THIRD NATIONAL COMMUNICATION OF TURKMENISTAN UNDER THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC)

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MINISTRY OF NATURE PROTECTION OF TURKMENISTAN

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Ministries and agencies participating in preparation and discussion of the Third National Communication of Turkmenistan included:

- Ministry of Economy and Development of Turkmenistan
- Ministry of Oil & Gas and Mineral Resources of Turkmenistan
- Ministry of Energy of Turkmenistan
- Ministry of Finance of Turkmenistan
- Ministry of Agriculture of Turkmenistan
- Ministry of Water Economy of Turkmenistan
- Ministry of Public Health and Medical Industry of Turkmenistan
- Ministry of Public Utilities of Turkmenistan
- Ministry of Architecture and Construction of Turkmenistan
- Ministry of Motor Transport of Turkmenistan
- Academy of Sciences of Turkmenistan
- National Committee on Hydrometeorology under the Cabinet of Ministers of Turkmenistan
- State Concern «Turkmennebit»
- State Concern «Turkmengaz»
- State Concern «Turkmenhimiya»
- Institute of Oil and Gas of the State Concern «Turkmengaz»
- State Committee of Turkmenistan on Statistics
- National Institute of Deserts, Flora and Fauna of the Ministry of Nature Protection of Turkmenistan
- Institute for Solar Energy of the Academy of Science of Turkmenistan
- Institute of Chemistry of the Academy of Sciences of Turkmenistan
- Scientific Research Institute of Agriculture under the Ministry of Agriculture of Turkmenistan
- State Livestock Association of Turkmenistan

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FOREWORD

At the turn of the 20th -21st centuries, climate change has become particularly pressing issue among other environmental problems. Its unique and extraordinary nature has necessitated Turkmenistan's active participation in the implementation of international programs on global climate change prevention and taking the necessary measures at the national level to mitigate climate change and enhance resilience to its adverse impacts. This problem is viewed as possible and serious obstacle for implementation of plans on sustainable economic development and promotion of human well-being.

Turkmenistan ratified both the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol on June 5, 1995 and January 11, 1999 respectively. The signing of these documents indicates on the willingness of the country to take actions to address multiple tasks set in them.

In 1999, the State Commission was established to ensure the effective implementation of commitments of Turkmenistan as a Party under the UNFCCC.

In 2000, Turkmenistan prepared and submitted to the UNFCCC Secretariat, its Initial National Communication on Climate Change, covering issues such as national circumstances, possible processes caused by climate change, and the consequences of climate change impacts on ecosystems and national economy were described. An national inventory of greenhouse gas emissions and removals for 1994 as well as measures to mitigate emission were provided. In 2009, Turkmenistan established the Inter-agency Committee as the National Designated Authority for the Clean Development Mechanism for Kyoto Protocol implementation.

In 2010, the Second National Communication was published which is the logical continuation of the Initial NC. It envisages expansion of activities to address the problem of climate change in Turkmenistan.

Turkmenistan's position is reflected in the number of state programs currently under implementation, particularly the "Strategy of socio-economic development of Turkmenistan until 2030" (published in 2010) and the "National Strategy of Turkmenistan on Climate Change" (published in 2012). These documents reflect the state policy on environmental protection for the shorter term taking into account the climatic characteristics of the country.

The National Strategy of Turkmenistan on Climate Change describes the basic principles, specific goals and measures to address this problem considering specific conditions of our climate. The goal of this strategy is to ensure sustainable development of Turkmenistan that will help to mitigate the impact of global climate change on socio-economic development, facilitate the adaptation of various sectors of economy to the adverse impacts of climate change and the promotion of human well-being, as well as the improvement of the economic, food and environmental security of the country.

The main activity envisaged by this strategy is to prevent climate change and adapt to it. At present, measures to mitigate climate change are developed within the framework of the National Action Plan to Reduce Greenhouse Gases (NAPRGG), and measures to adapt to climate change are to be carried out within the framework of the National Action Plan on Adaptation (NAPA). These documents are in the final stage of preparation

for economic sectors such as oil and gas, manufacturing industry, power industry, transportation, alternative energy, housing and utilities, waste management and tourism.

While developing the NAPA, particular attention was paid primarily to human health, water, soil and land resources, agriculture, ecosystems (flora and fauna) and forestry as well as to extreme hydrometeorological events.

Presently, the international community is seeking for solutions to address the global challenge posed by the climate change problem. Complex and ongoing international negotiations are underway. Turkmenistan is an active participant in the negotiation process to develop the new climate change agreement, which will enter the force upon the end of the second commitment period of the Kyoto Protocol. At the 69th Session of the UN General Assembly (September 2014) and the Climate Summit, held under its auspecies, Turkmenistan supported the decisions taken at the Summits on Climate Change in Copenhagen and Cancun, the 17th Conference of the Parties to the UN Framework Convention on Climate Change in Durban, Rio + 20. Turkmenistan expects the continuation of constructive international dialogue on this issue and is convinced of the need for consistent joint efforts at the international and regional levels, as well as the effective coordination of UN member states.

In June 2015, there was an official visit of the UN Secretary-General Ban Ki Moon to Turkmenistan. During the visit, along with other issues the problem of global climate change was discussed, in particular the preparation of the new international agreement on this issue which will be the subject of international negotiations within the framework of the 21 COP to the United Nations Framework Convention on Climate Change in December 2015 in Paris. Based on the discussion results, the mutual understanding between the government of Turkmenistan and the UN Secretary-General was reached on the need to conclude this agreement and identify the contribution of Turkmenistan to this process.

Turkmenistan pays great importance to partnership at the regional level. The Interstate Commission on Sustainable Development for Central Asian countries has entrusted Turkmenistan the coordination of works on implementation of decisions of the States of the region, adopted in June 2007 and in November 2008, on climate change. With its full responsibility, Turkmenistan has proposed a number of initiatives aimed at strengthening of regional cooperation and establishing of mechanisms to solve this problem. The point is about creating a regional center for technologies related to climate change. At present, organizational, technical, financial and other documentation for its activity has been prepared. The strategic partnership with the United Nations has been and remains to be the priority focus of the foreign policy of neutral Turkmenistan. Turkmenistan will constantly continue performing active and purposeful work with the UN and its specialized agencies, including UNEP and UNFCCC, which are our leading partners providing a great assistance to Turkmenistan in addressing climate change issues.

Currently, the broad discussion of the text for the new international agreement has been organized involving senior specialists and heads of the concerned ministries and departments. Turkmenistan supports the adoption of the international agreement based on the principles of the UNFCCC, which should reflect the interests of developing countries.

Our country confirms its commitment to the UNFCCC and its goals aimed at reducing the human impact on climate. Turkmenistan with all responsibility relates to the obligations under the Framework Convention, and will continue to contribute to a deci-

sion-making process regarding to global climate change problem at the international, regional and local levels.

The Third National Communication has been prepared in accordance with Articles 4.1 and 12.1 of the Convention and the Guidelines for preparation of National Communications of Parties, not included into Annex 1 of the UNFCCC. The Third National Communication of Turkmenistan to the UN Framework Convention on Climate Change has reflected actions aimed at solving climate change problems as well as new approaches Turkmenistan have been provided to prevent global warming.

EXECUTIVE SUMMARY

The Third National Communication (TNC) of Turkmenistan, prepared in accordance with the methodological guidelines of UNFCCC outlined in decision 17/CP.8.

The first chapter of TNC of Turkmenistan describes national circumstances in detail and provides analysis of socio-economic development in all key economy sectors was including information and communication technologies, public-private partnership and investments, as well as analysis of domestic technology and national intellectual prop- erty system. It also addresses issues of governance and legal framework on climate change; in particular, the legislative framework for assessing technology transfer in Turkmenistan.

The second chapter presents the inventory results of greenhouse gas emissions and sinks in Turkmenistan for 2000-2010. According to these data, the country's contri bution to global warming is slightly increasing and comprises about 66,000 Gg CO_2eq. The main greenhouse gases emitted in Turkmenistan are CO_2 and CH4. The inventory included GHG emissions from key sectors that make up 97% of total emissions. The inventory results helped to determine the priority areas for reducing emissions and increasing greenhouse gas sinks, as well as attracting advanced technology and invest- ments. The share of the energy sector in total GHG emissions is 85%.

The third chapter identifies industries whose activities are most vulnerable to climatic changes namely: agriculture, water management, healthcare, soils and land resources, natural ecosystems and forestry. A list of adaptation measures has been proposed for each sector to enhance resilience to climate change impacts. Current climate has been studied and scenario of climate changing in the future has been created using internationally recognized models. The comparison of these data shows the increase in average air temperatures and decrease in rainfall amount.

The fourth chapter provides information on measures taken by the Turkmen government to reduce greenhouse gas emissions (GHGs). Turkmenistan, being rich in energy resources, pays a great attention to reducing of anthropogenic emissions of GHGs, first of all, through using advanced environmentally safe and resource-saving technologies of leading foreign manufacturers in the oil and gas, energy, transport and other economy sectors.

The comprehensive analysis of national, sectoral and target programs of economic development of Turkmenistan for the period up to 2030 has been conducted. The macro economic indicators, GDP structure, dynamics of major economy sectors until 2030 and annual average growth rates, consumption of primary fuel and energy resource per capita, elasticity, carbon intensity and greenhouse gas emissions intensity have been analyzed. Measures have been developed to reduce consumption of all types of energy. The

analysis of production and consumption of fuel resources in 2020-2030 has been conducted. Consumption projecting of primary and secondary energy resources has been performed by major sectors (by types) up to 2030 for baseline and innovative scenarios. The analysis on conditioning of residential buildings and heating systems and possible energy saving measures has been conducted considering climate change.

The fifth chapter presents the scientific research results on climate change and status of systematic observations of climate and air pollution. International cooperation and initiatives of Turkmenistan on climate change, technology transfer, education, training and public awareness, as well as constraints, gaps and capacity needs have been described.

The Third National Communication of Turkmenistan on climate change has been prepared by the Ministry of Nature Protection, responsible for implementation of international environmental conventions and programs, in close cooperation with concerned ministries and agencies with active participation of the National Committee on Hydrometeorology under the Cabinet of Ministers of Turkmenistan and with project management support and technical assistance of UNEP.

CHAPTER 1. NATIONAL CIRCUMSTANCES

1.1.1. Geographic profile and natural resources
1.1.1. Geographic profile

Turkmenistan is a country in Central Asia bordering with the Republic of Kazakhstan to the north, Uzbekistan to the northeast and east, with the Islamic Republic of Afghanistan to the southeast, and the Islamic Republic of Iran to the south. From the west Turkmenistan is washed by the Caspian Sea. Administratively, the country is divided into five regions (velayats) - Dashoguz, Lebap, Mary, Akhal, and Balkan. The capital of Turkmenistan, Ashgabat, founded in 1881, is the largest administrative, political, scientific and cultural center of the country. The northern and central parts of the territory of Turkmenistan are occupied by sand deserts of Turan lowland - Central, Zaunguz and South-Eastern Garagum. In the south and southeast, the country is surrounded by the mountains. The highest point of Turkmenistan is located at the Koytendag ridge - 3139 m above sea level, the lowest – the Akchakay cavity that is 81 m below sea level. The area of Turkmenistan is 491,000 km^2. The country is located between 35°08'and 42°48' N and 52°27'and 66°41' E, to the north of the Kopetdag Mountain ridge, between the Caspian Sea in the west and the Amudarya River in the east. From west to east, its territory is 1100 km and from north to south - about 650 km. (Fig.1).

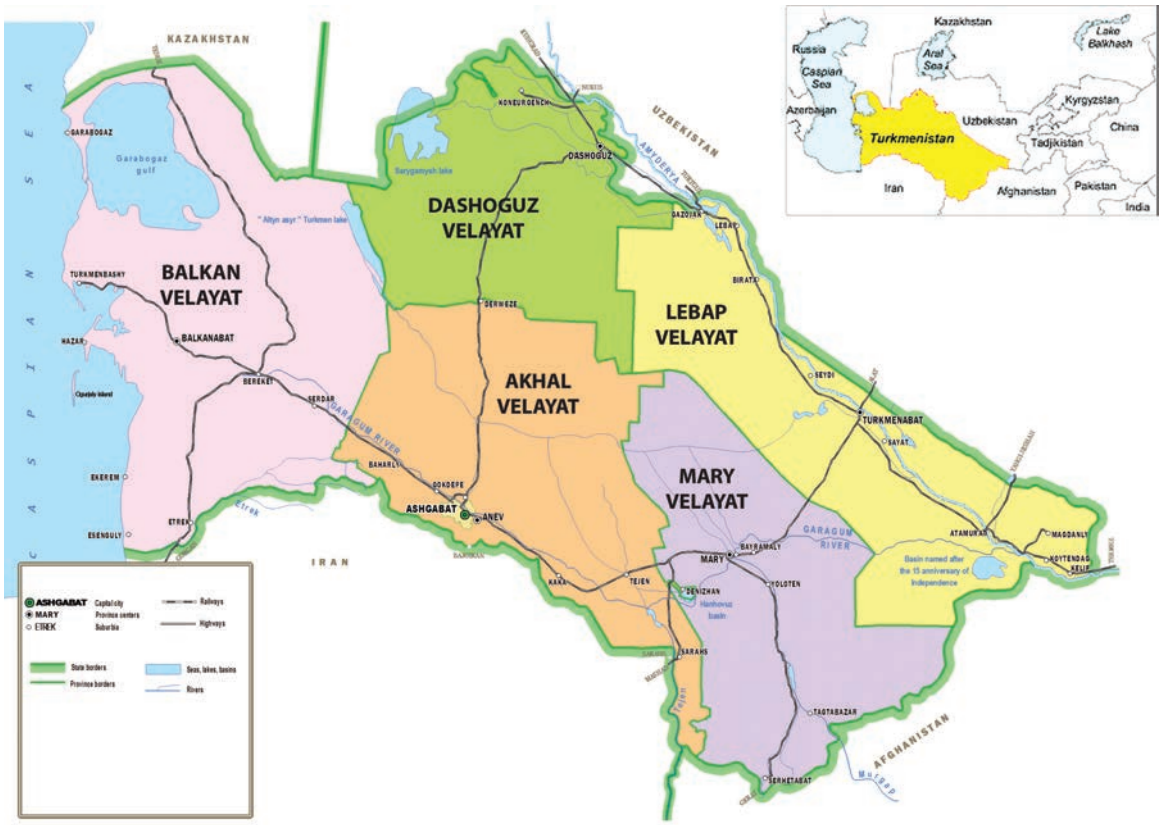


Fig. 1.Political and administrative map of Turkmenistan

1.1.2. Relief

The relief of the territory of Turkmenistan is quite diverse. Formation of major landforms is primarily tied to the geological history of the area and is driven by the physical and geographical influence. Turkmenistan is the flattest country among others of

Central Asia. Regarding the relief nature, 80% of the territory is a plain land occupied by deserts and semi deserts. The flat part has a continuous gradient towards the Caspian Sea from east to west. This is because in the recent geological past (before the Neogene), the whole territory of Turkmenistan was covered by seas that contributed to the formation of thick layer of sedimentary sheath. Most of the plainland lies at the altitude of 0-200 m above sea level. Geographically, the whole flat part of Turkmenistan belongs to the Turan lowland differed by three categories of landscape: a) tertiary plateau; b) sandy deserts; c) loessial piedmont plains. The Krasnovodsk plateau Ustyurt and Mangishlak tips belong to the first category, Central, Southeastern and Za-unguz Garagum – to the second, the northern foot of the Kopetdag and Paropamiz is to the third category. About 20% of the territory of Turkmenistan is occupied by mountains. In the south, sandy deserts transform to the hills and foothills of the Kopetdag – medium altitude (up to 2942 m above sea level) mountains; to the north of them two separate mountain ridges stand the Small and Big Balkhan. In the north, the Kopetdag adjoins the foothill plain interlocked to the Caspian Sea lowland plain in the west. In the southeast, Turkmenistan hosts the northern foothills of Paropamiz - Badkhyz (up to 1267 m) and Karabil highlands (up to 984 m), separated by the Murgab River. In the east, there are the Koytendag Mountains, in the west - the Caspian Sea that in some places reaches the depth of 1000 m.

1.1.3. Climate

Turkmenistan is characterized by sharply continental and extremely dry and moderate climate of deserts: long dry hot summer, cool humid autumn and warm winter with little snow. In the far northeast and southwest, the duration of winter period lasts minimum a month, and in the far north and northeast is about 4 months. The average monthly temperature reaches significant values in the far south of up to 28-33°C. Most of its daily amplitude is marked at the end of summer, when it is between 18-20°C in the south even as per average long-term data.

The average temperature of air varies from 21 to 34°C. The coldest month is January. In the warm season (from May to September), daytime air temperature often exceeds 40 ° C. The absolute maximum of it is + 50,1°C (Repetek, the Southeastern Garagum), and the absolute minimum temperature is -36,0°C (the Dashoguz velayat).

The annual amplitude of temperature in the northern areas is - 32° C and in the south - about 26 °C. The highest daily amplitudes are marked at the end of summer and according to the average long-term data are between 13-16°C in the northern and 18-22°C in the southern regions.

The absolute maximum temperature of soil surface of 80,0°C is registered in the southeastern Garagum (the Repetek station).

The frost-free season in the northeastern regions (the Dashoguz oasis) of Turkmenistan lasts 187-200 days, for the rest of the territory - 230-250.

The intensity of solar radiation is from 606.7 (in the northwest) to 682.0 kJ / cm^2 (in the southeast).

Turkmenistan belongs to the zone of insufficient humidity. The average annual precipitation varies from 76 to 380 mm.

The maximum relative air humidity reported in January is between 70-78%. The driest period is from June to September, when the relative humidity is 20-30 in the Garagum Desert and in oases range from 30-35%.

On the plain territory of the country, the average annual wind speed is 3.2-4.2 m /s. During the year, the number of days with dust storms varies from 35-67, and in some years between106-113.

1.1.4. Water resources

Water resources of Turkmenistan are formed due to surface runoff of the Amudarya, Murgab, Tejen, Kashan, Kushka, Etrek, Sumbar rivers and small streams flowing down from the northeastern slopes of the Kopetdag as well as groundwater. The river flow entirely or largely is formed outside of Turkmenistan.

The total volume of water resources of Turkmenistan is 25 km^3 per average annual water content. In total volume of surface water resources the Amudarya provides 22 billion m3 (88%); Murgab - 1.631 billion (6.5%); Tejen - 0.869 billion (3.5%); Etrek, Sumbar and Chandir - 0.354 billion m^3 (1.4%); small rivers - 0.15 billion m^3 (0.6%). All rivers of Turkmenistan, except for small streams of the northeastern slopes of the Kopetdag, are cross bordering, that is, 95% of surface water resources are formed outside the country. The main feature of all surface water resources is that their flow is completely used, or partially regulated, and then it is used for drinking water supply, irrigation, domestic and other needs of population. The registered groundwater reserves in Turkmenistan in whole make up 3.4 mln m^3/day, explored - 6 million, and predicted - 9 million m^3/day. In the water balance, the country's share of the ground water is 2.0-2.5%.

Return flow is mainly formed due to collector-drainage flow from irrigated lands and in small volume due to industrial, housing and domestic wastewater. The total volume of collector-drainage flow exceeds 6 km^3/year, and of industrial, housing and domestic wastewater - about 0.25-0.30 km^3/year. In this regard, only a small part of the collector-drainage flows in dry years (about 50 million m^3/year, representing 0.2% of the total volume of water resources) is used for irrigation.

The water sector in Turkmenistan is one of the most vulnerable to global climate change. The expected increase in air temperature and the consequent decrease in the volume of river flow may have significant adverse effects on the most important economic sectors.

1.1.5. Soils and land resources

The total area of Turkmenistan is 491.2 thousand km^2. About 80% of the country is occupied by the Garagum desert. Soils in Turkmenistan have a very low content of humus, which is caused by a minor amount of annual precipitation and strong heating of the surface. This limits the development of vegetation. The total area of agricultural lands on January 1, 2015 amounted to 39,812,000 ha of which the pastures accounts for 95.7% (38,081,400 ha).

The land area of meliorative fund suitable for development is 17 million ha. In Turkmenistan, more than 1.7 million ha are irrigated lands. However, due to location of irrigated soils around water and due to close bedding of saline groundwater, these soils are also affected by salinity. In the foothill parts of the country where precipitation is high, black soil is formed under relatively thick grass layer. In the mountains by the altitude change, vertical zones of soils are marked ranging from sierozem soils to brown soils in the top part.

The main areas of irrigated agriculture in Turkmenistan are Amudarya, Murgab, Tejen and Etrek oases and the Kopetdag foothill plain. From the total area of the country (as on 01.01.2015), 65.9% (32,4 million ha) constitute lands allocated for agricultural production, 27.1% (13,3 million ha) – lands of the state reserve and forests, 7.0% (3,4 million ha) - other land users.

1.1.6. Biological diversity

Turkmenistan has diverse ecosystems. They include plains and deserts, mountains, rivers, seas and coastal-marine ones, lakes and man-made ecosystems. Each ecosystem is characterized by diversity of its inhabiting living organisms. Due to its geographic location, Turkmenistan plays a key role in the region in maintaining global biodiversity and supporting the biosphere functions. The biological diversity of the country includes not less than 20,000 of species, including more than 7000 of plant species (of which about 3200 high and almost 4000 lower ones) and about 13,000 of animals (more than 720 - vertebrates). In addition, the biodiversity of Turkmenistan is characterized by high rates of autochthonous flora and fauna. All this diversity is distributed over different ecosystems - plain and desert (about 80% of the country), mountain, river, lake, sea, coastal-marine and man-made ecosystems.

All ecosystems – the mountains with plain deserts, unique rivers with Tugai forests, lakes and seas form the ecological and biological framework of arid communities in the country. They highlight the importance of biodiversity in Turkmenistan at the national and global levels.

As climate change process will increase at a faster pace, rather than adaptation to it of various kinds of flora and fauna, as well as due to linked influencing factors and limitations of adaptation options, many ecosystems (especially forests, mountain systems) are quite vulnerable to climate change effects.

The study results of biodiversity and capacity to conserve its components show that climate change has variable effects in Turkmenistan. In particular, in the lower reaches of the Etrek River, lack of water (over drying)

for a long time leads to significant restructuring in the ecosystem. It should also be noted that due to precipitation decrease and increase of air temperature in recent years, desert pasture yield is decreasing.

At the same time, the fauna diversity of the country in recent years has been enriched. Climate change causes a habitat shift for some species what causes entering of new ones to the country. This can be identified by results of ongoing monitoring. In particular, due to habitat expansion of some animal species and first of all, birds (caused primarily by climate change on a global scale), new species have appeared for wintering, that usually would spend winter to the south of our country - gray crane (Grusgrus), osprey (Pandion haliaetus), some waders.

1.2. Socio-economic model of development

The current stage of socio-economic development of Turkmenistan is characterized by large-scale reforms aimed at modernizing of economy to accelerate the transfer of all economic complexes to a new industrial-innovative development level.

The main objective of the strategy of industrial-innovative development of Turkmenistan is to form the modern industry structure, based on innovation and sustainable development. For this purpose economy diversification is performed, steps are taken to ensure the competitiveness of products in domestic and foreign markets, main production sectors are modernized, legal, organizational and economic measures and conditions are performed necessary for its transfer to the industrial-innovative development. Structural changes are made: creating new manufacturing industries, modern high-tech industrial complexes, factories, process industry facilities designed for production of domestic competitive products are put into operation meeting international quality standards.

The key areas of the new economic strategy are modernization, diversification and overall liberalization of the economy, the combination of elements of market and state regulation. Along with the priority development of the fuel, energy, and agro-industrial complex, transport and information and communication infrastructure, significant investments are made to science and education.

1.2.1. Social policy

Turkmenistan consistently pursues the policy aimed at protecting the rights and interests of citizens to create equal conditions and opportunities for all. Based on the Constitution provisions, the country adopted number of laws, where the constitutional norms received their further development and guarantees - Labor Code, Family Code, the Code of Social Protection, the Law on State Pension Insurance Act, the Law on the right guarantees of young people to work and other legislative acts.

Significant changes in health, education and science are under way. Major reforms in social sphere are carried out in accordance with sectoral medium-term program of development for 2012-2016. The program of the President of Turkmenistan on socio-economic development for 2012-2016 and the National Program of socio-economic development of Turkmenistan for the period 2011-2030 served as the reference while preparing these programs.

Social benefits for population remain valid, including financial security and social services of persons not capable to work, disabled people, families with children and others through payment of pensions and allowances. The government provides financial support to families with many children and young families receive financial assistance for building a house. As per the Labor Code financial allowance is provided to pregnant women, nursing mothers and mothers of disabled children, as well as it is envisaged to keep a job place of a woman who is on leave for child care. Minimum rates remain valid for using water, electricity, gas, housing services and accommodation, a one percent mortgage loan for purchasing a house and other benefits.

1.2.1.1. Population

Turkmenistan is a multinational state represented by more than 80 nationalities. As on 1 January 2015 the rural population accounted for 47.7%. In the structure of the resident population, women make up 50.2%. The population at working age is 64.0%, below that age - 29.6%, older - 6.4%. Population literacy aged 15 years and above - 99.9%.

1.2.1.2. Healthcare

The program of health development is closely linked with implementation of state social policy, including environmental issues taking into account climate change.

In this context, healthcare is given the decisive role in the whole socio-economic development. Government and public bodies, enterprises, institutions, organizations must provide assistance to protection of human health at work. The policy in this area is based on such factors as systemic prevention, orientation to modern standards of health and medical care, harmonious use of local traditions and achievements with updated world experience in the field of health, a science-based approach to human health considering the problems of climate change. In the complex of state and sectoral measures, it is important to note the reorientation of healthcare system to significant strengthening of efforts to prevent diseases, creating the conditions for forming and promoting healthy lifestyle, improving the «health education» and struggling with bad habits, developing physical culture and sport, especially among children and youth.

As part of the implementation of the program «Health», the healthcare system has been improved, as well by building ultramodern medical centers that facilitated a wide range of health facilities (hospitals, health centers and facilities) in accordance with the principles of new healthcare model.

As at 01.01.15, at the disposal of the Ministry of Health and Medical Industry were 27 health houses, 117 hospital facilities, 5 centers and 56 branches of emergency ambulance services, 5 homes for elderly and disabled people. In these institutions 12,792 doctors and 23,090 specialists representing paramedical personnel are working.

Significant progress has been made in health security, as evidenced by obtaining international certificates on elimination in Turkmenistan a number of infectious diseases. Positive results have been achieved at improving the sanitary-epidemiological situation in the country. The Sanitary Code of Turkmenistan has been adopted in the new edition; a number of new laws have been developed: on the quality and food safety, radiation safety, drinking water safety, on the protection and promotion of breastfeeding and requirements for infant feeding products. In addition, the National program is implemented in Turkmenistan on early child development and school readiness for 2011-2015 and others.

Over the last years, the country has achieved success in eliminating of dracunculiasis, polio, malaria, which was confirmed by relevant international certificates. The morbidity rate per 100,000 of the population with acute intestinal infections for 2007-2014 decreased from 109.2 to 66.3.

1.2.1.3. Education

In recent years, a solid and reliable legal framework of national science has been established, the government has developed measures to develop and improve its infrastructure, and a start has been given to a long-term international cooperation in science and high technology sphere with major international organizations and research centers. Improvement of the national legal system shows that Turkmenistan transfers to the innovative way of development, including scientific approach and projection, integration of science into production, education and entrepreneurship.

Each year, the government support for science is significantly increasing; financing is being improved for advantageous researches, experimental development and technological developments. The material and technical base of scientific institutions and universities is getting stronger, in their activities the latest information and communication technologies are widely introduced, including high-speed access to global database through Internet and digital libraries.

The country continues to work on implementation of activities under the National program on enhancement of social and living conditions in villages, settlements, towns, etraps and etrap centers for the period up to 2020. Significant funds are provided to construction and renovation of kindergartens, secondary and professional schools. As at of 01.01.15, there are 974 kindergartens, 1841 secondary schools, 131 primary vocational, 40 secondary vocational schools and 24 high schools in the country. In addition, there are a growing number of institutions for cultural conduction of leisure time.

1.2.1.4. Tourism and sport

In recent years, tourism has been intensively developed in Turkmenistan. In 2014, this sector of the Turkmen economy has maintained growth rates due to expansion of diplomatic, business, scientific and cultural ties between our country and other countries of the world. A major role in creating of attractive tourist image of the country belongs to the National tourist zone «Avaza». Every year there is an international tourist Congress and Exhibition «Tourism and Travel» held dedicated to the World Tourism Day. Many tourists from Europe and Asia visit Turkmenistan, following the route of the Silk Road that includes monuments entered the List of the World Heritage declared by UNESCO.

For tourists, Turkmenistan is attractive not only with its architectural and historical monuments, but also with natural ones (the Caspian Sea, the mountain range Koytendag with the famous dinosaur Plateau, the Kirkgiz cave, the Daraydere gorge, etc.).

There are many recreational areas in our country (mountain, seaside, desert), that are favorable for preventing and treating many diseases. There are several well-known resorts, among which the most popular health resorts are in Mollagara, Bayramali and Archman. Mineral water springs and therapeutic mud are used to treat diseases of kidneys, heart, nervous system, disorders of musculoskeletal system, spinal injuries.

Development of physical culture, sport and tourism is an integral part of activities of the government to protect health of citizens. Today, all kinds of sports are developed in the country, including those that once were not available due to our climate. Traditional national sports remain popular, involving competitions at various levels. A special place here, of course, belongs to races, as well as competitions devoted to national holidays. Horseracing plays a special role in the lives of the country citizens. A major and vivid evidence of this is the celebration of the Day of Turkmen Horse, which annually and on a large scale runs on the last Sunday of April.

1.2.2. Present economy

High rates of growth have become typical for a dynamically growing economy. For 2008-2013, the volume of GDP increased by 2.3 times. Changes have been also made in the GDP structure: the share of industry on 01.01.2014 amounted to 48.1%; agriculture - 8.5%; construction - 15.3%; trade - 6.7%; transport and communications - 5.4% (Fig. 2). Turkmenistan is currently characterized as industrial and investing country with developing infrastructure.

High economic growth rates are provided by an active investment policy. Over 2008-2013, the volume of fixed investment ratio has been increased by 3.3 times. State investments account for essential share - 68.5%.

A key focus of the economic strategy of Turkmenistan is to establish long-term and mutually beneficial trade and economic cooperation with foreign countries, leading foreign companies and financial institutions. Turkmenistan's foreign trade turnover is growing every year: in 2012, it amounted to more than 34 billion USD, which is 1.9 times higher than in 2010. The growth rates in foreign trade turnover over 2013 amounted to 102%.

Export of goods in 2012 exceeded imports by 41%. Economic and trade relations have been established with 107 countries of the world, 99 countries of which are importers. In 2013 in the structure of imports, 83% was amounted to production and technical purposes, including modern technology and equipment. The importers of technologies and equipment to Turkmenistan are China, South Korea, Turkey, Japan, Germany, France, UK, USA, Russia, Ukraine, Belarus and others.

In order to attract foreign investments into the country's economy and create favorable conditions for this, a complex program is implemented to further attract foreign investments, introduce advanced technologies, create the most favorable conditions for investors, developed by the initiative of the President of Turkmenistan.

The active investment policy and the creation of conditions to develop a construction complex in the country have led to the growth of the economy, its diversification, new advances in science and technology, creation of new innovative industries. In the Programme of the President of Turkmenistan on the socio-economic development for 2012-2016, the priority of the investment policy served diversification of the sectoral structure of the country's GDP by creating of new industries, as export-oriented and import substituting, the industrial-innovative development of the economy, leveling the standard of living of urban and rural population.

Investments aimed to meet these challenges not only contribute to the growth of industrial and construction industry, employment increase, but also contribute to their spread to other sectors of the economy.

Foreign investments in 2013 accounted for 15.7% of total assets. Mostly investments are made in exploration and production of hydrocarbon resources, light industry and construction.

In order to increase investments into the economy of Turkmenistan, the legal framework of the investment process has been consistently improved taking into account international requirements.

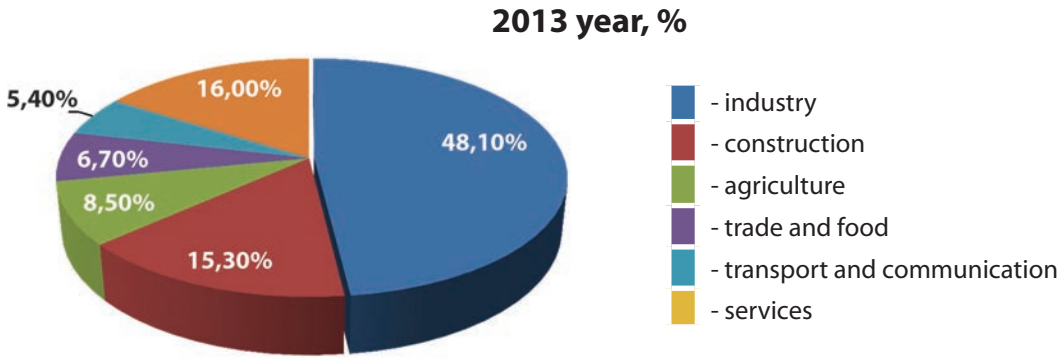


Fig.2.GDP structure, in 2014, %

1.2.2.1. Industry

Successfully implemented by the government industrial policy, investment projects in priority industrial sectors gradually allow the GDP structure of Turkmenistan approach to the GDP of industrialized countries (Fig. 3).Currently, the industry accounts for more than half of the volume of GDP. The industrial policy is aimed at accelerating development of processing industries, creating new and modernizing existing facilities, maintaining investment and innovation activities.

High growth dynamics, increasing capacity of industrial infrastructure, output volume of certified high-quality products relate to production of building materials, chemical industry, textile and carpet industry, which are rapidly developing in accordance with implemented in the country complex government and sectoral programs, plans of industrial diversification.

Huge potential and export opportunities are given to the chemical industry of the country - one of the fastest growing sectors of the national economy. Program objectives of the presidential strategy for change and enormous natural resources of the country

are driven by the rapid increase in capacity for production of high-quality mineral fertilizers, the need for which is constantly growing in the world and in our country in the context of agricultural reform, achieving food abundance. The past 2014 has become a decisive year for domestic chemical industry, promoting it to a new level of development, the strategic direction of which is export of products being in demand and highly competitive in the global marketplace.

In order to create a diversified, competitive industrial production based on innovation, it is necessary to establish a new production of import-substituting products, mainly based on own raw materials and their profound processing. This solution contributes to the implementation of regional programs for development of industries in all velayats of the country, taking into account the specifics of the region and work force availability. This, in turn, contributes to creation of new jobs, attraction of small and medium businesses to the sector, growing of living standards.

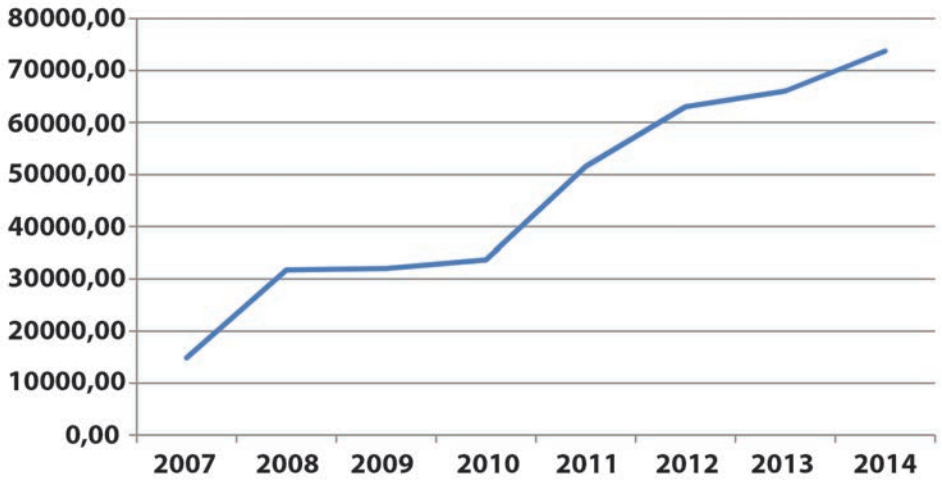


Fig.3. The volume of industrial production, million manats

1.2.2.2. Fuel and energy complex

Fuel and energy complex (FEC) is a base segment and industry of Turkmenistan that plays an important role in the development of entire economy of the country (Fig.4). At present, in the structure of industrial production in 2014 the share of FEC accounted for about 68.8%.

Its intensive development is one of the priorities in improving the competitiveness of the economy of Turkmenistan. FEC has significant influence on forming the state budget, export opportunities and energy security of the country. This complex consists of successfully operating power companies, oil and gas industries.

The basis of FEC is **gas industry,** which occupies more than half of industrial production, and it has gas producing and processing enterprise sectors operating in its composition. Currently, the gas industry has been actively working on searching, exploring and industrial development of new fields introducing highly advanced technologies at all stages of the production process, starting from discovery, exploration, field development, transportation to processing of hydrocarbons and providing consumers with the final product. The evidence of this is (September 2013) the giant field Galkynysh, which is

estimated at 26.2 trillion. m^3 of gas by its resource reserves, that puts Turkmenistan to a fourth place in the world for gas capacity.

In the **oil industry,** the works are under way on development of oil fields, upgrading the industrial infrastructure of oil fields to enhance oil production volumes.

The oil and gas industry plays a major role in the development of other sectors of industrial production. On its basis electric power engineering, petrochemical industry, production of mineral fertilizers, engineering and transport infrastructure are being developed in the country. Intensive development of this sector of the economy allows the government to continue to pursue structural reforms in the socio-economic sphere.

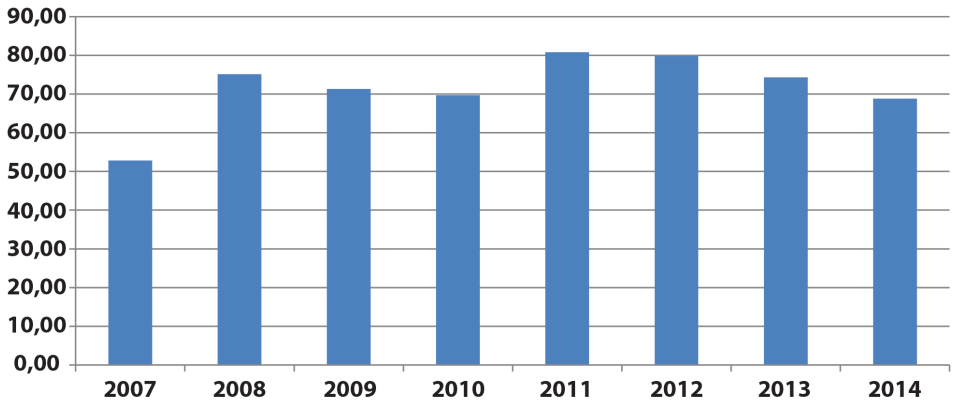


Fig.4. Production of fuel and energy complex, % of industrial output

1.2.2.3. Gas chemical complex

Turkmenistan consistently continues to implement energy policy aimed at the large-scale development of the national fuel and energy complex and its dynamic integration into the international energy system.

Based on clearly defined principles of the state strategy, the realistic evaluation of the resource base and capabilities of its operation, it was decided in the future to support deeper and more complex processing of natural gas, increase the share of its products in the export (Fig.5). Due to this, the country will significantly expand its position not only in the market of primary energy resources such as natural gas and crude oil, but also will take its place in the even more profitable market of expensive gas chemical products.

The diversification of natural gas processing is of great interest for Turkmenistan considering as well production of liquid fuels, polyethylene, polypropylene, hydrogen, methanol, ammonia and urea. Based on these products, it will be possible in the future to produce on a large scale tens of valuable chemical products - formaldehyde, urea-formaldehyde resins, methyl alcohol, acetic acid, polymethyl methacrylate (organic glass), polyvinyl acetate, cellulose acetate and others used in many sectors of the economy.

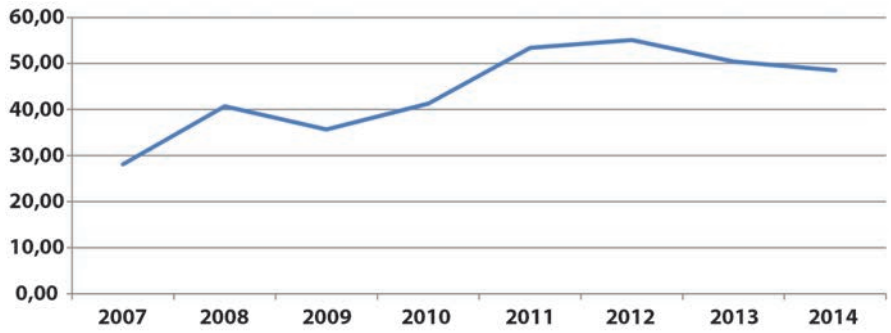


Fig.5. Production of gas complex,% of industrial output

1.2.2.4. Power industry

Over the last year the power industry of Turkmenistan has significantly increased the production capacity and now operates a number of power stations of new generation. All power stations related to state distribution system of power operate with local natural gas. Currently, 10 power plants and 32 turbines operate as part of the country's energy system. Power companies consistently continue demonstrating high rates of electricity production.

Due to consistent improvement of social conditions of life of the population and commissioning of energy-intensive industrial facilities, it is planned to construct new generating capacities in the near future. These plans are reflected in the concept development of the power sector of Turkmenistan for 2013-2020, approved by the President of Turkmenistan. Within the Concept in the next seven years in the velayats of the country, it is planned to build 14 gas turbine power plants. In May 2013, construction of small gas turbine power plants began in Akhal, Lebap and Mary velayats. The first of these with capacity of 141.7 MW was commissioned in December 28, 2013 in Akbugday etrap of Akhal velayat, the second - 149.2 MW of capacity - May 7, 2014. The construction of the expanded part of the Mari state power station has been completed where three gas turbines were installed with total capacity of 146.4 MW.

At present, specialists of the State power corporation «Turkmenenergo» of the Ministry of Energy of the country together with «Chalik Energy» company (Turkey) have started to implement the second and third stages of extensive program on modernization of power equipment and electrical networks in the capital region.

The electric power industry fully covers domestic needs of Turkmenistan in electricity and has an export orientation. Due to build in different regions of the country powerful power plants and new transmission lines, the greatly increased potential of the industry allows to increase electricity export to other states.

The implementation of large-scale projects will enhance energy security and independence of the country, increase reliability of electricity consumption, production efficiency, as well as will provide a powerful push to economic development of the country.

1.2.2.5. Chemical industry

The chemical industry of the country, one of the most challenging and fastest growing sectors of the national economy, has a huge potential and export opportunities.

The main objectives of the sector are maximum using of local raw materials, meeting urgent needs of other economy sectors, expanding export potential of the industry. Based on the objectives defined in existing government programs and the enormous resources of the country, the industry faces a task of accelerating the capacity for producing high-quality mineral fertilizers, demands for which are constantly growing, improving opportunities for mineral resource base, increasing innovative activity and further modernization of production facilities.

1.2.2.6. Construction

Accelerated modernization of the economy of Turkmenistan required intensive development of the building complex, as it takes part in the creation of fixed assets of all sectors and largely identifies success of solving economic, technical and social issues on forming the living environment and the economy in whole.

The construction industry of Turkmenistan is focused on solving strategic, social and economic problems. The development of this economy sector is given the highest priority. Huge investments in the construction sector, measures aimed at supporting domestic construction companies, a favorable investment climate attracting to the country leading foreign construction companies, manufacturers of materials, equipment and machinery - all this is intended to contribute to capacity building of housing, facilities of social and cultural spheres, industrial and transportation infrastructure. Comfortable houses, well equipped schools, kindergartens, health centers, cultural centers, stadiums are built in all the cities and villages.

1.2.2.7. Machinery and metalworking

Machinery and metal processing are the largest suppliers of products for facilities of power, transport and communications, chemical industry, housing and communal services, agriculture and other sectors of the economy.

A number of new types of production were acquired in 2014. Among them, there are new wheelhouses, different types of line coupling fittings. It is also planned to establish production of galvanized road parapets and octagonal lighting poles for needs of cities and villages of Turkmenistan. The most important types of products of this industry are anchor-angular bearings, power cables, wires not isolated, line coupling fittings for power lines, electrical products, lighting poles for streets and squares, equipment for mining and processing of petroleum products, cylindrical and rectangular containers for storage and centrifugal pumps for pumping, products of iron and non-ferrous castings.

1.2.2.8. Light industry

A variety of raw materials of non-food agricultural stock has made the light industry one of the leading industries in the industrial sector of the country. Its development is still directed to fulfilling needs of the domestic market with a wide range of consumer goods competitive with imported goods, as well as increasing volumes and commodity export diversification.

The government still pays great attention to modernization of textile industry, strengthening of its logistical and resource base. With this purpose, the current production is equipped with modern equipment and the construction of new enterprises involving both domestic and foreign investments; joint ventures have been created. All this contributed to

increasing the quality and volume of production, expanding its product range, increasing the depth of cotton processing.

As a result of construction of new and modernization of existing textile enterprises, manufacturing design capacity for processing cotton into cotton yarn at the end of 2014 totaled to 195,800 ton. More than 51% of cotton is processed on the territory of Turkmenistan. About 80% of textile products are exported outside the country. More than 20 out of 63 of industrial enterprises of the Ministry of textile industry supply products for export and have all the opportunities to increase the volume of its delivery.

1.2.2.9. Housing and utilities

Implementation of the State program on development of housing construction and providing population with affordable housing is one of the primary goals of social development. The key direction in implementing the housing policy of Turkmenistan is to meet international standards of construction and provide population with preferential credits for construction and purchase of property.

Significant changes take place in the villages. Adopted in 2007 the National Program of the President of Turkmenistan on improvement of social and living conditions in villages, settlements, towns and region centers for the period up to 2020 is under successful implementation. In the framework of this program, hundreds of modern facilities of social and cultural purpose have been built and continue being constructed in the rural areas of the country, including educational and sports schools, hospitals, sports facilities and kindergartens, houses, libraries, cultural centers and marriage palaces.

Overall, total living area provision for population in Turkmenistan for 2007-2014 years has increased from 19.9 to 23.2 m^2 (Fig. 6).

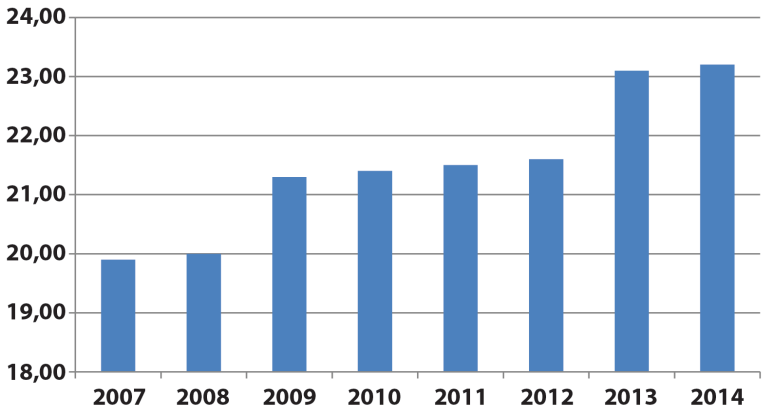


Fig. 6. Provision of population with total living area, m^2

1.2.2.10. Agricultural policy

The government of Turkmenistan supports the agricultural sector by technical re-equipment and modernization of the whole industrial infrastructure of agro-industrial

complex, development of the chemical industry, providing farmers with mineral fertilizers, solving issues of land reclamation and water supply. Advanced tractors, combines and other farm equipment are purchased for agricultural complex needs and are passed through advance testing in specific soil and climatic conditions of each region.

The agricultural production of the country envisages different forms of farming: farmers' associations and households; subsidiary farming of enterprises, organizations and institutions; private farming and private producers of goods. Features of AIC development are: powerful state support in the form of stable state procurement prices for cotton and wheat, subsidizing most of the costs for their production, implementation of additional payments to state procurement prices for seed cotton, high technical equipment, science-based land use, access of agricultural producers to credit resources on favorable terms.

The intensification of agricultural production and directing to this sector a big number of investments allowed in 2014 to increase the volume of gross agricultural output up to 14.2 billion manat with a growth rate to the level of 2013 to 110.7%.

Production of such a strategically important type of the product as wheat in 2014 amounted to 1,202,800 tons. The high yield of wheat produced in recent years, not only fully satisfies domestic needs of the country, but also enables its export.

Raw cotton is the main agricultural raw material for domestic textile industry. Its annual production in recent years consistently exceeds the needs of the country and it is exported. Production volume in 2014 amounted to 1,119,000 tons.

The country has a stable production of vegetables, potatoes, melons, grapes, rice, sugar beets.

Sustainable development of animal husbandry in recent years is due to increased livestock fodder base, increase of fodder crops yield grown on irrigated lands, harvesting of forage grass from natural pastures, as well as providing water supply for the last ones.

Improving the selection and breeding, implementation of measures to save the animals contribute to the increase the number of cattle, sheep and goats, poultry, camels and horses.

As a result, the volume of livestock production in all categories of farms is annually increasing. The largest share of livestock production belongs to the private sector.

1.2.2.11. Transport

Providing a highly efficient national transport system meeting demands for transportation of freight and passengers, their safety and quality, creating conditions for investment activity, increasing the competitiveness of domestic carriers in domestic and foreign markets are the main tasks of the government in development of transport works and services.

The transport and communication system of Turkmenistan includes a rail, road, water, marine, pipeline and air transport, communications as well as related infrastructure - railway, road, sea, river and airports and telecommunications. It plays a key role in ensuring the country's economic growth and it is developed in close connection with optimization of the national scheme of distribution of productive forces. At present, the transport complex of the country is steadily growing.

The operational length of public railways amounts to 3835,7 kilometers.

The aircraft depot of Turkmenistan performs regular flights to more than 15 countries all over the world. Great attention is paid to development of water transport. The

reconstruction and technical re-equipment are carried out for Turkmenbashi seaport which is called a «sea gate» of Central Asia.

New international transport corridors are created. The railway was opened in 2014 with the length of 900 km connecting Kazakhstan - Turkmenistan - Iran. This steel trunk is intended to be the most important element of the international transport corridor North - South. Since it was commissioned, the access to the Persian Gulf and the Gulf of Oman became easier for the countries of Western Europe, Russia, Turkey and others.

1.2.2.12. Information and communication technologies

In the functioning and developing of industrial and innovative economy, a huge role belongs to modern information and communication technologies (ICTs), due to which the information is stored, transmitted and distributed in big amount. Information and communication technologies contribute to development of all sectors of the economy by optimizing the management process, and they are used as in the commercial sphere and as in the sphere of public administration. The introduction of these technologies is a priority for socio-economic development of the country. The purpose of the state policy in the field of ICTs development is forming and developing the information society, improving the quality of life of citizens, development of economic, socio-political and cultural aspects of society, improving the governance, ensuring the competitiveness of products and services in the field of information and telecommunication technologies.

The comprehensive development of modern communications and telecommunications systems, the widespread introduction in this sector of the latest scientific and technical development and innovative technologies are one of the priorities of the state policy. Implemented innovative project in the output space of the National Sputnik opens up unlimited possibilities for accelerated introduction of modern ICTs. Broadband technologies of access to global networks will be extensively developed.

1.2.2.13. Partnership of public and private

The public-private partnership is one of the main strategic trends in development and modernization of the socio-economic structure of the country. The public-private partnership has a wide range of different forms. This is, first of all, a variety of contracts the government provides to private companies for execution of works and provision of public services, management, implementation and delivery of products for state needs, technical assistance contracts, and more.

The public-private partnership enables the integration of public and private capital. Especially, it is dynamically developed in the construction industry: over the last years, about 80% of the total amount of the executed contract works belongs to non-state enterprises. The entrepreneurs of Turkmenistan are actively involved in implementation

of almost all government programs, as well as programs for development of velayats. In a short term, the entrepreneurship development in Turkmenistan will be based on the activation of market reforms, introduction of innovative technologies, and participation in the implementation of government social and economic programs, defining as well the basic guidelines for the private sector.

1.2.2.14. Investments

A key role in the process of conduction of the large-scale economic and social reforms aimed at creating favorable conditions for sustainable economic growth in Turkmenistan belongs to investment activities.

Creating the favorable investment and business environment greatly contributes to the monetary policy, which is one of the most effective tools of state regulation of the economy. In Turkmenistan, it is subject to overall strategic goal - sustainable, dynamic development of the economy. This is achieved by preserving the stability of the national currency, maintaining an acceptable level of inflation, increasing liquidity and reliability of the banking system, the accumulation of available funds and their effective investment ensuring smooth and safe operation of the payment system.

Investments play a significant role at both macro and micro levels. Attracting foreign investments to the country's economy and their development has contributed to increasing production capacity and has served an important tool for transferring technical and managerial skills.

The total investment ratio in 2014 amounted to about 54.9 billion manat, , while their share in GDP - 44.4%. More than half of the investment was directed to industrial construction (Fig.7).

Investments made by foreign companies in the economy of the country increase annually. Thus, their volume in 2013 increased compared to 2007 in 9.4 times and amounted to 16% of the total investment volume.

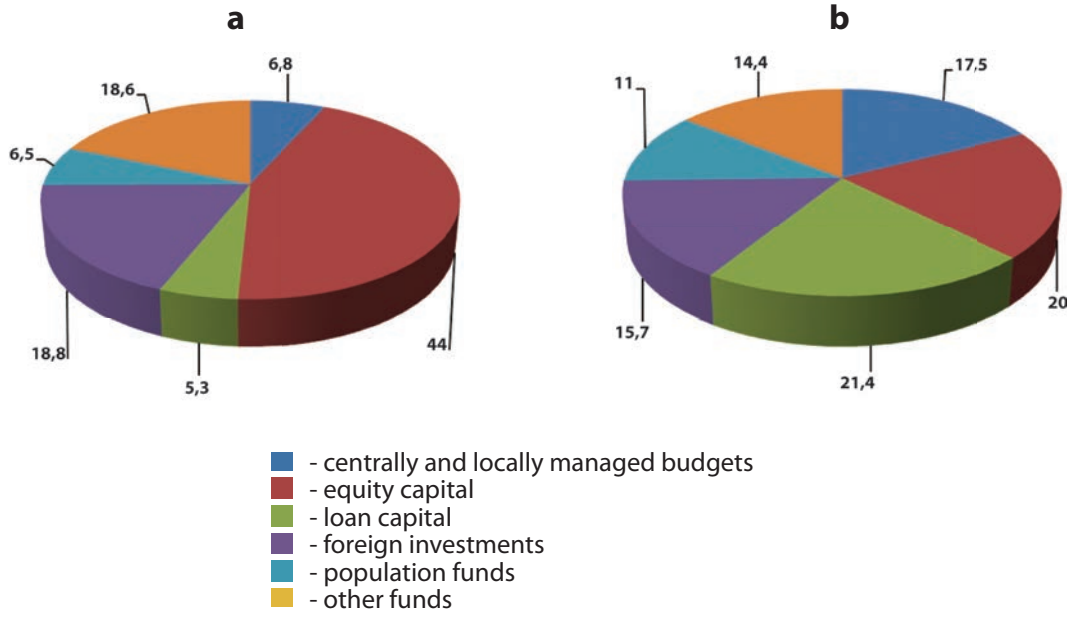


Fig. 7. Investment allocation in the primary capital by financing sources in 2007 (a) and in 2013 (b), %

1.3. Institutional and legal frameworks

1.3.1. Management structure

The President of Turkmenistan is the Head of the state and government, and is the guarantor of the national independence, territorial integrity, observation of the Constitution and the implementation of international agreements. The President and the Cabinet of Ministers approve, along with various government regulations, the environmental programs, being the guarantor of the implementation of the state policy on environmental protection. The Ministry of Nature Protection of Turkmenistan is responsible for implementation of all decisions made by the President and the Cabinet of Ministers on environment protection. Legislation acts adopted by this ministry are obligatory for implementation on the entire territory of Turkmenistan for legal parties and individuals conducting their activities regardless of ownership. The Ministry has velayat (regional) administrations to solve problems in the regions of Turkmenistan. The environment monitoring of air, water and soil composition is conducted by the Centre of Environmental Quality Monitoring, control and monitoring of the Turkmen sector of the Caspian Sea – by Environmental Services «Kaspekogozegchilik», department of the Ministry of Nature Protection of Turkmenistan.

The environmental quality is also controlled by the State Sanitary and Epidemiological Service of the Ministry of Health and the Medical Industry, Services for Land Use of the Ministry of Agriculture, departments of the Ministry of Water Resources and the State Corporation «Turkmengeology» within its mandate.

1.3.2. Environmental legislation

The Constitution of Turkmenistan guarantees the right of citizens to live in favorable environment. The new edition of the Constitution (2008) ensures responsibility of the state for environment safety and controls the rational use of natural resources (Articles 11, 36).

After proclamation of the state sovereignty, it has been guaranteed by law that the country's natural resources are national assets and their protection and rational use is the fundamental principle of public policy. Since 1991, the Turkmen government conducted a lot of work for forming the legal system, taking into account changes in the political, economic and social status of the country. Turkmenistan has adopted a number of laws and regulatory acts aimed at the conservation and sustainable use of natural resources. However, all available opportunities were not used for improving the national legislation on climate change and synchronizing it with provisions of multilateral conventions. In-depth analysis of laws and legal acts of Turkmenistan has been done related to climate change during preparation of the Third National Communication of Turkmenistan on climate change. The legislative process keeps the development trend and there are all reasons to believe that the national legislation and

international law in the field of climate change will gain the necessary combination. The analysis has revealed the gaps in the legislation of Turkmenistan and helped to identify the main directions of development related to climate change in all priority socio-economic sectors.

One of the first legislative acts of Turkmenistan relating to environment and natural resources was adopted after gaining Independence was the Law on Nature Protection (1991), which became the basic document governing the socio-economic and environmental law. The law was published in the new edition in 2014. The project for the Third National Communication of Turkmenistan on climate change contributed to the development and inclusion into the law the new article (47) - «Climate protection and mitigation of its negative effects». It describes objectives to mitigate climate change and identifies legal and physical persons and authorities responsible for prevention of climate change effects. Besides, in the same year, the Law on ecological expertise (2014) and the Law on Waste (2015) were adopted. TNC project experts took an active part in preparation and adoption process of these laws and; therefore, these documents include issues of climate change.

The need to improve the regulatory and legal acts in order to bring them in line with international legislation with obligatory account of local climatic characteristics led to adoption of several new laws: "On Hydrocarbon Resources" (2008); "On Protection of the Ozone Layer" (2009); "On Radiation Protection" (2009); "On Drinking Water" (2010); "On Fisheries and Conservation of Aquatic Biological Resources" (2011); "Chemical Safety" (2011); "On Specially Protected Natural Areas" (2012); "On Flora" (2012); "On Fauna" (2013); "Pastures" (2015), and "Sanitary Code" (2009) and Forest Code" (2011).

In general, the legislation enhancement in view of climate change problem will contribute to sustainable management of natural resources and will form the basis for adaptation measures, adoption of measures to reduce the volume of greenhouse gas emissions, introduction of strict environmental requirements for economic and other activities, improved management of natural resources, including public involvement.

The legal reform in the area of ecology affected different economy areas of the country. The recognition of various types of ownership of natural resources is of great importance for their sustainable use and creation of prerequisites for development of the market economy. Climate change, first of all, requires the improvement of legislation in the field of agriculture and water resources, oil and gas, energy and others. In this regard, emphasis should be placed on the implementation of provisions of the National Strategy on Climate Change (2012), which outlines the key adaptation measures, including legal ones.

Sustainable management of agriculture in climate change conditions the need to rise rights of farmers' associations as its primary link. It is necessary to ensure the improvement of legal regulation in the area of land and water resources. In particular, there is a need to adopt a new Water Code of Turkmenistan in view of improving water management and implementation of the commitments under the UN Convention (on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki, 1992).

It is advisable to update "Code on land" of Turkmenistan (2004), which should include provisions on adaptation to climate change, issues of stimulating of land use, securing effective warranties of land lease for long-term period. Considering specifics of irrigated agriculture, it is important to determine the legal regime of protection and use of this category of lands.

In biodiversity conservation the leading role belongs to forests and specially protected natural areas (SPNA). Ecological significance of the forest sets targets for legislation to assess such functions as biodiversity, climate regulation, protection of soil and water protection and others. In order to achieve these objectives, first of all, legal measures will be required to preserve forests as an essential component of the biosphere and the source of various renewable resources.

New legislation on SPNA is the basis for its development in the context of problem solving to expand the network and the total area of protected areas and sustainable use of natural ecosystems.

The major part of greenhouse gases belong to oil and gas industry of Turkmenistan due to fuel combustion, mining, transportation and storage of hydrocarbon resources. Intensive growth of Turkmenistan's economy, accompanied by increase in production and consumption of energy resources, will inevitably lead to further increase in the volume of greenhouse gas emissions. Under these circumstances, it is advisable to adopt the Law on energy saving and energy efficiency in Turkmenistan, in which it is important to provide legal, economic and organizational issues to promote energy saving and energy efficiency and development of alternative energy sources.

From regulations adopted in recent years to enhance the activities of the relevant structures in relation to climate change, it is necessary to pay attention to the following documents: "Regulation on the State Commission to ensure implementation of obligations in Turkmenistan under Conventions and UNEP programmers" (1999); "Resolution on the establishment of the State Commission for CDM" (2009); "Decision on approval of the National Strategy of Turkmenistan on Climate Change" (2012).

The international legal framework to guide national action on climate change in Turkmenistan is the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol. Turkmenistan has signed and ratified these international agreements in 1995 and 1999 and is fulfilling its obligations arising from these agreements in a timely manner.

CHAPTER 2. GREENHOUSE GAS INVENTORY INFORMATION

One of Turkmenistan's commitments arising from the UNFCCC is to conduct the national inventory of anthropogenic emissions of greenhouse gases (GHG) and their removal by sinks that are not controlled by the Montreal Protocol in accordance with approved international methodology. Since in Turkmenistan a national inventory system does not yet function, assessment of GHG emissions and sinks is carried out only within the preparation of the National Communications. The plan to improve the national inventory is being developed by the group of experts every time during preparation of the project proposals for the next National Communication. This group consists of experts from various sectors of the economy of Turkmenistan.

The national group on GHG inventory is divided into seven target sub-groups (Fig. 8). Due to priority of the energy industry in the «Energy» sector (the largest by volume of work) 3 working sub-groups were created on: «Fuel combustion in stationary sources», «Fuel combustion in transport» and «Fugitive Emissions».

During the inventory statistical data is primarily used as well as the materials of sectoral ministries, departments and large industrial enterprises consuming fuel for their own needs.

Emission assessment, as well as all coefficients and multipliers comply with the «Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories». The «Good Practice Guidance and Uncertainty Management in the National Greenhouse Gas Inventories» (IPCC, 2000), «Good Practice Guidance for Land Use, Land Use Change and Forestry» (IPCC, 2003) and 2006 IPCC Guidelines for National Greenhouse Gas Inventories have also been used.

In some cases, the national indicators were used, such as net calorific value for oil, natural gas and fuel oil.

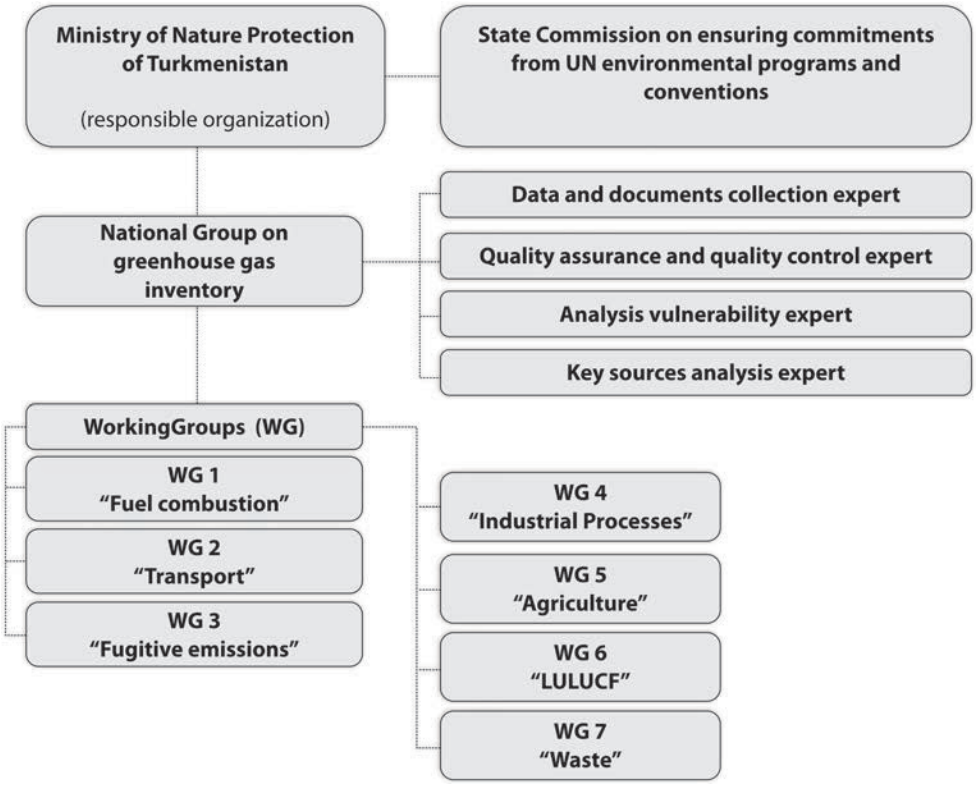


Fig. 8. Organizational structure of the National Inventory System

2.1. GHG inventory outputs

In the process of conducting the inventory, anthropogenic emission sources and GHG sinks have been considered in five sectors according to the IPCC guidelines: energy (fuel combustion and fugitive emissions), industrial processes, agriculture, waste, LULUCF (land use, land use change, forestry).

During preparation of the Third National Communication on Climate Change of Turkmenistan, the inventory of emissions and sinks of greenhouse gases for 2000-2010 has been conducted. Additionally, there were re-calculated the inventory results for 2000-2004 period previously obtained during the preparation of the Second National Communication on Climate Change. Total greenhouse gas emissions amounted to 50,315.63 Gg (CO_2-eq.) in 2000 and 66,367.2 Gg (CO_2-eq.) in 2010. Their decline was marked in 2009-2010 after a steady growth during the period 2000-2008 (Fig.9).

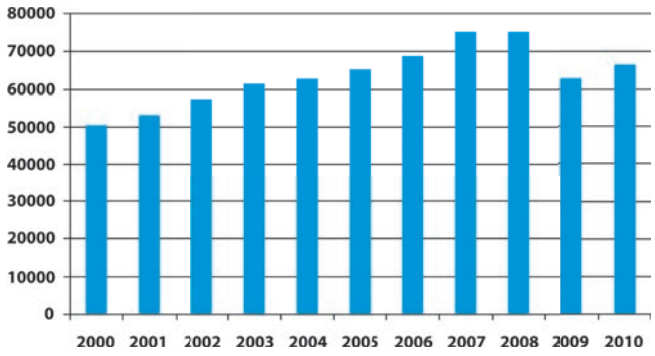


Fig. 9. Total emissions of direct GHG , Gg (CO_2-eqv.)

2.1.1. Direct GHG emissions trends

Despite some fluctuations in the volume of total emissions, CO_2 emissions in the period under report were steadily increasing. This is due to widespread gasification in this period, and accordingly, a sharp increase in the volume of gas combusted by population. The amount of used fuel in the country was growing and thus, the volume of GHG emissions was slightly increasing (Fig. 10).

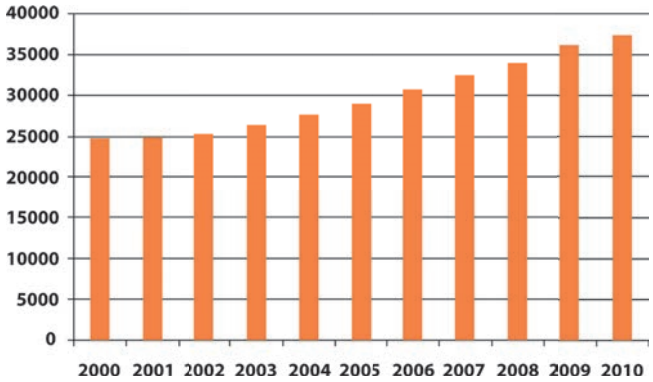


Fig. 10. CO_2 emissions, Gg

A big volume of methane emissions in the territory of Turkmenistan comes from the oil and gas sector. Some decline in production and sale of fossil hydrocarbons in 2009-2010 was the reason for sharp decline in methane emissions (Fig. 11). Some instability in the agricultural and industrial production also led to changes in the volume of N_2O emissions in 2000-2010 (Fig. 12).

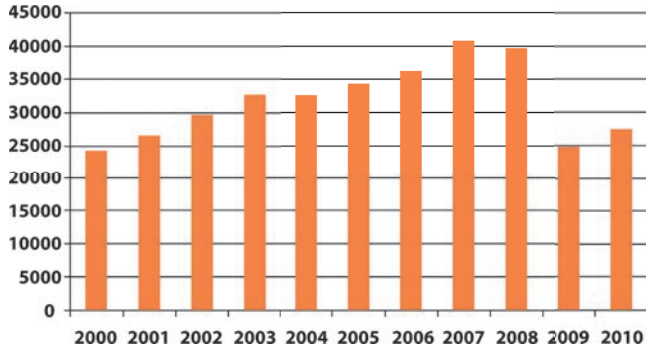


Fig.11.CH4 emissions, Gg (CO_2-eqv.)

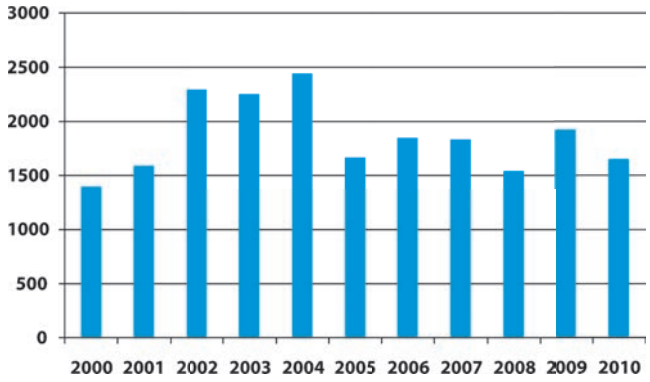


Fig.12. N_2O emissions, Gg (CO_2-eqv.)

Indicators of direct greenhouse gas emissions in 2000 and 2010 show increase of CO_2 up to 7% due to reduction of methane emissions. However, there is a little change in emissions of nitrous oxide in their total volume (Fig. 13).

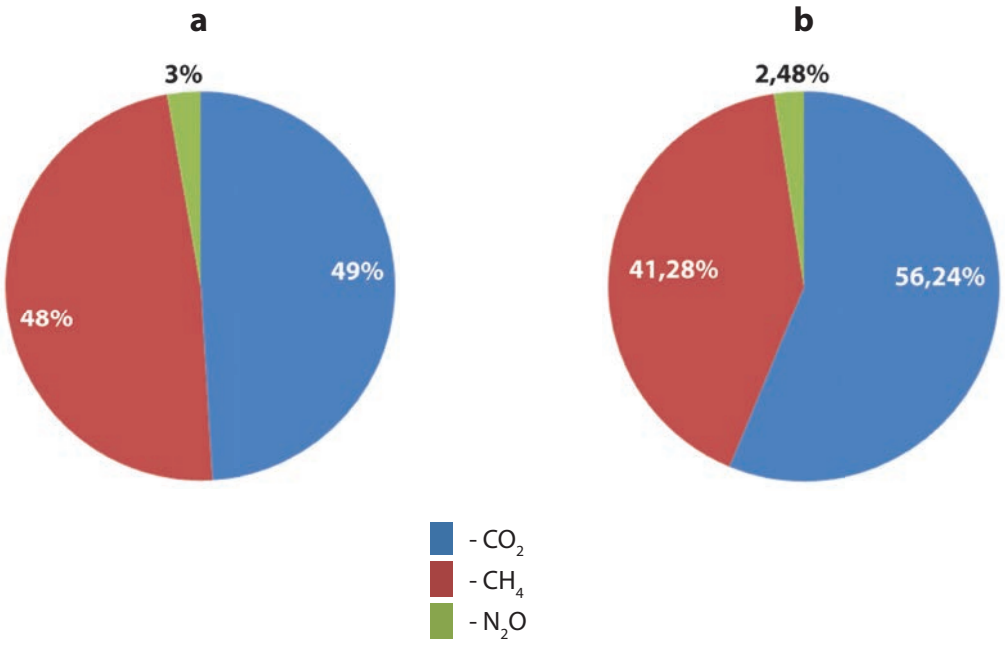


Fig. 13. Emissions of direct greenhouse gases in 2000 (a) and 2010 (b)

2.1.2. Indirect GHG emissions dynamics

During the reporting period, emissions of gases within direct greenhouse effect (NOX, CO, NMVOC, and SO_2) have slightly increased. The volume of NMVOC emissions in this period has increased by almost 2-fold (Fig. 14). The main share in total GHG emissions falls on "Energy" and "Industrial processes" sectors.

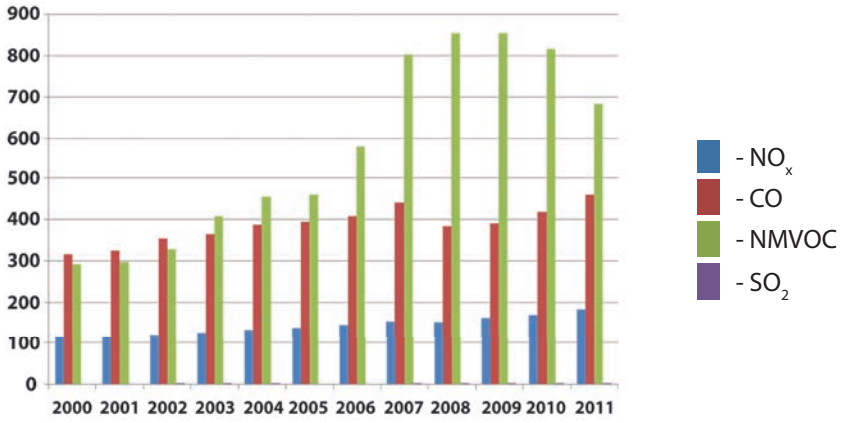


Fig. 14. Indirect GHG emissions, Gg

2.1.3. Hydrofluorocarbon emissions

The Vienna Convention on protection of the ozone layer (hereinafter - the Vienna Convention) and the Montreal Protocol on substances that deplete the ozone layer - ODS (the Montreal Protocol), were signed and ratified by Turkmenistan on November 18, 1993. The London Amendment to the Montreal Protocol was signed and ratified on March 15, 1994.

Turkmenistan joined the Copenhagen, Montreal and Beijing amendments to the Montreal Protocol on substances that deplete the ozone layer on January 22, 2008.

Initially our country has been classified as a Party operating under Article 2 of the Montreal Protocol. Later, by decision XVI / 39 of the Executive Committee of the Multilateral Fund of the Montreal Protocol in 2005, Turkmenistan was reclassified as a Party operating under paragraph 1 of Article 5 of the Montreal Protocol.

The Ministry of Nature Protection of Turkmenistan is responsible for implementation of the Montreal Protocol. The working body coordinating all activities on protection of the ozone layer is the Ozone center. Currently, its activities are funded by the Multilateral Fund of the Montreal Protocol.

According to information provided by Ozone Center, Turkmenistan does not produce ODS and equipment working with their application. The country also does not produce foam materials with ODS. All consumption of HCFCs accounts for the service sector.

The equipment imported to the country, ozone-depleting substances (ODS) and mixtures thereof are passed through the customs control.

The ODS consumption in Turkmenistan has been identified in accordance with the registration data of the State Customs Service of Turkmenistan, the State Service «Turkmenstandartlary», State Concern «Turkmenhimiya», the Ministry of Railway Transport of Turkmenistan, with contracts signed with customers and administrative bodies of the Ministry of Nature Protection of Turkmenistan.

According to available data, emissions of CFC-12, HCFC-22 and HFC-134a have been calculated (Fig. 15).

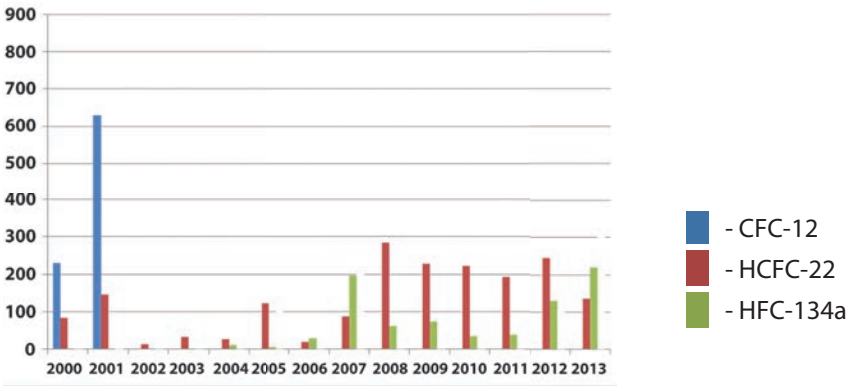


Fig.15. Emissions of CFC-12, HCFC-22 and HFC-134a, Gg

2.1.4. Distribution of GHG emissions by economy sectors

The energy sector is a major source of direct emissions of greenhouse gases; the second place is taken by agriculture of Turkmenistan.

The part of energy sector in GHG emissions amounted to 91.84% and in 2010 - 85.09% in Turkmenistan in 2000. (Fig. 16) In this case, emission decrease does not yet show decrease of the total amount of emission. The absolute value of emission in this sector is steadily increasing.

A comparative analysis of GHG emissions in various economy sectors in 2000 and 2010 show their increase in agriculture by 6%, due to intensive development of agricultural production in this period.

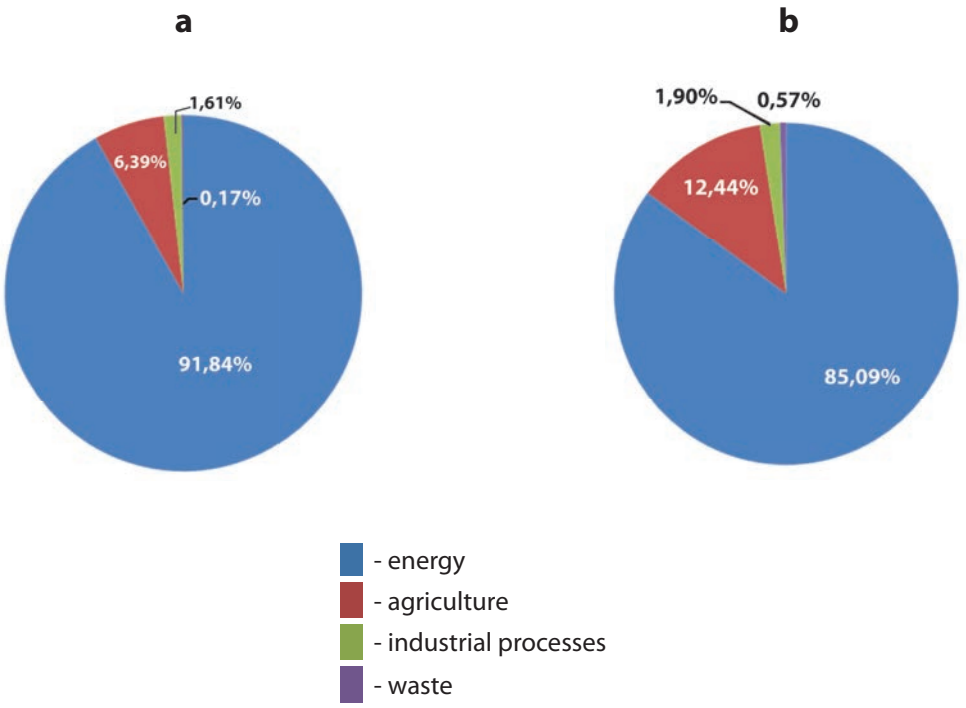


Fig.16. Direct GHG emissions by economy sectors in 2000(a) and 2010 (b)

2.2. GHG Emissions trends by economic sectors

2.2.1. GHG emissions assessment results in Energy sector

Considering dynamics of GHG emissions as a whole for the sector, it should be noted that during the indicated period, their volume has increased from 46210 to 56472Gg (CO_2-eqv.), (Fig.17). Moreover, in the short term this figure will increase in connection with the build-up of oil and gas production, the production growth of electricity and the number of cars.

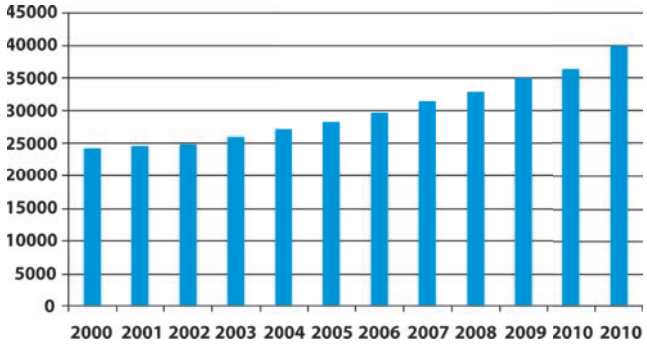


Fig.17. GHG emissions in "Energy" sector for 2000–2010, Gg (CO_2-eqv.)

According to 2010 data, in the total amount of GHG emissions, fugitive emissions account for 36% and 23% is for population, electricity–22%, transport–13%, municipal sector - 6%. The involvement of other sectors in this process is insignificant (Fig.18). As oil and gas sector and electric power industry will grow in future, the bulk of GHG emissions will fall for these industries, accordingly.

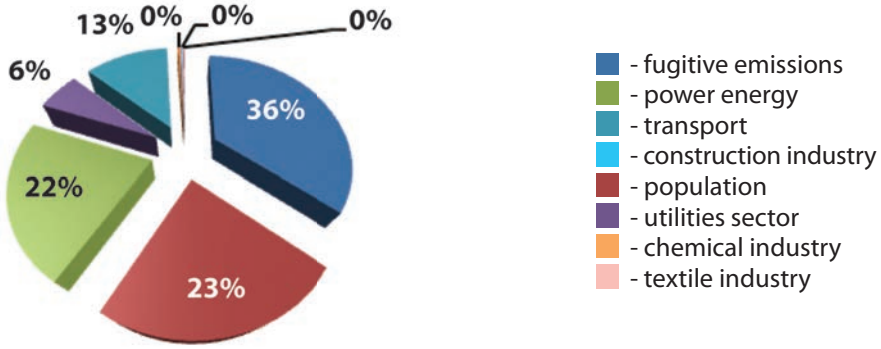


Fig.18. GHG emissions in "Energy" sector in 2010

2.2.1.1. Fuel combustion

Production of heat and power in Turkmenistan is based on the use of natural gas. Other fuels in this process are not used (less than 1%). Emission assessment was conducted for natural gas and fuel oil for 2000-2010. The part of population in GHG emissions in 2010 in production of heat and electricity was 36%, electricity – 34%, transport – 19%, communal sector - 9%. Other sectors account for 2% (Fig. 19).

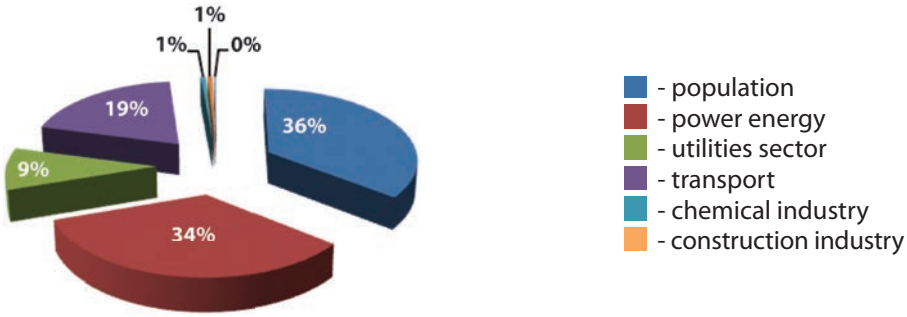


Fig.19. GHG emission structure for heat and power production in 2010

During the fuel combustion mainly carbon dioxide is emitted. The share of other gases in total emissions is negligible.

The main sources of emissions from fuel combustion are the population and the electricity sector. Given the increase in the production of electricity, the volume of GHG emissions is expected to be increased in the future (Fig. 20).

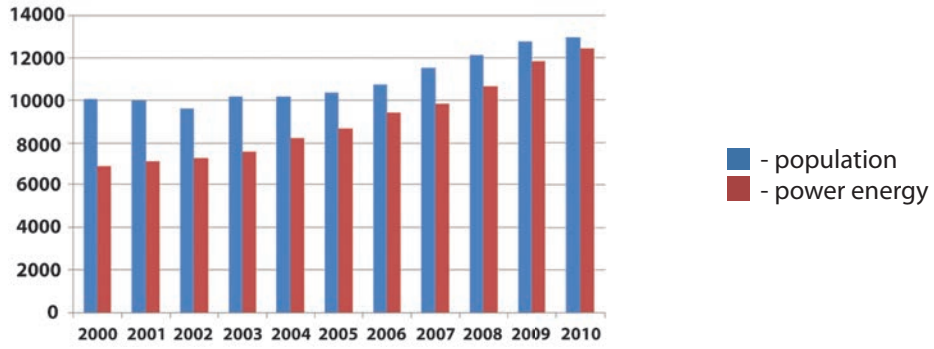


Fig.20. GHG emission from fuel combustion by population over 2000–2010, Gg (CO_2-eqv.)

Transport

Transport is a major source of hazardous emissions into the atmosphere (carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), carbon monoxide (CO), non-methane volatile organic compounds (NMVOC), sulfur dioxide (SO_2), particulate matters (PM) and nitrogen oxides (NOx)), causing or aggravating the problem of local or regional air pollution. More than 90% of GHG emissions account for automobile transport (Fig. 21 and 22).

In 2000, GHG emissions in this sector amounted to 4922.16 Gg (CO_2-eqv.), and in 2010 the value was 7,040.72 Gg (CO_2-eqv.). Emissions from motor vehicles in 2010 accounted for more than 90% of total CO_2 released. The growth of GHG emissions is mainly due to increase in the number of vehicles.

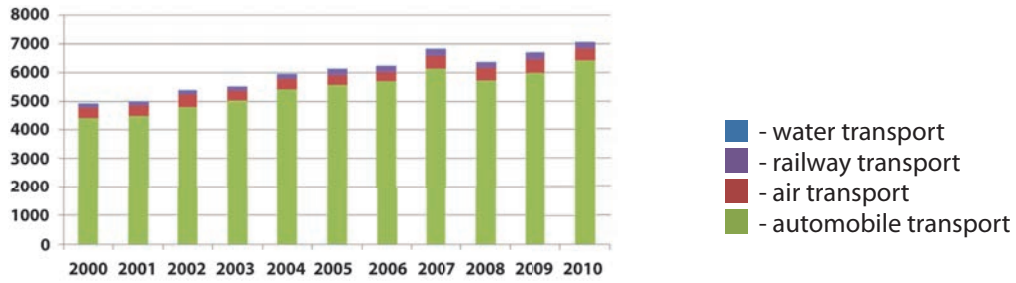


Fig.21. GHG emissions by transport types over 2000–2010, Gg (CO_2-eqv.)

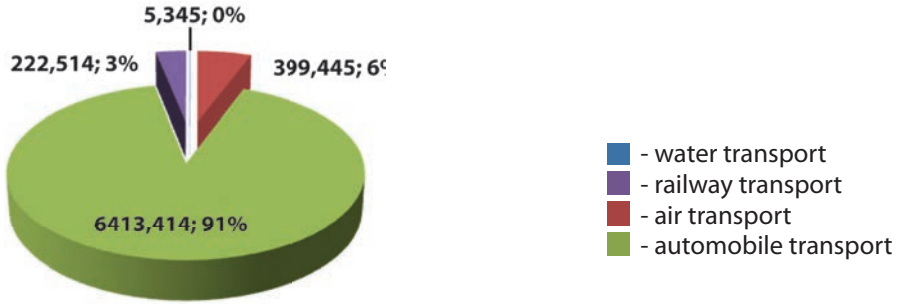


Fig.22. GHG emissions by transport types over 2010, Gg (CO_2-eqv.)

2.2.1.2. Fugitive emissions

The major volume of methane emissions in "Energy" sector falls on oil and gas industry as one of the leading industries of Turkmenistan's economy (Fig. 23). To evaluate GHG emissions from oil and gas industry of the country, average coefficients of IPCC were used in calculations.

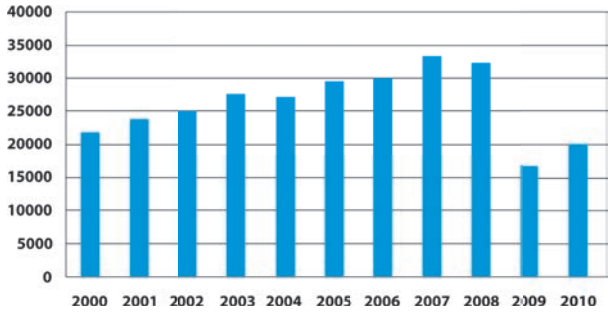


Fig. 23. Methane emissions from oil and gas industry over 2000–2010, Gg (CO_2-eqv.)

2.2.2. Industrial processes

GHG emission assessment in this sector was conducted according to the following their sources given industrial processes feature:

- Refining of mineral raw materials;
- Chemical industry;
- Production of food products.

The main components of industrial emissions in Turkmenistan are CO_2, N_2O and CH_4.

In the base year of 2000 the total amount of GHG emissions in this sector amounted to 807.8953 Gg (CO_2-eqv.) and in 2010 the figure was 1258.539 Gg (CO_2-eqv.). There was sinificant growth in emissions between the period 2000-2004. (Fig.24).

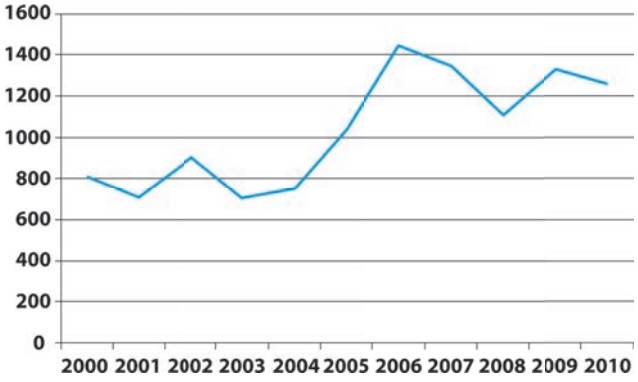


Fig.24. GHG emissions in "Industrial processes", Gg (CO_2-eqv.).

In recent years, amount of emissions is increasing from production of mineral products, and in the chemical industry, it is decreasing (Fig. 25).

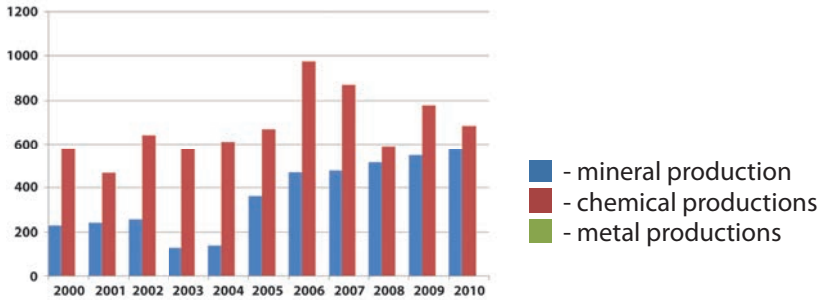


Fig. 25. GHG emissions from "Industrial processes" over 2000–2010, Gg (CO_2-eqv.)

In 2010, share of chemical industry in the total volume of emissions amounted to 55% and from production of mineral products, the value was about 45% (Fig. 26).

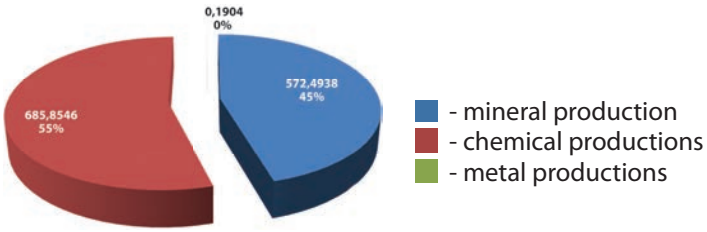


Fig. 26. Share of "Industrial processes" category in the total volume of GHG emissions over 2010

In the process of production of mineral products the most part of GHG emissions falls on the cement production, in the chemical industry – on nitric acid and ammonia (Fig. 27 and 28).

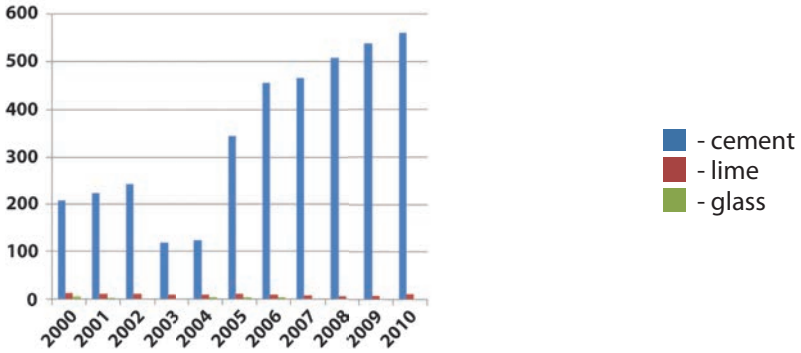


Fig. 27. GHG emissions with direct greenhouse effect from production of mineral products over 2000 – 2010, Gg (CO_2-eqv.)

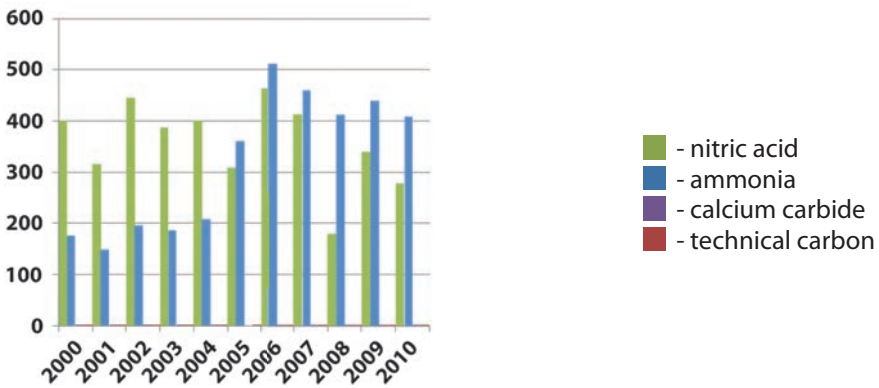


Fig. 28. GHG emissions with direct greenhouse effect from enterprises of chemical industry over 2000–2010, Gg(CO_2-eqv.)

N_2O forms the basis of total emissions from "Industrial processes" category and methane emissions are significantly less (Fig 29).

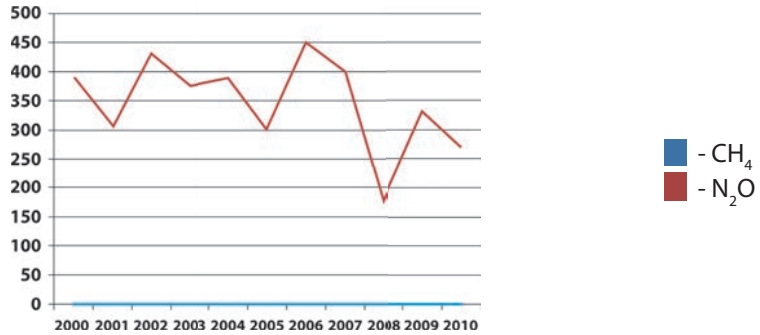


Fig. 29. GHG emissions with direct greenhouse effect from "Industrial processes" category over 2000–2010, Gg(CO_2-eqv.)

NMVOC emissions prevail (Fig.30) among gases with indirect greenhouse effect and amount of others is small.

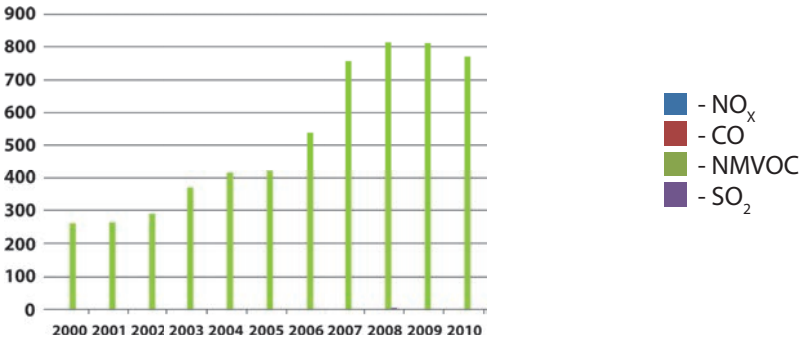


Fig. 30.GHG emissions with indirect greenhouse effect from "Industrial processes" category over 2000–2010, Gg (CO_2-eqv.)

2.2.3. Agriculture

GHG inventory in «Agriculture» sector was carried out in 2000-2010. Methane and nitrous oxide emissions were assessed from the following sources: livestock (cattle, sheep, goats, camels, horses, pigs and poultry) - enteric fermentation and manure; rice cultivation (flooding of rice fields) agricultural lands.

The assessment showed an increase in the volume of GHG emissions (Fig. 31) from 3213.61 (2000) to 8254.84 (2010) Gg (CO_2-eqv.). The share of agriculture in total volume of GHG emissions for 2010 is 12.44%. This is mainly methane (80%) and the rest - the nitrous oxide. Generally, greenhouse gas emissions in this sector comparing to 2000 levels have increased more than twice. Thus, agriculture is the second largest source of methane emissions in Turkmenistan. For enteric fermentation, one of the key sources of GHG emissions in this sector the values for the years 2000 and 2010 were 70% and 84% respectively.

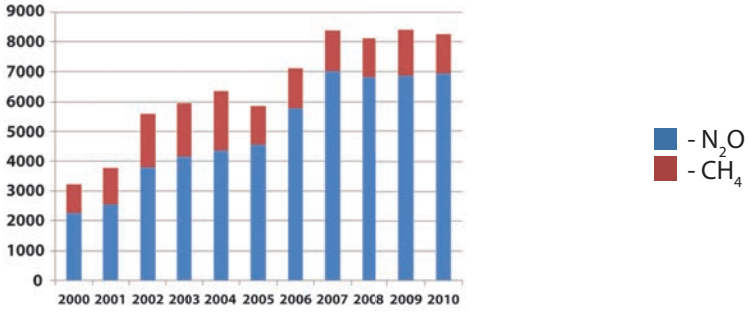


Fig. 31. GHG emissions with direct greenhouse effect in "Agriculture" sector over 2000–2010, Gg (CO_2-eqv.)

While using agricultural lands during these years, about 30% and 16% of GHG were emitted (Fig. 32).

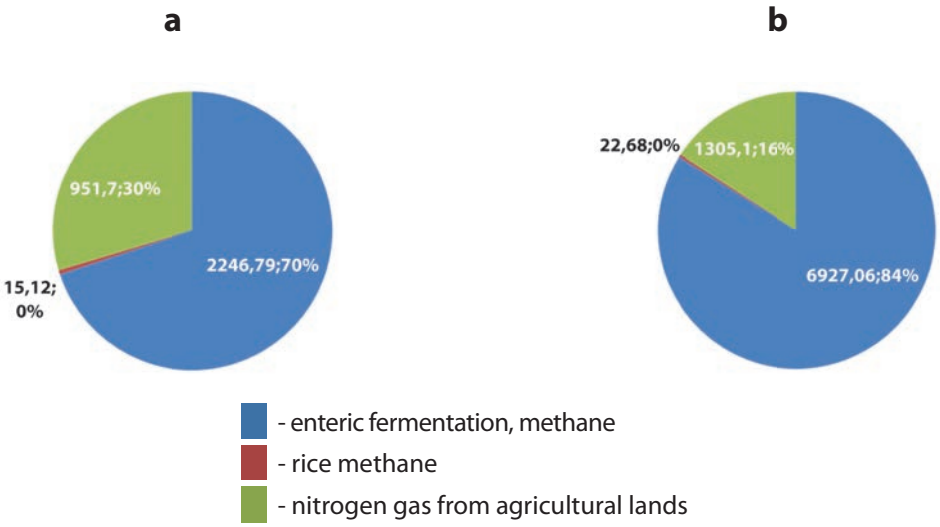


Fig.32. GHG emission structure in the "Agriculture" sector over 2000 (a) and 2010 (b)

Thus, in the period 2000–2010, the major part of emissions in the total volume of GHG emissions in the "Agriculture" sector is conditioned by activity related to domestic animals (Fig. 33).

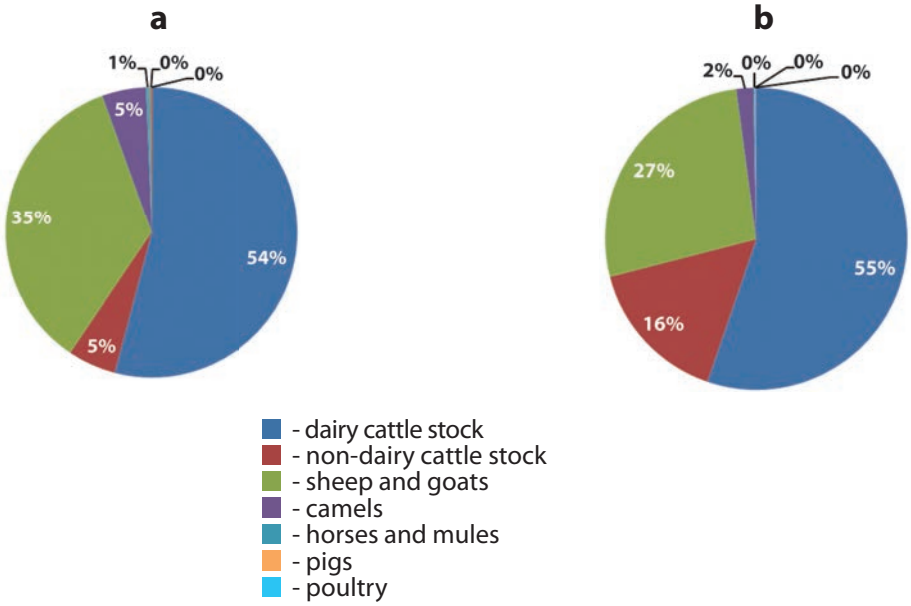


Fig.33. GHG emissions from keeping different kinds of animals over 2000 (a) and 2010 (b)

According to data of 2010, the bulk of emissions are caused by production processes associated with cultivation of dairy cattle (55%), sheep and goats (27%), non-dairy cattle (16%) and camels (about 2%).

In general, due to agricultural activities 84% of methane and 16% of nitrous oxide are emitted (Fig. 34).

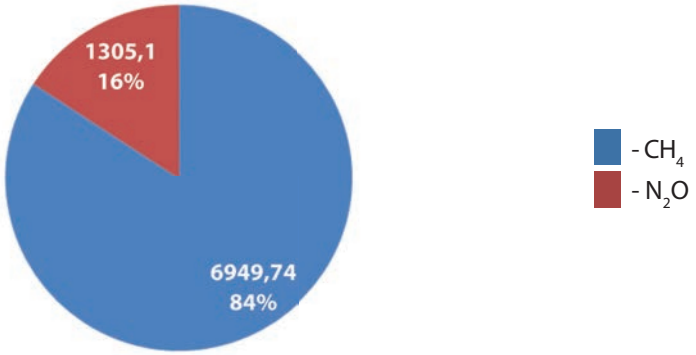


Fig.34. GHG emissions from agricultural activity in 2010

Overall, the share of emissions in the sector "agriculture" is characterized by high uncertainty of emission factors and activity data (underestimation of livestock on private farms, the lack of national emission factors, and others).

2.2.4. Land use, land use changes, forestry (LULUCF)

Sustainable use and conservation of land resources, the effectiveness of land relations have a direct impact on the economy, society and the development of its productive forces. The territory of Turkmenistan is located in the desert zone, which is characterized by fragile ecosystems. In the process of using agricultural lands, implementing forestry activities and other activities related to land use, the quality of ecosystems has been changing. Solving the problem of land-use and recovering the productivity of disturbed landscapes are a priority task today (Fig. 35).

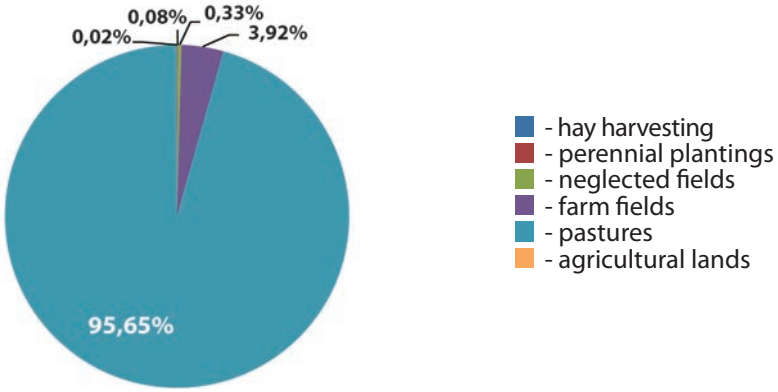


Fig. 35. Structure of agricultural lands

In the arid conditions of Turkmenistan, forests are of great importance as a source of maintaining the ecological balance in nature. Along with many common factors and climatic conditions of Central Asian countries, Turkmenistan is characterized by its unique forest cover. These conditions formed the uniqueness of vegetation, especially trees and shrubs, and sharp continental climate - the difference of mountain and foothill forests from the sand-desert ones. Forests and forest plantations in extreme conditions of the desert of Turkmenistan perform protecting function, prevent soil from erosion and deflation, serve as food and fuel, biological drainage, protect settlements and fields from dry winds and dust storms (Fig. 36).

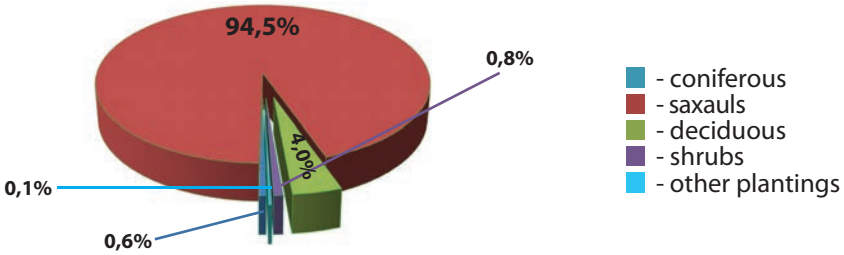


Fig.36. Forest groups of Turkmenistan

Given the data on forests condition in Turkmenistan is out-dated, the annual inventory conduction of forests is important. The accuracy in calculating GHG emissions and sinks in Turkmenistan directly depends on the quality of conducting such work.

The GHG inventory in this sector is conducted based on the document «Guidelines for Good Practice for land use, land-use change and forestry» (IPCC, 2003). Despite significant errors made during this assessment and driven by the uncertainty of data and coefficients used, the inventory has helped to identify the volume of GHG emissions and sinks.

According to the above-mentioned guidelines, changes in carbon runoff, emissions / sinks of GHG have been estimated by the following three categories:

- Forest lands remaining forest lands;
- Lands converted to forest lands;
- Biomass burned in fires.

During assessing the GHG emissions and sinks from different sources, where they are either accumulated (absorbed) or which they emit from, changes in carbon sinks in the aboveground and underground parts of the living biomass have been identified.

In general, in LULUCF sector GHG absorption is higher than their emissions (Fig. 37).

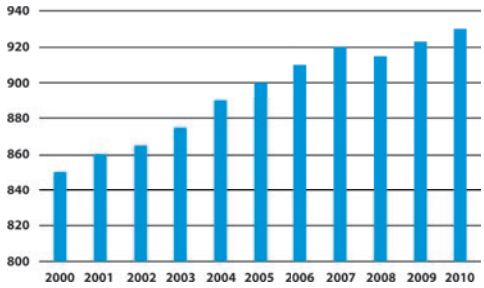


Fig. 37.CO_2 absorption, Gg

2.2.5. Waste

During conducting of the inventory in this sector, obtaining of information on emissions of wastewater in major cities of Turkmenistan was unsuccessful; therefore, the evaluation was based only on data disposal of solid domestic waste (Fig. 38).

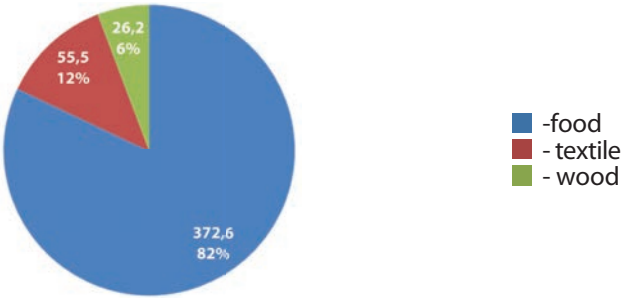


Fig. 38. Composition of solid domestic waste in 2010.

From 2000 to 2010, methane emissions had been increasing in the unstable way (Fig. 39).Their peak in some years, most likely is associated with inaccuracy of statistical data on activities in this sector. In general, increase in the volume of emissions is caused by the growth of population of the country and improvement of social conditions of life.

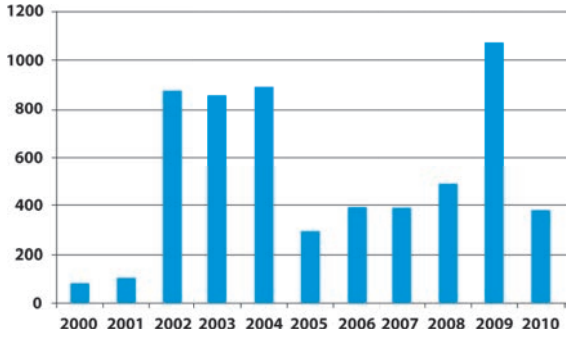


Fig. 39. Methane emissions from SDW disposal sites, Gg (CO_2-eqv.)

2.3. Uncertainty analysis

The analysis of uncertainty of greenhouse gas inventory was held in accordance with the following documents: "Revised Guidelines for National Greenhouse Gas Inventories (IPCC, 1996) and "IPCC Guidance for Good Practice and accounting factors of uncertainty in the National Greenhouse Gas Inventories" (IPCC, 2000). If national uncertainty factors were absent, they were identified by the average coefficients according to the following documents: "Guidance on good practices and accounting factors of uncertainty in the National Greenhouse Gas Inventories" (IPCC, 2000) and "Guidelines for National Greenhouse Gas Inventories" (IPCC, 2006). Regarding the uncertainty of data in different sectors, the qualitative and quantitative assessments have been conducted for them.

In preparation of the Third National Communication on Climate Change, there was an attempt to carry out qualitative and quantitative analysis of uncertainties. The assessment results were compared by methods of 1 and 2 tiers.

According to uncertainty analysis by 1 tier, the uncertainty accounted to the trend of common national emissions is equal to 30.2% of the total estimated emissions. The uncertainty assessment was conducted for emission volume of 49,856.15 (2000) and 65684.8 (2010) Gg (CO_2-eqv.).

2.4. Quality assurance and quality control (QA / QC)

Two expert groups are created in carrying out the procedure of quality assurance and quality control. The first group of experts is taking over the functions of the quality control. This group consists of representatives from the ministries and departments, organisations and enterprises of the oil and gas sector, energy, transport and agriculture. The second group is responsible for the quality assurance of the inventory and consists of representatives from the public environmental organisations, such as «Nature Protection", "Aarhus Centre", "Tebigy Kuwwat" and other stakeholders.

National Communications officially circulated to the ministries and departments to verify the quality of the data and results obtained, thereby increasing the transparency, consistency, comparability, completeness and accuracy of the national inventory.

2.5. Key sources

The analysis of key sources of GHG emissions allows revealing the major ones, allocating resources by priority, strategizing volume reduction of emissions and conducting their qualitative and quantitative assessment.

The key sources are those that make up most of the total volume of GHG emissions in CO2-equivalent: not less than 95% of total emissions for a certain period. These are enterprises of oil and gas, energy, agriculture and transport sectors.

According to inventory results conducted in 2000, 9 key sources were identified out of 41 analyzed. Their share in the total amount of GHG emissions accounted for more than 95%.

The bulk of GHG emissions (about 90%) falls on the «Energy» sector (combustion, production, transportation, storage of oil and gas), but due to intensification of agricultural production, their emissions are increasing as well (see App. Table 1 and 2).

According to results of the national GHG inventory for 2000-2010, emission trends have been identified in the dynamics of their time series. This made possible to reveal the sources where emissions trend differs from the one of total emissions (see. App. Table. 3).

CHAPTER 3. CLIMATE CHANGE VULNERABILITY AND ADAPTATION ASSESSMENT

3.1. Climate of Turkmenistan

Location of Turkmenistan in the middle latitudes of the Asian part of the northern hemisphere and influence of the northwestern and southern air currents caused the uniqueness of the climate. Enormous water area of the Caspian Sea from the west and mountains from the south and southeast, the underlying heterogeneity also play its role in formation of the climate of our country. Its characteristic feature is the long, hot and dry summer with temperatures over 40°C in the shadow. Frequent atmospheric drought is typical for warm half of the year due to moderate and hot dry weather.

Winter is characterized by unsustainable and variable weather, especially in the northern part, with frequent changes in positive and negative temperatures. The coldest month of the year is January with average temperature from -3.2 to -4.8ºC. At the same time, during the coldest winter months warming may occasionally increase up to 12-22ºC. In the cold period, the amount of rainfall is 60-84% of its annual amount. The existing observation system allows creating a database and obtaining information on climate change.

3.2. Climate changes observed

Evaluation of climate change observed in Turkmenistan was done on the basis of hydrometeorological observations conducted in 1950-2010 according to the following parameters: air temperature, precipitation, wind, humidity and others.

Air temperature. Extreme continental climate is characterized by wide range fluctuations in temperature. Despite the desert nature of the landscape, there are great differences between climatic conditions of northern and southern parts of the country.

The desert zone of Turkmenistan is characterized by increasingly continental climate and low humidity. Generally, the climate of this area is characterized by long hot summers, cold for these latitudes winters and large annual and daily amplitudes of air temperature, very dry air and partly sunny weather.

The average January temperature ranges from -1,6ºC in the west to 1,1ºC in the east. A temporary decrease in temperature up to -28ºC is recorded in the east and -35ºC in the north, as well as its increase up to 12-16ºC. Average temperature in July is 31,4ºC, in some days its increase up to 40-45ºC. Frequency of droughts is significantly increasing in the semi-arid zone.

Observations at meteorological stations of Balkanabat, Bayramali, Atamyrat and Birata for 1950-2010 show that air temperature in Balkanabat has increased up to 1,45 ºC, Bayramali – up to 2,05 ºC, Atamyrat - 2,4 ºC, Birata - 1,1 ºC (Fig. 40).

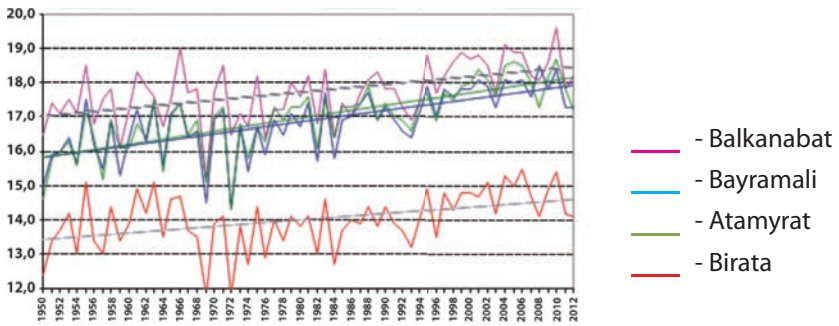


Fig.40. Changes in average annual air temperature based on data from meteorological stations of Balkanabat, Bayramali, Atamyrat and Birata

The northern part of the country - the territory of Dashoguz, northern areas of Balkan and Lebap velayats, located in the area of Siberian anticyclone, and characterized by severe and long winters with steady frost and snow cover. In these areas, summer is considerably shorter and less hot, with relatively equal precipitation, but in small amount.

The southern parts of the country are characterized by mild winters with occasional snow cover and frequent changes in air temperature from negative to positive range. Conditions of warm period are also different. Especially, parts of coastal zone of the Caspian Sea are characterized by mild climate.

In all seasons characteristic feature of the atmospheric air circulation over the territory of Turkmenistan is a high frequency of meridian processes. Although in the cold period of the year, they are less frequently recorded than in the warm period; in winter and in the transition period they are revealed in the weather variability: sharp change from heat to cold, strong winds and precipitation. Little snow and relatively warm winter is sometimes influenced by invasion of cold continental air masses and becomes severe and harmful to heat-loving plants, although frosts last only for few days.

In general, the average air temperature from 1950 to 2010 in Turkmenistan is increasing by about 0,3 °C over 10 years (Fig.41), and on average it has increased by almost 2 °C.

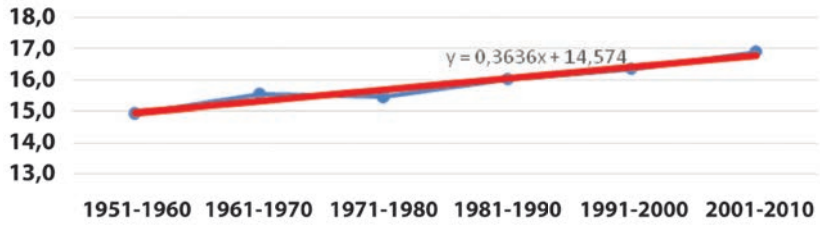


Fig. 41. Decadal trend of average mean temperature in Turkmenistan and regression equation

Precipitation regime. Severe winter predominates in northern areas with very low air temperature and frequent snow precipitation forming a steady snow cover. Lack precipitations are recorded from June to September (2.5 - 5 mm).

Factors that stimulate precipitation in this area are a high level of relative humidity in the lower layer of the troposphere. Maximum precipitation falls mainly in winter, spring and autumn months; summers are very dry.

The number of days with precipitation decrease in summer and from autumn to winter increasing.

The long-term average indicator of precipitation amount is 0-10 mm / day, although in some days it may be higher. Analysis of its intensity indicates on the prevailing of pre-

cipitation in smaller amount, for example, in the interval (0;1) - 30%, and (0;2) - 50% of the total number of precipitation days.

Maximum of precipitation falls in April (18.7 mm) and March (18.2 mm), 46.4% of the annual amount falls from March to May, and 45.2% - from October to February. During warm season precipitation amount is small: more than 4 months the average precipitation is 3.4 mm (8.4% of the annual amount).

Precipitation regime at the **eastern and southern** areas is determined by invasion of southern and western cyclones, northern and north-western cold air masses. Maximum precipitation (64.3 mm) is in March, from December to April falls up to 87.8%, in May and November is 10.1% of the annual amount. For 4 months of warm period of the year falls less than 5.0 mm (1.9% of the annual amount).

Balkan velayat is the area of **west zone.** Maximum precipitation (23 mm) falls in March. Majority (86.5% of the annual amount) falls during autumn and spring period, from October to May. Rainfall is often during warm seasons, but in small amounts: for 4 months at least 19.7 mm (13.5% of the annual amount).

The greatest number of days with precipitation falls during the cold season is located on the plain territory of the country. Its maximum recurrence in southern areas falls in the second half of winter and spring, when the intensity of cyclonic activity develops. The great bulk of the rainfalls are recorded during this period. Dry season comes in summer.

In the desert areas precipitation falls mainly during the cold period (5-8 days of each winter month), in the summer their probability is extremely small.

All the mountain areas are characterized by frequent rainfall throughout the year. Heavy rains in the mountains cause mudslides, often of destructive force.

The largest number of heavy rainfall cases characterized as «dangerous» and «natural» in all natural zones of Turkmenistan is observed in March - May. Heavy precipitations mainly fall in the foothills. The number of days with precipitation >20 mm is in the foothills and southern regions are between 3-8 a year and those with >30 mm is about 3.

Wind regime. Winds in the desert zone are weak, mainly of north-east direction, often no wind is observed. The diurnal variation of wind is typical mainland: in the evening and night is the calm, in the daytime wind increases reaching a maximum level in the afternoon.

The wind regime is determined by local barometric circulation regime and substantially changes from warm period of the year to cold one.

In the desert area of Turkmenistan in the winter north-east and eastern winds with a repeatability of 38% of the total number of observations (without calm) are dominated.

During warmer months the wind regime strongly changes in Turkmenistan: prevails removal of air from the extreme northern latitudes of the continent into central regions. Due to these circumstances the north-western, northern and north-eastern winds are dominated territories of the country.

According to the observations at Balkanabat, Dashoguz and Serdar stations the highest in the country average speed of wind are recorded, and the lowest one are at Bekreve, Baharly and Erbent stations.

The average wind speed from winter to spring and summer is slightly noticeable reduced, and then starting from autumn increases.

Average wind speed as per 10 years to10 years measurements on a particular station slightly changes: Atamyrat station - 3 m/s, Bayramali - 2 m/s, Balkanabad - 4.5 m/s, etc.).

As a result of the data analysis it was found that the wind speed in Turkmenistan mainly (75-90% of the winds) is 0-5 m/s.

Winds with a speed of 6-10 m/s are approximately 3-7% of the total, and more than 15 m/s - 1%.

According to 60-years observations conducted at Balkanabat and Serdar stations it was recorded 10-20 times more windy days than at other stations, and a smaller number of such days are recorded at Yekeje, Erbent and Repetek stations. But during the past two decades of observation at Balkanabat station indicate that the number of days with strong winds significantly reduced, the peak of this indicator were for 1971-1980.

As for the absolute air humidity by decades significant changes were not observed. In general, the summer humidity rises in Serdar and Balkanabat stations and it is the most high and at the Repetek and Tagtabazar stations are the lowest.

3.3. Climate risk assessment

Extreme hydrometeorological events cause considerable damage to economy branches and livelihoods of people all over the world. As part of the Third National Communication the assessment of these events was conducted in Turkmenistan for the period from 1950 to 2010. According to the research done it was found that the climate change here may result in the following:

- The air temperature increase.
- Reduce the amount of precipitation.
- Increased incidence of drought.
- Reduction of snow in the mountains.
- Increasing the number of dry years and others.

In Turkmenistan research of extreme hydrometeorological events such as drought, hail, wind storm, frost, heat waves, floods and mudslides are constantly conducted. It has been established that their frequency and intensity is increasing in recent years.

Drought: The biggest threat (risk) for socio-economic well-being of the country bears the drought, the appearance of which is due to high air temperatures and water scarcity. Currently, tendency to increase the frequency of dry years of the major rivers of Turkmenistan - Amudarya and Murgab is recorded. Climate warming will be an additional risk factor for the development of hydrological drought and desertification negatively reflected on water resources and hence agriculture.

Turkmenistan is the country where drought is often recorded in connection with the fact that about 80% of its territory is occupied by the Karakum desert, which is the one of the most urgent issues to be addressed and appropriate actions taken. The success of the country's livestock depends directly on the pasture productivity, which is defined by the climatic conditions of the area. Pasture vegetation is burned before terms registered on mean annual data, and its harvest at the same time is reduced by 50-70% in dry years.

Severe drought which was observed in 2000 and 2001 led to a significant decrease in productivity of pasture grasses. In those years it was 40-70 and 43-58% accordingly from the long-term norm. Taking into account the increase in the frequency of droughts since 2000, damage caused and the scale of this phenomenon, it is necessary to pay special attention that it represents a serious threat to the agricultural sector of the country. In this

connection it is necessary to pay attention to the issue of the likelihood of early warning of drought. This will reduce its negative impact and to take timely action in conditions of water shortage. Drought-prone regions may suffer from it for months and sometimes even for years. This is the most dangerous and widespread scourge from other similar natural phenomena in Turkmenistan representing a real threat to the country's economy and its sustainable development.

During 27 years out of 34-year period (1975-2008) water content ratio of Amudarya was high (Fig.42). Low-water with an average annual runoff below 77%, were 1982, 1986, 1989, 2000 years, and most low-water for the entire period of observation were in 2001 and 2008. - 66 and 56% respectively. This was due to the seasonal scarcity of snow in the catchment area.

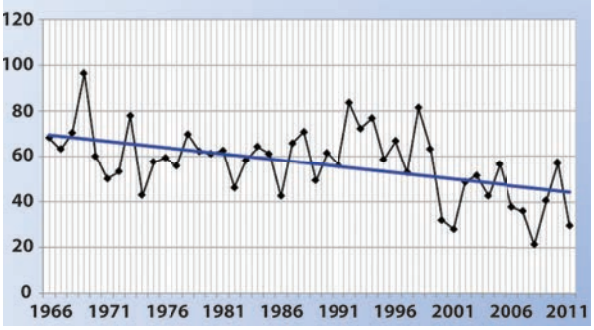


Fig. 42. Changes in runoff of Amudarya river, billion m³

Flooding and mudslides are quickly passing natural phenomena, but lead to more destruction and causing enormous economic damage.

The territory of Turkmenistan can be divided into three large dangerous in terms of possible landslide zones: Koytendag, Kopetdag, Greater and Lesser Balhans. In 80% of cases it is mudflow - water stream carrying different alluvions, 20% - its mud and mud-rock flows. In Turkmenistan, mudflows were observed on 229 permanent and temporary streams. Mudflow rivers are mainly located in Kopetdag. Almost for 100 years on 80 watercourses of Kopetdag were recorded more than 1,500 cases of landslide, 87% of them took place in April - August, as a result of intense rainfall. The most dangerous months in this respect are April and May; they account 54% of all recorded landslides.

Mudflow period on rivers and logs of Kopetdag is March - September, in rare cases, mudflow comes in October, still less in winter. In summer and autumn months floods are rare, but their intensity and volume of runoff can be greatly above the norm, in connection with which they do very considerable damage (Fig.43).

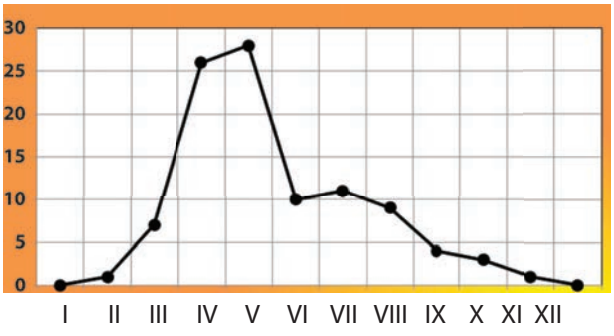


Fig. 43. Monthly distribution of mudflows, %

There are up to 20- 50 cases of landslide in some years in rivers and logs of Kopetdag. Analysis of these data has allowed identifying so-called «active» from this point of view years - 1962, 1963, 1969, 1972, 1976, 1981, 1986, 1992, 1998, 2003, 2009, 2012. According to the results of observations it was found that since 1990 mudflows of varying intensity occur each year. According to repetition frequency mudflow areas were distinguished: especially active - slopes of Eastern Kopetdag, active - slopes of Central Kopetdag, average activity - the slopes of the Western Kopetdag, especially river basins (Sekizyab, Archinyansu and others).

The greatest freshet and mudflow activity Murgab River, Tejen, Sumbar, Etrek, their tributaries and some small logs are differ. The most active mudflow activity in the foothills of the Kopetdag is recorded in the spring and summer. Spring rain showers in Afghanistan annually cause floods on Murgab River and its affluents Kushka and Kashan. Often, in the period from January to May (June) 5-8 floods are observed.

Sumbar and Etrek Rivers differ by greatest mudflow activity. Almost every year torrential rains fell mainly in Iran, cause landslide. The water level in Artek rises to 8-12 m in some years, exceeding the dangerous values. There are often 5-12 mudflows a year.

Rain freshet on the Etrek River, which occurred in August 2011, was the most powerful during the observation period. The level of the river was higher than its absolute maximum recorded in 2003. These floods are usually accompanied by a breakthrough of hydraulic dams, flooding settlements and farmlands.

There is often a summer wide flood on the Amudarya River, caused by an increase in air temperature in the area of snow melting. In the middle flow of the river for the spring-summer period is often the passage of a few floods observed, caused by heavy rains, melting of snow and glaciers in the mountains. Sometimes there are up to 10 floods per year. Maximum water flow is often at least 2 times higher than during spring flood. The water level at the peak of flooding is so high that sometimes causes the water outlet to the flood plain. Depending on the duration of floods and its intensity the destructive work of the river can continue not only days or weeks, but even months.

In some years, as a result of hanging ice dams in December - January, there is a significant rise of water level which results in flooding and destruction.

Hydrometeorological conditions emerging favorable period for the formation of mudslides, prolongs recently. From 2000 to 2013 eight floods have occurred on Murgab River in winter of 2001, 2003, 2004, 2009, 2010, 2011, 2012, 2013.

In view of the foresaid, it is necessary to intensify the study of floods and mudflows, which is one of the priorities for adaptation to climate change. To carry out regular monitoring at the areas of mudflow and flood impact analysis it is necessary to create a special hydrographic service and increase the number of monitoring stations for the mudslide equipped with modern facilities.

Statistical analysis of the historical series of observations, as well as changes during the last decade is the most important in the climate change study.

Analysis of Murgab river runoff during many years of observation has showed that its water content in 1929-1959 was 64%, in 1960-1990 - 60%, and in 1991-2013 - 48% out of norm. Since 2000 the rate of water content of water years has reduced, having

exceeded the norm by 10-18%. The most high water was in 1992, (Fig. 44) when the water content of the river was above the norm at 2 and 6 times.

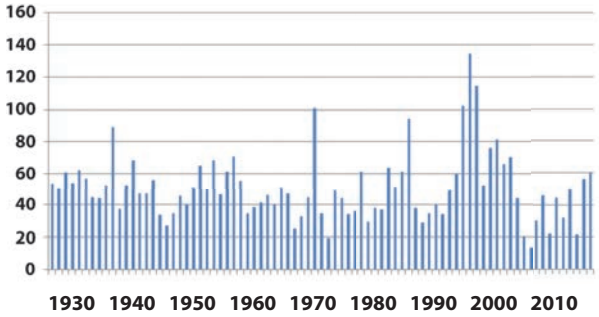


Fig. 44. The average annual water consumption of Murgab River (post Tagtabazar), m^3/sec

Eight years successively since 1991 it was 103-263% compared to the norm. This was due to large supply of snow in the mountains and heavy (above normal) spring rains. In 1992, the indicator of water content was the highest (2.6 times higher than the norm) for the entire period of observation. After the most high-water years there was a period of severe water shortage. As a result of meteorological observations since 2000, on Murgab River the number of dry years has increased. Seven years were characterized by very low water content - 48% out of normal. The same was observed in 1966, 1971 and 1977. However, the most of the low-water period of observations are 2000 - 38% relative to the norm, 2001 - 25%. It is caused by a very small stock of snow in the catchment area and as a consequence the lack of spring floods on the river.

Data on the snow stock at the area of snow cover in Murgab River Basin in 2002-2012 testifies to its reduction. In the context of not well enough research set in the highlands river basins of Central Asia, it is necessary to receive remote sensing data regularly. Only by accumulation and sequential study of these materials could be understandable of the flow patterns.

Ice phenomena: In winter especially in the middle reaches of Amudarya River, ice phenomena are observed in Turkmenistan. Almost every year at the Birata - Lebap site weak ice are formed due to lowering of temperature to negative values. In some years, as a result of lowering the temperature to -25-30ºS Amudarya is fettered ice forming powerful hanging ice dams, resulting in sharply rising level of water in it and the surrounding areas are flooded. Especially it is typical for the Turkmenabat - Birata area.

The strongest ice phenomena observed on Amudarya in 1969 and 2008. In 1969, as a result of ice jams water level has considerably exceeded the danger mark, which led to the flooding of Turkmenabat town.

In order to increase the level of emergency preparedness (EP) it was proposed to make corrections into procedures and action plans during emergency situations, taking into account the climate change. Early warning of emergencies is crucial to ensure readiness in the emergency situation cases, and this work should be carried out along the borders to ensure the exchange of information. It is presented a ranked list of dangerous phenomena and extreme weather events which pose the greatest threat, in view of their main characteristics: the repetition frequency, intensity, duration, scale. The most vulnerable areas of Turkmenistan have been highlighted from the combination of natural factors.

Measures to improve the collection and analysis of information about the possible social and economic damage were offered, improving warning systems about extreme weather events and dangerous phenomena regarding expansion recipients that receiving forecasts and warnings, the use of modern means of telecommunications, refining the forms and types of information, taking into account local conditions, conducive to its transmission directly to end users.

It should focus more efforts on reducing the risk of natural disasters rather than mitigation. At present, it is important to develop such activities as monitoring, forecasting and early warning of natural and man-made disasters. It can be economically justified modernization of hydrometeorological systems and investment in improving methods of forecasting of natural hazards.

3.4. Climate scenarios

Different approaches for building climate scenarios have been used in preparing of the First and Second National Communications to assess the impacts of climate change. In the First National Communication on Climate Change the following atmospheric general circulation model was used: GISS, CCCM, UK89, GFDL-R-30. In preparing the Second National Communication software package MAGIC / SCENGEN, based on the results of the use of 17 general circulation models of the atmosphere and ocean was used. Calculations were based on two scenarios of greenhouse gas emissions: B1 and A1FI, using the model ECHAM4 (Germany, Max Planck Institute) and HadCM2 (UK, Hadley Centre). Both models have showed possible increase in temperature and decrease in precipitation in Turkmenistan in the future. In the framework for preparation of the Third National Communication studies to assess future climate were continued. For more correct assessment of climate change impact on key sectors of the economy the averaging scenario was used (Fig. 45 and 46). The following figures show the results of calculations of air temperature and annual precipitation for the period of 2020-2100.

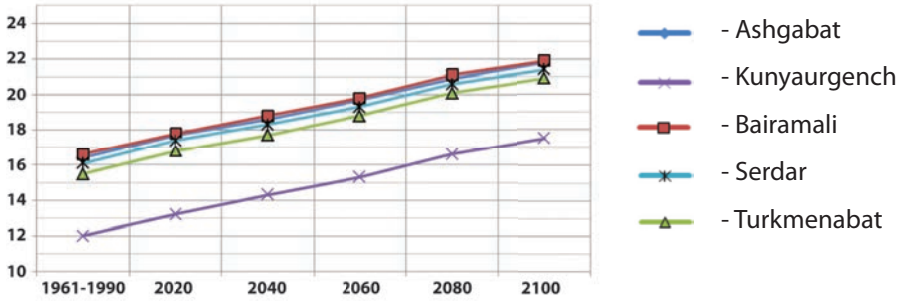


Figure 45. The average annual air temperature for averaging scenario, ° C

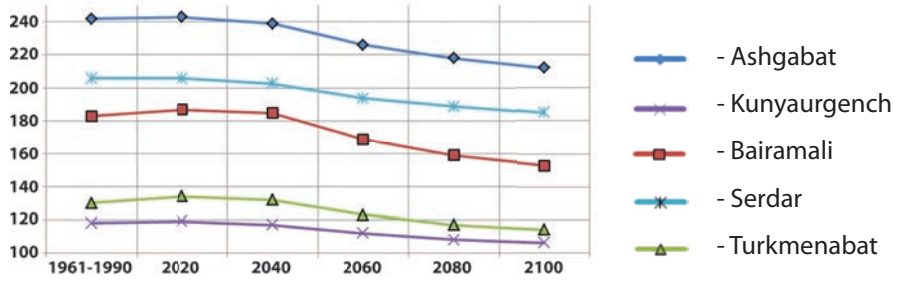


Fig.46. The annual amount of precipitation on averaged scenario, mm

The air temperature in Turkmenistan for 2020-2100 will steadily increase, and the amount of precipitation at first remains stable, fell sharply after 2030-2040. The most likely scenario was designed taking into account combination of economic and environmental priorities (Fig. 47).

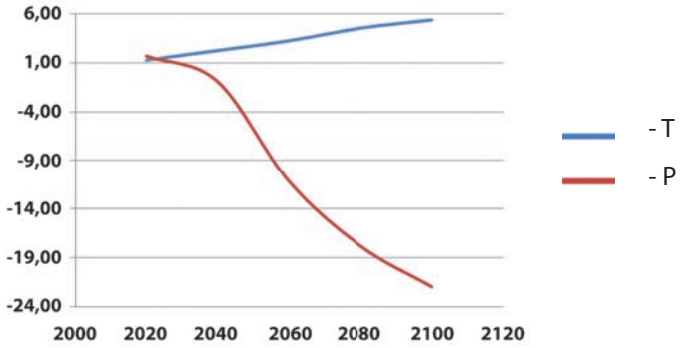


Fig. 47. Deviations from the normal average air temperature T (° C) and precipitation P (mm) for Turkmenistan on averaged scenarios A1FI and B1

As it is seen from the graphs, the difference between the air temperatures on the averaged scenario will increase by 2020 to 1.23°C, 2040 - to 2.21°C in 2060 - by 3.22°C, in 2080 - by 4.51°C, by 2100 - on 5.35°C. The difference between the annual precipitations up to 2020 compared with the long-term average for 1961-1990 may slightly increase (1.7 mm), and then it is assumed their steady decline from 0.9 mm - in 2040, up to 22 mm - to 2100.

Increased air temperature and decreased precipitation in the long term is a direct impact on activities of key sectors of the economy. First of all current risk is expressed to reduce the flow and changing river hydrograph. Indicators of this risk are the water flow use in the rivers and thus water availability as well as their distribution by economic sector.

Calculations have shown that the proposed increase in temperature and decrease in rainfall is in the first place, would adversely affect the total amount of available water resources (Fig.48). Agriculture is the main consumer of water in Turkmenistan, and therefore worsens the problem of changes in the volume of river flow and hydrograph by its reduction during the growing season. This problem is even more aggravated by the need to increase irrigation rates because of higher temperatures and transpiration.

Comparison of the data of averaging scenario to the actual obtained by region watershed of rivers by regression analysis, indicates a change in flow of small rivers. Thus, the annual runoff of Tejen, Murgab and Etrek may decrease by 5-8%. Particularly important here is the fact that due to lower annual flow of local rivers in the vegetation period it may be reduced to 30%.

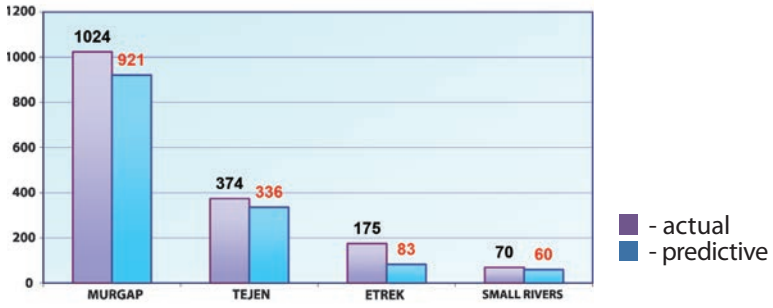


Fig. 48. Reducing the volume flow of Turkmenistan Rivers in connection with climate change, mln. m³ / year

Analysis of the results of studies conducted on Amudarya in 1911-2013has shown a steady downward trend in the volume of runoff. According to Uzbek scientists, water content of the Amudarya in relation to climate change by 2050 may already be reduced by 10-15%.

In preparation for the Third National Communication on Climate Change more detailed studies of Murgab River runoff have been conducted using modern modeling methods. Several international models and software were used to simulate changes in air temperature, precipitation, snow cover, and the volume of river flow.

According to preliminary estimates, as a result of climate change from 2001 to 2050 annual precipitation in the Basin of Murgab River is reduced by 8-10% (Fig.49). Fluctuations of their number on seasons are expected. Significant changes are expected in the autumn-winter period. The tendency to decrease in rainfall in January – March period, during the accumulation of snow in the upper watershed of the river was revealed. The expected increase in air temperature during this period can lead to decrease in river flow volume and increase in the number of dry years.

According to the long-term hydrological and meteorological observations in a lack of information about thawed and rainwater were estimated possible changes in the characteristics of the water regime of Murgab River. As the base climate the norms of average monthly temperatures and the amount of precipitation for a month for the Tagtabazar base station and the model CAWA-REMO were used.

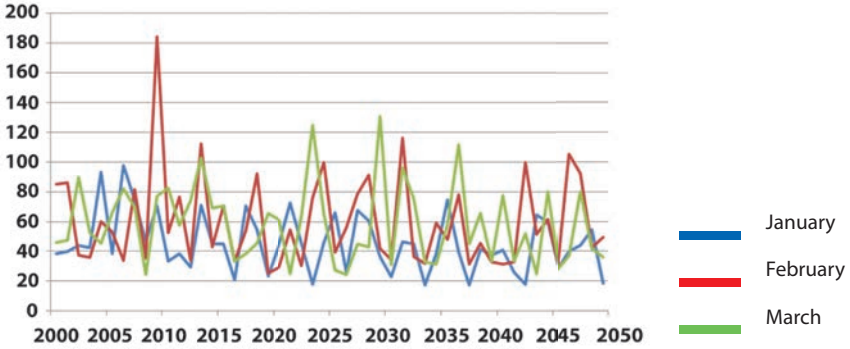


Fig.49.The amount of rainfall in the basin of Murgab River in January - February - March of 2000-2050 years.

The satellite information is a special value in the absence of actual data on the amount of rainfall and snow accumulation in the neighboring territories. A small data file on the snow covered area, obtained in the framework of the project CAWA «Water in Central Asia» for the Murgab River basin, implemented jointly with the Ministry of Water Economy of Turkmenistan, was very helpful in analyzing the overall picture of snow ac-

cumulation and its dynamics by comparing the current situation with the same or similar extreme years of the snow dynamics in the studying area.

At comparison of remote sensing data showed a trend toward a reduction of snow in the mountainous part of the basin district of Murgab was revealed. Snow cover will be exposed to high temperatures, which will lead to the change in the river flow regime.

Comparative analysis of runoff of Murgab River during the growing season from 1980 to 2012 indicates a gradual decrease in the volume of runoff, and since 2000 there was a trend of increasing frequency of dry years in the growing season. Projected climate change, reduction of total annual rainfall in the 2001-2050 and snow cover in the mountainous part of the basin will lead to reduction of the maximum water flow.

The results can be considered as a first approach to the assessment of the likely changes in the river flow in the middle of the XXI century. Water and agriculture are the most vulnerable sectors of the economy of Turkmenistan. The development of agriculture of Turkmenistan related with increase of water consumption, and therefore there is a necessity of redistribution of water resources and more rational use.

By 2040-2050 in the Turkmen part of the river basin of Murgab is supposed to increase in mean annual air temperature up to + 20 °C, in the period from May to September - at 1.30-2.03ºC, from November to February - at 2.15-2.56ºC. With the increase in air temperature during the winter, the most part of the precipitation will fall as rain, which leads to decrease of snow in the mountains, mudflow and rain floods, and as a result - increase of droughts in frequency.

Estimated increase of air temperature in Murgab River basin may affect the timing of the growing season and it will take place sooner (Fig.50).

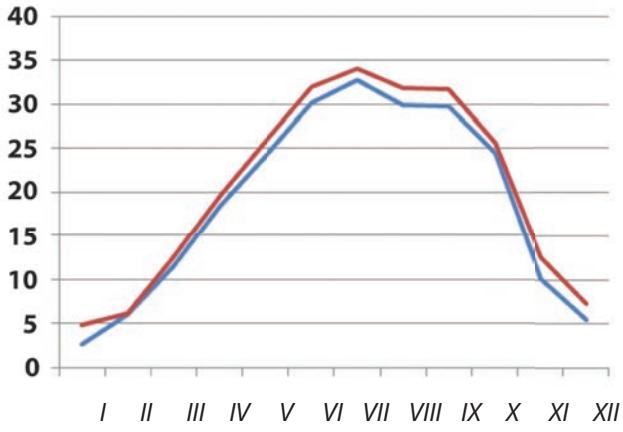


Figure 50. Actual (2001-2010) and forecast (2040-2050) data on air temperature

In preparation of the Third National Communication on Climate Change the work was continued on the construction of climate scenarios in the future with use of more advanced techniques (higher resolution), and involvement of international climate data sources and generation of climate change scenarios. In particular, we used global climate models ECHAM5.1 and UKMOHadCM3, recommended by IPCC, using three scenarios (A2, A1B, B1).

Modeling based on global climate models ECHAM5.1 and UKMOHadCM3 for 2030, 2050 and 2070 years shows that the average annual temperature will increase during the period (Fig. 51 A, B). As for precipitation for this period, according to the model ECHAM-5.1, their number will decrease (Fig.51 C) in the period under review. According

to the model UKMOHadCM3, rainfall will decrease (Fig. 51 D) in the first half of the XXI century, but will increase in the second one.

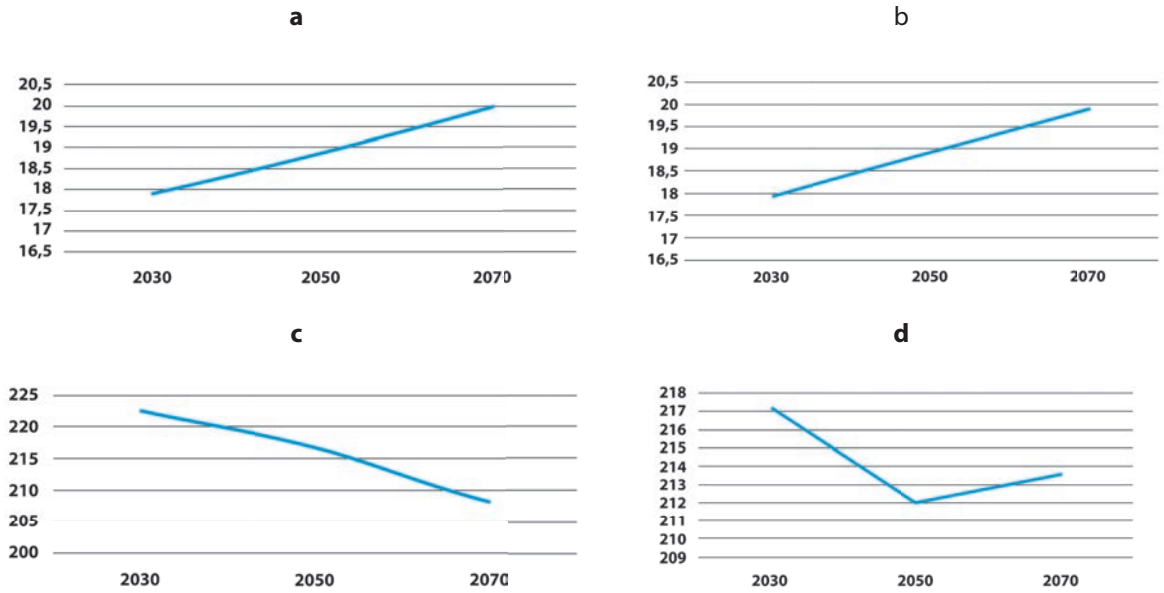


Fig.51. The average annual air temperature and the amount of precipitation according to the ECHAM5.1 and UKMOHadCM3 models

In the next 30 years the amount of precipitation will slightly decrease, but since the end of 40s of the XXI century it will decrease dramatically. The duration and the rate of warming will depend on the number and nature of anthropogenic GHG emissions. According to the scenario A1B emissions, increases in global air temperature 2-3°C are projected until the end of XXI century.

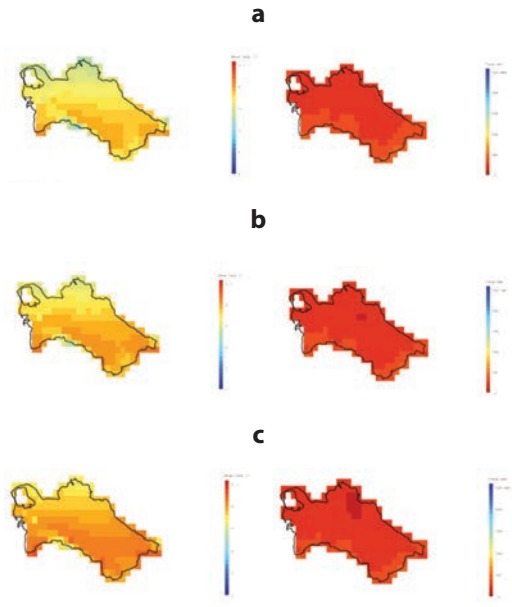


Fig.52. Maps of temperature change and precipitation of Turkmenistan on ECHAM5.1 model according to the A1B scenario for 2030 (a), 2050 (b) and 2070 (c)

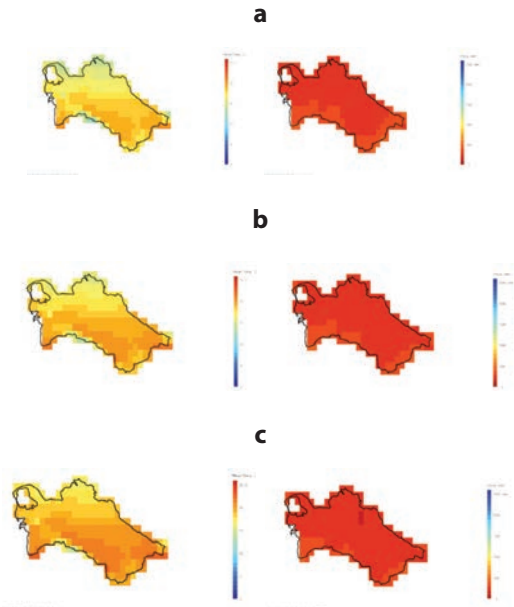


Fig.53 Maps of temperature change and precipitation of Turkmenistan on UKMO HadCM3 model according to the A1B scenario for 2030 (a), 2050 (b) and 2070 (c)

3.5. Climate change impact

Agriculture, water resources, health, soil and land resources, ecosystems (flora and fauna) and the forestry, extreme weather phenomena as the priority sectors of Turkmenistan's economy to adapt to the climate change are reviewed in the National Strategy of Turkmenistan on Climate Change (2012).

3.5.1. Agriculture and water resources

Due to the fact that agricultural production in Turkmenistan is based on irrigated agriculture (irrigated area - about 1.8 million ha), activities of the two leading sectors of the economy - agriculture and water economy, inextricably are linked and considered together.

Agriculture in the national economy provides about 10% of gross domestic product (GDP), moreover, here about 50% of the population are employing. In the last decade the total value of agricultural output share of animal production has increased (Fig.54).One of the main reasons for this is that currently more than 80% of the livestock numbers is concentrated in private farms.

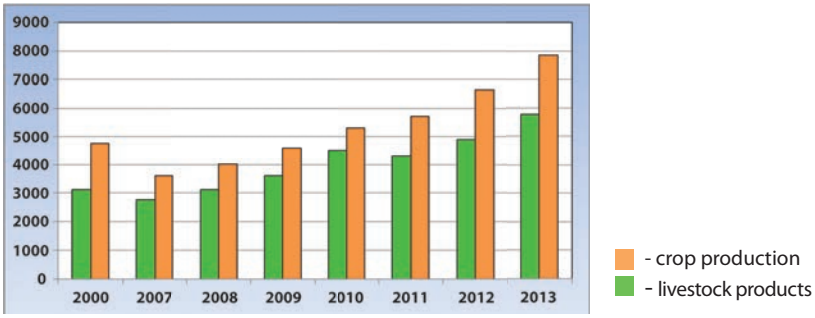


Fig.54. The cost of agricultural products (million man.)

The programme of socio-economic development of the country has planned to increase irrigated area by 2030 to 2 million ha. This leads the need for a set of preventive adaptation measures that will make up water scarcity expected due to climate change.

The quantity and quality of the crop of agricultural products in the world, more and more depends on weather conditions. Delayed response of the agricultural sector to the ongoing climate change could lead to negative consequences. The best way to reduce dependence on agro- ecosystems from possible global climate change - is to get adapted to them. Starting from the ancient times the system of husbandry and livestock farming as an important part of the national culture is characterized by high adaptability, ecological plasticity to the peculiarities of arid, hot, sharply continental climate, soil, topography, «whims» of weather there were existed in the territory of Turkmenistan.

Global climate change could have a negative impact on the state of the country's livestock fodder. Pasture productivity may reduce due to drought and high air temperature. Natural pasture as a source of valuable gene pool for breeding and introduction of new species and varieties of food plants, production of cheap high-quality feed, are of great importance in the development of domestic livestock.

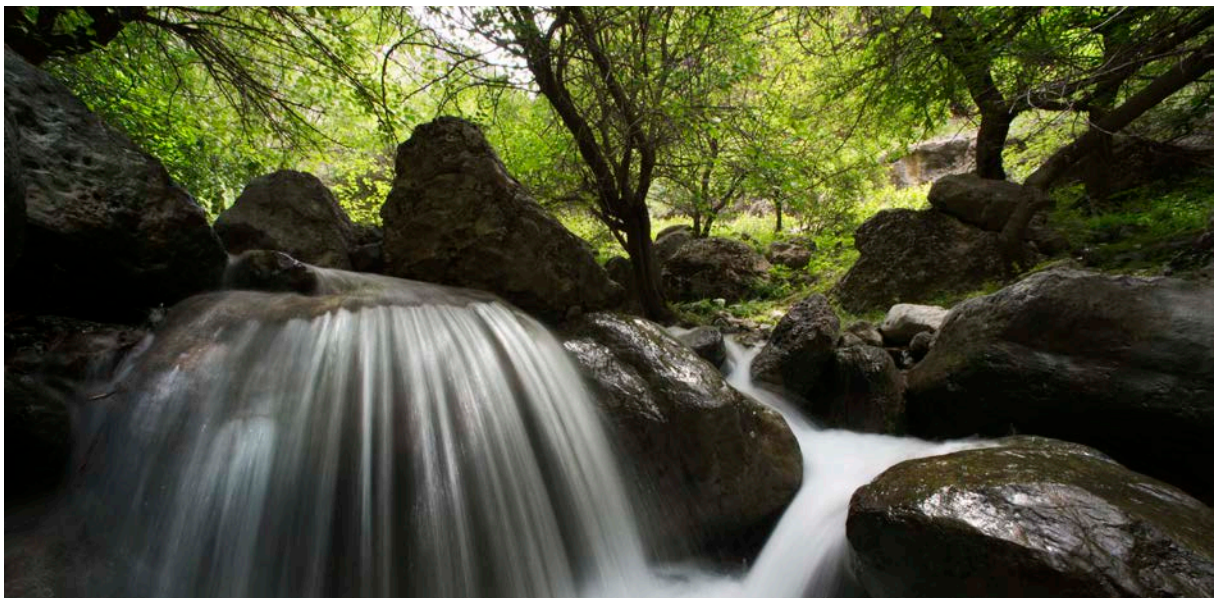
In connection with the change in the air temperature, humidity regime and influence of other factors may reduce agricultural productivity. Lack of water for irrigation, to increase the area of soil salinization, droughts and hot winds can lead to decrease in the profitability of production of major crops, yields of cotton, cereals, rice (in the north), to deterioration of pasture ecosystems.

The set of measures to ensure the reliable functioning of agriculture in connection with possible global climate change should include not only organizational measures, but also include new priorities in the Turkmen science. Determination of maximum permissible anthropogenic load on agrocenosis, agro-ecosystems and landscapes, and the accuracy of the account of influence of global and local climate changes, weather conditions in our lives, the environment - challenges that Turkmenistan's science faces today and which need to be addressed for the timely adoption of preventive measures and risk reduction. The acceptance of adaptation measures to reduce climate risk for agricultural biodiversity should be based on the results of research and technological development of different sectoral structures (institutes of agriculture, cotton production, animal husbandry, biology and medicinal plants, «Turkmensuvylymtaslama», «Gun», National Institute of Deserts, Flora and Fauna, etc..) and universities of the country, as well as the global scientific base. The emphasis should be done on the development of systems and technologies to reduce the risk of natural disasters (early warning, engineering and sanitary protection of the population, territory, economic facilities from natural disasters, phenomena and processes, such as extreme temperature changes, precipitation and so on).

The acceptance of adaptation measures in agriculture in terms of climate change, which are based on the environmental component, is a major factor in the stability and profitability of this sector of the economy.

Aspects of climate change identify optimization of conditions for the development of agriculture, the ways and means of human powers.

The development of the vegetation cover and productivity of pastures depend on the meteorological conditions of the growing season. A special role in this is the heat



and moisture. The global increase in air temperature will exacerbate the dependence of yield grown in Turkmenistan of major crops - cotton and wheat, from variety of factors, in particular from the agro-climatic zoning, irrigation, temperature, air, rainfall, fertilizer, diseases, pests (cotton bollworm, locusts, etc.) and others. For example, because of the warming of climate over the last 10-15 years the area of the Moroccan locust (Dociostaurus maroccanus) one of the most dangerous pests in Central Asia has expanded. Habitat of this insect has increased («up») to a higher level. Thus, in the Kopetdag and Koytendag the upper limit of this species is 300-400 m higher than in the mid-twentieth century. In Western Kopetdag suitable for mass breeding of the Moroccan locust habitats shifted to the north. Thus, the reaction of gregarious locusts on climate change has resulted in the latitudinal and altitudinal shift their habitat within the country.

The results showed that the most effective way to combat these insects is to conduct chemical protective measures in their natural foci, in limited areas, in places of hatching larvae.

Reducing grazing pressure, the recovery of mountain pastures by sowing perennial grasses contribute to the creation of micro-climatic conditions that are not favorable to increase the populations of xerophilous grasshoppers species. Because of the unpredictability of the upcoming growing season due to the global climate change, the success of the farmer depends on the timeliness and accuracy of action. At the same time optimization the structure of sown areas is achieved through the selection of crops and varieties that are significantly different from each other by planting dates, duration of vegetation phases of development, requirements for environmental factors.

Adaptation measures (adaptation policy) to the new climate regime in the production of agricultural products should be focused on:

Avoidance of pollution and destruction of the natural environment;

Minimizing the loss of biodiversity;

Modernization of irrigation systems, technical re-equipment of the irrigation network;

Conducting agro-meteorological observations in order to take appropriate measures to protect agro-ecosystems on climatic factors;

Study the possibility of expanding the area of irrigated agriculture;

The development of programs to combat desertification, soil erosion and land use with low productivity;

Agricultural production greening;

Receive high-quality and safe food products and raw materials for industry.

Further tactics and strategy of development of the agricultural sector must be economically viable, environmentally sound and socially acceptable. This will help reduce the volume of greenhouse gas emissions and thus their impact on the climate, as well as the adaptation of the agricultural sector and the population of Turkmenistan to new climatic conditions. It is a fact that violation of technology of cotton cultivation and in particular, reducing the number of irrigations (even one) reduces its productivity by

4-6%, which will lead to reduced income of agricultural producers, related industries (manufacturing industry) and consequently, people's living standards.

In addition, the shortage of irrigation water will contribute to the degradation of irrigated lands (intensive salinization, all kinds of soil erosion), and decreased precipitation would lead to reduction in area and degradation of natural pastures and consequently, to decrease in the efficiency of the sheep industry.

The study of the global climate change impact on the hydrological regime of water bodies of Turkmenistan is important in conditions of water scarcity. The geographical position, the fragility of ecosystems and socio-economic conditions make Turkmenistan very sensitive to climate change.

An urgent problem is to assess possible changes in river flow. The reliability of this estimate depends on the accuracy of climate change forecasts and dependence on the characteristics of the water regime from the climatic conditions.

Long-term observation of the volume flow of the rivers in the region, revealed a statistically significant changes that characterizes the sensitivity of rivers to climate change.

A significant impact on the Amudarya water management regime of the region should be noted. In this connection it is necessary to improve the system of joint management of water resources in the region.

Out of the total surface water resources the major part - 22 billion. m^3 (88%) belongs to Amudarya, the rest - to Murgab River - 1, 631 (6.5%), Tejen - 0.869 (3.5%), Etrek, Sumbar and Chandyr - 0.354 (1.4%), small rivers - 0.15 billion. m^3 (0.6%), (Fig.55).

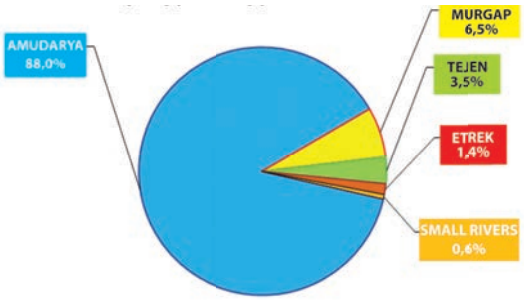


Fig.55. Surface water resources of Turkmenistan

Throughout the country, more than 130 deposits of underground water were explored which is currently partially used to meet the domestic and drinking needs of the population. The total groundwater extraction is 470-670 mln. m^3/year. With more than 45% of it is used for drinking water, about 30% - for irrigation, the rest - for other needs (watering of pastures, balneology).The water balance of the country's share of groundwater use is 2.0-2.5%.

Overall the complete water intake from natural springs in Turkmenistan is shown in Fig. 56. Irrigated lands takes 1,559,000 ha of the total area and considered as an arable land, 29.7 are perennial crops (orchards, vineyards, mulberry and others.). At present, 1.7 million ha is the irrigated area in Turkmenistan. Based on that counting on 1 hectare of irrigated land accounts is about 12.500 m^3 (gross) of water.

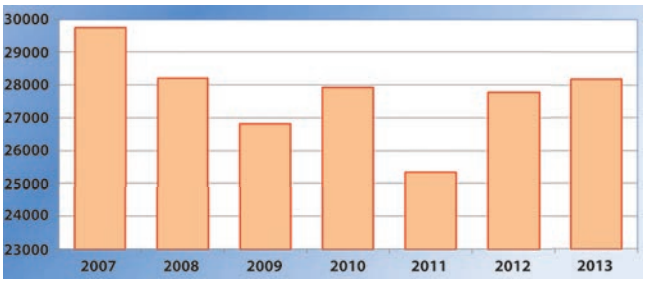


Fig.56. Water Consumption in Turkmenistan, million m³

By categories of consumers water distribution is presented in Fig.57.

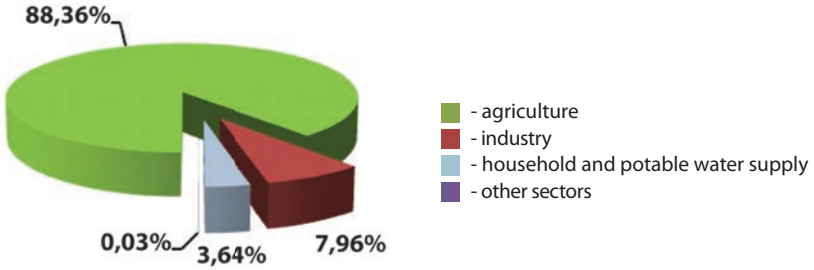


Fig.57. Distribution of water resources by industries, million m³

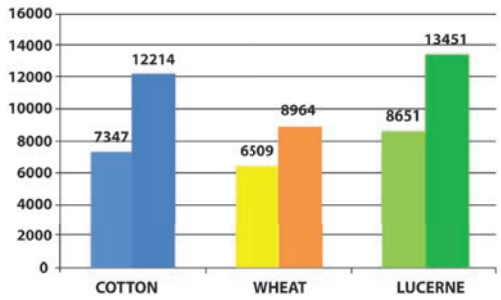
Programme of socio-economic development of the country in the future plan to increase irrigated area by 2030 to 2 million hectares. In connection with what is necessary to carry out a set of preventive adaptation measures that will make up the shortage of water resources due to climate change.

Population's drinking water needs are met due to surface runoff and underground fresh water, which is high quality although uneven distribution along the country. Water quality of Turkmenistan's rivers is characterized by high mineralization (about 400-1000 mg / l).

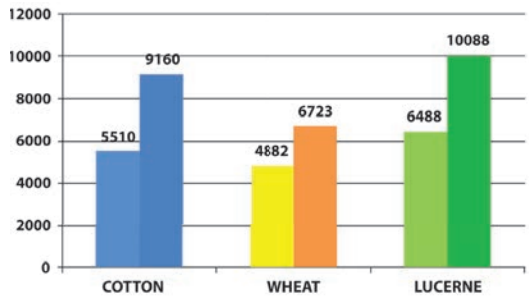
Reset into Amudarya drainage water (more than 4 billion m³) greatly increases its salinity, which is in the lower reaches of the river (target Birata) is 2200 mg/l.

With increase in air temperature evaporation will increase from the reservoir surface, as a result of intensive transpiration need to increase irrigation norms. The difference in the amount of evaporation will be 150 million m³ and irrigation norm for major crops increase to 2030-2040 years as minimum for 13%. For irrigation of crops additionally approximately 3,000 million m³ of water is required (Fig.58).

Kopetdag-Murgab and Tejen area



Lower Amudarya zone



Middle Amudarya area

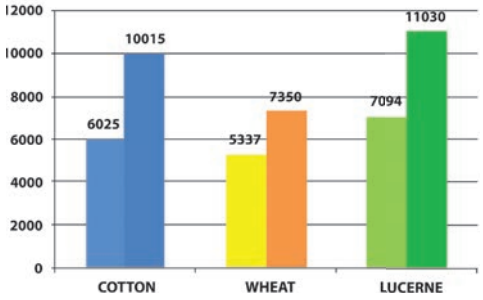


Fig.58. The irrigation norms of agricultural crops for agro-climatic zones of Turkmenistan (m^3 / ha)

The need for additional water resources without taking into account the growth of irrigated area in the future could be 5.5 billion. m^3.

The risk reduction of volume of water resources in the long term necessitates the definition and implementation of a number of adaptation measures to ensure replenishment of the alleged deficiency in the amount of about 5.5 billion. m^3. Therefore, in the present time in the Concept of Water Resources of Turkmenistan until 2030 was taken into account the potential of the water sector, which will carry out these activities and to prepare for the climate change. Among the priority adaptation measures the followings are planned:

• Improving the management of water resources (transition to integrated water resources management - IWRM);

• Optimization of agricultural production distribution, taking into account provision of needs of the country in requested agricultural products and to minimize the use of water resources;

• Implementation of measures to ensure the increase in the coefficient of performance (COP) of irrigation systems;

• Introduction of advanced irrigation methods (drip, sprinkler) and the improvement of existing (traditional) ones;

• Complex reconstruction of irrigated lands (CRIL);

• Implementation of measures for the reclamation of land used (RLU);

• Construction of new water reservoirs;

• Reconstruction of the existing hydraulic structures, ensuring the reduction of losses and rational use of water, etc.;

• Breeding work on cultivation of drought-resistant crops.

While solving the problem of water scarcity it is extremely effective to implement measures to ensure the increase in the coefficient of performance (COP) of irrigation systems. Their technical imperfections in the farms reduce their efficiency COP, which varies by velayats and the average of Turkmenistan is 0.57. The majority of irrigation canals has earthen channel. The length of the earthen channels - 42,760.2 km; channel lined with concrete - 2877.7; trays - 74; pipelines - 2637.5 km. The channels of the second and third level with artificial turf and closed systems (pipes) constitute about 10% of the irrigation network. Bringing efficiency of irrigation systems to 0.65 would save about 14% of irrigation water that will be a significant reserve for the replenishment of water scarcity in the conditions of climate change.

The introduction of advanced irrigation methods showed that the transition from traditional to new ways of irrigation (drip, sprinkler), allows you to save 30-40% of water.

The implementation of adaptation measures will almost completely fill the shortage of water for irrigation, which can be caused by climate change (Annex, Table 9).

In addition to the increasing scarcity of water resources, there is a serious problem - their protection from pollution. The volume of sewage and drainage water is about 5 km3 per year. Before the construction of the Turkmen lake collector-drainage waters is partially discharged into Amudarya, increasing salinity of water in it, and in the lowering of Karakum desert, flooding of pasture lands, where productivity is reduced, which leads to significant deterioration of the ecological condition of the desert as a whole.

In solving these problems is aimed the creation of the ambitious project of the «Altyn Asyr» Turkmen Lake in the Karakum desert. Work on its implementation has started in 2000.

Construction of the lake allows solving a number of environmental and economic problems, including:

- Collect all CDW from the irrigated lands and their subsequent use for business purposes;
- Return to agricultural use about 4,000 km^2 previously flooded desert pastures;
- Normalization of drainage systems, reduction of salinity of soils and groundwater level and as a consequence, increase crop yields by reducing the water level in the reservoirs of interstate Dashoguz 1-1.5 m;
- Termination of discharge into Amudarya CDW from the irrigated lands of Lebap velayat and as a consequence, improve the quality of water in it, promoting public health and environmental conditions in the lower reaches of the river.

On condition that shortage of irrigation water at the level of 5.5 billion m^3, lost production volume could reach 20% by 2030 and the loss of value of crop production only for the 15-years period (2016-2030.) will be about 58777 million manat (20.523 billion USD) according to expert estimates.

Estimation of loss of natural products shows that in the same period shortage of wheat could reach at least 3800 and cotton - 3,180, 000 tones.

Expenses for realization of the planned adaptation measures, according to preliminary estimates, will amount to about 10.5 billion USD.

3.5.2. Healthcare

The climate has a strong impact on human health and welfare. If the climate changes this effect may be direct (personal injury or death as a result of heat strokes and heat stress, of natural disaster), and indirectly, through the spread of diseases (mosquitoes, pathogenic microorganisms transmitted by water, air and water quality, availability and quality of food). Human health depends on the environmental, social and economic conditions, as well as organizational and managerial, technological and adaptation actions aimed at reducing the impact of climate change.

In Turkmenistan population health is an important indicator of the most capacious measures of their quality of life. Concern about the health of the population is one of the priorities of state policy.

Prevention as a complex of socio-economic and medical measures aimed at maintaining the health and longevity of human creativity, involves the removal of diseases causes, primarily due to the improvement of social conditions, the environment, propaganda of healthy lifestyles.

The Government is taking measures to improve water supply and sanitation, improving occupational health and life. Particular attention is paid to the revision of the existing sanitary standards; conduct ongoing monitoring of the environment, industrial activity, the use of chemical protection in agriculture.

A lot of work is carried out in the cities and in the countryside for provision Turkmenistan's population with clean drinking water and adequate sanitation in the framework of the state programs. For example, adoption of the Law on Drinking Water (2010) and the General Program of providing clean drinking water to settlements of Turkmenistan (2011).

State Sanitary and Epidemiological Service of the Ministry of Health and Medical Industry of Turkmenistan (MH & MIT) carries out sanitary surveillance of drinking-water supply to the population. Incidence of intestinal infections is regularly monitored. In the potentially dangerous from the standpoint of epidemic situation territories, the most vulnerable population group vaccination is done against hepatitis A. As a result, from 2008 to 2014 the incidence of hepatitis A has decreased by 38%, and dysentery - 7 times.

The country has 21 plants for production of bottling drinking water, the quality of which is controlled by Service with the issuance of the certificate of conformity. Six water treatment plants in Ashgabat city and in three in regional centers - Turkmenabat, Mary and Dashoguz were built and put into operation in recent years.

To provide population of the coastal areas of the Caspian Sea by drinking water the modern desalination plants operate in the national tourist zone «Avaza» and Khazar town. Under construction are new desalination plants in Turkmenbashi city and Ekerem settlement.

Within the National Program of healthy nutrition of Turkmenistan population for 2013-2017 and the National Strategy for the implementation of the Ashgabat Declaration on the Prevention and Control of Turkmenistan for 2014-2020 are being successfully implemented.

Radiation safety standards and hygienic standards in the field of toxicology have been developed. Improved methods of laboratory testing of environmental objects, including water and food have been approved.

In order to implement the resolutions of the President of Turkmenistan on salt iodization and flour fortification with iron, the production of flour enriched with folic acid and iron, in cooperation with UNICEF, a large-scale prevention of diseases related to micronutrient deficiency is being conducted.

With the assistance of international organizations seminars, conferences and meetings on the quality and safety of food, drinking water, environmental protection and adaptation to climate change are held regularly.

To ensure epidemiological welfare, a wide range of sanitation is realized, epidemiological surveillance of various kinds of infections was organized.

National program «Immunization», designed for the period of 2003-2020 years is successfully implemented. Since 2002, the Government of Turkmenistan has financed the purchase of vaccines and injection equipment in agreement with the UN Children's Fund (UNICEF). Immunizing children is implemented by high quality vaccines, certified by WHO.

Turkmenistan supported the strategic plan of the European Region of WHO «The transition from malaria control to its elimination by 2015». The national program and strategic plan for the elimination of malaria in Turkmenistan have been implemented. Based on the assessment of the malaria situation in the country, in 2010, WHO experts included Turkmenistan in the list of countries which has reached malaria elimination.

Good organization of anti-malarial measures and their implementation gave positive results. Evaluation of the malaria situation in the country which was conducted by WHO experts in 2010, promoted Turkmenistan to be included in the list of the countries that have achieved its elimination. And at the moment actions are carried out to maintain the status of malaria free country.

Much attention is paid to the prevention of tropical and parasitic diseases – issues actual worldwide. The documentation was updated; the reference laboratory for the diagnosis of parasitic and tropical diseases was created.

Protection of Turkmenistan from imported highly dangerous infections is the task of priority importance for the State Sanitary and Epidemiological Service. At all border crossings, airports, railways and highways quarantine offices and centers working around the clock.

In order to enhance human capacity Services regularly train staff, both at the national level and in the leading institutions of various countries in the framework of international cooperation.

The main affordable type of medical care is primary health care (PHC), which gives a complex of health care, therapeutic, preventive and hygiene measures. Currently primary health care services provided by 27 urban health houses, 952 rural centers and 679 rural health houses which are the part of etrap hospitals.

Family doctors were provided with compact, portable devices for the diagnosis of patients at home. Each family doctor services an area with population of 1,000 people.

Within the framework of the National Program of President of Turkmenistan on transformation of village from 2008 to 2014, 9 new etrap hospitals have been commissioned and 49 were reconstructed, 69 rural health houses and centers were built and 37 were renovated. All of them were equipped with modern medical equipment, «first aid» cars were provided with vital medicines.

To improve the quality of care, standards of diagnosis and treatment on an outpatient basis of diseases were developed and began to implement, such as hypertension, coronary heart disease, respiratory diseases and diseases of the gastrointestinal tract, kidneys, and others.

Family doctors and medical sisters (nurses) in the framework of national programs and strategies a great public education outreach on topics such as healthy lifestyles, risk factors, non-communicable diseases, the early development of the child, breast-feeding, respiratory diseases and diarrhea in children are conducted. Follow-up for pregnant and nursing women as well as women of childbearing age are conducted.

A set of measures for the prevention, prophylaxis, and timely detection of patients and their timely medical examination, treatment and rehabilitation led to decrease in morbidity rates, disability and population mortality.

For the 2006-2014 the overall morbidity of the population (Fig. 59) has decreased in 2 times (from 22064.0 to 17690.7), and children - by 17% (from 26,525.8 to 21,932.3).

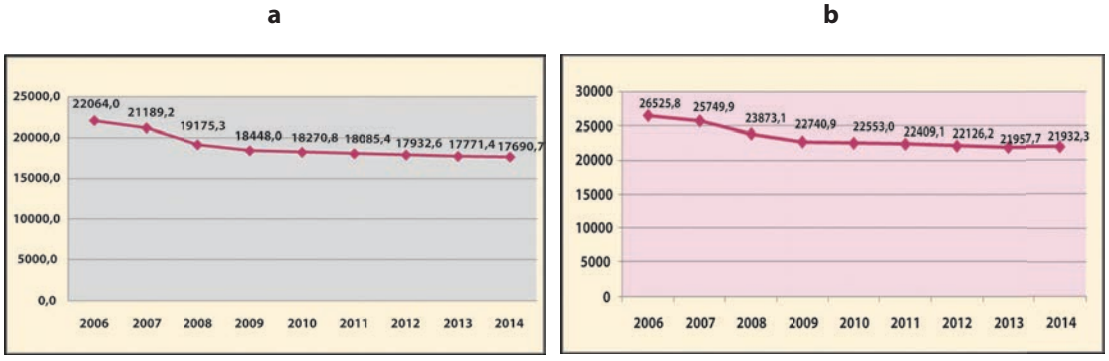


Fig.59. The dynamics of general morbidity of the population (a) of Turkmenistan and children under 14 (b) (for 100,000).

In Turkmenistan for 2006-2014 years the number of patients per 100,000 populations has decreased by main types of diseases. The exception is cancer, the number of which increased by 16%, and this trend is the characteristic for the whole world.

Hypertension, coronary heart disease and cerebrovascular disease are the leading causes of death in the world (with an annual increase), including in Turkmenistan.

During these years, the incidence of cardiovascular disease decreased by 24%, myocardial infarction - 16%, cerebrovascular disease - by 26%.

Respiratory diseases occupy first place in the structure of morbidity. In 2006-2014 this figure decreased to 22% in the country.

Malignant neoplasms are the second highest mortality rate, and more are recorded in persons of working age. In Turkmenistan for the past 9 years, the incidence of neoplasms increased by 16% but increase of this indicator is due to the ability to identify patients in the early stages of the disease through the introduction of modern methods of investigation (screening programs).

Oncology service was integrated into primary health care, and its activities have complex systemic action. The country has implemented the strategy to combat cancer (2008-2010 and 2011-2013), in particular cervical cancer and breast cancer - diseases that are most common.

Among the diseases, about which in recent years has significantly increased the number of references to medical institutions, faster rate compared to other diseases of the endocrine system the growing number of cases of diabetes. This increase to the certain extent is conjugate with improved diagnosis and staging of the disease to the medical registration for the provision of appropriate assistance. Specific gravity of the disease in the structure of endocrine diseases is 22%. In the intervening period the incidence of diabetes increased from 26.3 (2006) to 47.1 (2014).

In order to provide the population with rapid emergency and first aid, the Ambulance's auto park is regularly updated by special transport equipped with communication facilities and modern equipment. In 2006-2014, 824 cars were purchased at the expense of the state budget, of which 743 are «ambulance» cars, 15 reanimation cars, 6 trucks with fluorography setting. Equipping «first aid» cars by means of radio, helped to increase the efficiency of transmission and reception of respective teams' calls, to reduce the time of arrival to the place of call. «First aid» cars in Ashgabat equipped with mobile terminals with GPS-navigation, through which the data about the location and the direction of the traffic, which allows teams to receive the next call without returning to the base.

Center for Emergency Medicine and the Ministry of Health and Medical Industry of Turkmenistan since 2006 uses the latest means of communication for rapid response and management in emergency and emergency situations. Information about response calls of «Ambulance», the movement of patients into health care facilities, emergency, health status of the country, carried out by doctors' tasks through air ambulance from all velayats of the daily management is transferred to the Ministry. There is a helicopter «Super Puma AS 332 L2» in the Office Center of air ambulance and emergency medicine of MH & MP of Turkmenistan, which was provided with necessary equipment for the timely delivery of patients in any medical institution of the country, including the opened capital Center of response.

By Presidential Decree in 2006 the broadband communications system for telemedicine was created.

Telemedicine Center, established in the Directorate of International Medical Center of Ashgabat connects the centers of: cardiology, oncology, internal medicine, disease, head and neck, the hospital «Ene Myahri», the diagnostic center. The last one connected with all diagnostic centers of velayats. It has become the practice of holding Internet consultations by physicians of our country with foreign experts.

Presidential Decree on the improvement of information provision and management measures adopted in April 2010 provides the implementation of the Concept of creation and development of the unified system of interdepartmental electronic document management in the country.

In accordance with the Presidential Decree on the implementation of electronic circulation of documents (2010) currently the system operates in medical institutions in Ashgabat.

The country pays special attention to the development of the pharmaceutical industry based on the use of local raw materials, uninterrupted providing the population and medical institutions of the country by clean and competitive local production of medicinal products.

In the framework of the State Program «Development of Medical Industry of Turkmenistan for 2011-2015» in 2013-2014 six new plants for production of medicines and medical products were created. At present, 10 enterprise associations «Turkmendermansenagat» produce more than 340 kinds of medicines, most of which are included in the list of essential drugs. It produces and sells 50 types of fees medicinal tea, medicinal herbs growing in Turkmenistan. Medications of local production by quality, safety and effectiveness correspond to the relevant international standards.

The country has 20 curative springs. In 2014, the plant on bottling of mineral water «Berzengi» was put into operation, which is recommended for diseases of the gastrointestinal tract and kidneys, diabetes.

The organization of sanatorium treatment and rest of citizens is an important part of the national policy in the field of public health. A network of resorts to restore the health of the citizens operates in the country. In accordance with the National Programme for development of sanatorium services material-technical base of spa facilities has been strengthened in the country. The state has invested more than 200 mln.US dollars for their modernization. New sanatoriums of increased comfort have been built and reconstructed old ones, healing housings were equipped with modern medical equipment, improved health, and cultural and everyday patient cares increased the volume of services and increase their quality.

At present, there are 6 sanatoriums: Archman, Yylysuv, Mollakara, Bayramali, Farap, Dashoguz and sanatorium branch «Berzengi» Hospital with the scientific and clinical cardiology center.

An important role in expanding the network of recreational facilities in the country plays the national tourist zone «Avaza with dozens of health centers and health center for children and adults, holiday homes and hotels, a variety of social and cultural destination for recreation and health of our citizens and foreign visitors.

Currently, the Ministry of Health and Medical Industry have developed measures to prevent and reduce the impact of climate change on public health which were included in the State program «Health» for 2015-2025 years.

These activities include:

1. Raising public awareness, health professionals and policy makers on the impact of climate change on human health to implement the measures in the field of health.
2. Improvement of intersectoral collaboration of the Ministry of Health and Medical Industry of Turkmenistan on issues related to climate change with ministries, UN agencies and international organizations.
3. Science, actual data and information.
4. Strengthening health system.

3.5.3. Soils and land resources

According to the administrative and economic division, the territory of Turkmenistan is distributed as follows: 28.4% - Balkan; 19.9% - Ahal; 17.7% -Mary; 14.9% - Dashoguz; 19.1% - in Lebap velayat.

Soil cover: The geographical position of Turkmenistan determines the uniqueness of its soil. The flat part of the territory is represented mainly by gray-brown soils on Tertiary plateau and in the foothills, takyr- like - in the ancient deltas, sand and desert - in the vast area of the Karakum desert, meadow-alluvial and alluvial - in the river valleys. There are grey-earth and brown soil are in the mountains and foothills. The first ones are developed mainly on diluvial -proluvial loess loam with a mixture of stony inclusions.

The soils of the country are represented by 9 basic types. Most of territory of Turkmenistan is desert-sandy soils. Sandy soils are very poor in humus (0.3-0.5%), but they easy miss and well keep moisture in their horizons, creating at some depth the «suspension» horizon of humidity. Therefore, the vegetation on these soils is much richer than on clay sites.

In the foothills of Kopetdag, Badhyz, Karabil and Koytendag mainly on loess, formed grey earth- classic type of soil of the south part of the Central Asian deserts. Humus content in them can be up to 1.5%; in addition, they have a considerable reserve of phosphorus and potassium. Grey earth is certainly the best desert soils among other ones for agriculture, but they need nitrogen-rich and, above all, they can only be used under irrigation. On the outskirts of the plains, in the ancient delta of Amudarya, Murgab, Tejen and Etrek takyr soil widespread. They contain no more than 0.5% of humus and at depth of 15-30 cm harmful to plants sodium salt are accumulated. It is on the flat part of Turkmenistan takyr soil are the major fund of land suitable for irrigation.

Around the oases in places where drainage water is discharged, marshes wide are spread. After washing with good drainage they can also be used in irrigated agriculture.

Smaller area is occupied by meadow and marsh soils. They are common in almost all the oases in moderate and excessive moisture.

Irrigated soils are the most valuable in the land fund of the oases, which were formed over thousands of years in ancient oases of Kopetdag foothills, valleys and deltas of Amudarya, Murgab, Tejen and Etrek in the condition of irrigated agriculture. Irrigated soils have a powerful 2-meter (and more) agro-irrigation horizon, contain a lot of humus and are characterized by high fertility.

In general, in the structure of the land fund of the country desert and sandy soils (38.9%), grey earth (13.5%), gray-brown (11.4%), and takyrs and like takyr (7.3%) soils, weakly enshrined sands (9.1%), saline (5.5%) and not soil formations (7.5%) are dominated.

In the structure of the land fund of Turkmenistan not salted and slightly saline soils (about 67.3%) are dominated, large enough is the share of moderately saline (8.3%) and very saline (about 5.5%). This is mainly coastal, lake, deltaic and secondary marshes.

From the variety of soil types most suitable for irrigation are bright grey earth, meadow, meadow -takyr, meadow - grey earth, takyr and sandy desert soil.

On the territory of Dashoguz velayat the lands suitable for irrigation are 1,300,000 ha. These are: sites of Vas, Kyrkkyzoy, eastern, western and southern plains of the ancient delta of Amudarya and areas adjacent to the ruins of castles Shasenem and Gyaurkala.

The main land fund of ancient delta plain is presented by takyrs and takyr soils and area of ancient irrigation.

In the valley of the middle reaches of Amudarya are promising for the development of Samson and Sundykli arrays Tallimarjan and Koytendag plains. There are grey earth spread, bright takyrs, and takyr-like, gray-brown and sandy desert soils in the medium and strongly salted sandy, loamy and clayey sediments. In Amudarya floodplain meadow soils are found - mostly laminated loamy sediments underlain at the depth of 1.5-2.0 m by gray sands. The total area suitable for irrigation of Lebap velayat makes 1,363,000 ha.

Significant land resources in the area of Karakum river are concentrated in the basin of Murgab river (370,000 ha). The virgin lands are located in the northern part of the delta and are presented by meadow, takyr-like, sand-desert soils and takyrs that are composed primarily of light-, medium- and heavy and clay deposits.

In the area between Tejen and Murgab Rivers there are large tracts of takyrs, takyr-like and soil of transition type, stacked loamy and clayey sediments underlain at the depth of 1.5-2.0 m sand. Suitable for irrigation the lands lie to the north of the railway and south to Karakum River.

Most of the lands which are suitable for irrigation of Tedjen basin are takyr-meadow soils and takyrs, loamy and clayey sediments underlain at the depth of 1.5-2.0 m sand. The total area of land here is 732,000 ha. More promising lands are distributed mainly in the eastern, north-western and southern plains.

On the northern piedmont plain of Kopetdag most promising for development are takyr soil and light grey earth soil, meadow, prairie and sandy desert soil, replacing each other from north to south. In this area are promising for the development Meana-Chaacha plain area, Serdar etrap territories and other areas. Here bright grey earth and takyr soil are presented.

For the western regions of Turkmenistan gray-brown soils, saline soils, sands and weakly enshrined sands «spots» of sand-desert soils and takyrs are character. Gray-brown soils occupy narrow strip of Greater Balkhan piedmont plain and the northwestern part of the country. On the periphery among the sand areas there are small areas of takyrs. All these soils are composed of sandy loam, clay loam proluvial-alluvial deposits and highly saline. The total area of suitable land for development in the western region of Turkmenistan is about 800 hectares.

Southwestern Turkmenistan is one of the most promising areas of the country for the development of irrigated agriculture. It is dominated by takyrs, takyr-like, gray-brown, sandy desert, meadow alluvial soil and salt marshes. The most promising for ir-

rigated agriculture are Chatsky, Missiriansky, Etrek arrays, tract Choganly and takyrs near ridge Small Balhan.

The western part of the Caspian depression is occupied by salt marshes and semi enshrined sands. Highly saline underground water in the coastal area of the Caspian Sea and in the Valley of Etrek River lies at depth of 3 m. On the other arrays are suitable for development the area with their depth below 10 m. In south-western Turkmenistan the total land area of prospective exploration is 963,000 ha.

Irrigated agriculture entails water logging and salinization of soils along the unlined canals as a result of the infiltration of water through their walls, lifting of ground water and evaporation.

So-called anthropogenic salinization of irrigated land or pasture degradation as a result of overgrazing – the process leading to disruption of the global biosphere mechanism by which photosynthesis occurs and formed phytomass, performs the cycle of substances. It leads to the destruction of fertile soil (humus) soil horizon and, consequently, decreases their productivity.

Scientific-based approach to the use of irrigated arid lands and their rational exploitation will not only provide the population with food and livestock feed, get organic raw materials in amount of 4-5 times the current level, but also to eliminate the threat of global pollution of the biosphere as a result of excessive carbon dioxide emissions.

Important in the prevention of soil erosion have agro-forestry activities, including the establishment of shelter belts. This is powerful, long-term environmental factors are contributing to the stability of agricultural production and the transition to sustainable development. In protected areas significantly improved geothermal regime, in 3 times increase absorption of carbon dioxide and other greenhouse gas emissions, optimizing the process of soil formation.

Sustainable use and conservation of land resources, the effectiveness of the relationship of land use has a direct impact on the socio-economic development of the country and its productive forces.

In the process of land use in agriculture and other sectors of the economy is changing their quality. Currently, the process of human impact on the land has intensified. Along with global climate change and the influence of other environmental factors, this leads to desertification of large areas, increase the volume of mineralized drainage flow, salinity, erosion, pollution, soil compaction, etc., and in general, land degradation.

Climate change will exacerbate these effects, causing more frequent occurrence of drought and high summer temperatures. The lack of moisture and high temperatures will reduce the productivity of agricultural lands and their further salinization.

On this basis, it is necessary to develop a new system of agriculture, the conservation and improvement of soil quality. It is necessary to use new methods of soil cultivation to ensure the accumulation of humus and enhancing of biological processes in it by stabilizing its upper layer.

To date, these are moldboardless plowing, processing by flat hoe, peri-

odic deep tillage, alternative methods of use of fertilizers and irrigation, including a reduction in standards of mineral fertilizers and pesticides, and others. The system shall include as an essential element of the crop rotation, enriching the soil with organic substances (green manure, sowing of intermediates crops, etc.) In order to study the effects of climate change on soil fertility it is need to conduct a comprehensive inventory of natural resources with the detailed characteristics of the irrigated, rainfed and pasture lands of the country. This requires organizing a large-scale study (or large-scale mapping) by using pictures from space and modern GIS technologies.

To explore the mechanisms and limits of climate change impacts on cultivated and virgin soils is necessary to analyze the current soil-reclamation, physical, chemical and ecological status of the territories, and to develop agro-technical measures aimed at restoring and improving soil fertility.

In order to create a legal framework that ensures the deepening of economic reforms in terms of introduction of market relations, as well as rational use and protection of land it is necessary to improve land legislation. It is necessary to develop the mechanism for stimulating the rational use and increase soil fertility, increase the responsibility of land users, tenants and land owners for violation of land legislation.

In order to improve the soil fertility is recommended:

- Usage of fertilizers on the scientific basis;
- Implement and strictly comply with the science-based field crop rotation;
- Conduct consistent melioration through drainage network on the salinized territories.

3.5.4. Biological diversity

Natural ecosystems support conditions necessary for life on earth: clean air and water, stabilize and mediate the climate, restore soil fertility, recycle waste and others. Each species performs its special function and in full cannot be replaced with another. The collection of all kinds helps to maintain the life of our planet. The components of biodiversity are the source of the genetic material.

It is vitally important biosphere functions of biodiversity - maintaining stable environmental conditions, in other words, the ecosystem services provided by biodiversity components. The components of biodiversity and formed by them their natural communities played a crucial role in creating and maintaining environment fit for life.

Due to its geographical location, Turkmenistan plays a key role in maintaining of global biodiversity and maintenance functions of the biosphere. Very continental, extremely dry climate (long and hot summer, seasonal and daily variations in temperature within wide limits, low rainfall) and the geographical position of the country within the Eurasian continent greatly influenced the formation of the unique diversity of its flora and fauna.

Biological diversity of Turkmenistan plays an important role in the economy, culture and traditions of the people. Wildlife landscapes of Turkmenistan largely caused the presence of certain traditions of the people, its culture and formed the spiritual world.

The rich flora and fauna of the country and relatively well-studied of individual components of biological diversity allow characterizing its condition in the past and at the present stage of development of society, to give a definite forecast of the likely impact of climate change on biodiversity.

Biodiversity of wetlands, including the Caspian Sea. The main wetlands of the country are bays on the Turkmen coast of the South-East of the Caspian Sea, the valley of Amudarya River, Murgab RiverValley, Etrek and Karakum River (former Karakum canal), including lakes and reservoirs in the area of their influence, as well as Lake Sarykamysh.

Wetlands of coast of South-East Caspian -Turkmenbashi, North Cheleken, Balkan, Mikhailovsky and Turkmen bays play a crucial role in the life of waterfowl, especially during migration and wintering. On the coast of South-East Caspian acts Hazar State Nature Reserve with Ogurjaly Reserve and buffer zone, an area of 268,000 ha, or 12.44% of the total area of protected areas of the country. From 2007 winter Registry water birds on the coast of the Caspian Sea are conducted, which show decrease in the number of wintering birds, that, first of all, is a consequence of the widespread reduction in their numbers. At the same time over the past 20 years species diversity has enriched at the expense of these new species to the region, as glaucous gull *(Larus giperboreus),* long-tailed skua *(Stercorarius longicaqudus),* masked shrike *(Lanius nubicus),* or Uragus tailed bullfinch *(Uragus sibiricus),* Lapland Plantain *(Calcarius lapponicus),* Dubrovnik *(Emberiza aureola).* One possible reason is Climate Change.

Since 2000, as a result of large-scale construction project in the north-western part of the Karakum Turkmen Lake «Altyn Asyr» and Main collector supply it with discharge drainage water in Turkmenistan, the geography of the wetlands expands. 67 wetlands were distinguished, and more than 120 species of waterfowl have been recorded in the hydrographical net of the lake. Creating of this large hydraulic structure played a crucial role in the adaptation to climate change of many representatives of biodiversity.

Biodiversity of the river ecosystem: Biodiversity of inland waters is the important source of the country's population with food, receipt of income and livelihood. River ecosystems provide preservation of hydro-biological balance and habitats for different plants and animals. Along the plains (Amudarya and Murgab) and mountain (Sumbar, Chandyr, Etrek etc.) rivers of Turkmenistan are formed terrace relict forests of elm *(Ulmus)*, poplar *(Populus),* ash *(Fraxinus),* tamarisk *(Tamarix),* and others. Modern tugai complexes in the floodplain of Amudarya and Murgab with their inflows were developed and degraded today to varying degrees, taking intermittent sections of length from 50 to 500 m, and in some places more than 1 km. As a result of degradation of Tugais from communities in some places willow *(Salixacmophylla, S. excelsa)* and Turanga *(Populus pruinosa)* have disappeared. The most valuable species for the ecosystem is licorice root *(Glycyrrhiza glabra)*. The delta of Etrek, which is the largest mountain river of Southwestern Kopetdag, today because of the lack of water is practically lost its former importance in the preservation and maintenance of biodiversity, including tugai forests. By forces of the state reserves a lot of work carried out to expand their area. Fauna of river freshwater

ecosystems, with some exceptions, includes almost all representatives of its inland waters. From amphibians there are green and danatensis *(Bufoviridis, B. danatensis)* toads, frogs *(Ranamacrocnemis, R. nigromaculata, and R. ridibunda)*, a lot of lizards and snakes. Among the mammals are found wild boar *(Susscrofa),* otter *(Lutralutra),* muskrat *(Ondatrazibethicus)* and coypu *(Myocastorcoypus)*. The severe winter in 2008 greatly affected the condition of the last two species. The number of tugai deer *(Cervuselaphusbactrianus),* was on the verge of extinction, thanks to the taken measures has stabilized and has a tendency to a slight increase. Main place of its habitat are protected by Amudarya State Nature Reserve. Shortening of the area of tugais at different times adversely affected the francolins *(Francolinusfrancolinus),* pheasant *(Phasianuscolchicus)*. Carried out researches on the river Amudarya of the state of large and small Amudarya shovelnose *(Pseudoscaphirhynchuskaufmanni, P. hermanni)* indicated that their number remains stable at a low level, due to which both species are in the Red Data Book of Turkmenistan.

Biodiversity of mountain ecosystems. Mountain ecosystems of the country are located in its southern and south-eastern parts: Kopetdag, Big Balkan and Koytendag - in the south-western tip of the Hissar ridge of Pamir-Alai mountain system, between them - the hill and Badhyz and Karabil, Kopetdag, Koytendag and Badkhyz - «hot spots» of biodiversity concentration, is the center of origin of many cultivated species, and isolated natural foci of relic. It is here that focused a great variety of ecosystems and species, including endemic species, the genetic diversity of agricultural crops and their wild relatives. There are 2/3 of the terrestrial vertebrate species of the country in the mountains and foothills.

About 2000 grow plant species in Kopetdag and cross border areas of 332 (or 18%) of endemic and sub-endemic species of Kopetdag-Horasan relationship. Great Balhan is the habitat of 475 species of vascular plants; Koytendag is the habitat of 982 species, including 39 local endemics. More than 2000 species of local flora contain biologically active substances.

Prolonged and excessive load on the pasture *(overgrazing)* had a negative impact on the state of indigenous plant communities *(juniper, mountain feather-fescue steppes, shibliak communities),* has led to soil erosion and compaction, reduction of moisture. In recent years there a lot of work has been done to restore juniper.

Biodiversity of desert ecosystems. The main part of the country is occupied by arid desert ecosystems, which, despite the fact that they have relatively poor biodiversity, play an important role in maintaining the environment and the provision of ecosystem services. In addition, Turan lowland, which includes the Karakum desert, is considered to be the place of origin of a large number of invertebrate species.

The sandy desert of Karakum 757 species of higher plants grow, including 25 endemic. Semi-shrubby vegetation and saxaul, mixed white saxaul, wormwood, saltwort, ephemeral-wormwood and other formations are dominated. From trees and shrubs are dominated white saxaul *(Haloxylonpersicum)* and black *(H. aphyllum)* and types of sand acacia *(Ammodendronconollyi, A. karelinii)*.

Full gasification of settlements of the country had a positive impact on the condition of trees and shrubs in desert ecosystems.

Biodiversity of forest ecosystems. The forest fund of the country is represented by natural mountain *(juniper, pistachio),* tugai and desert *(saxaul)* forests, which occupy 8.68% of its total area. The largest area is occupied by sand-desert (3,958,000 ha) and mountain (146,000 ha) forests. The area of artificial forest belts expands. At the foothills of Kopetdag, around Ashgabat and other major population centers of the country, an area of over 100,000 ha forest -park zone *(«green belt»)* has been created from coniferous and deciduous trees and shrubs (1998-2014). This work is continuing successfully.

Mountain juniper *(Juniperus) (Juniperus turcomanica, J. zeravschanica),* pistachio *(Pistaciavera)* and deciduous forests *(Acer turcomanica, Celtiscaucasica, Ficuscarica, Berberis turcomanica, Crataegus pontica and others)* ravines of Kopetdag, Greater Balhan and Koytendag are major factor of sustainable conservation of mountain ecosystems .

By the 90th years of XX century the area of juniper has declined by more than 30%, and they went up to 500-700 m from their optimum, compared with the beginning of the century. A huge work carried out by the government for the gasification of settlements, contributed to the prevention of reduction of the juniper area. In order to attract public attention to the decisive role of juniper in the preservation of biotic and abiotic environmental factors this species was introduced in the second edition of the Red Data Book of Turkmenistan. The protection of natural juniper was enhanced, as well as work to expand the area of artificial afforestation. To date, it was succeeded not only to manage stopping the decline, but the trend towards expansion of their area, which has caused non-inclusion of juniper in the third edition of the Red Data Book of the country.

In 2013, the National Forest Programme of Turkmenistan was adopted to play a key role in the preservation of natural forests and expansion of their area, as well as the creation of artificial forest plantations. It provides solutions to the problem of preservation of forest resources, as well as plan of action to increase the forest area for the period up to 2020. The adoption in 2011 Forest Code, helped raise awareness of the population and relevant bodies to the importance of conservation and expansion of forest plantations. Since 2013 there is a forest inventory and survey, materials for the management are gathered, state accounting of forest resources and forest inventory is conducted. In the area of influence of Aral Sea crisis, in the north of the country, in order to reduce its impact a lot of work on planting on the area of 20,000 ha was developed; mainly desert plants - saxaul, kandym and others. Research programs aimed at restoration of juniper forests and the establishment of forest plantations pistachios, including the desert areas is being implemented. Preventing of fragmentation and reforestation is an important factor in adapting to the impacts of climate change.

Impact of climate change on biodiversity in Turkmenistan. The problem of biodiversity loss has a special place among the major environmental problems of our time. Therefore, its preservation and maintenance is put forward as an important criterion for sustainable development of Turkmenistan.

In 50-60 years of the twentieth century from the fauna of the country Turan tiger *(Pantheratigris),* Asiatic cheetah *(Acinonyxjubatus),* as well as flake woodpecker *(Picussquamatus),* inhabiting Murgab river reeds have disappeared. Since the late 70s in ravines and valleys of the Southwestern Kopetdag great spotted *(Dendrocopos (Picoides) major)* and green *(Picussquamatus)* woodpeckers are not found. From Central Kopetdag flora

Astragalus zolotistokolosy *(Astragaluschrysostachys)* has disappeared, and in the South-West medlar *(Mespilusgermanica),* which grows only in the ravine Gyuen *(river Chandyr)* is not found.

The causes of biodiversity loss are complex, and not only in the national but also at regional and global aspects. The most typical of these are the reduction of habitat of species, the excessive consumption of natural resources, the impact of alien species, climate change, anthropogenic factor *(land reclamation, pollution of environment).* Any living organism adapts to climate change, and usually it does not interfere with the survival of ecosystems, but due to the remarkably rapid pace of change, he does not have time to adapt or to more favorable habitats for him.

Studies on biodiversity and the preservation of its components show that in Turkmenistan climate change has certain effect on it as a result from the recent years. This effect is not so clearly, such as the disappearance from the fauna and flora of the country this or other species. In particular, in the lower reaches of Etrek river due to the lack of water for a long time (as in the catchment area in the territory of neighboring Iran is completely disassembled for watering), some types of fish lived here have disappeared. Such local character changes lead to significant restructuring of ecosystems. Furthermore, due to the decrease in precipitation and temperature rise in recent years, desert pastures yields reduce.

At the same time, the diversity of fauna species of the country over the past few years has been enriched. Climate change will lead to a shift in the boundaries of species; new ones penetrate into the country, particularly at the borders of the area. This can be established by means of continuous monitoring. In particular, due to the expansion of the range of some representatives of fauna, primarily birds (caused primarily by climate change on the global scale), new species fly for wintering in Turkmenistan previously hibernating just south of our borders - gray crane *(Grusgrus)* , osprey *(Pandionchaliaetus)*, some waders. Expansion of the range observed for the 5 species of birds that have become new for the Eastern Caspian region: the masked shrike *(Laniusnubicus),* the snow finch *(sparrow) (Montifringillanivalis),* Persian *(Prunellaocularis)* and Alpine *(P. sollaris)* dunnock, flycatcher flycatcher *(Ficedula hypoleuca)*.

8 new species of avifauna of Turkmenistan have been registered: these are suhonos *(Ansercygnoides),* Kumai *(Gypshimalaiensis),* glaucous gull, Parrot Kramer *(Psittaculakrameri),* Asian Koel *(Eudynamysscolopaceus)*, Uragus *(Uragussibiricus)*, Lapland Bunting *(Calcarius (Plectrophenax) lapponicus),* Dubrovnik *(Emberizaaureola)*. The problem of preservation and rational use of water resources is one of the most important issues for the economy as a whole and for the conservation of natural ecosystems in adapting to climate change.

In this regard, it should be emphasized the role of the Turkmen Lake «Altyn Asyr». This is the largest body in the region of water reservoir of drainage water which helps to improve the ecological status of the plains and desert areas of the country. In the lake, in its main reservoirs fish, wetland birds live; in the vicinity - some species of mammals, some moisture-loving plants. On the one hand, greatly enriched the biodiversity of the desert zone, on the other - favorable conditions for the habitat of its various representatives have been created, and the expansion of the area.

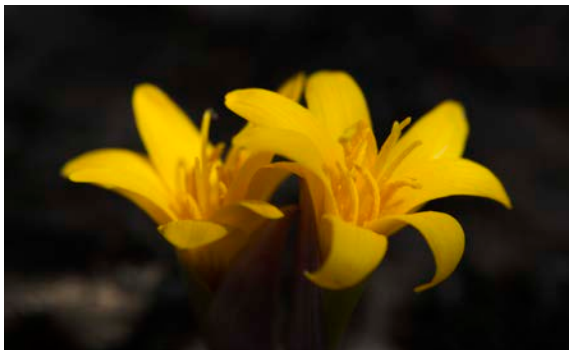
A quite clear correlation between the biological and chemical properties of water due to changes in its temperature is traced. Change in water quality is particularly noticeable during dry years and in years with its low level. It is accompanied by a decrease in dissolved oxygen in the water, pollution of it by hydrogen sulfide, increasing concentration of mineral salts to the characteristics of «tough» and «very tough». It is a violation of population growth and biomass of phytoplankton and periphyton, which in turn affects the state of higher aquatic and semi-aquatic vegetation and wildlife. The climate in the desert zone (high temperature, low rainfall, strong solar radiation, etc.) has a significant impact on the behavior of land animals - one of the most flexible systems of individuals and populations to adapt to the environmental change. This is largely due to the ability of an animal to change throughout its life. The results of observations show that at this stage of climate change by representatives of the animal world, especially the most «mobile» are birds, better adapt to its effects, than plants.

Another area of adaptation of flora and fauna representatives to climate change is the change of phenological processes occurring in their body. Development poikilotherms in relation to climate change begin at an earlier date and ends earlier. Early waking (January 21) and the beginning of the breeding season (February 26), for example, danatensis toads were registered unusually warm winter of 2007, when the afternoon temperature was 14-26ºC. The period of larval development of high saxaul Gorbatka (Dericorisalbidula) in the dry 2008 lasted 44 days, and in the wet 2009 - 55 days.

In recent years, more and more often there are cases of violation of ecosystems due to excessive increase in the number of insects, especially representatives of squad Orthoptera. In 2005-2008 Moroccan locust distribution area (Dociostaurusmaroccanus) in the country increased from 30,869 to 287,010 ha, which is almost 10 times. Outbreak of increasing the number of high saxaul Gorbatka in 2007-2008 (On the same bush haloxylon was noted between 200 and 500 young larvae) has resulted in damage to the saxaul that are not recovered even the next year. It is believed that such a significant increase in the number of these types the climate change played a definite role. In all these cases, there is violation of the ecological balance in natural ecosystems with relevant consequences. Pest control using chemicals adversely affects the functioning of the ecosystem in which insects live.

Effective adaptation measure in the sandy deserts and mountains can be reforested. To do this, you must first collect exhaustive material on the natural environment, information regarding the management of sand and mountain areas. These data should serve as the basis for the development of the project on reforestation.

The major limiting factor for the development of vegetation in the desert areas is water. With scanty rainfall forests can be only created from drought-resistant plants. A unique microclimate is formed in the growing areas of desert forests that have a beneficial impact on the environment. In the forest stands the number of species of herba-



ceous vegetation increased by almost 2 and their productivity in the spring - in 2-3 times, which increases the productivity of pastures.

Kopetdag mountain ecosystems in the reforestation should be considered by:

• Climatic factors (rainfall, temperature regime of the area, etc.);

• Relief (shape and exposure of slopes, their length and slope, size and form of catchment areas, the level of erosion basis);

• The nature of the soil-forming processes, the type of soil and its structure, the degree of covering vegetation, human activities.

In conditions of climate change the priority is to grow native plant species that have adapted to local conditions.

CHAPTER 4. ASSESSMENT OF MEASURES TO MITIGATE CLIMATE CHANGE

4.1. Current trends in energy consumption

The dynamic development of Turkmenistan's economy and population growth has led to increased production and consumption of fuel and energy resources.

Turkmenistan with vast oil and gas reserves almost entirely meets the needs of the country's energy resources.

Fuel and energy resources (FER) of Turkmenistan grew by 48.1% in 2012 compared to 2000, and amounted to 76.7 million toe. There was a decrease in the production of energy resources caused by the global financial crisis in 2009-2010. Since 2011, the volume of production of FER had been increasing and by 2012 had reached the level of 2008 (Fig. 60).

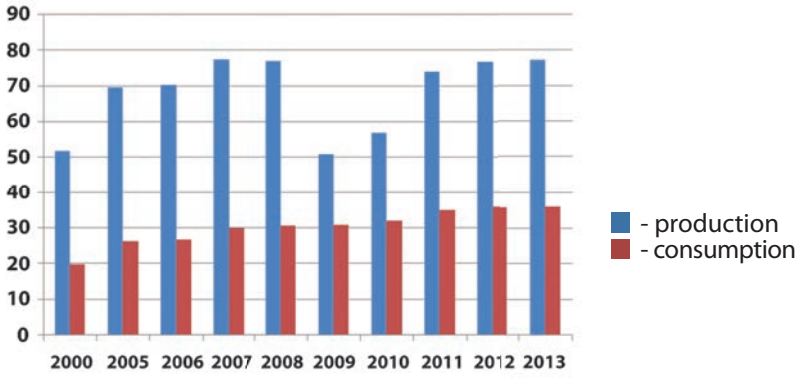


Fig.60. Production and consumption of FER, million toe.

Consumption of FER, compared to their production, was growing even more rapidly in 2000-2012. If in 2000, 19.7 million toe of primary and secondary resources was consumed, in 2012, this index increased by more than 1.8 times and amounted to 35.8 million.

The energy consumption in the structure of FER production increased from 38.1% - in 2000, to 46.7% - in 2012.

The analysis of actual production and consumption of FER, conducted under preparation of the Third National Communication of Turkmenistan under the UN Framework Convention on Climate Change indicates on their change in comparison with the data of the Second National Communication.

In the structure of FER production (01.01.2015), the share of the so-called primary energy resources - oil and gas, accounts for almost 86.1%, while natural gas accounts for 73.1%.

The share of the secondary energy resources in 2014 amounted to 13.9%. In their structure 41.2% falls for electric power.

In the total volume of FER consumption, gas is their main component. Its consumption was 65.4 % in 2012, and compared to 2000 increased by more than twice (209.4%), and since 2008 - by 1.3.

One of the main factors of growth in gas consumption was 2.1-fold increase in power generation, which is produced in Turkmenistan predominantly using the most environmentally safe type of primary energy.

The growth rate of domestic oil consumption amounted to 142% in 2000-2012, in particular, in 2012; its part in its general structure was 23%.

Despite the intensive growth in domestic energy market, fuel and energy complex as a whole continues to maintain the high export orientation. As known, the basis of the country's exports is mainly gas, oil and oil products. Exports of energy resources accounted for more than 60% in 2000, and in 2012 - 53.3%.

In 2012, in the total volume of energy production gas exports amounted to 58.8%; oil - 28.6%; oil products - about 60%; electricity - 13.4%. The main directions of export supplies of fuel and energy are China (57% of the total) and Russia (26.5%). In 2012, China received nearly 22 million toe of Turkmenistan's energy resources, including 21.9 million toe of gas.

In the structure of total volume of energy exports, the share of crude oil accounted for 8%, oil – 10%, power - 0.6%. In 2012, the energy intensity of GDP in PPP for production was 0.69 toe / USD and compared to 2000, it decreased by 65%, and since 2008 - by 41%.

The Second National Communication provided the plan data of energy intensity on energy production for 2010 at 1.7 toe / USD in PPP, but in fact, the figure was 0.60 toe / USD in PPP. Hence, actual energy intensity of GDP for production of energy fell by 64.7% compared to the calculation data (Fig.61).

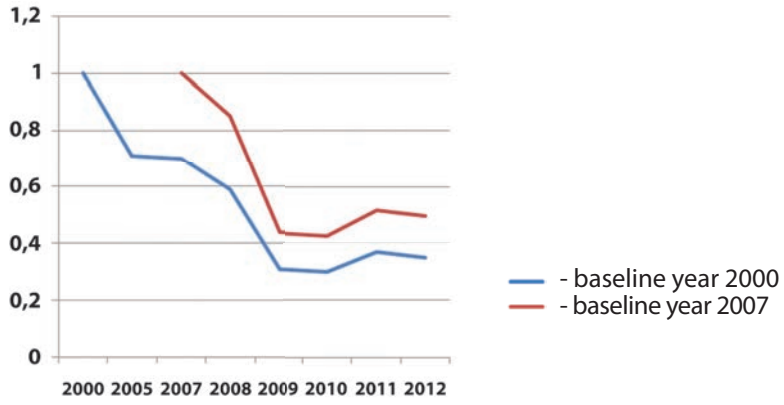


Fig.61. Dynamics of energy intensity on energy production

Despite the absolute increase in the consumption of FER, energy intensity index of GDP in PPP on energy consumption in 2012 decreased compared to 2000 by 57% and amounted to 0.32 toe / USD in PPP. This was caused by increase in the dynamics of growth of GDP in PPP in 4.2 times.

In the Second National Communication, energy intensity on energy consumption was projected at 0.48 toe / USD in PPP but in fact, this figure in 2010 was 0.34 that is it decreased by 29% (Fig. 4.3).

If consider 2007 as a baseline, the figure of energy intensity of GDP in PPP on consumption in 2012 was 39% below the level of 2007, while the GDP volume growth in PPP in 1.97 times (Fig. 62).

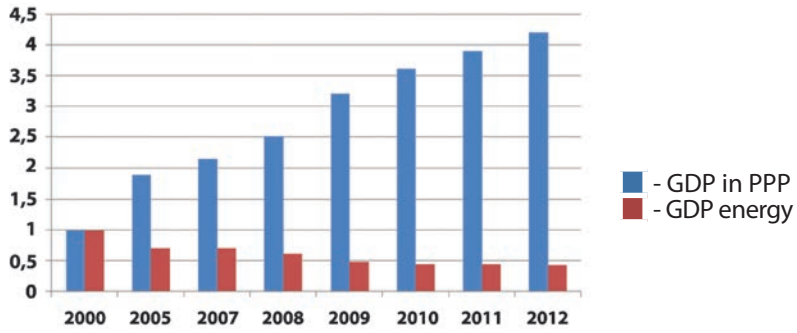


Fig.62. Dynamics of GDP and GDP energy intensity on consumption

High rates of decline in the energy intensity of GDP in PPP in 2008-2012 identified the average annual elasticity indicator of energy consumption, which in 2012 was 0.30, that is, under GDP growth by 1% during this period the energy consumption increased by 0.30%.

The final consumption of FER in 2000-2012 was growing at a more moderate pace than the total. In 2012, without regard to the loss of primary and secondary energy resources in networks, as well as the resources used as a raw material component in the manufacturing process, in the socio-economic sphere of Turkmenistan 18,653,200 toe of FER was consumed. The volume of FER consumption in 2012 compared to 2000 increased by 65%, and compared to 2008 - 18%. In 2000, the final consumption of FER in its total volume was 57%, and in 2012 - 52%. This was mainly due to increased volume of crude oil refined into products with a higher added value.

In the real sector of the economy, the most energy-intensive branch is **industry:** in 2012, 40.5% of primary and secondary energy resources were used, and in 2000 - 35.4%. Compared to 2000, energy consumption by industry increased at 1.9 times, and compared to 2008 - 1.2.

The largest consumer of FER is **population.** Its share in 2012 accounted for 38.2% of the total final consumption. The positive factor is declining of this figure compared to 2000, when it stood at 41.6%. The rate of growth of energy consumption by population in 2000-2012 amounted to 151.8%, in 2008-2012. - 114.7% (including housing services and utilities - 192.4% and 116.6% - respectively).

Agriculture in 2012 consumed 10.4% of the volume of final energy consumption, construction - 1.6%; transport - 6.5%; other industries - 2.8%. In comparison with 2000, energy consumption in agriculture of the country increased by 1.6 times, and in 2008 – by 1.2.

In 2000-2012, high (156%) growth rates of FER consumption were marked in the **transport sector** resulted by increasing number of transport including transit cargo transportation. Over 2008-2012 period, this figure has increased by 17.3%.

The growth rate of FER consumption in the **construction industry** for 2000-2012 has increased by 1.3 times.

In the structure of final FER consumption, its major share (about 80% in 2012) belongs to **gas.** For 2000-2012, this figure has increased by 1.7 times, and for 2008-2012 – by 1.2.

The main consumer of gas is **industry** that in 2012 used 46.6% of gas consumed by the country, while in 2000 - 41.1%. From 2000 to 2012, the gas consumption double increased, and compared to 2008 – in 1.2 times. The most part is consumed by **power industry** (80-85%) as a raw component for electricity production.

Compared to 2000, in 2012 the gas consumption by **population** increased by 1.5 % times and since 2008 - by 15%. Along with this, in the sectoral structure of gas consumption over this period there is a decrease of this figure from 50.2% to 43.1%.

In 2000-2012, the gas consumption rate in **agriculture** increased, mainly due to intensification of vegetable and animal husbandry by private farms (greenhouses, heated rooms for cattle). The gas consumption in 2012 compared to 2000 increased by 2.3% times and comparing to 2008 – by 1.2%. In 2012, the share of agriculture accounted for 5.9% of the total consumption against 4.4% in 2000.

Gasoline as a motor fuel is also one of the major energy sources. In the structure of energy consumption in 2012, its share was approximately 7%. For 2000-2012, the volume of gasoline consumption increased by 1.4 times, and for 2008-2012 – by 3.3%. Its main consumers are transport, agriculture and population: 31.3%, 27.4% and 32.7% - respectively.

The share of **diesel fuel** amounted for 5.9% of the volume of final consumption of FER in 2012. Its main consumers are agriculture (36.8%), transportation (47.1%), construction (8.4%) and industry (7.7 %).

In 2012 compared to 2000, the final consumption of **electricity** increased by 66%, and compared to 2008 – by 21%. Its share in the total consumption of FER in 2012 was 6.1%. The largest consumer of electricity is industry: in 2012 - 34.9% of the total consumption. In agriculture, the figure was 22.4%, the share of the population accounted for 21.7%, the construction industry - 5.3%, transport - 4.1% (Annex, Table 10).

The highest growth rates of energy consumption were marked in construction - 6.5 times, transport infrastructure - 1.9, the consumption by population - 1.8, agriculture - 1.6, industry - 1.3 times. High rates of energy consumption in construction are driven by active investment policy.

The growth of energy consumption in Turkmenistan has led to increase in CO_2 emissions. Because of high rates of economic development, decrease tendency has been noticed in carbon intensity index.

Regarding 2000, the carbon intensity index in 2012 was 0.47 (53% lower), and regarding 2007 - 0,63 (for 37%).

According to data provided in the Second National Communication, in 2010, this figure was 0.74, the Third National Communication - 0.51, which is a positive factor and it is driven by the growth of GDP in PPP and the reduction of CO_2 emissions (Fig. 63).

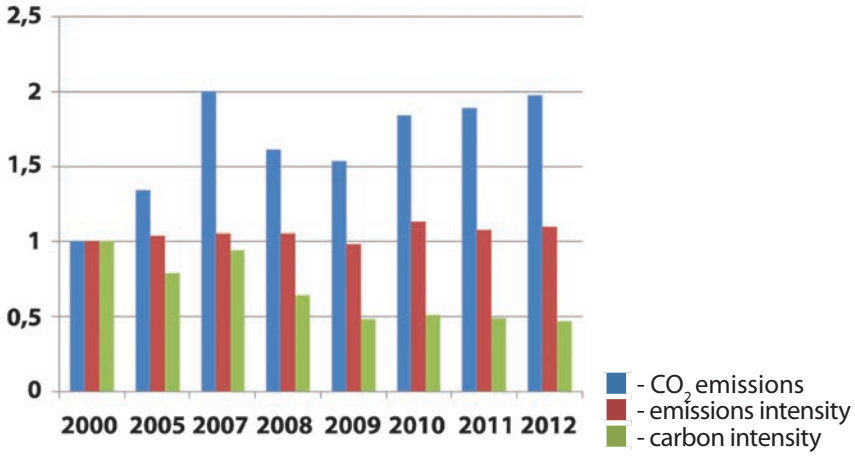


Fig.63. Dynamics of CO2 emissions, their intensity and carbon intensity of the economy

4. 2. Projection of energy consumption in Turkmenistan until 2030

The energy consumption scope in Turkmenistan until 2030 was projected based on two scenarios of the economic development - baseline and innovative.

The **baseline scenario** envisages implementation of measures under the National Programme of socio-economic development of Turkmenistan for the period of 2011-2030 in accordance with the needs of the state's economy, its active modernization and transition to industrial-innovative development.

The **innovative scenario** is focused on intensification of innovative processes, energy saving in all areas of social and economic life on the basis of modernization of the economy, technological renovation of production, taking into account environmental requirements, organization of legislative framework aimed at development and introduction of appropriate measures.

4.2.1. Common approaches for economic development under the baseline scenario

The economic growth of Turkmenistan in the future will be performed in accordance with industrial-innovative development direction, proclaimed by the President of Turkmenistan Gurbanguly Berdimuhammedov as a basic direction of its modernization.

The qualitative characteristics of the economic development will be identified, first of all, by the rich mineral resource potential of the country. In addition, production, processing and export of hydrocarbons will be a priority for development of the economy that will rapidly help to carry out structural reforms in the socio-economic sphere.

The baseline scenario is aimed to comply with needs of the economy and activities of the National Programme of the socio-economic development of Turkmenistan for the period of 2011-2030, plan programs for 2007-2014, legislative and regulatory acts.

Under these programs, the economic policy of Turkmenistan in the future (until 2030) is aimed at ensuring sustainable and balanced growth through its diversification and increase of competitiveness, gradual transfer to the industrial-innovative development.

During the first five-year period (2012-2016) with a purpose to maintain high economic growth rates, it was envisaged to establish favorable macroeconomic conditions for accelerated development of all its branches. It is supposed to ensure GDP growth of

10,8 -12,0%. After reaching such growth rates, nominal GDP volume compared to 2012 will almost double increase and GDP per capita in purchasing power parity (PPP) in 2016 will exceed 23 thousand USD.

Industry will continue making a significant contribution to GDP structure, its share in 2016 will be 55% against 52% in 2012. Thus, over 2012-2016 period the scope of industrial production will increase by 1.5 times, agriculture - by 1.3 times, construction - 12%, transport and communication - 1.3 times, services - 13%.

In the long-term future (until 2030), it is envisaged to support high rates of growth in all sectors of the economy. Over 2016-2030 period, the average annual GDP growth rate is expected to reach 106.3%.

High economic growth rates will be achieved mainly due to intensive development of production sectors, share of which in the volume of GDP will be 60-70%. At the same time, the main «engine» of growth will be the industry, the share of which will be accounted for almost half of GDP.

During the predicted period, the policy of increasing exports of hydrocarbons will be continued, and the gained profit will be directed as before to accelerated development of manufacturing industries. This will lead to further diversification and export potential of the economy, providing the domestic market with goods of domestic production. Quality indicators of industrial growth of the country will be improved, where non-hydrocarbon sector branches will play more important role.

The second most important industry in this period will be construction. The implementation of the National Program of the President of Turkmenistan on improvement of social and living conditions in villages, towns, cities, districts and district centers for the period up to 2020, housing and urban development programs, international transnational gas pipeline projects and transport corridors, modernization of existing and creation of new industries, etc. will ensure the maintenance of high average annual growth rate of gross domestic product of this economy sector. It is predicted that they will amount to 114-115%. However, as a result of structural reforms (increasing the share of services), there is a tendency of declining its share in GDP (see «Scenarios of economic development of Turkmenistan until 2030»).

Average annual growth of value added in the agriculture is projected to amount to 110-112%, and its share in GDP - 11.9%. The key factors in achieving this growth will be: further deepening of reforms in this sector; improving the efficiency of large-scale production (farmers' associations), while encouraging the development of small farms and private farms; improving regional specialization; improving crop area structure and land reclamation; sustainable land and water use; improving selection and breeding; widespread introduction of new technologies of cultivation of agricultural crops; increasing production of feed; improving infrastructure for processing and marketing of products.

It is expected that in the future about 30-40% of GDP will be achieved at the expense of sectors providing services. Transport, trade, education and health care, tourism, banking, and others will be further developed.

All this will provide the country a higher level of economic development, improvement of population welfare and GDP increase in PPP by 2030 compared to 2016 by 2.3 times (see. «Scenarios of economic development of Turkmenistan until 2030»).

The industry remains to serve as the base branch for solution of tasks for promoting the economy of the country to the pace set for its development.

Given the international experience, the policy in the area of industry development for the period up to 2030 will be based on the use of comparative advantages of the economy of Turkmenistan among that availability of rich hydrocarbon potential is a major one. Revenues from natural resources will, as before, be directed to diversification of the underlying assets - creating new industries and industries with higher added value, both in the processing and mining industry sector, human capital development, public service, private entrepreneurship. This strategy gives a better chance to achieve long-term results.

In this regard, the traditional focus of industrial growth will be further dynamic development of the **fuel and energy complex.** According to the medium-term program, in 2012-2016, FER production will be increased by 1.6 times: gas - 1.74 times; oil - 6%, oil and gas processing products - 1.3 times, electricity - by 12%. By 2030, compared to 2016, the volume of gas production will be increased by 1.9 times, oil - 5.7, refined oil products - by 3 times. The fuel and energy complex in the distant future will remain to be the basic structure of the state's economy driven by the growth of the world economy needs for energy resources.

In the **power sector,** according to the Concept of development of electric power industry of Turkmenistan for 2013-2020 foreseeing a large-scale modernization of the country by 2016, the first stage of its implementation (2013-2016.), it is planned to increase electricity production in comparison with 2000 in 2, 3 times, and in 2007 - 1.5. Electricity generation is expected to reach 22.5 billion KW/h and 4 billion of it will be exported. It is expected to provide it by construction of 8 gas turbine power plants with total capacity of 2082 MW, three of which is 140 MW each - in Akhal, Lebap and Mary velayats. It is also envisaged the construction of two modern plants in Akbugday (254 MW) and Ruhabat (500 MW) etraps, one - in Mary velayat (254 MW), two - in etraps named after Beyik Turkmenbashi (254 MW) and Serdarabat (400 MW) of Lebap velayat. In addition, it is envisaged to reconstruct power plants in the cities of Seydi and Balkanabat with a total capacity of 150 MW, as well as to construct high-voltage (500 kV) transmission lines Ashgabat - Balkanabat - Turkmenbashi.

By 2020, according to the above-mentioned Concept it is foreseen to generate 27.4 billion KW/h of electricity, 5.9 of which will be exported.

In general, for implementation of this Concept more than 5 billion USD will be allocated. In the second phase (2017-2020) it is planned to build 6 power plants with total capacity of 1622 MW: steam turbine (240 MW) and gas turbine (254 MW) - in Akhal velayat; steam turbine (120 MW) - in Dashoguz; two gas turbines (254 and 500 MW) - in Mary; gas turbine (254 MW) - in Balkan velayat.

A transition is envisaged to a combined gas turbine station operation in order to increase their energy capacity without increasing energy consumption of natural gas.

Construction of new transmission lines of electricity will be continued, particularly in the direction of Ashgabat - Mary. The realization of substation construction project with capacity of 500 kV will also be continued in Dashoguz, and further - construction of VL 500 from Dashoguz to Turkmenbashi. Thus, the country's energy system will be looped by electric transmission lines with voltage of 500 kV.

In 2025, electricity production will be 31.6 billion KW/h and 6.8 billion of it will be exported.

Production of electricity by 2030, according to the National Program of Socio-economic Development of Turkmenistan for 2011-2030., should reach 36.5 billion kW/h, 7.9 billion of which will be exported. This will provide cities, villages and industrial enterprises of the country with electricity in the uninterrupted way with a good quality and will increase the volume of its deliveries to other countries nearly by 9 times, in comparison with 2000.

In the **oil and gas sector,** it is supposed to implement large-scale modernization projects and strengthen its industrial capacity, expand the resource base, develop gas transportation infrastructure, increase energy production and export more advanced processing of hydrocarbon resources in order to further develop gas and oil, gas and petrochemical industries, establish appropriate industrial and service enterprises.

The oil industry provides as follows:

- Increasing the efficiency of exploration works to find new productive formations, rich in oil and gas;
- Increasing in oil recovery;
- Constructing 7 wells and 12-kilometer pipeline after development of gas condensate field Chekishler;
- Constructing complex gas compressible facilities at Goturdepe and Barsagelmez fields (Esenguli etrap of Balkan velayat) with capacity of 3.5 million/m^3/ day;
- Increasing the use and renovation of existing gas compressible facilities at the field of Barsagelmez with capacity of 4 million/m^3/day and in Hazar city with capacity of 6 million m^3/day;
- Technical re-equipment of drilling rigs and units for development of exploratory wells and repair maintenance;
- Intensive building of production capacities for oil industry enterprises, infrastructure construction, carried out by the government with foreign companies under the terms of agreement on joint production sharing.

The implementation of these measures will increase oil production in 2016 to 11.6 million tons, in 2020 - 23.4 million, in 2030 - 66.6 million tons. In addition, there will be exported 3.5 million tons, 10.4 and 35.5 million tons, respectively.

The **gas industry** envisages the implementation of large-scale investment program aimed at increasing the level of its productive capacity, a number of projects on arrangement of large gas condensate fields. Export component will be strengthened as a result of building the multi-variant system of delivery of Turkmen energy resources to the world market.

This will be facilitated by the following:

- The gradual complex development of Galkinish gas field, including the entire technological infrastructure in order to accelerate exploration, ensuring its volume of 30 billion m^3/year by 2018.
- Development of fields: Karabil - Kurrukbil (16 wells), the Central Karakum group (19 wells), other underground gas deposits, as well as development of rich hydrocarbon reserves in the Turkmen sector of the Caspian Sea;
- Facilities for liquefaction and storage of gas in Akhal, Lebap and Mary velayats;
- Commissioning of the III Stage of Bagadzhinsk gas processing plant with capacity of 1 billion m^3/year;

- By 2016 completion of construction of the gas pipeline East - West to link all fields of the country and ensure the delivery of Turkmen gas to the world market of hydrocarbons;

- Construction of the transnational energy bridge Turkmenistan -Afghanistan - Pakistan - India (TAPI) to provide long-term supply of natural gas from Turkmenistan to South Asia with a consistently high demand for energy;

- Continuing works on the project implementation to build a trans-Caspian pipeline;

- Completion by 2018 of constructing the fourth gas pipeline Turkmenistan - China and supplying the natural gas up to 65 billion m^3/year to this country in the future, continuing to supply natural gas to Russia and Iran;

- Intensive development of oil and gas processing industry, creating and developing domestic industry gas processing.

As part of these measures, in 2016 it is envisaged to produce 120.5 billion m^3 of gas, in 2020 - 187.7 billion, in 2030 - 229.8 billion m^3. Additionally, there will be exported 80.9 billion m^3, 146 billion and 179.9 billion m^3 of gas, respectively.

Development of **oil refining industry** will be associated with transition to the next technological mode, expanding the range of petrochemical products, improving the quality of products produced from hydrocarbons in the framework of modernization of Turkmenbashi complex of oil refineries. In addition, construction of plants will be implemented for primary oil refining CDU-AT-7 with capacity of 3 million tons/year, polypropylene production (2.2 million tons), production of diesel fuel by hydrogen purification (2.5 mln. tons), isomerization of light gasoline (230,000 tons). Besides, there will also be reconstructed and expanded a storage park with capacity of 10 million tons of crude oil, construction of several small and medium-sized enterprises for production of new oil chemical products has been completed (pipes, film, glassware, bags, etc.).

As a result of the above indicated measures, the production of oil refined products will be brought to the following volumes: in 2016 - 2,653,000 tons of gasoline, 3,588,000 tons of diesel fuel, 1,171,300 tons of fuel oil, 465,000 tons of liquefied gas (including for export - 1,286,000 tons, 2,433,000 tons, 1,131,300 tons, 443,000 tons accordingly); in 2020 - 3,274,600 tons, 4,454,600 tons, 2,296,700 tons, 484,700 tons accordingly (1,773,000 tons, 3,147,100 tons, 2,258,700 tons, 464,700 tons); in 2030 - 8,289,000 tons, accordingly, 12,683,400 tons, 2,861,500 tons, 1,059,600 tons accordingly (5,589,000 tons, 10,713,400 tons, 2,823,500 tons, 1,041,200 tons).

In the refining sector, creating new innovative sectors and industries with higher value added will be continued.

One of the most promising sectors of the economy will be the **chemical industry.** It will focus on the continuity of the previously formed directions of development, accelerating increasing rates in volumes of raw material processing, organization of the new production. Provision is made for further implementation of projects on large-scale development of the richest mineral resources of the Karabogazgol Gulf (Balkan velayat) and Magdanli-Garlik region (Lebap velayat).

Provision will be made for reinforcement of production potential on producing various types of mineral fertilizers. In particular, availability of gas stocks has predetermined the increase in production of nitrogen fertilizers (urea). There will be a plant commissioned for producing urea and ammonia in Mari with capacity of 640,000 and 400,000

tons per year. In Karabogaz city, it is planned to build a complex for production of urea and ammonia with capacity of 1,155,000 and 660,000 tons per year. The organization of these manufactures will help to meet the needs of the agricultural sector in nitrogen fertilizers and form the sufficient export potential.

In the structure of mineral fertilizers industry, there will be a new industry - production of potassium fertilizers. For this purpose, construction of mining and processing complex is under implementation with capacity of 1400 thousand tons of potassium chloride per year on the basis of Garlik potassium salts deposit.

Modernization and technical re-equipment of other enterprises of chemical industry is continued.

The development of **agriculture** in the long term will be focused on: the introduction of intensive resource generating and soil protective technologies that will improve the productivity of crop and livestock production, product quality; reducing consumption of fuel, seeds and fertilizers; land improvement and increasing of their fertility; the widespread introduction of drip and subsoil irrigation and industrial technologies of cultivation of agricultural crops; improvement of machinery in order to optimize operations of machines and tractors, as well as growth of its quantitative composition.

In particular, in the framework of grain industry development and with a purpose to ensure full safety and on-site processing of produced grain, along with construction of new elevators, modern granaries and mills, provision is made for conducting a set of measures for efficient use of similar commissioned facilities. This will not only increase the volume of wheat produced in the country, but also strengthen the food security.

As before, particular attention will be paid to development of the animal husbandry, the priorities of which is to increase cattle and small ruminants, increase in production volumes of various types of meat and dairy products.

Solution of these tasks will be contributed by activities of large livestock complexes with arable lands for growing fodder crops, and equipped with the latest technology, specialized units for irrigation and according field equipment, motor vehicles for transporting meat and dairy products with environmentally friendly technology on manure disposal and its processing.

In accordance with sectoral medium- and long-term programs of crop production development, production of such strategic products as wheat and raw cotton is expected to reach by 2016 to 1,600,000 and 1,050,000 tons - respectively; by 2020 - 1,810,200 and 1,185,000 tons; by 2025 - 1,849,000 and 1,215,800 tons; by 2030 - 1,896,200 and 1,217,600 tons.

Vegetable production by 2016 will be increased to 661,000 tons, by 2020 - 881,300, by 2025 - 912,900, by 2030 - 953,600 tons; melons - 376,600 tons, 430,800; 455,900 and 488,700 tons; fruit and berry crops - 260,400 tons, 282,000; 303,000 and 336,300 tons - respectively.

Provision is made for increasing in livestock production. Thus, the production of meat (live weight) will be increased by 2016 up to 652,900 tons, milk - 2,540,600 tons, eggs – 1196.9 mln. pcs .; by 2020 - 708,400 and 2,662,700 tons, 1,253.5 mln. pcs.; by 2025 - 759,200 and 2,832,900 tons, 1,279.6 mln. pcs.; by 2030 - up to 815,700 and 3,056,700 tons, 1,313.5 mln. pcs. - respectively. This will be achieved by increasing of livestock and poultry. The number of cattle will reach in 2016 - 2,551,000 in 2020 - 2,654,100 in 2025 -

2,728,100, in 2030 - 2,834,600; sheep and goats - 21,332,700; 22,199,700; 22,856,100 and 23,605,100; birds - 18,564,400; 19,790,600, 20,811,700 and 22,012,800 - respectively.

As a result, by 2030, according to expert estimates, the volume of agricultural production compared to 2016 will increase by 2.3 times.

Implementation of a large-scale urban development program will be continued in **construction sphere.** Modern villages will be built in all regions of the country; populated areas will be equipped with modern conveniences and become green; social and cultural objects will be built, as well as major infrastructure facilities of fuel and energy and transport sectors, and others.

Among the most important projects that will shape the future of Turkmenistan's economy there will be:

- Construction of the Turkmen Lake «Altyn Asyr», the completion of which will contribute to solving problems of diversion of saline drainage water from agricultural fields of the country. Installing desalination plants on the shores will allow forming a clean water source in order to return it to the economy;

- Development of the national tourist zone «Avaza», which is a pioneer in creating a powerful industry of recreation and tourism in Turkmenistan, as well as strengthening of the recreational potential of the country in order to expand services.

Building materials industry will rapidly develop and the material-technical base of this industry will be strengthened. Its production capacity will be expanded through construction and commissioning of a number of new enterprises: glass factory in Akhal velayat with the annual capacity of 5.8 mln. m^2 of 4-millimeter glazing glass, in the framework of which advanced float process technology will be used; the cement factory and glass manufacturing factory in Baharli village of Akhal velayat with capacity of 1 mln. t / year, and a number of other companies producing building materials from local raw materials in all regions of the country - ceramic bricks, composite materials made of basalt fiber, sanitary porcelain, ceramic products, etc.

It is planned to develop and improve the system of housing and utilities; mainly, providing uninterrupted supply of clean drinking water by creating the necessary production facilities for purification and desalination of water, to achieve high standards of living of citizens in each region, etrap, town and village.

The main direction of housing and utilities will be providing the population and other consumers with complex services meeting the social standards. At the same time, efforts will be aimed mainly at ensuring stable and uninterrupted operation of communal facilities. For this, provision is made for a system overhaul and current repair, infrastructure development of housing and communal system and strengthening of its material and technical base. Significant funds will be provided for landscaping and planting of populated areas in order to improve the environmental situation.

A priority will be given to constructing houses with high consumer qualities in the housing construction sector. Along with the traditional system, new living amenities will be provided with low energy consumption, using alternative energy sources. These trends, along with measures on strengthening the heat-shielding properties of houses, should be developed while reconstructing and modernizing existing housing stock, especially in rural areas.

Under the strategy realization on improvement of social and living conditions of population, house construction will be continued as at the expense of the state as through credit and private funds. As before, there will be widely used mortgage lending, both in urban and rural areas, the regulatory and legislative framework will be improved. The active implementation of urban development and housing programs will allow the housing provision reaching in 2030 almost 23 m^2 per person, against 21.6 m^2 in 2012.

Provision is made for developing **transport and communication** at accelerated pace. Within the framework of the National Program on socio-economic development of Turkmenistan for 2011-2030 and sectoral strategic programs and projects, the highly effective national transportation system will be formed to meet demands for cargo and passengers transfer, improve their quality and safety, the competitiveness of domestic carriers in domestic and international market of transport works and services. In addition, the development of transport sector will comply with growing trade relations between Turkmenistan and foreign countries in order to create profitable, reliable and affordable direct transit routes.

The modernization of transport through technological reconstruction of transport networks on the latest logistics and technological basis while ensuring effective service to all sectors of the economy will expand the marketplace for further development of international transport corridors - railway, aviation, marine, automobile and pipeline.

Therefore, in the future competitiveness of domestic carriers and transport corridors of the country will be increased. Additional working positions will be created in the transport sector and related industries. The transport component at the cost of final production and services will decline to 6.9%, the competitiveness of domestic export will be increased. The share of transport in GDP structure in the predicted period will vary from 4.8 (in 2015) to 7% (in 2030). Provision will be made for a significant increase of passengers (2.5) and freight turnover (4 times). Security of populated areas will be increased (more than 1.1 thousand units) by regular transport communication.

According to the National Program of Socio-economic Development of Turkmenistan for the period up to 2030, the average annual growth rates of volumes of freight and passenger transportation by all transport types will be 3-4%, which shall ensure by 2030 the transportation of 1,025.3 mln. tons of cargo and 1433. 7 million of passengers.

Automobile transport. The market of these services is more competitive in Turkmenistan compared to service markets provided by other types of transport. The top priority of the automobile transport at the service market on freight and passengers transportation is a consistent increase of private sector share in the structure of freight – 98.6 and 78% accordingly (2013), as its economic entities adapt faster to changing demands of customers in providing of the qualitative transport service.

A particular attention is given to quality component in the transport infrastructure activity, development of the regional roadway network, increasing environmental safety of transport, expanding transit transportation. While realizing this program, the length of automobile roads in Turkmenistan will increase by more than two times whereas, 70% of them will be hard-surfaced. A number of transport vehicles will increase as well. It is expected that car park in Turkmenistan will be increased by 6-7 times.

For development of road sector, only in the near future it is expected to provide 4 bln. manat. By these funds it is planned to reconstruct the automobile roads Turkmenbashi-

Karabagaz-Kazakhstan board (240 km), Turkmenabat-Gazachak-Dashoguz (541), as well as Mary-Serhetabat (330 km). By the end of 2016, the volume of subcontract works will be increased by 1.6 times and industrial – by more than 1.4 times, production of asphalt concrete will be 3.2 mln. t., and number of employees in the road sector will be increased for 35%. Total length of high-speed highways with the entire road infrastructure will be about 1700 km. It is planned to build new and reconstruct existing automobile roads into roads of the 1st category with 12.25 m width as average.

Railway transport. Under realization of strategic national and sectoral programs and projects of development along with construction of new railway lines, there will be a gradual introduction of a large-scale program of railway electrification. Among the most important projects, there is a two year construction of the railway stations along the railway road Kizilkaya-Bereket-Etrek. In addition, the railway road Atamurat-Imamnazar will be constructed and in Ovadandepe, the construction of a park will be initiated for locomotive shed and depot for passenger wagons with a service center. The railway roads will be reconstructed: Ashgabat-Bereket-Turkmenbashi 590 km long, Turkmenabat – Zerger – Atamurat – Amudarya 235 km long, Ashgabat- Mary-Turkmenabat 580 km long and Talimarjan-Amudarya-Kelif 190 km long.

Realization of the foreseen in the program measures will increase stability of the railway transport and improve safety and quality of services. It is expected to complete the united and effective organizational structuring of the industry and reduce the total costs for freight transportation, meet the growing demand for services provided in the railway transport, provide conditions for creating new for Turkmenistan infrastructure for high-speed communication. It is planned to create a fundamentally new system of signaling and communication system that will improve the technical condition, increase traffic safety of rolling stock and crossing capacity at the railway lines.

Air transport. The main direction in civil aviation development of Turkmenistan is a consequent replacement of old aviation technology, both terrestrial and aircrafts, ground infrastructure modernization, equipping airports with the latest equipment that meets requirements of the International Civil Aviation Organization (ICAO), and improving the quality of aviation services provided to population and economy of Turkmenistan. For this purpose, a new airport terminal in the city of Turkmenbashi has been built, meeting ICAO requirements; a new international airport of the capital of the country is under construction now, with capacity of 1600 passengers per hour. The fleet is constantly upgraded with modern «Boeing» airliners. Modernization of the aircraft fleet will lead for continuing close cooperation with this corporation. More comfortable liners «Boeing 737-700» and «737-800» are the most popular of all the planes and they will replace «Boeing-717-200», «Boeing 737-300» and «Boeing 757-200». By 2030, the country's civil aviation fleet will be increased from 27 to 43 aircrafts of the latest modification. Turkmen aviators associate the development of international passenger traffic primarily with «Boeing-777-200LR" aircraft, which has already joined the fleet of the country. Using of this aircraft will be a significant step in the development of the aviation passenger transportation, as this type of aircraft can accommodate more than 300 passengers and its flying range is 9,1-17,5 thousand km. The development of cargo air transport Turkmen aviators associate with IL-76 and the newest transport aircraft «Boing747-8.» This aircraft, as its developers state, consumes less fuel than any of the existing cargo aircraft.

Marine transport. Under realization of the General Development Plan of Turkmenbashi seaport and Turkmen marine trade fleet for the period until 2020, provision is made for building a modern technically equipped sea fleet of the country staffed with passenger ships, tankers, tugs and dry cargo ships. The volume of cargo transportation by sea in 2020 compared to 2015 will double increase, and from 2011 – by 7.3 times. The integrated development of sea transport communications will provide increased transportation of passengers by sea in 2020 compared to 2011 by 5.2 times. By 2020, the construction of ship repair base will have been completed in the port of Turkmenbashi designed for technical and repair services for all types of ships of Turkmenistan that will increase the capacity of qualified services to vessels entered the Turkmen sector of the Caspian Sea. The general plan of Turkmenbashi port until 2020 foresees its large-scale modernization with construction of shipyard, creating a database of emergency services and obtaining of environmental technology and environmental ships. Reconstruction is envisaged for railway ferry terminal, existing oil piers, harbor tugs purchase and reconstruction of dry-cargo port station berth Aladzha are also envisaged. A construction is planned for additional berths, including auto-passenger terminal, deepening and widening of the navigation channel port of Turkmenbashi, construction of new control tower to coordinate its work, building a logistics center, including the construction of berth for container and dry cargo vessels with a length of 1500 m and other works. As a result, the total area of multifunctional port will be more than 1,385,000 m^2, and the annual capacity - 15 mln.t. The multimodular logistics park will provide a range of services for storing and combined processing of container cargoes delivered by air, road and railways providing their reloading to a water transport and back. The port will have the latest equipment and special handling equipment for cargo handling. A distribution center will be built here (CFS - Container Freight Station); its functions will be assorting cargo by destination. A modern terminal will be built, designed for 300,000 passengers and 75,000 cars a year. In order to preserve the environment of the Caspian Sea, a biological treatment will be installed in each terminal. The project is designed in accordance with international standard "Green Port".

Thus, the foreseen in the future modernization of transport and logistics complex as a whole in Turkmenistan, building of integrated logistics models, including several types of transport will allow for further accelerated development of the effective system of interaction between automobile, railway and sea transport. This, in turn, will contribute to the expansion of transit, increasing the volume of freight and passenger traffic, improving the quality of transport services.

Given that transport is an important consumer of fuel and energy, among the most important areas of the industry there are still saving and rational use of energy resources through introduction of resource-efficient control and regulation equipment.

Strategic programs and projects on industry development envisage also measures for rational use of FER, mitigation of adverse impacts on the environment. They include the following:

- Harmonization of transport policy and the establishment of legal framework system in the field of transport;

- Improving the quality produced in local refineries of motor fuel and increasing the product range of lubricants for vehicles;

- Increasing share of alternative, environmentally clean types of motor fuels in applying to road transport;

- Reconstructing and equipping the production technical base complex with advanced equipment;

- Reconstruction in accordance with the modern European standards of railways and highways where international and transit transportation is performed;

- Improvement of technical condition, maintenance and operation of roads of local importance;

- Improving the technical condition of rolling stock, technical and technological modernization of transport on the basis of scientific and technological progress to improve the level and quality of transport services of the economy taking into account changes in cargo traffic;

- The gradual purchase of airborne vehicles with superior technical and economic parameters (efficiency in fuel consumption, reliability, safety, environmental friendliness, comfort);

- Upgrading of the transport fleet of Turkmenistan with vessels that meet international standards with economical fuel consumption;

- Providing the fleet with modern vehicles, prohibiting of using motor vehicles that do not meet environmental requirements;

- Reducing the consumption of fuel oil per unit of vehicle work, as well as reducing its consumption by commissioning of the rolling stock with higher performance for fuel economy.

By implementing measures on expert assessment, it will be possible over five years as average to reduce the amount consumed per unit of cargo fuel to 5.0%, and over 10 years - to around 9%.

The socio-economic indicators will be significantly improved in all areas of consumer market and services, the volume of which by the end of the projected period will increase by nearly 4 times.

Throughout the whole period under review, increase in production of high quality, competitive products will be based on introduction of modern energy-saving and environmentally friendly technologies.

In this regard, special attention will be paid by the state to energy conservation policy. According to experience of developed and developing countries, energy saving policy is the most powerful tool for maintaining the socially necessary rhythm of technological structures replacement. The introduction of energy-saving, high technology reduces specific energy consumption, increases labor productivity, and provides price and non-price competitiveness of goods and services. For integration into this policy of energy saving incentive mechanisms there will be required a phased reform of the growth in selling prices and energy tariffs.

The main difference between the scenario of the Third National Communication and the scenario of the Second National Communication concludes in the more dynamic transition to the energy-efficient model of development which involves:

- Building economic incentives for modernization of equipment and technologies for energy saving;

- Intensive introduction of energy efficient equipment and technologies of the fifth and sixth technological structures of the industrially developed countries that are im-

ported by the country, including in the oil and gas sector, which is one of the main sources of GHG emissions;

- Implementation of measures to reduce process gas loss due to using mobile compressor stations;

- Reduction of fuel combustion volume in the gas pipelines;

- Carrying out measures to improve the technical level of equipment operation, improving the structure of electricity and heat production and reducing specific fuel consumption at power plants;

- Transfer of gas turbine power plants to the combined cycle and reduction of electricity loss;

- Providing a breakthrough in the field of energy, including alternative (solar energy, solar, wind, etc.), that will help to develop the use of new, environmentally clean sources of renewable energy and reduce the specific energy consumption of GDP. Deserts in Turkmenistan occupy about 80% of its area and can be used for placement of solar power plants out of the economic development of lands without economy loss and negative impact on the environment;

- Further development of wind power with its modern technical equipment by constructing wind power plants with capacity of 150-250 kW for power supply of cattle farms;

- Installation of energy efficient equipment at the chemical industry enterprises, the intensification of chemical processes that will result in reducing the annual volume of emissions;

- Using better agronomic techniques, principle introduction of placing crops in accordance with soil and climatic characteristics of regions, improving the efficiency of low-yield lands, introduction of optimal cropping patterns and modern technologies, optimization of using fertilizers and plant protection products in agricultural production;

- Construction of energy efficient buildings using energy efficient materials and technologies, improving of thermal insulation and sealing of buildings, using modern materials and constructions of walls, roofs, floors and windows, as well as high-efficiency heating, ventilation, air conditioning and water heating systems;

- Installation of electricity, heat, gas and water meters and organization of systematic monitoring, inspection of buildings for heat leak by thermal imagers, and others. This will help to reduce drinking water, heat and electricity consumption excess without any financial investment.

- Using energy-efficient lighting systems of buildings and streets;

- Increasing environmental requirements for transport infrastructure and vehicles by strengthening control over the environmental characteristics of imported vehicles, the expansion of public transport to replace private cars;

- Continuation of implementation of programs on gardening and tree planting to enhance the absorption of GHGs.

Thus, the economic development of Turkmenistan in the framework of the strategic objectives to change the proportions of industry and sectors will lead in the long term, to declining of price environment dependence in the world energy market, i.e. to building of stable and developed economy. All these trends are provided in the baseline scenario. Due to the fact that Turkmenistan imports the energy-efficient equipment and

technology of the fifth and sixth technological structures from industrially developed countries, the baseline scenario assumes the features of energy-saving development. The main difference of the second scenario (innovation) from the first one is in advantage of energy efficient development of the entire socio-economic sphere and its rapid implementation.

4.2.2. Energy consumption trends under the baseline scenario

In the future until 2030, further strengthening of foundations and capacity factors for building a real dynamic, diversified, competitive and high-tech economy will ensure the efficient use of existing capacity and sustainable economic and social development of Turkmenistan.

According to estimates, in Turkmenistan over 2014-2030, the average annual growth rate of GDP in PPP will be 6.35%, while the country's economy will grow, compared to 2000, by 13 times. If 2007 is viewed as a base year, the production of GDP in PPP by 2030 will increase by 6 times (Fig.64).

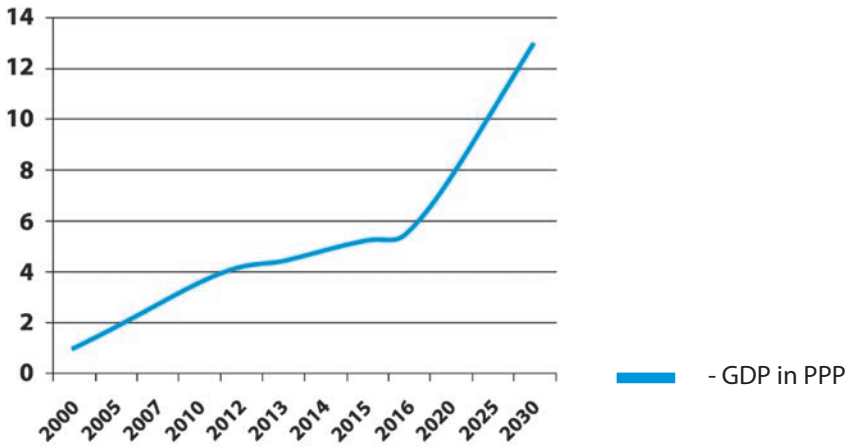


Fig. 64. Dynamics of GDP in PPP production, %

In the Second National Communication GDP in PPP was estimated at 30,000 USD. At the same time, indicated for future parameters in the program documentation and high growth rates of industries of Turkmenistan allowed to lay GDP in PPP per capita by 2030 in the amount of 48,000 USD (Fig. 65), promoting Turkmenistan to the level of developed countries.

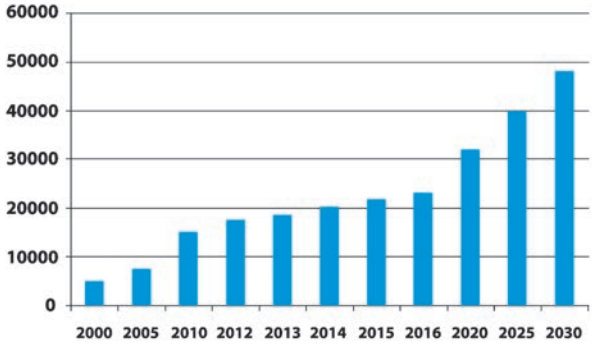


Fig. 65. GDP per capita in PPP, USD

Until 2030, the growth of the **industry** will maintain its key role in accelerating socio-economic development of the country. The volume of industrial production in 2012-2030 will be increased by nearly three times. In the GDP share of industry, by the end of the projected period it is expected to reach 45%. The relative share of the service sector will be significantly increased: from 25.9% - in 2012, to 37% - in 2030 (see «Scenarios of economic development of Turkmenistan until 2030»).

Oil and gas complex of Turkmenistan will continue to be of prime importance in enhancing the economic potential of the country.

In 2030, the total production volume of primary and secondary energy sources will be 288,740,400 toe. Compared to 2012, the production volume of energy will increase in 3.76 times.

The intraspecific structure of energy production will significantly change. For example, in 2030, the share of crude oil will increase to 24.2% against 15% level of 2012; the share of gas will drop to 65.6% against 74.3%, respectively.

In accordance with the program parameters of development of oil and gas industry of Turkmenistan for the period up to 2030, production of natural fuel resources at the end of the projected period will be 259,531,500 toe that exceeds the level of 2012 by 3.8 times. A high breakout is planned in oil production and its volume in 2030 will increase by 6 times. This figure is based on the rich resources potential and large investments in development of oil fields, both on land and on the Caspian shelf. The gas production will be increased with sufficiently high rates, and in 2030, it will increase by 3.3 times compared to 2012.

In the future, a number of measures are foreseen for a large-scale development of oil refining industry. So, in 2030 the volume of oil refining will increase compared to 2012 by 4.1 times.

The volume of **electricity production** by the end of the forecasting period will increase by 1.8 times that will save energy independence of the country and sufficient export potential (Fig. 66).

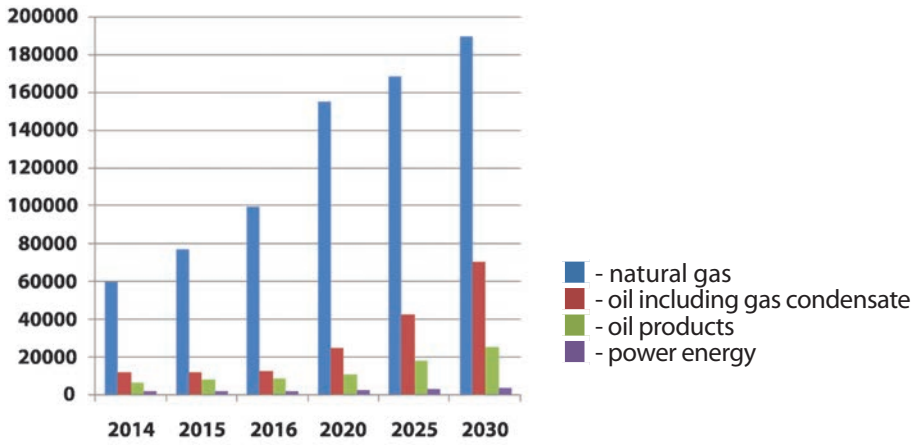


Fig. 66. Production of primary and secondary FER, thousand toe

The analysis of primary and secondary energy resource production estimated in the Second National Communication and existing indicators provided in the Third National Communication showed a decrease in its volumes by 17.9% due to gas by 8.1%, oil - by 38%, oil products – 9.8%, electricity - by 23.3%.

In connection with accelerated process of industrialization, intensive development of the agricultural sector, construction, transport and other sectors of the economy, demands of the country for energy are continuously increasing.

According to expert estimates, in 2030 the volume of primary and secondary energy will be 81,475,900 toe, which is 2.3 times higher than the level in 2012. The domestic consumption, according to the Third National Communication, declined by 4,037,900 toe, or 4.7% compared to the data of the Second National Communication. This is mainly due to reduction in oil consumption for 17.1%.

At the end of the projecting period, the share of domestic consumption in the volume of production of primary and secondary energy resources will amount to 28.2% against 46.7% in 2012. These structural changes will occur as a result of strengthening the country's integration into the global energy market and increase the export potential by more than 5 times.

The diversification of the fuel complex aimed at more advanced processing of raw materials and high benefit production will significantly increase the share of oil for processing into various types of motor fuel. So, in 2030, its share in the volume of domestic energy consumption will increase to 40.1% against 23% in 2014.

Despite the absolute increase in consumption of fuel energy resources, in 2030, the GDP energy intensity indicator in PPP on consumption will decrease in comparison with 2012 by 25% and will amount to 0.24 toe / USD GDP in PPP (see «Scenarios of economic development of Turkmenistan until 2030»).

If the Second National Communication projected decline in energy intensity in the period of 2000-2030 by 49%, in the framework of research for preparation of the Third National Communication it is projected - by 68% (Fig. 67).

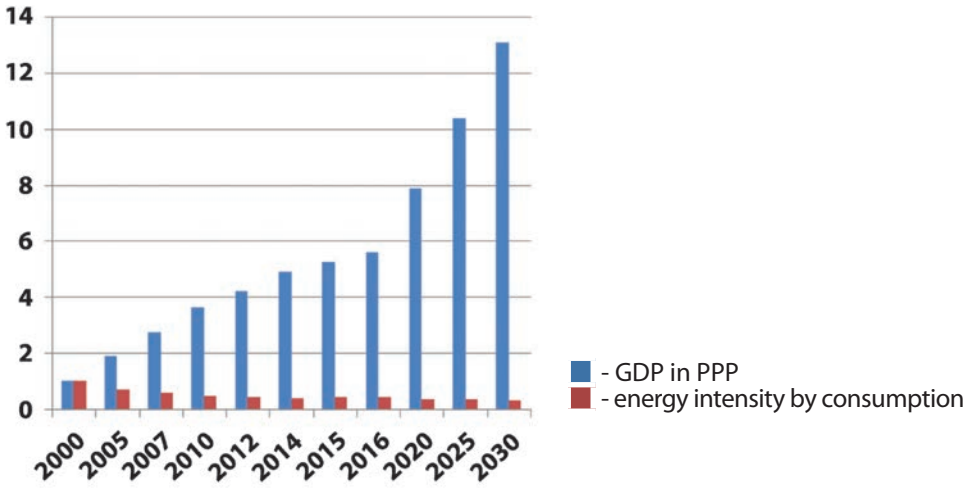


Fig. 67. Dynamics of GDP and GDP in PPP energy intensity on energy consumption, %

If 2007 is taken as a base year, the index of energy intensity of GDP in PPP on energy consumption in 2030 will be 55% below the level of 2007, under volume growth of GDP in PPP terms in 6.1 times.

In accordance with projected volumes of FER consumption and rates of economic growth in the baseline scenario, the elasticity coefficient by 2030 will amount to 0.87 against 0.30 in 2012.

According to the projecting, the final consumption of FER in 2030 will amount to 30,764,900 toe and will increase with respect to 2012 by 1.6 times. In the future, a tendency will continue for declining of final consumption share in the total volume of FER consumption to 37.8% compared to 52% in 2012. This is consistent with the intensification of the oil refining industry.

Due to intensification of development of industries, the industrial demand in energy sources will increase. The final consumption of energy by industry by 2030 will increase compared to 2012 by 1.7 times. In the structure of final consumption, industrial production will continue to have the largest share - 42.8% (2030) (Fig. 68).

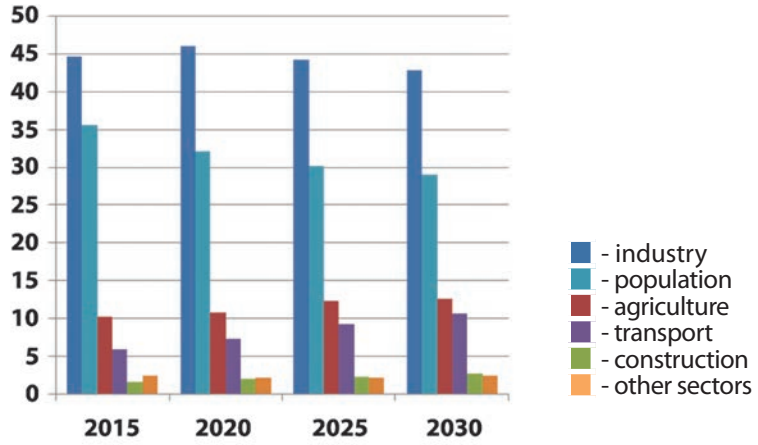


Fig. 68. FER consumption by economy sectors in 2015-2030, %

High growth rates of economy sectors in 2015-2030 will cause a decline in the share of energy consumption by population from 35.5% - in 2015, to 29% - in 2030.

The share of agriculture in the analyzed period will increase from 10.2 to 12.6%, transport - from 5.9 to 10.6%, construction - from 1.6 to 2.7%.

In 2030, the final consumption of gas will increase compared to 2012 by 1.6 times. Over 2012-2030, the share of gas in the volume of final consumption will decrease by 4%.

The largest consumer of gas will remain to be industry (mainly electric power industry); its need in this type of fuel will increase compared to the current level by 1.7 times. In 2030, the share of industry in consumption of gas will amount to 51.1 against 46.6% at present.

According to expert estimates, in 2012-2030, gas consumption by agriculture will nearly double increase. This growth is due to high rates of animal husbandry, vegetable production development, as well as the modernization of reclamation system.

Along with the absolute increase in gas consumption by population in 1.2 times by the end of the projecting period, the share of population in the total consumption of gas will decline and reach to 33.4 against 43.1% level of 2012, driven by the development of autonomous heating systems in houses.

In projecting period, consumption of gasoline according to expert estimates will increase by 2.2 times. The largest consumer of gasoline will remain to be transport, share of which in 2030 in the total volume of consumption will be 36.8%. In connection with growth of vehicle fleet, freight and passenger transports, the gasoline consumption in 2012-2030 will increase by 2.6 times.

The gasoline consumption by agriculture will increase by 2.3 times and its share in 2030 will be 7.4%.

A growth in consumption of diesel fuel by 2030 in 1.8 times is due to high rates of economic development and, consequently, the expansion of large-capacity transportation. The main consumer of diesel fuel is still transport, share of which in 2030 will be 46.6%. In connection with intensification of the regional development, a sufficiently stable growth in consumption of diesel fuel will be reported in construction and industry.

According to expert estimates, by 2030, the volume of electricity consumption will be 2,460,400 toe, which is 1.6 times higher than the current level. Leading growth rates of its consumption are envisaged in transport – by more than 4 times. In this regard, its share in the total volume of energy consumption by 2030 will rise to 8.7 against 4.1% in 2012. This is due to development of pipeline transport system (oil and gas pumping) and railway transport electrification. Energy consumption in industry and agriculture will increase by more than 2 times. The increase in energy consumption by population by 1.6 times is linked with population growth, increase of using household appliances at homes, and improvement of living conditions.

Under the baseline scenario of development for the period up to 2030, the volume of GHG emissions is calculated in accordance with projected volumes of FER (see. «Scenarios of economic development of Turkmenistan until 2030»). In 2030, the volume of emissions will amount to 135,833 tons of CO_2 equivalents, or increase compared to 2000 of approximately by 4 times and compared to 2012 - about 2 times. Due to high economic growth rate, carbon intensity index will decline and by the end of the projecting period, it will be 0.0004 thousand tons of CO_2 eqv. / thousand USD of GDP in PPP, which is in 1.7 times lower than the level of 2000. If 2007 is considered as a base year, this figure by 2030 will decrease by 60% (Fig. 69).

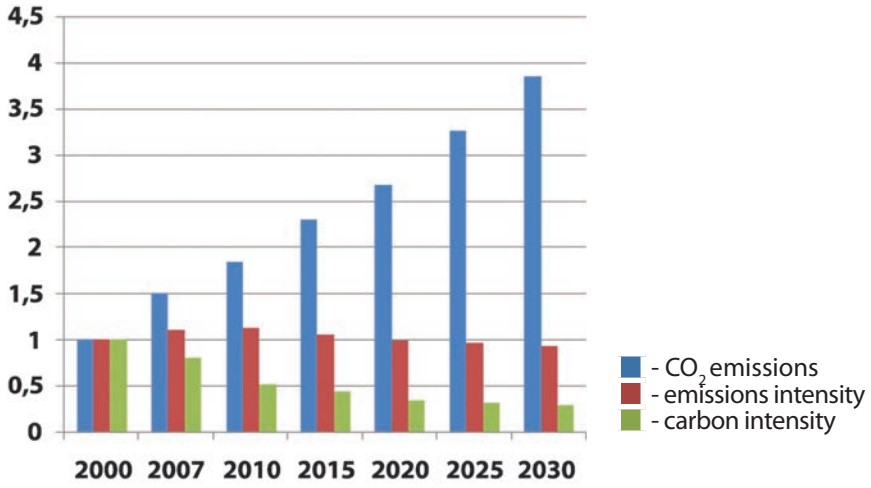


Fig. 69. Dynamics of CO_2 emissions, their intensity and carbon intensity of the economy

The projection of GHG emissions calculated in the Third National Communication shows a decline in the index carbon intensity from 0.61 to 0.29 by 2030, compared to the data provided by the Second National Communication.

4.2.3. Innovative scenario

The baseline scenario has been calculated in compliance with parameters of program documents adopted in the period from 2007 to 2014. Today's realities require a more profound restructuring of the economy, its modernization and innovation development. As noted above, the economy of Turkmenistan is now under its rapid development creating favorable conditions for fundamental diversification of its sectoral, production and technical structure. In this regard, the innovative component is important in the adopted and current national programs of social and economic development for medium and long term future. That is why in future developments the entire spectrum of innovative directions is taken into account that meets specifics and strategic directions in the economy development.

The intensive industrial-innovative development course of the country is aimed at fundamental changes in the nature of its economy, which will be more adapted to constantly changing conditions of the world economic market, internal and external challenges, and global crisis. This will ensure dynamic development and promotion of innovative processes, accelerate the development and introduction of energy and resource-saving and environmentally friendly technologies, and promote the production of high-quality, competitive products through the introduction of modern energy-saving and environmentally friendly technologies.

The innovative scenario of economic development is based on increasing of energy consumption efficiency in all sectors leading to sustainable reduction of energy intensity of GDP. In other words, it is proposed to implement such measures that would allow going beyond historical contingency margins of GDP growth rates and domestic consumption of energy as it comes out under the baseline scenario development. It is expected that their implementation will give a new, more active and dynamic push to sustainable socio-economic and technological development that, in turn, will contribute to economy sectors growth, increased energy consumption efficiency and radical decrease of energy intensity of GDP.

The innovative scenario assumes to create, by the end of the projecting period (2030), conditions for phased sequential transition to a new phase of economic and technological development of the country. A key feature of this phase shall become the comprehensive development of a human and human life related technologies - biological, informational, social, cognitive. The innovative scenario assumes the beginning of building a new type of energy for the country that can ensure reduction of geopolitical and environmental risks, improving the quality of energy supply, creating new technological possibilities for a final consumer.

The underlying strategic objective of the structural policy of Turkmenistan is to create a competitive innovative economy based on achieving top structure priority sectors of economy, the use of flexible mechanisms to diversify technology products, services and markets for their sales, improving the market infrastructure and institutional environment, the government support for development of the economy priority sectors and private entrepreneurship.

The innovation scenario assumes strengthening the innovation component of economic growth through implementation of institutional reforms and the system of national projects in the framework of presidential initiatives and long-term strategies for development of key economic sectors. It is aimed at improving the competitiveness of Turkmen business, further diversification and structural shifts for accelerated development of high-tech manufacturing sectors and the knowledge-based economy, while maintaining high investment ac-

tivity and the continuation of implementing major infrastructure projects, including international. In the innovative option increase in science, education and health care expenses are envisaged that not only shall ensure planned economic growth rates, but also affect the quality of economic growth in terms of innovative socially oriented type of development.

Improving the competitiveness of the country and growth rates of industries with high benefit involve the increasing science role in the economic development. In this regard, within the framework of the innovative scenario development, as well as the baseline, a special attention is paid to changes and reforms aimed at further quality improvement and modernization of the national scientific and educational system. To this end, under the active governmental support, strengthening of innovation constituent of the economic infrastructure and building effective science sector will be continued, able to solve problems of innovative part of the economic activity in the most promising industrial-innovative and information-technological areas. In addition, this research will be aimed at strengthening of innovative orientation of applied scientific research results and increase of their contribution to economic growth while maintaining public support for basic science. This activity involves organization of scientific and technical research on the country's potential of renewable energy sources, the introduction of scientific achievements in the field of «green» energy, material and energy saving, environmentally friendly advanced technology and innovations to modernize the industrial potential of the country and increase of its competitiveness. Much attention will be given to strengthening of the scientific sphere relationship with sectors of the national economy. Activities of the Technology Center opened in 2014 will contribute to effective solution of these issues. It is the largest national scientific complex uniting research institutions, educational institutions, exhibition areas, industrial facilities, leading industrial companies, including small and medium enterprises, business and other centers of the country, as well as territorial-production clusters formed under strategic programs.

In addition, space activities and the national space communications system will be developed as new directions for the country. This will allow not only to monitor the near-Earth orbit and conduct scientific research related to outer space, but also will facilitate the introduction of scientific achievements in the country's economy and give a powerful push to accelerated development of communication systems and the Internet, television and other industries.

Turkmenistan proceeded from the following main criteria in choosing a system of priorities for innovative development:

- Technological level of obtained goods (services) and technologies on the basis of innovation, their concept of novelty and consequent competitiveness;
- Technological needs of Turkmenistan's economy in the future, opportunities to provide innovative products in domestic and foreign markets, compliance with requirements for accelerating the economic growth;
- The availability of capacity for innovative breakthrough, the development of basic innovations - the results of basic research, applied research and constructive developments, domestic inventions, opportunity of providing financial resources;
- Socio-economic and other efficiency of innovative programs and projects.

The implementation of the innovative scenario will require higher rates of technological and social changes comparing to what was envisaged in the baseline scenario. These processes must be preceded by building and further development of specific institutional and organizational arrangements, relevant legislative and normative fields. According to expert estimates, taking into account the development and implementation of energy conservation measures in the practice of economic management, and considering that innovative foundation for development is also included in the baseline version, a clear effect of the energy saving policy will be seen after 2020. In this regard, until 2020, in the baseline and innovative scenarios, parameters of development, energy consumption and emissions is identical (see. «Scenarios of economic development of Turkmenistan until 2030»).

Since 2020, scenarios are differed by dynamics of GDP in PPP as well as by the main factors of growth, structural changes (shifts), and volumes of long-range energy consumption and energy intensity of the economy. According to expert estimates, the innovative scenario is more energy efficient than the baseline, as it is accompanied by some accelerated GDP growth under a moderate increase in energy consumption.

According to prediction calculations, as a result of implementing the innovative scenario of development based on program target-oriented approach to investment and innovation projects, as well as complex of regulatory measures to improve the competitiveness and growth rates of certain leading sectors of the economy, changes in the production structure will be formed in the accelerated and gradual way since 2020.

Given the nature of the active energy-saving policy in the framework of innovative scenario, acceleration of structural changes in the economy and the average annual GDP growth are envisaged, as evidenced by more intensive average annual (by five-year periods) GDP growth rates in PPP and GDP structure. As per the innovative scenario, GDP in PPP from 2007 to 2030 will increase by 6.5 times during the growth of energy consumption by 2.7 times, and from 2000 to 2030, respectively, by 14 and 3.9 times (Annex,Table. 6). At the same time, the average annual growth rate for 2016-2020, 2021-2025, and 2026-2030 is projected at 8.8%, 6.2 and 5.1% - respectively. Whereas, in the baseline scenario, these figures were formed, respectively, 8.5%, 5.7 and 4.7% (Annex,Table. 11). By 2030, the GDP in PPP per capita, according to projection estimates, will be more than 50,000 USD (Annex, Table 11).

As the experience of developing countries shows, industrial and innovative development along with expanded development of production sector (industry, agriculture, construction) is accompanied by faster growth rates in the entire spectrum of industries of the serving sector. They include: transport and communications, financial sector, retail and wholesale trade, health, education, science and scientific services, tourism. In this regard, in 2020 transformation of gross domestic product structure is projected in direction of reducing the share of the manufacturing sector and contribution growth of non-manufacturing sector to a newly created value. In the process of this, building of national innovation system is usually activated - the main factor of maintaining high growth rates

of economic development and growth of its sustainability level in the context of globalization, world crises and growing interdependence of economies of different countries.

According to expert projections, the economy structure in 2030 will be closer to the economy structure of developed countries, where the services sector is a priority. As per the innovative scenario, in the structure of GDP, share of services will account for 47 against 37% of the baseline scenario (Fig.70 and Annex, Table. 12).

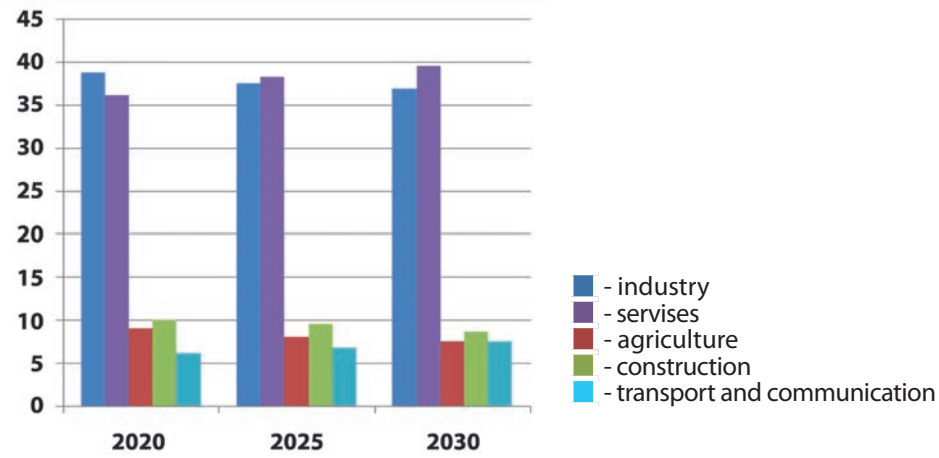


Fig. 70. GDP structure, %

Under the innovative development scenario, increase in the share of GDP is assumed in those industries that are efficient and can grow rapidly, including light and food industries, construction materials industry, new to high-tech industries, pharmaceuticals, construction, communication and tourism. Moreover, the share of fuel and energy sector, agriculture will gradually decline, which in turn would have an impact on the energy intensity of GDP and, consequently, greenhouse gas emissions in Turkmenistan.

Despite the fact that in projected future the innovative scenario envisages reduction of industry share, this sector of the economy continues to be one of the most effective promoters of innovative development and it facilitates rising of other manufacturing industries. Along with this, the scenario assumes a gradual change in the structure of production, namely the accelerated development of manufacturing industries, share increase of high-tech industries - chemical industry, mechanical engineering, pharmaceuticals, and reducing the share of fuel and energy complex. As a result, the structure of long-range energy consumption should change towards increasing of share of less energy-intensive industries (not electric-intensive engineering, light and food industries) and, accordingly, reducing of energy-intensive. These changes are consistent with global trends.

It should be noted that according to the innovative scenario, economic growth will be accompanied by reduction in specific energy consumption per unit of GDP (energy intensity), which reflects the positive changes in the structure of industrial production, including rapid increase rates of production in industries producing finished products, as well as increase in the share of the service sector in GDP (Fig.71, Annex Table. 16).

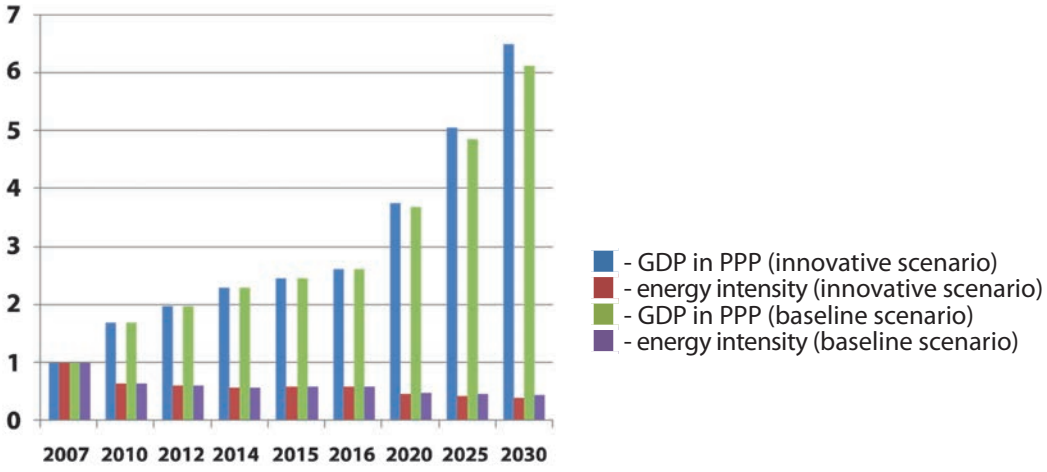


Fig. 71. Dynamics of GDP in PPP and GDP energy intensity on consumption (innovative and baseline scenarios) at % by 2007

According to expert estimates, as per the innovative scenario of the economic development compared to the baseline scenario in Turkmenistan, a reduction in energy consumption will be reported: 2020 – by 4.2%; 2025 - by 5%; 2030 - by 6%.

In 2020-2030, the share of domestic consumption in the volume of production of primary and secondary energy resources according to the innovative scenario compared to the baseline will drop to 1-1.5% (Fig.72 a, b).

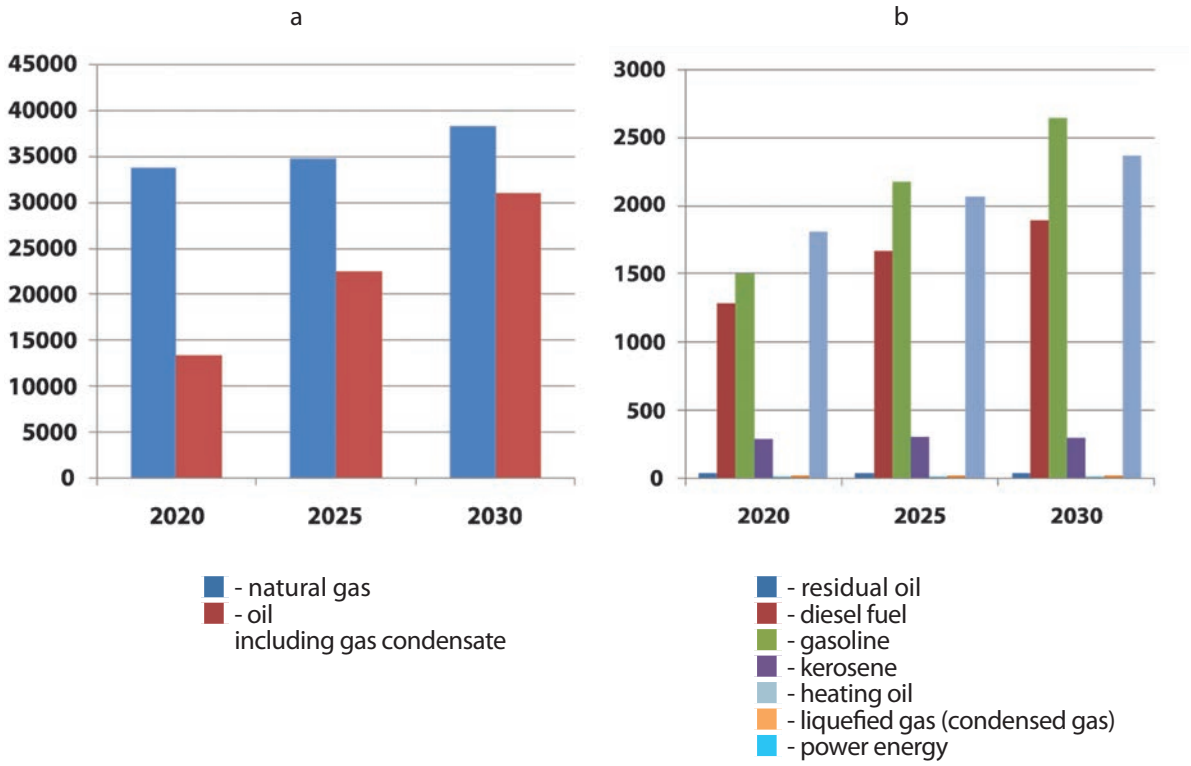


Fig. 72. Consumption of primary (a) and secondary (b) FER, thousand toe.

In the innovative scenario compared to parameters of the baseline scenario, there will be a decline in energy resource consumption:

- 2020: gas - by 5%; oil - by 2.5%; processed products of fuel - by 4.1%; electricity - by 2.5%;
- 2025: by 6%; 3.5%; 5.1%; by 3% - respectively;
- 2030: by 7%; 5%; 6.1%; by 4% - respectively.

As a result, the energy intensity on consumption against the baseline scenario indicators in 2020 will decline by almost 7.7%, in 2025 - by 8.3%, in 2030 - by 12.5% and will amount to - 0.24 toe/USD, respectively, 0.22 and 0.21 toe / USD. According to expert estimates, the country's energy intensity in 2030, according to the innovative scenario, with respect to 2007, should be reduced by more than 60% (Annex, Table 13).

In accordance with projected volumes of FER consumption and economy growth rates, elasticity coefficient by 2030 will amount to 0.76 against 0.87 of the baseline scenario. That is, under the innovative scenario for production of 1% of GDP, growth in energy consumption will decrease by almost 13% against the baseline scenario (Annex, Table 13).

It should be noted that both in the baseline and in the innovative scenarios, the final consumption of energy is mainly generated by production (including industry and services), transport and communal services sectors. Moreover, much of the growth in the projected period is focused on the industrial segment. However, under the innovation scenario this consumption is reduced due to modernization, optimization of equipment working regimes and energy-saving measures at existing facilities, as well as structural shifts in high-tech and less energy-intensive industries. The number of these measures includes building a clear system of accounting and control of consumed energy resources, intensive introduction of energy efficient equipment and technologies, increasing of contribution to energy needs of the country's renewable energy resources.

In the innovative scenario for the period of 2016-2020, an annual reduction is envisaged in the final energy consumption in comparison with the baseline scenario at 1%, in 2021-2025 – at 1.5%, in 2026-2030 – at 2.5%. In 2030, the final consumption of FER will be 29,995,800 toe.

According to expert estimates, in the final consumption of energy resources, structural changes will occur by reduction of the share of FER consumption by industry and population due to share increase of transport and agriculture. The industry remains to be the main consumer of energy resources. In 2030, it will account for 42.2%, which is 0.6% below this value, calculated according to the baseline scenario.

In the structure of final FER consumption, the share of transport will increase by 0.5% and agriculture – by 0.4%. In the first case, this is due to the significant increase in the future of transport fleet of the country, both public and private, the dynamic development of business in this area, the implementation of major transport infrastructure projects, both national and international.

In the second case, the growth of energy consumption by agriculture is associated with intensification of the sector, transferring it to the industrial basis, organization of

new production facilities for processing and production of competitive, environmentally friendly agricultural products. It is also associated with implementation of a number of programs aimed at improving the efficiency of using agricultural lands, irrigation systems, water saving and reduction of water consumption, as well as construction of new settlements in rural areas and improvement of existing ones (Fig.73).

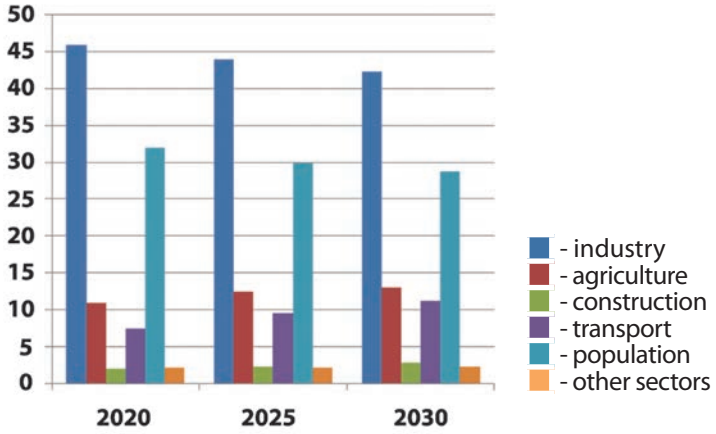


Fig. 73. Sectoral distribution of FER consumption in 2020–2030, %

In the structure of final consumption, the largest gas gravity and its share in 2020-2030 will decline from 81% to 76.3%.

More than half of the gas consumed is accounted for industrial production. As it is known, the largest consumer of gas in Turkmenistan is the electricity industry, which will involve the transfer of gas turbine power plants to a combined operation cycle. Thus, the transfer of 254 MW power plants from simple to the combined cycle may allow annual savings of about 250 million м^3 of gas to generate electricity and reduce 500,000 tons of CO_2 emissions into atmosphere.

In the long-term period, it is expected to introduce the energy efficient technology in other industries. In this connection, the industrial sector share in the consumption of gas as per the innovative scenario is reducing in 2020 by 0.2%; in 2025 – by 0.4%; in 2030 – by 0.9%. Modernization of agricultural complex, construction of specialized complexes associated with growing needs of population in livestock production, crop production, and also transport shift to the use of gas motor fuel cause an increase in gas consumption in agriculture and transport.

In the structure of gasoline consumption, as per the innovative scenario compared to the baseline, the share of transport and agriculture will increase, and share of using it by population will decrease. The share of transport will increase by 2030 from 26.8 to 38%, agriculture - from 28.6 to 29.2%.

The leading positions in consumption of diesel fuel will still be occupied by transport and agriculture, the share of which by 2030 will increase by 0.3% and 1% - respectively.

The innovative scenario of electricity consumption assumes reduction of its use by population and industry under increase in the share of transport. So, the share of electricity consumption by population in 2020 will drop from 20 to 18%, in 2025 - from 19 to 17.3% and in 2030 - from 18 to 16.1% compared to the baseline scenario, while in 2030,

the share of transport will rise from 8.7 (baseline scenario) to 11.2%.

The volumes of GHG emissions according to the innovative scenario of development for the period up to 2030 are calculated in accordance with projected volumes of FER. According to expert estimates, in 2020 the volume of emissions compared to the baseline scenario will decline by 1%, in 2025 – by 7.3%, in 2030 - by 9.4%.

The elasticity coefficient of CO_2 emissions on GDP in the innovative scenario will also be lower than in the case of implementation of the baseline scenario, emissions growth can be 2.7-2.9% per year, with 3,1-4,1% as per the baseline scenario (Annex,Table 14).

When implementing the innovative scenario, CO_2 emissions will increase by 2020 compared to 2007 in 1.67 times, by 2025 - in 1.9, by 2030 – in 2.2 times, whereas as per the baseline scenario, the figures are 1.68 times, 2.05 times and 2.43, respectively (Fig.74, Annex, Tables 15 and 16).

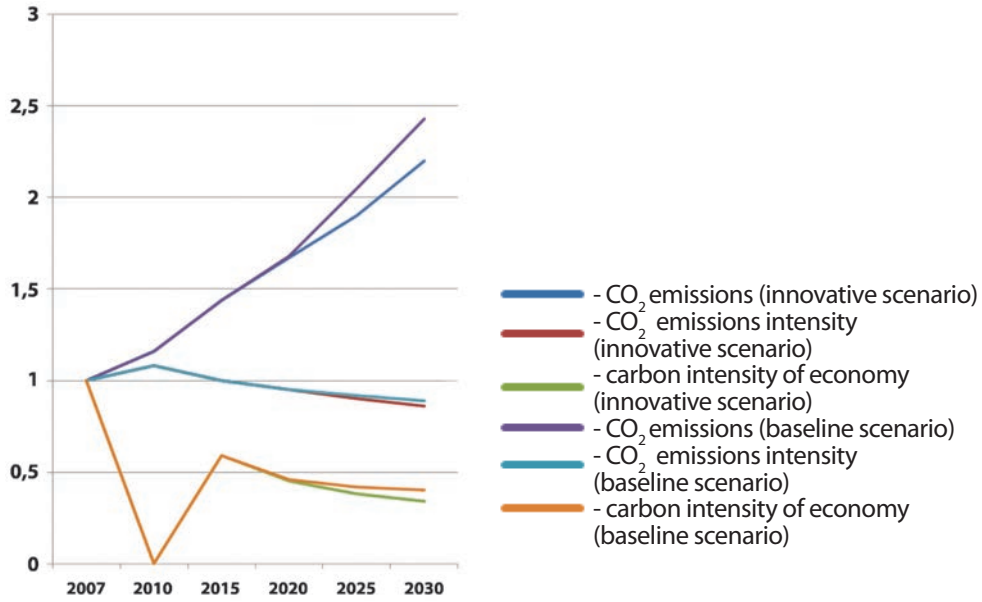


Fig. 74. Dynamics of CO_2 emissions, their intensity, carbon intensity and emissions intensity (baseline scenario)

Thus, according to preliminary expert estimates, a substantial increase of emission rates, particularly by 2020, is not observed; moreover, a more rapid growth of energy efficiency, according to the innovative scenario, facilitates reduction of CO_2 emissions and improvement of such quality indicators as emissions intensity and carbon intensity.

Due to rapid growth of the economy, these figures will reduce and by the end of the projected period, according to the innovative scenario, will amount to 0.0016 thousand tons of CO_2 eqv. / toe and 0.0003 thousand tons of CO_2 eqv. / thousand USD, respectively, against 0.0017 thousand tons of CO_2 eqv. / toe and 0.0004 thousand tons of CO_2 eqv. / thousand USD as per the baseline scenario (Annex, Table 14).

Based on expert calculations and estimates set out in the framework of the innovative scenario, progressive changes in organization of the country's energy system development will provide a transition to a more intense reduction of GHG emissions. At the same time, it will be effective only under the complex application of additional (compared to the baseline scenario) package of instruments and measures, guiding and regulating energy saving processes under implementation of the national policy on climate change mitigation.

As part of the strategy of the country, the following are major instruments of the

national policy for implementing of measures to mitigate climate change:

- Adoption of measures to improve energy efficiency, saving energy and resources across all sectors of the economy;
- Development and use of alternative energy sources;
- Technological growth for development and competitiveness increase;
- Energy security, diversification of the economy.

As for measures ensuring their implementation, they include:

- Improvement of the legislative framework;
- Improvement of institutional structures;
- Introduction of financial mechanisms which encourage reduction of greenhouse gas emissions;
- Creation of the national system for monitoring greenhouse gas emissions;
- Development of information mechanisms.

All these measures must be developed until 2017, so that by 2018, the practical groundwork would have been formed for active implementation of intensive industrial-innovative development.

Such package of national instruments and measures shall include:

- Development of the target state program on energy saving in Turkmenistan for a medium term (2018-2020) and for the future (next 5 years), the main purpose of which should be improving energy efficiency, energy and resource saving in all sectors of the economy.

Under these programs basic principles should be formulated to control the of process of energy saving and system enhancement of legal, administrative and economic measures ensuring efficient use of energy, the main priority directions shall be included and implementation of the most promising major energy efficiency projects in industry shall be proposed, especially in the fuel energy sector, agriculture, construction, transport, public sector, housing and communal utilities sector. Similar programs should be developed at the regional level as well. Moreover, an indicator of this activity measures implementation shall become saving of FER including implementing of programs on:

- Development and approval of methodology for calculating target indicators of energy efficiency to be applied in developing and implementing of energy efficiency programs in regions and industries;

- Building a system of mechanisms which would be aimed at strengthening the state's role in development and implementation of laws and programs on energy efficiency and energy saving, start-up of incentive mechanisms (additional economic incentives and sanctions) in order to motivate producers and consumers of energy;

- Improvement of tariff policy in the energy sector, aimed at the gradual introduction of market pricing principles for all types of energy in the real sector of economy;

- Building regulatory and legal framework in order to implement energy-saving policy and system of economic incentives. Moreover, the legislative support for energy-efficient development must be performed by the Law of Turkmenistan on energy saving to be developed. One of the purposes of this law - building of the ideology for energy saving. It will regulate administrative issues for irrational use of FER, benefits as a result of implementation of energy-saving measures as well as financial and economic mechanisms of state support for energy saving.

For creating a full regulatory framework, it is also necessary to develop laws on energy, technical regulation of energy systems, alternative and renewable energy sources and others.

The energy-saving effect shall be ensured by implementation of measures envisaged under the innovation scenario and aimed at the gradual transition to an energy-efficient model of development, creation of economic incentives for modernization of equipment and technology to save energy. These activities, for example, in the electric power sector include:

• Using advanced technologies for production and distribution of electricity along with building of appropriate legal and regulatory framework;

• Improving metering system of electricity used by manufacturers and consumers;

• Developing alternative sources of energy, increasing the role of renewable energy sources in the energy balance of the country, introducing for these purposes power plants using non-hydrocarbon sources of energy in the priority areas of the country;

• Conducting the annual inventory of greenhouse gas emissions in the electricity sector.

In turn, enhancing of infrastructure of metering and control in the sphere of energy consumption and energy efficiency will require:

- Development and implementation in practice of the fuel and energy balance of the country under the government statistics as an essential tool for monitoring the effectiveness of the national energy system and predicting the development of social and economic spheres;

- Conduction of statistical reporting and development of monitoring system in order to improve implementation of energy efficiency projects;

- Expanding powers of Gosenergonadzor of Turkmenistan in the sphere of supervising over the implementation of measures on conservation of energy resources and reduction of their consumption per unit of production (works, services);

- Improving the system of metering and consumption of fuel and energy resources through introduction of modern metering devices for gas, water, heat, electricity consumption, efficient appliances, lighting equipment and systems of program control on consumption of heat energy.

To improve the system of legal, administrative and economic measures ensuring efficient use of energy, it is necessary to envisage:

- Reduction of unit costs for production and use of energy resources through rationalization of their consumption, use of energy-saving technology and equipment;

- Encouraging development of small innovative and venture entrepreneurship in energy efficiency for creating competitive innovations;

- Attraction of foreign investments for implementation of energy efficiency projects;

- Amendments to existing standards, rules and regulations governing the expenditure of fuel and energy towards tightening of requirements for energy saving;

- Improving the rules of metering and control of energy consumption, setting its standards and mandatory certification of energy consuming appliances and equipment of mass application on their compliance with energy consumption standards;

- Carrying out regular energy audits of enterprises (mandatory for large enterprises and public sector);

- Creating additional energy-saving incentives for introduction of energy efficiency in business.

Measures on energy saving and efficient use shall become a mandatory part of the regional integrated programs (plans) of socio-economic development of the region, including regional energy programs. It is necessary to provide in the regional programs (plans) a mechanism for assessing the activities of system conduction of energy saving policy by local executive bodies in the regions.

The basis for development of the regional energy programs can become a medium-term sectoral program aimed at reducing greenhouse gas emissions, in the framework of which activities shall be provided to improve the economic performance of subordinate enterprises and organizations by increasing energy and resource efficiency, optimization of production processes, etc.

CHAPTER 5. OTHER ISSUES RELATED TO CLIMATE CHANGE

5.1. Research and systematic observations

5.1.1. Scientific research

The Government of Turkmenistan attaches a priority importance to development of science, qualitative growth and promotion of research activities. The country has a reliable legal framework for development of national science; decisions were made to improve the infrastructure, a long-term international cooperation in this area got off the ground with the competent international organizations and research centers.

All scientific studies, including issues of conservation and improvement of the environment, are conducted under the supervision of reconstituted in 2009 the Academy of Sciences of Turkmenistan.

Reinforcement at the legislative level is required for reform implementation of the national science. Enhanced national legal system in the field of science and education will facilitate a transition of our country to innovative way of development including forecasting, integration of science into production. For this purpose, the Law of Turkmenistan on scientific organizations was adopted; amendments were made to the Law on the status of researchers. The legal framework being updated in accordance with time requirements will contribute to successful implementation of scientific organization tasks, ensuring the regulation of relations with authorities and society.

Each year, the state support for science is growing, financing of long-range researches, experimental and technological developments are improved. The government creates all necessary conditions for development of scientific activities and expanding the range of investigations, complex conduction of research works and implementation of their results in practice. The material-technical base of scientific institutions and universities is strengthened; the latest information and communication technologies are widely introduced in their activities, including high-speed access to global database through Internet and electronic libraries.

In the scientific research, priority is given to such areas as:

- Introduction of innovative technologies in the industrial sector and the agricultural sector;
- Ecology and rational use of natural resources;
- Energy, fuel and their saving;
- Chemical technologies and creating new competitive products;
- Construction, architecture and seismology;
- Medicine and production of medical drugs;
- Information and communication technology;
- Economics, humanities and others.

The program of scientific research works of the Academy of Sciences of Turkmenistan is also aimed at:

- Development of geological, heliogeophysical, radiation and other studies;
- Improvement of monitoring process of the environment;

- Improvement of modeling and projecting methods in the study of natural resources under climate change;
- Investigation of physical processes in the Sun - Earth system and much more.

Climate change researches are particularly important for Turkmenistan because this process greatly affects all aspects of social and economic development of the country. The average annual air temperature in the country is one of the highest ones in the region. This has the adverse affect on the functioning of the human body and development of many sectors of the economy. Due to summer temperature rise, costs for energy resources sharply increase for cooling residential and industrial premises. Reducing the volume of surface water resources aggravates the already complicated situation with the water demand in the country.

Given the impact of climate change on various economy sectors, scientific research is carried out in the relevant scientific research institutions (the National Institute of Deserts, Flora and Fauna of the Ministry of Nature Protection of Turkmenistan, the Institute «Suwylymtaslama», the Institute of Agriculture of the Ministry of Agriculture) and universities (the Turkmen State University named after Magtymguly, the Turkmen State Agricultural University, the Medical University of Turkmenistan, the Turkmen State Institute of Architecture and Construction, the Turkmen State Institute of Oil and Gas) of the country.

5.1.2. Systematic observations

According to the Law on hydrometeorological activity in Turkmenistan, its government regulation and management are carried out by the Cabinet of Ministers of the country and the National Committee for Hydrometeorology (Turkmengidromet). The Cabinet of Ministers determines the national policy in the field of hydrometeorology and Turkmengidromet directly implements it, as the main organization involved in systematic climate observations. Its activity is aimed at providing information on weather, climate, water resources and environment, notifying of dangerous and extreme weather phenomena and extremely high levels of environment pollution.

Turkmengidromet is responsible for organization of monitoring of weather, marine environment, surface water, agricultural crops and pastures, radiation at the Earth's surface. In order to ensure monitoring, the activity of the observation network, system of collection, storage, processing, analysis and dissemination of information received is constantly improved.

Currently, in Turkmenistan meteorological observations are conducted at 48 stations following the program of station works of 2nd category. That is, at these stations regular 8-time monitoring is conducted on wind regime, air temperature, pressure and humidity, cloud cover, precipitation, soil temperature, visibility, sunshine duration, atmospheric phenomena. At 37 stations, the monitoring is carried out following the program of the weather station, that is, regular twice-daily observation of maximum and minimum air temperature, precipitation and atmospheric phenomena.

Hydrological observations are carried out at stations and posts in rivers, canals and reservoirs. Also the monitoring is carried out at 6 nautical stations on the east coast of the Caspian Sea, where observations are held of seaways, water temperature and salinity.

The agrometeorological network includes the characteristics of each farming zone of Turkmenistan. Currently observations are conducted by regional centers of hydrometeorology, meteorological stations and agrometeorological posts.

Since October 1957, the aerological observations are held only in the city of Turkmenbashi. Here, the temperature-wind sounding of atmosphere is conducted identifying such features on height as wind speed and direction, air temperature and humidity, atmospheric pressure.

There are 3 stations in Turkmenistan (Bikrova, Repetek and Mary), where regular observations of the atmospheric ozone is conducted. Observations on actinometry are conducted at meteorological stations in Bikrova, Repetek; observations are carried out of direct solar radiation, radiation balance, short-wave diffused, aggregated and reflected radiation.

In general, within the framework of Turkmengidromet the following activities are constantly performed:

a) Monitoring, observation network expansion and technological re-equipment of stations, metrological provision of hydrometeorological observations, development of technologies for collecting, processing and disseminating operational and regime observations, maintenance of the state fund of data on hydrometeorology;

b) Collection and management of climate data, preparation of operating and background information, as well as providing prognostic information to the public and various sectors of the economy.

Turkmengidromet is a member of the Global Climate Observing System (GCOS) and they transmit "SYNOP" report for 11 stations for exchange at the global scale, and for 20 - at the regional. They also send "CLIMAT" reports for 5 and 11 stations - respectively.

5.1.3. International cooperation

Turkmenistan participates in realization of many international projects and programs for climate research under UNDP, UNEP, and WMO, WHO, UNESCO and other organizations. In particular:

- World Climate Programme (WCP);
- World Climate Research Programme (WCRP);
- The Global Climate Observing System (GCOS).

Furthermore, our country takes part in the work of UNFCCC and IPCC, and is actively supporting efforts to strengthen regional cooperation in Central Asia. The country implements programs and projects aimed at addressing issues of climate change. The research in the field of ecology is carried out by intergovernmental (ISDC) and regional organizations (CAREC).

Official delegations participate in the meetings (Rio de Janeiro, 2012) and conduct negotiations (Durban, 2011, Abu Dhabi, 2013; New York, 2014) on environmental issues. Turkmenistan is in close contact with international organizations and countries on prevention of climatic disasters and adaptation to climate change. At present, the joint work is implemented with the United Nations Development Programme, United Nations Environment Programme and international banks (ADB, EBRD, and WB), European Union countries, other international organizations and embassies. The projects are implemented at national and local levels. The first ones focus mainly on capacity building, informa-

tion, technical assistance, the latter are demonstrative and are developed for local communities, address specific issues related to climate change.

International and regional cooperation in the field of systematic observation of climate in Turkmenistan is carried out through the World Meteorological Organization in the framework of the Interstate Committee on Hydrometeorology and under the International Fund for Saving the Aral Sea.

The National Committee in Hydrometeorology of Turkmenistan participates in the regional training seminars conducted by the World Meteorological Organization and other international organizations on climate change. The main themes of the seminars and meetings: automated weather observation systems, weather data, analyzing data quality, climate data management, and long-term climate forecast.

Currently, Turkmengidromet conducts works on creation of modern databases and opening of new stations.

In addition, it is necessary to strengthen technical and human capacities of hydrometeorological sector for qualitative regional and global environmental and climate change assessment.

5.1.4. Atmospheric pollution observations

Observations of air pollution are conducted by Environmental Control Service of the Ministry of Nature Protection of Turkmenistan (hereinafter, the "Service"), which is a state body. It was established in 2012 on the basis of the Scientific and Production Center of Ecological Monitoring of the National Institute of Deserts, Flora and Fauna of the Ministry of Nature Protection.

The main tasks of the Service are:

1) Monitoring the state of the environment, ensuring environmental safety, preserving natural resources and reaching a favorable level of environmentally sustainable development of society;

2) Providing state control in the field of environment protection and use of natural resources, compliance with environmental legislation and ecological requirements when implementing an economic activity;

3) Monitoring the environment state;

4) participate in the development of environment protection programs and activities within the framework of plans for socio-economic development and monitoring their implementation;

5) Collection and dissemination of environmental information, improvement of public awareness in the field of environmental protection;

6) Interaction with public associations.

The Service performs daily monitoring of the environment, preparation of daily information bulletin on the state of air, performs chemical analysis of water, air and soil, daily measures the natural radiation background, and prepares ecological passports, standards of maximum permissible emissions for industrial and agricultural facilities, conducts environmental impact assessment of constructed and reconstructed facilities.

Monitoring of air pollution is carried out in six cities (Ashgabat, Abadan, Turkmenbashi, Balkanabat, Mary, and Dashoguz) and 17 stationary stations of the "Station-2." There, daily air sampling on major pollutants is conducted.

In the laboratories of water and soil pollution control, the amount of the following elements is identified:

1. CO (carbon monoxide).
2. NO_2 (nitrogen dioxide).
3. NO (nitric oxide).
4. Dust.
5. Phenols (only in Ashgabat).
6. Formaldehyde (only in Ashgabat).

In addition, the laboratory of Mari velayat department of nature protection conducts the analysis on the content of ammonia (NH3) in the atmosphere, because there is a nitrogen fertilizer plant near the city. The laboratory of Balkan velayat department of nature protection holds control of chlorine content in water near Balkanabat iodine-bromine plant.

Analysis of water sources pollution is carried out for samples from 34 stations of all regions of Turkmenistan.

There are mainly identified:

1. Mineralization of water.
2. PH (hydrogen concentration).
3. The content of oil products (the Caspian Sea, the Murgab River and Tejen).
4. The content of pesticides in soil.

5.2. Technology transfer

A transition of Turkmen economy to industrial-innovative development path has led to the need of providing industrial sectors with high-tech equipment. In recent years, a great work has been done to attract foreign investments to the economy for creating new industries, modernization and technical re-equipment of enterprises of economy priority sectors.

At present stage of development of the economy of Turkmenistan, technology transfer is one of the major sources of changes.

Turkmenistan considers the technology transfer from developed countries as the main source of innovation changes. This involves exchange of experiences, skills, knowledge, technologies and technological processes, manufacturing methods, production samples and means of production.

In the world practice, transfer of technology is performed in two ways: at the local level and from developed countries. Turkmenistan mainly uses technology developed in China, Turkey, Korea, Japan, Germany, France, UK, USA, Russia, Ukraine, and Belarus. Our country supports economic and trade relations with 107 countries of the world, of which 99 - importing countries. In the structure of imports in 2013, products for industrial purposes, including modern technology and equipment amounted to 83%.

One of the indicators of technology transfer is the amount of foreign investment flows to the country's economy. Their influx contributes to improvement of the economy production structure, creation of new high-tech industries, modernization of fixed assets and technical re-equipment of enterprises, introduction of advanced achievements of management, marketing and know-how.

According to figures published by the UN Conference on Trade and Development (UNCTAD) in the World Investment Report for 2012, the volume of direct foreign investments in Turkmenistan amounted to 15.6% of its GDP. This is evidenced by their growth in recent years, which, according to macroeconomic indicators of economic development, increased by 8.6 times. By the index of foreign direct investments, Turkmenistan is placed among top ten countries.

Investments made by foreign companies in the economy increase ever year. Their volume in 2013 increased compared to 2007 in 9, 4 times and amounted to 16% of the total investment volume.

The policy of «open doors» and a favorable investment climate, created in the country, contribute to successful business. Turkmenistan is committed to long-term, mutually beneficial and fruitful cooperation. The underlying principles here are economic efficiency of joint projects, their social importance and environmental safety.

The success of such cooperation is provided as well by a valid and effective legal framework. In particular, these are the laws of Turkmenistan on foreign economic activity, foreign investments, investment activity, on currency regulation and currency control in the foreign economic activity, the Regulations on the licensing of exports and imports of goods (works, services), Presidential Decree on measures to regulate foreign economic activity in Turkmenistan and a number of other legal acts.

In the oil and gas industry, investment policy envisages, firstly, building of diversified system of providing Turkmen energy resources to the world market by building an extensive pipeline system; secondly, a long-term partnership with leading international companies for effective development of natural oil and gas reserves, conduction of deep exploration and development of hydrocarbon resource fields on land and in the Caspian Sea in order to increase the volume of their production, processing and export.

In the chemical industry, a chemical production development is planned, including construction of carbamide plants, facilities for production of chloride and potassium sulphate, caustic soda and chlorine. Also, there is a plan to develop the inexhaustible source of valuable chemical raw of Karabogazgol Gulf.

The textile industry provides for increase of volumes of cotton processing through creating new highly profitable textile enterprises, introduction of advanced technologies as well as production of competitive products for supplying to both domestic and foreign markets.

In other industries, the emphasis is made on their reorientation from raw materials to production of the final production, a combination of both export-oriented and import-substituting industries. On this basis, the parameters and objectives have been identified to attract investments for development of energy potential of the country, petrochemical, metallurgy, building materials industry.

In the agroindustrial complex, along with production and processing of grain, the investment policy provides for development of cotton growing, harvesting and processing of wool, rawhides. Among the priority areas there is increase in grain production and creation of high-tech system of its processing, namely the mill and milling complexes, manufacturing of high quality food products and supplying it to domestic consumer market.

In the transport and communication sector, the main flow of investments goes for development of road, air, rail, river and sea transport, road construction and improvement of telecommunication system, postal telecommunications.

In the market of Turkmenistan more than 1,700 foreign enterprises and companies are registered, most of which are engaged in the construction of production facilities and their infrastructure, building industrial enterprises.

In construction of high-tech industrial facilities well-known foreign companies are involved, such as «Bouygues», «Mitsubishi», «General Electrical», «Ronessans», «Schlumberge», «CNPC», «Interbudmontazh», «Vozrozhdeniye», «Polimex», «NAATA» «Hyundai», «LG» and others. Dozens of objects constructed by these companies are on the turnkey basis.

The main requirement to technologies imported to Turkmenistan is their environmental safety.

Technology transfer to Turkmenistan is carried out in two directions - commercial and non-commercial - in the form of industrial cooperation, creation of joint ventures, providing technical assistance, engineering, transfer of know-how and licenses, conduction of international exhibitions and symposiums, publication of scientific and technical literature, exchange of delegations and organization of meetings of scientists, engineers, inventors, students and graduate students training abroad, cooperation in the field of science and technology with the advanced countries of the world.

At the current stage of development of Turkmenistan, foundation is laid for development of domestic technologies and equipment:

- a modern technology center has been established in compliance with global standards, on the basis of which complex fundamental and applied research studies are carried out;
- Research priorities in the country have been identified;
- The structure of the Academy of Sciences has been enhanced;
- Links with academic institutions of developed countries have been established;
- Exchange of knowledge and experience at the international and regional level is conducted;
- Training of scientific personnel has been intensified; necessary conditions were made to stimulate innovations.

Comprehensive developments of science, introduction of its achievements into production, building of intellectual potential of society are priorities of science and technology policy in Turkmenistan.

In this context, creation of fundamentally new scientific and technical base is of high importance. Nano-, bio- and information and communication technologies, micro- and nano-electronics, biomaterials and biomedicine, molecular biology, genetic engineering and nanomaterials are new trends for Turkmenistan that received its development since the commissioning of the Technology Centre of the Academy of Sciences of the country.

By strengthening relations between ministries, departments and research and design institutes in the Technology Center, equipped with the latest generation equipment, research works are held to develop new technologies for production of asphalt concrete coatings, studying of groundwater, oil, gas, condensate and rocks, studying of herbs.

The Center supports research proposals for conducting studies on composition of gas and possibilities of using sulfur as well as on genetics. Based on the Laboratory of Geographic Information Technologies, a work is conducted on building of scientific bases of geographic information systems.

One of the most important aspects of science development is to train professionals. The head of the state initiated establishment of the University of Engineering and Technology of the Academy of Sciences using innovative principles that unite educational, scientific and practical training of engineers, engineer-researchers based on fundamental and applied sciences, introduction of modern techniques and technologies, organization of independent design, research and engineering activity of students.

Necessary organizational and economic conditions have been created for improving the national system of protection of intellectual property and its legal framework.

Intellectual property protection is now an integral part of the national infrastructure of Turkmenistan. XXI century - the century of knowledge-based economy, in the development of which a key role is played by the creative activity of people, and reliable protection of intellectual property. Turkmenistan as a full member of international cultural and scientific exchange, a member of the World Intellectual Property Organization (WIPO), has committed to ensure the observance of rights of citizens and foreigners.

The state policy in the field protection of rights for intellectual property provides the inseparable link in the chain of creating and using its results (inventions, know-how, computer programs, etc.) in the latest technological items and technologies. In addition, the system of these rights protection contributes to:

- Strengthening the scientific and technological potential of the country, promoting creative activity, including young people;
- Developing and using new technologies, producing competitive products;
- Developing innovative activity;
- Creating conditions for domestic and international exchange of new techniques and technologies, forming market of scientific and technical products;
- Encouraging fair competition;
- Protecting the domestic market from counterfeit goods, supporting domestic producers of goods and services;
- Creating a favorable investment climate and attracting investment in high technology and high-tech industries;
- Preparing and disseminating information about new achievements and developments.

The effective functioning of the intellectual property rights system is one of the priorities of government bodies, and it is based on the weighted state policy in this sphere.

The most important and required condition to ensure the import of modern equipment and technology, as well as attracting foreign investments into the country is a reliable legal framework of intellectual property protection. Over the last years, Turkmenistan has implemented a number of organizational measures and adopted legislation acts to strengthen protection of intellectual property.

Since March 1, 2013, the State Intellectual Property Service, established by the President of Turkmenistan, has started its work. It is responsible for state regulation of ac-

tivities in the field of industrial property and selection, compliance with copyright and related rights in relation to objects of intellectual property that are the source of innovations and innovation processes.

The legal basis for protection of intellectual property in Turkmenistan is the following laws:

- On inventions and industrial designs;
- On trademarks, service marks and appellations of origin;
- On selection achievements;
- On copyright and related rights;
- On the legal protection of algorithms, programs for computers, databases and topographies of integrated circuits;
- On foreign investments;
- Arbitration Procedure Code;
- The Code of Administrative Offences;
- Criminal Code;
- Code of Civil Procedure;
- Customs Code.

The laws of Turkmenistan on inventions and industrial designs, trademarks, service marks and appellations of origin allowed to draw the necessary basis for inventive creativity, create strong incentives for local inventors and scientists, increase business activity and increase the inflow of foreign investments and advanced foreign technologies. These two laws have replaced the earlier acting Patent Law of Turkmenistan, which contained quite diverse objects of industrial property (IP), in particular, on one hand - inventions and industrial designs, on the other - trademarks and service marks. The adoption of new laws has allowed according to example of other countries around the world to separate diverse objects of industrial property and bring them into conformity with international conventions, agreements and treaties on protection of industrial property signed by Turkmenistan. It is important to emphasize that each of the law contains new sections such as use of industrial property, as well as customs controls.

While consistently building a strategy to strengthen measures on intellectual property protection, Turkmenistan adopted a new edition of the Law of Turkmenistan on approval and enactment of the Customs Code. The new edition of the Code includes all progressive changes and innovations in the field of customs legislation of developed countries and international standards.

Including to the Customs Code of Turkmenistan modern legal norms to ensure effectiveness of the existing registration mechanism of the State Customs Service of patented and registered in the country facilities of IP, will allow their owners to protect themselves on the border from the counterfeit attacks by third parties. This practice has now been adopted by most countries and contributes to implementation of civilized trade, as well as implementation of international obligations undertaken by each country.

The active legislative activity in the field of protection of owner's rights of intellectual property led to adoption of the Law of Turkmenistan on legal protection of selection

achievements. After adoption of this law, a real mechanism has appeared regulating the property and private non-property legal relations arising in the sphere of creating, legal protection and using of new patented plant varieties and animal breeds.

The availability in Turkmenistan of more than 3000 plant species, many of which have valuable economic properties, including medical drugs, makes this task particularly important. The work of research institutions of the country and breeders on improving the economic traits of field, cultivated, garden and fruit crops with a final result in the form of a patent for a plant variety bred allows legislatively securing these achievements for innovators.

The new edition of the Criminal Code and the Code of Administrative Offences contains legal provisions on protection of intellectual property; others contain the indirect reference to them. The legal thrust of these acts regulates, from one side, the liability for an offense, from the other side – the rights to legal entities and individuals associated with a property ownership, including industrial property (IP), investment activity, the activities of enterprises and entrepreneurs, certification and standardization of goods and services.

Improving the organizational structure and legal framework of the national system of intellectual property protection, building incentives to promote the inventiveness have reflected on the quantitative and qualitative indicators of local scientific and technological potential. As of November 1, 2014, the State Register of the country registered 1,213 patents granted under the national procedure, 592 of which - foreign applicants, 621 - local. Out of all the patents granted 30% - in the sphere of oil and gas industry, 28% - medicine and medical industry 13% - chemical industry, 12% - building industry, 7% - agriculture, 10% - other industries.

It should be noted that the interest of foreign investors in Turkmenistan is traced by the instructions of the country as well in the international system of PCT (Patent Cooperation Treaty), administered by the World Intellectual Property Organization.

Turkmenistan is also a member of the Eurasian Patent Organization (EAPO), which includes eight former Soviet republics.

The process of enhancing the national system of intellectual property protection will be continued. Currently, a draft Law of Turkmenistan is under preparation on unfair competitions, brand names, protection of domain names, rationalization of proposals, legal protection of genetic resources, traditional knowledge and folk art, which are envisaged to be adopted in 2015-2016.

After adoption of the Law of Turkmenistan on innovation technology in August 2014, a transfer to our country was legally enshrined. According to this law, transfer of technology is a complex of measures to transfer innovations from the sphere of their development to the sphere of their practical use. An agreement on transfer of technology involves using of complex of exclusive rights of goodwill, knowledge and expertise of the licensor to a certain extent with or without the use of the territory in relation to a particular field of business (sale of goods produced by the licensee, the implementation of other economic activity, works and services).

The technology transfer agreement can be concluded in the form of a commercial concession (franchising), license agreement or other agreement stipulated by the legislation of Turkmenistan.

Concluding the agreement in writing shall be a prerequisite.

The agreement stipulating the use of intellectual property, protected under patent laws of Turkmenistan, shall be registered in the State Service of Intellectual Property.

The technology transfer agreement may allow the user's right to permit others to use a complex of exclusive rights provided to him/her or a part thereof under sublicense terms, agreed with the user, or identified by the agreement on transfer of technology.

Commercial sub-concession agreement cannot be concluded for a longer period than the technology transfer agreement based on which it is concluded.

The government may transfer the rights for technologies developed and acquired at the expense of budget and other state funds to developers and third parties in order to commercialize them in the manner prescribed by law and other normative legal acts of Turkmenistan. The State may purchase from individuals and legal entities the rights to use technology for their needs, as well as to ensure the interests of the national security.

Conclusion of an agreement on import of technology shall comply with the legislation of Turkmenistan, enhance the scientific and technical level and ensure the development of the national economy.

In addition, it is allowed to:

- Import technology, when under the same or more favorable terms the same or an equivalent technology may be purchased on the territory of Turkmenistan;
- Oblige the recipient of technology to make payments that do not meet the value of the technology on which the contract is concluded.
- The agreement on import provides for duties of a party transmitting technology:
- Ensure the quality of products manufactured as a result of using imported technology, reducing the cost of its production, saving energy and materials;
- Make the last improvements related to a transferred technology available to a receiving party during the agreement validity;
- Inform about the dangers of harmful effects of technology on lives and health of people and the environment.

5.3. Education, training and public awareness

Education, training and public awareness on climate change and its effects (Art. 6 of the UNFCCC) take an important place among the activities stipulated by the UNFCCC and are aimed at involving of large sections of society in related activities. The work on promoting public awareness and knowledge about climate change in Turkmenistan is coordinated by the Ministry of Nature Protection, the responsible body for implementation of the UNFCCC in our country. In order to actively promote the implementation of all the provisions of the indicated article and involve the public in decision-making and implementation process to achieve the objectives of the UNFCCC, the New Delhi work program was adopted at the 8th Conference of Parties of the UNFCCC (New Delhi, 2002). As a country party to the UNFCCC, Turkmenistan is actively implementing this program. This work covers variety of population sectors (target groups) - scientists, teachers, schoolchildren, students, senior officials, experts of the ministries and departments of key economy sectors, industrial enterprises, representatives of business and private sectors, media, activists of environmental non-governmental organizations and the public.

The main activity focuses on the following:

- Conduction of training seminars for various target groups;
- Conduction of national workshops with representatives of ministries and departments, public officials, decision-makers, professionals involved in preparation of plans and strategies for development of individual economy sectors that have an impact on climate or to a large extent depend on its changes;
- Participation in the regional and international meetings on climate change issues and the Kyoto Protocol;
- Preparation of guidelines and study guides for pupils, students and teachers;
- Releasing educational films and videos;
- Publication of information booklets and calendars;
- Conduction of companies and events related to ecology days devoted to the World Environment Day, Caspian Sea Day and others associated with these dates;
- Giving a speech on television and radio, publications on climate change and its negative impact in the periodical press, including the quarterly magazine "Ecological Culture and Environment Protection", which is published in three languages.

Over the last few years, in Turkmenistan the media interest in climate change has dramatically increased. This is due to increasing number of abnormal natural phenomena in the country and in the world. Thus, public awareness and education activities in Turkmenistan in recent years have significantly increased the interest and activity of the population. Information is disseminated through the media, radio, TV and print media, the Internet, etc., is published as news feeds and reports and in special sections devoted to environmental issues.

However, the coverage of public in this activity is not sufficient yet.

In 1999, there was adopted a National program of training and education of preschool children in Turkmenistan, developed in accordance with the International Declaration on the Rights of the Child, the Constitution of Turkmenistan, the Law on Education. To promote knowledge, traditional extracurricular works are used: the Day of environmental knowledge, theme evenings, competitions, drawing contests, lectures on environmental issues organized by local experts involved in protection of nature and representatives of public organizations. Over the last years, after adoption of the Law on Public Associations (2003), their activity has been visibly intensified.

In accordance with the Presidential Decree of Turkmenistan on improving the education system, a lot of attention is paid to environmental education in secondary schools and universities of the country within the framework of mandatory standards. To ensure the quality of pre-school education services, the government has developed a new educational standard.

Regarding the aspects of climate change, the basic knowledge in this area is provided in the study of subjects of «Nature study» and «Geography». These disciplines include air and its composition; weather and climate; climatic factors; the impact of climate change on human life and economic activity; agro-climatic resources and others. According to curriculum, students are introduced to basic concepts on this issue and general provisions of the environmental and ecological legislation of Turkmenistan, as well as relevant international conventions. Furthermore, additional, optional classes and

theme evenings are conducted in high schools and universities, as well as according clubs are available.

Professional knowledge on scientific basis of climate change can be received in two higher educational institutions of Turkmenistan. The «Fundamentals of Meteorology and Climatology» course that includes the issues of climate change is taught at the Department of Meteorology, Faculty of Geography of the Turkmen State Pedagogical Institute named after S. Seydi and at Ecology and Hydrometeorology Department of natural-geographical faculty of the Turkmen State University named after Magtymguly. The program of this course is complemented by new information obtained in the process of preparation of the National Communication on Climate Change of Turkmenistan.

The Turkmen State Institute of Architecture and Construction prepares technical engineers and ecologists specializing at «Environmental protection and rational use of natural resources» for production and processing, design and research activity in the field of technology of refining and recycling of industrial wastes, development of environmentally sound and resource saving technologies. Special courses are taught on «Applied Industrial Ecology», «Theoretical Foundations of Environmental Protection», «Environmental Chemistry», «Protection of air from pollution», «Waste-free production, and secondary resources», «Environmental monitoring», «Fundamentals of design and environmental assessment», «Human Ecology».

Many universities of the country offer courses on «Environmental Economics», «Nature Protection», «Ecology and rational use of natural resources».

One of the key areas of education reform implemented in Turkmenistan is a broad international cooperation. In this large-scale process, priority is given to studying international best practices, attracting professors from leading universities of the world for working in the country, regular exchange of students, establishment of close interuniversity and scientific contacts, introduction of innovative educational technologies, including multimedia and information. The relationship established between higher education institutions of Turkmenistan and the European countries in the framework of EU program and successfully implemented joint projects today largely contribute to solution of the tasks set.

Students who are future ecologists during their studying do their internship at subordinate units of the Ministry of Nature Protection of Turkmenistan - the National Institute of Deserts, Flora and fauna, nature reserves and Environmental Protection Administrations at velayats, gaining necessary skills for future work. Students who are future meteorologists do their internship at subdivisions of the National Hydrometeorology Committee. As institutional measures on environmental education, which are actively implemented within the framework of national plans, mass media is widely used to sensitize the population.

The issues of providing public access to information on ecology have been reflected in a number of international environmental conventions ratified by Turkmenistan, the most important of which is the 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 relating to the environment. Turkmenistan ratified this international legal document in 1999. In this regard, major efforts to ensure public

access to information on climate change and sustainable development are made by Arhus Centre of Turkmenistan established in 2012 under the active support of the Ministry of Nature Protection of Turkmenistan. In the framework of its activities, the Centre in a relatively short period, has already implemented many useful activities, including:

- Publication of the brochure on using of provisions of the Arhus Convention for protection of the environment, including climate change and sustainable development;
- Preparing a CD disk on environmental legislation of Turkmenistan and the official documents of the ratified international conventions.

All materials have been disseminated among stakeholders to activate civil society and assist public authorities in promoting the effective implementation of international environmental conventions.

In addition, the Arhus Centre implemented a project to enable exchange of information on the environment, as well as the beginning of the dialogue between representatives of government agencies and non-governmental organizations working in the field of environmental protection, taking into account national traditions and conditions to apply provisions of the national environmental legislation in practice.

Turkmenistan conducts the work on preparation and publication of modern learning and teaching aids, including ecology and climate change issues. However, as for now their quantity and quality lag behind today's requirements.

Involving the public and non-governmental organizations in decision-making and public participation in the work of the Convention and access to information are essential for public support in combating the effects of climate change and adaptation to them.

In Turkmenistan, there is a number of NGOs actively working in the field of environmental protection, including climate change. These organizations work in such areas as information, education, expertise and technical support, the implementation of practical projects in the field of adaptation and mitigation, participation in special meetings. The most active public organization working on climate change in Turkmenistan is called «Nature Protection».

Discussions conducted within the framework of the National Communications preparation indicate on the need for further awareness rising of society, shortage of qualified staff and educational materials on climate change.

5.4. Constraints, gaps and capacity needs

Identifying the needs for capacity building is an essential and important element of sustainable development and plays a crucial role in minimizing the adverse effects of climate change and adaptation to them.

Capacity building is a process of expanding technical skills and institutional capacity in developing countries and countries with economies in transition, enabling them to participate in all aspects of adaptation, mitigation and other studies in the field of climate change.

Capacity building in Turkmenistan includes:

1. Development and implementation of educational and public awareness programs, training and personnel exchange or secondment for preparing experts in this

field, promoting public awareness and their access to information on climate change at the national level.

2. Providing local, regional and national authorities and civil society with capacity to respond to disasters, adaptation to climate change, development and adoption of measures to mitigate its adverse effects.

3. Support for scientific research and systematic observations.

4. Improving the use of methods of measurement and recording of information.

5. Support for introduction of according technologies to facilitate climate change adaptation and mitigation of its effects.

6. Improving knowledge and awareness level of decision makers.

7. Building updated national legal framework and solving institutional and administrative issues.

During the preparation for the Third National Communication of Turkmenistan on Climate Change, it was found out that the level of public understanding of the importance of this issue had increased compared to the preparation period of previous communications. Such increase was caused by adoption of the National Strategy of Turkmenistan on climate change and measures taken for its implementation. However, in recent decades the growing acuteness of climate change problem and its present adverse impacts on sustainable development process of society requires to strengthen measures to prevent and mitigate its effects. The problem of global climate change is not only the environmental, but also economic directly affecting the society development. Since independence, Turkmenistan has chosen the path of gradual transition to a market economy. Moreover, the state regulation serves as a base for economic relations in the transition period. The Government attaches special importance to rational use of natural resources and environmental protection. In this work, it is necessary to use all opportunities and mechanisms for successful solution of problems and elimination of various constraints. In particular, it is necessary to enhance the legislative and institutional frameworks to improve activities of the state and citizens in addressing the problem of climate change in Turkmenistan.

Currently, in accordance with the National Strategy of Turkmenistan on climate change, a program of Green Development is under preparation. Within its framework, the national plans of action on adaptation and mitigation are finalized; they contain numerous project proposals on improved actions on climate change in the country. However, proposed today measures to prevent climate change are insignificant compared to the scale of economic activity in Turkmenistan. Considering that the problem of climate change is serious enough, it is necessary to continue developing measures to reduce greenhouse gas emissions by economy sectors and regions.

It is important to continue the process of assessing the vulnerability of different economy sectors to climate change. The major task is to develop sectoral adaptation strategies, particularly for highly vulnerable economy sectors. For all priority sectors with involvement of international institutions and experts, it is necessary to analyze the costs and benefits of proposed adaptation measures for various scenarios of economic development, population growth and climate change, attracting a software modeling.

It is gratifying that most of the proposals provided in the first draft of the national plans of action are financed by local funding and will be carried out without assistance of international donors.

Despite the measures taken by the Government of Turkmenistan to strengthen capacity in addressing climate change in order to achieve results that are adequate for sharpness of this problem, it is necessary, first, to improve the legal framework and institutional structure of the state.

Among the most important tasks - improving the system of assessment of GHG emissions and sinks, i.e. building the national inventory system (NIS). This will allow to identify in dynamics the «contribution» of Turkmenistan to global warming and give an impulse to preparing real plans to reduce GHG emissions. It is necessary to improve the statistical reporting system, incorporating into it the data required for GHG inventory conduction. It is important to expand the scope of scientific research works on climate change, such as identifying of national GHG emission factors from various sources, the effects on human health and the development of various economy sectors of Turkmenistan.

Until now, because of the difficulty of obtaining some macroeconomic data in preparation of NS, the baseline and mitigation scenarios are developed mainly based on assumptions and expert assessments. For the same reason and because of lack of experienced experts on economic modeling, the software LEEP, MARCAL and others were not used, that are intended for computer modeling of GHG emissions in accordance with the economic development of the country and separate sectors of the economy. Development of scenarios using software was not possible, because the program requires a large set of macroeconomic indicators as input.

Existing legislation acts on energy efficiency in industries such as oil, gas and electricity were developed more than 25 years ago. They are outdated and do not meet current realities. It is therefore necessary to improve the norms and standards in the field of energy production and use.

It is necessary to restore the energy balance preparation on a regular basis and develop a strategy for radical energy saving for 20-30 years. To improve economy efficiency of the country it is necessary to develop and adopt the law on energy conservation, which should include a system of incentives for rational use of FER.

Environmental issues in Turkmenistan are given the constant and close attention. Large-scale national reform programs in the economic sector and the social sector are closely linked to the environmental component as an integral condition for economic and social development. Together with authoritative international organizations - United Nations Development Programme, United Nations Environment Programme, the Global Environment Facility and other international organizations, dozens of environmental programs and projects are implemented at the national and regional levels.

In order to expand international cooperation in addressing climate change, it is required to involve leading experts from relevant ministries and agencies to participate in international meetings, conferences, workshops, including the Conference of Parties and sessions of UNFCCC / United Nations. It is also necessary to actively participate at activities of international networks on climate change issues, particularly in the Asia-Pacific and Central regions.

To improve activities radically to address climate change in Turkmenistan, it is necessary to strengthen the material-technical base of the National Hydrometeorology Committee of Turkmenistan, expand the observation network and types of observations,

ensure more extensive covering of these issues by media and promote measures to prevent adverse effects and adapt to them. The results of work carried out under preparation of the Third National Communication on Climate Change have led to considering of this problem in preparation of long-term development programs, for example, at such sectors as «Agriculture», «Water Management», «Forestry» and «Health care». It is necessary to continue works on integration of climate change issues in all national plans and development programs, particularly in vulnerable economy sectors of the country.

One of the most important areas of capacity building is to improve systems of ecological indicators and informativeness in nature protection, environmental management, and monitoring of its condition. The improvement of this system is impossible without ensuring its latest and modern achievements to enhance the technical capacity of environmental monitoring services, laboratories, as well as creating of data banks to summarize the information about the state of the environment and sources of exposure to it.

The Ministry of Nature Protection of Turkmenistan plans and implements a number of measures for protection of the environment, monitors compliance with environmental policy, conducts large-scale informing and develops environmental indicators to include them into the national system of statistics. The national statistical agencies issue a collection of the chapter «Environmental protection and use of natural resources in Turkmenistan», prepared according to the official statistical reports, developed in government statistics agencies as well as data of ministries, departments and organizations whose activities are related to environmental management, environmental monitoring and environment protection. However, unfortunately, these collections are not available online. It is extremely essential to develop unified and standard monitoring programs, including informational ones for a wide public in activities of various industries, which will enable greater access to information and raise awareness on environment state.

In order to improve and increase the efficiency of environmental monitoring and provide information at the present level in the light of new environmental problems and tasks, currently there is an urgent need for development of the National Information Environmental System (IES), with its integration into the regional. It is desirable to create a model of IES, which will include both national and international requirements of environmental documents. It must be adapted to the national systems of Central Asian countries. Sharing of data requires common standards for its transfering, storage and quality, as well as harmonization of systematic plans. It is necessary to use international experience in the development to make the system compatible with international information systems.

Existing constraints lead to some gaps in implementation of activities under UNFCCC in Turkmenistan. The main directions for improving them are to:

1. Continue to work on compliance of the legislation of Turkmenistan on climate change with international requirements.
2. Provide regular updates of national plans on adaptation and mitigation and monitor their implementation.
3. Establish the national permanent institutional framework on climate change.
4. Train staff on climate change.

5. Establish the national GHG inventory system.
6. Reflect climate change issues fully in the long-term economic development programs of the country.
7. Cover climate change issues extensively in the media.
8. Include in the curriculum and programs in schools and universities of Turkmenistan topics related to climate change.
9. Provide translation of international documents on climate change in the state official language.
10. Improve coordination of ministries, departments and economic entities of Turkmenistan on cooperation in addressing climate change.
11. Expand international relations of Turkmen specialists.
12. Publicate educational, popular science and informational materials, manuals in the state language.
13. Transit to a constant development of energy balance of the country.
14. Develop the National Information Environmental System (IES).
15. Continue to develop environmental indicators.
16. Develop the law on energy saving.
17. Actively participate in the international networks on climate change.
18. Strengthen the material-technical base of the National Hydrometeorology Committee of Turkmenistan; expand the observation network and types of observations.
19. Expand working with international organizations (GEF, UNDP, UNEP, UNESCO, EU, WB, ADB, etc.).
20. Prepare the program for developing the use of renewable energy sources (RES) in Turkmenistan.

Existing constraints and gaps in the work to achieve the objectives of UNFCCC in Turkmenistan show the importance to increase the capacity building in this area. The preparation process of the Third National Communication (TNC) showed that many of the capacity needs mentioned above (legal, technical, institutional, methodological, financial and scientific-educational) on climate change today are very relevant and non-act may slow down the development pace of society in using modern, environmentally friendly, energy-efficient and energy-saving technologies.

ABBREVIATIONS

ADB	Asian Development Bank
WB	World Bank
GDP	Gross domestic product
RES	Renewable energy sources
WMO	World Meteorological Organization
WHO	World Health Organization
IHE	Institution of higher education
SRPS	State regional power station
GCOS	Global Climate Observing System
GTU	Gas turbine unit
GTPS	Gas turbine power station
HFCs	Hydrofluorocarbons
HPS	Hydro power station
GEF	Global Environment Facility
IWM	Integrated Water Management
CE	Coefficient of efficiency
CCD	Convention to Combat Desertification
CBD	Convention on Biodiversity
FF	Forests remaining forests
LF	Lands converted to forest lands
IPCC	Intergovernmental Panel on Climate Change
bn.	billion
IFAS	International Fund for the Aral Sea
CDM	Clean Development Mechanism
NMVOCs	Non-methane volatile organic carbons
NEAP	National Environmental Action Plan
OR	Oil Refinery
ISEAST	Institute of Solar Energy of Academy of Science of Turkmenistan
OSCE	Organization for Security and Cooperation in Europe
GHG	Greenhouse gases
PPP	purchasing-power parity
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change
SDW	Solid domestic wastes
FER	Fuel & energy resources
TPP	thermal power plant
TPS	thermal power station
Eqv.	equivalent
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
FAO	Food and Agricultural Organization

LULUCF	Land Use and Land Use Change in Forestry
MAGICC/SCENGEN	Model for theAassessment of Greenhouse-gas Induced Climate Change / A Regional Climate SCENario GENerator
NCSP	NationalCommunicationSupportProgram
NAPA	National Adaptation Plan of Action
NAMA	Nationally Appropriate Mitigation Actions
ICSD	Intergovenmental Commission on Sustainable Development
EBRD	European Bank for Reconstruction and Development
WCP	World Climate Programme
WCRP	World Climate Research Programme
CAREC	Central Asia Regional Environmental Center
ODS	Ozone Depleting Substances

Units of Measurement

°C	Celsius degree
tcf	Tons of conventional fuel
ha	Hectare
km	Kilometer
km^2	Square kilometer
km^3	Cubic kilometer
m^3	Cubic meter
mm	Millimeter
t	Ton
toe	Ton of oil equivalent
Gg CO_2-eqv.	Gigagram in CO_2-equivalent
Gcal.	Gigacalorie
kWh	Kilowatt-hour
MW	Megawatt
kg/ha	Kilogram per hectare
mg/L	Milligram per liter

Chemical symbols

H_2O	Water
CO	Carbon monoxide
CO_2	Carbon dioxide (carbonic gas)
HFCs	Hydrofluorocarbons
N_2O	Nitrous oxide
NOx	Nitrogen oxide
CH_4	Methane
SO_2	Sulphur Dioxide

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ANNEXES

Table 1:National inventory of anthropogenic greenhouse gas emissions and their outlets not controlled by the Montreal Protocol in 2000, Gg

Categories of sources and sinks of greenhouse gases	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
Energy	24277	1042.5473	0.127822	113.64371	314.4787	32.929181	0
A. Fuel combustion (by sector)	24277.003	1.06102592	0.12782151	113.6437084	314.478668	32.92918055	0
1. Energy industry	6910.962	0.12469583	0.01263258	18.56853939	2.46946631	0.61532906	
a) the production of electricity and thermal energy	6910.962	0.12469583	0.01263258	18.56853939	2.46946631	0.61532906	
2. Industrial Processes	204.069	0.00406809	0.00048276	0.54691398	0.0699679	0.01654249	0
a) chemical industry	95.931	0.00171862	0.00017186	0.25779247	0.03437233	0.00859308	
b) production of construction materials	61.196	0.00109634	0.00010963	0.16445063	0.02192675	0.00548169	
c) the textile industry	46.942	0.00125313	0.00020127	0.12467088	0.01366882	0.00246772	
d) Other							
3. Vehicles	4878.462	0.7122	0.0927	61.519	307.538	31.197	0
a) Civil aviation	340.536	0.0094	0	1.352	0.562	0.085	
b) Road transport	4377.592	0.6903	0.0887	56.457	306.241	30.921	
c) railway transport	147.603	0.0116	0.0037	3.44	1.208	0.255	
d) water transport	12.731	0.0009	0.0003	0.27	0.085	0.02	
4. Other sectors	12283.51	0.220062	0.02200617	33.009255	4.401234	1.100309	0
a) The municipal sector	2231.93	0.039986	0.00399855	5.997825	0.79971	0.199928	
b) population	10051.58	0.180076	0.01800762	27.01143	3.601524	0.900381	
5. Other	-	-	-	-	-	-	
B. The methane emissions from activities associated with oil and gas	0	1041.48626					
1. Oil and Natural Gas		1041.48626					
a) oil		1.118055					
b) Natural gas		1011.057					

Categories of sources and sinks of greenhouse gases	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
c) ventilation and flaring at oil and gas pro-duction		29.3112					
For memory							
International bunker							
aviation							
Sea							
CO_2 emissions from biomass							
Industrial Processes	406.198	0.017	1.2947	2.3023	0.9434	268.7391	1.756
A. Production of mineral raw materials	226.6648	0	0	0	0	259.8101	0.1259
1. Production of cement	207.4115						0.1259
2. Production of lime	13.05						
3. Production of glass	6.2033					0.1621	
4. Production and Use of Asphalt						259.648	
B. Chemical industry	177.133	0.017	1.2947	2.3022	0.9413	0.6125	1.627
1. Ammonia production	175.8084				0.9259	0.5509	0.0035
2. Production of nitric acid			1.2947	2.3016			
3. Production of sulfuric acid							1.6188
4. Production of carbon		0.017		0.0006	0.0154	0.0616	0.0048
5. Production of calcium carbide	1.3246						
6. Production of polypropylene						0	
B. Other production	2.4	0	0	0.0001	0.0021	8.3165	0.003
1. Production of food products and beverages						8.3163	
2. Production of metal	2.4			0.0001	0.0021	0.0002	0.003

Categories of sources and sinks of greenhouse gases	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
G. The use of fluorocarbons and sulphur hexafluo-ride							
1. Refrigerators and air conditioners							
2. Foam fire extinguishers							
3. Other extinguishers							
4. Aerosols							
5. Solvents							
D. Other							
Agriculture		107.71					
A. Enteric fermentation		106.99					
B. Rice Cultivation		0.72					
B. Agricultural Soils			3.07				
Land use, land use change and forestry»	0						
A. Forestry							
1. The area of forest remaining as forests							
2. The areas of forests turning into the forest							
3. Fires (burnt biomass)							
B. Land Use; Land Use Change							
1. Changes in land use							
2. Perennials							
3. Localities General waste							
A. Solid waste	0	4					
B. Agricultural Soils		4					
Land use, land use change and forestry»							

Categories of sources and sinks of greenhouse gases	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
1. Managed waste		4					
2. Unmanaged waste							
3. Other							
B. Wastewater							
1. Industrial wastewater							
2. Domestic and commercial wastewater							
3. Other							
V. burn waste							
G. Other							

Table 2: National Inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and precursors of greenhouse gases in 2010, Gg

Categories of sources and sinks of greenhouse gases	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
Energy	36344.24	955.59496	0.1952588	167.99581	416.14105	44.75168	0
A. Fuel combustion (by sector)	36344.235	1.49209624	0.19525877	167.995809	416.141052	44.751676	0
1. Energy industries	12486.981	0.22434426	0.02255188	33.5537562	4.46926631	1.117806	0
a) the production of electricity and thermal energy	12486.981	0.22434426	0.02255188	33.5537562	4.46926631	1.11780599	
2. Industrial Processes	533.744	0.00978838	0.00102053	1.43351253	0.18951361	0.0475521	0
a) chemical industry	220.654	0.00395306	0.00039531	0.59295957	0.07906128	0.01976532	
b) production of construction materials	209.119	0.00374642	0.00037464	0.56196257	0.07492834	0.01873209	
c) the textile industry	103.971	0.0020889	0.00025058	0.27859039	0.03552399	0.00905472	
d) Other							
3. Vehicles	6976.308	0.9651	0.1424	89.079	405.625	42.122	0
a) civil aviation	399.214	0.011	0	1.585	0.66	0.099	
b) Road transport	6351.342	0.9364	0.1368	82.244	403.779	41.733	
c) railway transport	220.446	0.0173	0.0055	5.138	1.805	0.38	

Categories of sources and sinks of greenhouse gases	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
d) water transport	5.306	0.0004	0.0001	0.112	0.035	0.008	
4. Other sectors	16347.202	0.2928636	0.02928636	43.92954	5.857272	1.464318	0
a) The municipal sector	3402.008	0.0609477	0.00609477	9.142155	1.218954	0.3047385	
b) population	12945.194	0.2319159	0.02319159	34.787385	4.638318	1.1595795	
5. Other	-	-	-	-	-	-	
B. The methane emissions from activities associated with oil and gas	0	954.102859					
1. Oil and Natural Gas		954.102859					
a) oil		1.488859					
b) Natural gas		923.427					
c) ventilation and flaring at oil and gas pro-duction		29.187					
For memory							
International bunker							
aviation							
sea							
CO2 emissions from biomass							
Industrial Processes	980.9312	0.0069	0.895	1.591498	2.155	771.1298	2.724
A. Production of mineral raw materials	572.4939	0	0	0	0	768.8	0.3393
1. Production of cement	558.929						0,3393
2. Production of lime	12.075						
3. Production of glass	1.4899					0,0389	
4. Production and Use of Asphalt						768.8	
B. Chemical industry	408.2469	0.0069	0.895	1.591488	2.1548	2.2909	2.3849
1. Ammonia production	407.9519				2.1485	1.2782	0.0082
2. Production of nitric acid			0.895	1.591188			
3. Production of sulfuric acid							2.3748
4. Production of carbon		0.0069		0.0003	0.0063	0.025	0.0019

Categories of sources and sinks of greenhouse gases	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
5. Production of calcium carbide	0.295						
6. Production of polypropylene						0.9876	
B. Other production	0.1904	0	0	0.00001	0.0002	11.69121	0.0002
1. Production of food products and beverages						11.6912	
2. Production of metal	0.1904			0.00001	0.0002	0.00001	0.0002
G. The use of fluorocarbons and sulphur hexafluoride							
1. Refrigerators and air conditioners							
2. Foam fire extinguishers							
3. Other extinguishers							
4. Aerosols							
5. Solvents							
D. Other							
Agriculture	0	330.94	4.21				
A. Enteric fermentation		329.86					
B. Rice Cultivation		1.08					
B. Agricultural Soils			4.21				
Land use, land use change and forestry»	0						
A. Forestry							
1. The area of forest remaining forests							
2. The areas of forests turning into the forest							
3. Fires (burnt biomass)							
B. Land Use Land Use Change							
1. Changes in land use							
2. Perennials							
3. Localities	0	18.17					

Categories of sources and sinks of greenhouse gases	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
General waste		18.17					
A. Solid waste							
1. Managed waste		18.17					
2. Unmanaged waste							
3. Other							
B. Wastewater							
1. Industrial wastewater							
2. Domestic and commercial wastewater							
3. Other							
V. Burn waste							
G. Other	-	-	-	-	-	-	-

Table 3: Emission and absorption of greenhouse gas emissions in Gg CO_2 eq. in 2000

Categories of sources and sinks of greenhouse gases	CO_2	CH_4	N_2O	HFCs	PFC	SF_6	Sum
The amount of national emissions and removals	24683.206	24239.76029	1392.68157				50315.648
Energy	24277	21893.49	39.6246				46210.1
A. Fuel combustion (by sector)	24277.01	22.281932	39.62457				24338.91
1. Energy industries	6910.962	2.619	3.916				6917.497
a) the production of electricity and thermal energy	6910.962	2.6186124	3.9161				6917.497
2. Industrial Processes	204.069	0.0854299	0.149656				204.3041
a) chemical industry	95.931	0.036091	0.053277				96.020368
b) production of construction materials	61.196	0.0230231	0.033985				61.253008
c) the textile industry	46.942	0.0263157	0.062394				47.030709
d) Other		0	0				0
3. Transport	4878.466	14.9562	28.737				4922.159
a) civil aviation	340.54	0.1974	0				340.7374
b) Road transport	4377.592	14.4963	27.497				4419.5853
c) railway transport	147.603	0.2436	1.147				148.9936

Categories of sources and sinks of greenhouse gases	CO_2	CH_4	N_2O	HFCs	PFC	SF_6	Sum
	12.731	0.0189	0.093				12.8429
d) water transport	12283.51	4.621302	6.821913				12294.95
4. Other sectors	2231.93	0.839706	1.239551				2234.0093
a) The municipal sector	10051.581	3.781596	5.582362				10060.945
b) population	-	-	-				0
B. The methane emissions from activities associated with oil and gas		21871.211					21871.21
1. Oil and Natural Gas		21871.211					21871.21
a) oil		23.479155	0				23.479155
b) Natural gas		21232.197	0				21232.197
c) ventilation and flaring at oil and gas pro-duction		615.5352	0				615.5352
For memory							0
International bunker		0	0				0
aviation		0	0				0
sea		0	0				0
CO2 emissions from biomass							0
Industrial Processes	406.198	0.357	401.357				807.912
A. Production of mineral raw materials	226.6648	0	0				226.6648
1. Production of cement	207.4115	0	0				207.4115
2. Production of lime	13.05	0	0				13.05
3. Production of glass	6.2033	0	0				6.2033
4. Production and Use of Asphalt		0	0				0
B. Chemical industry	177.133	0.357	401.357				578.847
1. Ammonia production	175.8084	0	0				175.8084
2. Production of nitric acid		0	401.357				401.357
3. Production of sulfuric acid		0	0				0
4. Production of carbon		0.357	0				0.357
5. Production of calcium carbide	1.3246	0	0				1.3246
6. Production of polypropylene		0	0				0
B. Other production	2.4	0	0				2.4

Categories of sources and sinks of greenhouse gases	CO_2	CH_4	N_2O	HFCs	PFC	SF_6	Sum
1. Production of food products and beverages		0	0				0
2. Production of metal	2.4	0	0				2.4
G. The use of fluorocarbons and sulphur hexafluoride	0	0	0				0
1. Refrigerators and air conditioners		0	0				0
2. Foam fire extinguishers		0	0				0
3. Other extinguishers		0	0				0
4. Aerosols		0	0				0
5. Solvents		0	0				0
D. Other							0
Agriculture	0	2261.91	951.7	0	0	0	3213.61
A. Enteric fermentation		2246.79					2246.79
B. Rice Cultivation		15.12					15.12
B. Agricultural Soils			951.7				951.7
Land use, land use change and forestry»	0						0
A. Forestry							0
1. The area of forest remaining as forests		0	0				0
2. The areas of forests turning into the forest		0	0				0
3. Fires (burnt biomass)		0	0				0
B. Land use							0
Land use change							0
1. Changes in land use		0	0				0
2. Perennials		0	0				0
3. Localities		0	0				0
General waste	0	84					84
A. Solid waste		84	0				84
1. Managed waste		0	0				0
2. Unmanaged waste		84	0				84
3. Other		0	0				0
B. Wastewater							0
1. Industrial wastewater		0	0				0
2. Domestic and commercial wastewater		0	0				0
3. Other		0	0				0

Categories of sources and sinks of greenhouse gases	CO_2	CH_4	N_2O	HFCs	PFC	SF_6	Sum
V. Burn waste							0
G. Other							0

Table 4: Emission and absorption of greenhouse gas emissions in Gg CO2 eq. in 2010

Categories of sources and sinks of greenhouse gases	CO_2	CH_4	N_2O	HFCs	PFC	SF_6	Sum
The amount of national emissions and removals	37325.166	27398.94896	1643.08022				66367.19538
Energy	36344.2	20067.49	60.5302				56472.2593
A. Fuel combustion (by sector)	36344.24	31.334021	60.53022				36436.09924
1. Energy industries	12486.98	4.7112295	6.991083				12498.68331
a) the production of electricity and thermal energy	12486.98	4.7112295	6.991083				12498.68331
2. Industrial Processes	533.744	0.205556	0.316364				534.2659203
a) chemical industry	220.654	0.08301426	0.1225461				220.8595604
b) production of construction materials	209.119	0.07867482	0.1161384				209.3138132
c) the textile industry	103.971	0.0438669	0.0776798				104.0925467
d) Other		0	0				0
3. Vehicles	6976.308	20.2671	44.144				7040.7191
a) civil aviation	399.214	0.231	0				399.445
b) Road transport	6351.342	19.6644	42.408				6413.4144
c) railway transport	220.446	0.3633	1.705				222.5143
d) water transport	5.306	0.0084	0.031				5.3454
4. Other sectors	16347.2	6.1501356	9.078772				16362.43091
a) The municipal sector	3402.008	1.2799017	1.8893787				3405.17728
b) population	12945.194	4.8702339	7.1893929				12957.25363
5. Other	-	-	-				0
B. The methane emissions from activities associated with oil and gas	0	20036.16	0				20036.16004
1. Oil and Natural Gas		20036.16	0				20036.16004
a) oil		31.266039	0				31.266039
b) Natural gas		19391.967	0				19391.967

Categories of sources and sinks of greenhouse gases	CO_2	CH_4	N_2O	HFCs	PFC	SF_6	Sum
c) ventilation and flaring at oil and gas pro-duction		612.927	0				612.927
Memory		0	0				0
International Bunker		0	0				0
Aviation		0	0				0
Sea		0	0				0
CO2 emissions from biomass		0	0				0
Industrial Processes	980.931	0.1449	277.45				1258.5261
A. Production of mineral raw materials	572.4939	0	0				572.4939
1. Production of cement	558.929	0	0				558.929
2. Production of lime	12.075	0	0				12.075
3. Production of glass	1.4899	0	0				1.4899
4. Production and Use of Asphalt		0	0				0
B. Chemical industry	408.2469	0.1449	277.45				685.8418
1. Ammonia production	407.9519	0	0				407.9519
2. Nitric acid production		0	277.45				277.45
3. Production of sulfuric acid		0	0				0
4. Production of carbon		0.1449	0				0.1449
5. Production of calcium carbide	0.295	0	0				0.295
6. Production of polypropylene		0	0				0
B. Other production	0.1904	0	0				0.1904
1. Production of food products and beverages		0	0				0
2. Production of metal	0.1904	0	0				0.1904
G. The use of fluorocarbons and sulphur hexafluoride		0	0				0
1. Refrigerators and air conditioners		0	0				0
2. Foam fire extinguishers		0	0				0
3. Other extinguishers		0	0				0
4. Aerosols		0	0				0
5. Solvents		0	0				0
D. Other		0	0				0
Agriculture	0	6949.74	1305.1				8254.84
A. Enteric fermentation		6927.06	0				6927.06

Categories of sources and sinks of greenhouse gases	CO_2	CH_4	N_2O	HFCs	PFC	SF_6	Sum
B. Rice Cultivation		22.68	0				22.68
B. Agricultural Soils		0	1305.1				1305.1
Land use, land use change and forestry»	0	0	0				0
A. Forestry		0	0				0
1. The area of forest remaining as forests		0	0				0
2. The areas of forests turning into the forest		0	0				0
3. Fires (burnt biomass)		0	0				0
B. Land use		0	0				0
land use change		0	0				0
		0	0				0
1. Changes in land use		0	0				0
2. Perennials		0	0				0
3. Localities	0	381.57	0				381.57
General waste		381.57	0				381.57
A. Solid waste		0	0				0
1. Managed waste		381.57	0				381.57
2. Unmanaged waste		0	0				0
3. Other		0	0				0
B. Wastewater		0	0				0
1. Industrial wastewater		0	0				0
2. Domestic and commercial wastewater		0	0				0
3. Other		0	0				0
V. burn waste		0	0				0

Table 5: Key sources. Based on the level in 2000

Categories of sources	GHGname	Emission for 2000 CO_2 CO_2- equivalent, Gg	Assessment of levels%	Accumulated contributions%
Total		50315,63		
Transportation and distribution of gas	CH_4	11149,1860	22,16	22,16
Fuel combustion, population	CO_2	10051,5800	19,98	42,14
Gas production	CH_4	7762,5830	15,43	57,56
Fuel combustion, energy industry	CO_2	6910,9620	13,74	71,30
Burning fuel, transport	CO_2	4878,4620	9,70	80,99
Leaking gas for internal consumption	CH_4	2320,4290	4,61	85,61
Agriculture, livestock, enteric fermentation	CH_4	2246,7900	4,47	90,07
Fuel combustion, municipal sector	CO_2	2231,9300	4,44	94,51
Agriculture, livestock, soil	N_2O	951,7000	1,89	96,40
Ventilation and flaring during oil and gas production	CH_4	615,5350	1,22	97,62
Industrial processes, chemical industry, production of nitric acid	N_2O	401,3570	0,80	98,42
Industrial processes, production of mineral products, cement	CO_2	207,4115	0,41	98,83
Industrial processes, chemical industry, production of ammonia	CO_2	175,8084	0,35	99,18
Fuel combustion and chemical industry	CO_2	95,9310	0,19	99,37
Waste methane emissions from solid waste disposal sites	CH_4	84,0000	0,17	99,54
Fuel combustion, construction industry	CO_2	61,1960	0,12	99,66
Fuel combustion, the textile industry	CO_2	46,9420	0,09	99,75
Burning fuel trucks	N_2O	28,7370	0,06	99,81
Extraction of petroleum	CH_4	17,7830	0,04	99,85
Agriculture, rice cultivation	CH_4	15,1200	0,03	99,88
Burning fuel, Transport	CH_4	14,9562	0,03	99,91
Industrial processes, production of mineral products, manufacture of lime	CO_2	13,0500	0,03	99,93

Categories of sources	GHGname	Emission for 2000 CO_2 CO_2- equivalent, Gg	Assessment of levels%	Accumulated contributions%
Industrial processes, production of mineral products, glass production	CO_2	6,2033	0,01	99,94
Fuel combustion population	N_2O	5,5820	0,01	99,96
Fuel combustion, energy industry	N_2O	3,9160	0,01	99,96
Oil refining	CH_4	3,8450	0,01	99,97
Fuel combustion population	CH_4	3,7820	0,01	99,98
Fuel combustion, energy industry	CH_4	2,6190	0,01	99,98
Industrial processes Metal production	CO_2	2,4000	0,00	99,99
Industrial processes, chemical industry, calcium carbide	CO_2	1,3246	0,00	99,99
Fuel combustion, municipal sector	N_2O	1,2400	0,00	99,99
Oil transportation	CH_4	1,1540	0,00	100,00
Fuel combustion, municipal sector	CH_4	0,8400	0,00	100,00
Oil storing	CH_4	0,6970	0,00	100,00
Industrial processes, chemicals, carbon black	CH_4	0,3570	0,00	100,00
Fuel combustion, the textile industry	N_2O	0,0620	0,00	100,00
Fuel combustion and chemical industry	N_2O	0,0530	0,00	100,00
Fuel combustion and chemical industry	CH_4	0,0360	0,00	100,00
Fuel combustion, construction industry	N_2O	0,0340	0,00	100,00
Fuel combustion, the textile industry	CH_4	0,0260	0,00	100,00
Fuel combustion, construction industry	CH_4	0,0230	0,00	100,00

Table 6: Key sources. Based on the level in 2010

Categories of sources	GHGname	Emission for 2000 CO_2 CO_2-equivalent, Gg	Assessment of levels%	Accumulated contributions%
Total		66367,1932		
Fuel combustion, population	CO_2	12945,1900	19,51	19,51
Fuel combustion, energy industry	CO_2	12486,9800	18,82	38,32
Gas production	CH_4	7729,6910	11,65	49,97
Transportation and distribution of gas	CH_4	7499,1550	11,30	61,27
Burning fuel, transport	CO_2	6976,3100	10,51	71,78
Agriculture, livestock, enteric fermentation	CH_4	6927,0600	10,44	82,22
Leaking gas for internal consumption	CH_4	4163,1220	6,27	88,49
Fuel combustion, municipal sector	CO_2	3402,0080	5,13	93,61
Agriculture, livestock, agriculture soil	N_2O	1305,1000	1,97	95,58
Ventilation and flaring during oil and gas production	CH_4	612,9270	0,92	96,50
Industrial processes, production of mineral products, cement	CO_2	558,9290	0,84	97,35
Industrial processes, chemical industry, production of ammonia	CO_2	407,9519	0,62	97,96
Waste methane emissions from solid waste disposal sites	CH_4	381,5700	0,58	98,54
Industrial processes, chemical industry, production of nitric acid	N_2O	277,4500	0,42	98,95
Fuel combustion and chemical industry	CO_2	220,6540	0,33	99,29
Fuel combustion, construction industry	CO_2	209,1190	0,32	99,60
Fuel combustion, the textile industry	CO_2	103,9710	0,16	99,76
Burning fuel trucks	N_2O	44,1440	0,07	99,83
Extraction of petroleum	CH_4	24,2690	0,04	99,86
Agriculture, rice cultivation	CH_4	22,6800	0,03	99,90
Burning fuel trucks	CH_4	20,2671	0,03	99,93
Industrial processes, production of mineral products, manufacture of lime	CO_2	12,0750	0,02	99,95
Fuel combustion population	N_2O	7,1890	0,01	99,96

Categories of sources	GHGname	Emission for 2000 CO_2 CO_2-equivalent, Gg	Assessment of levels%	Accumulated contributions%
Fuel combustion, energy industry	N_2O	6,9910	0,01	99,97
Fuel combustion population	CH_4	4,8700	0,01	99,97
Oil refining	CH_4	4,8040	0,01	99,98
Fuel combustion, energy industry	CH_4	4,7110	0,01	99,99
Fuel combustion, municipal sector	N_2O	1,8890	0,00	99,99
Industrial processes, production of mineral products, glass	CO_2	1,4899	0,00	99,99
Oil transportation	CH_4	1,3230	0,00	100,00
Fuel combustion, municipal sector	CH_4	1,2800	0,00	100,00
Oil storing	CH_4	0,8700	0,00	100,00
Industrial processes, chemical industry, calcium carbide	CO_2	0,2950	0,00	100,00
Industrial processes, Metal production	CO_2	0,1904	0,00	100,00
Industrial processes, chemicals, carbon black	CH_4	0,1449	0,00	100,00
Fuel combustion and chemical industry	N_2O	0,1230	0,00	100,00
Fuel combustion, construction industry	N_2O	0,1160	0,00	100,00
Fuel combustion and chemical industry	CH_4	0,0830	0,00	100,00
Fuel combustion, construction industry	CH_4	0,0790	0,00	100,00
Fuel combustion, the textile industry	N_2O	0,0780	0,00	100,00
Fuel combustion, the textile industry	CH_4	0,0440	0,00	100,00

Table 7: Assessment of trend

IPCC source category	GHG	GHG emissions tonnes CO_2-eq.		Assessment of trend	Trend contribution	Accumulated trend
		Base year (2000)	Current year (2010)			
Total		50315,63	66367,1932	23,9764		
Transportation and distribution of gas	CH_4	11149,186	7499,155	8,2323	0,343	0,343
Agriculture, livestock, enteric fermentation	CH_4	2246,79	6927,06	4,5275	0,189	0,532

IPCC source category	GHG	GHG emissions tonnes CO_2-eq.		Assessment of trend	Trend contribution	Accumulated trend
		Base year (2000)	Current year (2010)			
Fuel combustion, energy industry	CO_2	6910,962	12486,98	3,8512	0,161	0,693
Gas production	CH_4	7762,583	7729,691	2,8665	0,120	0,812
Leaking gas for internal consumption	CH_4	2320,429	4163,122	1,2594	0,053	0,865
Burning fuel, Transport	CO_2	4878,462	6976,31	0,6186	0,026	0,891
Fuel combustion, municipal sector	CO_2	2231,93	3402,008	0,5232	0,022	0,913
Fuel combustion population	CO_2	10051,58	12945,19	0,3576	0,015	0,927
Industrial processes, production of mineral products, cement	CO_2	207,4115	558,929	0,3259	0,014	0,941
Waste methane emissions from solid waste disposal sites	CH_4	84	381,57	0,3093	0,013	0,954
Industrial processes, chemical industry, production of nitric acid	N_2O	401,357	277,45	0,2878	0,012	0,966
Ventilation and flaring during oil and gas production	CH_4	615,535	612,927	0,2274	0,009	0,975
Industrial processes, chemical industry, production of ammonia	CO_2	175,8084	407,9519	0,2012	0,008	0,984
Fuel combustion, construction industry	CO_2	61,196	209,119	0,1466	0,006	0,990
Fuel combustion and chemical industry	CO_2	95,931	220,654	0,1074	0,004	0,994
Agriculture, livestock, agricultural soils	N_2O	951,7	1305,1	0,0569	0,002	0,997
Fuel combustion, the textile industry	CO_2	46,942	103,971	0,0481	0,002	0,999
Burning fuel, Transport	N_2O	28,737	44,144	0,0072	0,000	0,999
Industrial processes, production of mineral products, glass production	CO_2	6,2033	1,4899	0,0068	0,000	0,999
Industrial processes, production of mineral products, manufacture of lime	CO_2	13,05	12,075	0,0058	0,000	1,000

IPCC source category	GHG	GHG emissions tonnes CO_2-eq.		Assessment of trend	Trend contribution	Accumulated trend
		Base year (2000)	Current year (2010)			
Agriculture, rice cultivation	CH_4	15,12	22,68	0,0031	0,000	1,000
Fuel combustion, energy industry	N_2O	3,916	6,991	0,0022	0,000	1,000
Fuel combustion, energy industry	CH_4	2,619	4,711	0,0014	0,000	1,000
Extraction of petroleum	CH_4	17,783	24,269	0,0009	0,000	1,000
Burning fuel, Transport	CH_4	14,9562	20,2671	0,0006	0,000	1,000
Fuel combustion, municipal sector	N_2O	1,24	1,889	0,0003	0,000	1,000
Oil refining	CH_4	3,845	4,804	0,0003	0,000	1,000
Oil transportation	CH_4	1,154	1,323	0,0002	0,000	1,000
Fuel combustion, municipal sector	CH_4	0,84	1,28	0,0002	0,000	1,000
Fuel combustion population	N_2O	5,582	7,189	0,0002	0,000	1,000
Fuel combustion population	CH_4	3,782	4,87	0,0001	0,000	1,000
Oil storing	CH_4	0,697	0,87	0,0000	0,000	1,000
Industrial processes, chemical industry, calcium carbide	CO_2	1,3246	0,295	0,0000	0,000	1,000
Industrial processes, Metal production	CO_2	2,4	0,1904	0,0000	0,000	1,000
Industrial processes, chemicals, carbon black	CH_4	0,357	0,1449	0,0000	0,000	1,000
Fuel combustion and chemical industry	N_2O	0,053	0,123	0,0000	0,000	1,000
Fuel combustion, construction industry	N_2O	0,034	0,116	0,0000	0,000	1,000
Fuel combustion and chemical industry	CH_4	0,036	0,083	0,0000	0,000	1,000
Fuel combustion, construction industry	CH_4	0,023	0,079	0,0000	0,000	1,000
Fuel combustion, the textile industry	N_2O	0,062	0,078	0,0000	0,000	1,000
Fuel combustion, the textile industry	CH_4	0,026	0,044	0,0000	0,000	1,000

Table 8: Analysis Summary

№	Category the IPCC	Direct GHG	Criteria for determining the CCT
1	Transportation and distribution of gas	CH_4	Assessment of the level, trend
2	Agriculture, livestock, enteric fermentation	CH_4	Assessment of the level, trend
3	Fuel combustion, energy industry	CO_2	Assessment of the level, trend
4	Gas production	CH_4	Assessment of the level, trend
5	Leaking gas for internal consumption	CH_4	Assessment of the level, trend
6	Burning fuel, Transport	CO_2	Assessment of the level, trend
7	Fuel combustion, municipal sector	CO_2	Assessment of the level, trend
8	Fuel combustion, population	CO_2	Assessment of the level, trend
9	Industrial processes, production of mineral products, cement	CO_2	Assessment of trend
10	Waste methane emissions from solid waste disposal sites	CH_4	Assessment of trend
11	Agriculture, agriculture soil	N_2O	Assessment of trend

Table 9:Adaptation measures to replenish the water scarcity for the period up to 2030

Action	Costs in general, mln. USD.	The volume of saving (additional) water bln. M3
Improving water management	4.1	0.2–0.3
Optimization of agricultural production	18.5	1.0–1.5
Complex reconstruction of irrigated lands (CRIL) on the area of 143 thousand. ha	1075	0.2–0.3
Improved reclamation of land used (MUZ) on an area of 214 thousand. ha	4155	0.2–0.3
Reconstruction of existing and construction of new waterworks, reducing wastage and ensuring the rational use of water, and so on.	850	0.1–0.2
Improvement of existing (traditional) methods of irrigation on the area of 385 thousand. ha	6,6	0.3–0.4
Drip irrigation on an area of 38 thousand. ha	844	0,1–0.3
Sprinkler irrigation on an area of 69 thousand. ha	924	0.1–0.2
Brackish collector-drainage water (up to the amount of use of 650 million. M3) - 374	374	0.65
Underground water (volume to use 470 million. M3)	243	0.47
Waste water (use volume to 410 million. M3)	179	0.41
The construction of new and the increase in capacity of existing reservoirs	793	0.5
TOTAL	10482	4.2–5.5

Table 10: power balance (mln.KW. H)

	2000	2005.	2006	2007	2008	2009	2010	2011	2012
Produced electricity	9943,4	12936,7	13883,4	14771,9	15724,3	16420,6	16848,4	19085,3	20053,2
Imported	…	0,4	0,4	0,3	-	-	-	-	-
Consumed power:	8014,5	9926,7	10397,1	10871,9	10927,3	11195,3	11685,9	12593,4	13212,0
Industry	3445,5	4124,5	4309,2	4039,8	3961,4	4039,2	4220,7	4409,7	4617,1
Building	106,8	226,2	187,4	220,4	350,4	511,4	646,8	771,1	698,4
Communal	1563,9	1976,9	2184,0	2250,6	2233,8	2336,8	2383,8	2545,2	2864,0
Economy	1818,4	2293,9	2411,6	2679,4	2624,7	2707,7	2782,0	2910,1	2961,6
Agriculture	284,8	511,7	503,7	724,4	795,2	539,9	443,5	529,2	546,3
Transport	795,1	793,5	801,2	957,3	961,8	1060,3	1209,1	1428,1	1524,6
Other sectors	1035,3	1690,9	1878,5	2031,2	2559,7	2545,1	3057,9	3968,9	4153,3
Losses	893,6	1319,5	1608,2	1869,1	2237,3	2680,2	2104,6	2523,0	2687,9

Table 11: Actual values and predicted dynamics of GDP on PPP of Turkmenistan for the period till 2030

	Retrospective						scenario	Perspective period				
	Years							Years				
	2000	2005	2007	2008	2010	2012		2015	2016	2020	2025	2030
The growth rate of GDP at PPP, % to the previous period (of five-year periods)	-	190			190	167,7	I	145,1	132,8	150,2	131,9	126,1
							II			152,5	135,2	128,5
The annual growth rate of GDP at PPP, %%	-	13,7			13,7	10,9	I	7,7	5,8	8,5	5,7	4,7
							II			8,8	6,2	5,1
GDP per capita in PPP dollars. US	4971	7500	9050	10600	15100	17500	I	21700	23100	32000	40000	48000
							II			32506	41653,2	50920,4

I – base scenario , II – innovation scenario

Table 12: The current and projected GDP structure of Turkmenistan for the period till 2030

	Retrospective						Scenario	Perspective period				
	Years							Years				
	2000	2005	2007	2008	2010	2012		2015	2016	2020	2025	2030
The structure of GDP	100	100	100	100	100	100		100	100	100	100	100
including												
Industry	34,4	33,9	36,6	50,5	40,4	52,0	I	53,0	55,0	40,0	42,0	45,0
							II			38,7	37,5	36,9
Agriculture Construction	22,5	18,3	17,6	10,7	11,3	9,1	I	8,6	9,5	11,0	10,0	9,0
							II			9,0	8,0	7,5
Services	6,6	5,5	6,3	10,1	18,7	13,0	I	14,5	14,0	7,0	8,0	9,0
							II			10,0	9,5	8,6
The structure of GDP including	36,5	42,3	39,5	28,7	29,6	25,9	I	23,0	22,0	42,0	40,0	37,0
							II			42,3	45,0	47,0
Industry	5,2	4,8	5,8	4,1	5,9	4,1	I	4,8	5,0	6,0	6,5	7,0
							II			6,2	6,8	7,5

I – base scenario

II – innovation scenario

Table 13: Retrospective and forecast for the period up to 2030 of energy consumption and energy intensity of the economy of Turkmenistan

	Retrospective						Scenario	Perspective period				
	Years							Years				
	2000	2005	2007	2008	2010	2012		2015	2016	2020	2025	2030
Consumption of all types of energy, thous. TOE	19732,8	26195,2	29901,7	30453,4	32077,1	35848,2	I	43001,4	45630,8	53137,5	66558,1	81475,9
							II			50895,3	63244,1	76546,7
The growth rate of energy consumption of all kinds, % to the previous period (of five-year periods)		132,7			122,5	117,7	I	134,1	127,3	123,6	125,3	122,4
							II			118,4	124,3	121,0
The annual growth rate of energy consumption, %%		5,8			4,2	3,3	I	6,0	4,9	4,3	4,6	4,1
							II			3,4	4,4	3,9
The elasticity of energy consumption on the GDP, 1 % of GDP growth in energy consumption		0,43			0,31	0,30	I	0,78	0,85	0,51	0,81	0,87
							II			0,39	0,71	0,76
Energy intensity, TNE / USD. PPP US	0,75	0,53	0,53	0,46	0,34	0,32	I	0,31	0,31	0,26	0,24	0,24
							II			0,24	0,22	0,21

I – base scenario

II – innovation scenario

Table 14: Retrospective and forecast for the period up to 2030 CO_2 emissions, carbon intensity and the intensity of CO_2 emissions.

	Retrospective						Scenario	Perspective period				
	Years							Years				
	2000	2005	2007	2008	2010	2012		2015	2016	2020	2025	2030
CO2 emissions, thous. Tonnes of CO2 equivalent	35235,8	48678,1	56007,7	56833,5	64717,1	69507,2	I	80813,3	86311,4	94237,2	114970,1	135833,0
							II			93429,2	106593,8	123099,3
The rate of growth of CO2 emissions, % to the previous period (of five-year periods)		138,1			132,9	122,3	I	124,9	124,2	116,6	122,0	118,1
							II			115,6	114,1	115,5
The annual growth rate of CO2 emissions, %%		6,7			5,9	4,1	I	4,5	4,4	3,1	4,1	3,4
							II			2,9	2,7	2,9
The elasticity of CO2 emissions by GDP, 1 % of GDP increase in CO2 emissions		0,49			0,43	0,38	I	0,59	0,76	0,37	0,71	0,71
							II			0,33	0,43	0,57
Carbon intensity, tonnes of CO2 equivalent / thousand. dollars. US	0,0013	0,0010	0,0010	0,0009	0,0007	0,0006	I	0,0006	0,0006	0,0005	0,0004	0,0004
							II			0,0004	0,0004	0,0003
The intensity of emissions, tonnes of CO2 equivalent / TOE	0,0018	0,0019	0,0019	0,0019	0,0020	0,0019		0,0019	0,0019	0,0018	0,0017	0,0017
										0,0018	0,0017	0,0016

I – base scenario
II – innovation scenario

Table 15: Dynamics of GDP in PPP terms, energy consumption, energy consumption, CO_2 emissions, carbon intensity and emission intensity in the baseline scenario in %

										Forecast					
	2000	2005	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2020	2025	2030
GDP at PPS															
Index 2007 =1			1	1,17	1,50	1,69	1,82	1,97	2,09	2,29	2,45	2,61	3,68	4,85	6,12
Index 2000 =1	1	1,90	2,14	2,51	3,21	3,61	3,90	4,20	4,47	4,89	5,23	5,58	7,86	10,36	13,07
Consumption of all types of energy															
Index 2007 =1			1	1,02	1,03	10,7	1,17	1,20	1,21	1,30	1,44	1,53	1,78	2,23	2,72
Index 2000 =1	1	1,33	1,52	1,54	1,57	1,63	1,77	1,82	1,83	1,97	2,18	2,31	2,69	3,37	4,13
Energy intensity															
Index 2007 =1			1	0,87	0,69	0,64	0,64	0,61	0,58	0,57	0,59	0,58	0,48	0,46	0,45
Index 2000 =1	1	0,70	0,71	0,62	0,49	0,45	0,45	0,43	0,41	0,40	0,42	0,41	0,34	0,33	0,32
Emissions CO_2															
Index 2007 =1			1	1,01	0,96	1,16	1,19	1,24	1,26	1,37	1,44	1,54	1,68	2,05	2,43
Index 2000 =1	1	1,34	1,59	1,61	1,53	1,84	1,89	1,97	2,01	2,18	2,29	2,45	2,67	3,26	3,85
Carbon intensity															
Index 2007 =1			1	0,87	0,64	0,68	0,65	0,63	0,61	0,60	0,59	0,59	0,46	0,42	0,40
Index 2000 =1	1	0,73	0,74	0,64	0,48	0,51	0,49	0,47	0,45	0,45	0,44	0,44	0,34	0,31	0,29
emissions intensity															
Index 2007 =1			1	1,00	0,93	1,08	1,02	1,04	1,05	1,05	1,00	1,01	0,95	0,92	0,89
Index 2000 =1	1	1,04	1,05	1,05	0,98	1,13	1,07	1,09	1,10	1,11	1,05	1,06	0,99	0,97	0,93

Table 16: Dynamics of GDP in PPP terms, energy consumption, energy consumption, CO_2 emissions, carbon intensity and emission intensity at the innovative scenario in %

	Retrospective									Forecast					
	2000	2005	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2020	2025	2030
GDP at PPS															
Index 2007 =1			1	1,17	1,50	1,69	1,82	1,97	2,09	2,29	2,45	2,61	3,74	5,05	6,49
Index 2000 =1	1	1,90	2,14	2,51	3,21	3,61	3,90	4,20	4,47	4,89	5,23	5,58	7,98	10,79	13,87
Consumption of all types of energy															
Index 2007 =1			1	1,02	1,03	10,7	1,17	1,20	1,21	1,30	1,44	1,53	1,70	2,12	2,56
Index 2000 =1	1	1,33	1,52	1,54	1,57	1,63	1,77	1,82	1,83	1,97	2,18	2,31	2,58	3,21	3,88
Energy intensity															
Index 2007 =1			1	0,87	0,69	0,64	0,64	0,61	0,58	0,57	0,59	0,58	0,46	0,42	0,39
Index 2000 =1	1	0,70	0,71	0,62	0,49	0,45	0,45	0,43	0,41	0,40	0,42	0,41	0,32	0,30	0,28
Emissions CO_2															
Index 2007 =1			1	1,01	0,96	1,16	1,19	1,24	1,26	1,37	1,44	1,54	1,67	1,90	2,20
Index 2000 =1	1	1,34	1,59	1,61	1,53	1,84	1,89	1,97	2,01	2,18	2,29	2,45	2,65	3,03	3,49
Carbon intensity															
Index 2007 =1			1	0,87	0,64	0,68	0,65	0,63	0,61	0,60	0,59	0,59	0,45	0,38	0,34
Index 2000 =1	1	0,73	0,74	0,64	0,48	0,51	0,49	0,47	0,45	0,45	0,44	0,44	0,33	0,28	0,25
Emissions intensity															
Index 2007 =1			1	1,00	0,93	1,08	1,02	1,04	1,05	1,05	1,00	1,01	0,98	0,90	0,86
Index 2000 =1	1	1,04	1,05	1,05	0,98	1,13	1,07	1,09	1,10	1,11	1,05	1,06	1,03	0,94	0,90

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