NATIONAL STRATEGY OF TURKMENISTAN ON CLIMATE CHANGE

PRESIDENT OF TURKMENISTAN
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THE NATIONAL GERB OF TURKMENISTAN

THE NATIONAL FLAG OF TURKMENISTAN

THE NATIONAL ANTHEM OF TURKMENISTAN

I am ready to give life for native hearth
The spirit of ancestors descendants are famous for.
My land is sacred. My flag flies in the world
A symbol of the great neutral country flies.

Chorus:
The great creation of people,
Native land, sovereign state,
Turkmenistan, light and song of soul,
Long live and prosper for ever and ever!

My nation is united and is veins of tribes
Ancestors' blood, undying flows,
Storms and misfortunes of times are not dreadful for us,
Let us increase fame and honour!

Chorus:
The great creation of people,
Native land, sovereign state,
Turkmenistan, light and song of soul,
Long live and prosper for ever and ever!

National Strategy of Turkmenistan on Climate Change (New Edition)

Introduction

At the turn of the twentieth and twenty-first centuries, the global climate change issue became particularly relevant in a number of other environmental problems of our time. In Turkmenistan, it is regarded as a possible and serious obstacle to the implementation of plans for sustainable economic development and improving the welfare of the country's population.

In recognition of the actual continuity of climate change issues for the sustainable development of Turkmenistan, the President of Turkmenistan, Mr. Gurbanguly Berdimuhamedov, has signed on June 15, 2012, a Decree on adoption of the National Strategy of Turkmenistan on Climate Change (NSTCC), which is the major national document for the implementation of climate change activities for the time being.

The National Strategy of Turkmenistan on Climate Change represents the national vision of climate change issues and is the basis for the development and implementation of Turkmenistan's state policy on climate change and its consequences.

In preparing the NSTCC, the urgency of the problem of climate change was addressed due to the conclusions of the 4th Report of the Intergovernmental Panel on Climate Change (IPCC, 2007) and the results of the Second National Communication on Climate Change of Turkmenistan (2009). In 2013-2014, the new 5th IPCC Report was published, listing new facts showing exacerbation of climate change issues. The report indicated an acute need for urgent measures - programs, strategies and plans at the international and national levels to strengthen the climate change mitigation.

Amongst other things, it was noted that the climate warming is undoubtedly manifested in atmosphere and ocean temperature increase, glaciers melting, sea levels rise, and frequency of the extreme events. There is a very high probability (>90%) that the observed climate changes occur primarily due to the anthropogenic increase in the content of greenhouse gases in the atmosphere. The further greenhouse gas emissions lead to increased warming and climate change, greater than in the 20th century.

Even with stabilizing greenhouse gas concentrations, warming and sea levels rise will progress for several centuries.

An observed climate change impacts are the following:

1) sharp increase in carbon dioxide over the past 50 years;

2) increase in average global air temperature by 0.8°C over the past 100 years;

3) ocean level rise of about 17 cm over the past 100 years and 3 mm per year over the past 10-15 years.

Progressive greenhouse gas emissions will cause further warming and long-term changes in all components of the climate system, increasing the likelihood of severe, comprehensive and irreversible impacts on people and ecosystems. Climate change mitigation will require a substantial and sustainable reduction in greenhouse gas emissions, which, along with the adaptation, can restrain the climate change risks.

According to prospective estimates, during the 21st century the surface air temperature will increase in all considered emission scenarios. It is very likely that heat waves will occur more frequently and will be longer and that in many regions extreme precipitation will become more intense and frequent.

Adaptation and mitigation are complementary strategies for climate risk reduction and management.

Without additional mitigation efforts, other than those currently in place, and even with adaptation measures, by the end of the 21st century, warming will lead to a high – very high risk of serious, widespread and irreversible global impacts.

After publication of the results of the 5th IPCC Report, the international community has called for the enhanced mitigation measures. On September 27, 2015, at the UN Sustainable Development Summit in New York, the heads of states have adopted a new 2030 Agenda with the list of Sustainable Development Goals (SDGs) that will determine the global development program until 2030. The SDGs contain 17 goals, which include 169 targets.

Adoption of the Sustainable Development Goals at the international level, in turn, has accelerated the international negotiation process on the development of new agreement on climate change. The new Paris Climate Agreement was adopted on December 12, 2015, following the 21st Conference of the UN Framework Convention on Climate Change (UNFCCC, 1992) in Paris. The Agreement was supported by all

197 participants of the UNFCCC. Delegations from all over the world agreed that humanity needs to keep the growth of the average temperature on the planet within 1.5–2°C in relation to the corresponding indicator of the pre-industrial era in order to prevent irreversible environmental consequences.

The Paris Agreement entered into force on November 4, 2016 and became a major international treaty aimed at preventing global climate change. By signing the new agreement, all Parties to the UNFCCC made a voluntary commitment to reduce greenhouse gases emissions and informed the Secretariat about the choice of low-carbon development. Turkmenistan has ratified the Paris Climate Agreement on October 21, 2016.

Thus, the aggravation of the problem of global climate change and the ambitious tasks chosen by the Government of Turkmenistan to achieve the SDGs, including Goal 13: «Adoption of urgent measures to combat climate change and its consequences», low-carbon development and the need for timely fulfillment of obligations under the Paris Agreement, as well as past fundamental changes in the structure of the executive branch in the country and the rules for regular five-year renewal stipulated earlier in the National Strategy, have necessitated revision and updating the National Strategy of Turkmenistan on Climate Change (NSTCC). In this regard, considering all circumstances, in 2018, the Ministry of Agriculture and Environment Protection of Turkmenistan, with the support of UNDP, has initiated preparation of an updated version of the National Strategy of Turkmenistan on Climate Change.

The aim of the updated NSTCC is to ensure sustainable development of the country. This includes the economic, food, water and environmental components to the climate change impact by creating reliable favorable conditions, determining an effective and coordinated process of climate change adaptation of all priority sectors and developing effective mitigation measures that contribute to accelerating the country's low-carbon development, as well as the timely implementation of the international commitments to the UNFCCC, the Paris Climate Agreement and the related Sustainable Development Goals (SDGs).

The following tasks must be solved to achieve the goals of the National Strategy:

1. improvement of hydrometeorological observations of weather and climate change in the territory of Turkmenistan;

2. development and implementation of climate change adaptation and mitigation measures (to prevent climate change);
3. measures to save fuel and energy resources and stabilize greenhouse gas emissions until 2030 through the use of energy-efficient and resource-saving technologies;
4. increasing the level of scientific support and international cooperation in the field of development and implementation of climate change measures.

At the international level, the National Strategy of Turkmenistan on Climate Change is the main instrument of Turkmenistan for determining its positions in negotiations under the UNFCCC, the Paris Agreement, and the basic document for preparing reports on the implementation of its obligations under the global climate agreements.

Section 1. Main Results of the Implementation of the National Strategy of Turkmenistan on Climate Change for the Period 2012-2018

The adoption of the National Strategy of Turkmenistan on Climate Change (NSTCC) in 2012 gave a serious impetus to strengthen activities on climate change issues in Turkmenistan. Therefore, our state expressed its readiness for active measures aimed at solving a wide range of problems associated with the global climate change. First, this led to the wide integration of climate change issues into national development processes. After adoption of the National Strategy, all newly developed national programs, plans and strategic documents were drafted considering its provisions and overall climate change issues.

Many international organizations and companies have expressed a desire to help in fulfilling the tasks set in the National Strategy. Representatives of organizations and enterprises have approached the Ministry of Agriculture and Environment Protection. The Ministry is a responsible executor of the National Strategy in the field of climate change, including the issues of attracting eco-friendly technologies to our country, adapting to climate change, reducing emissions and obtaining international assistance. All new large enterprises were formed using the latest world technology. This is especially true for oil and gas companies and the electric power industry, which are the main emitters of greenhouse gases. An

estimation of gross greenhouse gas emissions in Turkmenistan for the period 2011-2017 shows that their growth rate is reduced compared to the period 2000-2010.

Implementation of the National Strategy of Turkmenistan on Climate Change at the National Level

In the National Strategy of Turkmenistan on Climate Change, much attention was paid to the development of the country's water sector as the most vulnerable one to the effects of climate change. For the period under review, activities were carried out and are still in process to adapt the country's water economy to climate change, including the secondary use of collector-drainage water and provision of governmental soft loans for the introduction of modern water-saving technologies.

The National Forest Program of Turkmenistan was prepared given the provisions of the National Strategy of Turkmenistan on Climate Change and later approved by the Decree of the President of Turkmenistan on January 11, 2013. This program has a key role to play in preserving natural forests and expanding their area, as well as creating artificial forest plantations and attracting the attention of country's population and relevant structures to the importance of this issue. The program provides ways to solve the problem forest resources conservation, as well as a plan of action to increase the area of forests for the period until 2020. Since 2013, the inventory and survey of forests has been carried out, materials on forest inventory are being collected, state forest fund accounting is being carried out, and work is underway to prepare the forest cadaster.

Within the framework of the National Forest Program, annual campaigns are held nationwide to plant up to 3 million seedlings throughout the country. Afforestation measures consider soil and climatic conditions of the regions to ensure environmental sustainability. For example, in Dashoguz velayat, desert species of plants such as white saxaul are being planted.

In the zone of influence of the Aral crisis, in the north of the country, activities were launched to plant an area of 20 thousand hectares, first, with desert plants - saxaul, kandym, etc., in order to reduce climate change effects. Between 2013 and 2018, seedlings of desert trees and shrubs were planted on a total area of 14 thousand hectares and

at present planting operations continue successfully. In general, to date, about 6 million seedlings of saxaul and other desert plants have been planted in this region of Turkmenistan as a part of adaptation measures. In 2015, the Third National Communication (TNC) of Turkmenistan to the UN Framework Convention on Climate Change was completed, where topical issues related to the climate change problem in Turkmenistan were considered in accordance with the UNFCCC Resource Guide for Preparing the National Communications.

The TNC of Turkmenistan describes in detail national conditions, provides analysis of the country's socio-economic development in all key sectors of the economy, including information and communication technologies, public-private partnerships and investments, as well as analysis of domestic technologies and the national intellectual property system. The issues of governance and legislative framework on the problem of climate change were also considered, in particular, the legislative framework for the technology transfer in Turkmenistan was assessed.

Within the process on preparation of the Third National Communication, an inventory of greenhouse gas (GHG) emissions and sinks was conducted in Turkmenistan for the period of 2000–2010. According to these data, the country's contribution to global warming is growing slightly and amounts to about 67,000 Gg. The main greenhouse gases emitted in Turkmenistan are CO_2 (carbon dioxide) and CH_4 (methane). The inventory considers GHG emissions from key sectors of the economy, which comprise 97% of total emissions. The results of the inventory made it possible to identify priority areas for reducing emissions and increasing greenhouse gas discharges, as well as attracting modern technologies and investments. The share of the energy sector in total GHG emissions is 85%.

The sectors being mostly affected by climate change were defined: agriculture and water economy, health, soil and land resources, ecosystems and forestry. For each of these sectors, a list of adaptation measures to mitigate the effects of climate change is proposed. The state of climate has been studied at present and different scenarios of its future were developed based on the use of recognized international climate models. Comparison of these data indicates an increase in average air temperature and a decrease in precipitation in Turkmenistan during 1955-2010.

The TNC also outlines measures taken by the Government of Turkmenistan to reduce the human impact on climate. In Turkmenistan, rich in energy resources, great attention is paid to solving the problem of reducing human impact on the environment. First of all, it is done through the use of modern eco-friendly and resource-saving technologies of leading foreign manufacturers in oil and gas, energy, transport and other sectors of the national economy.

Comprehensive analysis of the national, sectoral and target programs of the economic development of Turkmenistan was carried out for the period up to 2030. Macroeconomic indicators, the GDP structure, dynamics of development of the main sectors of the economy up to 2030 and average annual growth rates, consumption of primary fuel and energy resources per capita, elasticity, carbon intensity and greenhouse gas emission intensity were analyzed. Measures have been developed to reduce consumption of all types of energy. The analysis of the production and consumption of fuel resources in 2020–2030 is carried out. The forecast of consumption of primary and secondary energy resources by the main industries (by type) for the basic and innovative scenarios is produced for the period until 2030.

The results climate change studies and the status of systematic observations of climate and air pollution are presented. The international cooperation and initiatives of Turkmenistan on climate change, technology transfer, education, training and public awareness, as well as limitations, gaps and capacity needs are described.

The Third National Communication on Climate Change of Turkmenistan was prepared by the Ministry of Agriculture and Environment Protection of Turkmenistan. This is the state body responsible for the implementation of international environmental programs and conventions, in close cooperation with interested ministries and departments and active participation of the Hydrometeorology Service of the Ministry of Agriculture and Environment Protection of Turkmenistan through the UNEP/GEF technical assistance.

Currently, the process of preparing the Fourth National Communication of Turkmenistan and the updated biennial report on the UNFCCC was launched in the framework of cooperation between UNEP and UNDP.

At the UN Summit on Sustainable Development, held on September 27, 2015 in New York, the President of Turkmenistan supported adoption

of the 2030 Agenda with the list of Sustainable Development Goals (SDGs) and stated Turkmenistan's readiness to implement the SDGs. To coordinate all the Goals, their targets and indicators, national consultations were held with key industry ministries and agencies. The Government of Turkmenistan approved all Sustainable Development Goals, including Goal 13: Taking urgent measures to combat climate change and its consequences, which in turn indicates the priority of climate change problems in Turkmenistan and the country's readiness for further actions to address issues related to climate change. This includes improving the legal framework (for example, preparing the Law "On Climate Change") and developing new national programs and strategies. At the national level, a special Decree of the President of Turkmenistan "On Measures to Implement Sustainable Development Goals in Turkmenistan" (November 17, 2017) was adopted. The document stipulates creation of the national coordination mechanism and Working Group composed of representatives of ministries and agencies, public associations.

Turkmenistan was among the first countries to start adapting Sustainable Development Goals to national plans and programs for social and economic development. For this purpose, the country has created a relevant permanent mechanism for interaction with UNDP.

Implementation of the SDGs in Turkmenistan has an announced social orientation; this is the assurance of food security and improvement of people's nutritional status, widespread adoption of healthy lifestyle, gender equality, creating conditions for inclusive, fair and high-quality education. At the same time, much attention is devoted to the implementation of the Goal ensuring access to and rational use of water resources and sanitation for all.

In accordance with the provisions of the NSTCC, work has begun on the formation of national legislation in the field of climate change and development of a regulatory framework in this area. Thus, when preparing the Law of Turkmenistan "On Nature Protection" (2014), the independent Article "Protection of Climate and Mitigation of Its Negative Consequences" (Article 47) was included into the Law for the first time. Subsequently, considering climatic changes and UNFCCC requirements, laws "On Pastures" (2015), "On Wastes" (2015), "On Air Protection" (2016), the Water Code of Turkmenistan (2016) and others were adopted.

Since the adoption of the National Climate Change Strategy, the following projects related to the climate change have been completed and are being implemented with the assistance of various international organizations:

- Climate Risk Management in Turkmenistan, 2010-2014;
- Addressing Climate Change Risks to Farming System in Turkmenistan at the National and Community Level, 2011-2017;
- Improving Energy Efficiency in the Residential Sector of Turkmenistan, 2012 – 2017;
- Energy Efficiency and Renewable Energy for Sustainable Water Management in Turkmenistan, 2015-2021;
- Ecosystem - based on Land and Forest Management of the Tugai Habitats of the Amu Darya River for Improved Livelihood of Local Communities as Adaptation Strategy to Climate Change, 2015-2017;
- Supporting Climate Resilient Livelihoods in Agricultural Communities in Drought-Prone Areas of Turkmenistan, 2016-2021;
- Sustainable Cities in Turkmenistan: Integrated Development of Green Cities in Ashgabat and Avaza, 2018-2024;
- Ecosystem-based Land Use and Conservation of Ecosystems at the Lower Reaches of Amu Darya River, 2019-2020;
- UNDP Regional Project - Climate Box: Education and Awareness on Climate Change Issues.

International Initiatives of Turkmenistan in the Field of Climate Change

Turkmenistan actively supports all measures taken by the international community to prevent possible climate change and mitigate its impact, contributing to adaptation to climate change and reducing the amount of greenhouse gas emissions into the atmosphere. Evidence of the balanced and consistent policy of the Government of Turkmenistan in the field of environmental protection and, in particular, climate change was proclaimed in the speech of the President of Turkmenistan Mr. Gurbanguly Berdimuhamedov at the 2012 Rio + 20 Global Summit on Sustainable Development. In his speech, the Head of State informed the international community about adoption of the National Strategy

of Turkmenistan on Climate Change and took the initiative to create a Regional Center for Climate Change Technologies for Central Asia.

While delivering speech at the 70th Anniversary Session of the UN General Assembly, the President of Turkmenistan emphasized that our country supports the adoption of new international climate agreement and suggested colleagues not postpone this issue and adopt it at the next Conference of the Parties to the UNFCCC. Turkmenistan's strong position in favor of vigorous international efforts to respond to the harmful processes of climate change was also reflected in the speeches of the heads of country's delegation at several sessions of the UN General Assembly, the Climate Summit (September 2014), as well as at the 21st Meeting of the Conference of the Parties to the UNFCCC, Paris (December 2015). Assistance of our country to the development and adoption of the Paris Agreement was expressed in the preparation of specific proposals (Nationally Determined Contributions) and the intention to implement them at the national level. Turkmenistan signed the Paris Climate Agreement on September 21, 2016, and ratified it on October 23, 2016. This is another confirmation of our country's readiness to contribute to the implementation of international environmental and climate change agreements.

The problem of saving the Aral Sea is among the most important topics for the regional cooperation with the international community. As is well known, at the Rio + 20 World Summit, the President of Turkmenistan Mr. Gurbanguly Berdimuhamedov proposed the development of the UN Special Program for the Aral Sea Basin. This proposal was widely supported by the international community, including the Resolution adopted by the UN General Assembly on May 28, 2019.

On August 24, 2018, at the initiative of the President of Turkmenistan Mr. Gurbanguly Berdimuhamedov, the Summit of the Heads of States - Founders of the International Fund for Saving the Aral Sea (IFAS) was held in the Avaza National Tourism Zone. At the meeting, the Presidents of Central Asian countries considered a number of important issues aimed at improving environmental, water and socio-economic situation in the Aral Sea basin.

Also, during the Summit, the Resolution of the UN General Assembly "On Cooperation between the United Nations and the

International Fund for Saving the Aral Sea" dated April 12, 2018 and initiated by Turkmenistan was noted with satisfaction.

In their speeches, the Heads of States - Founders of the IFAS noted that they consider IFAS as a universal platform for interaction between the countries of the region in resolving a whole range of issues of regional importance, including through the implementation of regional projects and programs aimed at improving environmental and socio-economic situation in the Aral Sea basin. The Heads of States expressed readiness for the further development of cooperation in this direction.

In the Joint Communique adopted at the Summit, the Heads of States noted the importance of development of the Action Program to Assist the Aral Sea Basin Countries (ASBP-4). This Program should facilitate efforts and capacities of the states of the region and international community in order to address common priority issues as water, environmental and socio-economic problems of the Aral Sea basin.

One of the striking examples of solving the problem of the Aral Sea saving is the project of creating "Altyn Asyr" Turkmen lake. This is a thoughtful, long-term action, that will positively impact the environment of the entire region. Aimed at collection of drainage water from the irrigated lands of all five provinces of the country, the project of "Altyn Asyr" Turkmen lake is designed for fundamental improvement of the reclamation state of farmland, prevention of soil degradation, and land restoration.

Broad prospects are opening up for the cultivation of salt resistant crops, irrigation of pastures, development of fishing and creation of water resources stock. The lake has already become a habitat for migratory birds. The ecosystem's biodiversity today numbers about 250 bird species and 25 fish species, and many animal species listed in the Red Book of Turkmenistan.

Speaking from the rostrum of the Third UN World Conference on Natural Disaster Risk Reduction (March 2015, Sendai, Japan), Turkmenistan proposed to create a specialized structure under the auspices of the UN – the Regional Center for Climate Change Technologies for Central Asia. Turkmenistan also proposed to include the proposal on the establishment of this Center in the Framework of Action Program on Disaster Risk Reduction for the period after 2015.

To date, with the coordination of the Ministry of Foreign Affairs of Turkmenistan and with the support of UNICEF, a draft National Concept for the Natural Disaster Risk Reduction was prepared.

Speaking at the Seventh World Water Forum (April 2015, Taegu, Republic of Korea), the Esteemed President of Turkmenistan said: "It is in the creation of a new political and diplomatic form of multilateral communication, which could be a "water diplomacy", that we see the possibility of a systemic dialogue, aimed at addressing all the problems associated with the formation and restoration of water sources, their reasonable and economical use. I am sure that such a joint activity of the states and international organizations can become the foundation for the work on preparation of the United Nations document on water resources. The UN Water Strategy could also be such a document. Taking this opportunity, I invite the participants of the World Water Forum to substantively consider this initiative of Turkmenistan".

Presenting initiatives for the rational water use, the Head of Turkmenistan consistently pursues water policy, based on the principles of positive neutrality, mutual respect and equality, based on generally accepted norms of international law. Turkmenistan is steadily following the principle that water is the common property of the peoples of the world, and fair conditions for the availability of clean drinking water are the fundamental right of every person. Speaking at the 73rd Session of the UN General Assembly in September 2018, the President of Turkmenistan Mr. Gurbanguly Berdimuhamedov emphasized that the development of states, their economies, social sphere, well-being and quality of life directly depend on access to water resources and their effective management.

Section II. Climate Change in Turkmenistan.

Observed Climate Changes

The climate of Turkmenistan is one of the most severe in the Central Asian region. The highest air temperatures and the lowest rainfall levels are registered here.

In general, the territory of Turkmenistan is characterized by sharply continental and exceptionally dry climate. Despite the desert nature of the landscape, the differences between climatic conditions of the northern and southern parts of the territory are very great. The northern part,

including the territory of Dashoguz velayat, the northern regions of Balkan and Lebap velayats, located in the sphere of activity of the Siberian anticyclone, are characterized by severe and long winter with steady frosts. In these areas, summers are much shorter, less hot with relatively regular rainfall, but in small quantities.

The southern regions of the country are characterized by mild winters with unstable snow cover and frequent transitions from frosts to positive air temperatures. Conditions of the warm period also differ. The areas of the coastal zone of the Caspian Sea are especially distinguished by their mild climate.

The difference in the nature of temperature regimes of northern and southern parts of the territory is determined by different conditions of atmospheric circulation in the cold and warm six months. The relative severity of winter with very low temperatures and rare thaws in the northern part of the territory is entirely due to the development of powerful Siberian anticyclone and intense radiation in clear anticyclonic weather. The temperature regime of winter months of the southern part of the territory is notable for its considerable mildness due to the development of intensive cyclonic activity here at this time. Frosty weather usually does not last long for whole days. Only in the coldest winters, when the Siberian anticyclone reaches high intensity, periods with negative temperature remain for a long time. However, even in such years, under the influence of a significant influx of radiation, daytime temperatures often reach positive values.

January is the coldest month. In the warm period of the year (from May to September), the daily air temperature often exceeds 40°C. The absolute minimum air temperature is –36.0°C (Dashoguz velayat), and the absolute maximum is + 50.1°C (Repetek, South-East Karakum).

Based on the analysis of hydrometeorological observations of the Hydrometeorology Service of the Ministry of Agriculture and Environment Protection of Turkmenistan, an assessment of the observed climate changes in Turkmenistan for 1955–2010 was carried out. It included such parameters as temperature, precipitation, wind, humidity, etc.

Figure 1 shows observations data at the hydrometeorological stations of Balkanabat, Bayramali, Kerki and Darganata for 1960–2012, which show that the air temperature in Balkanabat increased by 1.45°C, Bayramaly - by 2.05°C, Kerki - by 2.4°C , in Darganata - by 1.1°C (Fig. 1).

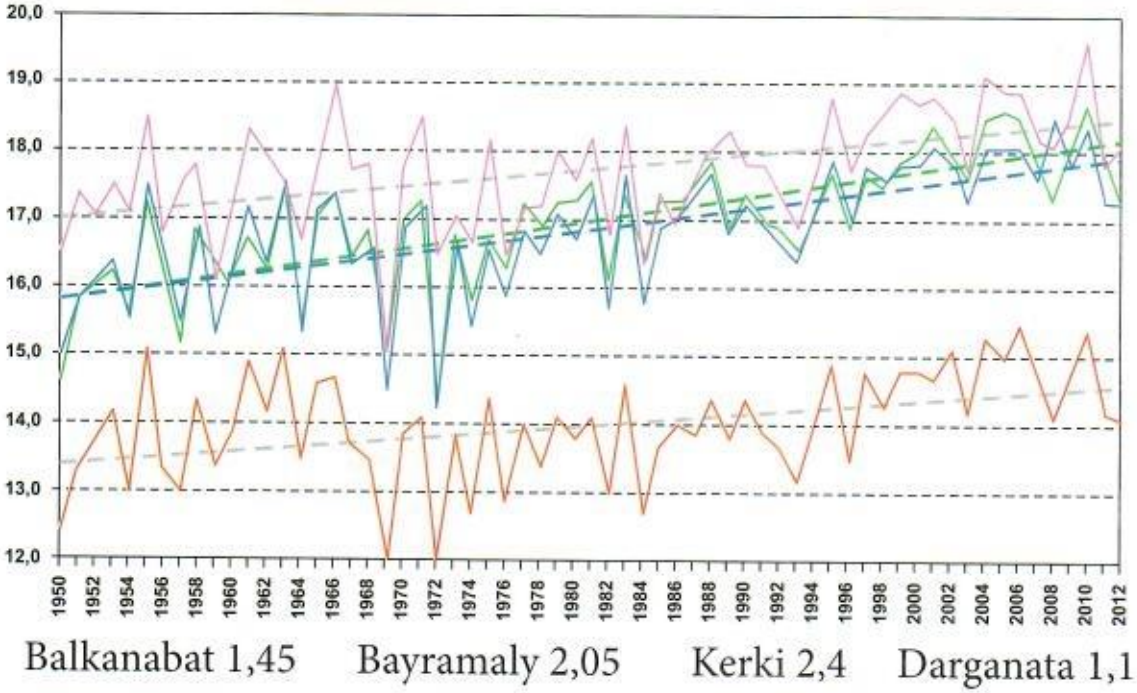

Fig.1. Change in the average annual air temperature according to the data of weather stations in Balkanabat, Bayramaly, Kerki and Darganata

In general, the average air temperature for the period from 1950 to 2010 in Turkmenistan increases by about 0.3°C throughout 10 years (Fig. 2), and on average it rose by almost 2°C.

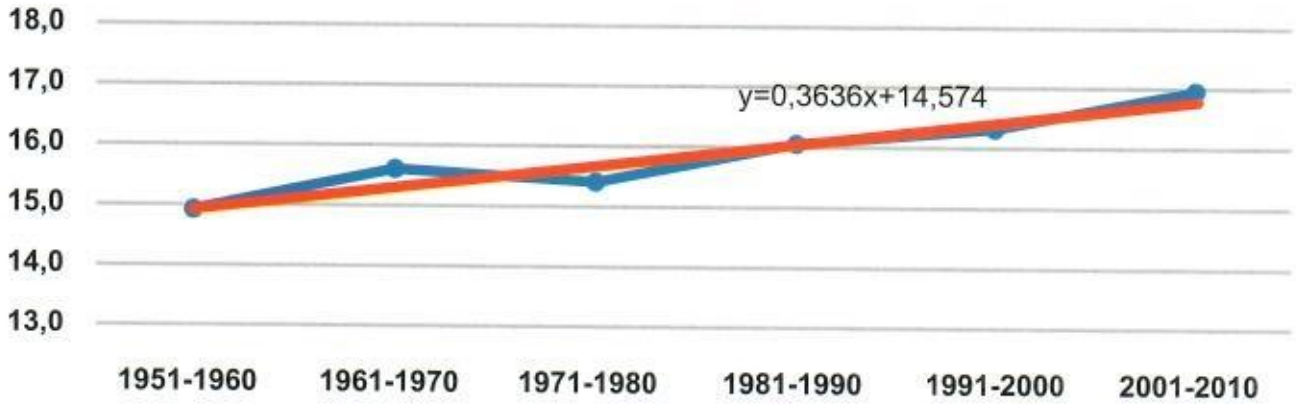

Fig. 2. Dynamics of averaged over ten-year periods of the average temperature in Turkmenistan and the regression equation

Expected Climate Changes

Currently, when climate change is becoming more noticeable in different sectors of human activity due to the global warming, there is a need to improve estimates of the degree of anthropogenic impact on climate. It is necessary to build regional climate scenarios for the territory of Turkmenistan in order to assess the likely future climate changes and possible consequences, as well as to identify and evaluate adaptation strategies.

Climate scenarios provide information on how climate will possibly change over a period of time in the future. These scenarios are developed by the authorities responsible for meteorology and climatology issues, together with research institutes, based on climate models. The calculations are based on assumptions of future atmospheric changes. They describe the interaction of physical processes occurring in a closed air-ground-water system and include emission scenarios that represent assumptions about future greenhouse gas emissions. Further, the results of these global models can be detailed using regional models.

As part of the preparation of the Third National Communication (TNC), the specialists conducted studies to assess the future climate. For a more accurate assessment of the climate change impact on the activities of the main sectors of the economy, the results of averaged scenarios were used (Figs. 3 and 4). The below following figures show the results of calculations of air temperature and annual precipitation for the period 2020–2100.

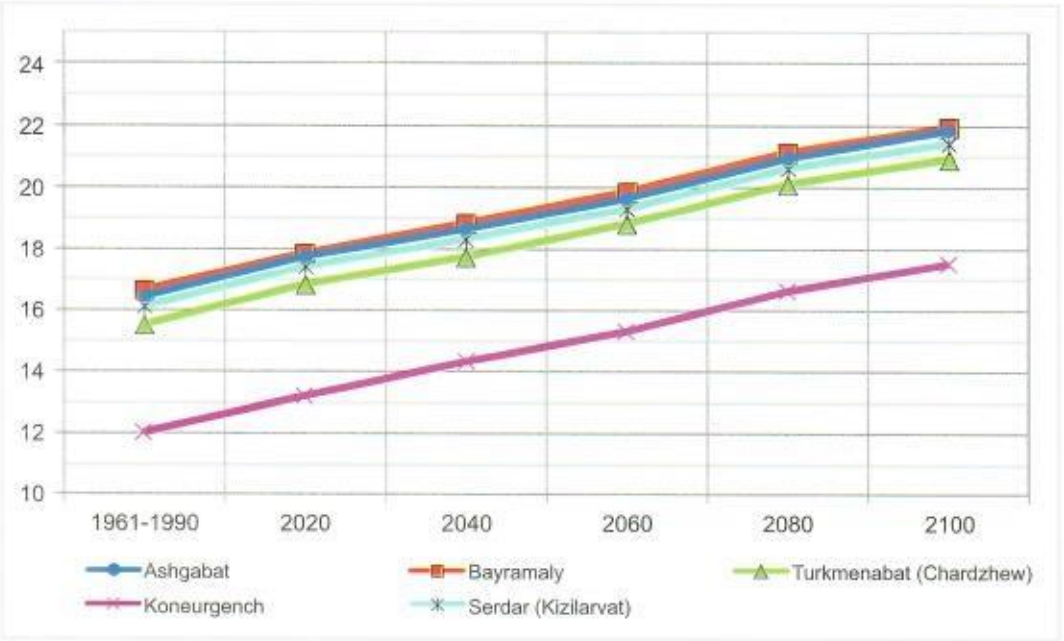

Fig.3. Average annual air temperature according to the averaged scenario, °C.

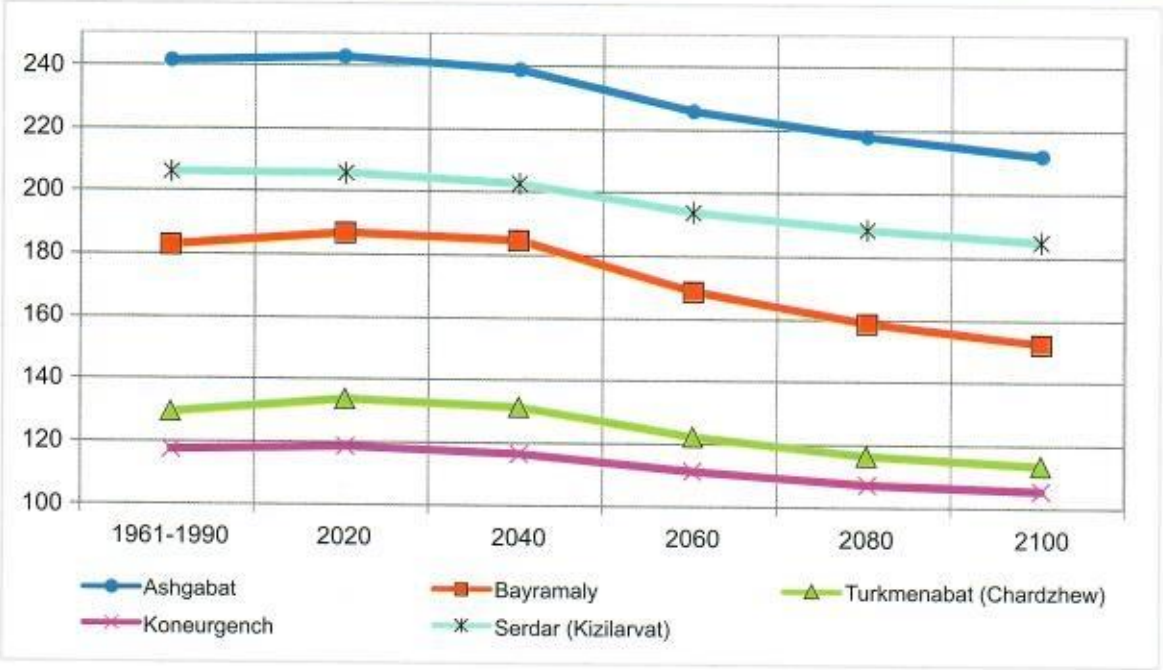

Fig.4. Average annual rainfall in the averaged scenario, mm/year.

Air temperature in Turkmenistan will steadily increase during 2020–2100, and the amount of precipitation, initially remaining stable, will drop sharply after 2030–2040. The most likely scenario was developed considering the combination of economic and environmental priorities (Fig. 5).

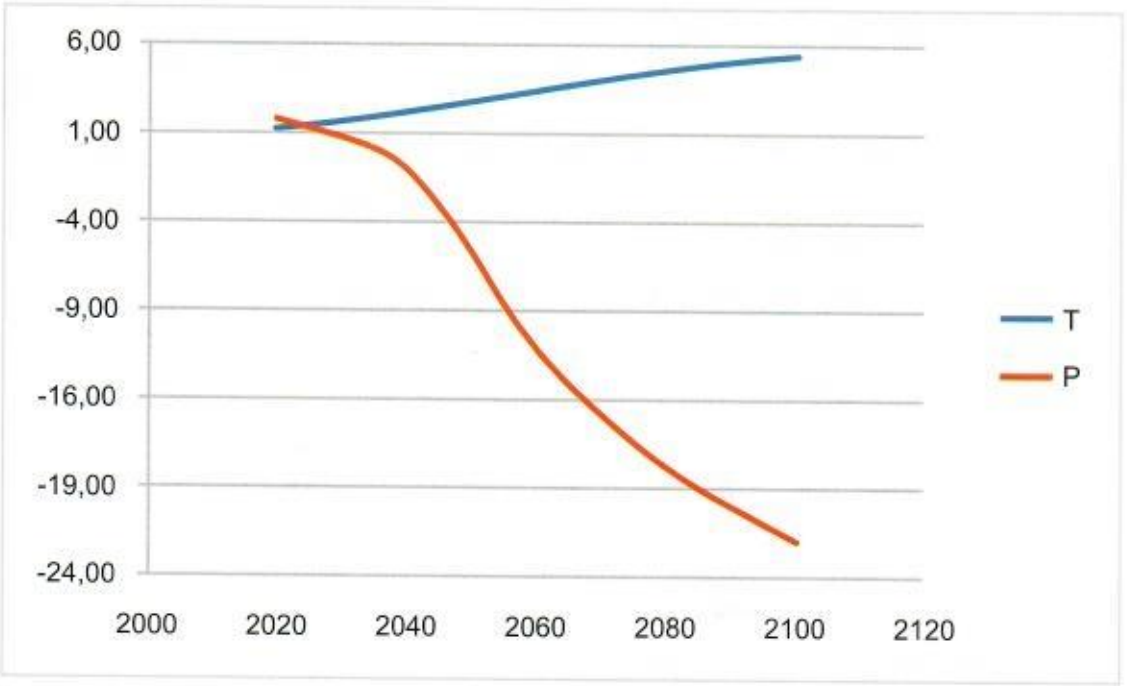

Fig. 5. Deviations from the norm of average annual air temperature T (°C) and the amount of precipitation P (mm) for Turkmenistan averaged over two scenarios.

As can be seen from the graphs, the difference in air temperature according to the averaged scenario will increase by 1.23°C by 2020, 2040 - by 2.21, 2060 - by 3.22, 2080 - by 4.51, and by 2100 - by 5.35°C. The difference in annual rainfall until 2020 compared with the long-term average for 1961–1990 may grow slightly (1.7 mm), and then stable decrease is expected from 0.9 mm in 2040 to 22 mm by 2100 (TNC data).

Climate and Economy, Climatic Risks

According to the conclusions of the Fifth Report of the Intergovernmental Panel on Climate Change (IPCC), the expected climate change will entail increase in air temperature variability during the day and month, pressure, humidity; increased frequency and strength of natural weather events of regional and local scales: droughts, floods and mudflows, sand storms, etc.

According to the world experts' forecasts, it is no longer possible to stop global warming, but the world must apply efforts and keep it at the level no higher than 1.50C compared to the pre-industrial era. The Earth can reach this threshold already in 2030. If the temperature continues to rise, the Earth will experience loss of ecosystems and cataclysms of a planetary scale.

The impact of climate change on sectors of the economy is expressed through the effects of various natural phenomena. Extreme hydro-meteorological phenomena, aggravated by climate change, cause significant damage to sectors of the economy and the livelihoods around the world. Within the preparation of the Third National Communication, assessment of the climate change risks in Turkmenistan was carried out for the period 1950 - 2010. In Turkmenistan, risks are constantly being researched in relation to such extreme hydro-meteorological phenomena as drought, hail, gale, frosts, heat waves, floods and mudflows, etc. It was ascertained that during recent years their repeatability and intensity has been increasing.

Drought. The greatest risk to socio-economic well-being of the country is drought, caused by high air temperature and lack of water resources. Currently, there is a noticeable tendency of increasing the frequency of low water years of the main rivers of Turkmenistan: Amu Darya and Murgab.

Climate warming will become an additional risk factor for the development of hydrological drought and desertification, negatively affecting water resources and agriculture accordingly.

In this regard, attention must be paid to resolving the issue of early warning of the likelihood of drought. This will reduce its negative impact

and facilitate taking timely measures in conditions of low water. The regions prone to drought can suffer from it for months and sometimes for years. This is the most dangerous and large-scale disaster of other similar natural phenomena in Turkmenistan, representing real threat to the country's economy and its sustainable development.

Floods and mudflows are fast-moving natural phenomena, but causing great damage and enormous economic losses.

The territory of Turkmenistan can be divided into three large dangerous zones, in terms of the possibility of mudflows: Koytendag, Kopetdag, Bigger and Smaller Balkhans. In 80% of cases, it is a mudflow, carrying various sediments, and in 20% it is mud and mud-stone flows. In Turkmenistan, mudflows are observed in 229 permanent and temporary streams. Prone to mudflow rivers are located mainly in Kopetdag. Over nearly 100 years observations, more than 1,500 cases of mudflows were recorded on 80 watercourses of Kopetdag, 87% of them occurred in April - August as a result of heavy rains. The most dangerous months in this regard are April and May, accounting for 54% of all recorded mudflows.

In some years, 20 to 50 cases of mudflows are observed in the basins of rivers and ravines of Kopetdag. Analysis of these data made it possible to distinguish the so-called "active" years from this point of view - 1963, 1969, 1976, 1981, 1986, 1992, 1998, 2003, 2009 and 2012.

The Sumbar and Etrek rivers are characterized by the greatest mudflow activity. Almost every year, heavy rains, mainly in Iran, cause mudflow. Often, 5-12 mudflows come off a year.

Quite often, wide summer flood is observed on the Amu Darya River, caused by increase in air temperature in the snowmelt zone.

The most severe floods in the Amu Darya, caused mainly by heavy rains and intense snowmelt, were observed in 1969, 1981, 1992, 1994, 1998, 2000, 2005, 2009, and 2010.

Ice phenomena. In winter, ice phenomena are observed in the territory of Turkmenistan, especially in middle reaches of the Amu Darya River. Almost every year, in the Darganata - Lebap area, weak ice phenomena forms due to decrease in air temperature to minus degrees. In some years, as a result of lowering air temperature to $-25 \div 30°C$, the Amu Darya River is ice-bound with the formation of powerful gaps. As a result, the water level sharply rises and the adjacent territories are flooded. This is especially true for the Turkmenabat - Darganata section.

Over the long-term observation period, strong ice formation in the Amu Darya was recorded in 1972, 1973, 1974, 1977, 1996 and 2001, with ice jumpers and rise of water to a dangerous level. The strongest ice events in the Amu Darya River were observed in 1969 and 2008. In 1969, as a result of a jam, the water level significantly exceeded the dangerous mark.

More efforts should be focused on disaster risk reduction. Currently, it is important to develop such areas of activity as monitoring, forecasting and early warning of natural and man-made disasters. Modernization of the hydrometeorological system and investment in improving methods for predicting natural hazards can be economically justified.

Mainly global processes of climate change have a strong impact on such sectors of the economy of Turkmenistan as agriculture and water, health, soil and land resources, ecosystems (flora and fauna) and forestry. They also lead to dangerous weather phenomena (spontaneous natural hydro-meteorological phenomena). In this regard, there is an urgent need for active adaptation measures in these sectors. Climate change processes also affect other sectors: industry, oil and gas, energy, transport, utilities, waste, etc. However, due to the lack of local data on the impact of climate change on the activities of these sectors, it is planned to study their adaptation in preparation of the next national communications or national adaptation plans.

Section III. Climate Change Related Measures

The effectiveness of adaptation and mitigation responses depends on policies and measures taken at various levels: international, regional, national and local.

Policies at all levels supporting the development of technologies, their extension and transfer, and financing of climate change response measures can complement and enhance the effectiveness of programs that directly contribute to climate change adaptation and mitigation. One of the options for such policy at the national level is the improvement of planning methods for socio-economic development, i.e. transition to long-term (30-50 years) and alternative planning (scenario planning method - considering various development scenarios) of the economy, population and climate. The initiative of the President of Turkmenistan to digitalize the economy in the country fully coincides with the requirements of the Paris Agreement to ensure transparency, comprehensiveness and alternative assessments.

In order to reduce future economic losses and costs, to increase sustainability of social and economic development against the negative effects of climate change, Turkmenistan will take further measures to adapt to the observed and expected climate changes, and limit greenhouse gas emissions.

Climate Change Adaptation Measures

Adaptation options are available in all sectors of the country's social and economic development, but the specific features of their implementation and the potential for reducing climate risks vary from sector to sector and from region to region. Some adaptation measures entail significant co-benefits, synergistic effects and compromise solutions. Increasing climate change will scale-up challenges for many adaptation options. To mitigate climate risks in vulnerable sectors, appropriate activities should be planned on a long-term basis. Adaptation measures should be reflected in long-term national strategies, plans (NAPs) and country development programs, designed to consider scenario planning methods. In the coming years, it is necessary to begin preparing regional, sectoral and departmental adaptation plans.

Public Health

Climate has a strong impact on human health and well-being. With climatic changes, this effect can be direct (injury or death due to heat stroke, natural disaster) or indirect, through the growth of diseases (transmitted by insects, caused by pathogenic microorganisms, expanded by water and air quality, availability and quality of food). Human health depends on the state of the environment, socio-economic conditions, as well as organizational, managerial, technological and adaptation measures aimed at reducing the impact of climate change.

In 2017, the UNICEF Office in Turkmenistan conducted the "Analysis of the Impact of Climate Change on Children in Turkmenistan". The findings of this analysis state that climate and environmental change can have a negative impact on the health and well-being of children. The result of these changes may be shortage and low quality of drinking water and air, which will have a serious impact, primarily on children's health.

Due to climate change, further capacity building of the healthcare system of Turkmenistan is required. To this end, the quality of medical

care to the population is being enhanced, material and technical base and infrastructure of health facilities are being improved, ultramodern medical centers have been built, furnished with necessary equipment and innovative technologies. They are continuously supplied with consumables, medical products, essential medicines, computer equipment, vehicles, and inventory.

The health of the nation in Turkmenistan is ranked as a state priority. A large-scale state comprehensive program "Health" is developed and successfully implemented.

Currently, the Ministry of Health and Medical Industry of Turkmenistan have developed measures to prevent and reduce the impact of climate change on public health, which are included in the State Health Program for 2015–2025.

Also, with the support of the WHO Regional Office for Europe and WHO Country Office, development of the National Plan for Adaptation of Public Health to Climate Change has been initiated, which aims to reduce vulnerability and strengthen adaptation measures to minimize the adverse effects of climate change on human health in Turkmenistan.

In general, the following measures are proposed to improve the healthcare system in Turkmenistan in connection with climate change:

1) development and implementation of the national plan for the adaptation of public health to climate change and its adverse effects in Turkmenistan;

2) strengthening the health system to minimize the impact of climate change on public health;

3) raising awareness of the public, health workers, policy makers about the impact of climate change on human health for healthcare measures;

4) distribution of sanitary-educational materials, conducting trainings, campaigns, "health months" among various population groups to raise awareness;

5) inclusion of the impact of climate change on public health issues in the curricula of the State Medical University of Turkmenistan and medical colleges;

6) strengthening regional and international cooperation of the Ministry of Health and Medical Industry of Turkmenistan in developing specific mechanisms for the implementation of health sector action plans in connection with climate change;

7) managing health risks of population in extreme climatic conditions;

8) development and implementation of measures to prevent and reduce sickness rate and mortality from infectious diseases (interconnected with insect vectors, water, air and food quality) and noninfectious diseases related to climate change;

9) conducting scientific research on the influence of high air temperature, extreme changes in weather conditions on the health of the country's population;

10) development of preventive programs to adapt the population to the adverse effects of climate change;

11) preparation of the National report on assessing the impact of climate change on public health.

The key organization responsible for the implementation of adaptation measures in the healthcare sector is the Ministry of Health and Medical Industry of Turkmenistan.

Agriculture and Water Economy

Agriculture

According to the IPCC data, arid regions of Asia, Africa and Latin America can suffer great damage as a result of global warming. Shortage of water is a very serious problem in these areas; this problem will increase and require large adaptation costs in the future.

Since the agricultural production of Turkmenistan is based on irrigated agriculture (the area of irrigated lands is about 1.8 million hectares), the activities of the two leading sectors of the country's economy – agriculture and water management - are under the great influence of global warming and are inextricably linked with each other.

The agriculture provides about 10% of the gross domestic product (GDP) in the country's economy. In addition, about 50% of the country's population lives in rural areas.

Over the past decade, the share of livestock production has increased in the total value of agricultural products. One of the main reasons for this is that at present more than half of the livestock is concentrated in personal subsidiary farms.

The socio-economic development programs of the country provide for an increase in irrigated area to 2 million hectares by 2030. This

dictates the need for a set of preventive adaptation measures that will make up for the shortage of water resources expected with climate change.

The quantity and quality of crops in the world increasingly depend on weather conditions. Lack of response by the agricultural sector to ongoing climate change can lead to negative consequences. The best way to reduce the dependence of agriculture on possible global climate changes is to adapt to them. Traditional system of farming and animal husbandry, as an important part of the national culture in the territory of Turkmenistan, is highly adaptable, ecologically resilient to the peculiarities of arid, hot, sharply continental climate, soil, topography, and weather caprices.

Global climate change may adversely affect the state of the country's livestock feed supply. Due to drought and high air temperature, pastures productivity may be reduced. Natural pastures as a source of valuable gene pool for selection and introduction of new species and varieties of fodder plants, production of high-quality cheap fodder are of great importance in the development of domestic animal husbandry.

The priorities for adapting agriculture to climate change are as follows:

1) development and implementation of a set of measures to adapt agricultural production to climate change;

2) optimization of the distribution of agricultural production, considering the country's needs for the obligatory agricultural products and minimizing the use of water resources;

3) creation of agricultural innovation systems providing consulting services to agricultural producers;

4) adoption of a new edition of the Land Code of Turkmenistan, considering climate change and other related legislative and regulatory acts;

5) improving the legal basis of rural business communities to develop their self-organization;

6) implementation of measures to strengthen the human capacity of analytical laboratories for environmental protection, land resources and hydro-meteorological services, and their retraining in modern ways of processing analysis results;

7) comprehensive reconstruction of irrigated lands (CRIL);

8) conducting phyto-reclamation works;

9) development of programs on combating desertification, soil erosion and restoration, and further use of lands with low productivity;

10) "greening" agricultural production and obtaining high-quality and safe food and raw materials for industry;

11) breeding works on the cultivation of salt resistant and drought tolerant crops;

12) implementation of methods and practices to obtain several harvests per year;

13) development of economic and mathematical models for optimizing the distribution of agricultural production;

14) introduction and strict observance of pasture rotation, creation of pasture protection belts of fodder tree and shrub plants;

15) re-allocation of pastures between land users, taking into account forage consumption and future growth of livestock numbers;

16) introduction of documentation certifying the right to use and lease pastures;

17) design and implementation of projects with the introduction of pasture rotation;

18) further development of livestock husbandry with respect to adaptation measures;

19) significant increase in the area of irrigated pastures;

20) introduction of solar and wind installations for the power supply of outrun livestock breeding;

21) expansion of the area of halophyte crops in the zone of "Altyn Asyr" Turkmen lake for winter feeding of livestock.

The key organization responsible for the implementation of adaptation measures in the agricultural subsector is the Ministry of Agriculture and Environment Protection of Turkmenistan.

Water Economy

The study of the global climate change impact on the hydrological regime of water facilities in Turkmenistan is important in conditions of water scarcity. The geographical position makes Turkmenistan very sensitive to climate change. The water economy does not only provides agriculture with water, but also other sectors of the country's economy. This sector also satisfies needs of the society, providing a reliable drainage system, solving environmental problems and problems to combat the harmful weather effects.

An urgent problem is the assessment of possible changes in river flows. The reliability of such an assessment is determined by the accuracy of climate change forecasts and the dependence of characteristics of the water regime on climatic conditions. Significant impact of water management by the states of the region on the regime of the Amu Darya River should be noted.

In this regard, it is necessary to improve the system of joint water resource management in the region.

Increasing the efficiency of irrigation systems will save significant amounts of irrigation water, which will become a significant reserve for replenishing the water shortage in the conditions of climate change.

The introduction of advanced irrigation methods has shown that the transition from the traditional method of irrigation to new ones (drip, sprinkling, laser land leveling) allows to save up to 30-40% of water.

Implementation of adaptation measures will significantly compensate for the shortage of water for irrigation, which may be caused by climate change.

The priority tasks for adapting water management to climate change are as follows:

1) improving efficiency of irrigation systems through modernization and technical re-equipment;

2) improving water resource management through the transition to integrated water resource management (IWRM);

3) improving the legal regulation of management, protection and use of water resources through the adoption of by-laws to the Water Code of Turkmenistan (2016);

4) improving the system of joint water resource management in the region;

5) introduction of advanced irrigation methods (drip, sprinkling and others) and improvement of existing (traditional) ones, including the use of digital technologies;

6) introduction of advanced desalination methods and the re-use of collector-drainage water in compliance with environmental standards;

7) construction of reservoirs, reconstruction of hydraulic structures and ensuring the safety of dams;

8) development and implementation of methods to stimulate rational water use;

9) implementation of measures for reclamation improvement of used lands, ensuring reduction of losses and sustainable use of water, etc.;

10) introduction of modern methods and forms in the relations between the structures of water management agencies and water users;

11) improving water metering system and optimizing conditions for paid water use by introducing smart digital systems and technologies;

12) continuation of construction of "Altyn Asyr" Turkmen lake;

13) strengthening international cooperation in the field of conservation and use of transboundary water facilities;

14) construction of mudflow facilities, water collection to create additional water resources;

15) ensuring reliable functioning of coastal protective belts and hydraulic structures;

16) enhancing public participation in resolving issues of uninterrupted and high-quality water supply, as well as in programs to improve ecological education of the society;

17) expanding research woks in the field of water management;

18) creation of unified digital information system in the water sector;

19) development of new irrigation regimes of crops, considering natural and climatic factors;

20) development of smart irrigation planning information systems;

21) improvement of technical condition of irrigation and drainage systems;

22) transfer of diesel pumping stations to electric drive and use of alternative energy sources (solar, wind).

The key agency responsible for the implementation of adaptation measures in the subsector of water management is the State Committee for Water Resources of Turkmenistan.

Land Resources

Soil and land resources play a unique role in the issue of climate change, being both an object of influence and a source of GHG emissions leading to climate change and carbon storage. Soil and land resources quality is changing in the process of using them in agricultural production and other sectors of the economy. Currently, the process of human influence to land has intensified. Along with the global climate change and the impact of other natural factors, this leads to desertification of large areas,

increase in the volume of mineralized drainage flow, salinization, erosion, pollution, soil overgrowth, etc., and, in general, land degradation.

To maintain the quality of soil and land resources in connection with climate change, as well as to strengthen their mitigation potential, the following measures are necessary:

1). In the field of strengthening the institutional capacity, inventory and monitoring of land and soil resources:

a) updating the National Action Program to Combat Desertification;

b) conducting comprehensive inventory of soil and land resources with detailed description of the irrigated lands and grazing lands of the country;

c) widespread introduction and use of GIS technologies in the processing of data on land resources;

d) updating land legislation, taking into account ongoing reforms in the country's agricultural sector and transition of agriculture to market relations;

e) preparation of the draft Law of Turkmenistan "On Soils" in order to improve soil requirements, and, above all, for industrial facilities under construction that damage the fertile soil layer;

f) preparation of the National Plan of Turkmenistan "On Meeting the Effects of Drought";

g) development of the Law "On Pastures" through the preparation and adoption of by-laws on provision of pastures for use and lease;

h) creation of mechanism for regulating the use of pastures by forming commissions under local self-government bodies; tariffs for the use of pastures, etc.;

i) implementation of measures aimed at improving education and advanced training of specialists in the field of the State Land Cadaster;

j) creation of digital system of the State Land Cadaster.

2). In the field of technologies development:

a) use of new methods of tillage, ensuring accumulation of humus and activation of the soil biological processes by stabilizing its upper layer;

b) introduction and strict observance of science-based field crop rotation;

c) implementation of measures to improve conditions of used lands and to increase the level of agriculture;

d) carrying out soil protection measures in mudflow hazardous areas;

e) increase the coefficient of land use (CLU);

f) strengthening control over compliance with the technology of growing crops;

g) implementation of a set of measures to prevent soil land salinization, pasture degradation and desertification of territories;

h) continued implementation of science-based methods to improve land fertility.

The key organization responsible for the implementation of adaptation measures in the land resource sector is the Ministry of Agriculture and Environment Protection.

Ecosystems (Flora and Fauna) and Forestry

Natural ecosystems maintain the conditions necessary for life on Earth: they clean air and water, stabilize and soften the climate, restore soil fertility, recycle waste, etc. Each biological species has its own special functions and cannot be completely replaced by another. The totality of all species contribute to the maintenance of the life of our planet. The components of biodiversity serve as a source of genetic material.

Climate features in the desert zone (high temperature, low rainfall, strong solar radiation, etc.) have significant impact on the behavior of terrestrial animals - one of the most flexible systems for adaptation of individuals and populations to environmental changes. To a large extent, this is due to ability of the animal organism to change throughout its life. Observations show that at this stage of climate change, wildlife, especially birds, are better adapted to its effects than plants.

Another direction of flora and fauna adaptation to climate change is the change in phenological processes occurring in their organism. The development of poikilothermic animals in connection with climate change begins earlier and ends earlier.

Due to its geographical location, Turkmenistan plays a key role in maintaining global biodiversity and keeping the functions of the biosphere. The sharply continental, exceptionally dry climate (long and hot summers, seasonal and daily large range fluctuations in temperature, low precipitation) and the country's geographical position within the Eurasian continent significantly influenced the formation of the unique diversity of its flora and fauna.

The biological diversity of Turkmenistan plays important role in the country's economy, culture and traditions of the people. The wild nature of the landscapes of Turkmenistan largely determined the presence of certain traditions of people, formed its culture and spiritual world.

Turkmenistan has rich biological resources - more than 20,000 species of fauna and flora, which determine the development of individual sectors of the economy. The country has a large number of rare and endemic species of fauna and flora. Conservation and rational use of biological resources is one of the conditions for the country's sustainable development.

Forests of Turkmenistan are valuable as a source of food products, raw materials for medicine and production of dyes, ornamental plants, seeds of various plant species, and are also the main absorber of carbon - the main greenhouse gas.

Due to climate variability, there may be loss of biodiversity, changes in species composition, reduction in habitat, and the spread of pests.

For the implementation of preventive measures to increase ecosystem resilience to climate change, the following tasks shall be addressed:

a) development of the National Report on enhancing ecosystems resilience;

b) development of a system of comprehensive observations of the state of environment (monitoring), assessment and forecasting of changes in its state under the influence of natural and anthropogenic factors;

c) improvement of the financing system for specially protected natural areas (SPNAs) with introduction of innovative sources of financing;

d) improving the economic potential of SPNAs by reforming the system of specially protected areas, expanding their total area, creating national parks and introducing alternative sustainable financing mechanisms;

e) implementation of the principles of improving the ecosystems sustainability, rational use of land and water resources in the activities of the fuel and energy complex, transport and construction;

f) plant protection from pests;

g) implementation of biodiversity management goals in the activities of the economic sector so that production processes support the functions of natural ecosystems;

h) strengthening state control over the protection of ecological systems, prevention of pollution of land, surface and underground waters, marine environment of the Turkmen sector of the Caspian Sea and its coastal zone;

i) enhancement of ecological audit practice;

j) development and adoption of the Program for the development of SPNA system;

k) development of tariffs for the services provided in specially protected natural areas;

l) systematic implementation of work to protect the biodiversity of the marine environment of the Caspian Sea and continuous monitoring of compliance with the standards of activity of coastal production enterprises.

Priority tasks for adaptation of forestry to climate change are as follows:

1) protection and improvement of the quality of forests as reservoirs and absorbers of greenhouse gases, the use of rational methods of forestry, including afforestation and reforestation;

2) creation of new forests;

3) updating the National Forest Program of Turkmenistan;

4) improvement of the forest accounting system and enhancement of the mechanism of economic incentives;

5) adoption of legal, economic and organizational and technical measures aimed at expanding the area of forests;

6) expansion of reforestation;

7) implementation of the forest fund inventory;

8) development and implementation of the forest monitoring system;

9) development of a methodology for calculating payments for the use of forest fund and a procedure for their collection as well as methodology for calculating the amount of damage caused by violation of forest legislation;

10) together with the authorized State Fire Safety Agency, defining measures to strengthen protection of forests from fires;

11) development and implementation of measures to protect forests from pests and diseases;

12) development of international cooperation in the field of forestry.

The key organization responsible for the implementation of adaptation measures in ecosystems (flora and fauna) and forestry sector is the Ministry of Agriculture and Environment Protection.

Hydro-Meteorological Phenomena

The IPCC Special Report data on global warming by 1.5°C shows an increase in average temperature in most land and ocean areas. It also indicates increase in the frequency of extremely hot weather (increase in the number of days with the rise in temperature up to 3°C) in most populated areas, increase in frequency, intensity and/or amount of

extreme precipitation in a number of areas, and increase in frequency and intensity of droughts and precipitation deficit in some areas of the planet.

The Hydrometeorology and Environment Protection Departments of the Ministry of Agriculture and Environment Protection of Turkmenistan are working around the clock to provide vital meteorological and climate information for all sectors of the economy of Turkmenistan. Their warnings about severe weather events and fluctuations in air quality, as well as climate variability and change allow people, organizations and enterprises, as well as decision makers to better prepare for what is happening. Their warnings help save lives and property, protect resources and environment, and support social and economic growth.

Due to climate change, the strength and frequency of spontaneous extreme hydro-meteorological events that cause significant damage to the economy and the environment will increase. Increase in demand of socio-economic sectors of Turkmenistan in accurate hydro-meteorological information is expected.

In order to timely provide all sectors with reliable information about the actual and expected climate in Turkmenistan and to further develop the potential of the hydro-meteorological industry in the country, the following tasks should be solved:

1) expansion of agro-meteorological observations in order to take appropriate measures for protection of agro-ecosystems from climatic factors;

2) improvement of the climate monitoring system of hazardous weather events;

3) creation of the Center for monitoring, assessment and forecasting of climate change and natural hazards;

4) enhancement of short-term forecasting of dangerous hydro-meteorological phenomena, medium-term and long-term hydro-meteorological forecasts;

5) assessment of vulnerability of the regions of Turkmenistan to climate change;

6) development of the existing early warning system and bringing climate information to the consumer using modern technologies;

7) development of methodology for calculating risks and assessing damage from climate change for agriculture;

8) strengthening and expanding the network for hydro-meteorological observations;

9) creation of the climate data fund;

10) development of a weather and climate risk insurance system.

The key organization responsible for implementing adaptation measures in the hydrometeorology sector is the Ministry of Agriculture and Environment Protection.

Climate Change Mitigation Measures (Reducing Greenhouse Gas Emissions)

Climate change mitigation options are available in every sector. Mitigation can be more cost-effective if it uses an integrated approach combining measures to reduce energy consumption and greenhouse gas intensity in the end-use sectors, decarbonize energy supplies and increase of carbon sinks in the ground (terrestrial) sectors.

In Turkmenistan, rich in energy resources, great attention is devoted to solving the problem of reducing human impact on the environment. First of all, it is done through the use of modern eco-friendly and resource-saving technologies of leading foreign manufacturers in oil and gas, energy, transport and other sectors of the economy.

The determining factor for the development of the state policy of Turkmenistan on climate change is the increase of energy efficiency of the economy, which should serve as the basis for national strategy for reducing GHG emissions. In order to be a safe strategy, it must be built on a long-term and alternative basis. Consumption of fuel and energy resources (FER) determines the national level of greenhouse gas emissions. Energy sectors of the economy, including oil and gas complex and electric power industry, have significant potential for energy conservation and can significantly contribute to improving national energy efficiency indicators and reducing GHG emissions in Turkmenistan.

At the international level, the energy sector (production, extraction, storage and transformation, energy transfer) is the main and fastest growing source of GHG emissions. In 2010, 35% of all greenhouse gas emissions were accounted for the energy sector, 24% for land use, 21% for industry, 14% for transport, and 6% for buildings. Considering indirect emissions from the production of electricity and heat used in industry and buildings, their share rises to 32% and 18% respectively.

The main sources of greenhouse gas emissions in Turkmenistan are enterprises in oil and gas, energy, agricultural and transport sectors and housing communal services. The largest volumes of GHG emissions are

generated during fuel combustion, production, transportation and storage of oil and gas. Figure 6 shows the distribution of emissions by sources in the energy sector according to the Third National Communication data.

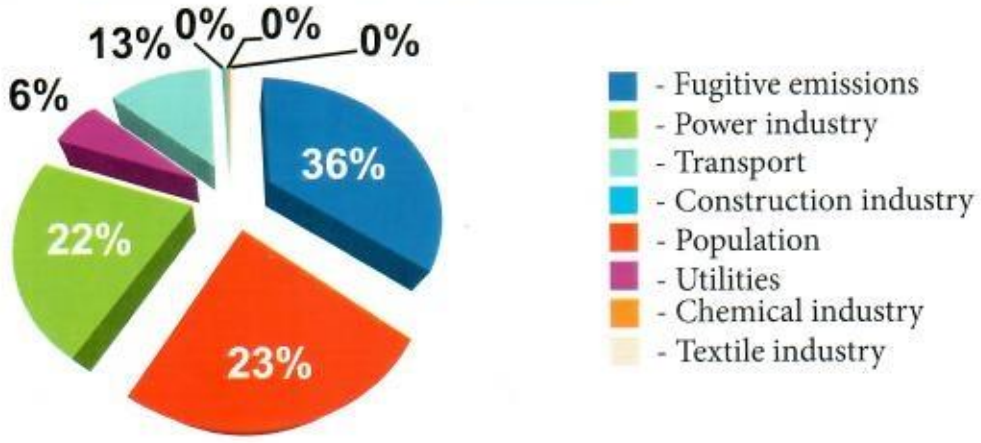

Fig. 6. Greenhouse gas emissions in the energy sector in 2010

Major part of emissions – 36% - are fugitive emissions in the oil and gas industry. Next is the population accounting for 23%, electricity 22%, transport 13% and utilities 6%. The remaining sources collectively produce less than 1% (Fig. 6).

The development of Turkmenistan during the years of independence was marked by a high growth in industrial production and investments in the country's economy. Intensive economic growth of the country is associated with the increase in the use of energy products, primarily oil and gas, which in turn contributed to the increase in greenhouse gas emissions. According to the results of emissions estimates for 18 years (2000-2017), the total amount of greenhouse gas emissions in the country more than doubled (Fig. 7).

Total GHG emissions (Gg CO_2)

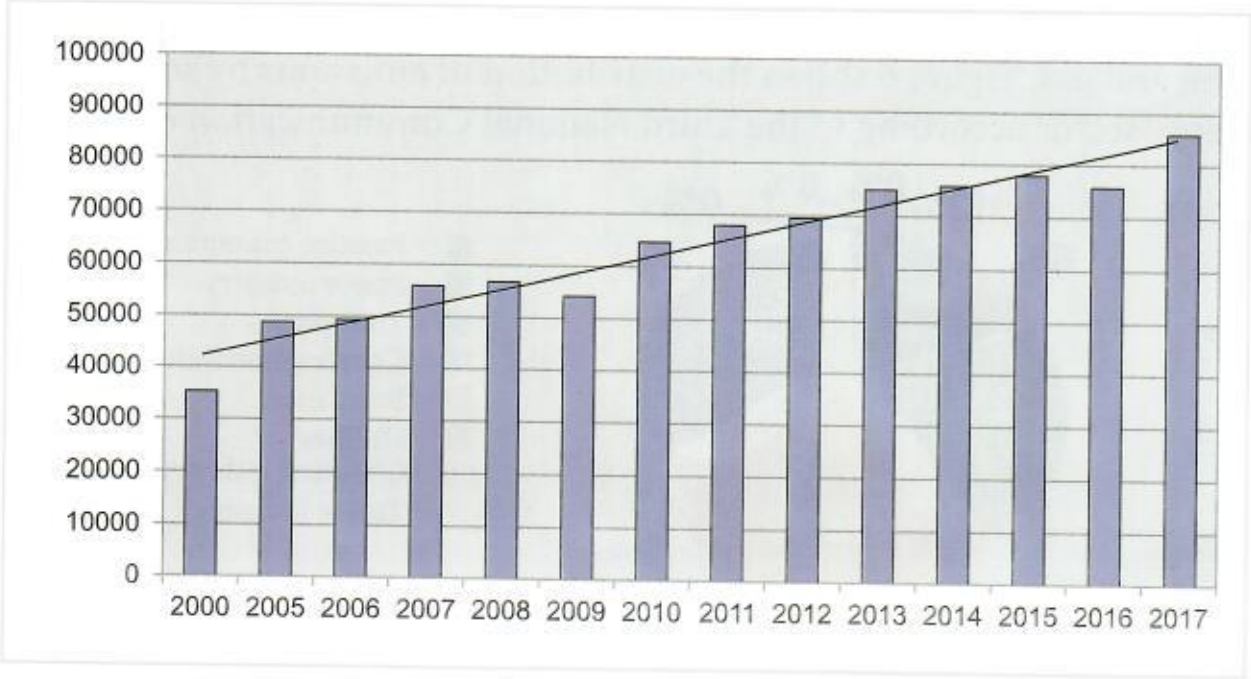

Fig. 7. Total greenhouse gas emissions in Turkmenistan for 2000-2017 (basic approach)

Energy efficiency and energy saving, rational use of natural gas and oil products and increase in the use of alternative energy sources are the main priorities of the policy to limit greenhouse gas emissions. To implement such a policy, tools and measures will be used to limit greenhouse gas emissions in key sectors of the economy - in industry, transport, housing and communal services, which are simultaneously able to maintain high growth rates of the economy as a whole. An important step has already been taken in this regard. In 2018, the President of Turkmenistan signed the Decree "On Approval of the State Energy Saving Program for the Period 2018-2024", which lists the priority measures planned to be carried out in Turkmenistan. The adoption of the Law of Turkmenistan "On Energy Efficiency and Energy Saving" is also important and relevant, given the huge potential of Turkmenistan in this area.

For the successful implementation of national mitigation measures brought by the signing of the Paris Agreement by Turkmenistan, it is necessary to provide a legislative basis for the development and elaboration of the Nationally Determined Contribution (NDC), including plan for its implementation, for example, relevant regulatory documents (decrees, orders, etc.) of the authorized bodies.

In accordance with the provisions of the Paris Agreement, it is necessary to prepare National Programs/Strategies for Low Carbon Development in 2020.

By this time, the National Inventory System for greenhouse gas emissions and sinks should be prepared. In order to ensure transparency in the realization of the National Inventory, the implementation of a set of Measures, Reporting and Verification (MRV) is required. Such a complex provides recognition of the results of national inventory conducted by local experts and international reputable organizations.

Also, in order to significantly reduce greenhouse gas emissions, it is necessary to adopt the Kigali Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, and to accelerate the implementation of its provisions.

Oil and Gas Complex

In the oil and gas complex, it is planned to implement large-scale projects to modernize and strengthen its industrial potential, expand the resource base, develop gas transportation infrastructure. It is also expected to increase production and export of energy resources, deeper processing of hydrocarbon resources in order to further develop gas and oil refining, gas and petrochemical industries, and create appropriate industrial and service industries.

The priority goals of improving technological and economic efficiency in the oil and gas sector are the large-scale introduction of new advanced energy-efficient technologies and the latest achievements of global science in the entire production cycle: from exploration and development of oil and gas fields to transportation, storage and use of oil and gas.

The main measures to improve energy efficiency and energy conservation in the oil and gas sector are the following:

1) carrying out measures to reduce leaks during extraction, transportation, storage and processing of natural gas;

2) taking measures to reduce gas leaks in gas distribution networks of the city of Ashgabat and velayats (regions);

3) reconstruction of gas distribution networks in the gas supply system;

4) introduction of modern methods for controlling the amount of pollutant emissions;

5) use of automatic systems for leak detection;

6) leak reduction in gas distribution networks of low and medium pressure;

7) timely repair and replacement of equipment inside the field and major oil and gas pipelines;

8) modernization of the flare economy, introduction of new equipment and technologies for the utilization of casing-head gases in oil fields;

9) strengthening monitoring of domestic natural gas consumption;

10) development of measures to limit and (or) reduce methane emissions from the production, transportation and distribution of natural gas;

11) conducting diagnostic examination of the corrosive state of main gas pipelines and stop valves;

12) overhaul of high-pressure gas pipelines based on the results of in-line inspection; replacement of abnormal and outdated gas pipelines;

13) overhaul of gas pipelines of the gas distribution network of gas supply systems;

14) gradual replacement of low-efficiency gas pumping units (GPU) of compressor stations with new generation units of increased efficiency;

15) elaboration of internal systems for inventory of greenhouse gas emissions at oil and gas enterprises in accordance with the reporting criteria of the Paris Agreement;

16) development of the energy conservation program in the industry.

The key organizations responsible for the implementation of mitigation measures in the oil and gas complex sector are State Concerns "Turkmennebit" and "Turkmengas".

Power Industry and Renewable Energy

In recent years, production capacities of the power industry have been significantly increased in Turkmenistan and several new generation power plants are operating. All power plants included in the state energy distribution system operate on local natural gas. Electricity enterprises continue to demonstrate consistently high rates of electricity production. The power industry of Turkmenistan is one of the basic sectors of the economy. The implementation of national plans to accelerate social and economic development and ensuring the country's energy security depends on the level of development of this industry.

The power industry fully covers Turkmenistan's domestic electricity needs and has an export focus. Due to powerful power plants built in various regions of the country and new power lines, the multiply increased

potential of the industry allows to increase electricity exports to other countries.

At the same time, intensive growth in electricity production contributes to increase in greenhouse gas emissions. The implementation of large-scale projects will strengthen energy security and independence of the country, increase the reliability of electricity consumption, production efficiency and give a powerful impetus to the country's economic development.

In recent years, the share of alternative energy in the world has been constantly increasing, and in 2018, almost a third of all electricity in the world was generated using renewable energy sources. About 20% of this electricity comes from hydropower plants of different capacities. In 2017, the amount of electricity received from renewable energy sources in Europe exceeded the generation of coal-fired thermal power plants. In 2017, more than 100 GW of solar power plants were commissioned for the first time. According to scientists, in 20 years, more than half of the world's electricity will be generated using renewable energy sources, while the share of solar and wind energy will be about 34%.

Natural and climatic conditions of Turkmenistan are extremely favorable for the widespread use of renewable energy sources, such as solar, wind and geothermal energy, in the production of electricity and heat.

The following measures will be implemented in the electric power sector:

1) further transfer of gas turbine power plants to the combined cycle;

2) implementation of measures to limit greenhouse gas emissions while generating energy from fossil fuels;

3) development of the legislative framework in order to implement energy-saving and energy-efficient policies;

4) elaboration of a system of economic and financial incentives;

5) use of advanced technologies and intelligent systems in the production and distribution of electricity;

6) modernization and timely repair of equipment in the industry;

7) improving the system of accounting and control over the functioning of the electric power system;

8) support for the implementation of regional energy conservation and energy efficiency programs;

9) reconstruction and improvement of the state power plants;

10) construction of power lines and transformer stations;

11) emission control using energy-efficient equipment: introduction of energy-efficient lighting sources and establishment of requirements for lighting devices;

12) carrying out measures to increase the technical level of equipment operation, improve the structure of electric and thermal energy production and reduce specific fuel consumption at power plants;

13) creation of the ring electric power system in Turkmenistan in 2019-2022;

14) construction of 254 MW gas turbine power plant in the Akhal velayat in 2019-2022;

15) preparation of feasibility study on providing consumers located far from the facilities of the power system of Turkmenistan, with electricity generated by solar panels;

16) development of internal systems for inventory of greenhouse gas emissions at enterprises of the electric power sector that meet the reporting requirements of the Paris Agreement;

17) development of energy conservation program in the industry.

In the renewable energy sources sector, the following measures will be implemented:

1) further support of scientific research and development of renewable and alternative energy technologies, as well as their adaptation to the climatic conditions of Turkmenistan;

2) in the short term, the introduction of small and medium-sized renewable and alternative energy installations in remote and sparsely populated areas;

3) in the medium and long term, the introduction of own production capacities and increase in the share of renewable energy in the country's energy balance;

4) creation of economic incentives for the use of alternative energy sources;

5) dissemination of knowledge about energy conservation, improving energy efficiency and use of renewable energy as methods of solving the problem of anthropogenic impact on climate;

6) implementation of measures for the use of renewable energy sources for generation of thermal and electric energy;

7) introduction of innovative technologies based on the use of renewable energy sources;

8) elaboration of national program for the development of RES in Turkmenistan;

9) establishment of a scientific and production center of non-traditional and renewable energy sources at the Turkmen State Energy Institute.

The key organization responsible for the implementation of mitigation measures in the electricity and renewable energy sectors is the Ministry of Energy of Turkmenistan.

Industry and Communications

The industrial sector successfully developed by the state is represented by enterprises in the power industry, oil and gas production, oil refining, chemical and petrochemical industries, machine building and metal processing, construction materials manufacturing facilities, light and food industries. The ongoing investment projects in priority production sectors allow phasing closer the structure of the GDP of Turkmenistan to the structure of the GDP of industrialized countries and contribute to increasing energy efficiency of industries and individual enterprises. Currently, the industry accounts for more than half of GDP. Industrial policy is aimed at accelerating the development of processing industries, creating new and modernizing existing facilities, maintaining investment and innovative activity, considering energy efficiency and energy conservation.

Common approaches for the successful development and implementation of measures to reduce greenhouse gas emissions are as follows:

1. development and implementation of economic instruments to limit greenhouse gas emissions in industry;
2. development of energy saving program in the industry;
3. special training for personnel, increasing their interest in energy conservation;
4. improving the system of commercial and technical metering of energy consumption by enterprises;
5. modernization of ongoing technological processes, as well as optimization of specific enterprises' structures;
6. introduction of energy management, analysis of the main technological processes;

7. development and implementation of measures to improve energy efficiency of existing cement production technologies;

8. installation of energy-efficient equipment at chemical industry enterprises, intensification of chemical processes, which allows to achieve reduction in annual emissions;

9. creation of economic incentives for the modernization of equipment and technologies in order to save energy resources in the industry.

The key organization responsible for the implementation of mitigation measures in the industry sector is the Ministry of Industry and Communications of Turkmenistan.

Transport

Conventional transport planning aims to increase mobility, most often for vehicles, and may inadequately account for longer-term effects. But the real purpose of transport is to provide access to work, place of study, goods and services, friends and family. And there are proven methods for improving access while reducing environmental and social consequences, as well as preventing congestion.

The transport and communication system of Turkmenistan is one of the main components of successful economic development. It is represented by road, air, rail and water transport. According to the main indicators of the transport system, high growth rates are observed annually. Significant growth in the vehicle fleet as a result of improving people's well-being and expanding the scale of large-capacity transportation will lead to an intensive increase in gasoline and diesel fuel consumption. This will entail a rapid increase in greenhouse gas emissions. Transport systems have a significant environmental impact, accounting for an average of about 10% of greenhouse gas emissions in Turkmenistan. Greenhouse gas emissions from transport are growing more rapidly than in any other energy sector.

Road transport is also one of the main causes of local air pollution and formation of smog. Traffic congestion increases economic costs, causing people to waste time and slow down the delivery of goods and services.

The following measures to optimize the work of the transport sector are the priority areas for reducing the impact of transport on climate, as well as maintaining air quality in cities and large settlements:

1) supporting development of public transport, including spreading of electric vehicles;

2) optimization of traffic flows to prevent congestion using modern management methods;

3) development of transport infrastructure, including new junctions, study of needs and opportunities for multi-tiered traffic;

4) replacement of the vehicle fleet, strengthening administrative and regulatory control over its timely repair;

5) improvement of mechanisms for regulating the import of vehicles considering energy efficiency;

6) switching to other, cleaner and more economical types of fuel, including compressed natural gas or liquefied petroleum gas;

7) transfer of railway transport to electric traction;

8) improving vehicles' fuel economy;

9) development of measures for the use of vehicles on alternative fuels, including gas fuel;

10) development of technical regulations that establish requirements for road safety in the design, construction, reconstruction and overhaul, considering requirements for reducing greenhouse gas emissions;

11) elaboration and implementation of a package of measures to upgrade the fleet of vehicles;

12) increasing environmental requirements for transport infrastructure and vehicles;

13) establishment of a highly efficient national transport system aimed at meeting the demand for transportation of goods and passengers, increasing their safety and quality;

14) reducing greenhouse gas emissions in the transport sector: improving the fuel effectiveness of vehicles;

15) transfer of passenger cars and trucks to the use of liquefied natural gas;

16) development of electric vehicles;

17) elaboration of the energy conservation program in the industry.

The key organization responsible for the implementation of mitigation measures in the transport sector is the Ministry of Industry and Communications of Turkmenistan.

Housing, Communal Services and Wastes

The economic upturn in Turkmenistan is also reflected in the intensive renewal of the housing stock, domestic sector of the country, and improvements in waste management. New residential buildings are being built using modern technologies, in particular with thermal insulation of walls with foil mineral wool. According to the plans on increasing living space per person and forecasted population growth, it is planned to build many high-rise residential buildings provided with heat and hot water by using autonomous gas boilers and modern waste collection systems. The old high-rise residential buildings were built without considering the climatic features of Turkmenistan, in particular, without consideration of increased solar radiation.

Wastes have diverse environmental impact, including emissions into air and water, pollution of groundwater, as well as allocation of significant areas for waste landfills. It is necessary to improve waste management processes. Further improvement of the country's rational and environmentally sound waste management system will contribute to improving the environment and protection of natural resources. Waste is also a source of secondary material, fuel and energy resources.

In Turkmenistan, increase in greenhouse gas emissions in the housing and communal services sector and increase in wastes production and consumption are associated, first of all, with the growth of the country's population, industrial production and improvement of social and living conditions.

In this regard, the priority areas in the housing and communal services sector and waste in Turkmenistan are the following:

1) introduction and use of energy-efficient lighting systems for buildings and streets;

2) improving the efficiency of urban heating systems;

3) further renewal of the housing stock, while considering climate change;

4) use of modern materials and structures of walls, roofs, floors and windows, as well as highly efficient heating, ventilation, air conditioning, and hot water systems in the houses under construction;

5) enhancement of the regulatory framework and standards that ensure energy saving in construction that meets modern international requirements;

6) adaptation of building codes to ensure sustainability of infrastructure to dangerous climatic developments;

7) development of the regulatory framework, legal support and organization of state regulations in the field of energy efficiency;

8) activities to increase public awareness and interest in energy efficiency in buildings and waste management;

9) certification of household and industrial appliances and equipment for energy efficiency;

10) construction of energy-saving buildings, use of energy-efficient materials and technologies in the construction of new residential buildings, improvement of thermal insulation and tightness of buildings;

11) installation of modern electricity, heat, gas and water meters in buildings with the introduction of energy monitoring and energy management;

12) preparation of the National Action Plan for the rational use of energy resources in the housing stock;

13) development of the state waste management strategy/program;

14) implementation of waste sorting systems in settlements;

15) introduction of modern technologies for the disposal of domestic and industrial waste;

16) deep treatment and disposal (recycling) of wastewater;

17) waste composting;

18) building national capacities to ensure environmentally sound management of hazardous wastes;

19) development of economic mechanisms to facilitate the use of eco-friendly technologies, prevent formation and minimization of waste, as well as public and private support for waste processing enterprises;

20) development of a waste management strategy/program;

21) development of the inventory system for waste generated and accumulated;

22) limiting greenhouse gas emissions during the development and operation of buildings and structures;

23) ensuring widespread use of renewable energy in housing construction;

24) development of legislation in the field of waste management;

25) construction of waste sorting and waste recycling complexes;

26) creation of a register of landfills operating in the country for waste disposal;

27) development of the energy conservation program in the industry.

The key organizations responsible for the implementation of mitigation measures in the housing, public utilities and waste sector are the Khyakimliks (Municipalities) of Ashgabat and the velayat centers.

Section IV. The National Strategy Implementation Arrangements

Coordination of Implementation

The National Strategy of Turkmenistan on Climate Change will be realized through the Paris Agreement Implementation Plan and preparation of updated Nationally Determined Contributions (NDC). The plan will include both measures aimed at mitigating effects of climate change and adapting to observed and predicted changes. It will also include measures for scientific and technological development, development of climate research, climate risk assessment and analysis of effectiveness, including economic one, other various response measures, as well as creation of financial and coordination mechanisms for the implementation of these programs and plans. Soon, it is necessary to begin the preparation of velayat (regional) and departmental plans for adaptation and mitigation. These plans will consider existing climate change measures in velayat and sectoral development plans and will improve the planning of the relevant measures for adaptation and reduction of GHG emissions.

The National Strategy is designed to stimulate transition to integrated and dynamic planning in order to ensure sustainable development of economic sectors of the country, while considering forecasts of climate change in the medium and long term. The strategy, being environmental and economic document, should harmonize development of the economy of Turkmenistan with the environment protection. As showed the experience of the past six years after adoption of the National Strategy in 2012, it is necessary to strengthen the institutional and legislative framework for the high-quality and timely implementation of the tasks defined by the Strategy. In the near future, it is planned to develop the Law of Turkmenistan "On Climate Change". The legislative acts under development should regulate issues related to climate change, especially interaction of ministries and agencies, and their responsibilities. The

National Strategy is a reliable basis for fulfilling the objectives of the 2030 Agenda with the list of Sustainable Development Goals (SDGs) - Goal 13: Taking urgent measures to combat climate change and its consequences. It is also necessary to clearly define the issues of access and collection of diverse and numerous data and information for conducting inventory of greenhouse gases, assessing impacts and adaptation to climate change, and for preparing measures to prevent climate change, etc.

In this regard, in order to intensify the implementation of the National Strategy of Turkmenistan on Climate Change , it is necessary to create an Interagency Commission on Climate Change, which should have the authority to consider all issues related to climate change in Turkmenistan (inventory of greenhouse gases, vulnerability assessment and adaptation to change climate, etc.). Such a mechanism will strengthen ties and cooperation between sectors at all levels and increase understanding of the benefits of cooperation between all interested parties. The Commission will also receive reports from relevant ministries and departments, which are key in the respective priority sectors of adaptation and mitigation of the National Strategy of Turkmenistan on Climate Change, on the implementation of the UNFCCC, the Paris Agreement and other international obligations on climate change. Analysis of the situation in this sphere shows the feasibility of providing the coordinating body with appropriate authority for interdepartmental coordination and management, mobilizing financial and logistical resources, monitoring and evaluating the implementation of adaptation and mitigation measures, and informing interested organizations and the public.

It is planned to create a permanent Secretariat for the provision of technical support to the Interagency Commission on Climate Change.

The Secretariat shall develop mechanisms for interagency coordination, justify functional responsibilities of the Commission and the legal framework for its activities, establish links between key ministries, and form the basis of monitoring system for adaptation and mitigation activities (indicating the timing and implementation criteria), ensure creation of the national network of experts on all aspects of climate change.

The structure of the institutional framework for adaptation and reduction of climate risks includes key ministries, agencies and organizations that have certain relationship with the issues raised, local executive authorities

and local governments, including local communities and daykhan (farmers) associations:

1) Ministry of Finance and Economy of Turkmenistan:
2) Ministry of Agriculture and Environment Protection of Turkmenistan;
3) Ministry of Defense of Turkmenistan;
4) Ministry of Health and Medical Industry of Turkmenistan;
5) Ministry of Industry and Communications of Turkmenistan;
6) Ministry of Education of Turkmenistan;
7) Ministry of Sport and Youth Policy of Turkmenistan;
8) State Committee for Water Resources of Turkmenistan;
9) State Statistics Committee of Turkmenistan;
10) Academy of Sciences of Turkmenistan;
11) local executive authorities (Khyakimliks);
12) local authorities (Gengeshes);
13) Union of Industrialists and Entrepreneurs of Turkmenistan.

Clear coordination and interaction between these bodies and organizations is needed to effectively address emerging issues in the area of climate change, vulnerability and adaptation.

At all stages of the implementation of the Strategy, an important role will be assigned to the development and strengthening of cooperation with other countries where approaches and practices in the field of reducing greenhouse gas emissions and adaptation to climate change have been successfully tested. Also, the experience and potential in this area of international organizations such as UNDP, UNEP, WHO, UNICEF, UNIDO, the World Bank, the EU and others will be applied.

Raising awareness and understanding of the problem among stakeholders on climate change issues and their impact on people's lives, the economy and the environment are important factors in the successful implementation of the Strategy. Measures to publicize issues related to climate change and their consequences, training of environmental culture, culture of consumption of natural resources, including energy, and educating the population on how to deal with critical situations will be included in action plans for adaptation and reduction of greenhouse gas emissions.

The Strategy focuses on the identification and assessment of threats to the country's development and security related to climate change. This

includes threats to the economy, infrastructure, water management, public health, and provision of reasonable precautions when planning and implementing measures to ensure the safety of the Turkmen people and the state from adverse effects of climate change.

Climate change affects almost all sectors of the economy, and preventative measures are costly. The reduction of climate risks is directly related to the solution of the complex of issues: legislative, methodological, economic, financial, resource, technological, scientific, educational, personnel. This necessitates close cooperation at the national, regional and international levels. Therefore, the implementation of adaptation and mitigation measures is defining the socio-economic development of the country nowadays.

Financing of Implementation

The existing financing of climate change activities is provided from the following sources: State budget, loans, extrabudgetary means and funds, private sector, external (international) sources, etc.

To implement the Strategy, external sources of financing, technical and technological assistance can be attracted. External sources of financing are the additional resource to internal sources of financing. As a rule, the size of external financing depends on how much funds can be raised domestically and the number of co-financing parties.

Concerning external resources, the following will be used: already created, existing and planned financial mechanisms, and funds under the UNFCCC and the Paris Agreement, such as:

1) Global Environment Facility;
2) Adaptation Fund;
3) Green Climate Fund;
4) bilateral funds;
5) bilateral agreements;
6) other types of international financing, including grants.

In addition, various international banking structures may potentially be involved in the implementation of the Strategy, such as:

1) World Bank;
2) Asian Development Bank;

3) European Bank for Reconstruction and Development;
4) Islamic Development Bank;
5) Eurasian Development Bank.

As well as international organizations, such as:
1) UN Environment Program;
2) UN Development Program;
3) UN Industrial Development Organization;
4) World Health Organization;
5) UN Children's Fund;
6) European Union;
7) Organization for Security and Cooperation in Europe;
8) German Society for International Cooperation (GIZ), TIKA, etc.;
9) Regional Environmental Center for Central Asia, etc.

The transition of the country's economy to the path of low-carbon development requires significant financial resources. To support and successfully carry out actions on climate change and the transition to low-carbon economic development, it is necessary to find appropriate sources of financing and create stable regulatory framework for raising and use of funds. Normative documents should determine respective funds and their roles, responsibilities, rights and obligations.

The climate strategy requires that, in the future, industry action plans to reduce greenhouse gas emissions and adaptation determine financing schemes for each individual measure.

At the national level, the Strategy provides for the creation of the National Clean Climate Fund, the budget of which can be formed from various national sources, such as:

1) state budget of Turkmenistan;
2) attraction of private capital;
3) established percentage deductions from projects related to the production, transportation, distribution and consumption of energy resources;
4) established deduction percentage of income from export of saved gas and oil as a result of implementation of energy saving measures;
5) preparation and implementation of projects of the Sustainable Development Mechanism;

6) other sources of funding.

The main factor in the implementation and sustainability of any project is its guaranteed financial support. This is especially true for environmental projects. The beneficiaries of environmental projects are various ministries and agencies, which primarily include the Ministry of Agriculture and Environment Protection, the State Committee for Water Management, local executive bodies (Khyakimliks), local governments (Gengeshes) and local community.

Of particular interest in this matter is the implementation of integrated financial system, which involves raising funds to implement programs in support of initiatives in the field of solving environmental problems from various sources:

1) domestic financial resources;
2) external financial resources;
3) innovative financial resources.

Internal financial resources include:

1) state funds, which in turn consist of budgetary sources of financing, own funds of enterprises and organizations;
2) loans and borrowings;
3) funds of daykhan and public associations;
4) funds of non-governmental organizations;
5) funds of the population and funds not prohibited by the legislation of Turkmenistan.

Innovative financing mechanisms include:

1) offset schemes for ecosystem services;
2) PES - Payments for environmental services;
3) small targeted grants;
4) benefits for environmental protection activities;
5) mechanism of sustainable development.

Implementation of the National Strategy will be based on the use of both external and national sources of financing, technical and technological assistance.

Education, Staff Training and Awareness

Education, training and public awareness on the climate change issues and consequences (Article 6 of the UNFCCC) occupy an important place among the actions stipulated by the UNFCCC and is aimed at involving broad sections of the society in the related activities.

The work on raising public awareness of the issue of climate change in Turkmenistan is coordinated by the Ministry of Agriculture and Environment Protection, responsible body for the implementation of the UNFCCC in our country. In order to actively contribute to the implementation of all provisions of this article and to involve public in the adoption and implementation of decisions to achieve the UNFCCC goals, the Delhi Work Program was adopted at the 8th Conference of the Parties to the UNFCCC (Delhi, 2002). As a member country of the UNFCCC, Turkmenistan is actively implementing this program. This work covers various segments of the population (target groups): scientists, teachers, schoolchildren, students, decision makers, specialists from ministries and departments of key sectors of the economy, industrial enterprises, representatives of business and private sector, media, environmental non-governmental organizations and civil society.

The main activities focus on the following:

1) conducting training seminars for various target groups;

2) conducting national seminars with the participation of representatives of ministries and agencies, public figures, decision makers, specialists involved in the elaboration of development plans and strategies for individual sectors of the economy that affect the climate or are largely dependent on its change;

3) participation in regional and international meetings on climate change issues;

4) development of methodological manuals and teaching aids for schoolchildren, students and teachers;

5) production of popular science films and videos;

6) publication of information booklets and calendars;

7) holding environmental campaigns and ecology days dedicated to the World Environment Day and other related dates;

8) speeches at television and radio, publications on climate change and its negative impact in periodicals;

9) raising awareness of climate change and disaster risk reduction problems among the population.

In accordance with the reform of the education system in the country, much attention is paid to environmental education in secondary schools and universities of the country within the framework of mandatory standards. To ensure high-quality provision of educational services at the preschool level, the Government of the country has developed new educational standard.

From an early age, it is necessary to develop skills of careful attitude of the young Turkmen generation to the environment and develop basic knowledge about main principles of sustainable development.

In order to implement the Climate Change Agenda, the Government of Turkmenistan, together with UNICEF, has taken a number of steps aimed at presenting and further introducing the subjects related to adaptation to climate change into the education system of Turkmenistan. Existing curricula were reviewed and updated for five school subjects: Natural History, Life Sciences, Ecology, Geography, Agriculture in primary and secondary schools, and they included components for climate change.

In the process of teaching subjects on climate change, modern interactive teaching methods, audio-visual materials and interactive teaching materials were used; they were developed and presented by UNICEF, and then adapted to local conditions.

The following issues are considered within the Natural History and Geography subjects: air and its composition; weather and climate; climate-forming factors; impact of climate on human life and its economic activities; agroclimatic resources, etc. In accordance with the curriculum, students get acquainted with the basic concepts on this issue and the general provisions of the environmental and ecological legislation of Turkmenistan, as well as relevant international conventions. In addition, it is practiced conducting additional, optional classes and thematic evenings in secondary schools and universities; special groups (clubs) were established.

Professional knowledge on the scientific foundations of climate change can be obtained at two universities in Turkmenistan. The training

course "Fundamentals of Meteorology and Climatology", which includes climate change issues, is taught at the Department of Meteorology of the Faculty of Geography of the Turkmen State Pedagogical Institute named after S. Seydi and at the departments of environmental studies and hydrometeorology, Faculty of Geography, Turkmen State University named after Makhtumkuli. The program of this course is supplemented with new information received during the development of the National Communications on Climate Change of Turkmenistan.

The Turkmen State Institute of Architecture and Civil Engineering educates engineers and ecologists, with specialization in the Environment Protection and Rational Use of Natural Resources. They will be engaged in industrial, technological, design and research activities in the field of technology for the treatment and disposal of industrial waste, development of eco-friendly and resource-saving technologies. Special disciplines delivered are the following: Applied Industrial Ecology, Theoretical Foundations of Environmental Protection, Environmental Chemistry, Protection of Atmospheric Air from Pollution, Waste-Free Production and Secondary Resources, Environmental Monitoring, Basics of Engineering and Environmental Expertise, Human Ecology.

In many universities of the country, the courses on Environmental Economic, Environment Protection, Ecology and Rational Use of Natural Resources are delivered.

One of the key areas of education reform in Turkmenistan is widespread international cooperation. In this large-scale process, priority is given to studying international best practices, attracting teachers from world leading educational institutions to work in the country, regularly exchanging students, establishing close inter-university and scientific contacts, and introducing innovative teaching technologies, including multimedia and information. The tasks set in many respects are facilitated by the relations established between universities of Turkmenistan and European countries within the framework of the EU Program and joint projects that are being successfully implemented today.

In the process of study, the students-ecologists undergo practical training in subordinate units of the Ministry of Agriculture and Environment Protection of Turkmenistan: National Institute of Deserts, Flora and Fauna, nature reserves and velayat (regional) Departments of Nature Protection, gaining

necessary skills for future work. Meteorological students have practical trainings in divisions of the Hydrometeorology Service of the Ministry of Agriculture and Environment Protection of Turkmenistan. As institutional measures for environmental education, the mass media use its opportunities for public awareness raising. This work is actively implemented within the framework of national plans.

Recommended work to continue building capacity in education and staff training related to climate change is as follows:

1) familiarization and dissemination of the Regional Climate Box Initiative, created by the specialists of the Ministry of Education of Turkmenistan in cooperation with the UN Development Program;

2) development and distribution of additional methodological material on climate adaptation and ecology (posters, videos, visual aids in electronic form);

3) advanced training of secondary school teachers in the field of natural sciences, basics of life, ecology, climate, biology and geography;

4) revision of curricula and plans considering climate change issues, development and implementation of training materials on adaptation to climate change and environment;

5) organization and implementation of training on climate change and disaster risk reduction at all levels of the education system, including vocational education and training;

6) modernization of classrooms/buildings and promotion of education for sustainable development;

7) provision of comprehensive assistance and support to increase resilience and adaptation to climate change in the education sector.

Issues of ensuring public access to ecological information are reflected in several international environmental conventions ratified by Turkmenistan. The most important document is the UN Economic Commission for Europe Convention on Access to Information, Public Participation in Decision Making and Access to Justice on Environmental Matters (Aarhus Convention). Turkmenistan ratified this international legal document in 1999. A lot of work to ensure public access to information, including information on climate change and sustainable development, is carried out by the Aarhus Center of Turkmenistan, which was established in 2012, with the active assistance of the Ministry of Agriculture and Environment Protection Turkmenistan

and the OSCE Center in Ashgabat. Within the scope of its activities for a fairly short period, the Center has implemented many actions aimed at increasing public awareness in the field of ecology, including climate change and its effects.

Over the past few years, media interest in climate change has increased dramatically in Turkmenistan. This is due to the increasing frequency of abnormal natural phenomena in the country and in the world. Therefore, informational and educational activities in Turkmenistan over recent years have significantly increased the interest and activity of the population. Information is distributed through the media, radio, TV, as well as printing, the Internet, etc. It is published both on news feeds and in reports, and in special columns devoted to environmental protection issues.

Role of Private Sector and Civil Society

The problem of climate change is global, not only in the sense of area, but also in the universal value. Climate change has devastating effect on biodiversity, water and ecosystems, as well as the intensity of land and agriculture degradation. It is a critical factor that exacerbates extreme weather events, such as droughts and floods, and aggravates instability due to food insecurity, economic problems, or disaster-related dislocations. This has serious consequences for the world and its security. It does not have mercy on a single state and a single person, from the Arctic region to small island developing states. Most affected are the poorest and most vulnerable groups.

The international community has long recognized the enormous role of the private sector and civil society, which includes various groups and communities: family, political parties, trade unions, interest associations (business centers, clubs and others), schools (private), etc. in solving this problem. At present, calls for the private sector and civil society to get involved in the fight against climate change are voiced at all global, regional and national conferences and meetings devoted to this problem. And gradually, the private sector and civil society are making increasing contribution to the common cause - climate protection.

Climate change combating activities of private sector and civil society representatives of Turkmenistan are at the stage of their active formation. In recent years, several private enterprises and firms started to realize

their ideas in such areas as energy efficiency, energy conservation, renewable energy, water conservation and waste management. Currently, in the lights of the preparation of sectoral adaptation and mitigation measures for the updated NSTCC, there is a huge opportunity to involve these organizations in the implementation of the strategy. In this regard, it becomes necessary to take measures that exclude various legislative or bureaucratic obstacles to their proper work, in close cooperation with the Union of Industrialists and Entrepreneurs of Turkmenistan and public organizations.

Monitoring and Evaluation Mechanism

In order to comply with the current socio-economic reforms and directions laid down in the National Program for Social and Economic Development until 2030, the Strategy period is designed until 2030. If requiring conditions arise, the National Strategy can be reviewed every 5 years.

Monitoring of the Strategy implementation and proposals development for revising its provisions is entrusted to the Interagency Commission on Climate Change.

In addition, key ministries and departments of each adaptation and mitigation sector should prepare a semi-annual/annual report on the relevant sector indicating the quantitative indicators of the measures taken.

In order to ensure high-quality monitoring and analytical information, an electronic information management system will be developed, with the main units for adaptation and reducing greenhouse gas emissions. This system will be multifunctional and cover all sectors of the economy in order to fully comply with the initiative of the President of Turkmenistan on Electronic Government.

The basis for the development and implementation of the electronic system will be matrices with detailed indicators and expected results, which will be developed as a part of subsequent action plans to adapt and reduce greenhouse gas emissions.

In accordance with the objectives of the National Strategy, for the proper implementation of the UNFCCC and transparency framework in the Paris Agreement requirements, it is necessary to establish reliable MRV mechanism (Measures, Reporting and Verification).

In assessing adaptation and mitigation, the current data collection mechanisms make it difficult to provide accurate and timely data in key areas. This leads to poor reporting to the UNFCCC and inconsistency with the criteria of the transparency framework of the Paris Agreement. In addition, in order to clarify the contribution of Turkmenistan to global warming and inform about the development of expanded policies and actions for consistent reduction of emissions on continuing basis, it is necessary to develop and implement the National Inventory System for greenhouse gas emissions and drains.

Development and implementation of the above national systems are the basis for the successful implementation of the goals of the updated National Strategy of Turkmenistan on Climate Change .

Priority Measures for the Implementation of the Paris Agreement in Turkmenistan

	Name of the activity	Responsible national authorities and international organizations	Implementation timeline
1	Development of the plan to implement the Paris Agreement, including Nationally Determined Contributions	MAEP, MFE, UNDP	2019-2020
2	Preparation of the fourth National Communication and the first Biennial Updated Report on the UNFCCC	MAEP, UNDP, UNEP	2019-2022
3	Identification of priority strategic actions for adaptation and mitigation at the level of economic sectors (NAP and NMP)	MAEP, sectoral departments, private sector, UNDP	2019-2023
4	Development and implementation of the National Inventory System for greenhouse gas emissions and drains	MAEP, State Statistics, industry agencies, UNEP	2020-2023

5	Development and implementation of Monitoring, Reporting and Verification System for the preparation of Nationally Determined Contributions	MAEP, MFE, State Statistics	2020-2030
6	Development of information, scientific and human capacity in the field of climate change	MAEP, Ministry of Education, AST, public organizations, private sector, UNDP, UNICEF	2020-2030
7	Development and implementation of the national climate change projects' accounting system	MFE, MAEP	2020-2025
8	Conduction of New Technology Needs Assessment according to the UNFCCC (NTNA)	Sectoral agencies, MAEP, UNDP, UNEP	2020-2025
9	Preparation of the National report on assessing the impact of climate change on public health and developing adaptation measures	MHMI, UNICEF, WHO	2019-2020
10	Establishment of the Climate Data Fund of Turkmenistan	MAEP, State Statistics, AST, UNDP	2019-2025
11	Enhancement of national legislation on climate change, including: • The Law of Turkmenistan "On Climate Change"; • The Law of Turkmenistan "On Soils"; • The Law of Turkmenistan "On Energy Efficiency and Nature Conservation"; • New edition of the Land Code of Turkmenistan, etc.	Mejlis (Parliament), MAEP, UNDP	2019-2021
12	Adoption and implementation of the Kigali Amendment to the Montreal Protocol on Ozone Layer Depleting Substances by Turkmenistan	Mejlis (Parliament), MAEP	2019-2020
13	Elaboration of strategies/programs and regulatory acts on the development of RES in Turkmenistan	Mejlis, Ministry of Energy, MAEP, UNDP	2019-2023

Abbreviations

ADB	Asian Development Bank
WB	World Bank
GDP	Gross Domestic Product
RES	Renewable energy sources
WHO	World Health Organization
WFP	World Food Program
GIZ	German Federal Enterprise for International Cooperation
GEF	Global Environment Facility
EBRD	European Bank for Reconstruction and Development
EDB	Eurasian Development Bank
EU	European Union
GCF	Green Climate Fund
IDB	Islamic Development Bank
IPCC	Intergovernmental Panel on Climate Change
IFSA	International Fund for Saving the Aral Sea
NSTCC	National Strategy of Turkmenistan on Climate Change
OSCE	Organization for Security and Cooperation in Europe
ASBP	Action Program of Assistance to the Countries of the Aral Sea Basin
GHG	Greenhouse gas
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change
RECCA	Regional Environmental Center for Central Asia
TICA	Turkish International Cooperation Agency
TNC	Third National Communication
SDGs	Sustainable Development Goals
UNEP	United Nations Environment Program
UNIDO	UN Industrial Development Program
UNICEF	United Nations Children's Fund