategy of the National Hydrometeorology Services of Kazakhstan up to 2020.

IX. EDUCATION, TRAINING AND AWARENESS RAISING

The education system of the Republic of Kazakhstan includes the concept of «environmental education» in the framework of which questions of climate change are considered. It deals with aspects of environmental education at the following levels:
• Pre-school and secondary education;
• Vocational education and training (VET);
• Higher and postgraduate education.

9.1. Pre-school and secondary education

The educational process of all age groups of Kazakhstan pre-school facilities is based on the curriculum approved by the Order of the Ministry of Education and Science of the Republic of Kazakhstan No. 628 dated October 28, 2008 according to which subject «Basic Environmental Culture» was introduced.

To ensure the quality of pre-school educational services the Government of the country in cooperation with UNESCO and international experts developed a new educational standard. This standard entered into force in 2007 and includes five educational areas: communication, knowledge, health, creativity, society. The educational area – knowledge contains understanding and study of environmental issues.

The following list of study material is recommended to be used in pre-school facilities in 2010-2011. This list includes such educational resources as:

- «Insight into the out world, ecology», demo material, teacher resource book and workbook (V. Rakhimbekova, V .Chubko, Almatykitap, 2008);
- «The world around us, ecology», teacher resource book, ABC-book and reading-book (A. Mankesh, Almatykitap, 2008);
- «The world around us, ecology», didactic material (A. Aliyakbarova, G. Baigushikova, Almatykitap, 2008);
- «Tutorial guidance for organization of activities of the subject «Self-knowledge» in the pre-school group / form» (S. Kaliaskarova, V. Kim, M. Iliyasova, Bobek, 2009);
- «Self-knowledge», didactic materials for seniors and pre-school groups of pre-school facilities» (T. Lukasheva, N. Krasnova, O. Kisilenko, V. Kim, 2009).

The Ministry of Education and Science of the Republic of Kazakhstan has developed several programs for pre-school children including «Zerek bala» and «Biz mektepke baramyz» which are in both Kazakhstani and Russian languages. Number of child care centres and children enrolled in the programs is shown in Table 9.1. These programs are aimed at developing environmental awareness of pre-school age children and forming personal values contributing to the realization of a person as a part of nature and his / her dependence on the natural environment and the necessity of living in harmony with the environment.

Table 9.1

The number of children covered by the training program «Zerek bala» and «Biz mektepke baramyz»

	2008	2009	2010	2011
The number of permanent public pre-school facilities	1692	1852	4781	6133
Children covered, thousand people	257,1	274,9	390,8	489,4

Sources: Statistical agency of the Republic of Kazakhstan

In addition to kindergartens, preschool education covers mini-centers at schools that use the above mentioned educational programs. Thus it can be concluded that pre-school education in the country gives rise to the formation of environmental awareness of pre-school age children.

According to the Statistical agency of the Republic of Kazakhstan the number of children covered by the comprehensive school in the period from 2010 to 2011 school year was 2,531 thousand people. Environmental issues in general are studied in the framework of scientific knowledge system about natural processes and phenomena, namely «Knowledge of the World», «Natural Science», «Geography», «Biology», «Physics», and «Chemistry». As for the aspects of climate change, the basic knowledge in this area is provided during the study of the subject «Geography». Such issues as climate of Kazakhstan, climatic factors, and impact of climate change on human life and economic activities of a man, agro-climatic resources are studied in the framework of this subject.

Since the period from 2010 to 2011 new subjects have been introduced into the academic activity such as «Self-knowledge» and «Environmental Ethics». Unfortunately, issues relating directly to the climate change are not studied in the framework of these subjects but learning of these programs contributes to the understanding of the nature effect on a person and vice versa as well as the effect of flora and fauna on a person.

State educational standard does not provide an advanced study of climate change issues but on the initiative of teachers extracurricular activities, electives, clubs related to this issue take place in many schools. Initiatives are mainly implemented by teachers who have attended trainings and courses in the framework of international projects. For example, in the framework of the project «Demonstration of solar energy using on the example of secondary schools of Karaganda and Almaty regions» (2009) participants of the introductory seminars on climate change, energy efficiency and preparation for the demonstration of solar panels became 30 teachers of secondary schools in Karaganda, Temirtau, Shakhtinsk and other cities of Karaganda region as well as representatives of the Karaganda Institution of Advanced Training.

In addition to education approved by the state standards, the Government is engaged in activities aimed at the improvement of environmental education including climate change issues by means of common projects with international non-governmental organizations, and business representatives.

In the framework of UNESCO's «Education for Sustainable Development» a number of international projects on environmental education and education for sustainable development are being implemented. About 100 schools in Kazakhstan are implementing the international program «Eco-Schools», more than 800 schools are using the materials of the project SPARE (problems of sustainable energy) in the teaching of subjects «Geography», «Chemistry», «Physics», in the framework of the environmental clubs activities. Among the materials of the project there are: (1) Tutorial guidance for carrying out lessons in energy efficiency and climate change, (2) Computer lesson «Global climate change and energy industry of Kazakhstan» (3) Energy saving. The pilot project of a textbook for the 7th form of a secondary school and (4) Energiyany unemdeu (textbook in Kazakh).

Another example of integration of climate change issues into the educational process in natural subjects can be the project of CAREC being implemented with the support of the British Embassy. Kazakhstan has developed five educational posters and a 20 minute video about climate change which were the additional learning resources for the textbook «The environment for future generations». The teaching aid received positive expert opinion of the Ministry of Education and Science of the Republic of Kazakhstan, it was translated into Kazakh, a tutorial guidance for its application was prepared and materials were distributed to pilot secondary schools in the cities of Almaty and Karaganda.

Climate change issues were covered in detail in a new multimedia educational resource for school children (from 13 to 15 years) - Green pack for Central Asia prepared in the framework of the project of the CAREC with the assistance of the Regional Environmental Centre for Central and Eastern Europe, UNESCO Cluster Office for Central Asia, OSCE Centre in Astana, SGP GEF / UNDP (Small Grants Program of Global Environment Fund / United Nations Development Program) and company «Chevron». The course is approved by the MES and recommended for use in secondary schools. More than 500 teachers have attended advanced training (from 2009 to 2010) on the use of the course and now practice using educational materials during their classes.

In addition to the initiatives of the international community, it is necessary to note the role of business and non-governmental organizations in environmental education. The annual competition for environmental projects among school children held by «Chevron» can serve as a successful example. Among non-governmental organizations the public association «EcoObraz» is a proponent of informal environmental education for children in Kazakhstan. The organization has been implementing the program «Young Reporters for the Environment» for 6 years. Pupils write articles on various categories and climate change is among these categories.

To sum up, it can be concluded that nowadays there is an academic base for the integration of climate change issues into the block of natural sciences which is developed mainly in the framework of international initiatives. According to experts, the most effective measures to inform the public on how to mitigate the human impact on climate change and adapt to its effects will be introduction of the courses into the general education curriculum[13]. Given this fact, it is advisable to work on strengthening and integration of existing academic base into the subjects of natural sciences in secondary education systems especially for classes specialized in Chemistry and Biology, and Physics and Geography.

9.2. Vocational education and training

As of July 1, 2010, according to government statistics 786 VET educational institutions are in operation including 306 vocational schools, 480 colleges. Compared to the equivalent period in 2005 the number has risen by 64. 22.8% of them are located in the countryside.

In order to generate knowledge on the issues of sustainable development in all VET occupations and specialties the study of the 32-36 hour course «Environmental Protection» is provided. Standard curriculum for this subject does not include the study of climate change issues.

[13]The report on the UNDP project «Social research of public opinion for assessment of the basic level of public awareness of climate change» LPP Business information, social and marketing research centre «BISAM Central Asia», Otenko T.V.

List of middle ranking specialists in environmental issues is made in Kazakhstan under the state VET specialties and occupations classification shown in Table 23, Annex 5.

Standard curricula for specialties «1514000 Ecology and Efficient Use of Natural Resources (by industries)» and «1509000 Ecology and Environmental Activities (by types)» do not provide advanced study of climate change issues. Some aspects of climate change are studied in the scope of the specialty «1515000 Hydrology and Meteorology», the profession-oriented subject of which is Geography. Unfortunately, the issues of the impact of climate change on the environment and human are not paid due attention.

Regarding the national VET development policies (state VET development program for the period from 2008 to 2012), this system is expected to play a stimulating role in solving pressing problems of sustainable energy, water resources, mitigation of climate change effects and adaptation to these effects. In addition, there is a strengthening of the role of VET as the implementation of measures and technology needs for the «green economy» increase the requirements for the level of knowledge, skills, and require a change in skill requirements and development of new specialties. To solve these issues it is important to integrate climate change issues into basic curricula for all specialties as well as strengthen profession-oriented subjects with regard to present knowledge in the context of climate change and new technologies.

9.3. Higher and post-graduate education.

Since preparation of the SNC (Second National Communication) the higher education system of Kazakhstan has completely merged into the three-level staff training system agreed in the European Area. In 2010, Kazakhstan signed the Bologna Declaration and became a full member of the European Higher Education Area. Thus, 3 degrees in the specialty relating to environmental protection and climate change issues can be obtained – Bachelor, Master and Doctor.

In higher school just like in VET there are two directions to study climate change issues: the general (basic) one – for students of all specialties and profession-oriented (advanced) for students of natural and geographical, ecological, chemical and biological, technical specialties. In basic education climate change issues are studied in the framework of the discipline - Ecology and Sustainable Development (90 hours). Standard curriculum of this course provides study of climate change issues in the context of human factors contributing to the instability in the biosphere. As to the subject aspects such as sectoral and market mechanisms, adaptation, prevention, emission reduction etc., these issues are not touched upon in the framework of the standard curriculum. Given the national policy of the transition to the «green economy», the demand for specialists of law, technical, economic, agricultural, and other specialties with specialist area of environment and climate change increases with every passing day. In this regard there is a great importance of further development and introduction of basic and specialized courses in all faculties as well as development of teaching and learning aids which present the specific nature of sectors and country and in the national and Russian languages.

The course «Energy Efficiency and Sustainable Development» for the technical universities of Kazakhstan may serve as an example of introduction of a specialized course. The course was designed in the framework of the pilot project of the CAREC on the basis of Satbayev Kazakhstani National Technical University. The program of the discipline «Energy Efficiency and Sustainable Development» is based and organically connected with the program of the discipline «Ecology and Sustainable Development» introduced as a compulsory component from the section of general studies in all universities of Kazakhstan and at the specialties of vocational education.

In many universities of Kazakhstan in accordance with the nomenclature of specialties staff training on environmental issues is carried out, environment-oriented faculties and the departments for the protection and sustainable use of natural resources are in operation. There is training in such specialties as «Ecology», «Safety and Environmental Protection», «Geo-Ecology and Nature Use Management». Training in these specialties provides a more advanced study of environmental issues including climate change. The students in these specialties study the causes and effects of ozone layer depletion and climate change, methods of inventory of sources of environment pollution. Subject matters are studied in the framework of such disciplines as «Geo-Ecology», «Environmental Monitoring». There is no specialized subject relating to climate change issues.

Climate change issues are studied more thoroughly in the specialty «Meteorology» at the Department of Meteorology and Hydrology of Al-Farabi University.

The country has created a research base for activities of the candidates for a master’s degree and candidates for a doctor’s degree. Research centres established at leading universities in which research in the area of climate change is being carried out can serve as an example. Thus, the Centre for Energy Research at Nazarbayev University[14] built a Model of development of the energy system of Kazakhstan allowing to obtain quantitative

[14]www.nu.edu.kz

estimates of the impact of energy and environmental policies, to simulate different scenarios in the context of the «green economy» development. In 2011, the Centre of environmental safety and the law of nature was founded at Al-Farabi University. The main research area of the Centre is a generalized legal analysis of global climate change in the context of sustainable development and law of nature.

Leading universities of Kazakhstan in the framework of international cooperation, organize lectures on climate change issues for candidates for a master's degree and candidates for a doctor's degree with the participation of professors and experts from the whole world. Kazakhstani students have a possibility of grants to study in leading universities with a specialization in environmental protection and climate change by means of international scholarship «Bolashak». It is important to note that the scholarship holders are to work at least 4 years in Kazakhstan after completion of education abroad.

The program of education modernization carried out in Kazakhstan requires a new level of relations between business, educational institutions and society. The business community supports educational activities, but unfortunately, the departments of ecology are not included in the priority list. Research Innovation Consortium established in October 2011 which includes KazNMU named after S.D Asfendiyarov represented by the department of common hygiene and ecology and LLP «Company Kenesary» can serve as one of the examples. The purpose of the project is unification of intellectual, labor, material and technical and other resources in order to carry out research work with financial support from the business community. Consortium carries out research work on request of such companies as: «Agip Kazakhstan North Caspian Operating Company N.V.», «Karachaganak Petroleum Operating», «Tengizchevroil», «Offshore Kazakhstan International Operating» etc.

The most important element of the staff training is sphere of retraining and advanced training. Specialized courses in the field of environmental protection and climate change were introduced into a number of centres of retraining and advanced training. Thus, there is a Centre of retraining and advanced training in the field of environmental protection and use of natural resources at the Ministry of Environmental Protection of the Republic of Kazakhstan. The International Professional Academy «Turan-Profi» worked out an advanced training course «Management of Energy Saving Rehabilitation of Buildings» adapted to the conditions of Kazakhstan. The course takes place at the Academy and its regional centres. The environmental law course is held in the framework of the activity of the Kazakhstan Aarhus Centre. «Zhasyl Damu» JSC of the Ministry of Environmental Protection of the Republic of Kazakhstan holds specialized courses «Inventory of greenhouse gas emissions. Amendments and supplements to the Environmental Code on the issues of state regulation of activity of users of natural resources in the area of greenhouse gas emissions». Advanced training courses are mostly carried out on a fee paid basis.

Active role in this process is given to the social fund Climate Change Coordination Centre which together with international partners holds trainings for representatives of ministries, companies and NGOs. The purpose of training is to spread knowledge about the international process of the UNFCCC and the Kyoto Protocol, the mechanisms of the Kyoto Protocol, emissions trading system and its elements of efficiency raising etc. The list of workshops held within the period of 2009-2011 is shown in the Annex 5 table 24.

9.4. The analysis of information on public awareness campaigns, research and information centres, participation in international activities, regional cooperation, creation of and participation in network operation and synergy between conventions, institutional support of the UNFCCC in Kazakhstan.

Institutional support of the UNFCCC

In Kazakhstan, the provisions of the UNFCCC are implemented by a number of institutional structures. RSE «Kazhydromet», «Zhasyl Damu» JSC being the structures of the Ministry of Environmental Protection of the Republic of Kazakhstan provide expert and technical assistance in the issues of prevention of climate change and adaptation. Expert assessment is also carried out by a non-governmental organization – Climate Change Coordination Centre. A number of international non-governmental organizations, such as Scientific Information Centre of Interstate Commission on Sustainable Development, Regional Environmental Centre for Central Asia also deal with issues of climate change, carry out expert work and work aimed at the raise of the civil society potential.

General coordination of work at the state level is performed by the Ministry of Environmental Protection of the Republic of Kazakhstan, the central executive body that carries out management and inter-sector coordination in the implementation of state policy in the field of environmental protection and use of natural resources and provision of environmentally sustainable development of society. In particular, the structural unit of the Ministry of Environmental Protection Department of Low-Carbon Development is working on the integration of the principles of green low-carbon development, creation of national greenhouse gases emissions trading system.

9.5. International activities

Kazakhstan ratified over 20 international environmental agreements (convention, protocol). Nowadays the country is working to fulfill the obligations under these agreements. International environmental conventions ratified by Kazakhstan are harmonized with norms of the Environmental Code (2007). The industry program «Zhasyl Damu» developed in 2010 provides mechanisms of the coordinated approach in the implementation of obligations under international agreements such as the Kyoto protocol in addition to the United Nations Framework Convention on Climate Change – 2009, Stockholm Convention on Persistent Organic Pollutants – 2007, Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade - 2007, the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes – 2003.

Kazakhstan takes an active part in the implementation of international projects and programs on the issues related to climate change. Official delegations of the country are participating in the largest climate meetings and negotiations (Copenhagen 2009, Cancun 2010, Durban 2011). Kazakhstan is closely working with international organizations, countries and partners in order to prevent the climate catastrophe and adapt to the effects of climate change. At this time our country is working with the UN Development Program, implementing the projects of the United Nations Environment Program and United Nations Industrial Development Organization Program, cooperating with multilateral development banks (Asian Development Bank, European Bank for Reconstruction and Development, World Bank), with countries of the European Union and other international organizations and embassies (Table 25 Annex 5). The projects are implemented both at local and national levels. Projects of the national level focus mainly on strengthening of potential, provision of information, technical assistance provision. Whereas, projects of the local level are mostly demonstrative and are developed with an emphasis on local communities, for example projects of the Small Grants Program of Global Environment Fund (grant program for projects on adaptation to climate change at the local community level in the countries of Central Asia).

9.6. Regional cooperation

Kazakhstan is an active participant in activities aimed at strengthening of regional cooperation between the countries of Central Asia. The country is implementing programs and projects aimed at solution of these problems. Work in this area is carried out by intergovernmental (Interstate Commission on Sustainable Development, Eurasian Economic Community etc.) and regional organizations (Regional Environmental Centre for Central Asia, Regional Mining Centre for Central Asia etc.) as well as international organizations and donors (EU, OSCE, UNIDO, UNDP, GEF etc.).

Since 2010 the CAREC has been acting as sub-regional node in the framework of the Asia-Pacific Network for adaptation to climate change. According to the results of the implementation of a range of projects, a number of regional studies on adaptation to climate change in Central Asia[15] were published:

- «The analysis of activities in the field of adaptation to climate change in Central Asia. Requirements, recommendations, practices»;
- «A review of experience of adaptation to climate change in Central Asia»;
- «Assessment of technology requirements for adaptation of agriculture and water resources to climate change in Central Asia».

The project «Integrated Approach for the Development of Low-Carbon Development Strategies in Central Asia» implemented by the CAREC (2012-2013) aims at strengthening of the potential of the countries of Central Asia in order to the implement the project of NAMA and policies on energy efficiency (EE) and renewable sources of energy (RES). Development of the Green Growth Strategy in cooperation with the Climate Change Coordination Centre is carried out for. Kazakhstan.

In 2011, at the request of the OSCE and European Environment Agency, CAREC in partnership with Adelphi Research a regional workshop on the development of scenarios «The effects of climate change for water, energy industry and agriculture, and safety in Central Asia».[16]

With the support of UNDP Kazakhstan, projects on strengthening of regional cooperation are also implemented. For example, the Central Asian multinational Climate Risk Management Program[17] is a program launched in order to raise region potential in the field of climate risk management and adaptation to climate change (from 2011 to 2014). Another initiative was a special grant program for the GEF SGP projects on adaptation to climate change at the level of local communities in the countries of Central Asia.[18]

In 2009, the UNIDO and Eurasian Economic Community (Kazakhstan is a member of EurAsEC) signed a memorandum of cooperation in the field of energy and climate change, environmental protection, including water management; agricultural sector as well as strengthening of commercial potential and private sector development.[19]

[15] 15http://www.carecnet.org
[16] http://www.carecnet.org
[17] http://www.climate-action.kz
[18] http://gefsgp.un.kz
[19] IISD Reporting Service 2009

Another area for cooperation on climate change issues in the region is the Interstate Commission on Sustainable Development (ICSD) in the framework of which a regional network of experts on climate change issues was created and brought together national points of contact of the UNFCCC, experts in the field of adaptation and mitigation.

During the Third High-Level Conference «EU-Central Asia» in Rome in November 2009, a regional working group «EU-Central Asia: climate change and strategic planning of use of natural resources» was created. The main purpose of the working group was to contribute to the implementation of the Platform for Environment and Water Cooperation between the EU and Central Asia and conduct a regular dialogue on ways and methods of working on a resolution of the threats posed by climate change in Central Asia. The first meeting was held in Brussels in 2010, the second one – in Almaty in 2012.

In 2010, the Second Central Asian-European Forum on Climate Change took place in Bishkek. The main purpose of the conference was to develop a regional approach to climate change policy and strengthen the transfer of knowledge and develop cooperation between the countries of Central Asia and Europe on the problems of post-Kyoto.

In general much effort was applied in order to develop regional cooperation and reduce tension around the issue of access to energy resources and climate change issues. As a result, the governments of the five countries of Central Asia signed a number of bilateral and multilateral agreements, and working groups, expert networks were created, plans and programs were worked out as well as strategies aimed at development of a coordinated approach to resolution of these issues.

9.7. Dissemination of information

For the last few years the interest of the Kazakhstan mass media in climate change has been expanding rapidly. This is due to the frequent abnormal natural phenomena in the country and in the world. Information is disseminated by means of the mass media as well as print media, Internet etc., published both in the news and reports and in special sections relating to the environment. Such promotional event as «Earth Hour» and other great environmental events are held.

Specialized print publications include: newspaper «Ecological Courier», «EkologNS», «Ecological Bulletin», «Ekologiyalyk zharshy», «Atameken», magazines «Eco», «Ecology and Society», «Ecology and Life» and many others. In addition, subdivisions of the Ministry of Environmental Protection in the Republic of Kazakhstan publish quarterly ecological newspapers. Today special section «ecology» is present in most national newspapers («Panorama», «Kazakhstan Today», «Liter» etc.). In almost every region of Kazakhstan newspapers with a special section devoted to the coverage of environmental protection issues of the specific area are published («Prikaspiyskaya Kommuna» («Caspian commune»), «Magnitka Plus», «Kostanay-Agro»).

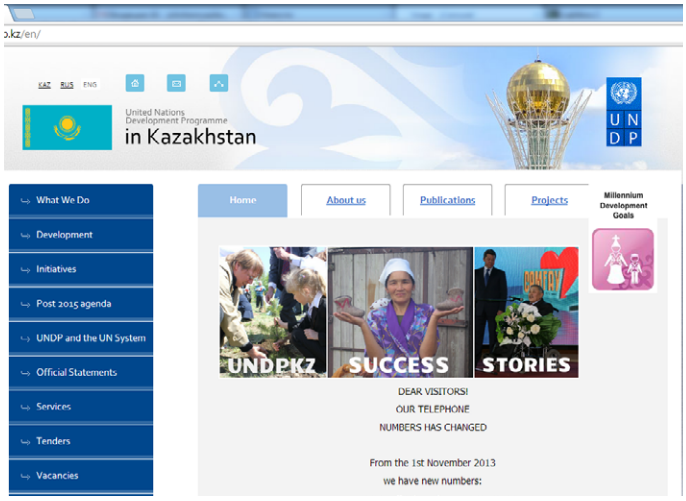
The television in the framework of ecological sections also produces TV shows devoted to the issues of environmental protection and climate change («Green Economy» on the channel 24.kz, TV-show «Ekologuichesky Patrul'» («Ecological Patrol») on the channel «Rakhat-TV», «Ekologuiya Bekety» («Ecological Post») which is shown on the channel «Yuzhnaya Slotitsa» («Southern Capital») etc.).

Since SNC holding of specialized trainings and workshops for journalists in tin the field of dissemination of information on climate change became the major achievement. For example:

1. Training workshop for the mass media: «Adaptation to climate change: national priorities and implementation at the local level» (UNDP Kazakhstan, July 2012);
2. Training workshop «The specifics of the media coverage of climate change issues in Kazakhstan» for working journalists and senior students of the Department of Journalism (the International Centre for Journalists MediaNet, October 2010)
3. Training workshop «Problems of the media coverage of environmental issues» for working journalists (OSCE Centre in Astana, April 2012);

In addition to trainings and workshops the activity relating to the organization of special competitions for journalists is carried out. Kazakhstani journalists got the opportunity to participate in such competitions as:

1. Climate Change TV: where short videos lasting up to three minutes and devoted to climate change were considered, they were shot after the conference on climate change in Cancun in December 2010
2. Best publication of young journalists on the subject of Climate Change Issues in Kazakhstan and the necessary steps to adapt to these changes (UNDP / Ministry of Environmental Protection of the Republic of Kazakhstan)
3. Earth Journalism Awards – a competition of eco-journalism during which there is celebration of the achievements of those professional and informal journalists and bloggers who use their skills and influence to attract public attention to the problem of climate change and explain its main aspects.
4. The Climate Change Media Partnership – a scholarship program that supports the participation of journalists at United Nations conferences on climate change, for example the one in Doha in the end of 2012. The scholarship allows journalists to cover the issue of climate change in the mass media of their countries working together with other experienced journalists all over the world and get the information required for a multifaceted understanding of global effects of climate change.



After holding a training workshop for the mass media: «Adaptation to climate change: national priorities and implementation at the local level», there was appearance of such works as: newspaper «Liter», section «Ecology»: «All that is left to do is to adjust» (Liter, 27.07.2010, A . Gabbasova), «Adapt who can» (Liter, 11.08. 2010, T. Kazantseva), newspaper «Info-tses» section «»Human Environment»: «Drought and heat will be defeated by drip watering» (30.07.2010, N. Guk), «The night is young!» (13.08.2010, N. Guk), one program on television – the evening news on the TV channel STV (23.07.2010 - 20:00 (Eng), 18.30 (Kz)), one publication in the newsline Information Agency «Kazinform» (23.07.2010), video and radio broadcasts for the website of World Radio Service of BBC, review material on climate change in the magazine «Agrarny Sektor» («The agricultural sector»).

Nowadays the major sources of information, especially among young people, are social advertising on television, the information in print publications and Internet. According to the results of social research of public opinion for assessment of the basic level of public awareness of climate change in the age group of 18-29 years a great role was given to the information in the Internet (66% of pollees), in other age groups – to social advertising on television (75% of pollees)[20].

The main web sources of this information are: websites of organizations: Climate Change Coordination Centre, Ministry of Environmental Protection of the Republic of Kazakhstan, RSE «Kazhydromet», Zhasyl Damu JSC, CAREC, National Aarhus Centre of the Republic of Kazakhstan, Climate Change Coordination Centre, Zhaiyk-Caspian Aarhus Centre, information portals http://www.climate-action.kz and http://www.climatechange.kz/, ecological society «Green Salvation» and others. These web resources provide information on climate change: breaking news, events, current national and international projects, progress of the international negotiations, legislation etc.

9.8. The analysis of the process of involvement of the public and non-governmental organizations, public access to information on climate change and its effects as well as encouragement of public participation in resolution of problems of climate change and its effects and development of adequate response measures.

The issues of public access to environmental information have been reflected in a number of international environmental conventions ratified by the Republic of Kazakhstan. One of the most important is Convention of the United Nations Economic Commission for Europe on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters. Kazakhstan ratified this international legal instrument in 2000. But not all the provisions and norms of the Aarhus Convention were directly reflected in the national legislation of the Republic of Kazakhstan.

The major state body and organizations disposing information on climate change in Kazakhstan is Ministry of Environmental Protection with the following structures:

- RSE «Information-Analytical Centre for Environmental Protection» which processes, stores, publishes and disseminates environmental information is responsible for the implementation of the Aarhus Convention. On its base in June 2009 the National Aarhus Centre of the Republic of Kazakhstan was established, it maintains a web portal www.aarhus.kz, provides support for information and advice service, electronic database of legal documents in the field of environmental protection and climate change. Centre has representative offices in 5 cities of Kazakhstan
- Republican State Enterprise «Kazhydromet» provides the environmental monitoring, forecasting and warning about dangerous and particularly dangerous hydrometeorology phenomena, keeping of fund database on hydrometeorology and pollution of the environment, participation in the water inventory keeping. The company has its structures in all regional centres, with the exception of Taldykorgan and Kokshetau as well as in the cities of Almaty and Astana.
- Zhasyl DamuJSC is an industry research institute of the Ministry of Environmental Protection of the Republic of Kazakhstan. General information on climate change, which is in disposal of Zhasyl Damu JSC is:

1) information on the implementation of the Kyoto Protocol to the UNFCCC as Working and Authorized Body for coordination of implementation of the UNFCCC Kyoto Protocol in the Republic of Kazakhstan;

[20]The report on the UNDP project «Social research of public opinion for assessment of the basic level of public awareness of climate change» LPP Business information, social and marketing research centre «BISAM Central Asia», Otenko T.V.

2) annual national inventories of emissions and absorption of greenhouse gases which are not governed by the Montreal Protocol;

3) information under the UN Convention to Combat Desertification, UN ECE Convention on Transboundary Air Pollution over Long Distances, Vienna Convention for the Protection of the Ozone Layer and Montreal Protocol on Substances that Deplete the Ozone Layer;

4) annual national reports on the state of the environment in the Republic of Kazakhstan;

- **Water Resources Committee** carries out special executive and regulatory functions as well as inter-sectoral coordination in the use and protection of water resources. In terms of implementation of informational work one should notify the Public Institution of Republic Methodical Centre «Kazagromeliovodhoz» and Affiliated State Enterprise «Institute of Water Resources»» situated in the city of Taraz which are under the authority of the Water Resources Committee. Water Resources Committee keeps track of the section of data on water inventory on the use of water based on the reporting of water users and has primary responsibility for preparing and publishing the water inventory editions.
- **Committee for Forestry and Hunting** is a structure carrying out special executive and regulatory functions as well as inter-sectoral coordination in the field of forestry and hunting, specially protected natural territories. Committee for Forestry and Hunting performs functions of collection, processing, analysis, storage and dissemination of information on the following main aspects related to climate change: (1) accounting data and inventories of forests, specially protected natural areas, fauna and flora objects (except for fish and aquatic animals), (2) forest ecosystems monitoring data and (3) forestry management and forest reproduction.
- **Fisheries Committee** is a structure of government carrying out state fisheries management, special executive and regulatory functions as well as inter-sectoral coordination in the field of fisheries. Information resources of the Committee relating to information on climate change issues include:
  1. accounting data and fishery resources monitoring data;
  2. authorization for fishing and catching other aquatic animals;
  3. documents for implementation of works on the acclimatization of fish and other aquatic organisms and fish stocking of ponds.

The Ministry of Emergency Situations of the Republic of Kazakhstan is a central executive body and performs inter-sector coordination as well as special executive and licensing functions in the field of prevention and liquidation of emergency situations of natural and man-made disasters, civil defense, fire safety, supervision of safe conduct of operations in the industry and mining supervision. Among the subordinate organizations that play an important role in terms of working with information on emergency situations including the effects of climate change are the Public Institution «National Crisis Centre» and the Republican State Enterprise «Centre for Computer Science, Telecommunications, Informatics and Situational Analysis», State Enterprise «Kazselezaschita».

The Ministry of Health of the Republic of Kazakhstan and its structure. The Committee for State Sanitary Epidemiological Surveillance disposes of information about the impact of the state of the environment including the effects of climate change on the health of citizens (infectious and occupational diseases).

Statistical agency is a central executive body in charge of leadership in the sphere of government statistics. Information Fund of the Statistical Agency contains essential data and information relating to the protection of the environment and climate change: A. The state of the environment (water, air, forest, fauna and flora) B. Factors and measures affecting the environment (wastes, environmental measures).

Certain part of the information listed is publicly available on the websites of the mentioned ministries or their subordinate structures or can be provided upon request of the public. Most information relating to climate change issues (information of Kazhydromet, Zhasyl Damu) is provided on a fee paid basis[21].

If the public is considered as a potential consumer of information on climate change, it can be relatively divided into two groups: urban and rural residents. For the first group information on air pollution is of great interest. According to social research 83% of residents surveyed indicated severity of the problem of air pollution[22]. It is important to take into account the fact that the information should be able to be understood by the inhabitants. Unfortunately, nowadays there are no such sources of information in the country.

[21]The legislation of the Republic of Kazakhstan provides the opportunity of the provision of services by public authorities in accordance with the Regulation No. 651approved by the Government of the Republic of Kazakhstan dated July 9, 1998. Public institutions subject to the requirements of the Aarhus Convention on access to the environmental information often have a dominant position in the market. The regulation of prices for information services of these organizations is carried out in accordance with the law on the limitation of monopolistic activity and competition protection.

[22]The report on the UNDP project «Social research of public opinion for assessment of the basic level of public awareness of climate change» LPP Business information, social and marketing research centre «BISAM Central Asia», Otenko T.V.

For the second group (especially residents of rural areas) other aspects relating to information on climate change are important, namely the impact of environment and climate on the yield and cattle. Also, this group of people needs to obtain information on the number of days with a stable, unchangeable weather for gathering the harvest or planting. However, the rural population in general does not dispose of such information, especially those remote from regional centres, since public awareness of the weather forecast is mainly with reference to the regional centre.

Farmers need customized information and forecasts for the timely response, adaptation and prevention of potential adverse effects. Such information is provided on a fee paid basis or is not available.

9.9. The involvement of the public and non-governmental organizations

Involvement of the public and non-governmental organizations in the decision-making process and public participation in the operation of the Convention and access to information are essential for public support of effort to combat climate change and adaptation.

In Kazakhstan, there is a range of non-governmental organizations actively operating in the field of environmental protection including climate change. These organizations work in such areas as creation of awareness, education, and expert technical support, implementation of practical field projects of adaptation and prevention, participation in the climate meetings. The representatives of NGOs are actively involved in the negotiations and clarifications on Kazakhstan's position in the negotiations.

Among the most active non-governmental organizations working in Kazakhstan on the issues of climate change are such as: Climate Change Coordination Centre, Eco-forum NGO of Kazakhstan, Regional Environmental Centre for Central Asia, Network of Experts for Sustainable Development.

Social fund Climate Change Coordination Centre: the first NGO working in the field of implementation of the UNFCCC and the Kyoto Protocol, Vienna Convention for the Protection of the Ozone Layer and Montreal Protocol on Substances that Deplete the Ozone Layer since 2002. Climate Change Coordination Centre experts are involved in the development of national legislation, preparation of National Communications; they participate in the Conference of the Parties to the UNFCCC. The centre has carried out many international projects; trainings and workshops for all sectors of society on climate change are held on a regular basis.

Eco-forum NGO of Kazakhstan is the largest national ecological network of the country representing more than 100 non-governmental organizations in Kazakhstan. Representatives of Eco-forum participate in all the activities carried out by the Ministry of Environmental Protection of the Republic of Kazakhstan and they are members of the Council for Sustainable Development of the Republic of Kazakhstan, Publishing and Editorial Board of the Ministry of Environmental Protection of the Republic of Kazakhstan.

Members of Eco-forum perform pilot and demonstration projects including issues on adaptation to climate change. Among the main activities of Eco-forum relating to climate change issues there are two main areas: (1) strengthening of the potential of the network members on energy efficiency and reduction of greenhouse gas emissions, (2) access to the information on climate change issues through the Aarhus Centres in Kazakhstan.

The Regional Environmental Centre for Central Asia: climate change issues are covered by the activities of the program «Climate change and sustainable energy». The program was created in 2008 with the aim of contributing to the improvement of energy efficiency and reduction of greenhouse gas emissions in the region of Central Asia. After conducting the study «Gap Analysis in the area of Climate Change and Energy Efficiency», the program set for itself such activities as: (1) contribution to the reduction of greenhouse gas emissions in Central Asia, (2) assistance in the implementation of the Kyoto Protocol and post-Kyoto period, (3) raise of the importance of renewable energy sources in Central Asia, (4) improvement of energy efficiency in Central Asia. The CAREC functions as Asia Pacific Adaptation Network (APAN).

The Network of Experts for Sustainable Development: the association is created for the support of the process of sustainable development, implementation of analytical research in the field of sustainable development, participation in the preparation of national and regional strategies for the protection of the environment and sustainable development, support of regional cooperation among scientists studying the problem of sustainable development. The experts of the network carried out such research in the field of climate change as «Opportunities of the use and integration of the «Green Growth» mechanisms into the system of strategic planning of the Republic of Kazakhstan» (2010), «Kazakhstan National Green Growth Plan» (2012). The experts of the network participate in the implementation of the projects of the United Nations Development Program, United Nations Environmental Program etc.

ANEXES

Annex 1. Table to section 2.

Table 1

The population of the Republic of Kazakhstan during the period from 1995 to 2011

Years	Population, thousand people			
	Total population	Urban	Rural	Average annual number, involved in the economy
1995	15675,8	8730,3	6945,5	6551,5
1996	15480,6	8635,2	6845,4	6518,9
1997	15188,2	8499,4	6688,8	6472,3
1998	14955,1	8414,5	6540,6	6127,6
1999	14901,6	8397,6	6504,1	6105,4
2000	14865,6	8413,4	6452,2	6201.0
2001	14851,1	8429,3	6421,7	6698.8
2002	14866,8	8457,1	6409,7	6708.9
2003	14951,2	8518,2	6433,0	6985.2
2004	15074,8	8614,7	6460,1	7181.8
2005	15219,3	8696,5	6522,8	7261.0
2006	15396,9	8833,3	6563,6	7403,5
2007	15571,5	8265,9	7305,6	7631,1
2008	15982,3	8649,6	7332,7	7857,2
2009	16204,6	8806,9	7397,7	7903,4
2010	16442,0	8961,4	7480,4	8114,2
2011	16675,4	9114,6	7560,8	8301,6
2012	16909,8	9277,5	7632,2	8981,9

Source: «Kazakhstan during Years of Independence, from 1991 to 2010», Agency of Statistics of the Republic of Kazakhstan, 2011; «Kazakhstan in figures», Agency of Statistics of the Republic of Kazakhstan, 2012; Population Dynamics, www.stat.kz.

Table 2

Electricity balance of the Republic of Kazakhstan (million kWh)

Years	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Generated electricity	51635,1	55355,8	58289,5	63819,3	66894,0	67846,9	71668,5	76,620,9	80,347,9	78729,3	82646,5	86567,1
Imported	6026,9	3636,3	2391,6	2448,1	3481,5	3518,1	4880,4	3268,7	2768,0	1709,6	2913,6	3405.5
Exported	3292,6	2210,1	2521,9	4119,1	5319,7	3647,8	3288,4	3616,4	2482,6	2378,0	1756,6	1808,7
Including:												
By industry and construction	33578,7	37098,8	37374,1	40257,0	42617,3	44020,9	45968,8	48611,5	50706,2	48497,3	53317,9	56959,1
By agriculture	2649,4	2811,7	2849,0	2965,4	2237,2	2332,7	2407,3	2448,2	2439,9	2327,4	1905,1	1932,8
By transport	3065,7	2682,5	2885,7	3724,3	3429,3	3448,4	3750,0	4079,1	4691,7	4835,5	4825,3	4784,1
By other industries	8161,2	7363,1	7794,7	8122,6	9932,8	10969,5	12150,7	13269,7	14453,0	14959,5	8901,8	16827,4
Circuit losses	6914,4	9825,9	7255,6	7079,0	6839,2	6945,7	6650,8	7190,8	7113,7	6455.5	6612.9	6479,4

Source: Statistical compilations «The Industry of Kazakhstan and Its Regions», Agency of Statistics of the Republic of Kazakhstan, Astana, 2011. 2012..

Table 3

1Industrial production structure by types of economic activity for the period from 1998 to 2011 (as % of total)

Branch of industry	Өнеркәсіптік өндірістің жалпы көлеміндегі үлес салмағы												
	1998	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
All industry	100	100	100	100	100	100	100	100	100	100	100	100	100
Mining industry	24,2	44,3	47,9	48,4	53,4	59,4	57,8	56,9	61,1	60,3	61,3	63,3	60,8
Processing industry	55,1	46,9	43,3	42,9	39,7	35,3	37,0	37,8	33,6	32,3	31,7	30,1	32,2
Electric power. Gas and water production and distribution	20,7	8,8	8,8	8,7	6,9	5,3	5,3	5,3	5,3	5,3	5,3	5,6	4,6

Source: Statistical compilations «Kazakhstan Kazakhstan during Years of Independence, from 1991 to 2010», Agency of Statistics of the Republic of Kazakhstan, 2011; «The Industry of Kazakhstan and Its Regions, 2011», Agency of Statistics of the Republic of Kazakhstan, 2012.

Table 4

Vehicles fof the Republic of Kazakhstan (number of units: at the end of a year)

Years	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Railway transportation												
Locomotives	1913	1896	1770	1711	1659	1695	1714	1720	1684	1681	1772	1865
Railway engines	54	54	53	34	36	26	26	26	-	-	-	-
Diesel-powered locomotives	1242	1227	1126	1082	1071	1077	1093	1094	1106	1106	1202	1313
Electric locomotives	617	615	591	595	552	592	595	600	578	575	570	552
Freight wagons	86119	87715	88726	60792	86921	56895	61523	59756	60605	53104	55909	66503
Passenger cars	2088	2094	2559	1922	1874	2768	2740	2188	2307	2354	2306	2302
Baggage wagons	132	132	135	100	100	118	1150	116	60	62	56	55
Inland water transport												
Power-propelled cargo ships	2	2	2	6	9	9	10	9	12	12	12	10
Dry cargo ships	2	2	2	2	5	7	6	6	10	10	10	8
Tank ships	-	-	-	4	4	4	4	3	2	2	2	2
Towboats, pushboats	38	44	51	49	49	49	46	51	51	51	52	56
Passenger and cargo boats	8	10	13	13	8	7	7	8	23	24	24	27
Automobile transport												
Trucks	204568	214191	223063	224872	281598*	311828	359194	414332	410793	397598	414018	428862
Buses	50162	51367	61391	62894	65698	75042	83372	89220	94824	93956	98441	97268
Passenger cars	1057801	1062554	1148754	1204118	1405325	1745025	2183152	2576654	2656892	3087632	3553814	365040
Special vehicles*	36960	36938	38264	40373	-	-	-	-	-	-	-	-
Electric urban transport: trams	258	260	257	264	263	263	248	245	246	240	231	220
Trollebuses	481	450	427	388	365	351	329	334	305	280	193	229

* special vehicles are attributed to trucks

Source: Statistical compilations «Transport and communications in the Republic of Kazakhstan from 2006 to 2010», Agency of Statistics of the Republic of Kazakhstan,, Astana 2011; Statistical compilations «Transport in the Republic of Kazakhstan from 2007 to 2011», Agency of Statistics of the Republic of Kazakhstan,, Astana 2012

Table 5

Total land area and agricultural lands in distribution by land users (thousand ha)

Years	Land, which are used by land users	Including: Of agricultural enterprises	Of peasant (farm) enterprises	In private hands of citizen
		Total land area		
2001	91192,5	60220,2	30576,0	396,3
2002	86500,5	54591,5	31519,5	389,5
2003	83622,1	50469,7	32766,3	386,1
2004	82505,7	47156,9	34959,9	388,9
2005	82499,4	44704,7	37424,0	370,7
2006	85283,8	45058,5	39897,4	327,9
2007	87142,7	44899,9	41847,4	395,4
2008	88671,9	45125,7	43156,0	390,2
2009	92022,4	45482,3	46144,0	396,1
2010	93681,3	45562,5	47745,7	373,1
2011	94024,5	44955,3	48690,6	378,6
2012	93731,5	42417,1	50930,8	383,6
		Total agricultural lands		
2001	84562,5	54464,4	29761,0	337,1
2002	80445,7	49393,5	30722,0	330,2
2003	78601,1	46265,0	32012,6	323,5
2004	77972,4	43419,5	34227,7	325,2
2005	78383,0	41439,2	36634,9	308,9
2006	81261,8	41908,4	39064,1	289,3
2007	83406,3	42091,2	40992,6	322,5
2008	85470,4	42310,6	42840,8	319,0
2009	88165,3	42700,1	45140,4	324,8
2010	89802,2	42815,1	46685,4	301,4
2011	90199,1	42321,1	47576,6	301,4
2012	90343,0	40244,8	49793,4	304,8
		Ploughs		
2001	20476,9	12854,8	7375,7	246,4
2002	21429,1	12876,9	8311,7	240,5
2003	21351,9	12755,2	8363,6	233,1
2004	21968,1	12921,4	8815,6	231,1
2005	22152,0	13371,5	8560,2	220,3
2006	22106,1	13583,1	8312,2	210,8
2007	22117,6	13678,3	8227,3	212,0
2008	22704,7	14043,9	8448,3	212,5
2009	23407,8	14399,1	8791,9	216,8
2010	23583,9	14504,0	8861,8	218,1
2011	24033,6	14752,7	9061,9	219,0
2012	24403,4	14956,5	9224,9	222,0
		Hay fields and pastures		
2001	61146,4	40030,3	21087,8	28,3
2002	56463,3	35253,5	21182,5	27,3
2003	54344,0	32064,4	22250,6	29,0
2004	53142,7	29133,0	23976,6	33,1
2005	53324,4	26869,4	26421,1	33,9
2006	55824,3	26960,1	28837,1	26,8
2007	57701,3	26928,0	30713,4	59,9
2008	59386,5	26905,0	32425,1	56,4
2009	61644,1	26984,0	34601,9	58,2
2010	63074,6	26959,1	36083,2	32,3

Years	Land, which are used by land users	Including:		
		Of agricultural enterprises	Of peasant (farm) enterprises	In private hands of citizen
2011	63257,4	26320,5	36904,4	32,5
2012	63191,0	24108,6	39050,5	31,9

Note: Data on total land area and agricultural lands in distribution by land users is provided for the 1st of November of the relative-year.

Sources: Statistical compilations «Kazakhstan in 2010», Agency of Statistics of the Republic of Kazakhstan, Astana, 2011; Statistical compilationss – «Agriculture, forestry and fishery of Kazakhstan from 2006 to 2011», Agency of Statistics of the Republic of Kazakhstan, 2012..

Table 6

Cultivated area of main agricultural crops

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total cultivated area	16195,3	12438,2	448,2	160,3	102,6	38,8	22,5	2823,7	20119,2	21424,9	21438,7	21083,0	21190,7
Including:													
Grain and legume crops	16785,2	13208,7	347,5	164,6	107,7	41,4	19,9	2701,7	16190,1	17206,9	16619,1	16219,4	16256,7
Oil crops	17756,3	14022,7	409,6	163,0	108,7	47,0	19,8	2805,5	913,7	1186,1	1748,1	1 816,2	1853,9
Potato	17454,2	13872,6	631,9	166,9	110,2	42,2	22,2	2399,3	163,7	170,3	179,5	184,4	190,2
Field vegetables	18036,4	14278,0	665,0	168,2	111,3	43,6	22,3	2515,8	112,9	110,6	120,3	128,7	128,7
Cucurbits crops	18445,2	14841,9	669,7	168,2	110,8	43,4	17,5	2380,6	55,9	52,4	63,3	67,7	81,8
Sugar beet	18369,1	14839,8	751,4	153,9	103,0	42,0	14,4	2255,6	13,1	10,6	11,2	18,2	11,8
Forage crops	18954,5	15427,9	672,8	155,5	104,2	38,8	13,7	2329,0	2486,2	2535,8	2555,6	2484,3	2517,4

Sources: Statistical compilationss – «Agriculture, forestry and fishery of Kazakhstan from 2000 to 2011», Agency of Statistics of the Republic of Kazakhstan, from 2011 to 2012.

Table 7

Main indexes of forest fund

Years	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total area of forest fund (including forests, assigned for temporary use), million ha	26,7	26,1	26,2	26,5	26,8	27,8	27,8	28,4	28,7	28,8	28,8
Forested lands, million ha	11,7	11,7	12,4	12,4	12,3	12,3	12,3	12,2	12,3	12,4	12,5
Total reserve of standing timber, million cubic meters	373,6	373,6	375,6	375,8	375,8	375,8	380,7	380,7	380,7	380,7	412,3
Forest cover of the territory, in percent	4,3	4,6	4,6	4,5	4,5	4,5	4,5	4,5	4,5	4,6	4,6
пайыздармен											

Sources: Statistical compilations «Environmental protection and sustainable development of Kazakhstan», Agency of Statistics of the Republic of Kazakhstan, Astana 2011 and 2012.

Annex 2. Tables to section 3

Table 8

CO_2 emissions by the source categories in Kazakhstan, Gg.

Source categories	1990	1999	2005	2008	2009	2010	2011
1.Energetic activities	**250 860,74**	**101 016,29**	**167 748,51**	**169 971,12**	**194 544,56**	**213 591,11**	**200 179,55**
A. Fuel combustion (sectoral approach)	244 844,47	93 813,70	162 553,21	166 364,99	191 135,83	210 868,42	197 591,66
1. Energy industry	113 513,36	48 892,05	83 236,20	80 686,88	87 330,84	95 404,38	93 657,17
2. Processing industry and construction	21 891,41	19 304,86	25 394,57	26 497,92	25 765,63	25 295,34	26 292,54
3. Transport	22 490,91	5 827,12	13 168,26	21 936,69	20 379,30	19 809,93	19 910,39
4. Other sectors	51 747,99	7 405,89	10 667,24	15 021,37	13 207,62	14 348,16	16 795,38
5. Other sources	35 200,80	12 383,76	30 086,92	22 222,12	44 452,44	56 010,61	40 936,17
B. Fugitive emissions	6 016,27	7 202,60	5 195,31	3 606,13	3 408,73	2 722,69	2 587,89
1. Coal	169.06	89,83	125,30	168,19	149,08	174,46	181,17
2. Oil and gas	5,847.20	7 112,77	5 070,01	3 437,95	3 259,65	2 548,23	2 406,73
2. Industrial processes	**17 869,44**	**8 791,70**	**12 992,19**	**13 178,71**	**12 242,60**	**13 043,37**	**14 959,73**
A. Mineral products	5 955,81	1 446,70	3 806,24	4 295,40	3 670,99	4 133,54	5 360,16
B. Chemical industry	1 588,67	48,04	152,37	285,43	252,67	243,10	273,53
C. Metal production	10 324,96	7 296,96	9 033,59	8 597,88	8 318,94	8 666,72	9 326,04
5. LULUCF	**-2 167,00**	**-12 342,0**	**-2 863,67**	**-2 475,00**	**-2 482,33**	**-2 893,00**	**-3 094,67**
A. Forest lands	-1 774,67	-6 218,67	-2 845,33	-2 702,33	-3 025,00	-3 058,00	-3 215,67
B. Plough	-11,00	69,67	106,33	-69,67	-58,67	-58,67	NE,NO
C .Pastures	-381,33	-6 193,00	-124,67	297,00	601,33	223,67	121,00
6. Waste	-	-	-	**0,60**	**5,40**	**5,79**	**3,55**
C. Combustion of medical waste	-	-	-	0,60	5,40	5,79	3,55
International*) bunker	-	-	-	-	508,10	458,01	397,95
Aviation	-	-	-	-	508,10	458,01	397,95
Biomass*)	***1 083,33***	***581,65***	***315,75***	***357,03***	***459,97***	***511,41***	***495,34***
Total CO_2 emissions excluding international bunker and biomass	**266 563,18**	**97 466,00**	**177 877,04**	**180 675,43**	**204 310,23**	**223 747,28**	**212 048,16**

*) – Emissions from international bunker and biomass are not included to the total national emissions

Annex 3

Description of methodology, which is used for forecasting greenhouse gas emissions in Kazakhstan

Model for forecasting greenhouse gas emissions during fuel combustion

Emissions of the sector of fuel combustion and energy supply were forecasted by 2030 using analysis method of energy systems and MARKAL / TIMES / VEDA program, which was created as a project for system analysis of technologies of the International Energy Agency (IEA-ETSAP).

Data on last years, i.e. on 1990, 1995, 2000, 2005 and 2011, is the fact of greenhouse gas emissions for relative years according to the inventory (Zhasyl Damu JSC). Forecasts, which are provided for 2015, 2020, 2030, are results of the model. The year of 2011 was chosen because it is the last year when the inventory and calculations were made.

System analysis is based on the system principles, which are oriented at the assistance for persons, who deal with problem identification, quantitate assessment and system management. In view of many targets, limits, resources, this analysis aims to point out possible operative directions, considering risks, costs and profit. Analysis of the whole energy system offers an advantage in determining the most important variants of replacement, which are related to the system in general, in comparison with the individual analysis of each part of the system. This analysiscannot be supported by the individual technologies, goods and sectors.

Energy industry consideration as a unified system means arrangement of all energy data in the overall and arranged energy balance. A new version of energy balance, which was based on the official fuel and energy balance of Kazakhstan [2], was created for 2009 (and for previous years). Fuel demand and supply, which were arranged according to the form, proposed by the International Energy Agency [www.iea.org], was balanced. It allowed eliminating inconsistency, dual accounting and contradictions of data on important types of fuel and sectors. As result, balance (Table 44) seems to be more detailed and accurate in comparison with a balance, which is published by the Statistical Office of the International Energy Agency [www.iea.org].

Now we present the energy system as a detailed technical and economic development model - TIMES-KZ. Each generated Integrated MARKAL EFOM System (TIMES) represents two sets of system elements: economic and technical, which include energy industry, emissions and technologies. Model takes into account economic and technical regularities.

Development of the energy system is caused by the demand for energy in all sectors: agriculture, population and services, industry and transport. Demand for energy services is set by the user for the Basic scenario and has own price elasticity. That is the reason why demand changes according to prices in alternative scenarios. Thus, the model calculates the dynamic partial equilibrium for the national energy market and emissions market on the basis of the total profit maximization, and which are determined as a sum of profits from suppliers and consumers.

Table 9

Fuel and energy balance of Kazakhstan, 2009, arranged by NURIS (*)

Kazakhstan 2009 (petajoule)	Coal	Crude oil	Oil products	Gas	Hydro	Bio and waste	Electricity	Heating	TOTAL
Production	1795	3319	0	945	25	56	0	0	**6140**
Import	23	252	69	108	0	0	6	0	**458**
Export	-475	-2885	-254	-351	0	0	-9	0	**-3973**
Account balance at year end	-3	2	3	9	0	0	0	0	**11**
Total primary energy supply	***1339***	***689***	***-181***	***711***	***25***	***56***	***-2***	***0***	***2636***
All stations	-849	0	-5	-217	-25	0	280	349	**-466**
Oil refining	0	-663	630	0	0	0	0	0	**-33**
Coal conversion	-93	0	0	0	0	0	0	0	**-93**
Liquefaction plants	0	0	0	0	0	0	0	0	**0**
Charcoal production	0	0	0	0	0	-13	0	0	**-13**
Own consumption of energy industry	-38	0	-68	-286	0	0	-64	-53	**-508**
Losses	-19	-25	-1	-48	0	0	-23	-46	**-163**
Final consumption	***340***	***0***	***376***	***160***	***0***	***43***	***190***	***250***	***1359***
Industry	**165**	**0**	**75**	**32**	**0**	**0**	**119**	**96**	**487**
Ferrous metal industry	83	0	8	1	0	0	39	25	**155**
Chemical industry	1	0	1	4	0	0	7	5	**18**

Kazakhstan 2009 (petajoule)	Coal	Crude oil	Oil products	Gas	Hydro	Bio and waste	Electricity	Heating	TOTAL
Non-ferrous metal industry	28	0	15	0	0	0	42	36	**121**
Non-metal minerals	18	0	1	6	0	0	3	3	**31**
Mining operation	30	0	16	13	0	0	15	5	**80**
Food and tobacco products	3	0	9	5	0	0	5	12	**33**
Other productions	1	0	4	1	0	0	3	3	**12**
Construction	1	0	22	1	0	0	4	7	**37**
Transport	**1**	**0**	**246**	**49**	**0**	**0**	**4**	**1**	**300**
Roads	0	0	216	0	0	0	0	0	**216**
Domestic aviation	0	0	15	0	0	0	0	0	**16**
Railways	0	0	13	0	0	0	3	0	**17**
Pipe lines	0	0	0	49	0	0	1	0	**50**
Other	**171**	**0**	**43**	**77**	**0**	**43**	**67**	**153**	**554**
Population	127	0	7	63	0	41	31	96	**366**
Services	35	0	14	14	0	2	35	45	**144**
Agriculture and forestry	8	0	22	0	0	1	2	12	**44**
Fishery	0	0	0	0	0	0	0	0	**0**
Non-energy use	**4**	**0**	**12**	**2**	**0**	**0**	**0**	**0**	**19**

(*)Sums can differ from the total amount due to rounding

Sources: NURIS

CO_2 assumptions, which are based in the maximum profit, are especially difficult in the field of energy industry and environment, where prices for oil are under the strong influence of the Organization of Petroleum Exporting Countries that leads to dissatisfaction of consumers. In consequence the model can work in modes, where assumptions of just economic balance are simplified. In some cases the developer of the model can add social and political restrictions, such as delimitation of market share of best technologies for model engineering of restricted access to the information, or use special technological interest rate for model engineering of different propensities to risk, thereby implementing non-technical restrictions to the development of market balance.

In practice the process of the model solution creates the optimal Basic Energy System for each period of time by technology and fuel selection in order to maximize the overall balance (profit), which is equal to minimization of the total system value for the whole planned horizon period in the most elementary case (for example, optimal technic and energy ways). Thus, the model determines the optimal combination of technologies (potential and activeness) and fuel for each period, its related emissions, mining and trade activities, quantity of goods and its prices, equilibrium level of demand for energy services, everything is within the time series from the basic year to horizon period of the model.

TIMES-KZ model, which is used in this research, analyses the period from calibrated years of 2009 to 2030. About 1600 goods and processes are included to the model. Annual values of electricity and heating are divided by year seasons and day times, and are equal to nine time lines in total. TIMES-KZ technic and economic model depends generally on totality of plants, infrastructure, demand for equipment, which exist in the country in the basis year (2009) and on the technological improvement, which are possibly can be achieved in horizon of designed time (2030). Curves of demand and supply for many goods are technologically accurate in the model: there are linear gradual functions, where each step complies with the certain technology or demand for equipment, instead of the simple econometric profile of quantitative price functions, which depend on some elasticity. As the model depends on the times lines of macroeconomic variables only slightly, the results suffer from the young economy of Kazakhstan much less than econometric models.

TIMES-KZ model represents the demand for 33 different energy services. Demand was projected until 2030, and it changes depending on population size, GDP and GDP per capita, and also other demand drivers comply with the following formulas

Linear mathematical program, which is generated by this technic and economic model, has about 60 thousand variables, 45 thousand equations and 300 thousand of coefficients, which are not equal to zero. This model solves with the best optimizers the scenarios on the basis of the standard Windows operational system as a matter of minutes.

Results of the model engineering depend mainly on available and assumed data of the basic year. Total emissions, which are related to fuel combustion, are calculated for 2009 applying national emission coefficients to a new edited energy balance, they differ a little from summary emissions, which are mentioned in the National Inventory; discrepancies are more important at the industrial level. As TIMES-KZ model is based on the edited energy balance, model projections begin with values of 2009 in some cases, which differ from the National Inventory. In order to comply with the National Inventory emission forecasts of the model were moved upwards, and for the purpose of values agreement at the beginning of 2009emission forecasts of the model were moved downwards. In view of the TIMES-KZmodel limitation, the results of 2015 were less accurate that was the reason why values of 2015, which were indicated in the tables and diagrams, were sometimes interpolated between actual values of 2011 and model results of 2020.

Several scenarios were prepared using TIMES-KZ model. As actual experiments are impossible for the future, these mental experiments, which are based on different assumptions, and usually alternative and contrast, allow studying broad expanses of possible future events. For the purposes of the present national communication we will consider two main scenarios (other scenarios are not given in order to maintain brevity of the report): scenario with measures and scenario with additional measures.

Scenario with measures assumes low economic development, flat and average growth of prices for main raw energy products and no restrictions for greenhouse gas emissions. Scenario with additional measures includes all above mentioned assumptions, but also implies reduction of emission by 41.2 million tons of CO_2 equivalent by 2020 and by 115.2 million tons of CO_2 equivalent by 2030 in comparison with the scenario with current measures. Methodologically this scenario turns out to be economically essential by means of posing a restriction on acceptance of any variant to the value of $ 10 ‘2,000 / tons of CO_2 equivalent.

Methodology, which is used for proposed forecast of greenhouse gas emissions from processes, which are not related to fuel combustion

Calculation data was changed according to the inventory of previous years during forecasting emissions from some industrial processes due to the use of different data for calculations, and also use of the IPCC Guidelines for national greenhouse gas inventories, 2006 [17], while Zhasyl Damu used the IPCC Guidelines for national greenhouse gas inventories of previous years [14, 16]. These processes include as follows: production of concrete, lime, glass and aluminum industry.

Calculation methodology of emissions from concrete production

Data on clinker has been gathered by the Agency of Statistics of the Republic of Kazakhstan since 2004 (Table 10)

Table 10

Clinker production, thousand tons

Region	2004	2005	2006	2007	2008	2009	2010	2011
East Kazakhstan region	657,4	675	903,8	1 134,3	1 234,9	1 030,2	1 014,5	1 072,4
Karaganda region	-	-	-	-	635,4	742,2	933,8	954
Total for the Republic of Kazakhstan	**657,4**	**675**	**903,8**	**1 134,3**	**1 870,3**	**1 772,4**	**1 948,3**	**2 026,4**

Sources: Data of the Agency of Statistics of the Republic of Kazakhstan

Historical dynamics of two numerical series, namely total volume of clinker output and GDP size in relation to 2004, were studied for assessment of dependence between clinker production volumes and GDP dynamics (table 11)

Table 11

GDP dynamics

GDP	2004	2005	2006	2007	2008	2009	2010	2011
Index of physical volume of GDP, in %of the previous year	109,70	109,71	110,68	108,88	103,29	101,18	107,32	107,50
GDP index in relation to 2004	1,00	1,10	1,21	1,32	1,37	1,38	1,48	1,59

Sources: Data of the Agency of Statistics of the Republic of Kazakhstan

Using the linear regression, historical dependences of numerical series were determined, which after were used for projection of clinker production by 2030 with the following assumptions of GDP growth: six percent of gain growth annually during the period from 2013 to 2020 included and five percent of gain growth annually during the period from 2021 to 2030 included.

Table 12 represents the forecast of clinker production by 2030. A single weight coefficient of CO_2 emissions from produced clinker was used for calculation of forecast on carbon dioxide emissions during clinker production, and it was equal to 0.52 (IPCC Guidelines for national greenhouse gas inventories, 2006 [17]).

Table 12

Forecast of clinker production

Index	2011	2015	2020	2025	2030
Clinker production, thousand tons	2 026,4	3 293,1	5 179,0	7 240,6	9 871,8

Sources: NURIS

Calculation methodology of emissions from lime production

Table 13

Dynamics of lime production

Index	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total lime production of the Republic of Kazakhstan, thousand tons	622,9	689,3	710,7	786,1	859	993,5	988,1	1023,2	905,9	798,2	886,6	959,8

Sources: Data of the Agency of Statistics of the Republic of Kazakhstan

Table 14

GDP dynamics for the period from 2000 to 2011

GDP	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Index of physical volume of GDP, in % of the previous year	109,8	113,5	109,8	109,6	109,7	109,7	110,7	108,9	103,3	101,2	107,3	107,5
GDP index in relation to 2000	1,00	1,14	1,25	1,37	1,50	1,64	1,82	1,98	2,05	2,07	2,22	2,39

Sources: Data of the Agency of Statistics of the Republic of Kazakhstan

Linear regression of two numerical series, namely lime production and GDP, allows determining the linear dependence of two indexes.

Table 15 represents the results of calculations of the forecast on lime production by 2030. A single weight coefficient of CO_2 emissions from produced lime was used for calculation of forecast on carbon dioxide emissions during lime production, and it was equal to 0.762 (IPCC Guidelines for national greenhouse gas inventories, 2006 [17]).

Table 15

Forecast of lime production

Index	2011	2015	2020	2025	2030
Lime production, thousand tons	959,8	1 126,6	1 334,5	1 568,2	1 853,4

Sources: NURIS

Calculation methodology of emissions from ammonia production

Nowadays the emission calculation is made using Tier 1 with default coefficients. By virtue of the fact that «KazAzot», LLP had provided information about own production and capacity indicators, it was a possibility to use for this calculation data, which is meant for TIER 2. And also on account of that new calculation rules will be valid from 2015, the IPCC Guidelines for national greenhouse gas inventories, 2006 [17] were used.

$$TFR_i = \sum_j \left(AP_{ij} * FR_{ij}\right) = AP_{ij} * 31,8 \frac{\text{ГДж}}{\text{тонна}} \text{аммиака}$$

TFRi – total need for fuel, 31.8 gigajoule / tonof ammonia
AP – ammonia production, tons
FR – need for fuel per production unit

Calculation of aggregated coefficient of emissions per production of one ton of ammonia:

$$E_{CO2} = \Sigma_i\left(TFR_i * CCF_i * COF_{ij} * 44/12\right) - R_{CO2} = AP_{ij} * 31,8 * 15,3 * 1 * \frac{44}{12} = 1,78 * AP_{ij}$$

ECO_2 –CO_2 emissions, kg
TFRi- total need for fuel of i type, gigajoule
CCFi – coefficient of carbon content for fuel of i type, kg C/gigajoule
RCO_2 – extracted for further production (carbamide production, recovery and storage of CO_2), kg
CCFi, COFi, RCO_2 – default data from IPCC Guidelines for national greenhouse gas inventories, 2006 [17].

Calculation methodology of emissions from calcium carbide production

Data of Zhasyl Damu JSC for the period from 2000 to 2011 was used for projection of emissions from this category.

Table 16

CO_2 emission dynamics from use of dolomite in the metal industry

Index	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
CO_2 emissions from use of dolomite, thousand tons	834	1 074	1 515	1 550	1 650	1 836	1 817	1 565	1 975	1 619	1 726	1 997

Sources: NURIS, according to the data of Zhasyl Damu JSC

Linear regression of actual emissions with historical dynamics of GDP allows making projection of emissions until 2030 in respect of assumptions about future GDP dynamics, which are mentioned above.

$$E_{CO2} = AD * EF$$

ECO_2 – CO_2 emissions, tons
AD – data on calcium carbide production
EF – CO_2 emission coefficient. EF is equal tothe average amount of CO_2 emissions per carbide production unit, ton of CO_2/ ton of carbide products.

Default coefficient of emissions were determined according to the IPCC Guidelines for national greenhouse gas inventories, 2006 [17].

Calcium carbide production, CO_2 emission coefficient EF = 1.090

$$E_{CO2} = AD * 1{,}090$$

Calcium carbide consumption, CO_2 emission coefficient EF = 1.100

$$E_{CO2} = AD * 1{,}100$$

2.95 tons of CO_2 equivalent accounts for a ton of produced calcium carbide according to the calculation of Zhasyl Damu JSC [1].

Calculation methodology of emissions from coke production

Calculation of methane emissions from coke production is to be determined by the product of emission coefficient by the volume of annual products in the chemical industry. Thus, 0.5 kg of CH4 accounts for a ton of products.

Table 17

Forecast of coke production during2012-2030

Type of activity	Year								Compare with 2012
	2012	2014	2016	2018	2020	2022	2025	2030	
Coke production, thousand tons	2 867,2	3 339,1	3 892,9	4 535,7	5 285,5	6 028,6	7 343,7	10 174,5	3,5 есе өсу

Sources: NURIS

Calculation methodology of emissions from iron and steel production

Iron- and steelmaking industry are the key industries in the Republic of Kazakhstan. In this regard it is recommended to apply formulas for CO_2 emission calculations according to TIER 2 (IPCC Guidelines for national greenhouse gas inventories, 2006 [17]) for iron- and steelmaking industry.

Data on energy carrier consumption is provided by ArselorMittal Temirtau. Data on gas density are taken from the table, which was prepared by Teknopoli company [7]. Methane emission coefficient is equal to 0.07 kg / ton of agglomerate during its production (IPCC Guidelines for national greenhouse gas inventories, 2006 [17]). Methane emission coefficient is deemed to be equal to 0.5 kg per ton of iron during iron production (according to the tables 2-10 of Revised guidelines, t.3 [17]). Data on carbon content in the raw material was taken from the above -mentioned table (IPCC Guidelines for national greenhouse gas inventories, 2006 [17]). Data on steel and iron production are taken from the Statistical compilations «Industry of Kazakhstan and its regions from 2007 to 2010» of the Agency of Statistics of the Republic of Kazakhstan.

According 2006 IPCC Guidelines, Metal Industry Emissions, methane emissions became negligible during production.

Calculation methodology of emissions from ferroalloy production

Ferroalloy production is the key production of the Republic of Kazakhstan. In this regard it is recommended to apply the formulas for carbon dioxide emission calculations according to TIER 2 (IPCC Guidelines for national greenhouse gas inventories, 2006 [17]) for ferroalloy industry.

Calculation of carbon dioxide emissions was made on the basis of data on raw consumption of Aksu Ferroalloys Plant. Data of Agency of Statistics of the Republic of Kazakhstan on amount of produced ferroalloy products was used. Emission factors were taken from the IPCC Guidelines for national greenhouse gas inventories, 2006 [17]. Data on carbon content in ferroalloy products was taken from GOSTs. Data on carbon content in ore was taken from the handbook on the theory and technology of chrome alloy production [8].

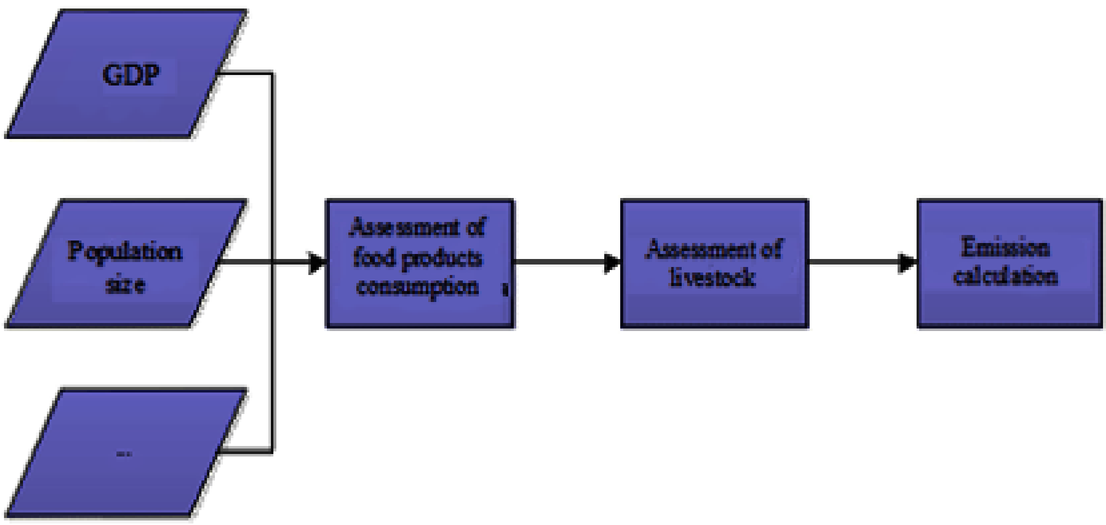
According to the State Program of Forced Industrial-Innovative Development of the Republic of Kazakhstan, an enterprise for ferrosilicon manganese production with a rated capacity of 64.8 thousand tons / year will be constructed by 2015 in Zhambyl region. Also an enterprise on ferrochrome production with a rated capacity up to 440 thousand tons / year will be constructed by 2015 in Aktobe region. This increase of ferrochrome and ferrosilicon manganese production is reflected in the forecast.

Calculation methodology of emissions from enteric fermentation of animals

Calculation scheme of emissions from the cattle breeding sector assumes an assessment of greenhouse gas emission by the line «future consumption of food products» – «assessment of necessary animal livestock» – «emission assessment» in the assumption about relative privacy of markets (milk, beef, mutton, eggs) or about the supply structure in the section of import – domestic production (pork, poultry meat, horse meat) on the basis of historical data, official documents and assessments of experts (figure 1).

Figure 1

Assessment scheme of greenhouse gas emissions from the cattle breeding sector



Forecast of meat consumption is prepared on the basis of dependence between consumption and amount of gross domestic product per capita considering the law of diminishing utility, which is reflected on the selection of regression function for assessment of future consumption. Analysis of the international statistics on meat consumption per capita of different countries shows that meat consumption per capita depends on the logarithm of GDP per capita in this country, which is reflected in constant prices, in many countries with relatively stable macroeconomic and political situation.

Figure 2

Meat consumption in different countries

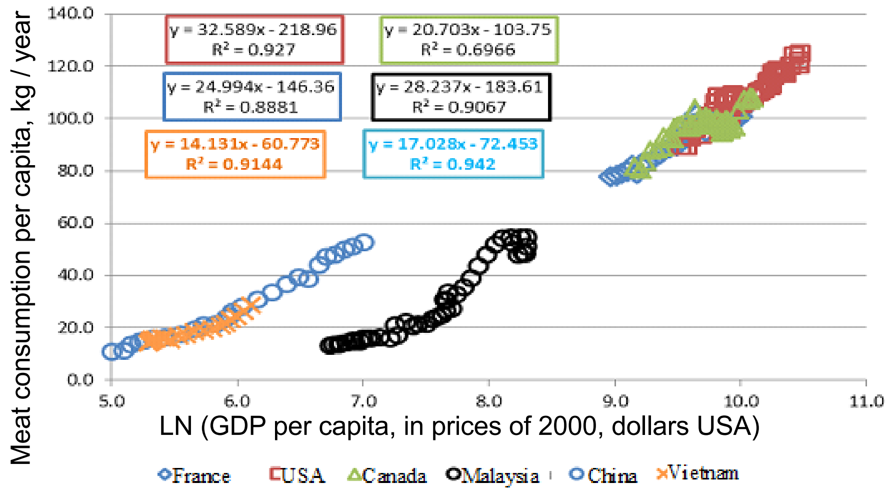
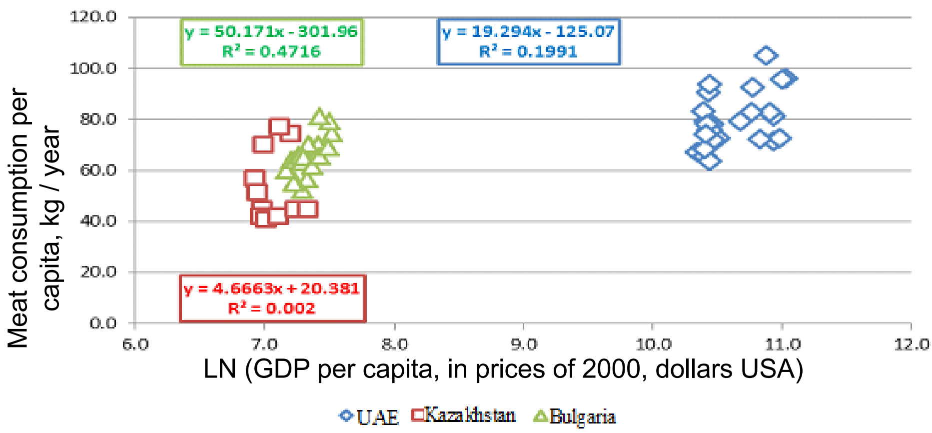


Figure 3

Meat consumption in different countries

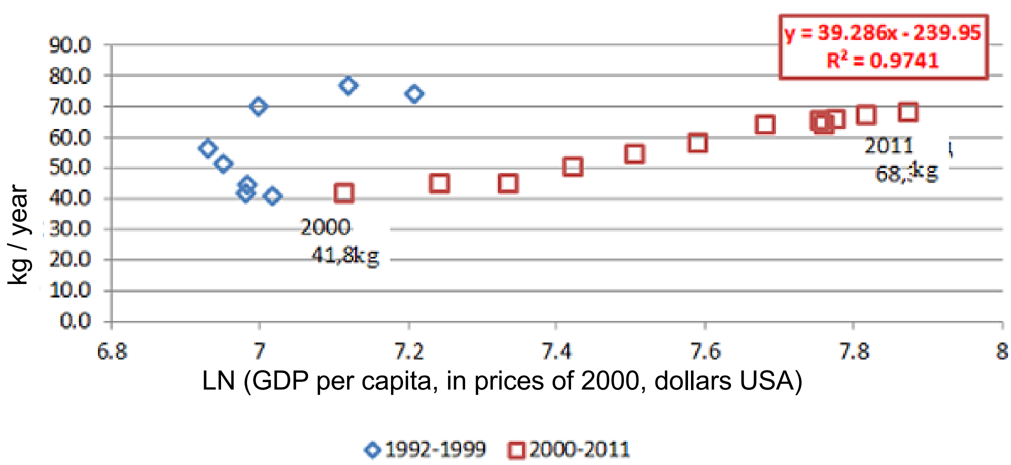


There are also countries, where this regularity is not concerned. In particular, it is United Arab Emirates, where an essential decrease in GDP per capita is observed (in constant prices) by 40% in 2011 in comparison with the period of the observation beginning (1996) due to high rates of population growth: population size has increased in 3 times for 15 years.

In countries of socialist coalition, if considering the socialist and early post-socialist period, also this regularity is not concerned, maybe, due to the nonmarket economic order, which transformation took a long time period. Nevertheless, if considering the period of 2001-2011, then the mentioned regularity becomes well-posed for Kazakhstan.

Figure 4

Meat consumption per capita in Kazakhstan



Dependence between consumption and GDP by each type of meat is much difficult in particular, and, generally, it is violated during achievement of certain level of living standards due to change of consumer preferences both with the course of time and growth in incomes. Factors, which form one or another regularity of certain meat type consumption, are very different, and many of them are difficult to be accounted during forecast preparations for a long period. In this regard the below mentioned forecasting assessments assume reasonably the absence of both price shocks and sharp technological and behavior changes. Under such conditions an application of current formulas for assessment of possible consumption of different meat types per capita is seemed to be reasonable.

Non-dairy cattle livestock

Cattle livestock forecast is based on the necessary volume of meat production for provision of domestic needs due to the following features of the domestic market:

- Share of breeding cattle of meat destination does not exceed 2% in the Republic of Kazakhstan that causes the sustainable but relatively low indexes of dressed weight per one head and give reasons to think that there will be no essential structure changes in the medium term;
- Market is relatively closed for receipts of imported meat due to import quotas, which form a negligible part (about 2.5%) of general consumption;
- Market is also relatively closed because of own specificity: main mass of beef is sold as cooled products due to consumer preferences that naturally insulate it from import receipts.

Probabilities of Kazakhstan beef export are limited due to unfavorable epizootic situation in most regions; in this regard an actual export remained negligible during a series of years (second decimal places of percent).

Figure 5

Number of cases of placing Kazakhstan regions under quarantine during 2006-2009

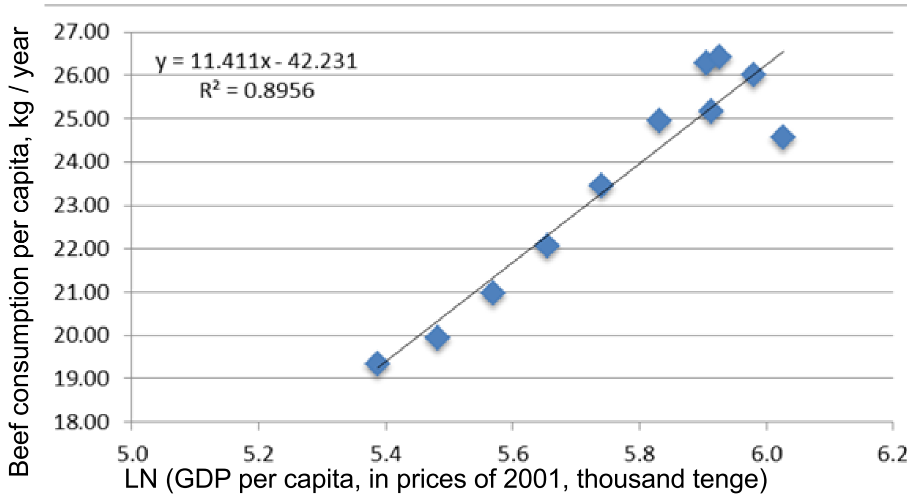
Relying on mentioned preconditions, livestock of non-dairy cattle can be forecasted on the basis of the forecast of domestic consumption volumes.

There is no direct data on beef consumption of Kazakhstan, but average actual consumption can be assessed on the basis of production and consumption balance, during which calculation the carryover reserves should be neglected due to lack of data.

Relying on the abovementioned information, consumption per capita can be assessed using different approaches. The first approach is based on the GDP volume per capita, characterizing the living standards of the country population

Figure 6

Equation of beef consumption

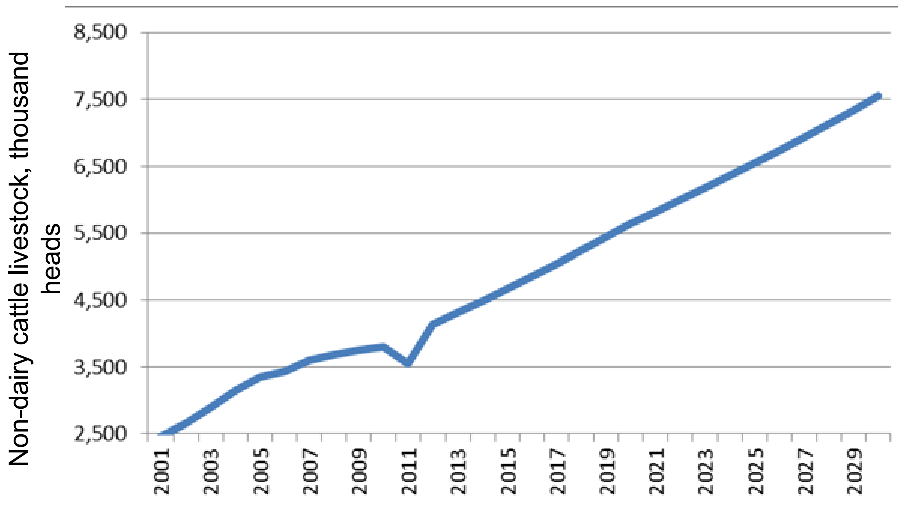


Relying on the essential correlation between non-dairy cattle livestock and beef production volume, it may be concluded that the main part of non-dairy cattle livestock is directed for beef production, and in this case other types of cattle (plow or multifunctional cattle) can be neglected within non-dairy cattle.

Livestock calculation, which is needed for sustainable production, can be made by the direct method or assess by the linear regression in virtue of the essential correlation of these indexes. The second method will be applied in this case.

Figure 7

Forecast of non-dairy cattle livestock



An additional assumption, which is not reflected in the scenario, but indirectly included to the equations, is also stability of dressed weight output per 1 head according to the above-mentioned aspects of the domestic market and production. Nevertheless, this parameter can essentially change in prospect by 2030, because increase in productivity of cattle breeding is one of priorities in the state support of agriculture.

Livestock of dairy cattle

Milk production of Kazakhstan exceeds the level of 300 kg per capita a year in recent times; herewith export of milk and dairy products is extremely small(export of dairy products did not exceed 0.15% of production in terms of milk in 2012).

Table 18

Milk production per capita in Kazakhstan

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Milk production per capita, kg/year	261	273	286	300	311	319	326	330	333	334	321	293

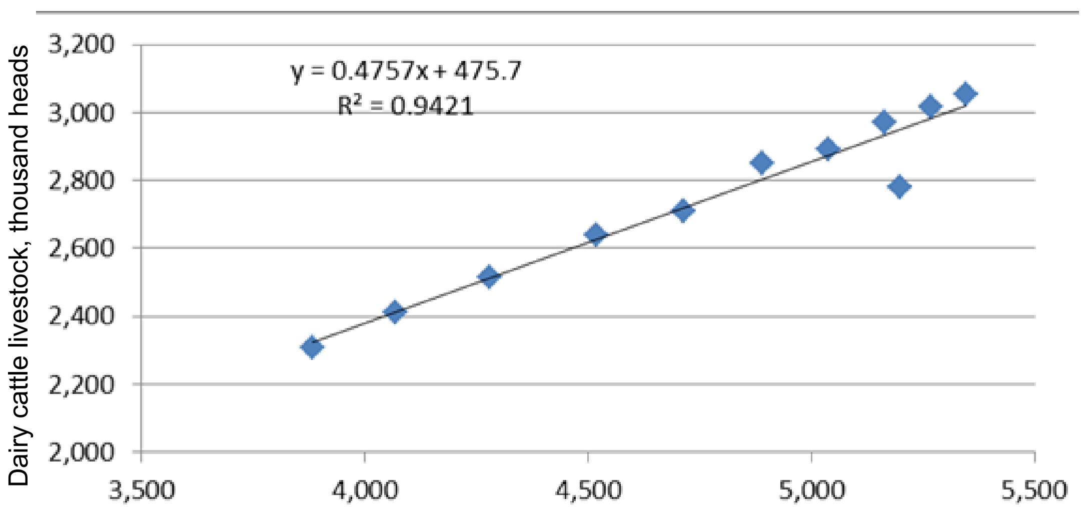
Sources: NURIS

Thus, it can be believed that all produced milk is consumed within the country. Kazakhstan is inside the top ten of leading countries according to the index of milk and dairy-products consumption.

In this content it seems to be possible that the further growth of consumption per capita will be hindered. In this content it is supposed in the basic scenario that growth of milk production will comply with the growth of population size, when consumption per capita is equal to 320 kg per year during the whole period under consideration.

Figure 8

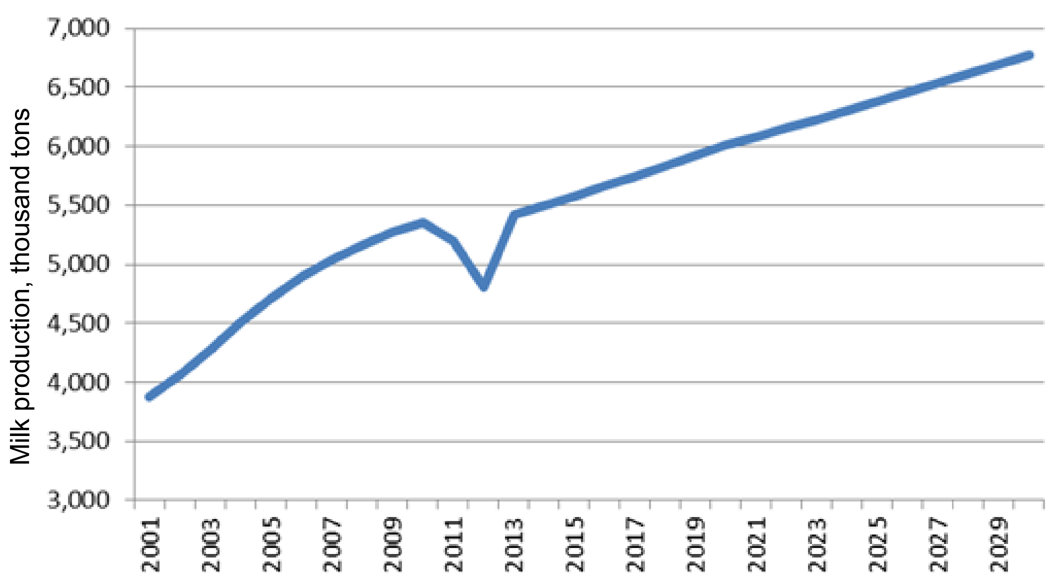
Equation of dairy cattle livestock



Relying on the mentioned assumptions and basing on the forecast of population size, the total volume of milk production is presented in figure 9

Figure 9

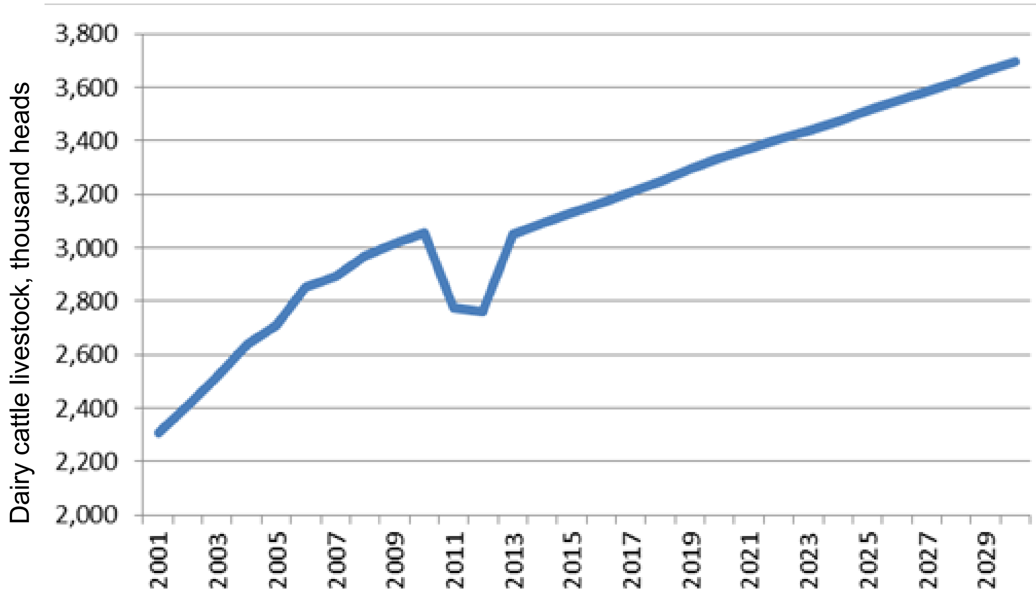
Forecast of milk production



Number of dairy cattle livestock is calculated by the assessed regression coefficients according to this forecast.

Figure 10

Forecast of dairy cattle livestock



There is a risk that decrease in milk production volumes, which has been outlined for last two years, can fix in the medium term. Coming into effect of the customs union between Russia, Belarus and Kazakhstan has created conditions, wherein domestic producer can't compete with Belarusian and Russian products. In particular, it concerns dried and condensed milk. Agriculture of the Republic of Belarus receives high-scale support from the state. It determines the fact that some type of Belarusian agricultural products, and also its by-products, possesses good price competitiveness. According to the Customs Union Treaty, the Belarusian party assumes an obligation to reduce the support level from 16% to 10%gradually according to the assessments of 2010 by 2016. From another part Kazakhstan has a possibility and will extend volumes of the state support during next several years, and advanced processing of agricultural products is inside the number of the priority development directions. In view of announced factors, the long term dynamics should comply with the sustainable production level per capita, because uniquely dominant factors are not expected in terms of decrease or increase of production per capita in prospect until 2050.

Livestock of sheep and goats

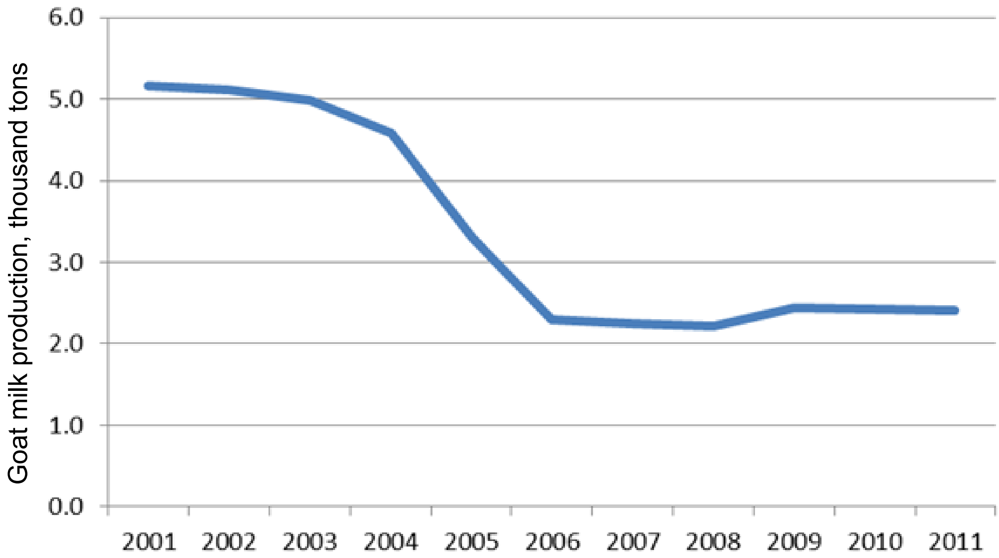
Livestock of sheep and goats are reflected as a single index in the national statistics, in this regard further calculations will be made collectively by these types of cattle.

Distribution of sheep and goats began to bemade during the livestock calculation by the Agency of Statistics of the Republic of Kazakhstan [2] only over the last years. At the beginning of 2013 the main number of livestock accounts to sheep, while number of goats is equal to about 17% of livestock of this animal group.

Goat livestock is forecasted weakly, because this is not to say that current circumstances of this animal type breeding have uniquely treated nature. Goat breeding does not require any essential efforts, but goat milk is not popular, maybe, that is the reason whythe level of this animal type breeding has an inverse dependence from the living standards. One more factor is migration of rural population: increase in its population size leads, maybe, to increase in goat livestock. Lack of data (data on goat livestock is available only since 2009) on the problem under consideration prevents for carrying out the necessary analysis. The most accurate index, which indirectly reflects the goat livestock in the period up to 2009, can be the amount of produced goat milk.

Figure 11

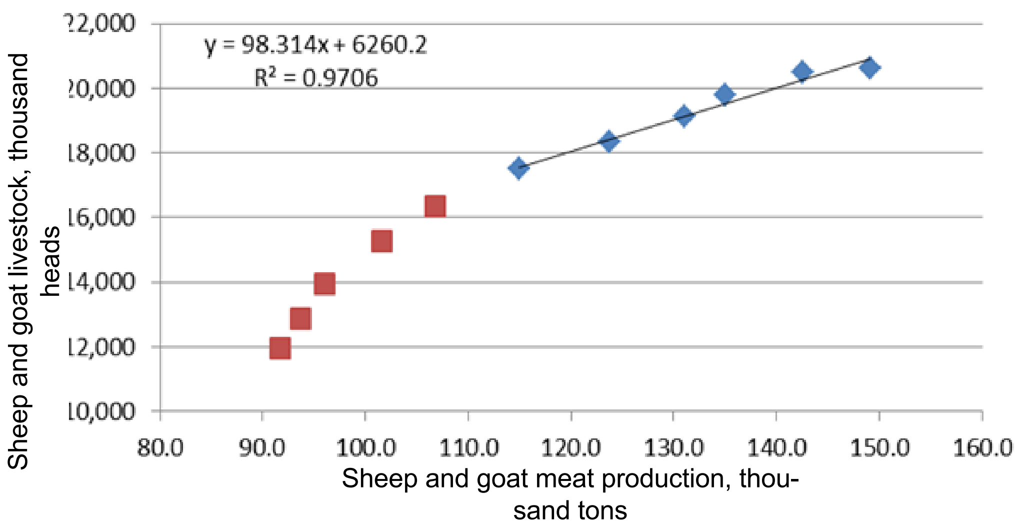
Dynamics of goat milk production



Analysis shows that goat milk production has stabilized at the level of about 2.3 thousand tons annually during the period from 2006 to 2011 after the decrease in more than two times since 2001. Thus, maybe, goat livestock exceeded essentially its current value during the period from 2001 to 2005, and it is reasonable to take into account values of the last 6 years (from 2006 to 2011) during the assessment of the regression coefficients of livestock dependence from meat production volumes, because dressed weight of goats is less than dressed weigh of sheep.

Figure 12

Equation of sheep and goat livestock



Such an approach supposes that goat livestock will remain relatively stable during the forecasting period that is admissible, because possible factors, which impact on this animal type livestock, have an inverse character: supposedly, growth of living standards leads to decrease in motivation for goat breeding, while increase in rural population size as a part of natural population increase should conversely promote the growth of goat livestock.

Principle of further calculations of livestock forecast is similar with calculations of non-dairy cattle to the large extent that is the reason why it does not need comments.

Figure 13

Equation of mutton (sheep and goat meat) consumption

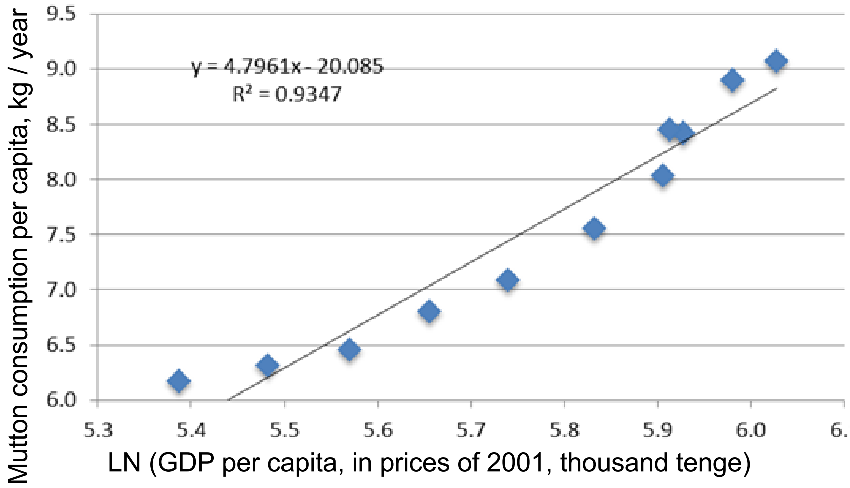
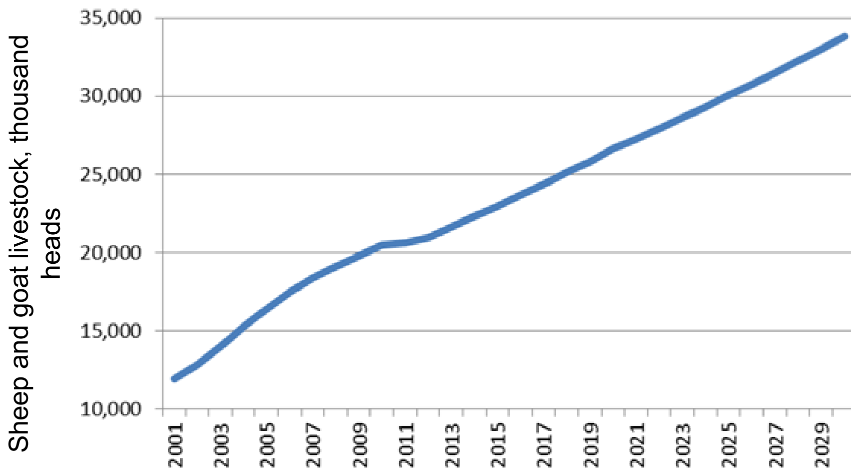


Figure 14

Forecast of sheep and goat livestock



Camel livestock

By analogy with dairy cattle, camel livestock is assessed by the camel milk production volumes, which consumption demonstrates the expressed dependence from GDP level per capita. Import and export of camel milk is not carried out because raw milk is a perishable product, and dairy product (shubat) is mainly produced for domestic consumption.

Figure 15

Equation of camel livestock

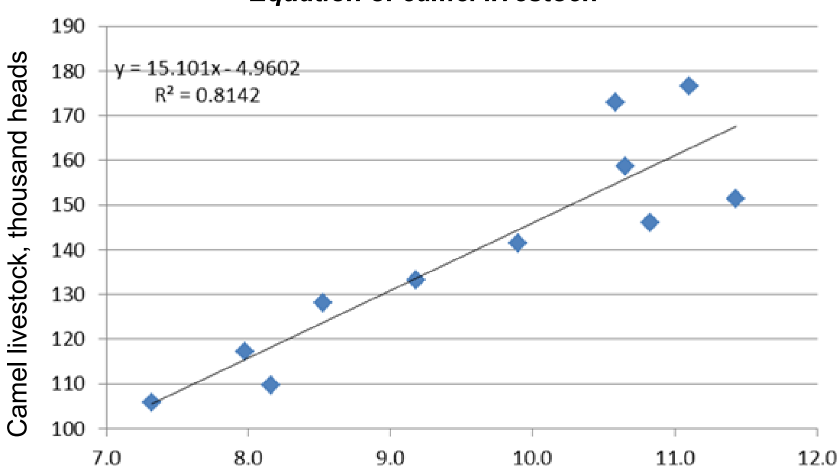
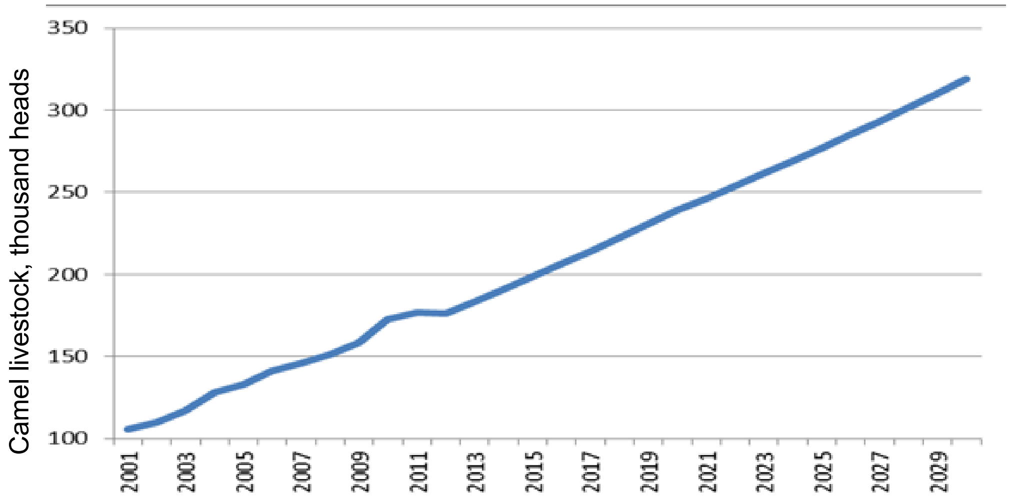


Figure 17

Forecast of camel livestock

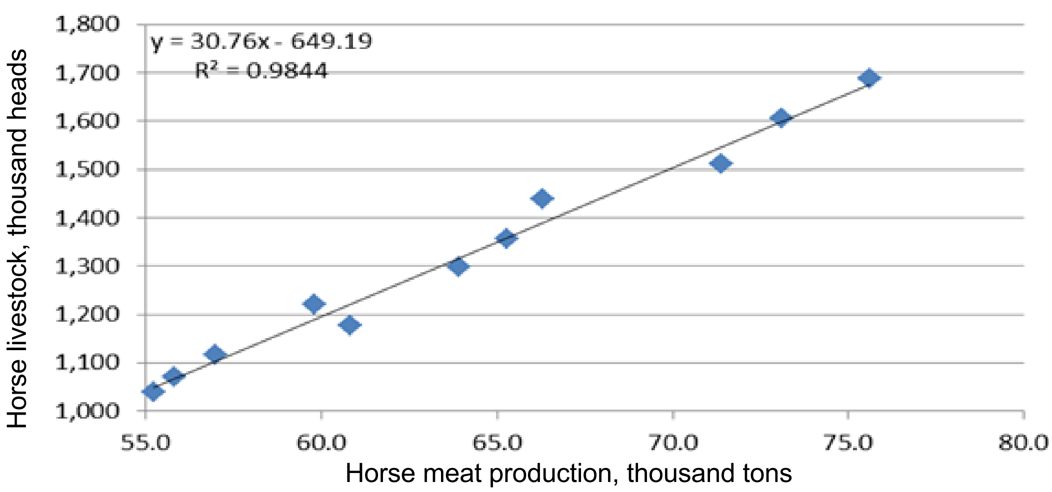


Horse livestock

Main products, which are produced during horse breeding: meat and milk for kumiss production to a lesser extent.

Figure 18

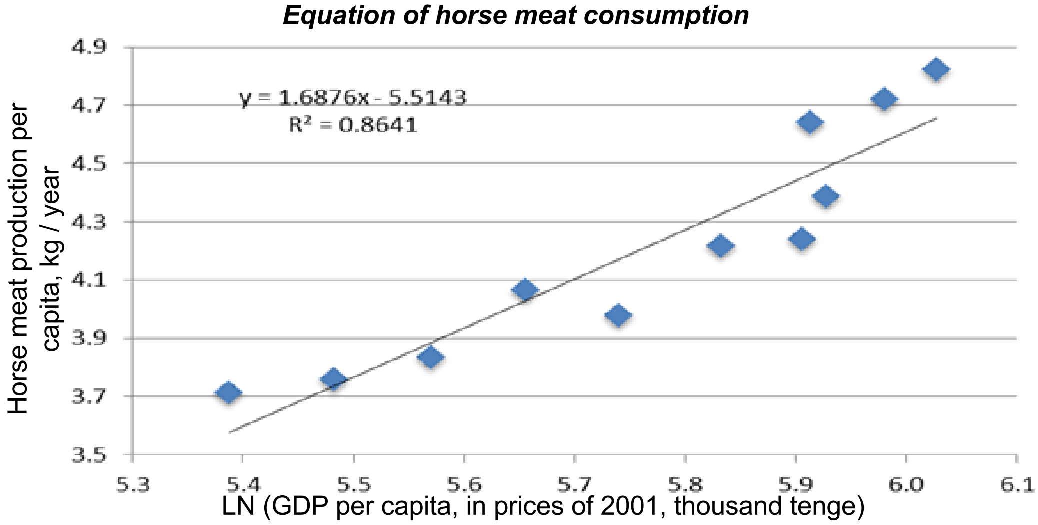
Equation of horse livestock



In Kazakhstan traditions of horse meat consumption have deep historical roots, and meat itself is related to gourmet items and is at the upper price niche. In this regard horse meat consumption per capita will increase with growth of living standards

Figure 19

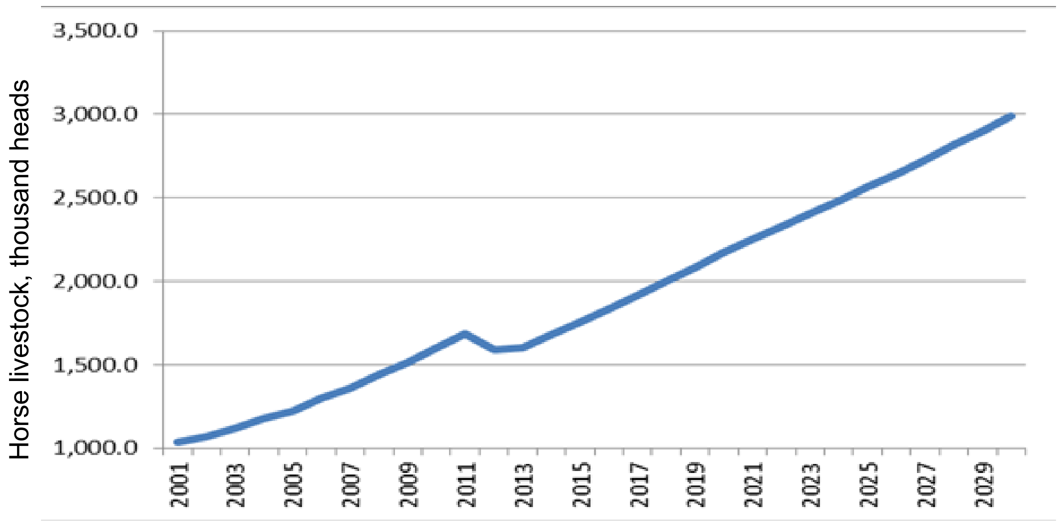
Equation of horse meat consumption



Whereas some growth of horse meat import has been observed lately, this growth will be limited considering that cattle meat, including horse meat, is mainly consumed as a fresh product that limits the possibilities of its import to Kazakhstan market. Due to insufficiency of historical data (horse meat import has been observed only for last 4 years), it is impossible to carry out the quantitative assessment of this import volumes. In view of made assumptions it is accepted in calculations that horse meat import will be equal to 10% of total consumption volume during the period under consideration

Figure 20

Forecast of horse livestock

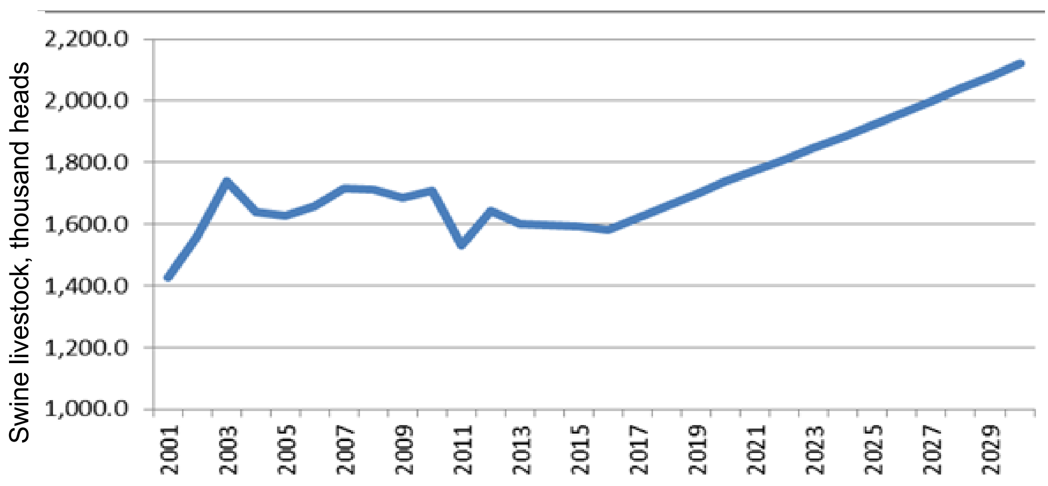


Swine livestock

Main observations, which are related to forecasting pork consumption volumes, are given below.

Figure 21

Forecast of swine livestock



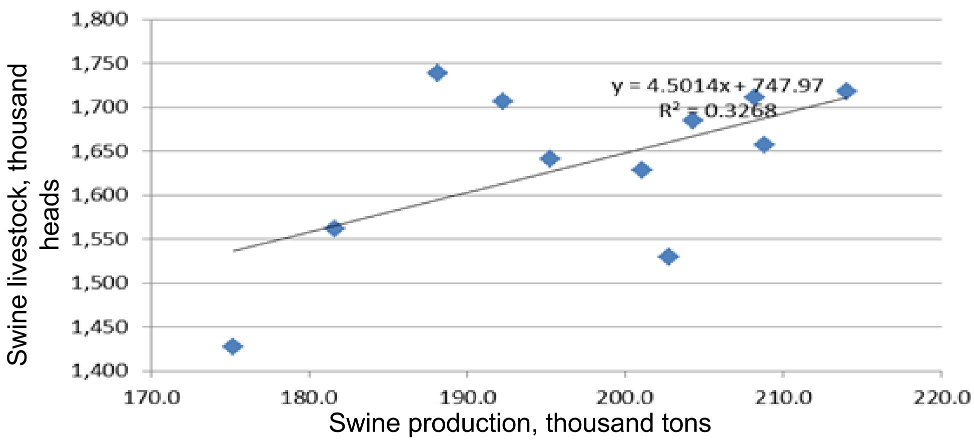
In Kazakhstan pork consumption does not have strongly marked dependence from GDP per capita due to the structural changes of population ethnic composition, which have been taking place up to now. As there is no demand for pork in the Moslem part of population pursuant to religious grounds, supposedly, the main consumer of pork is non-Moslem population and also producers of meat products. There are no official data series on the religious content of Kazakhstan population, but its structure can be assessed by the ethnic composition. Non-Moslem population of Kazakhstan is mainly represented by the following ethnic groups: the Russians, Ukrainians, Belarusians, Germans, and Koreans etc. In this case a sustainable outflow of the Germans and Slavic nationalities to the historical homelandwas observed over last ten years. Maybe, that is why the potential growth of pork consumption, which could take place due to the growth of living standards, was graded by decrease of consumer number due to external migration.

Share of non-Moslem population has approximately reduced from 35% to 25% from 2001 to 2011, and rates of this index decrease accelerated during the period from 2009 to 2011.

Nevertheless, maybe, growth rate of total pork consumption will accelerate after stabilization of migration processes, and it will exceed the rate of population size growth.

Figure 22

Equation of pork consumption



The following assumptions were also made during the forecast of pork production: pork import will be limited to 10% of total consumption; there will be no pork export. In this case it is necessary to point out that the last assumption can be violated in prospect by 2030, because Russia as a pork consumer is an attractive selling market, and there is a high probability that export to this country will have big scopes in case of epizootic problem solution.

There are no stable relations between swine livestock and pork production volumes that relate to the feature of its breeding: its pantophagy (i.e. in relation to the low cost of its management under home conditions) and long period of growth with stable feed conversion (that means flexible scalability of production for one and the same livestock). In this regard forecast of livestock on the basis of here used approach can't be deemed reliable and should be considered as an indicative reference point in relation to the possible further development of this area of focus.

Calculation of methane emission from enteric fermentation was made according to the equation 4.12 «Emissions from a LIVESTOCK category» of IPCC Guidelines [16].

Average values of coefficients for the period from 2009 to 2011, which were assessed for cattle within calculation of the National Report [1], and informative default emission factors of other cattle categories were chosen as emission factors for certain livestock.

According to abovementioned calculations, number of livestock of all enterprise categories will be increased by the range from 25 to 90% by 2030 depending on the cattle type in the assumption that the production structure will not change and main cattle, small cattle and other livestock will be concentrated in the private subsidiary farming units as it took place during at least last 15 years.

Table 19

Forecast of cattle livestock

Average annual cattle livestock, thousand heads	1995	2011	2015	2020	2025	2030
Cattle	7 614	6 330	7 801	8 975	10 060	11 244
Dairy cattle	3 380	2 778	3 130	3 335	3 511	3 697
Non-dairy cattle	4 235	3 552	4 671	5 640	6 549	7 547
Sheep and goats	22 327	20 625	22 973	26 601	30 030	33 803
Camels	133	177	198	239	277	319
Horses	1 635	1 688	1 757	2 174	2 563	2 990
Swine	2 061	1 529	1 591	1 739	1 921	2 121
Poultry	21 008	33 199	36 981	43 545	49 792	53 079

Sources: NURIS

Calculation methodology of emissions from cleaning, storage and dung use:

According to the IPCC Guidelines [16], calculations of emissions from systems of cleaning, storage and dung use were made on the basis of livestock calculations.

Coefficients, which are given in the calculations of emissions from systems of cleaning, storage and dung use of the National Report [1], were used as coefficients of methane and nitrogen emissions.

Table 20

Coefficientsof CH_4 emissions from systems of cleaning, storage and dung use

Coefficients of CH_4 emissions from systems of cleaning, storage and dung use	Coefficients of CH_4 emissions, CH_4 kg per head per year	Nitrogen emission coefficient, N kg per head per year
Dairy cattle	6.00	70,0
Non-dairy cattle	4,00	50,0
Sheep and goats	0,10	16,0
Camels	1,28	25,0
Horses	1,09	25,0
Swine	4,00	20,0
Poultry	0,01	0,60

Calculation methodology of forest fire areas

Averaged fire area can be reflected as a function with the following parameters:

$$S_F = f(S, V_d, T, P, M),$$

where S – forest area,
V_d – dead tree stand volume per 1 hectare of forest area
T – amount of temperaturefor summer period,
P – amount of precipitationfor summer period,
M – measures on fire prevention:
possessing the following features among other things in relation to own arguments:

$\frac{\partial f(S,V_d,T,P,M)}{\partial V_d} \geq 0$ – fire area increases with forest area under other equal conditions

$\frac{\partial f(S,V_d,T,P,M)}{\partial V_d} \geq 0$ – fire risk increases in case of increase in the dry tree stand volumes as one of fire hazards

$\frac{\partial f(S,V_d,T,P,M)}{\partial T} \geq 0$ – fire risk increases with growth of summer temperature amount

$\frac{\partial f(S,V_d,T,P,M)}{\partial P} \leq 0$ – fire risk decreases in case of increase in the amount of precipitations

$\frac{\partial f(S,V_d,T,P,M)}{\partial P} \leq 0$ – measures on forest fire extinguishment and prevention decrease its consequences and reduce the risk of its occurrence.

For this reason, taking into account the fact that forest areas are forecasted at the level of 2011 with a little gain growth for 20 years, it is supposed that fire area will be annually observed at the level of the average value over the period of last 4 years. This value is essentially lower that fire area of the period from 1995 to 2005, but maybe, that fact reflects the effect of measures, which are taken by the Forestry Committee and Emergencies Ministry. The indirect proof of this hypothesis is the fact that there was no essential growth of fire numbers during the anomalous hot year of 2010.

Calculation methodology of N_2O emissions from waste waters of human life and activities

The calculation was made according to the methods, which are described in the «Guidelines for national greenhouse gas inventory» [17]. Nitrogen share in protein and N_2O-Nemission factors were taken by default and are equal to 0.16 N kg / protein kg and 0.01 N_2O-N kg / nitrogen kg in waste waters.

Initial calculation data. Data on population size of the Republic of Kazakhstan was taken from KazStat online publication (http://www.stat.kz) and was extrapolated linearly by 2030. Data on protein consumption per capita (104 g per day per capita) was taken from FAO data base (http://faostat.fao.org). It is supposed that protein consumption per capita will achieve and stabilize at the level of developed countries (110 f of protein per day per capita) in future

Table 21

Plan of carrying out Quality assurance / Quality control procedures for preparation of National GHG Inventory

Time of performance	Measures
April 15	Beginning of works on National Inventory: readiness confirmation, preparation of technical tasks for experts by sector, provision of guidance and other materials
May 25	Analysis of calculation procedure and determination of needs in data, current loopholes, preparation of inquiries to the state bodies and other organizations
June 15	Receipt of data on activities to the specialized organization on National GHG Inventory preparation from other organizations and agencies
June 25	Analysis of received information, completeness and sufficiency of data for inventory preparation. Beginning of calculations of emissions and absorption of greenhouse gases according to received data
July 25	Analysis of work progress, loopholes and ways of additional information receipt. Preparation of diagram on carrying out QA/ QC (quality assurance / quality control) procedures
October 25	Preparation of model of greenhouse gas inventory (tables of Common Reporting Format). Procedure determination for quality assurance and control of inventory model
October 30	Matching of measures on quality assurance and control
November 1 – December 20	Assurance and control of the greenhouse gas inventory quality
December 25	Consideration of quality assurance results
December 26	Discussion of comments and suggestions on preliminary results of calculations. Determination of improvement ways and decision making on further actions
February 5	Preparation of national inventory project and tables of Common Reporting Format in virtue ofcomments and suggestions and its submissionto Ministry of Environment Protection of the Republic of Kazakhstan
February 6 - 20	Provision of the inventory quality
February 21	Submission of the inventory project with comments and suggestions to the Ministry of Environment Protection of the Republic of Kazakhstan
February 25	Presentation of the final variant of the inventory in the Ministry of Environment Protection of the Republic of Kazakhstan
March 1	Inventory presentation in state bodies for discussion and reconcilement
April 15	Inventory presentation in FCCC Secreteriat
April 24	Publishing of inventory data and its accompanying materials in public media, publishing in the website of the Ministry of Environment Protection of the Republic of Kazakhstan

Annex 4. Tables to section 7

Table 22

Detailed project list of the Program «Climate change and sustainable energy» of the Regional Environmental Centre for Central Asia

№	DONOR	Country	Project Title	TERMS OF CONTRACT
1	European Aid via GFA and GIZ	CA	Sustainable Energy Programme for Central Asia: Renewable Energy Sources & Energy Efficiency EuropeAid/132442/C/SER/Multi	March 2013 – February 2016
2	EC_tender	Kz	COMO-East_Supporting Participation of Eastern Partnership and CA Cities in the Covenant of Mayors (Ref 130567 /C /SER/MULTI («the services»)	10.2011–10.2013
3	German Government	CA	Integrated Approaches to the Development of Climate Friendly Economies in Central Asia (NAMA-NAPA big)	16.12. 2011–30.11.2013
4	Delware corporation «NEXANT»	CA	under the Framework contract with NEXANT _Approved Background Note and the Final Survey status report	09.05.2012–28.05.2012
5	Adelphi through OSCE	CA	Providing a services for facilitation a scenario building workshop on the security and co-operation in Europe	05.11.2012–30.04.2013
6	GIZ	Kz	Rreview of energy effeciency in Kyzylorda	25.12.2010–15.02.2011
7	GIZ	CA	Service contract under the GIZ Programme on supporting economic and environment development of the Aral Sea region	28.03.11–30.06.11
8	GIZ	Kz	On the path to Green Growth: an environmental dialogue between Germany and Kazakhstan	13.06.2011–12.07.2011
9	OSCE Secretariat in Vienna through Adelphi	CA	Provision of Services for Facilitating a Scenario Building Workshop on the Security Implications of Climate Change in Central Asia (ENVESEC 1)	08.11–02.12.2011
10	Adelphi, ENVSEC	CA	Background study for the project "Planning for Energy Security and Sustainability in Central Asia" (ENVESEC 2)	08.11–30.12.2011
11	IGES	CA	Asia-Pacific Adaptation Network Sub-regional Node for Central Asia_2012_2	5.07.2012–15.03.2013
12	IGES	CA	Support tasks to be implemented by the sub-regional node from CA_APAN 3	24.01.2012–15.03.2012
13	UNEP/IGES	CA	APAN 2_Review of good adaptation practices in Central Asia	01.09.2011–31.10.2011
14	GIZ	CA	Organising a side event "on the path to Green Growth" on the EfE7 in Astana, Kazakhstan	15.09.11–30.09.11
15	NL Energy and Climate	Kz	Workshop on Emissions Trading System in Kazakhstan	01.11.10–30.11.2011

№	DONOR	Country	Project Title	TERMS OF CONTRACT
16	GTZ	Kz	Capacity development for sustainable energy and Climate Policy in Central and Eastern Europe, Russia and Central Asia_Promotion of PPP in the field of EE and RE technologies through cooperation with Social Enterpreneur Corpration in Kazakhstan	15.02.2010–15.11.2010
17	GTZ	Kz	Promoting adaptation and mitigation strategies on CC in CA and billateral (German) fact finding mission to Turkmenistan	10.08.2010 -28.02.2011
18	USAID	Trm	Research on low carbon development policy in Kz	1–30.08.2010
19	GTZ	Kz	Programme to support economic and env. in Aral River Basin, Kazakhstan_ Analysis of the legal framework and identification feasible interventions for the development of renewable energies in Kyzylorda oblast	12–30.04.2010
20	AIT / UNEP RRC.AP	Kz	Producing Gap analysis and good adaptation practices reports for Central Asia_ conducting Implementation Plan of Asia Pacific Climate Change Adaptation Network 2010-2011	20.08.2010–20.03.2011
21	USAID	CA	Integrated Energy Efficiency Approach in Residential Housing of Dushanbe, Tajikistan - Technology, Finance, Outreach	30.09.2010–29.09.2012
22	SGP GEF via NGO Otrazhenie	Tj	Demonstration of solar energy using on the example of secondary schools of Karagandy oblast and Almaty city"	14.08.2009–15.08.2010
23	Japan Consulting Institute	Kz	the Fact finding mission to Kz, Uz, Turkm. regarding Kyoto protocol and CDM policy, practices and business opportunity in each country	29.01.2009–08.04.2009
24	GTZ	CA	Support towards the formulation of a joint Position of the Central Asian States to the forthcoming COP-15 meeting in Copenhagen	31.09.2009 – 31.12.2009

Annex 5. Tables to section 9.i

Table 23

Technical specialties in the field of environment protection and climate change

Code of specialty of professional education in the RK	Title of specialty	Qualification
1514000	Environment and rationale use of natural resources (in terms of sectors)	
151401 2		Laboratory technician of fire assay
151402 2		Laboratory technician-microbiologist
151403 2		Laboratory technician of spectral assay
151404 2		Laboratory technician of chemical analysis
151405 2		Laboratory technician of chemical-biological analysis
151406 2		Laboratory technician of physical testing
151407 2		Sampler
151408 2		Laboratory technician-radio-operator
151409 3		Ecologist
1515000	Hydrology and meteorology	
151501 3		Technician-hydrologist
151502 3		Technician-metrologist
151503 3		Technician-agro-meteorologist
151504 3		Hydro-meteorological observer
1509000	Environment and environment-protective activity (in terms of types)	
150901 3		Inspector on natural resource protection and use
150902 3		Technician of specially protected natural areas
150903 3		Technician-hydro-ameliorator
150904 3		Technician-mechanic
150905 3		Technician-technologist

Sources: State VET specialties and occupations Classification

Table 24

Workshops of Climate Change Coordination Centre, which were given for the period from 2009 to 2013

Name of workshop	Date and place	Partners
«Integration of political measures – Energy efficiency and renewable energy sources»	February 27, 2009, Astana	LECG
«Renewable energy sources and Kyoto Protocol»	April 20, 2009, Astana	German Agency of Energy (dena)
«Obligations of Kazakhstan under Montreal Protocol on Substances that Deplete the Ozone Layer, meaning of abbreviations and planned measures for performance of international obliga-tions»	June 27, 2009, Almaty	Ministry of Environment Protection of the Republic of Kazakhstan, Climate Change Coordination Centre with support from UNEP
«Public diplomacy for the purposes of adaptation to climate change»	August 18, 2009, Astana	International Program «Leadership for Environment And Development» (LEAD)

Name of workshop	Date and place	Partners
«Possibilities for increase of energy efficiency of industrial enterprises and mechanisms of Kyoto Protocol»	September 15, 2009, Astana September 18, 2009, Atyrau September 21, 2009, Almaty September 23, 2009, Karaganda September 24, 2009,	IRBARIS
«Preparation of National carbon trading platform in Kazakhstan»	Astana, October 19, 2009	Federal Ministry for Environment
Institutional enhancement of possibilities for performance of Kazakhstan Program for Phasing Out of Ozone-Depleting Substances and UN Framework Convention on Climate Change	January 16, 2010, Astana	United Nations Environment Program
«Implementation of GHG (greenhouse gas) Emission Inventory in Kazakhstan»	January 19, 2010, Atyrau January 20, 2010, Almaty January 22, 2010, Karaganda January 25, 2010, Pavlodar	IRBARIS
Preparation of national CO2 emission trading system in Kazakhstan, how to distribute CO2 emission rights among participating installations	Astana, February 17, 2010	MEP
«Phasing out of consumption of ozone-depleting substances – performance of obligations under Montreal Protocol on Substances that Deplete the Ozone Layer»	March 30, 2010, Almaty	MEP, UNEP
Preparation of National trading system in Kazakhstan, monitoring, reporting and verification, functions and requirements to national trading platform in trading system of Kazakhstan	Astana, October 13 -14, 2010	MEP, DIW econ
«Phasing out of consumption of ozone-depleting substances – performance of obligations under Montreal Protocol on Substances that Deplete the Ozone Layer»	December 14, 2010, Shymkent January 16, 2011, Astana	MEP, UNEP
«Actions on mitigation of influence of climate change after 2012. Possibilities and influence on oil and gas sector.»	May 24, 2011, Astana	Carbon Limits
«Assistance in Clean Coal & Environmentally-Sound Storage Solutions»	July 12-13, 2011 in Ekibastuz July 14, 2011, Astana November 1 – 3, 2011, Almaty	Ecorem, University of Liege, University of Hasselt, Geological investigations
Workshop «Technology Needs Assessment»	August 3, 2011, Astana	MEP of RK, UN Environment Program, UNEP Risoe Centre on Energy, Climate and Sustainable Development (Risoe Centre,URC)

Table 25

Some projects on climate change, which are realized in Kazakhstan*.

Donor/Executive	Name of project	Winterқаша сипаттама/міндеттер	Duration
GEF/UNDP RK	Sustainable transport in the city of Almaty	– Improvement in management of public transport and air quality in Almaty; – Capacity building in Almaty for integral planning and improvement of efficiency and quality of public transport; – Capacity building for integral planning and implementation of measures on integrated traffic management in Almaty; – Realization of demonstration project in order to raise awareness about sustainable transport.	From 2011 to 2016
	Assistance to the Republic of Kazakhstan in preparation of Third National Communication according to the UN Framework Convention on Climate Change (UN FCCC)	The present project will allow Kazakhstan to prepare and present the Third National Communication to the Conference of the Parties (COP) according to the obligations, provided for in Articles 4 and 12 of UN Framework Convention on Climate Change (UN FCCC), as well as subsequent decisions of CP.	From 2010 to 2015
	Climate Risk Management in Kazakhstan	– Strengthening of institutional frameworks, technical potential on management of risks, related to climate change, and of capabilities by integration on national, sub-national and local levels; – Strengthening of strategies, policy and legislation, related to climate change adaptation in priority sectors and geographic regions; – Enhancement of financing possibilities on national, sub-national and local levels for covering of costs on risk management in the country, related to climate change; – Realization of activities on risk management, related to climate change in priority sectors; – Distribution of information about how to include the climate variability, knowledge about change and risks in the development process on national, subnational and local levels.	From 2010 to 2014

Donor/Executive	Name of project	Winterқаша сипаттама/міндеттер	Duration
	UNDP Central Asia Multi-Country Climate Risk Management Program	– Strengthening of technical potential of the countries to cope with climate risks; – Exchange of knowledge and integration of issues of climate risks into processes of regional development; – Synthesis and further development of knowledge system about glaciers of Central Asia.	From 2011 to 2014
	Capacity building for sustainable development through integration of issues on climate change in strategic planning in the Republic of Kazakhstan	– Capacity building of national partners for effective participation in international negotiation process on issues of climate change, including on inclusion of Kazakhstan into Annex B of Kyoto Protocol; – Support in activity of RK Government on performance of obligations under post-Kyoto period after 2012 and preparation of national low-carbon development strategy and integration of principles into national policy and development strategy; – Support in activity on climate change adaptation in Kazakhstan and integration of issues on climate change adaptation into main policy and development strategy; – Assistance in preparation to regional conferences on «Environmental protection and development» in 2010 for Asian-Pacific countries and on «Environment for Europe» in 2011 for Europe and CIS countries.	From 2009 to 2010
GEF SGP	Climate Change Adaptation Program	Main task of this program is practical processing of organizational and managerial decisions on adaptation of economic activity to changing climatic conditions. Realization of this program is carried out in 10 countries of the world, including in Kazakhstan. In each country the program is adapted to local conditions and in Kazakhstan the program realization is carried out with focus on agriculture. In addition the thematic emphasis is put on ground degradation control. Finally the objective of CBCCA Program in Kazakhstan will be implementation of sustainable communitarian management of natural resources, including activities, reducing risks, which are caused by climate change.	From 2009 to 2011
EU/CAREC	Analysis of unused possibilities in the field of climate change and sustainable energy	CAREC conducted an opinion poll of organizations and experts, working in the countries of Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan) in order to determine main spheres of activity of «Climate Change and Sustainable Energy» program. Analysis of unused possibilities in Central Asia was performed and key working areas in climate change and energy efficiency were determined on the basis of this opinion poll.	From 2009 to 2010

Donor/Executive	Name of project	Winterқаша сипаттама/міндеттер	Duration
Federal Ministry for Environment / CAREC	Promotion of strategy on adaptation and prevention of climate change in Central Asia	Project is oriented on Central Asia capacity building in formation of general positions on main issues of international negotiations and in promotion of regional interests at the development process of new ones and review of available national strategies by development of general understanding of further negotiation process.	From 2010 to 2011
Federal Ministry for Environment / CAREC	Assistance in formation of general position of Central Asia countries on 15th Conference of the Parties of UN Framework Convention on Climate Change in Copenhagen	Support in formation of general position of Central Asia countries with respect to climate change is a method for acceleration of their dialogue and making a decision on the most severe problems of climate change in the region.	2009
ENVSEC/CAREC	Planning for energy security and sustainability in Central Asia	Objective of this project was improvement of expert knowledge in the field of energy and sustainable development in Central Asia with respect to forecast simulation, analysis and planning in the field of energy and environment, as well as available problem recording methods of environment and sustainable development at development of energy development strategy. General objective is determination of methods how environmental problems may be transferred into supporting tool of cooperation, joint risk management and confidence building in Central Asia and beyond its borders.	From 2011 to 2012
Agency NL Energy (Netherlands)/ CAREC	Workshop of Emission Trading System (ETS) in Kazakhstan	Studying of Dutch experience in working with ETS, as well as raise of awareness of Kazakh private sector about principles of work with ETS, which is scheduled to be launched in 2013, by state officers, engaged in development of emission trading system in Kazakhstan.	From 2010 to 2011
Federal Ministry for Environment / CAREC	Integrated approach for the development of low-carbon economic strategies in Central Asia countries	– Capacity building of Central Asia countries for NAMA realization and policy on EE and RES; – Contribution to technology transfer for building of capacity in EE and RES; – Establishment of connection and effective cooperation between private enterprises, local authorities and society.	From 2012 to 2013
EU/CAREC	Covenant of Mayors – East	Project provides for support of cities of Central Asia countries in the Covenant of Mayors. Since the beginning of 2012 the Central Asian Regional Environmental Centre (CAREC), being consortium member of «Covenant of Mayors – East» project, realizes this initiative on the territory of Central Asia. Information meetings with interested parties in five countries of CA were held for this period.	From 2011 to 2015
UNEP/CAREC	Asia-Pacific Adaptation Network on Climate Change (CAREC, UNEP, IGES, AIT, SEI)	Holding of consultative meeting on MSED6 (6th Ministerial Conference on Environment and Development in Asia and the Pacific). Preparation of Analysis of capabilities assessment and Report on best practices in climate change adaptation in Central-Asia region.	From 2010 to 2012

Donor/Executive	Name of project	Winterқаша сипаттама/міндеттер	Duration
EBRD	KAZSEFF – Kazakhstan Sustainable Energy Financial Facility	Creation of framework financial facility in the amount of 75 mln. US dollar in the form of targeted credit lines to local financial institutions for subsequent crediting of private companies for the purposes of financing of investments in sustainable energy. Investments in increase of energy efficiency in industry and small projects of development of renewable energy sources will be financed.	From 2008 to 2011
USAID	Regional Energy Security, Efficiency and Trade (RESET)	– Creation of organizational regulatory framework for price regulation on energy exchange, additional services and sale of electric energy; – Implementation of calculation mechanisms of market value of services on water level control in order to control the floods and irrigation and promote investments in hydro-power industry.	From 2010 to 2013
UN Development Account/UN ECE	«Climate change mitigation by attracting direct investments in advanced technologies for use of fossil fule»	– Improvement of skills for creation and maintenance of attractive investment climate for attraction of direct foreign investments to coal electric power industry in order to satisfy growing demand on electric power and achieve objectives in the field of climate change mitigation; – Improvement of cooperation between heads, responsible persons for energy policy in the countries with emerging market and investors; – Improvement of skills in preparation of preliminary Feasibility study of projects in electric power sector; – Provision of exchange of experience and learned lessons in attraction of investments in environmentally-friendly electric-power production among countries, covered by the project and probably beyond its borders.	From 2009 to 2012
UNEP-RRC. AP (Regional Resource Centre for Asia and the Pacific)	Capacity building in development of strategic framework for promotion of low-carbon emission societies in Central Asia	– Creation of regional expert network on climate change and adaptation; – Capacity building through holding of trainings and workshops on issues of climate change in the region.	From 2010 to 2012
ICF International	Climate Change Interventions in Central and West Asia (CICWA)	Provision of assistance to Central and West Asia (Afghanistan, Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyz Republic, Pakistan, Tajikistan, Turkmenistan and Uzbekistan) with respect to development of climate change policy, capacity building of national institutions, engaged in the field of climate change, removal of barriers for development of renewable energy sources and development of incentives and sanctions, oriented on increase of energy efficiency.	From 2009 to 2013

Donor/Executive	Name of project	Winterқаша сипаттама/міндеттер	Duration
UN ECE (UN Economic Commission for Europe)	Promoting cooperation to adapt to climate change in the Chu-Talas trans-boundary basin	Simulation of possible climate changes in water resources of Chu-Talas basin and development of modern scenarios; Preparation of joint assessment of environmental vulnerability with a focus on selected fields/sectors, having specific meaning for activity of Commission for Water Management; Development of package of possible adaptation measures and respective procedures for Commission in order to contribute to mitigation of potential stress due to water regime change. These procedures and measures are to be included in official activity and strategy of Commission as applicable.	From 2010 to 2012

Appendix 6

Predicted changes in ground air temperature (°C) within the territory of the Republic of Kazakhstan

Figure A.1

Predicted changes in ground air temperature (°C) within the territory of the Republic of Kazakhstan in case of change of CO_2 concentration under A1B scenario with respect to group of various atmosphere-ocean general circulation models for 2016-2045 (2030), calculated with respect to base period of 1961-1990.

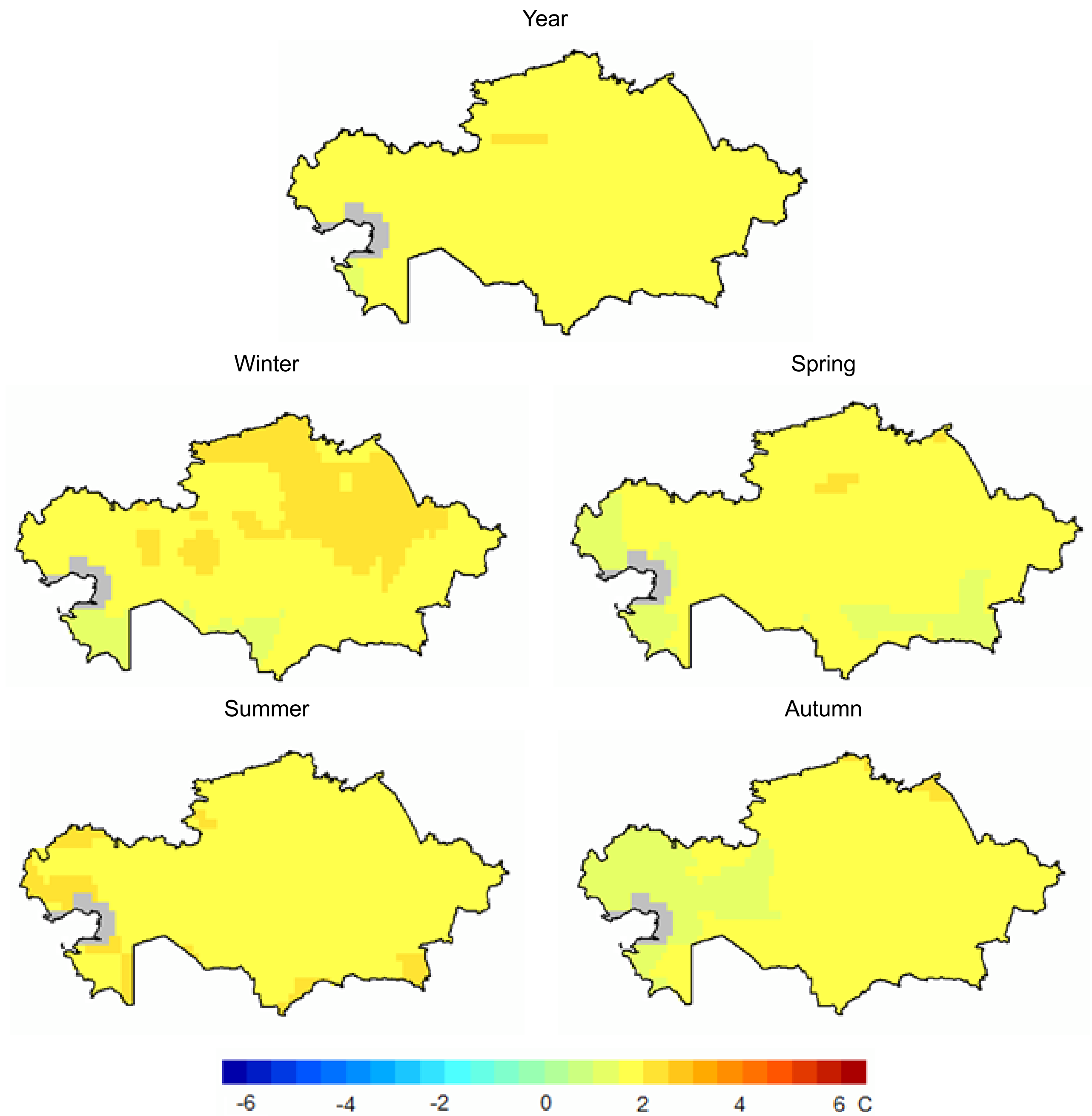


Figure A.2

Predicted changes in ground air temperature (°C) within the territory of the Republic of Kazakhstan in case of change of CO_2 concentration under A1B scenario with respect to group of various atmosphere-ocean general circulation models for 2036-2065 (2050), calculated with respect to base period of 1961-1990

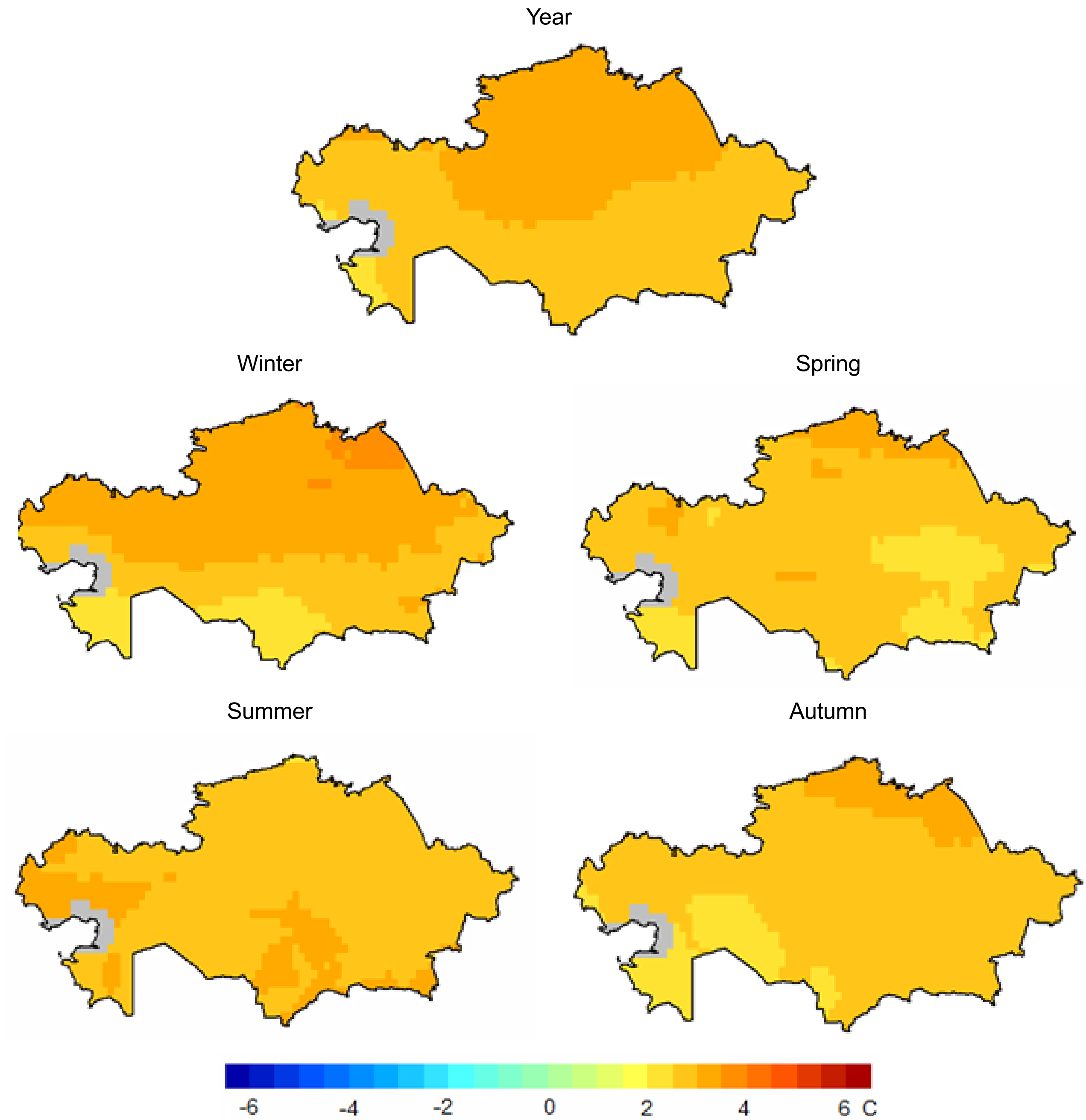


Figure A.3

Predicted changes in ground air temperature (°C) within the territory of the Republic of Kazakhstan in case of change of CO_2 concentration under A1B scenario with respect to group of various atmosphere-ocean general circulation models for 2071-2099 (2085), calculated with respect to base period of 1961-1990.

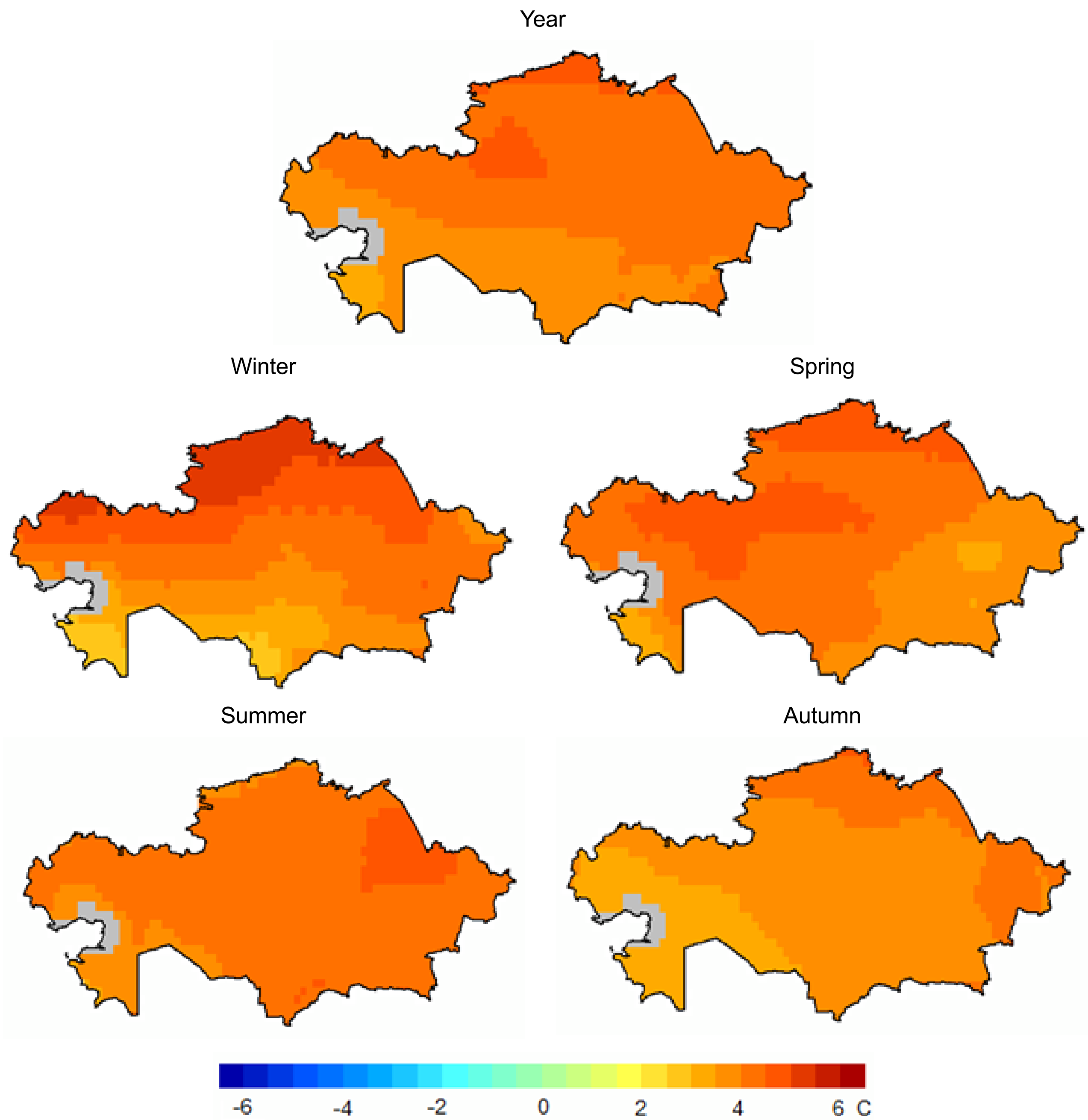


Figure A.4

Predicted changes in ground air temperature (°C) within the territory of the Republic of Kazakhstan in case of change of CO_2 concentration under A2 scenario with respect to group of various atmosphere-ocean general circulation models for 2016-2045 (2030), calculated with respect to base period of 1961-1990.

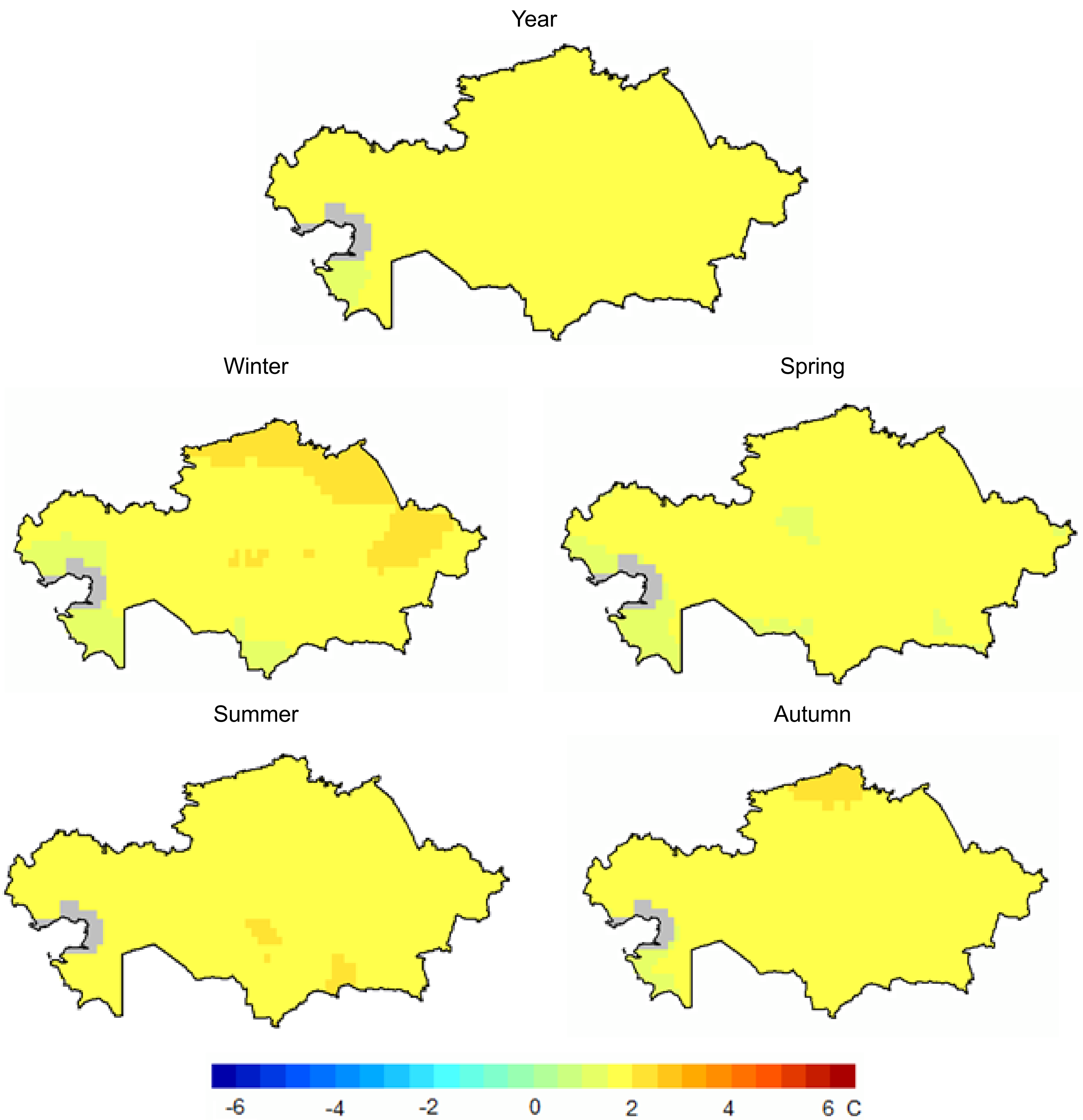


Figure A.5

Predicted changes in ground air temperature (°C) within the territory of the Republic of Kazakhstan in case of change of CO_2 concentration under A2 scenario with respect to group of various atmosphere-ocean general circulation models for 2036-2065 (2050), calculated with respect to base period of 1961-1990.

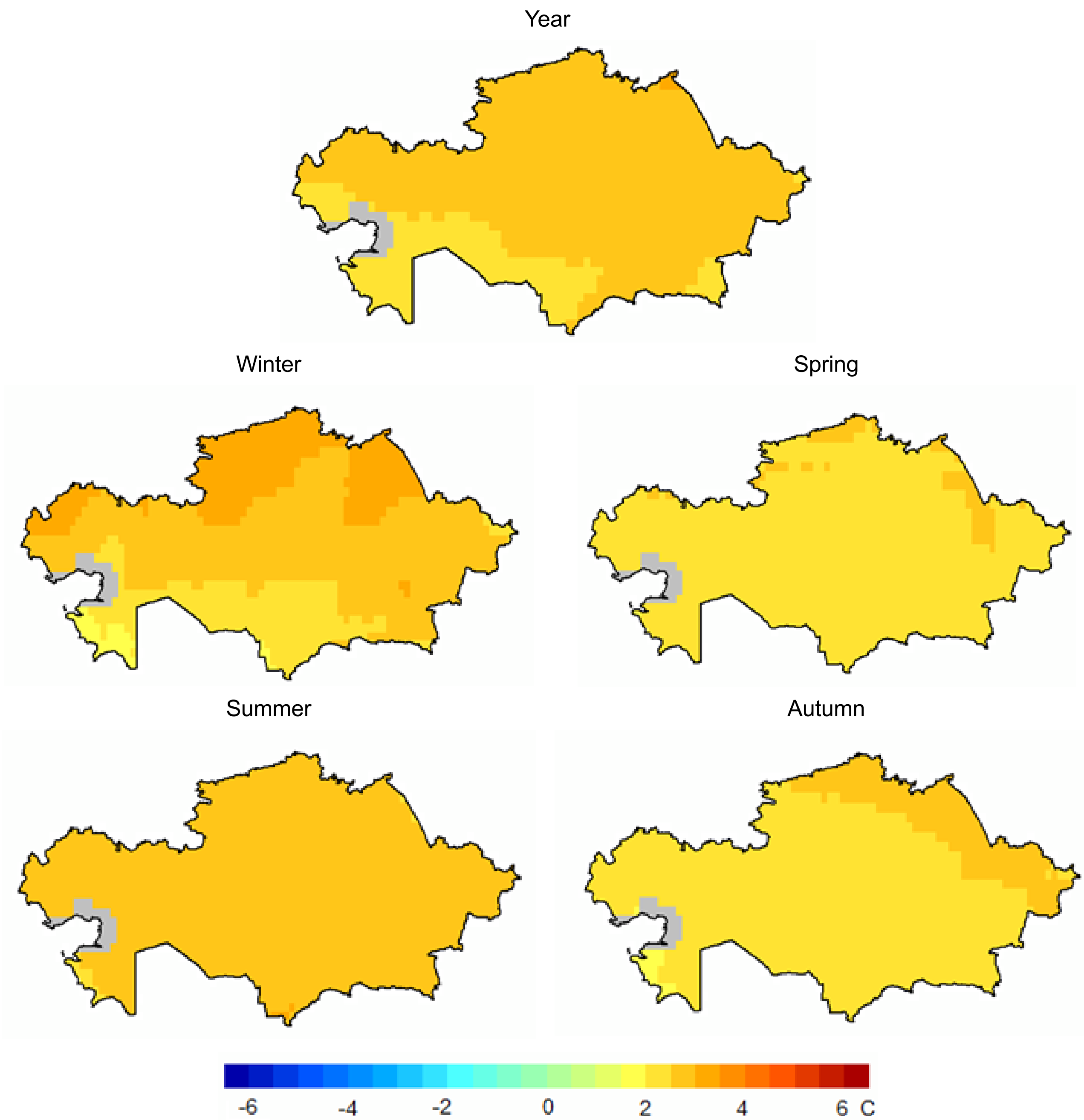


Figure A.6

Predicted changes in ground air temperature (°C) within the territory of the Republic of Kazakhstan in case of change of CO_2 concentration under A2 scenario with respect to group of various atmosphere-ocean general circulation models for 2071-2099 (2085), calculated with respect to base period of 1961-1990.

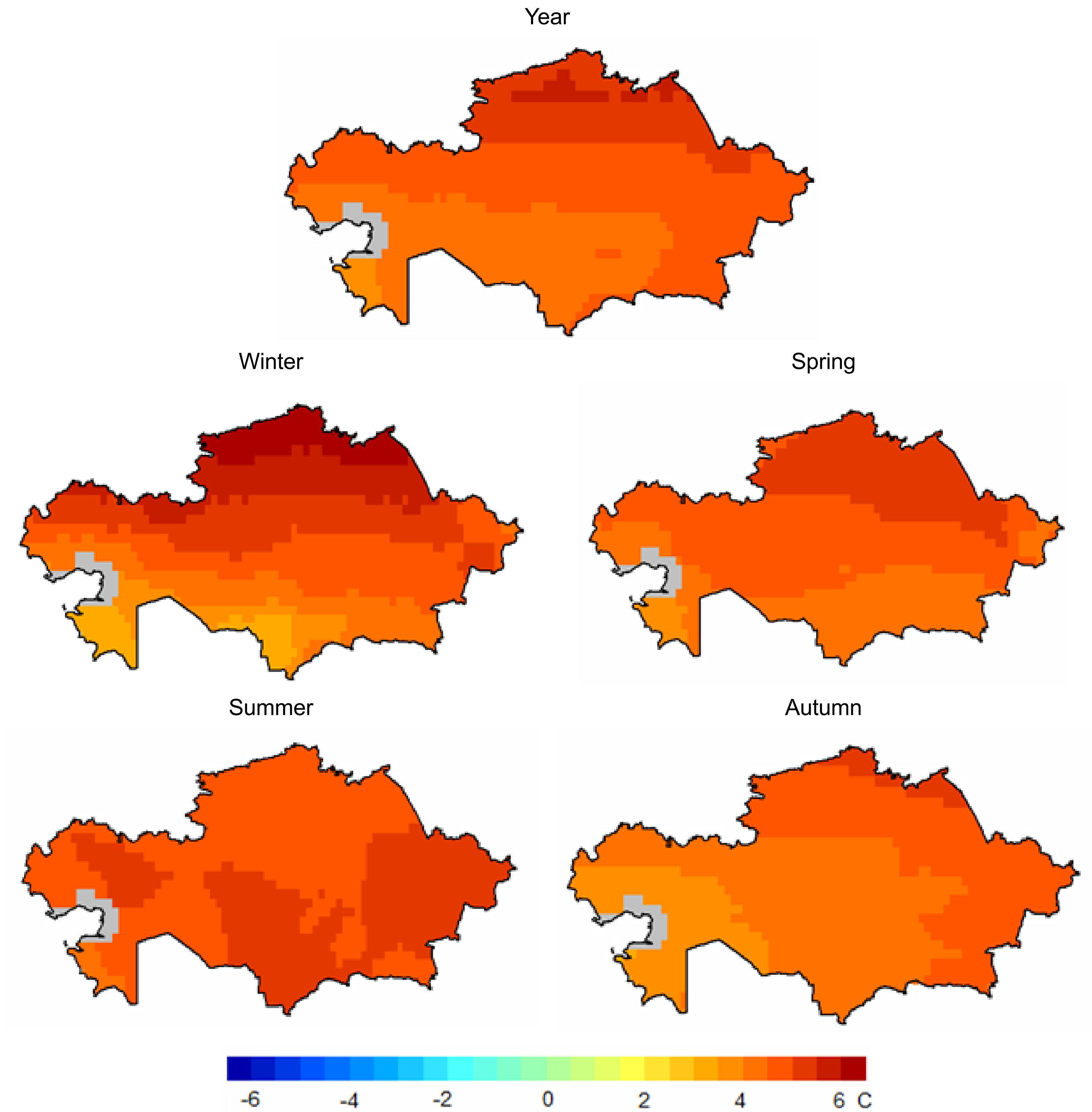


Figure A.7

Predicted changes in ground air temperature (°C) within the territory of the Republic of Kazakhstan in case of change of CO_2 concentration under B1 scenario with respect to group of various atmosphere-ocean general circulation models for 2016-2045 (2030), calculated with respect to base period of 1961-1990.

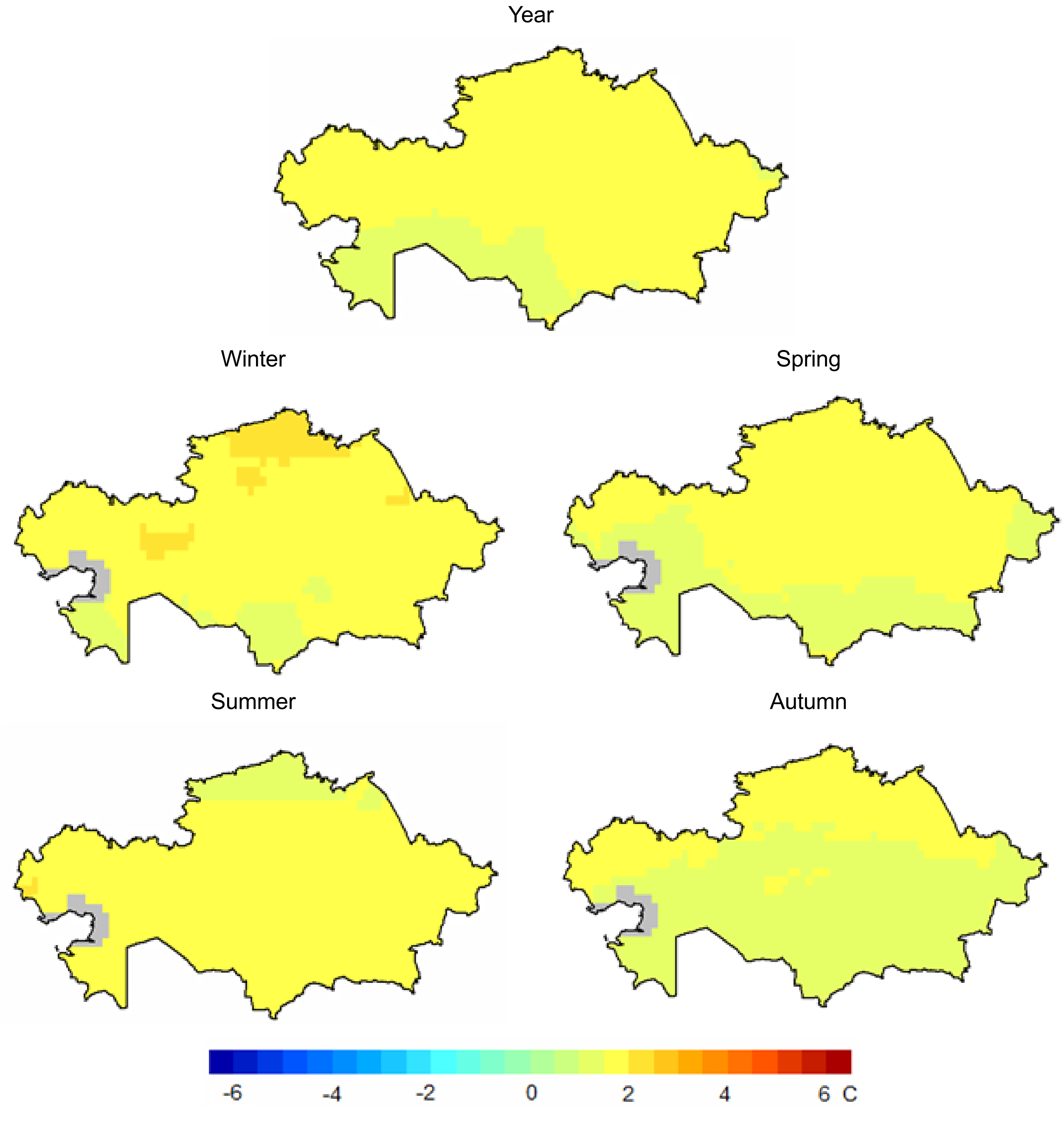


Figure A.8

Predicted changes in ground air temperature (°C) within the territory of the Republic of Kazakhstan in case of change of CO_2 concentration under B1 scenario with respect to group of various atmosphere-ocean general circulation models for 2036-2065 (2050), calculated with respect to base period of 1961-1990.e

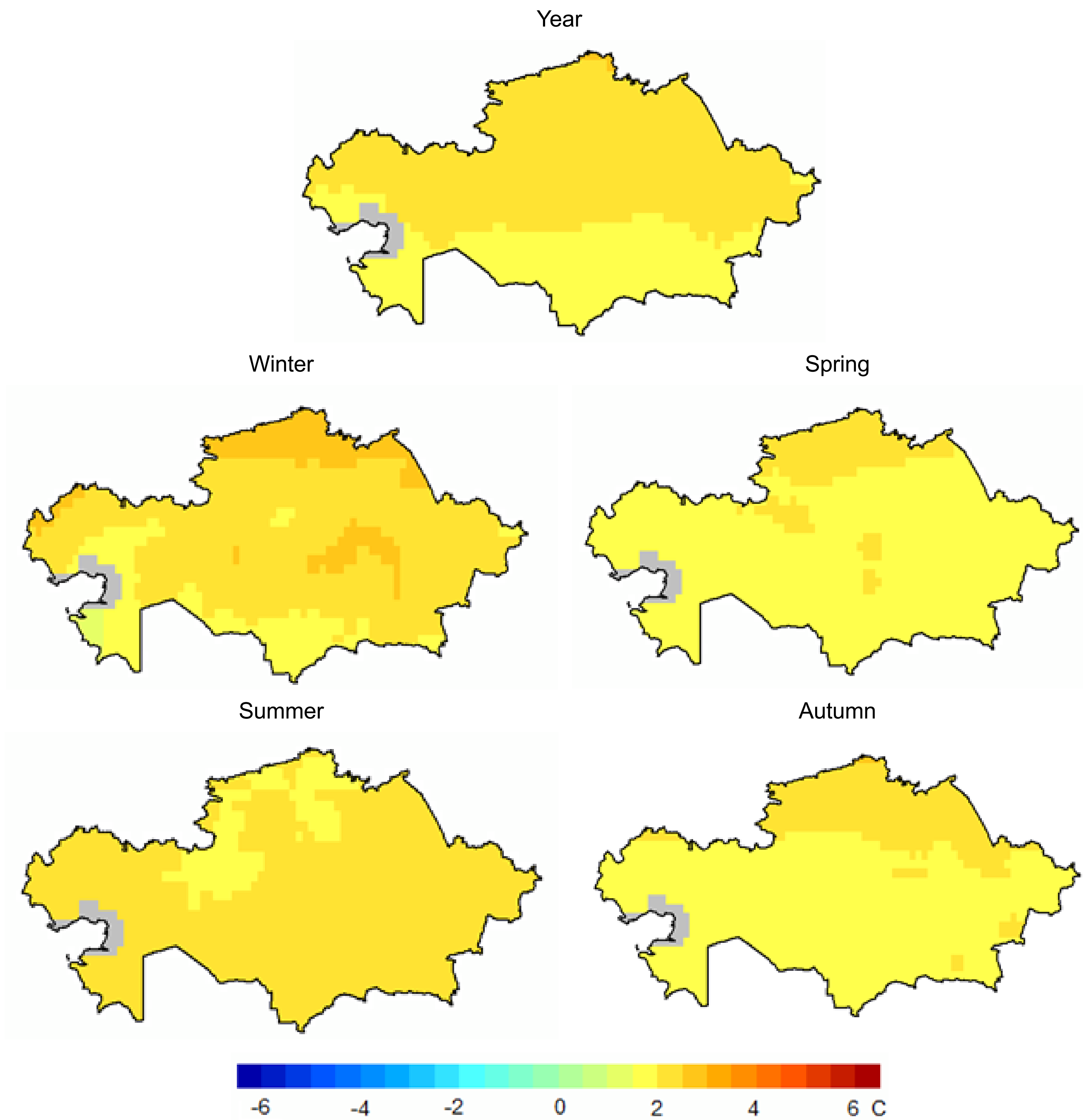
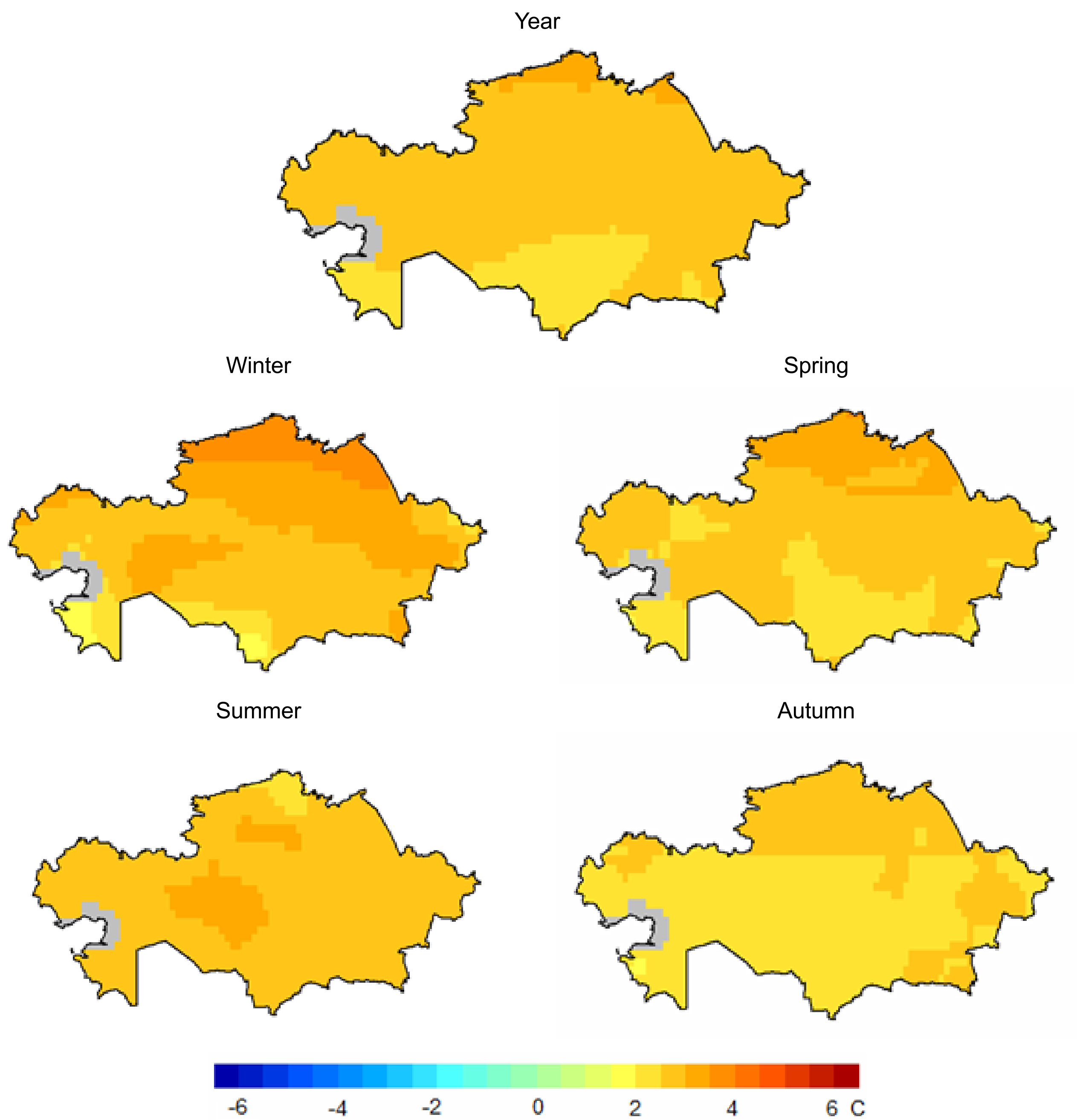


Figure A.9

Predicted changes in ground air temperature (°C) within the territory of the Republic of Kazakhstan in case of change of CO_2 concentration under B1 scenario with respect to group of various atmosphere-ocean general circulation models for 2071-2099 (2085), calculated with respect to base period of 1961-1990.



Appendix B

Predicted changes in precipitation amount (%) within the territory of the Republic of Kazakhstani

Figure B.1

Predicted changes in precipitation amount (%) within the territory of the Republic of Kazakhstan in case of change of CO_2 concentration under A1B scenario with respect to group of various atmosphere-ocean general circulation models for 2016-2045 (2030), calculated with respect to base period of 1961-1990.

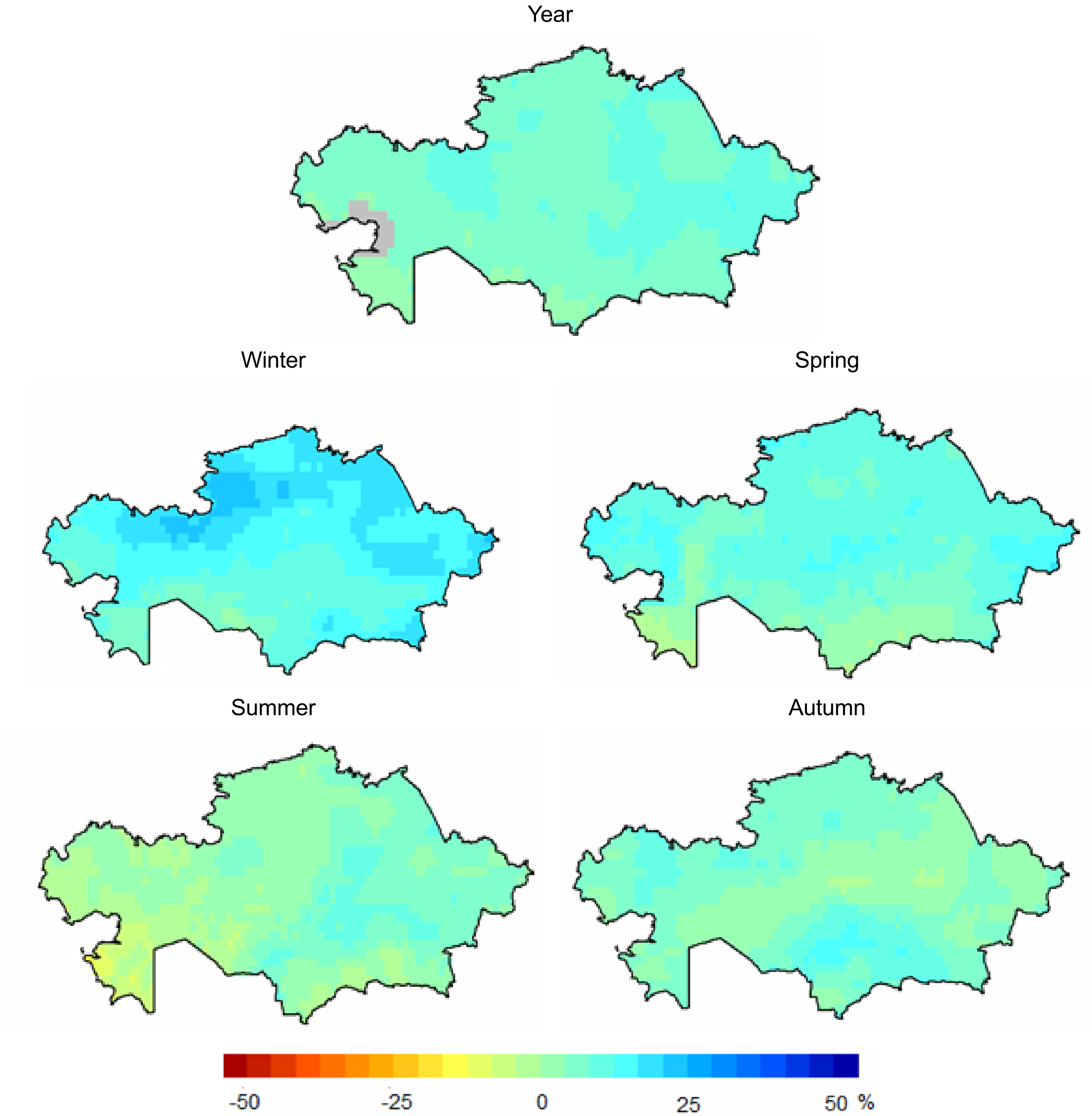


Figure B.2

Predicted changes in precipitation amount (%) within the territory of the Republic of Kazakhstan in case of change of CO_2 concentration under A1B scenario with respect to group of various atmosphere-ocean general circulation models for 2036-2065 (2050), calculated with respect to base period of 1961-1990

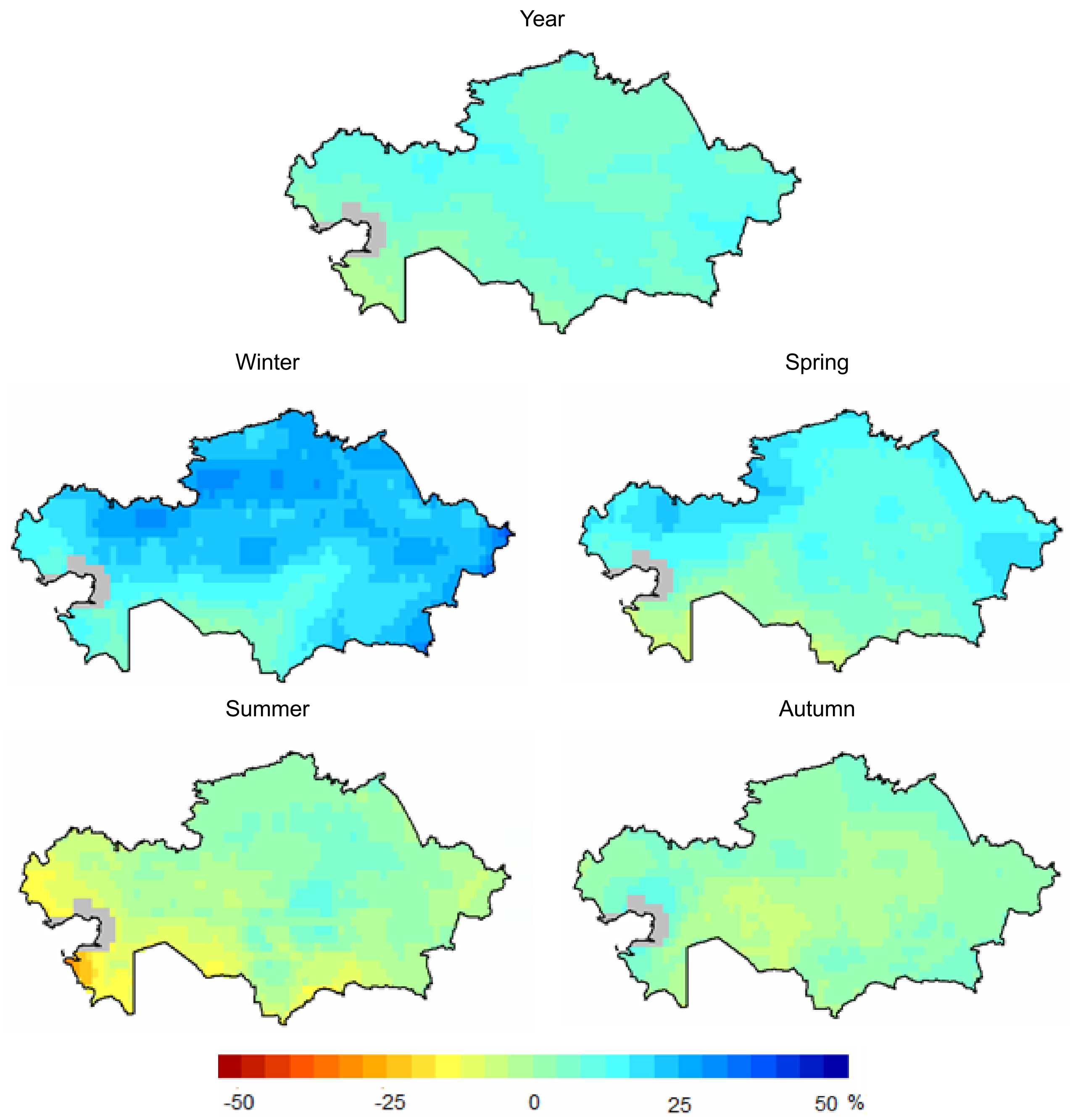


Figure B.3

Predicted changes in precipitation amount (%) within the territory of the Republic of Kazakhstan in case of change of CO_2 concentration under A1B scenario with respect to group of various atmosphere-ocean general circulation models for 2071-2099 (2085), calculated with respect to base period of 1961-1990.

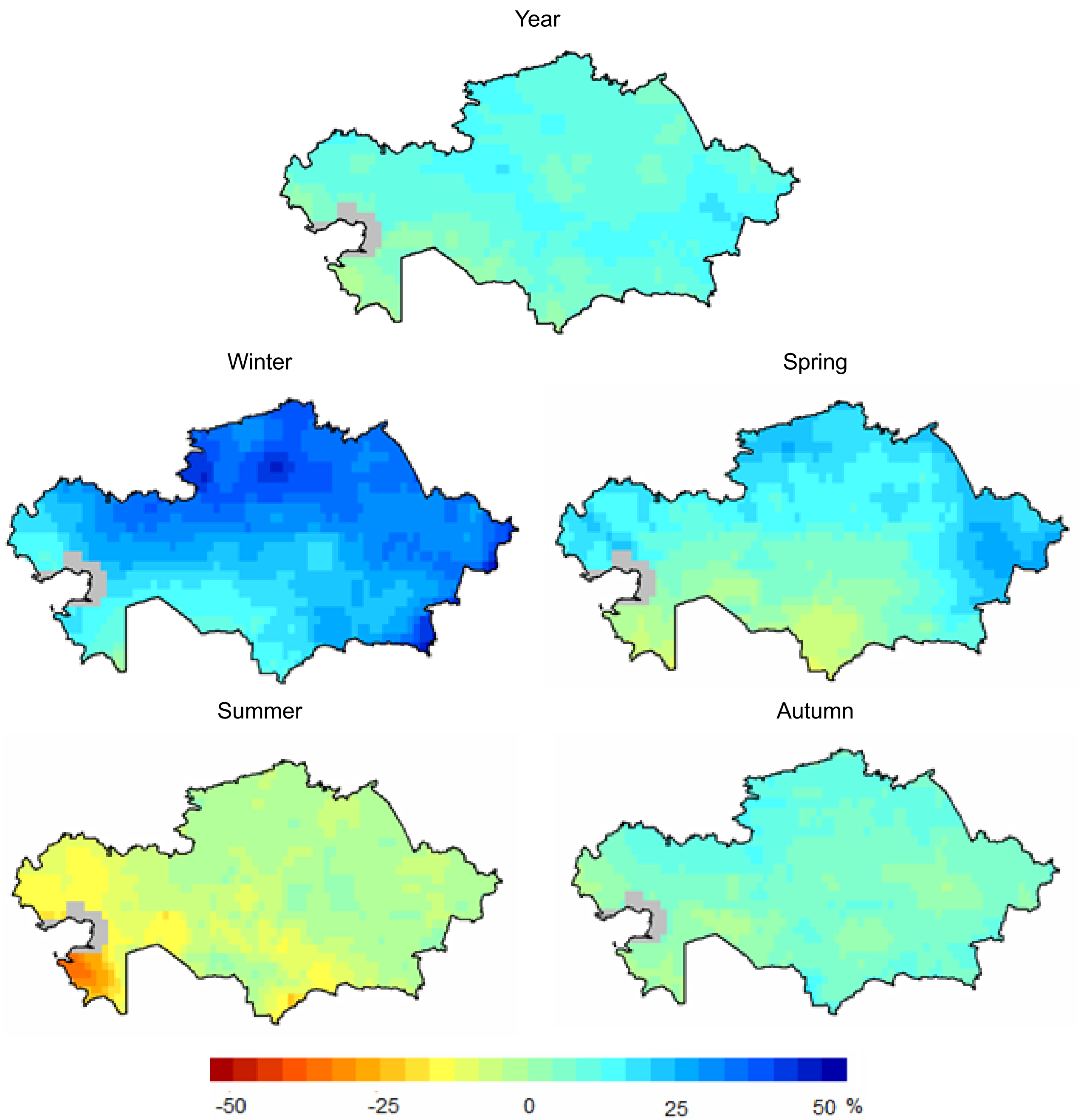


Figure B.4

Predicted changes in precipitation amount (%) within the territory of the Republic of Kazakhstan in case of change of CO_2 concentration under A2 scenario with respect to group of various atmosphere-ocean general circulation models for 2016-2045 (2030), calculated with respect to base period of 1961-1990

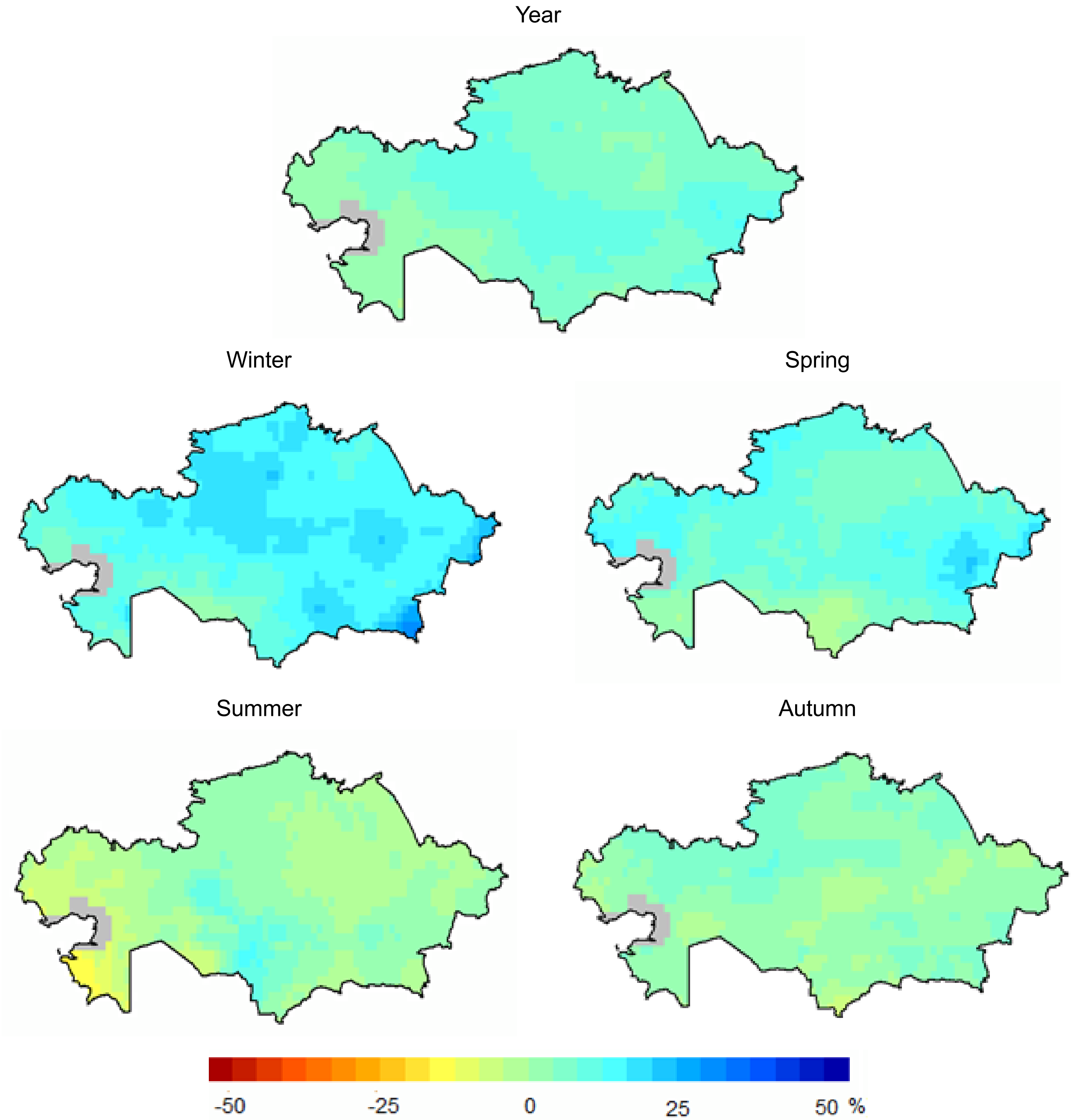


Figure B.5

Predicted changes in precipitation amount (%) within the territory of the Republic of Kazakhstan in case of change of CO_2 concentration under A2 scenario with respect to group of various atmosphere-ocean general circulation models for 2036-2065 (2050), calculated with respect to base period of 1961-1990.

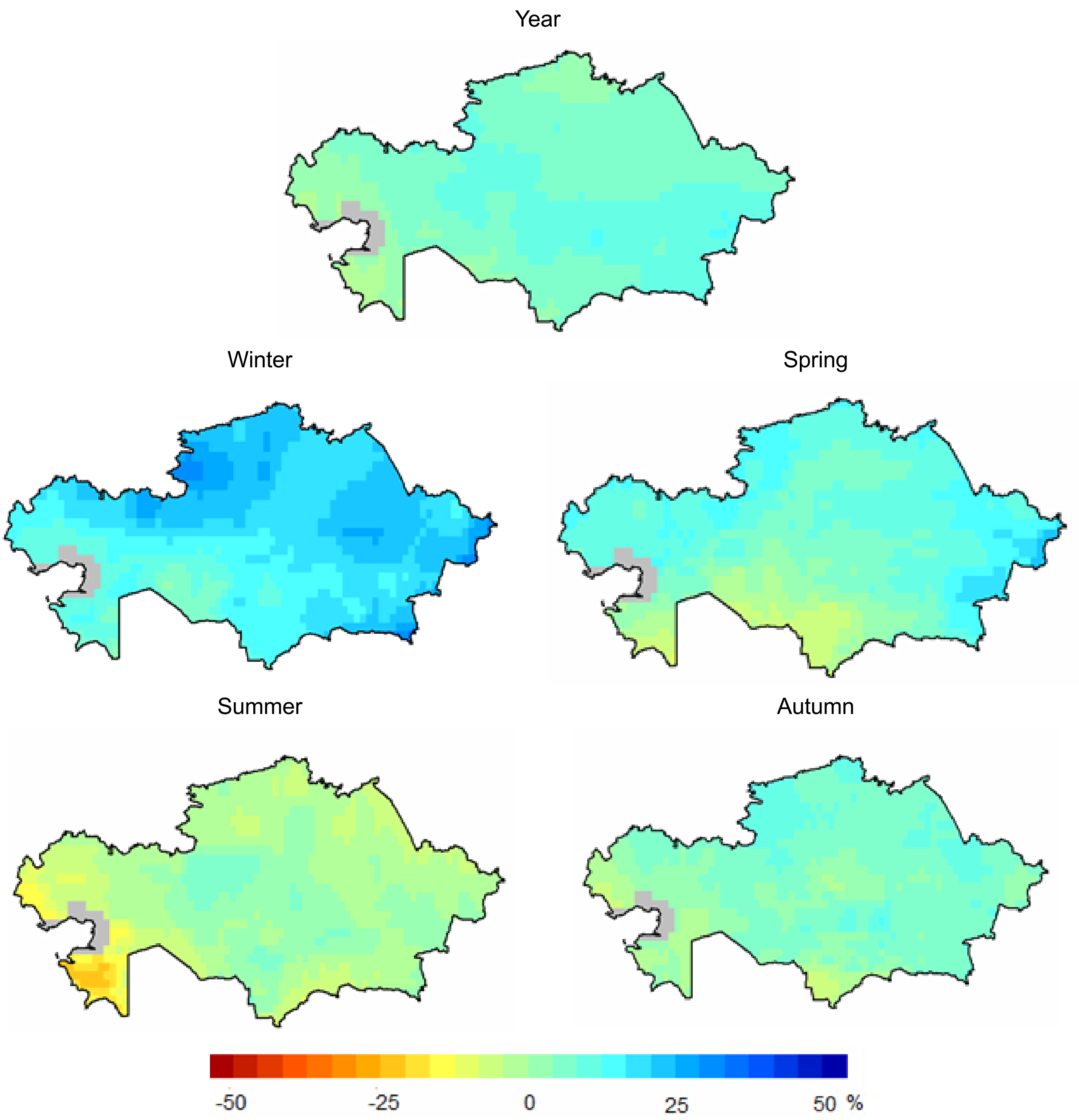


Figure B.6

Predicted changes in precipitation amount (%) within the territory of the Republic of Kazakhstan in case of change of CO_2 concentration under A2 scenario with respect to group of various atmosphere-ocean general circulation models for 2071-2099 (2085), calculated with respect to base period of 1961-1990.

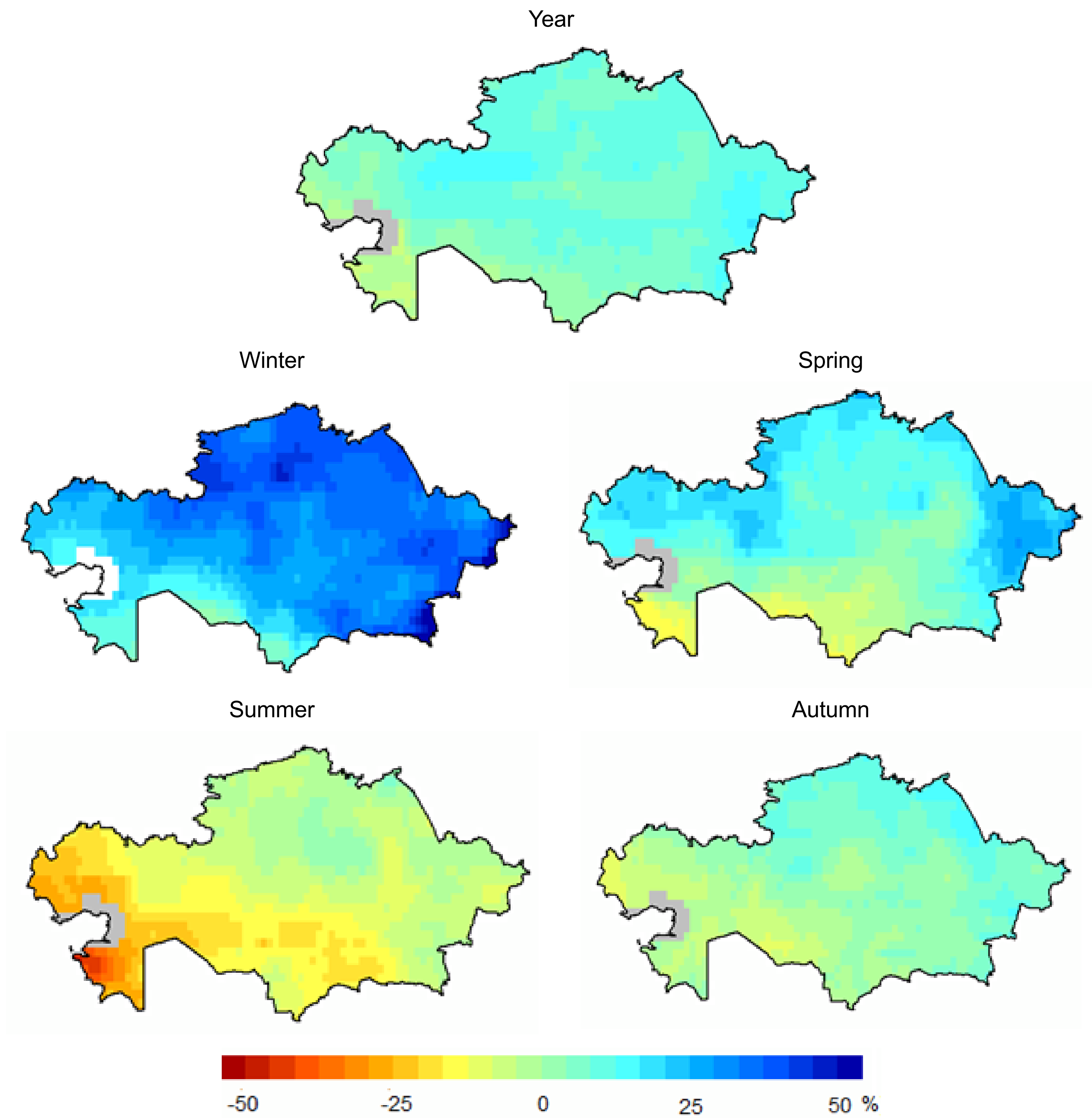


Figure B.7

Predicted changes in precipitation amount (%) within the territory of the Republic of Kazakhstan in case of change of CO_2 concentration under B1 scenario with respect to group of various atmosphere-ocean general circulation models for 2016-2045 (2030), calculated with respect to base period of 1961-1990.

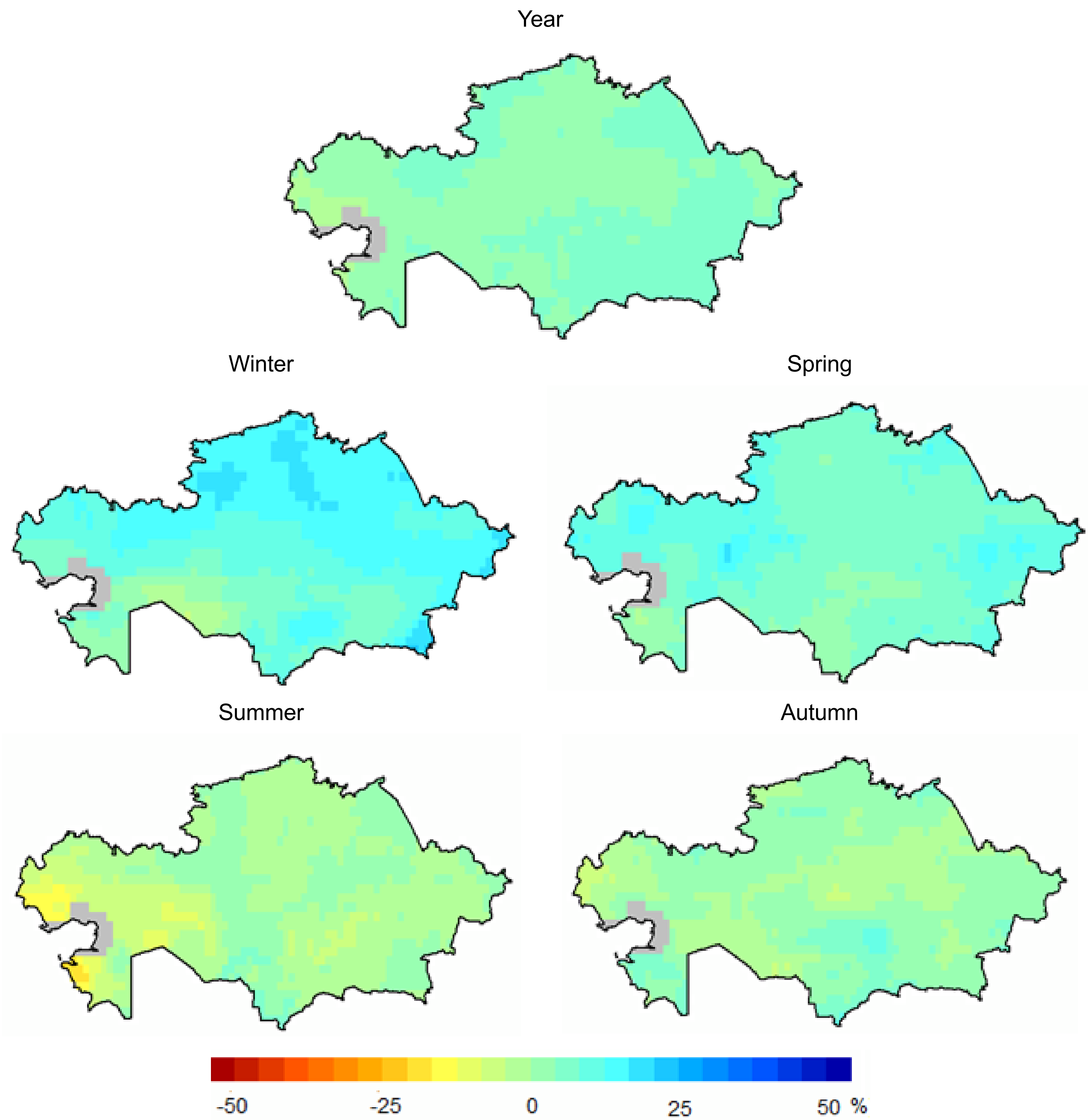


Figure B.8

Predicted changes in precipitation amount (%) within the territory of the Republic of Kazakhstan in case of change of CO_2 concentration under B1 scenario with respect to group of various atmosphere-ocean general circulation models for 2036-2065 (2050), calculated with respect to base period of 1961-1990.

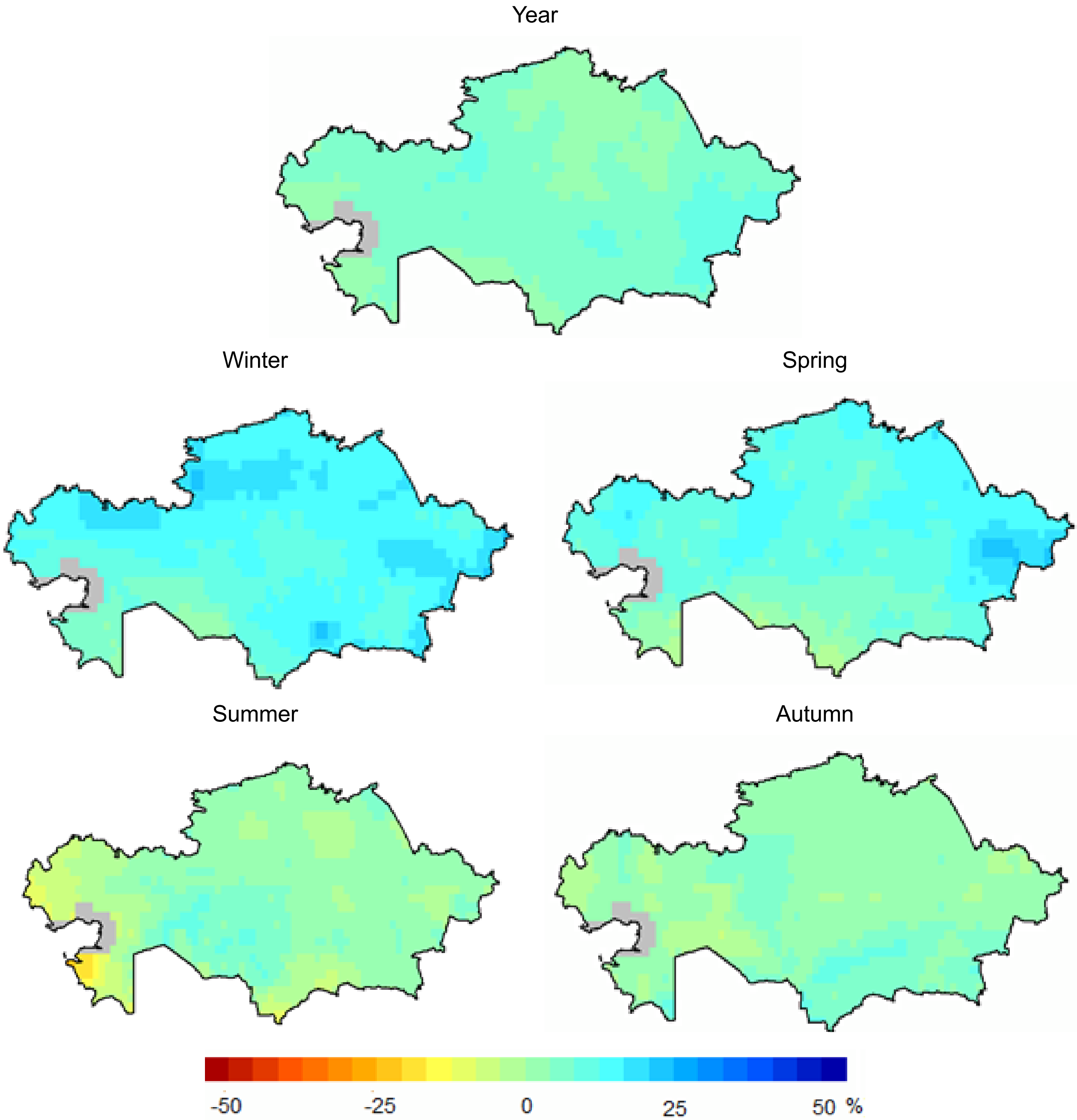
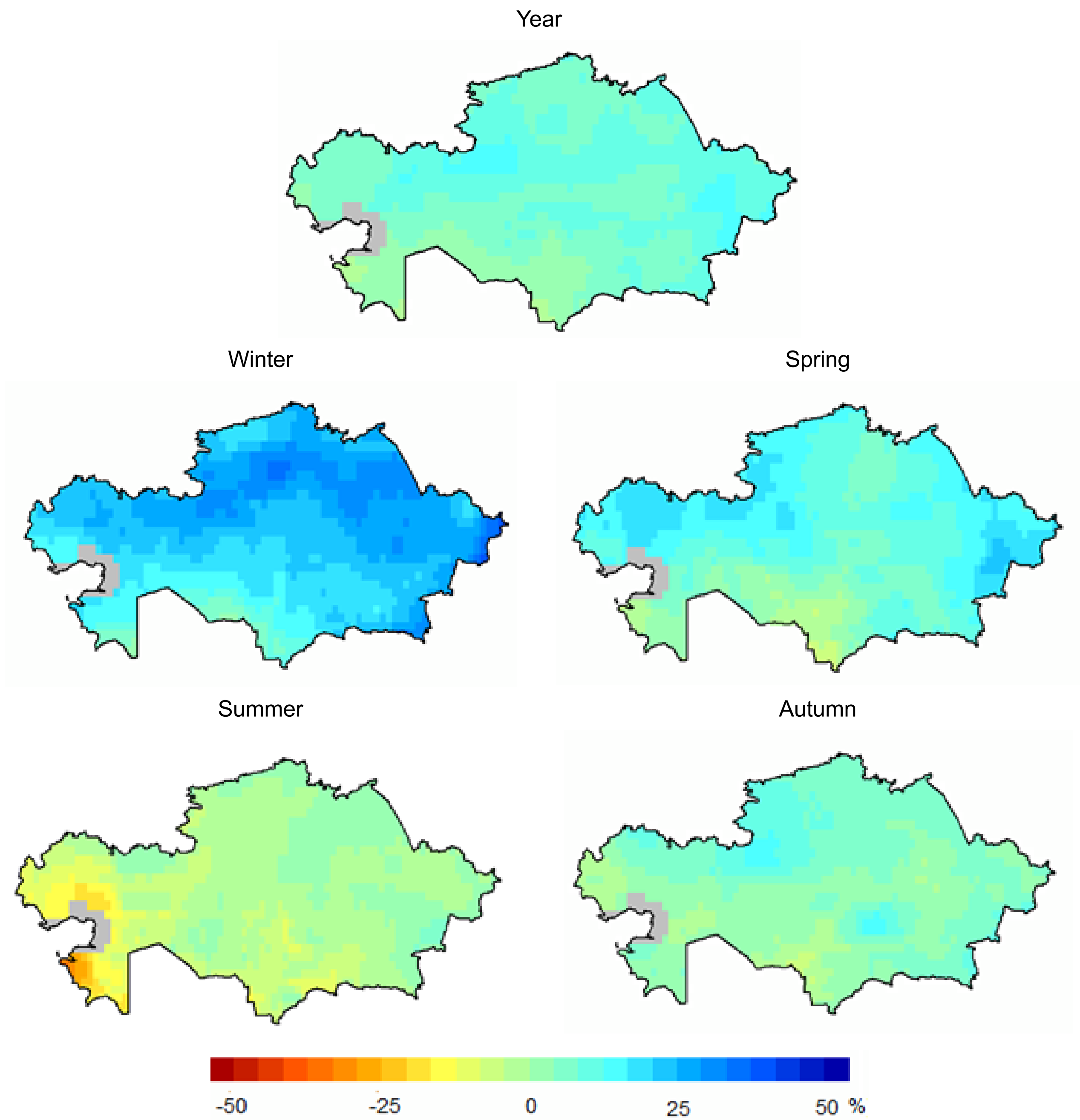


Figure B.9

Predicted changes in precipitation amount (%) within the territory of the Republic of Kazakhstan in case of change of CO_2 concentration under B1 scenario with respect to group of various atmosphere-ocean general circulation models for 2071-2099 (2085), calculated with respect to base period of 1961-1990.



LIST OF ABBREVIATIONS

AC	Agency for Construction of the Republic of Kazakhstan
ACS	Access control system
ADB	Asian Development Bank
AFC	Agency for Construction
AIT	Asian Institute of Technology
AMS	Automated management system
AOGCM	Atmosphere-Ocean General Circulation Model
APAN	Asia Pacific Adaptation Network
ARNM	Agency on regulation of natural monopolies
ASRK	Agency of Statistics of the Republic of Kazakhstan
BAT	Best available technology
BBC	British broadcast Company
CA	Central Asia
CAC DRMI	Central Asia and Caucasus Disaster Risk Management Initiative
CAI	Central Asian Initiative
CAREC	Central Asian Regional Environmental Centre
CBCCA	Community-based Climate Change Adaptation Program
CCCC	Climate Change Coordination Centre
CCGT	Combined-cycle gas turbine unit
CCHP plant	Cogeneration combined heat and power plant
CCSE	Climate Change and Sustainable Energy Program
CDM	Clean development mechanism
CFB	Circulating fluidized bed
CHP plant	Combined heat and power plant
CI	Confidence Interval (med.)
CIS	Commonwealth of Independent States
CNG	Compressed natural gas
COMO	Covenant of Mayors
COP	Conference of the Parties
CPP	Condensation power plant
CRF	Common Reporting Format
CSTISA	Centre for Computer Science, Telecommunications, Informatics and Situational Analysis
DBK	Development Bank of Kazakhstan
EBRD	European Bank for Reconstruction and Development
EC	Environmental Code
EE	Energy efficiency
EF	Emission factor
ES	Emergency situations
ETS	Emission Trading System
EU	European Union
EWE	Extreme weather events
FAO	Food and Agriculture Organization
FNC	First (Initial) National Communication
GCOS	Global Climate Observing System
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GFA	GFA Consulting Group
GHG	Greenhouse gases
GIS	Geographic Information System

GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GLSOS	Global Land Surface Observing System
GMWRUCS	General multipurpose water resources utilization and conservation scheme
GNP	Gross National Product
GOOS	Global Ocean Observing System
GOS	Global Observing System
GOST	State Standard
GPPP	Gas-piston power plant
GPU	Gas pumping units
GTN	Global Telecommunications Network
GTPP	Gas-turbine power plant
GTU	Gas turbine unit
GUAN	GCOS Upper Air network
HFC	Hydrofluorocarbon
HPP	Hydro Power Plant
HTC	Selyaninov's Hydrothermal Coefficient
HU	Housing and utilities
IAC	Information and Analysis Centre
ICSD	Interstate Commission on Sustainable Development
IEA	International Energy Agency
IG	Institute of Geography of the Republic of Kazakhstan
IGES	Institute for Global Environmental Strategies
IPCC	Intergovernmental Panel on Climate Change
IPV	Index of physical volume
IWRM	Integrated water resources management
JSC	Joint-Stock Company
KAZSEFF	Kazakhstan Sustainable Energy Finance Facility
KEGOC	Kazakhstan Electricity Grid Operating Company
KSRIWE	Kazakh Scientific Research Institute of Water Economy
LLP	Limited Liability Partnership
LRK	Law of the Republic of Kazakhstan
LULUCF	Land-Use, Land-Use Change and Forestry
MA RK	Ministry of Agriculture of the Republic of Kazakhstan
MEBP RK	Ministry of Economic Development and Trade of the Republic of Kazakhstan
MEP RK	Ministry of Environment Protection of the Republic of Kazakhstan
MEWR	Ministry of environment and water resources
MES RK	Ministry of Education and Science of the Republic of Kazakhstan or Ministry of Emergency Situations of the Republic of Kazakhstan (please see context)
MGO	Main Geographical Observatory
MINT	Ministry of Industry and New Technologies of the Republic of Kazakhstan
MOG	Ministry of Oil and Gas of the Republic of Kazakhstan
MRD RK	Ministry of Regional Development of the Republic of Kazakhstan
MTC RK	Ministry of Transport and Communications of the Republic of Kazakhstan
NAMA	Nationally Appropriate Mitigation Actions
NAPA	National adaptation programme of action
NEDO	New Energy and Industrial Technology Development Organization
NGO	Non-governmental Organization
NHMS	National Hydro-Meteorological Service
NL	Netherland
NURIS	Nazarbayev University Research and innovation systems
OECD	Organization for Economic Cooperation and Development

OSCE	Organization for Security and Cooperation in Europe
PC	Performance coefficient
PFC	Perfluorohydrocarbon
POP	Persistent organic pollutants
PPP	Public-Private Partnership or Purchasing power parity
PRC	People's Republic of China
QA/QC	Quality assurance and quality control
R & D	Research and development
RA	Research Area
RE	Renewable energy
REC-CEE	Regional Environmental Centre for Central and Eastern Europe
REC CA	Regional Environmental Centre for Central Asia
RES	Renewable energy sources
RF	Russian Federation
RIHMI	Russian Research Institute of Hydrometeorology Information
RK	Republic of Kazakhstan
RLA	Regulatory legal act (please see context)
RMC CA	Regional Mountain Centre for Central Asia
RRC	Regional Resource Centre
RS	Rural settlement
RTA	Road traffic accident
SCR	Selective catalytic reduction
SCSE	State Compulsory Standard of Education
SDPP	State District Power Plant
SDW	Solid domestic waste
SES	Sanitary-epidemiological station
SF	Social Fund
SGP	Small Grant Program
SHP	Stable hot period
SI	State institution
SME	State Municipal Enterprise
SNC	Second National Communication
SNCR	Selective non-catalytic reduction
SPCGF	Scientific Production Centre of Grain Farming
SPIIAD	State Program for Accelerated Industrial and Innovative Development of the Republic of Kazakhstan
SPNA	Specially protected natural area
SRES	Special report on emission scenarios
TPP	Thermal power plant
UAS	Upper air station
UCF	Unit Capacity Factor
UNDP	United Nations Development Program
UNEP	United Nations Environmental Program
UNESCO	United Nations Educational Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
UN	United Nations
USA	United States of America
USAID	United States Agency on International Development
USSR	Union of Soviet Socialist Republics
VCS	Voluntary Carbon Standards

VPN	Virtual Private Network
WAM	Scenario with additional measures
WB	World Bank
WHO	World Health Organization
WKR	West-Kazakhstan Region (Oblast)
WM	Scenario with current measures
WMO	World Meteorological Organization
WO	Scenario without measures
WPP	Wind power plant
WRC	Water Resources Committee of the Ministry of Environment Protection of the Republic of Kazakhstan
WTO	World Trade Organization
WWW	World Weather Watch

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Eugeniy Tkachenko – Blogger
UNDP Projects – Photographs from UNDP ongoing and finalized projects

CHAPTER 1
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