Ministry of Ecology and Natural Resources
Republic of Azerbaijan

Second National Communication to the United Nations Framework Convention on Climate Change

Baku-2010

The document represents the second national report of the Republic of Azerbaijan on the implementation of the United Nations Framework Convention on Climate Change. It presents national situational analysis, information on emissions and removals of greenhouse gases (GHGs), overview the activities Azerbaijan undertakes to implement the Convention, assessment of vulnerability to climate change, and calls for adaptation measures.

The document is published within the framework of the joint project of the Government of Azerbaijan and United Nations Development Programme "Enabling Activities for the Preparation of Azerbaijan's Second National Communication to the UNFCCC" with the financial support of the Global Environmental Facility (GEF).

UNDP Azerbaijan

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ACRONYMS

AFOLU	Agriculture, Forestry and Land Use
CDM	Clean Development Mechanism
CE	Coal equivalent
CFCs	Chlorofluorocarbon
CH_4	Methane
CIS	Commonwealth of Independent States
CO_2	Carbon gas
COE	Coefficient of Efficiency
CSC	Close Stock Company
DNA	Designated National Authority
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gases
HES	Hydroelectric station
HFK	Chlorfluocarbon
IEA	International Energy Agency
INC	Initial National Communication
IPCC	Intergovernmental Panel on Climate Change
MENR	Ministry of Ecology and Natural Resources
MIE	Ministry of Industry and Energy
N_2O	Nitric oxide
NA	National Authority
NATO	North Atlantic Treaty Organization
NGO	Nongovernmetal Organization
NOx	Nitrogen oxide
NMVOCs	Non-methane Volatile Organic Compounds
ODS	Ozone Dephleting Substances
OSC	Open Stock Company
OSCE	Organization for Security and Cooperation in Europe
OSS	Open Stock Society
PFK	Perfluocarbon
SC	State Company
SNC	Second National Communication
SOCAR	State Oil Company of Azerbaijan Republic
SRES	State Regional Electric Station
TES	Thermal Electric Station
TPC	Thermal Power Center
TPP	Thermal Power Plant
UN	United Nations
UNDP	United Nations Development Programme
WES	Water Electric Station
WMO	World Meteorological Organization

INTRODUCTION

Global climate change is one of the greatest threats to the world community, a cause of adverse socio-economic and environmental effects. The continuing increase in atmospheric concentrations of greenhouse gases has had a perturbing effect on the earth's radiation balance, which has resulted in the rise of the annual mean temperature around the globe.

Recognizing the importance of this issue, the Republic of Azerbaijan joined other nations in ratifying the UN Framework Convention on Climate Change in 1995 and joining the Kyoto Protocol in 2000 with a view to supporting initiatives towards the mitigation of climate change effects.

This Second National Communication has been prepared as part of commitments under the UN Framework Convention on Climate Change. The report presents a national situational analysis, quantifies greenhouse gas emissions, posits a number of future climate scenarios, assesses the vulnerability of various economic sectors and ecosystems, and calls for various adaptation measures. For the first time, the Communication presents an assessment of possible climate change impacts on human health

The first National Communication was prepared in 1998-2000. At that time, many enterprises had ceased to operate due to an economic crisis, casting doubt on a wide range of data, particularly on greenhouse gas emissions and the evaluation of abatement measures. Circumstances resulting from the occupation of 20% of the country's territory by Armenia have cast doubt on some data in the present report.

In recent years the country's economy has grown rapidly. Fortunately, the use of new technologies and the implementation of abatement measures have prevented a concurrent rise in greenhouse gas emissions. Energy efficiency has increased as alternative energy research and projects are implemented, and ever-more carbon dioxide is removed from the atmosphere with expanding forest and vegetation cover zones.

The Republic of Azerbaijan will continue to contribute to the abatement of global climate change effects.

EXECUTIVE SUMMARY

The Republic of Azerbaijan ratified the UN Framework Convention on Climate Change in 1995. In order to facilitate the implementation of the Convention, a State Commission on Climate Change was established in 1997 by a resolution of the President. The Commission was composed of representatives of all related institutions and ministries. In 2000 the Kyoto Protocol was ratified. The Initial National Communication to the UN Framework Convention on Climate Change was developed between 1998 and 2000 with funding from the Global Environmental Facility and the UN Development Programme. The Initial National Communication covered the period of 1990 to 1994.

1. CONTEXT

The Republic of Azerbaijan was established on 28 May 1918 and regained its independence in 1991. Independence Day has been celebrated on the 18th of October since 1991.

The country's area covers 86.6 thousand km^2, with a population of 8730.3 thousand (2009). The population density is 100.8 people per km^2. The capital city is Baku and the state language is Azerbaijani.

Azerbaijan is located at 38°25'-41°55' North Latitude and 44°50' - 50°51' East Longitude. Its neighbors are Russia, Georgia, Armenia, Turkey and Iran. The eastern part of the country is bordered by the Caspian Sea.

The form of state governance of the Republic of Azerbaijan is presidential. It acceded to the United Nations and the OSCE in 1992 and has been a member of the Council of Europe since 2001.

For over 14 years, 20% of the country's land has been occupied by Armenia.

The economy is driven mainly by oil and gas production, chemicals and petrochemicals, metallurgy, mechanical engineering, textiles and food industry. The agricultural sector consists mostly of wheat, cotton, wine, fruit, tobacco, tea, vegetables and cattle breeding. The chief exports are oil and oil products, electrical energy, cotton and silk fibers, and wine. Industrial products accounted for 28.1 billion manats in 2008. GDP increased from 4718.1 million manats in 2000 to 38005.7 million manats in 2008.

Some 62 oil and natural gas fields are found in Azerbaijan, 16 of them in the Azerbaijani sector of the Caspian Sea. The country's oil stores may constitute 10 billion tons, and stores of natural gas may equate to 8 trillion cubic meters. Contracts have been signed with international oil companies for joint exploration of Gunashli, Azeri and Chirag fields, and with 11 companies for the exploration of 11 potential fields.

At present more than half of national revenue comes from the oil industry. The Baku-Tbilisi-Ceyhan pipeline to Europe plays an important role, with the capacity to transport 40-50 million tons of oil annually. For natural gas, the Baku-Tbilisi-Arzurum pipeline has been laid and the NABUCCO pipeline project is under consideration.

Electrical energy has been significant in the development of the country's economy. The network is comprised of thermo- and hydroelectric stations. Thermal Electric Stations operate on fuel oil and gas. Electricity production output reached a peak in 1988. In 2005, electricity production output figure constituted 22.9 billion kWt/hour where the share of Hydroelectric Stations was 3 billion kWt/hour.

The main products of the chemical industry are sulfuric acids, superphosphate fertilizers, sodium hydroxide, chlorine, aluminum chloride, sulafanol, synthetic detergents, and bromide. The major

products of the petrochemical industry are ethanol, synthetic resin, technical rubber products, tires, plastic, glass fibers and polyethylene. Many chemical plants have scaled back or shut down since 1990, particularly as a result of the collapse of the integrated raw materials market of the former Soviet Union.

Agriculture, forestry, fishery and hunting products totally accounted for 1072.6 million manats in 2000 and 3324.8 million manats in 2008. The overall land area of the country is 8.6 million hectares, of which 55% is considered fit for cultivation. Cattle breeding, poultry farming, forestry, fishery and hunting are all well developed in the country.

As in other countries, environment protection and natural resources issues have come to the fore in recent years. With a view to enhancing environment protection, many important laws and regulations have been passed since 1997 in concert with European legislation. Progress on many domestic environmental challenges has been slow in the country's transition era. Therefore, priority has been given to the development of international, regional and intergovernmental bilateral cooperation. The Republic has joined 20 international conventions in this area.

The country's main environmental problems are wastewater pollution including trans-boundary pollution; emission of harmful substances and greenhouse gases from industrial plants and vehicles; improper disposal of solid municipal and industrial wastes including hazardous wastes; depletion of biodiversity; and decline in forest resources and fauna.

Freshwater is mainly derived from rivers. Most of these (69-72%) originate in Georgia, Armenia, Turkey, Iran and Russian Federation. Presently, the release of untreated wastewater from the territories of Georgia and Armenia into the Kura River adversely affects its hydrochemical condition and quality; considerable concentrations of copper, zinc, phenol and oil products have been found in the water. The occupation of 20% of Azerbaijan's territory by Armenia has made it difficult to monitor pollution levels in the Kura River basin. Since these areas are beyond Azerbaijani government control, observers have reported the destruction of natural monuments, ruthless exploitation of natural resources and extreme pollution of water resources. As for the Araz River, the main causes of pollution are the copper-molybdenum and copper-ferrous metals plants in Armenia.

Due to the decline in industrial activities since 1990, the level of greenhouse gasses released into atmosphere from stationary and mobile sources has reduced. While the level of pollution equated to 71.1 million tons of CO_2 in 1990, in 2008 this figure accounted for 50.6 million tons of CO_2.

Soil cover has been degraded as a result of erosion, soil salinity, bogging, chemical pollution and other processes associated with human activity. Erosion has affected some 3.7 million hectares and 1.2 million hectares suffer from salinity. As a consequence of mining operations, intensive desertification and other impacts of human activities have affected 30 thousand hectares of land. This includes 14 thousand hectares contaminated by oil, 108 hectares contaminated by chemical wastes, 5571 hectares contaminated by sedimentation of irrigation channels, 1580 hectares affected by mineral exploration, and 163 hectares contaminated by construction and municipal waste management agencies.

About 4500 species of higher plants and 18 thousand fauna species are found in the country, but human activities have led to the depletion of biodiversity. These include unregulated grazing of sheep and cattle, harvesting of rare and medicinal herbs by local communities and firms; poaching; and logging for firewood. With regard to the latter, 11% of the country is covered by forests, but lack of gas and other sources of energy in rural regions have recently led to the widespread use of wood for fuel.

Irreversible environmental damage has been done to the area occupied by Armenia, which includes 250.9 thousand hectares of forest. Already some 10.2 thousand hectares of forest have been destroyed through ruthless logging practices.

MENR has given special emphasis to broadening relations with international organizations and donor countries in the interest of tackling environmental challenges. Partners include UNDP, the UN Environment Programme, the UN Industrial Development Organization, NATO, OSCE, the Global Environmental Facility, OECD, the World Bank, the Asian Development Bank, World Wildlife Fund and other agencies. Bilateral cooperation has also been established with several developed countries.

INVENTORY OF GHG

The very first GHG inventory was conducted between 1998 and 2000 as part of the Initial National Communication supported by the Global Environmental Facility and UNDP. The inventory covered the period 1990 to 1994.

In order to enhance the quality of the GHG inventory, a regional project was implemented in 2003 to 2006 to cover the period 1990 to 2003.

With a view to registration of emissions from industry, a data form was developed and is now included in reports of the State Statistics Committee.

The GHG inventory was conducted as part of the Second National Communication, which has been prepared since July 2006 with the support of UNDP and GEF.

The following table shows the calculations to determine the value of Global Warming Potential from GHG emissions and removal in CO_2 equivalent (CO_2 eq.).

Table 1. GHG emissions and removal ($GtCO_2$ eq)

GHG	1990	1994	2000	2001	2002	2003	2004	2005
Emissions								
CO_2	50677	35985	29274	28842	28703	31347	33280	35845
CH_4	20036	9849	11354	12522	12537	12603	12895	14433
N_2O	992	620	360	347	344	347	350	357
Total	**71705**	**46454**	**40988**	**41711**	**41584**	**44297**	**46525**	**50635**
Removal								
CO_2	-3438	-2456	-3145	-3145	-3585	-3663	-3702	-3769
Net emissions	**68267**	**43998**	**37843**	**38566**	**37999**	**40634**	**42823**	**46866**

Emissions in 2005 constituted 70.6% of the 1990 baseline level. Azerbaijani expert projections suggested that emissions would $_{reach}$ the baseline level in 2007-2008.

The main sources of CO_2 emissions in Azerbaijan are the energy and industrial sectors. The principal carbon sinks are represented by the agriculture and forestry sectors, as well as land use change.

CO_2 emissions in the **Energy sector** come from the burning of fuel including in the production of energy, oil and gas extraction, transport, and human settlements. CO_2 emissions from stationary sources equated to 45120 Gt in 1990, falling to 31375 Gt by 2005. Emissions from human settlements constituted 114% of the baseline year level, while 76.4% came from energy production and 71.9% from industry.

The level of CO_2 emissions in the transport sector changed from 4341 Gt in 1990 to 3632 Gt in 2005. Aviation and vehicles contributed the highest gains in emissions; domestic aviation accounted for 302 Gt in 2005.

In the **industrial operations and materials use sector**, the biggest sources of CO_2 emissions have been mineral materials production and metallurgy. After a period of decline in the metallurgical sector, it started to grow again after 2004. The production of lime nearly ceased altogether but has resumed in recent years. CO_2 emissions from cement production accounted for 478 Gt in 1990 and 391 Gt in 2005.

The emissions from international aviation and international shipping that are part of the **International bunker** were not included in the national cadastre. Emissions from these sources increased from 431 Gt and 31 Gt in 1990 to 1375 Gt and 47 Gt in 2005. The increase in emissions in aviation is caused by the broadening of international relations.

CO_2 sinks in Azerbaijan are mainly represented by forests**.** Sinks also appear as a result of changing land use. Here the statistics varied only slightly over time (3438 Gt in 1990, 3769 Gt in 2005).

CH_4 is emitted by nearly all sectors of the economy, but increased mostly in the agricultural sector due to fermentation and manure, and in the wastes sector due to human settlements. Thus, in 2005 the agricultural sector share of CH_4 increase was 121.6% (4265 Gt CO_2 eq in the baseline year). In total, CH_4 emissions accounted for 20036 Gt CO_2 eq in 1990 in 1990 and 14433 Gt CO_2 eq in 2005.

N_2O emissions declined in comparison with the baseline year. N_2O emissions in 2005 reduced by 64% from 992 GtCO_2 eq in 1990.

Emissions of the halogen substances perfluorocarbon, hydrofluorocarbon and sulfur hexafluoride are not found at significant levels in Azerbaijan.

POLICY AND ACTIONS

The relatively high socio-economic indicators of the Republic of Azerbaijan during the Soviet era began to fall in 1990, when many economic ties were broken. The economy began to revive in 1999 and the increase in oil and gas exploration brought about high economic growth. Growth in oil exports will continue to drive the country's economic development.

For the past five years one of the main factors that ensured dynamic development of the country were the allocation of oil revenues to the non-oil sectors, infrastructure development projects and the push for balanced development of the various regions.

Unfortunately the growth in oil and gas extraction and the increased demand for power also results in greater GHG emissions.

A number of international and regional programmes were implemented in Azerbaijan towards raising the awareness of climate change and capacity-building toward implementation of projects aimed at GHG reduction.

In 2005 the Ministry of Ecology and Natural Resources was declared by presidential resolution as the National Focal Point for enhancing participation of Azerbaijan in Cleaner Development Mechanisms of the Kyoto Protocol.

As most energy in Azerbaijan is generated from burning hydrocarbons, a reduction in emissions might be possible through gains in efficiency, energy saving, transfer from liquid fuel to gas and the use of alternative energy sources.

The country also depends on natural gas, fuel oil and water resources. The Azerbaijan electric

energy system is comprised of 10 TESs and 6 HESs. Of the total generated energy the share of TESs constitutes 89%, while 10% is contributed by HESs and only 1% is made up of renewable energy sources. Between 2001 and 2007 the amount of fuel used for generation of one kWt per hour of energy was reduced from 415 gr of coal equivalent (CE) to 355 gr of coal or CE.

In 2007 the total amount of natural gas and fuel oil used for generation of electric power was 4.5 billion cubic meters and 1.2 million tons, respectively. In 2007, 352.8 gr of CE was used for generation of 1 kWT hour of energy and 183.6 kg of CE was required for generation of 1 Kcal of thermal energy.

Azerbaijan has high potential for alternative energy generation. The potential of wind and small hydroelectric stations in the Absheron Peninsula, along the banks of the Kura River, as well as in the Nakhchivan Republic were estimated at 2070 MWt and 5 billion kWT per hour, respectively. The output of existing hydroelectric stations is 1020 MWt, and the country's 11 small hydroelectric stations generate 27.7 MWt. The 5 hydroelectric stations currently being constructed will generate a total of 572 MWt. According to the plan prepared by the Ministry of Industry and Energy, the construction of 300 small hydroelectric stations is envisioned. Five will have been constructed by 2012.

Around the world, the highest priority is given to alternative energy sources as a solution to energy insecurity, environment pollution, climate change and other problems. To this end, the State Programme on the Use of Alternative and Renewable Energy Sources was signed by the President of Azerbaijan in 2004.

After the Programme was signed, negotiations were initiated with various international organizations and developed countries. Following negotiations with the Republic of South Korea, an agreement was reached on the construction of a 60 MWt wind electric station in Gobustan.

Azerbaijan has been extracting oil and gas for industrial purposes for more than 160 years, and extraction of oil has increased over the past 5 years. The capacity of the country's oil refinery is about 20 million tons. However, since this plant has become obsolete, the level of oil production has slumped; most crude oil is now exported to foreign countries. The potential sources of GHG in the oil and gas sector in Azerbaijan are Azneft Production Unity, Heydar Aliyev Oil Refinery in Baku, and AzerNeftYag Oil and Gas Refinery, all belonging to the State Oil Company (SOCAR).

Yearly 3 million tons of GHG in CO_2 eq are emitted by SOCAR, by Operating Companies and Joint Ventures in Azerbaijan. Of this amount, about 1.3 million tons are associated gas. Starting from the end of 2009, as a result of actions by SOCAR 600 thousand tons of emissions will be utilized. A major part of associated gas emissions come from BP facilities. During oil extraction about 500 thousand tons in CO_2 eq of associated gas is released per year, but by taking appropriate actions the GHG emission which result from the release of associated gas can reduced by 1.2 million tons.

Cement production is worthy of attention as a source of GHG; at present some 400 thousand tons are produced per year. Cleaner production and burning processes can be employed to reduce emissions. A second cement plant is now being constructed, which will use a cleaner dry process of production.

The amount of emissions from the production of lime, sodium, metal, steel and aluminum is still low. However, as a result of development in these areas, the level of carbon gas emissions will likely increase.

Since the metallurgy, petro-chemical and chemical industries are still in crisis, no increase in their emissions is expected in the immediate future.

In 2005, GHG emissions generated by domestic animals equated to about 5.1 million tons in CO_2 eq. About 0.5 tons of this amount come from manure. At present a uniform project proposal

uniting a number of farming facilities on the production of biogas from manure was developed by the Ministry of Agriculture. In addition, GHG emissions can also be reduced as a result of processing dry wastes generated from agricultural plants.

Wastes have always posed a critical environmental problem. Ongoing economic development, urbanization and population growth have exacerbated the situation. According to estimates, the amount of wastes will reach 13 million tons in 2025. At present there are 200 landfills in Azerbaijan. About 1.5 million tons of municipal waste is generated per annum, 50% of which comes from Baku and its environs.

A number of waste management improvement projects are being implemented. A contract has been signed with a Japanese company Mitsui on the construction of a waste incineration plant near the Balakhani landfill.

In addition to the solid waste problem, the issue of methane gas from wastewater remains to be addressed.

The National Programme on the Rehabilitation and Expansion of Forests of 18 February 2003 calls for the reforestation of 69000 hectares. This would include 44700 hectares of newly planted forest, taking natural recovery actions on 25000 hectares, planting 14300 hectares of greenbelt along new highways and railways, in lowlands, around water ponds and along coastal areas. Three million manats have been allocated by decree of the President for forest rehabilitation and forestation projects.

To enhance effectiveness of actions under CDM projects prescribed by the Kyoto Protocol, amendments and additions to environmental legislation have been prepared and submitted to the Cabinet of Ministers. The Ministry of Ecology and Natural Resources has signed CDM cooperation agreements with Denmark and Germany, and such agreements with other countries are pending.

Since the Kyoto Protocol took effect in 2005, interest in CDM projects has risen in Azerbaijan. A number of GHG reduction projects have been prepared in various sectors (Table 2).

Table 2. Project proposals on CDM registered by NFP

#	Sector	Number of project proposals	GHG reduction rate, thousand tons/year CO_2 eq.
1	Energy, including	17	13675,4
2	Alternative energy	9	1775,0
3	Agriculture	2	3331,0
4	Wastes	3	287,1
5	Forestation and afforestation	3	62,7
	Total	**34**	**19131,2**

Assessment of vulnerability to climate change and adaptation measures

Using data provided by the National Hydrometeorology Department of MENR, yearly temperature and precipitation abnormalities from 1991 to 2000 have been analyzed. Over the past 10 years the mean temperature has increased by 0.41°C. The increase observed from 1961 to 1990 was 0.34°C, which means that the increase from 1991 to 2000 was 3 times faster.

The yearly mean temperature increase from 2021 to 2050 is projected at 1.50°C-1.60°C, or approximately 0.30°C every 10 years. By 2050, precipitation will increase 10-20% compared to its level during the period of 1961 to 1990.

Between 2071 and 2100 the temperature is projected to increase by 5°C in most parts of the country. An increase in precipitation of 20% to 80% from West to East, respectively, is forecast, while in Nakhchivan, precipitation will likely decrease by 20%.

Water resources. Surface water resources are projected to reduce by 23% between 2021 and 2050, a loss of 22.5 km^3. In the period 2071 to 2100, water resources are likely to reduce up to 20.7km^3, or 29% lower than the baseline year level. The level of water shortage in that period will likely be 3.5 to 4 times higher than the baseline level. As today, agriculture, hydroenergy and water supply will continue to be the most vulnerable areas. In order to mitigate the adverse effects of future climate change, the following adaptation measures are proposed: enhancement of the water resources management system; introduction of additional sources of water; clean-up of river channels, strengthening defenses against inundations and flash floods; reducing water wastage and improving quality in supply networks; restoration and reconstruction of main water channels, watering and drainage systems; and construction of small HESs on mountain rivers and irrigation channels, etc.

Agro climatic resources. It is forecast that in 2021-2050 the number of days with mean temperatures above 10^0C will rise by 100-700%, for an additional 10 to 35 such days per year. during 2071-2100 the number of days with mean temperatures above 10^0C will rise by 1100-1500% over the baseline figure, for an additional 25 to 80 such days per year. As for humidity, evaporation will likely rise by 15% over the baseline year level by 2050. However, because of the projected simultaneous rise of 10 to 20% in rainfall levels, a shortage of humidity experienced by plants during vegetation (climatic water balance) will be reduced by 85 to 260 mm, as compared to the baseline year. In 2071-2100 the level of precipitation is forecast to rise by 20 to 40% in most of the irrigated areas of the country. But because of the forecast prevailing increase in the level of evaporation, the climatic water balance might rise 20-100mm during vegetation.

Agriculture. The forecast increase in warming resources and extension of the duration of vegetation could favorably impact cotton plantations. Thus, presently cultivated medium-ripening varieties can be replaced with better quality late-ripening long fiber ones. It is possible to raise their productivity to match the high numbers achieved in 1980s or even improve this figure even higher. In both periods there will be favorable conditions for the present borders of areas where cereals are grown to move towards mountains (much more in the second period). However, due to a shortage of favorable soil resources in these areas, the expansion will be limited. Despite the fact that the duration of plant's potential vegetation in conventional areas of cereals growing will extend due to global warming, the actual plants' vegetation will shorten by 10-15 or 20-25 days. This will make it possible to grow cereals in wider areas. In addition, early harvest of wheat followed by sowing of forage, melons, greens, etc. will make it possible to harvest two and three times a year, raising overall productivity. However, this will be greatly dependent on water supply.

In 2021-2050 the borders of vineyards of industrial importance might, dependent on region, move up from the present 800-900m elevation another 200-450m toward the mountains. In 2071-2100 favorable conditions for plants may exist at 1400-1700m, but a lack of suitable lands for vineyards will limit the expansion. Harvest on fallow vineyards is expected to rise by 4-5 times in the first period. The level of sugar in grape juice will likely rise 2-3% in the first period and 6 to 7% in the second. In both periods a slight rise (up to 1%) in the level of acid in grape juice is expected to take place.

In spite of the increasingly favorable climate for winter pastures, their area might diminish due to soil erosion and an increased crops growing. In both periods the increased precipitation might cause a rise in the productivity of winter pastures both in winter and spring.

As for summer pastures, in both periods there will be favorable climactic conditions for expansion, but again this will be limited by lack of land and new use pressures. Rising precipitation in humid areas will little contribute to the growth of productivity. Unless pressure from human activities is reduced, erosion induced by the rise in precipitation will be more intensive.

The following adaptation measures should be taken to address the effects discussed above: selection and introduction of plant varieties that are thermophilic, drought resistant and highly productive; continuation and broadening of interventions against soil salinity, erosion and drought; wide application of water-saving technologies; improvement and upscaling of an agricultural products storage system (warehouses, cold storage, etc.).

Coastal zones. Some 500 km^2 of the Azerbaijani coast has been subjected to flooding since 1978 due the rise of the Caspian Sea. The damage to the economy since 1978 due to this issue is estimated at US$ 2 to 2.5 billion. During the periods considered here the sea level might rise another 150 cm, flooding another 825.1 km^2. The following adaptation measures must be implemented: transference of coastal facilities to secure locations; installation of flood protection structures; installation of local protection structures for the remaining facilities and human settlements; and implementation of environmental protection actions.

Public health. As a result of the 1.5^0 C temperature rise in Baku during the summers of 2003-2006, cases of various illnesses increased 20-34% as compared to previous years. The general mortality rate is not high (3.4%), but the number of those dying from myocardial infarction and stroke increased by 26 % and 56% respectively. The growing elderly population and the future occurrence of urban heat islands might raise the rates of illness and mortality further.

The country is divided into three zones for the purposes of **malaria** analysis: endemic, epidemic and malaria-free zones. As a result of global warming, the borders of both endemic and epidemic malaria zones might move up towards the mountains and the periods of epidemic might lengthen in mountainous areas. Temperatures that support sporogony have already been observed from 2003-2007 in previously unaffected areas. In 2021-2050 the malariagenic climatic conditions will be almost the same as in 2003-2007. However, a further rise of temperature in 2071-2100 will provide conditions for the expansion of the malariagenic areas and extension of epidemic periods. Considering that only 1.2% of the population live above 1500m, the probability of occurrence of new malaria spots at these heights is not significant.

To reduce the possible adverse effects of climate change to human health, the following adaptation measures should be implemented: taking account of existing heat islands effects and future climate change in urban planning; greening the cities in a more rapid way and planting vegetation in large areas around the cities; building capacity to forecast and prevent malaria epidemics; strengthening the systems to combat infection-carrying mosquitoes; reduction of cases of malaria entering the country; improving drinking water quality; adherence to standards of food storage, etc.

SYSTEMATIC MONITORING AND RESEARCH

In Azerbaijan, as in any party to the World Meteorological Organization, hydrometeorological observations are conducted; forecasts are made; climate, agroclimate and water resources are assessed; and their changing trends are monitored.

Meteorological, agrometeorlogical, hydrological and oceanological observations are carried out by the Hydrometeorological Department of MENR, and environmental pollution monitoring (of soil, water and air) is conducted by the Monitoring Department of MENR. In addition, the State Amelioration and Water Management OSC implements hydrological monitoring of large and small lakes.

After Azerbaijan joined the WMO and acceded to a number of conventions, it gained the opportunity to take part in various international observation systems. Five Azerbaijani stations are now linked to the Global Observation System and 18 stations are part of the Global Climate Observation System. One station in Astara (GJOS/GSN) has access to the Global Surface Observation Network.

The meteorological surface observation network of Azerbaijan is composed of 78 stations, of which 12 are located in the territory occupied by Armenia and are not in use.

58 stations are presently operating to provide information about the climate to the public. All observations are conducted based on WMO best practices.

Some types of surface observations have not yet been introduced in Azerbaijan, including monitoring of CO_2 emissions, and increase in biomass and forests. Existing infrastructure makes it possible to establish such systems in the future, but financial, technical and methodological support is required.

With a view to building capacity in this area, the National Programme on Development of Hydrometeorology was approved by a resolution of the President. It calls for strengthening capacity of the climate monitoring system and development of a database on global climate change and related issues for decision-makers and the public. Particular attention is given to the purchase of equipment meeting contemporary standards.

EDUCATION AND AWARENESS-RAISING

One of the most important activities implemented in the area of environment protection is public education and awareness-raising. Since the preparation of the Initial National Communication, a number of international institutions have supported the education and awareness-raising of environmental protection personnel in Azerbaijan, with particular regard to climate change issues. These have included the Canadian International Development Agency assistance to the Caspian Littoral States and regional technical assistance projects by TACIS for the implementation of commitments arising from the Kyoto Protocol. Outcomes of these projects have been published on the MENR website.

In the country's public education system, environmental subjects are taught at the levels of middle and high school. Specialists in climate studies and scientific basics of climate change are educated at the Geography department of Baku State University. Environmental protection programmes are also offered in other universities and institutes, particularly in technical universities and institutes.

Discussion of climate change issues at higher international fora has raised an interest in this topic in Azerbaijan. Climate change issues are addressed in nearly all the mass media, and MENR specialists and NGOs representatives have solicited ideas and proposals from the public to address the problem.

2. NATIONAL CIRCUMSTANCES

2.1. GEOGRAPHIC POSITION OF AZERBAIJAN

The territory of the Republic of Azerbaijan, stretching 400 km from North to South and 500 km East to West, is located in between 38°25'-41°55' North Latitude and 44°50' - 50°51' East Longitude.

Sitting at the crossroads of Europe and Asia and enjoying a unique geopolitical and geographical position, Azerbaijan has retained its importance for world economic and cultural relations from ancient times up to the present day.

Its border with Russia in the North stretches 289 km, with Georgia in the Northwest 340 km, with Armenia in the west 766 km, with Turkey in the Southwest 11 km and with Iran in the South 618 km. The Eastern part of the country is bordered by the Caspian Sea at a length of 825 km.

The capital city of the country is Baku.

2.2. POPULATION

The population of Azerbaijan was 8730.3 thousand at the beginning of 2009, 51.5% of which is urban. Azerbaijan belongs within the category of densely populated countries, with 100.8 people per km^2. The most densely populated area is the Absheron Peninsula, and the most scarcely populated area is the central highlands.

Of 4400 human settlements, 200 are cities, towns, and rural small towns, and 4200 are villages.

Throughout its history, the birth rate in Azerbaijan has been high—as high as 40-50 per year per 1000. However, during the transition period this rate declined considerably.

2.3. POLITICAL PROFILE

When the Republic of Azerbaijan proclaimed its independence on 18th October 1991, the presidential form of state governance was established, divided between executive, legislative and judicial powers.

Azerbaijan is acknowledged by the world community as an independent state. It acceded to the United Nations and OSCE in 1992. It has been a member of the European Council since 2001.

Striving for good relations with all countries, Azerbaijan promotes an active foreign policy. It gives particular attention to continuous development of political, economic and cultural relations with its neighbors in the region.

A military conflict with Armenia over 14 years has resulted in the occupation of 20% of the country's land. This impedes the full development of the country. Therefore, the basis of the country's policy in the present time is to put an end to the military conflict by means of a political dialogue and regain the occupied territory.

Successful implementation of the economic policy of President H. Aliyev has placed Azerbaijan at the forefront among CIS countries. Further strengthening the economic potential of the country will, in the long run, contribute to the resolution of the military conflict.

2.4. ECONOMIC PROFILE

The territory of the Republic of Azerbaijan enjoys favorable climate conditions and rich natural resources. The economy is driven mainly by oil and gas production, chemicals and petrochemicals, metallurgy, mechanical engineering, textiles and food industry. The agricultural sector consists mostly of wheat, cotton, wine, fruit, tobacco, tea, vegetables and cattle breeding. The chief exports are oil and oil products, electrical energy, cotton and silk fibers, and wine. Industrial products accounted for 28.1 billion manats in 2008. GDP increased from 4718.1 million manats in 2000 to 38005.7 million manats in 2008.

Fuel-energy complex. The fuel-energy complex of the country is composed of oil and gas extraction, refinery and electroenergy.

The extraction of oil in the country for industrial purposes started in late 19th century. In 1970-1980 5 large oil refineries operated in Azerbaijan. At independence, two large complexes were established through a merger.

Some 62 oil and natural gas fields are found in Azerbaijan, 16 of them in the Azerbaijani sector of the Caspian Sea. The country's oil stores may constitute 10 billion tons, and stores of natural gas may equate to 8 trillion cubic meters. Contracts have been signed with international oil companies for joint exploration of Gunashli, Azeri and Chirag fields, and with 11 companies for the exploration of 11 potential fields.

At present more than half of national revenue comes from the oil industry. The Baku-Tbilisi-Ceyhan pipeline to Europe plays an important role, with the capacity to transport 40-50 million tons of oil annually. For natural gas, the Baku-Tbilisi-Arzurum pipeline has been laid and the NABUCCO pipeline project is under consideration.

Positive changes taking place in the oil and gas industry provide favorable conditions for the creation of a sophisticated marine oil industrial complex in the Azerbaijan sector of the Caspian sea.

Electroenergy. Electrical energy has been significant in the development of the country's economy. The network is comprised of thermo- and hydroelectric stations. TES operates on fuel oil and gas.

The country's energy generating stations include Mingachevir, Shamkir, Varvara, Yenikend, Sarsang, and Araz hydroelectric stations, Azerbaijan, Ali-Bayramli regional state electric stations, and Baku Thermal-Electric Center-1. Electricity production output reached a peak in 1988. In 2005, electricity production output figure constituted 22.9 billion kWt/hour, where the share of Hydroelectric Stations was 3 billion kWt/hour.

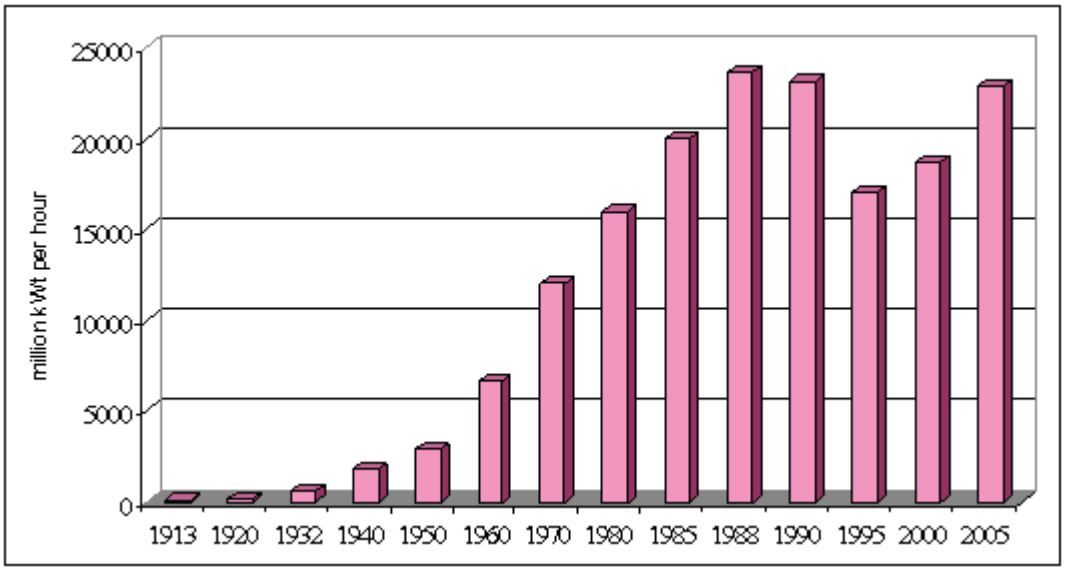


Figure 2.4-1. Dynamics of Electric Energy Production (million kWt per hour)

Chemical and petro-chemical industry. This complex differs from other branches of industry by the degree to which it consumes various raw materials; an increasing demand for its products; complicated production technology; and specifics of its regional location.
The main products of the chemical industry are sulfuric acids, superphosphate fertilizers, sodium hydroxide, chlorine, aluminum chloride, sulafanol, synthetic detergents, and bromide. The main products of the petrochemical industry are ethanol, synthetic resin, technical rubber products, tires, plastic, glass fibers and polyethylene.

Various raw materials are available in the country for the development of chemical and petro-chemical industry, including rock salt, barite, alunite, pyrite, oil, natural gas and other minerals.

Petro-chemical plants are mainly concentrated in Sumgayit. In order to modernize production technologies and reconstruct facilities, contracts have been signed with a number of international companies.

Chemical plants have significantly reduced their production since 1990 and some have closed down completely.

Along with the aforementioned branches of industry, Azerbaijan can boast of significant development in such sectors as metallurgy, mechanical engineering, construction materials, and food production.

Agrarian industry complex. This complex plays a significant role in the economic development of Azerbaijan. The most important area in agrarian industry is plant cultivation. Lands in Azerbaijan are highly productive. The total land area of Azerbaijan is 8.6 million hectares, of which 4.7 million hectares or 55% are suitable for agriculture.

Crop production occupies a prominent place in the country's horticulture. Wheat is the most widely grown crop, and is of growing importance for bread products and as feed for cattle and poultry. The area of land under crop cultivation as of 2004 constituted 814.9 thousand hectares, when the harvest equated to 2158.2 thousand tons (Figure 2.4-2).

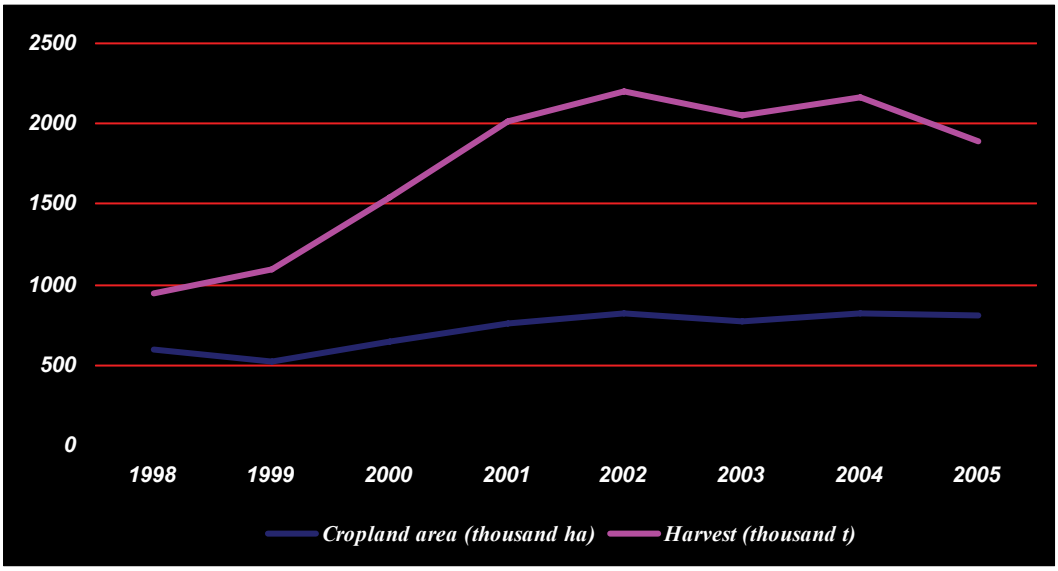


Figure 2.4-2. Dynamics of Harvest and Land Area Used for Crop Cultivation
Source: State Statistics Committee

ANIMAL HUSBANDRY

The needs of the population for meat, dairy, and poultry products are met through **animal husbandry**, which also provides the industrial sector with wool, fur, rawhide, down, and other materials.

Cattle-breeding accounts for more than half of total income from animal husbandry. Cattle-breeding is mainly developed in the Kura-Araz Lowland and in foothill regions. Animal husbandry is mainly represented by cows, sheep and goats (Figure 2.4-3), though buffalo breeding plays an important role for milk production. Presently, buffalos constitute more than 20% of livestock in Azerbaijan.

Sheep-breeding in Azerbaijan is predetermined by climatic conditions. Sheep-breeding for both meat and wool is well-developed in mountainous regions.

Poultry farming is an increasingly profitable area of animal husbandry, yielding meat, eggs and down. In order to develop this area in accordance with good practice, one of the prerequisites is to provide for mixed food stores.

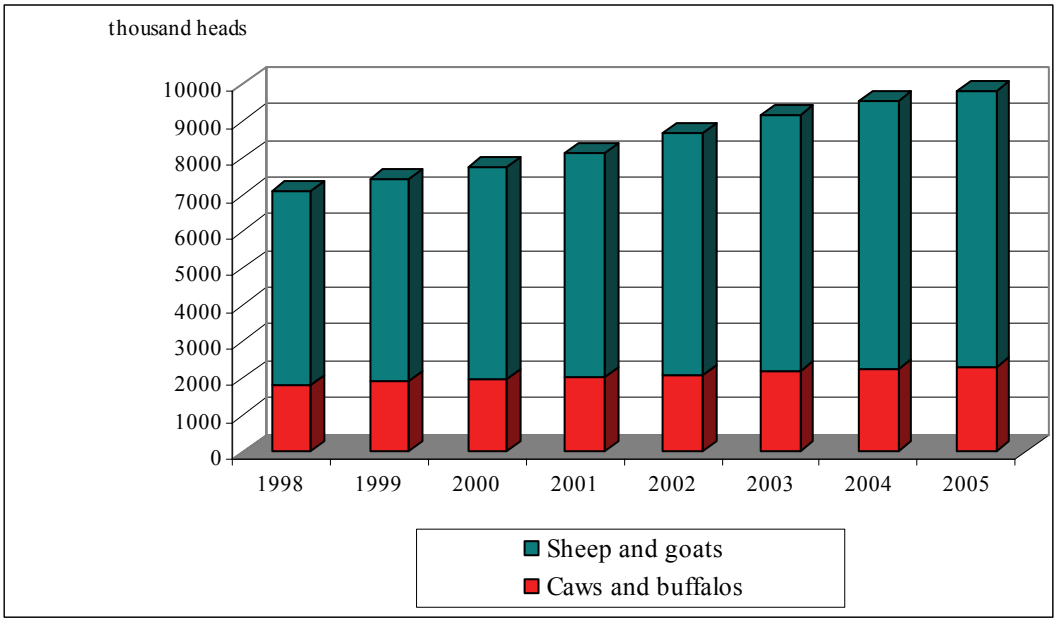


Figure 2.4-3. Number of livestock over time (thousand heads)
Source: State Statistics Committee.

2.5. STATE OF THE ENVIRONMENT IN THE REPUBLIC OF AZERBAIJAN

Rapid development over the last hundred years has resulted in increasing adverse effects for the environment and overexploitation of natural resources.

As in most other countries, environmental protection and sustainable natural resource exploitation have recently come to the fore. A number of important laws and regulations have been adopted since 1997 in accordance with European legislation. As it was not feasible to resolve domestic environmental problems during the country's transition away from the command economy, priority was instead given to the development of regional and intergovernmental bilateral cooperation. The Republic has joined 20 international conventions in this area.

Major environmental challenges in Azerbaijan are as follows:

- Pollution of water resources with wastewater, including transboundary pollution;
- Inadequate supply of quality water to human settlements, wastage in delivery, shortage of sewer lines;
- Air pollution by industrial plants and vehicles;
- Degradation of fertile soil lands (erosion, salinity, etc.);
- Improper disposal of solid industrial and municipal wastes including hazardous wastes;
- Biodiversity decline including depletion of forests and fauna.

WATER RESOURCES

The river network is unevenly distributed over the country's territory. While some areas enjoy access to large and small rivers, the areas of Kura-Araz Lowland, Gobustan-Absheron, Ceyranchol, and Nakhchivan have very limited access to permanently-running rivers.

Drinking water in Azerbaijan is mainly sourced from rivers, the greater part of which (69-72%) originate in Georgia, Armenia, Turkey, Iran and Russian Federation.

Azerbaijan falls behind other Caucasus countries in terms of the amount of surface water resources available per capita, and per km^2. Of the total amount of water in the South Caucasus (310 billion m^3), some 62% and 28% belong to Georgia and Armenia respectively, leaving Azerbaijan with the remaining 10%.

8.67 billion m^3 of annual water resources in Azerbaijan are concentrated in groundwater bodies. Groundwater constitutes 23% of the total available water resources, but only 48.8% groundwater is used.

In 2005, 12.1 billion m^3 of water was drawn from all sources and 8.6 billion m^3 of it was consumed. In spite of the country's water shortage, over one fourth of drawn water was lost in delivery. 160.5 million m^3 of untreated wastewater were released to water bodies, and much water is lost due to failure of the supply network to meet contemporary technical standards.

Unsustainable use of water resources and pollution of water bodies is the consequence of the failure to equip human settlements with adequate sewerage systems and modern wastewater treatment facilities.

POLLUTION OF TRANSBOUNDARY RIVERS

The catchment area of the Kura River, which is an important source of drinking water for the population, encompasses ¾ of the territory of Azerbaijan. The greater part of water entering Azerbaijan originates in Georgia and Armenia, and the release of untreated wastewater into the Kura in those countries has serious negative impacts on hydrochemical conditions and water quality. Considerable concentrations of copper, zinc, phenol and oil products are found in the river water. As a result of the occupation of 20% of Azerbaijan's territory, pollution monitoring has become difficult. Furthermore, since these areas are beyond the environmental control of the Azerbaijani state, ruthless exploitation of natural resources and extreme pollution of water resources are occurring unchecked.

Copper-molybdenum and copper-ferrous metals plants in Armenia are the main hot spots polluting the Araz river.

AIR

Due to the decline of industrial activities since 1990, the level of greenhouse gasses released into atmosphere from stationary and mobile sources has reduced. While the level of harmful emissions from stationary sources equated to 2.1 million tons in 1990, in 2005 this fell to 1054.3 thousand tons.

In the past, large cities suffered high levels of air pollution. The decline in industrial production significantly improved air quality, but ever-greater numbers of vehicles are reversing the trend. (Figure 2.5-1) Presently, air is primarily polluted by transport, industry and energy production.

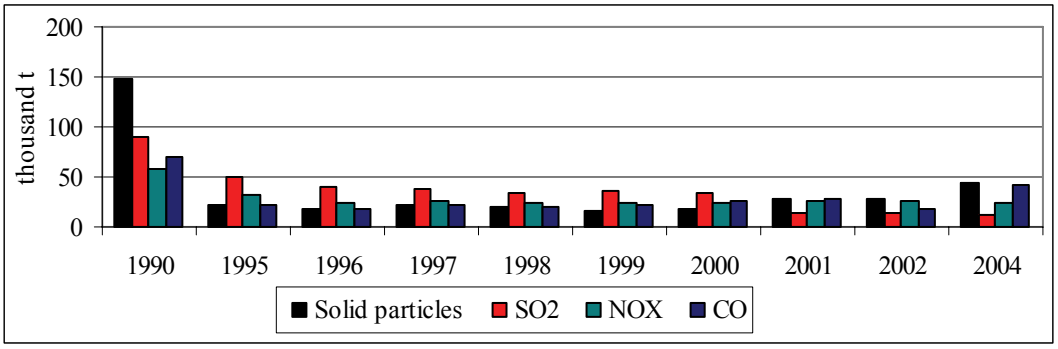


Figure 2.5-1. Harmful emissions from stationary sources (thousand tons)
Source: State Statistical Committee

Bottom-up approach in the waste cadastre system in Azerbaijan. Annual reports on wastes are submitted by polluting enterprises and are summarized by the State Statistical Committee.

According to data from 2005, automobile transport accounts for 47% of total emissions (Figure 2.5-2).

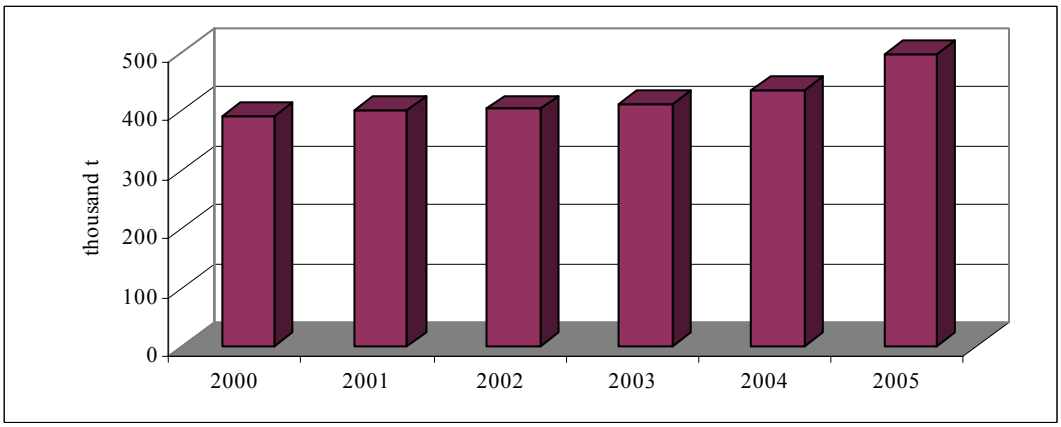


Figure 2.5-2. Emissions by automobile transport

SOILS

The state of the soil varies by territory, but often suffers from the negative impacts of human activities. Only 49.3% of the total 8.6 million hectares of the country's land are suitable for agriculture. Soil degradation has assumed a large magnitude on these lands as a result of erosion, salinity, bogging, chemical pollution, etc. Erosion from wind, water, gullies and irrigation has

affected 3.7 million hectares, of which 0.7 million are intended for agriculture. Besides natural climate conditions, the main causes of erosion are a lack of proper land management over time, poor cultivation practices, uncontrolled grazing, destruction of forests and vegetation, and other human-induced factors.

1.2 million hectares are affected by salinity, of which over 600 thousand are irrigated lands. These lands have been withdrawn from the cultivation cycle due to the poor condition of the drainage network; improper construction of water impoundments; and inundation of the coastal zone.

About 300 km^2 of land area is affected by floods. Flooding in the Greater Caucasus chain every other year washes out as much as 1 million m^3 of soil and causes great damage to nature.

Until recently the country lacked a system of hazardous waste management, but a hazardous waste landfill has now been constructed to partially resolve the problem.

An additional 30 thousand hectares have been withdrawn from the cultivation cycle as a consequence of mining operations, intensive desertification and other human impacts. Of this total, 14 thousand hectares are contaminated by oil, 108 hectares by chemical wastes, 5571 hectares by sedimentation of irrigation channels, 1580 hectares by exploration of mineral resources, 163 hectares by construction and municipal waste management agencies, with the remainder contaminated by mining activities.

Oil contaminated areas. The use of outdated technology in oil production over decades has led to the contamination of soil. Presently, the area of contaminated soil in the Absheron peninsula and around it is 10 thousand hectares, all of which is a potential source of air pollution. Recovery of soil is a costly undertaking in the present economic conditions.

Very little oil is extracted onshore in Azerbaijan, but according to SOCAR a two-phase recovery programme has been prepared for lands previously affected by oil exploration. In the first phase, some 2800 hectares will be mechanically and biologically remediated for future cultivation and grazing. The second phase encompasses only technical reclamation of the lands, for lands intended for building construction or industry. Mechanical remediation includes the dehydration of artificial lakes and marshes, leveling the land surface and designation of this area for the disposal of municipal wastes. The World Bank preferentially supports pilot projects centered on biological remediation.

BIODIVERSITY DECLINE

Azerbaijan is the country with the most diverse natural resources in the Caucasus region. About 4500 species of higher plants are found in the country, 7% of which (240 species, belonging to 108 genera and 36 families) are endemic and relics.

Most of the endemic species are found in the Talish mountains and include ironwood, Lankaran acacia, chestnut-leaved oak, Caucasian persimmon, Hircanic buxus, all from the Tertiary period. Special protection is necessary for 400 plant species in the country. 140 rare and endangered species have already been included into the Red Data Book of Azerbaijan.

18 thousand species of fauna occur in Azerbaijan, including 97 species of mammals, 357 species of birds, 100 species of fish, 67 species and sub-species of amphibians and reptiles and about 15 thousand species of insects. Biological species diversity is primarily supported by the geological history of the region, the complicated landscape structure and the various climatic conditions.

An ongoing trend towards biodiversity decline has resulted from human impacts on the environment. About 4500 species of higher plants and 18 thousand fauna species are found in the country, but human activities have led to the depletion of biodiversity. These include unregulated

grazing of sheep and cattle, harvesting of rare and medicinal herbs by local communities and firms; poaching; and logging for firewood.

Forests. According to official statistics, only about 11 percent of Azerbaijan's territory is covered in forest, which is about half of the normal standard in world forestry practice. Lack of gas and other sources of energy in rural regions have recently led to the widespread use of wood for fuel. In the past the import of wood and coal from Russia prevented much tree logging. Large-scale logging is not possible in lowland woodlands due to their limited area. Most forests grow on steep slopes where logging poses a threat of erosion.

As a consequence of the Armenian aggression, 250,928 hectares of forest (or 25% of the total forest cover) are now under occupation and 10,233 hectares of forest have been destroyed through logging.

2.6. TRENDS IN ENVIRONMENTAL POLICY

Azerbaijan is a country rich in natural resources and developed industry. However, the aforementioned environmental challenges have long been ignored and must now be tackled: pollution of water bodies including the Caspian Sea by municipal and industrial wastewater; damage caused by the rise of the level of the Caspian Sea; emissions of harmful gases; biodiversity decline; soil erosion and salinity; improper disposal of industrial and municipal wastes; etc.

At the 1992 UN conference in Rio de Janeiro, it was declared that the world's future development will depend principally on how environmental issues are resolved. The conference considered possible solutions to environmental problems and endorsed important concepts including 'sustainable development', which has become a theme for all international environmental institutions. This concept seeks to harmonize economic development with environmental balance, giving priority to environmental protection and resolution of environmental issues, meeting the needs of the present generation without compromising the ability of future generations to meet their own needs. To these ends, economic gains should be made in a way that protects the environment.

As a follow-up to the Rio Conference, the world's development principles were reconfirmed at the World Summit in Johannesburg in 2002. By now, issues of environmental protection are integrated into the programme documents of leading international institutions.

Azerbaijan has found success in social and economic development in recent times. Ensuring sustainability in these achievements has been adopted by the state as a top priority. The environmental strategy of the country is aimed at the protection of natural resources at national, regional and international levels by strengthening coordination of actions, the application of scientifically-grounded development principles, and ensuring the sustainable use of resources to meet the needs of the present and future generations.

Ensuring environmental sustainability of development requires the elimination and restriction of serious problems arising from industrial activities.

Given the contemporary state of the environment and socio-economic conditions, three main directions of national policy can be identified:

1. Prioritizing the maximum reduction of environmental pollution and stringent environmental regulation;
2. Sustainable use of natural resources to meet the needs of the present and future generations, including the use of renewable sources of energy and more efficient consumption;

3. Assessing global environmental problems at the national level and working to ameliorate them by identifying possible solutions and broadening relations with international institutions.

The following principles should be taken as priority to achieve objectives in environmental policy:

- Use of contemporary methods of economic and human resources management for improving the quality of the environment;
- Development and introduction of incentive-inducing economic models and technologies to meet the needs of the present and future generations;
- Implementation of principles of fair distribution of resources among present and future generations;
- Protection of the ecosystems and biodiversity that support daily human activities;
- Consideration of alternatives in the effort to meet short- and long-term economic, environmental and social objectives;
- Wider involvement of representatives of the public and non-governmental organizations in decision-making processes on environmental issues;
- Prevention of any activities likely to result in an irreversible damage to the environment;
- Ensuring the development of a strong, multifaceted economy that provides for the protection of environment;
- Broadening relations with international institutions and developed countries in the area of environment protection;
- Enhancement of education and public awareness-raising.

In 1996, the national environmental policy was presented as part of the National Report on the State of the Environment in Azerbaijan. The National Environmental Action Plan was prepared in 1998, in which priority projects on alarming environmental issues were identified.

Evidence of its successful promotion include: the development of a relevant legislative base to European standards; improved governance on environment protection; and steady implementation of priority projects in partnership with international institutions.

As socio-economic processes develop rapidly, new methodologies and principles are emerging in the environmental policy realm. The National Programme on Environmentally Sustainable Socio-economic Development prepared by MENR and approved by the President in 2003 has reflected an improved environmental policy and provided opportunities for its application.

Upscaled awareness-raising efforts including an increase in the number of curriculum hours devoted to environmental protection at the middle school level are also important elements of the existing policy in the area of environment in the country. A number of laws on environmental issues adopted by the National Parliament of the Republic of Azerbaijan in recent years, including the Law on Public Environmental Education and Awareness-Raising, have made it possible to fill gaps in this area.

Particular attention is given by MENR to the development of relations with international institutions and donor countries, with a view to the resolution of current problems. Notably, cooperation has now been extended with UNDP, UNEP, the EU, UN Industrial Development Organization, NATO, OSCE, the Global Environmental Facility, the Organization for Economic Development and

Cooperation, the World Bank, the Asian Development Bank, the World Wildlife Fund and other agencies. In addition, bilateral cooperation has been established with various developed countries.

The Republic has to date joined 20 international environmental conventions and signed relevant protocols.

Further implementation of state programmes and projects towards resolving environmental problems and ensuring ecological balance will gradually improve the state of the environment.

3. INVENTORY OF GREENHOUSE GASES

Solar energy in the form of visible light exerts permanent pressure on the earth's climate. 30% of incident solar energy is reflected back into space, while 70% passes through the atmosphere and heats the earth. Infrared rays contained in this energy are reflected by the Earth's surface back into the atmosphere. "Greenhouse gases (GHGs)" absorb infrared rays reflected by the Earth and impede their quick transit to space.

GHGs are mainly represented by water vapor, ozone, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), halocarbons and other industrial gases. The level of GHGs in the air increases over time as a result of human induced activities. Carbon dioxide (generated from oil and natural gas burning), methane and nitrous oxide (generated from oil and gas extraction and mainly from agriculture and land use), ozone (from exhaust gases) and persistent industrial gas emissions such as CFCs, HFCs, and PFCs alter the ability of the atmosphere to absorb energy.

The climate system must be adjusted to account for the increase in the level of gasses to retain the global energy balance. In the long run, the Earth should be able to get rid of energy with the same speed with which it is received from the sun. A dense concentration of GHG impedes the leakage of energy to space. The climate must be changed in such a way as to be able to keep balance between the received and released amount of energy.

Chlorofluorocarbons (CFC), hydrofluorocarbon (HFC) are GHGs that deplete the ozone layer. These gases were not found in air before and are products of human-induced chemical processes. They are regulated by the Montreal Protocol.

By ratifying the UN Framework Convention on Climate Change in 1995 and becoming a full non-Annex 1 member of the Convention, Azerbaijan assumed a commitment before the Convention to prepare, update and present to the Conference of the Parties to the Convention a cadastre of human-induced emission sources and sinks of GHGs that are regulated by the Montreal Protocol.

The GHG inventory was initially conducted in Azerbaijan in 1998-2000 under financial support of Global Environmental Facility and UNDP as part of a project of the Initial National Communication to the UN Framework Convention on Climate Change. The GHG inventory covered the period of 1990 to 1994.

In order to enhance the quality of the GHG inventory, a regional project was implemented under the support of UNDP and GEF from 2003 to 2006. As part of this project, the GHG inventory covering years 1990 to 2003 was conducted. The project addressed the issues of exhaust gas and fugitive gas emissions in the energy sector, internal fermentation and manure emissions in the agricultural sector, and solid municipal wastes in the wastes sector. Under this project, a GHG inventory covering the period of 1990 to 2003 was conducted and compared against the inventory of 1990-1994. Uncertainties in emissions were estimated and issues of quality assurance, quality control and documentation were considered.

In order to verify data on GHG removal in the industrial sector and to facilitate their documentation, a blank form on "Information about the Amount of GHG Released to Air from Enterprises'' was prepared by MENR and proposed for incorporation into reports to the State Statistics Committee. Presently, this information is being published in a compendium.

The Second National Communication was initiated in July 2006 with the support of UNDP and GEF. One of its components was the GHG inventory.

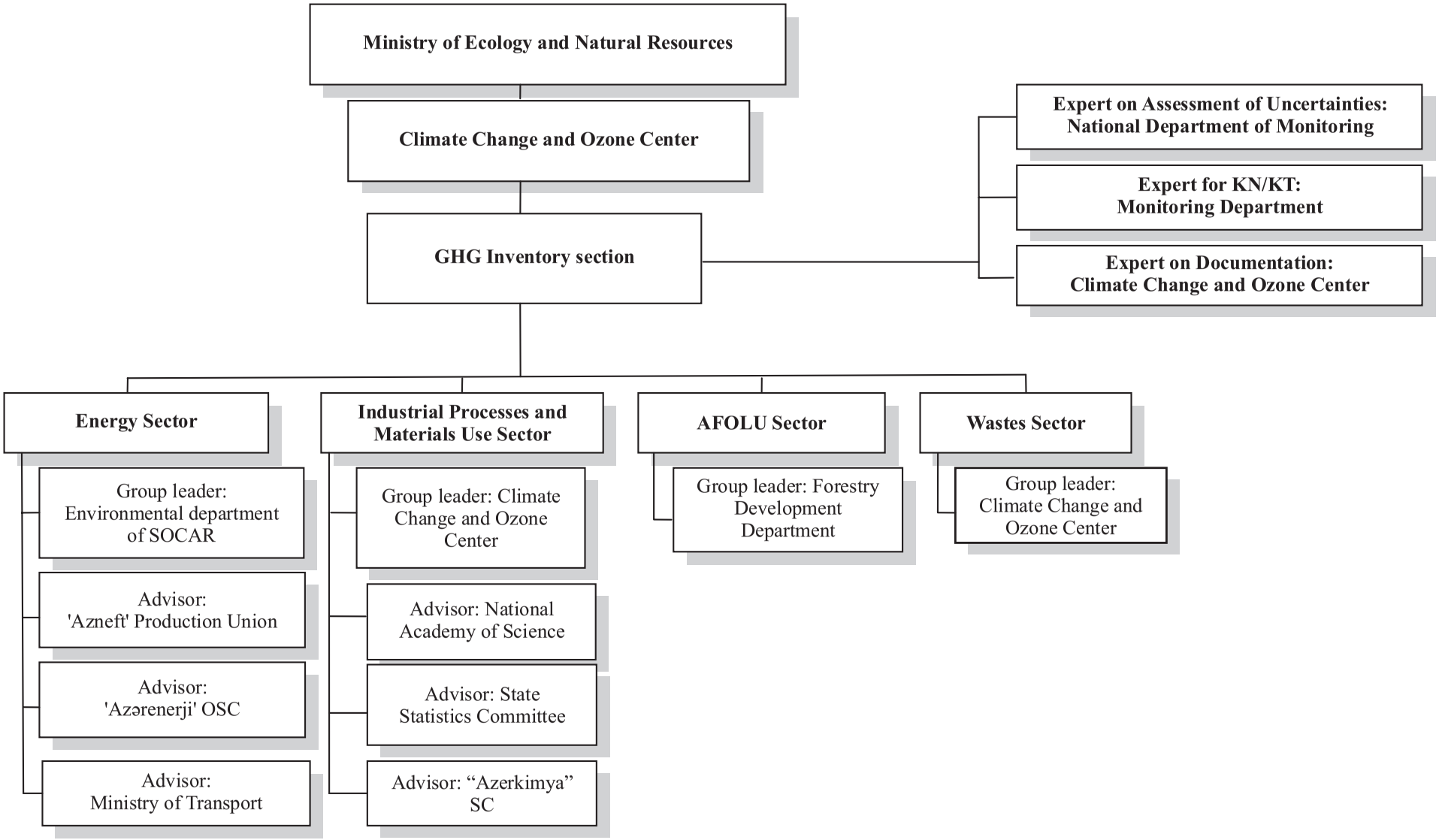
In order to develop national inventory of GHG an institutional structure was established (Scheme 1).

National coefficients of emissions and removal, and in some cases, coefficients prescribed in IPCC guidelines were used in the calculation of emissions levels.

The results were analyzed at INC and SNC. National emissions and removal coefficients were applied and reporting errors were documented before recalculation.

The present GHG inventory covers all sectors over the period 1990 to 2005. Emissions, trends and uncertainties were calculated. The report on CO_2 in the energy sector was compared with IEA reports.

Data were obtained from national and international statistical reports and from stakeholders.



Scheme 3.1. Institutitonal chart for GHG Inventory

3.1. TOTAL GHG EMISSIONS AND REMOVAL IN AZERBAIJAN

Taking as a basis the Global Warming Potential Value, the level of main gases by sectors was calculated in CO_2 equivalent, both by gases and by sectors. In accordance with IPCC guidelines the following Global Warming Potential Values were assigned to CO_2, CH_4 and N_2O respectively: 1, 21 and 310. The levels of GHG generated in Azerbaijan were then calculated by gases and by sectors (Figure 3.1-1).

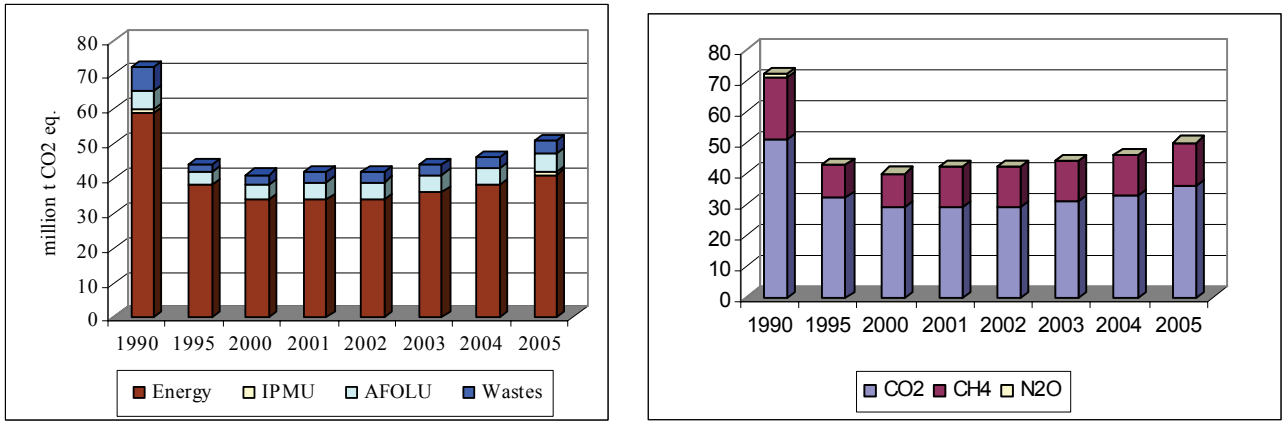


Figure 3.1-1. GHG by gases and by sectors

Accounting for CO_2 removal by agricultural lands and woodlands, net GHG emissions in Azerbaijan are given in the table below.

Table 3.1-1. GHG emissions and removal (Gt CO_2 eq)

GHG	1990	1994	2000	2001	2002	2003	2004	2005
Emissions								
CO_2	50677	35985	29274	28842	28703	31347	33280	35845
CH_4	20036	9849	11354	12522	12537	12603	12895	14433
N_2O	992	620	360	347	344	347	350	357
Total	**71705**	**46454**	**40988**	**41711**	**41584**	**44297**	**46525**	**50635**
Removal								
CO_2	-3438	-2456	-3145	-3145	-3585	-3663	-3702	-3769
Net emissions	**68267**	**43998**	**37843**	**38566**	**37999**	**40634**	**42823**	**46866**

The level of emissions in 2005 constitutes 70.6% of the 1990 base year level. In INC, according to Azerbaijani experts, emissions will reach the level of the baseline year in 2007-2008. Information on GHG emissions per capita is given in the figure below.

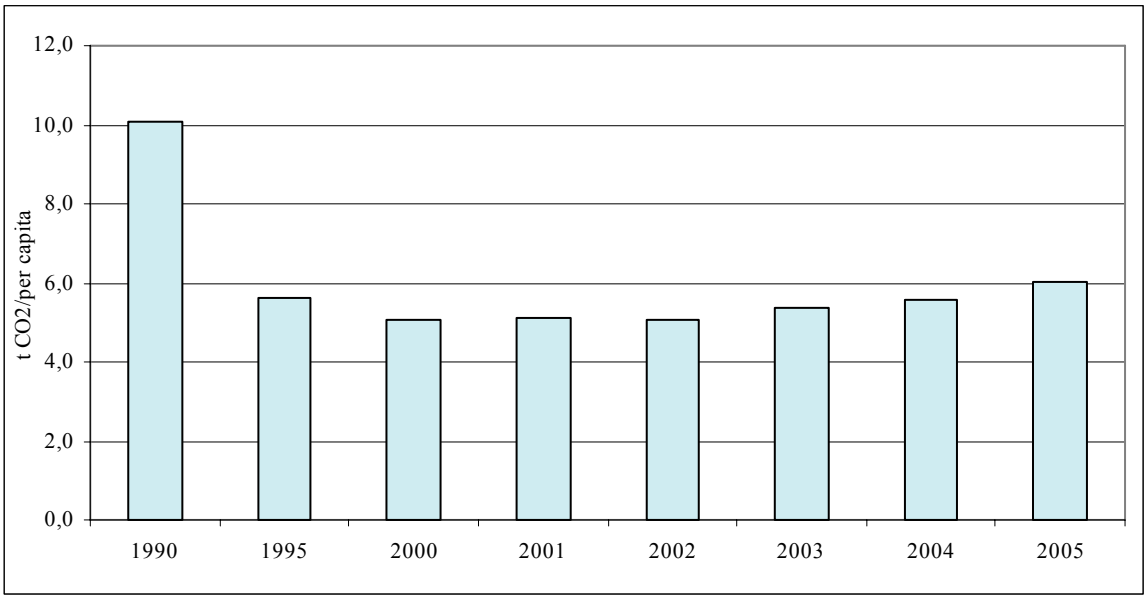


Figure 3.1-2. GHG emissions per capita

3.2. EMISSIONS AND REMOVAL OF MAIN GASES

3.2.1. Emissions and removal of CO_2

The main sources of CO_2 emissions in Azerbaijan are the energy and industrial sectors. Sinks are found in the forms of agricultural lands, forests and land use change. Information on CO_2 emissions is given in Figure 3.2-1.

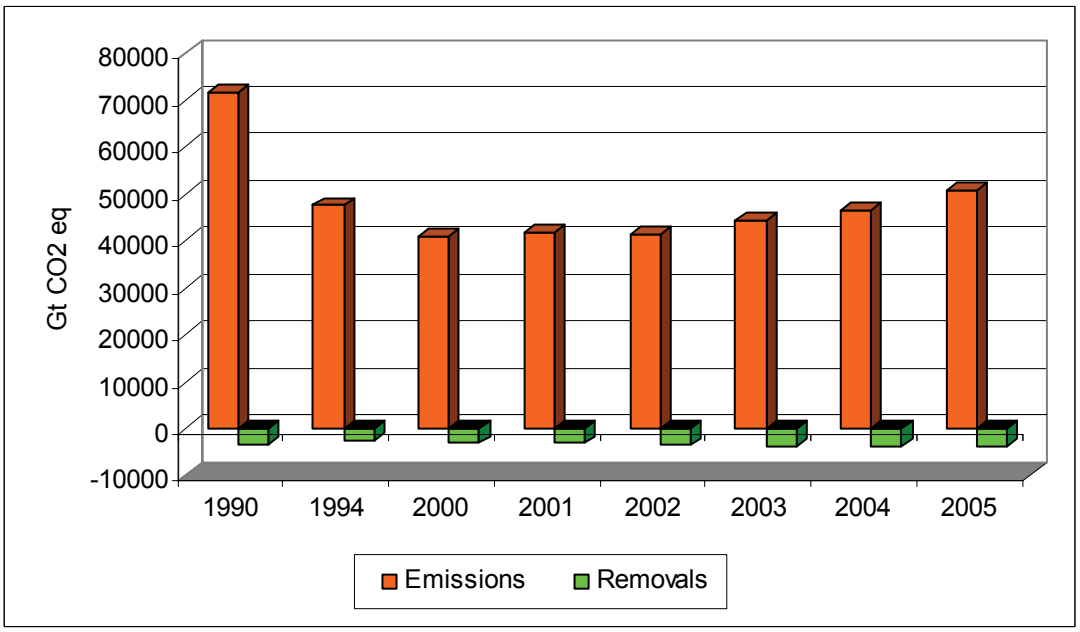


Figure 3.2-1. Emissions and removal of CO_2

3.2.1.1. CO_2 emissions

ENERGY SECTOR

CO_2 emissions come mainly from the energy sector, specifically the burning of fuel (production of energy, oil and gas extraction, transport, human settlements, etc.). (Figure 3.2-2.)

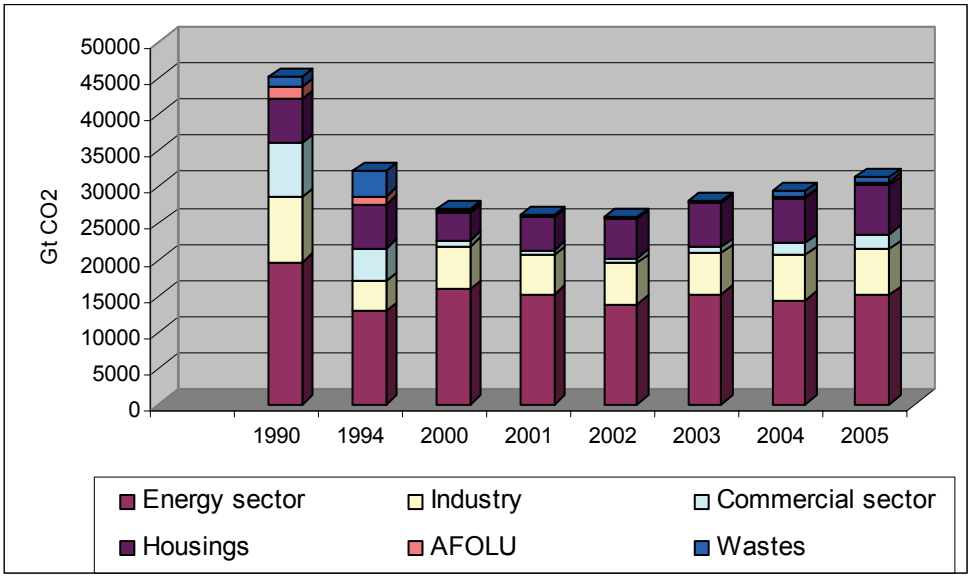


Figure 3.2-2. CO_2 emissions in energy sector

CO_2 emissions increased as compared to the baseline 1990 year, due solely to the contributions from human settlements. A comparative analysis is presented below, calculated based on IPCC guidelines (Table 3.2-1).

Table 3.2-1. Comparative analysis of CO_2 emissions from fuel burning

Source	1990	1994	2000	2001	2002	2003	2004	2005
By all types of fuel, Gt	63154	42986	31418	31229	30760	32565	33316	35876
By sectors, Gt	49462	35664	29131	28595	28338	30945	32812	35007
Balance, %	**21,7**	**17,0**	**7,3**	**8,4**	**7,9**	**5,0**	**1,5**	**2,4**

The relative balance between the amounts of CO_2 emissions by fuel and by sector up to 1998 is explained by the lack of reliable data for those years.

Industrial Operations and Materials Use

The major sources of emissions from this sector are in mineral materials production and metallurgy industry. After a period of decline in the metallurgical industry, it started to grow again after 2004. Of mineral materials, only cement production is continued. Until recently the production of lime had all but ceased. (Figure 3.2-3).

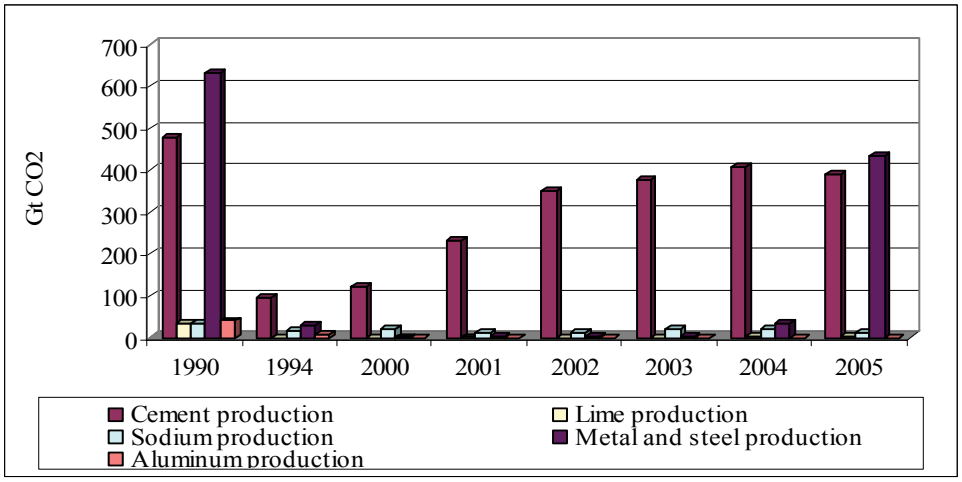


Figure 3.2-3. CO_2 emissions in Industrial Operations and Materials Use sector

3.2.1.2. CO_2 removal

According to reports by the Forestry Development Department, woodlands in Azerbaijan are divided into three types: conifers (13.7 thousand hectares), broadleaved (848.3 thousand hectares) and others (soft-leaved trees prevail in the latter group and constitute about 53.9 thousand hectares). National coefficients were developed for determining an annual growth in biomass in woodlands, and the volume of CO_2 removal by woodlands and lands withdrawn from cultivation was calculated (Figure 3.2-4).

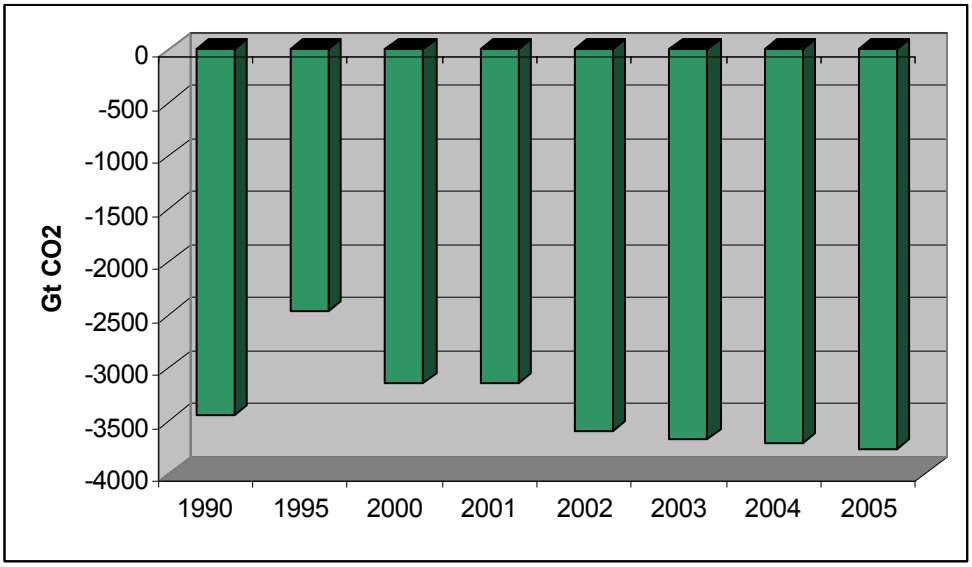


Figure 3.2-4. CO_2 removal by woodlands and lands withdrawn from cultivation

3.2.2. CH_4 emissions

Methane gas is released by all sectors. In the energy sector, methane is released both through the burning of fuel and through the production of oil and gas: refining, transportation and distribution. In the Industrial Operations and Materials Use (IOMU) sector, methane is released by chemical plants, but the amount is insignificant. In the agriculture sector, potential methane sources are internal fermentations and manure generated by domestic animal husbandry. In waste management,

methane is generated by municipal waste landfills, industrial plants and municipal wastewater (Figure 3.2-5).

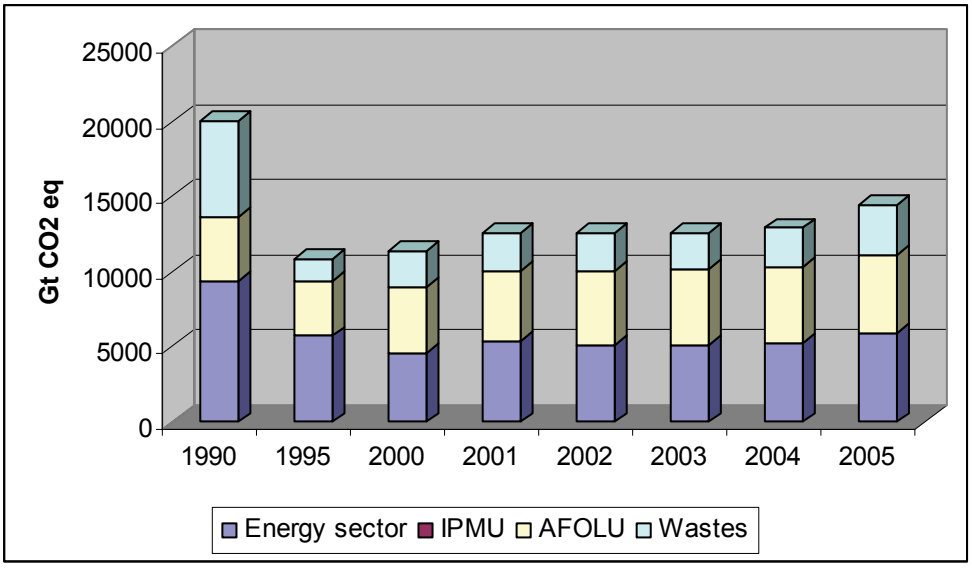


Figure 3.2-5. CH_4 emissions

3.2.3. N_2O emissions

N_2O gas is released by the burning of fuel in energy sector, the use of nitrogen fertilizers in the AFOLU sector, and through waste management processes. Emissions levels of this gas are now lower than the baseline year. The use of nitrogen fertilizers was discontinued in 1995, bringing N_2O emissions to zero in the agricultural sector. (Figure 3.2-6)

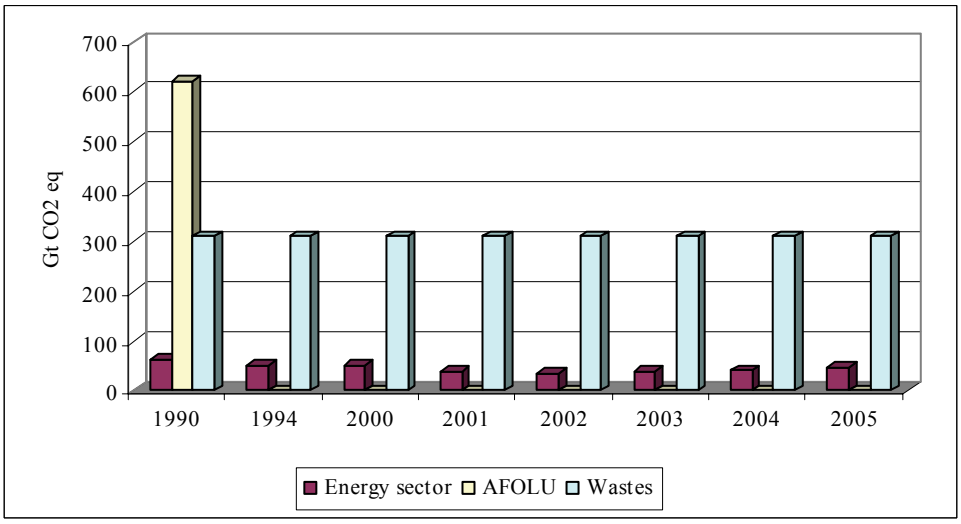


Figure 3.2-6. N_2O emissions

3.3. GHG EMISSIONS BY SECTOR

3.3.1. Energy sector

3.3.1.1. Dynamics of fossil fuels extracted and consumed

In a country rich in oil and gas resources, oil products and natural gas are the most commonly-consumed fossil fuels. Coal was important in Azerbaijan until 1990, but its import ended with the fall of the Soviet Union. Condensed natural gas is produced, but only at small volumes.

The dynamic of use of oil products and natural gas is directly dependent on the volume of extracted oil and gas. (Figure 3.3-1)

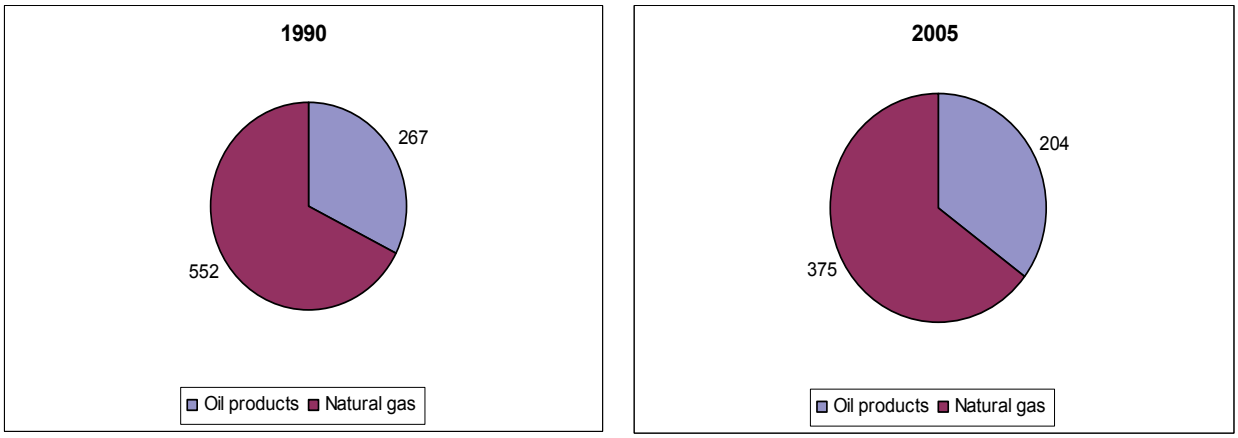


Figure 3.3-1. Oil and gas extraction in 1990 and 2005 (PJ)

The dynamic of use of the same fuel types in the aforementioned years is given in Figure 3.3-2.

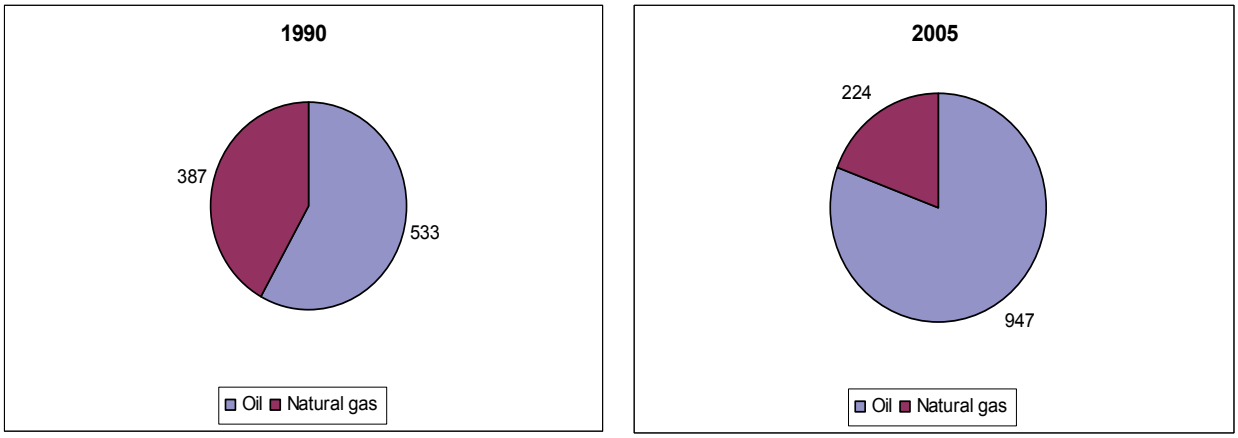


Figure 3.3-2. Use of oil products and gas in 1990 and 2005 (PJ)

In 1995 and 2005 a surplus of oil products was produced and exported, while natural gas demand exceeded production, requiring imports.

3.3.1.2 Comparison of reports on CO_2 emissions from fuel burning

In accordance with the IPCC guidelines, the amount of CO_2 emissions was calculated over time, by all types of fuel used, and by sectoral approach. Results of the inventory covering the period 1990 to 2000 are presented in the figure below.

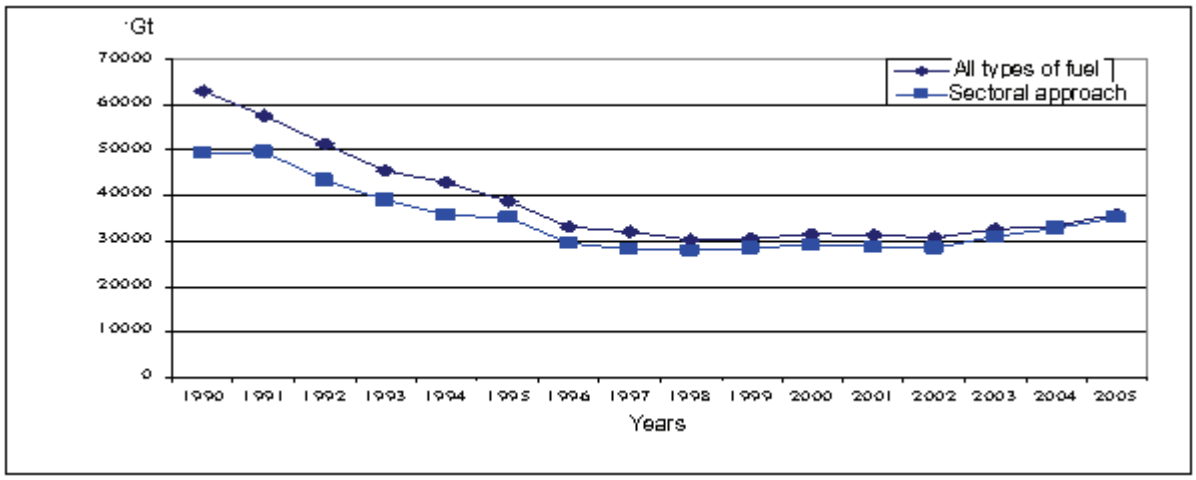


Figure 3.3-3. CO_2 emissions in the energy sector

The amount of CO_2 emissions in this sector has significantly reduced as compared to the baseline year level. The remarkable deviation between the amounts of CO_2 emissions by all types of fuel and by sectors up to 1998 is explained by the intermittent operation of generating plants in that period; they were not reporting to the State Statistics Committee in an organized manner. Statistical data on those years is thus unreliable.

The amount of emissions determined by the inventory was compared with emissions calculated by IEA for the period 1992 to 2002 (Figure 3.3-4).

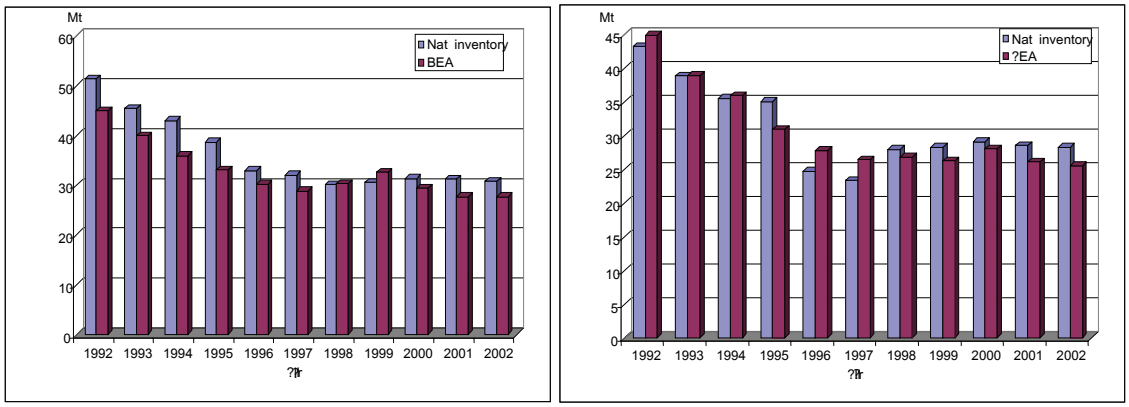


Figure 3.3-4. Comparison of CO_2 emissions by all types of fuel and by sectoral approach

The difference between the calculations is insignificant. The difference in the sectoral calculations is less than 10%. The only eye-catching difference was in the fuel sector, which constituted more than 10% in 1993 and 1994.

3.3.2. International Bunker

Emissions in Azerbaijan from international aviation and maritime transport (also known as international bunker fuel emissions) are not included in the national cadastre. CO_2 emissions under this category are given in Figure 3.3-5.

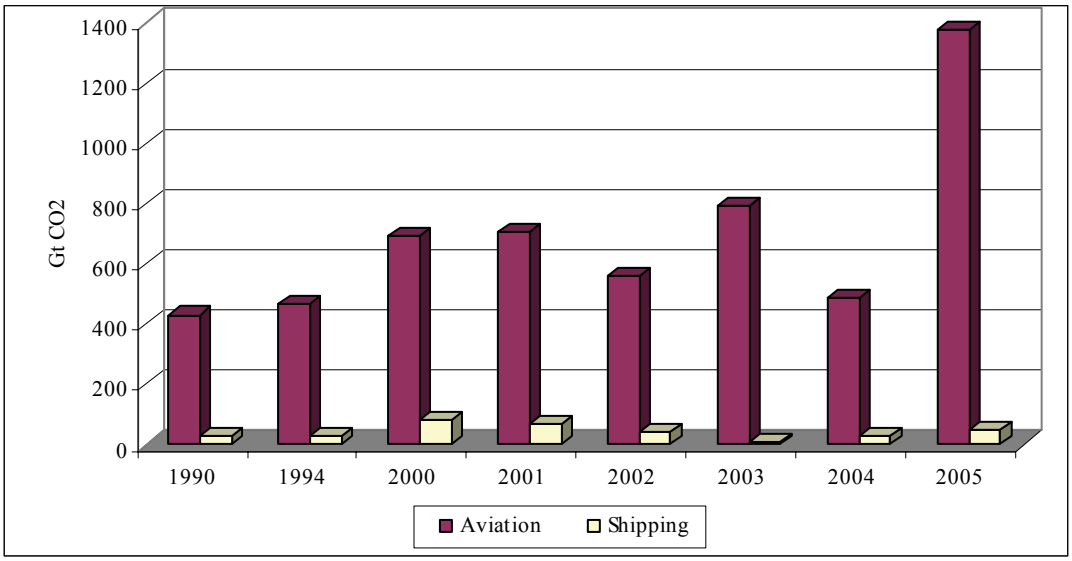


Figure 3.3-5. CO_2 emissions of the International Bunker

3.3.3. Combustion

3.3.3.1. Stationary sources

Fuel burning is a part of almost all sectors of economy. According to IPCC methodologies, this category is divided into 5 sub-categories, and the following codes and names are assigned to them:

1A1 Energy;
1A2 Industry and construction;
1A4 Miscellaneous (commercial, human settlements, agriculture, forestry, fishery);
1A5 Not defined

The following sources are considered under the energy category: fuel used for production of electric and heating energy, for oil and gas extraction and refining, etc. In industry, emissions generated from industrial plants are taken into consideration. The transport category covers aviation, automobile transport, railways and shipping, the latter two of which are each divided into two parts: domestic and international aviation, national and international shipping. GHG emissions from international aviation and shipping are not included in the national inventory report.

ENERGY (*1A 1)*

As an oil and gas country, Azerbaijan has been continuously extracting oil and gas for industrial purposes over 130 years. These fossil fuels are found both under the sea and on land. There is one gas and two oil refineries in the country. The production capacity of the oil refinery plants is 20 million tons per year. However due to the obsolescence of the plants, the level of oil refining has declined. Most oil is now exported; there are three pipelines intended for export: Baku-Novorosiysk, Baku-Supsa, and Baku-Tbilisi-Ceyhan. Baku-Tbilisi-Erzurum pipeline was launched in 2007.

Energy generation is dominated by thermal-electric stations of two types: condensation and heating. Retrofitting at many of these stations has resulted in the reduction of GHG emissions, and other such projects are envisioned for implementation as part of CDM.

INDUSTRY AND CONSTRUCTION (1A 2)

The main sources of emissions in this category are the production of mineral materials, metallurgy and some chemical plants. Primary sources in the production of mineral materials are cement manufacturing and metallurgy. A recession in this sector ending in 1995 caused production capacity to decline by 70%. However, after the 2005 signing of the Oil Contract, a revival has been observed.

MISCELLANEOUS (COMMERCIAL, HUMAN SETTLEMENTS, AGRICULTURE, FORESTRY, FISHERY) (1A 4)

This category includes natural gas, diesel oil, kerosene, and fuel oil. From 1990 to 2005 the amounts of fuel types used varied. In 1990-1994, when there was a shortage of liquid fuel and natural gas, fuelwood use became dominant. According to the IPCC guidelines, emissions from fuelwood burning are not included in the national cadastre and are calculated separately.

Not defined (1A 5)

Fuel types that are burnt at military and other non-defined sources are included here.

Emissions from stationary sources

Information on CO_2 emissions from stationary sources is given in Figure 3.3-6.

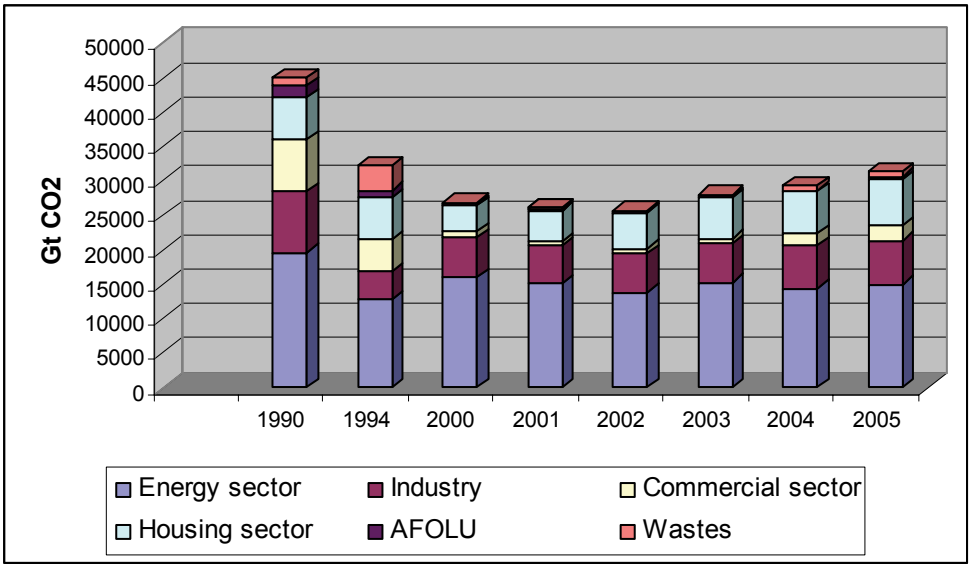


Figure 3.3-6. CO_2 emissions from stationary sources in the energy sector

Information on CH_4 and N_2O is presented in Figure 3.3-7.

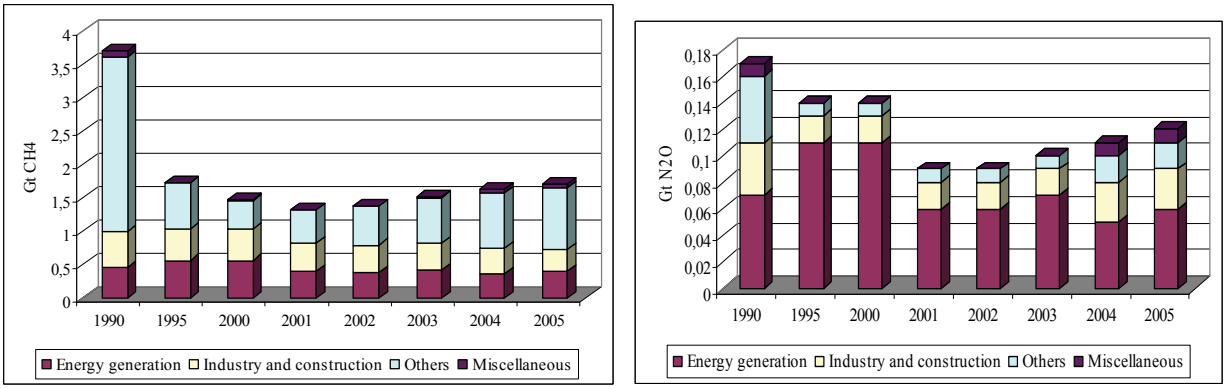


Figure 3.3-7. CH_4 and N_2O emissions

The greenhouse effect is indirectly caused by NOx, CO and NMVOC fuel, and is dependent on technologies applied at the source. (Figure 3.3-8.)

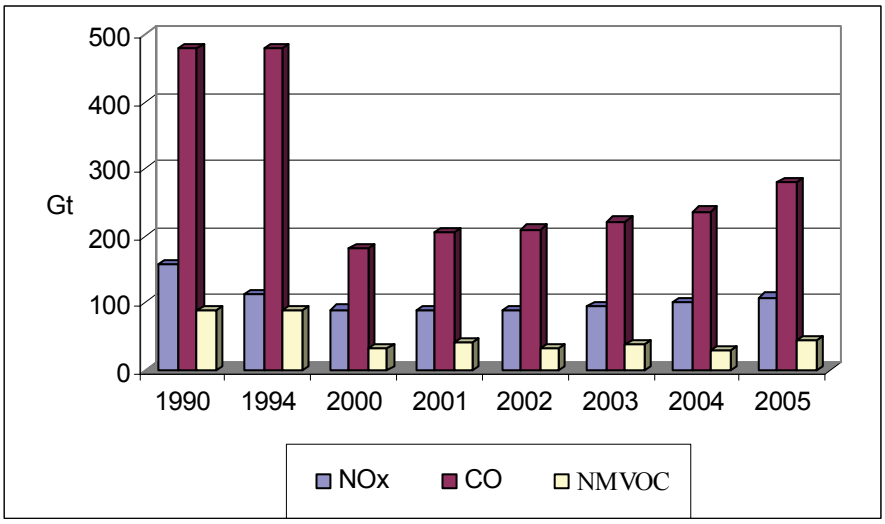


Figure 3.3-8. Emissions of gases indirectly contributing to greenhouse effect

3.3.3.2. Emissions from transport

This category includes aviation, automobile transport, railways and shipping, the most important of which is automobile transport. Transport is responsible for the emission of CO_2, CH_4 and N_2O and indirect GHG including NOx, CO and NMVOC gases.

Since the State Statistics Committee does not possess data on transport up to IPCC standard, it is impossible to conduct a large-scale GHG inventory in this sector. Still, an inventory has been completed for the automobile and aviation categories.

Emissions from the transport sector have been rapidly expanding since 1999, according to calculations based on the amount of fuel consumed. Calculations on aviation were made on Level 2, dependent on the data obtained.

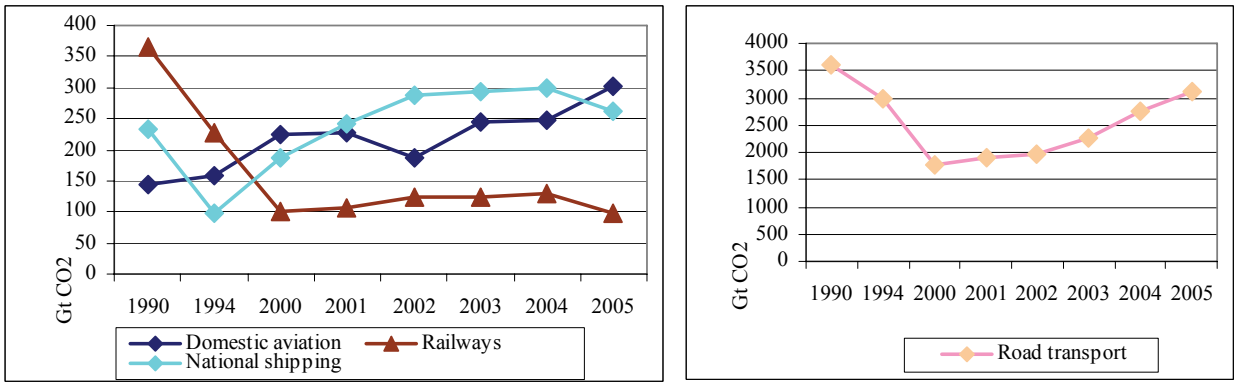


Figure 3.3-9. CO_2 emissions from transport

CO_2 emissions from transport were lower in 2005 than in the baseline year; the only rise was seen in aviation (109.7%). The fall in the level of CO_2 emissions from railways is explained by the greater variety of transport types used in railway operations. In shipping, the replacement of vessels with new and relatively larger ones has led to the reduction of emissions.

CH_4 and N_2O gases and indirect greenhouse NOx, CO, NMVOC gases are inventoried below, but since the annual level of CH_4 and N_2O equated to zero, they are not reflected.

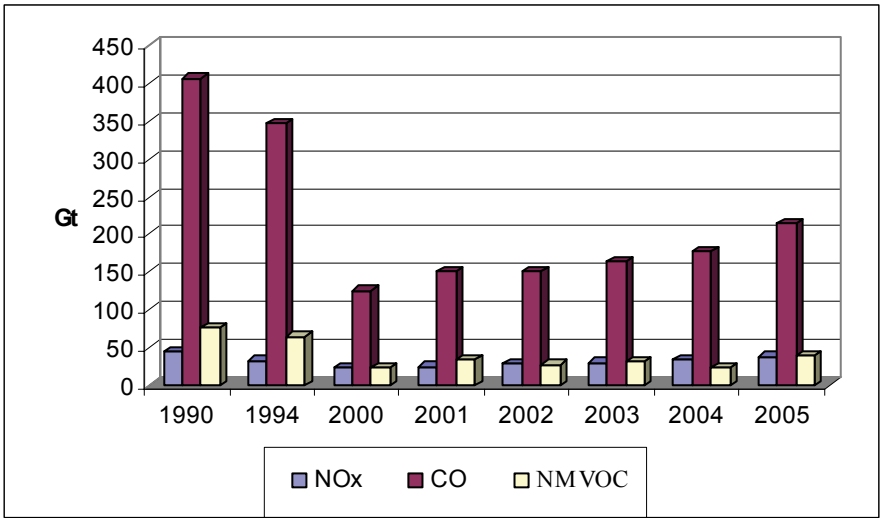


Figure 3.3-10. Indirect GHG from the transport sector

3.3.4. Fugitive emissions from fuel (1B)

Fugitive emissions are generated in the energy sector in the course of natural fuel production, refining, storage, transportation, burning in chimney-stacks and other leakages. In general, the following is included in this category:
1B1 Solid fuel
1B2 Oil and natural gas
1B3 Production of other energy sources

Coal is not produced in Azerbaijan. During Soviet times it was imported from Russia, Kazakhstan and other republics, but today no longer.

CH_4 and other hydrocarbons are the most prominent fugitive emissions, especially methane (CH_4) emitted from wells as by-product of refining operations. (Figure 3.3-11)

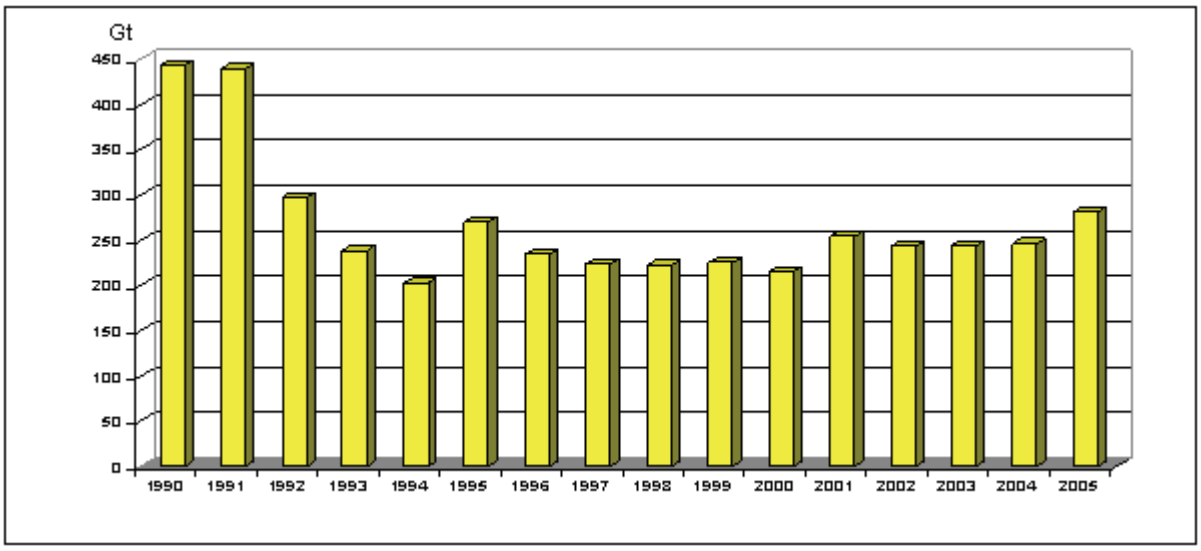


Figure 3.3-11. CH_4 emitted from oil and gas handling

In accordance with IPCC's 2006 guidelines, an assessment of uncertainties was made. For the priority gases CO_2 and CH_4, these constitute 3.7% and 58.1%, respectively.

3.4. Industrial operations and materials use

The following are included in this category in Azerbaijan:

- 2A Production of raw materials:
  - Cement production;
  - Lime production;
  - Glass production;
  - Sodium production and wastes from consumption.
- 2B Chemical industry:
  - Wastes from chemical and petro-chemical industries;
- 2C Metallurgy industry:
  - Wastes from metal production;
  - Wastes from the production of cast iron and aluminum.
- 2H Others
  - Wastes from food products and beverages industries.

PRODUCTION OF MINERAL PRODUCTS (2A)

The production of mineral materials in Azerbaijan is confined to the manufacture of those materials that are needed in the construction sector. The enterprises contributing to the generation of GHG are plants producing cement, lime, sodium and glass.

The main source of these emissions in the mineral materials production category is cement manufacturing. Until 1990 there were two large cement manufacturing plants, but only Garadagh Cement Plant operates today. Its production capacity is 1.2 million tons per year. In 1990, 990 thousand tons of cement was manufactured. Its manufacture then declined until 1999. At present, 1.5 million tons of cement is manufactured in Azerbaijan, and domestic demand has necessitated the import of cement and clinker. Production of other construction materials is relatively low. There are only small-sized lime operations today, wastes from which do not have warming potential.

In 1990 there were three glass-producing factories in the country: Sumgayit Glass, Baku Glassware, and the Baku Lamp factory. At present, Sumgayit operates at 50-60% of capacity, Baku Glassware at10-15% of capacity and Baku Lamp has fully shut down.

CHEMICAL INDUSTRY (2B)

Until 1990 there was a large chemical complex operating in the country. At present, these firms operate at 15-20% of capacity and there is no GHG potential there.

METALLURGY INDUSTRY (2C)

Most of the old metallurgy enterprises do not operate, or they produce very little.

Six firms do specialize in cast iron production: MCT, Baku Electric Casting OSC, Ship Repair Plant, Baku Mechanical Casting OSC, Cultivation Equipment Mechanical Repair, and Mechanical Repair Construction.

Seven plants are engaged in steel casting production, the most modern of which is Baku Steel. The capacity of Baku Steel Casting OSC and other plants is incomparably lower.

USE OF ODS ALTERNATIVES (2F)

After Azerbaijan joined the Vienna Convention and the Montreal Protocol on Ozone Layer Protection in 1996, a number of actions were taken to phase out the use of ozone-depleting substances. The Baku Air Conditioner Plant and Sumgayit Compressors Plant were modernized and their CFCs will be replaced with R-134a and R-600. This process started after 2005.

OTHERS (2H)

Alcoholic beverages, bread and other bakery products, etc. are included in this category as emitters of NMVOCs.

CO_2 emissions result from the production of cement and lime, consumption of sodium, and the manufacture of steel, metal and aluminum. Information on emissions calculated as a result of the inventory covering the period of 1990 to 2005 is given in Figure 3.4-1.

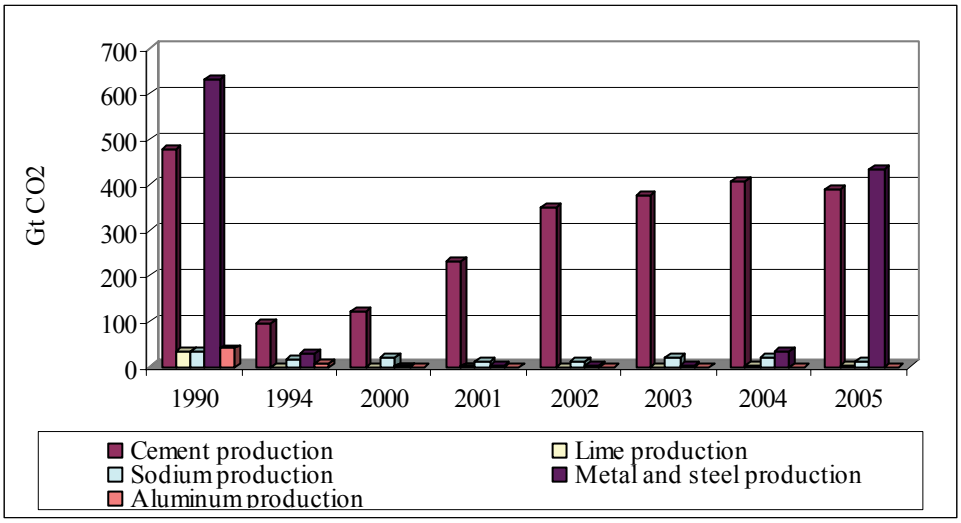


Figure 3.4-1. CO_2 emissions for the period 1990 to 2005

CH_4 emissions are only emitted from the production of chemical substances and do not represent a warming threat (Figure 3.4-2).

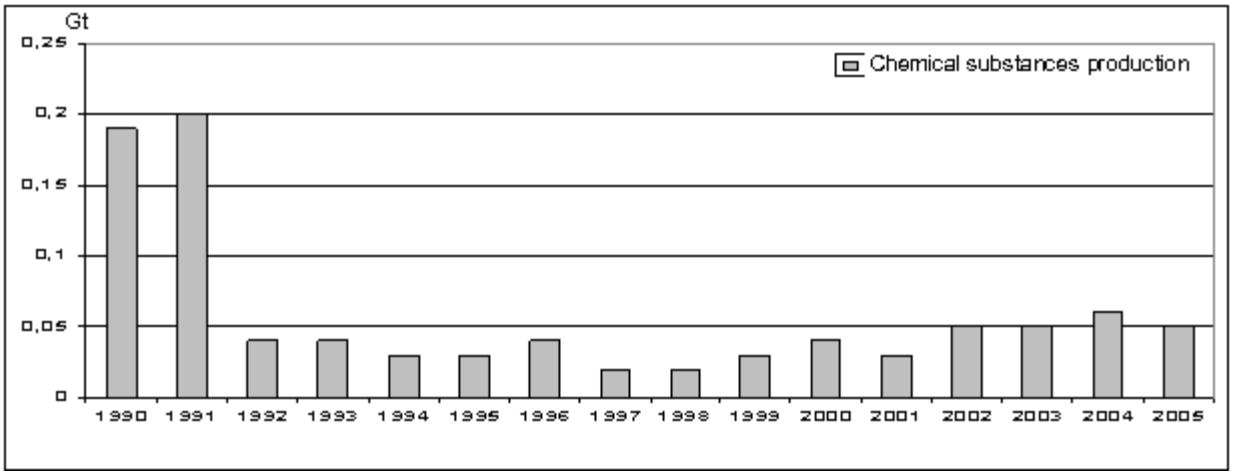


Figure 3.4-2. CH_4 emissions

As seen above, emissions in this sector significantly reduced as compared to the baseline year level.

N_2O emissions in this sector are insignificant and therefore do not represent a warming threat.

NOx emissions are generated from industrial processes during the manufacture of metal, steel and aluminum. Due to the fact that activities in this sector were halted in 1995, the level of GHGs has significantly fallen. (Table 3.4-1)

Table 3.4-1. NOx emissions (Gt) from metallurgy and non-ferrous metals operations

	1990	1994	2000	2001	2002	2003	2004	2005
Metal and steel production	0,02	0	0	0	0	0	0	0
Aluminum production	0,06	0,01	0	0	0	0	0	0
Total	0,08	0,01	0	0	0	0	0	0

CO emissions are generated in this sector only from industrial processes in the manufacture of aluminum. Emissions were the case until 1996 as from the base-year followed by a complete cessation of operations (Figure 3.4-3).

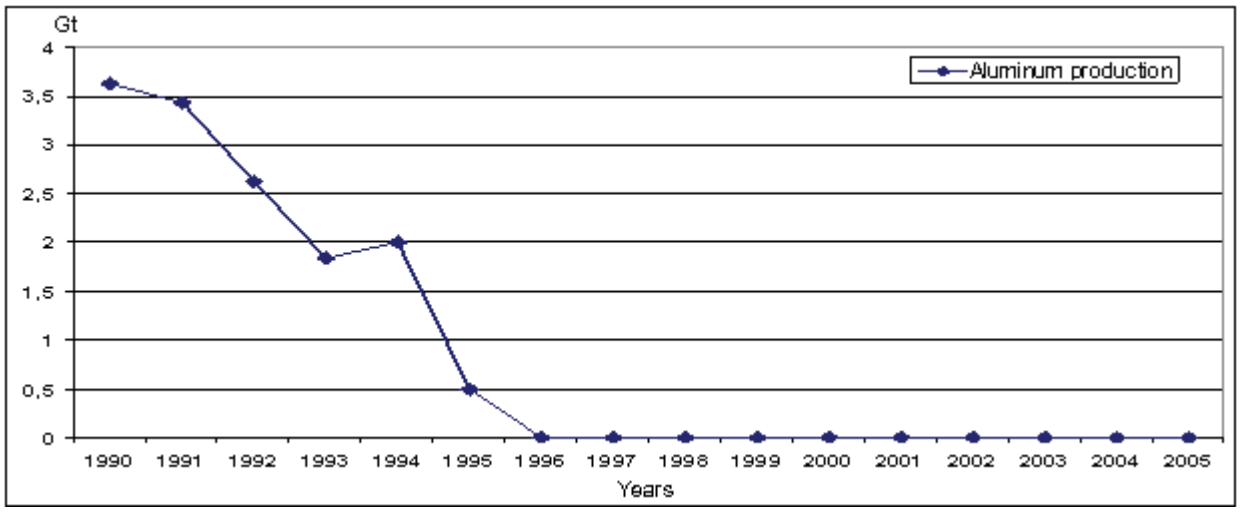


Figure 3.4-3. CO emissions from the Industrial Processes and Materials Use sector

NMVOCs emissions are generated in the industrial processes and materials-use sector from technologies used in laying asphalt cover on roads, glass production, production of other chemical substances, production of metal and steel, production of alcohol beverages, and production of bread and other food products. As mentioned above, after 1990 the production of glass, a number of chemical substances, metal and steel, and alcohol beverages declined by 10-15%. Subsequently, emissions also fell. (Table 3.4-2)

Table 3.4-2. NMVOCs in IPMU sector (Gt)

Subcategory	1990	1994	2000	2001	2002	2003	2004	2005
Asphalt laying on roads	318,27	164,48	41,18	53	43,18	35,69	71,11	106,75
Glass production	0,3	0,03	0,02	0,01	0,01	0,02	0,01	0,01
Production of other chemical substances	1,04	0,23	0,29	0,24	0,36	0	0	0,46
Metal and steel productions	0,01	0	0	0	0	0	0	0
Beverages production	3,44	19,13	81,94	93,74	69,67	68,77	65,74	74,5
Production of bread and other food products	5,47	9,05	5,59	5,68	5,79	5,86	5,98	9,54
Total by industries	328,53	192,9	129,02	152,67	119,01	110,34	142,84	191,26

3.5. AGRICULTURE, FORESTRY AND OTHER LAND USE

The IPCC's 2006 National Inventory guidelines combine the agricultural sector, land use change and forestry into one sector in view of the fact that emissions and sinks can take place on all types of land.

Categories have been divided as follows:

- 3A Domestic animals;
- 3B Lands;
- 3C General sources of CO_2 and non-CO_2 emissions in lands.

Included in this sector in Azerbaijan are domestic animals, forestry, and lands withdrawn from cultivation. Other categories do not represent a warming threat. However, a shortage of data on these categories and difficulties in the selection of coefficients make it complicated to conduct inventory.

3.5.1. Emissions and removal in the sector

CH_4 emissions generated from internal fermentations of domestic animals were calculated again for the period 1990 to 1994 and the inventory covers the period until 2005 (Table 3.5-1).

Table 3.5-1. CH_4 emissions from domestic animals' internal fermentations (Gt)

Animals type	1990	1994	2000	2001	2002	2003	2004	2005
Cows	115,4	105,9	132,3	137,5	142,8	147,0	146,7	149,6
Buffalos	10,1	9	11,1	11,5	12,0	12,3	12,7	12,9
Sheep	26,1	21,9	27,8	30,0	32,0	33,4	34,4	34,9
Goats	1,0	0,9	2,7	2,8	3,0	3,0	3,0	3,3
Camels	0,0	0	0,0	0,0	0,0	0,0	0,0	0,0
Horses	0,7	0,8	1,1	1,2	1,2	1,2	1,3	1,3
Donkeys	0,3	0,3	0,4	0,4	0,4	0,4	0,4	0,5
Pigs	0,2	0	0,0	0,0	0,0	0,0	0,0	0,0
Poultry	29,1	14,4	14,7	15,4	17,1	17,5	18,3	19,0
Total	**182,9**	153,2	**190,1**	**198,8**	**208,5**	**214,8**	**216,8**	**221,5**

The level of emissions in all the above categories increased. Methane gas emissions rose in this category mainly due to the growth of herds of cows, buffalos and sheep. The amount of CH_4 emissions from manure of domestic animals was also calculated again for the period 1990 to 1994 (Table 3.5-2).

Table 3.5-2. CH_4 emissions from manure of domestic animals (Gt)

Animal type	1990	1994	2000	2001	2002	2003	2004	2005
Cows	17,7	16,4	20,6	21,4	22,3	22,9	22,5	22,9
Buffalos	1,1	1	1,2	1,3	1,3	1,3	1,4	1,4
Sheep	0,5	0,7	0,6	0,6	0,6	0,7	0,7	0,7
Goats	0,0	0	0,1	0,1	0,1	0,1	0,1	0,1
Camels	0,0	0	0,0	0,0	0,0	0,0	0,0	0,0
Horses	0,0	0,1	0,1	0,1	0,1	0,1	0,1	0,1
Donkeys	0,0	0	0,0	0,0	0,0	0,0	0,0	0,0
Pigs	0,5	0,1	0,1	0,1	0,1	0,1	0,1	0,1
Poultry	0,3	0,3	0,1	0,2	0,2	0,2	0,2	0,2
Total	**20,2**	**18,6**	**22,7**	**23,7**	**24,6**	**25,3**	**25,1**	**25,5**

While CO_2 is removed by woodlands, during land use change, both emission or removal might take place. CO_2 is removed by woodlands of Azerbaijan (Figure 3.5-1), but the analysis shows that removal has remained unchanged at -822 Gt over the years considered.

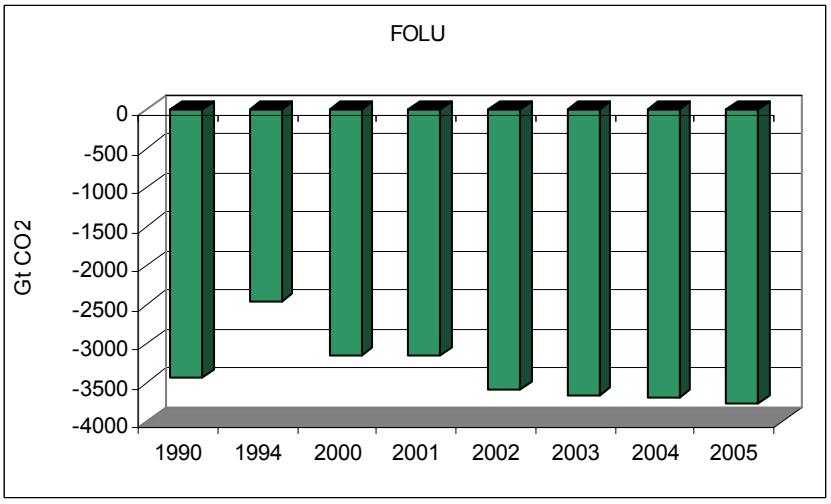


Figure 3.5-1. CO_2 removal by woodlands

3.6. WASTES

This section concerns the inventory of CH_4 gas generated from solid waste landfills and wastewater treatment, and N_2O gas from human activities.

It has been known since early 1980 that the methane component of gases generated at solid waste landfills might pose a threat to the environment unless precautionary measures were taken.

Sources identified for wastes sector in Azerbaijan are as follows:

- Solid waste landfills
- Wastewater treatment
- Wastes generated as a result of human-induced activities

In Azerbaijan, the main emission sources of the sector from those listed above are solid wastes landfills and wastewater treatment.

3.6.1. Emissions in the sector

The levels of CH_4 from solid municipal wastes for the period 1990 to 2005 are given in Figure 3.6-1.

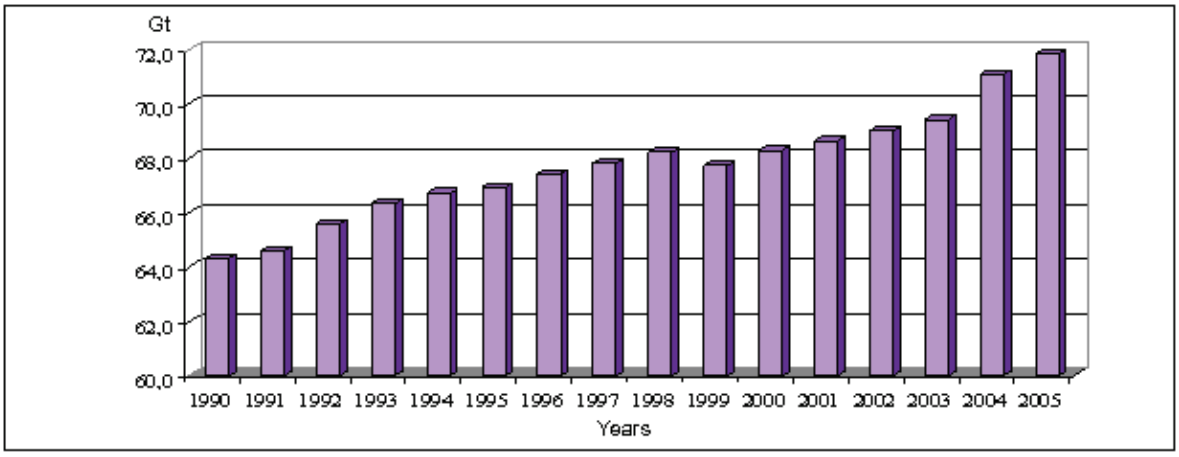


Figure 3.6-1. CH_4 emissions from solid municipal wastes

Methane is mainly generated in the industrial processes from the manufacture of metal and steel, non-ferrous metal, fertilizers, food and beverages, petro-chemical products and rubber. The level of production in the above recessed after the baseline 1990 and only a few branches continue to develop. Those are shown in Table 3.6-1.

Table 3.6-1. Methane from industrial wastewater

Source	1990	1994	2000	2001	2002	2003	2004	2005
Metal and steel	56	50,6	0,002	0,09	0,03	0,08	1,2	16,1
Non-ferrous metal	8,8	4,9	0	0	0	0	0	0
Fertilizers	43,7	1,2	0,2	0,2	0,2	0	0	0
Food and beverages	119,4	6,6	37,6	45,2	46	41,4	47,5	63,6
Petro-chemical products	10,7	6,1	5	3,8	3,9	3,8	3,8	4,5
Rubber	0,009	0	0	0	0	0	0	0
Total	**238,6**	69,4	**42,8**	**49,3**	**50,1**	**45,3**	**52,5**	**84,2**

Information on the level of N_2O generated from human-induced activities is given in Figure 3.6-2.

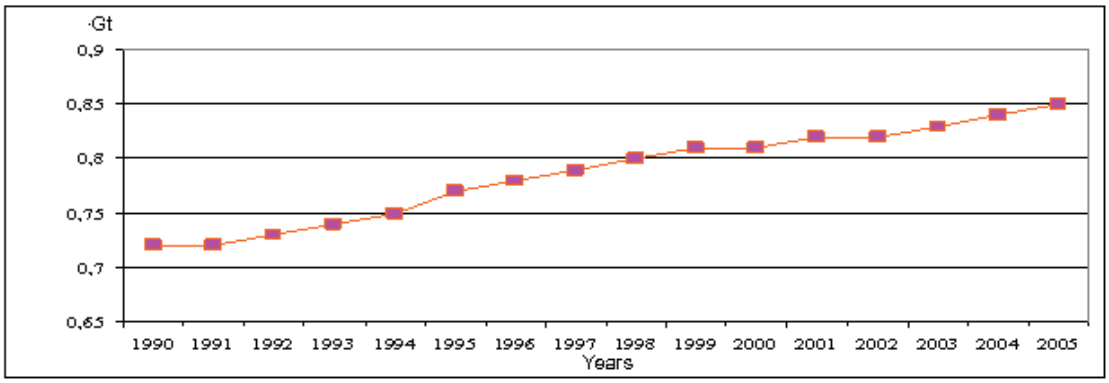


Figure 3.6-2. N_2O from human-induced activities

The level of GHGs from human-induced activities (generation of electric energy, human settlements, agriculture and animal husbandry and the waste sector) increased more rapidly as compared to other categories.

4. POLICY AND MEASURES

4.1. AZERBAIJAN'S ECONOMIC DEVELOPMENT FORECAST

The high socio-economic indicators of the Republic during Soviet times declined from 1991 to 1999, when the increase in oil and gas exploration brought new economic development. (Table 4.1-1)

Table 4.1-1. Main social economic indicators of Azerbaijan

Main social economic indicators of Azerbaijan	2000	2003	2004	2005	2006	2007	2008
No. of population (by the end of year), in thousand	8081	8265.7	8347.3	8436.4	8532.7	8629.9	8730.3
Gross Domestic Product, million manats	4718.1	7146.5	8530.2	12522.5	18746.2	28360.5	38005.7
Gross value of industrial products, million manats	3639.5	4982.1	5961.4	9290.5	15509.4	22441.4	28108
Main capital investment, million manats	967.8	3786.4	4922.8	5769.9	6234.5	7471.2	9081.4
Load turnover in the transport sector, million tons per km	15948	22291	23283	26534	43294	78007	88607
Retail sales turnover, million manats	2119.9	3062	3729.9	4622.2	5760.3	7591.4	10876
Chargeable services to the public, million manats	477.2	592.2	694.6	960.7	1400.7	2348.3	3393
International trade turnover, million US dollars	2917.3	5216.6	7131.4	8558.4	11638.9	11771.7	54919.7
Including:							
Export	1745.2	2590.4	3615.4	4347.2	6372.2	6058.2	47756.2
Import	1172.1	2626.2	3516	4211.2	5266.7	5713.5	7163.5
Public income	4047.3	5738.1	6595.1	8063.6	10198.5	14558.2	20058.2
Income per capita, manats	510.5	707.2	805.6	974.9	1219.2	1720.6	2343.2

For the past five years, oil revenues have accrued to non-oil sectors, infrastructure development projects and the development of rural areas in a more balanced way.

The development of the oil sector is also seen as leading to climate change. The growth in fossil fuels extraction and high demand for electricity have resulted in an increase in GHG emissions.

The development of the oil, gas, and energy industries is considered a priority in the action plan of the government of the Republic of Azerbaijan. It is projected that the volume of oil and gas extraction will be increasing until 2013 (Figure 4.1-1).

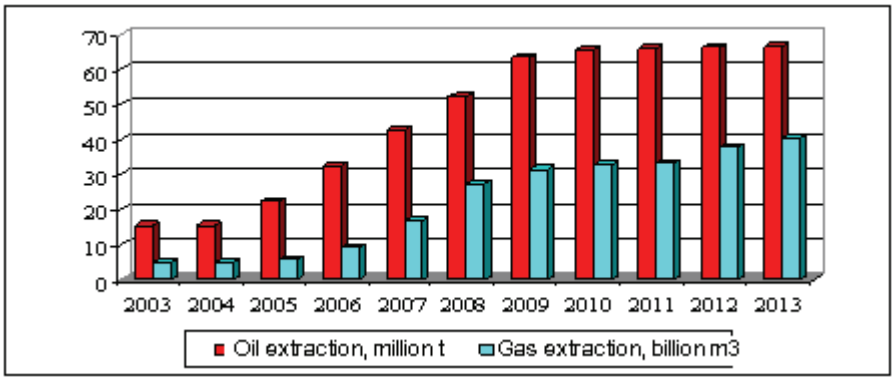


Figure 4.1-1. Projections of oil and gas extraction in Azerbaijan

The launch of new electric stations, electric distribution networks, electric transformers, auxiliary stations, and repair and reconstruction works have improved the supply of electricity for the needs of the public and economy. The country has plans to launch a steam-gas turbine electric station (517 MWt) in Sumgayit, the Shimal-2 steam-gas facility (400 MWt) in Baku, a modular electric station (300 MWt) in Sangachal District, and an electric station (760 MWt) in Shirvan. Alongside the development of alternative and renewable energy sources, these will increase the consumption of electricity to 28 billion kWt hours by 2013. (Figure 4.1-2)

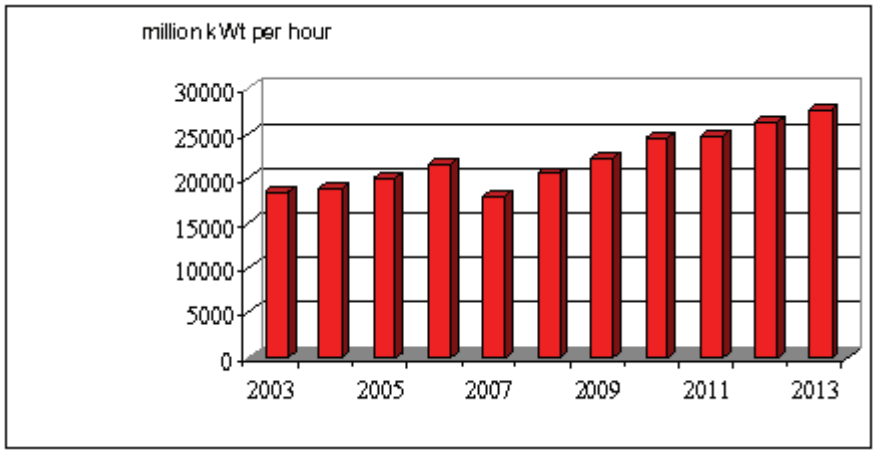


Figure 4.1-2. Forecast of electricity consumption

The gas supply network will be expanded to reach under-served human settlements and regional centers. Main and distributional gas supply pipelines will be rehabilitated and the installation of gas consumption meters in houses will be completed. (Figure 4.1-3)

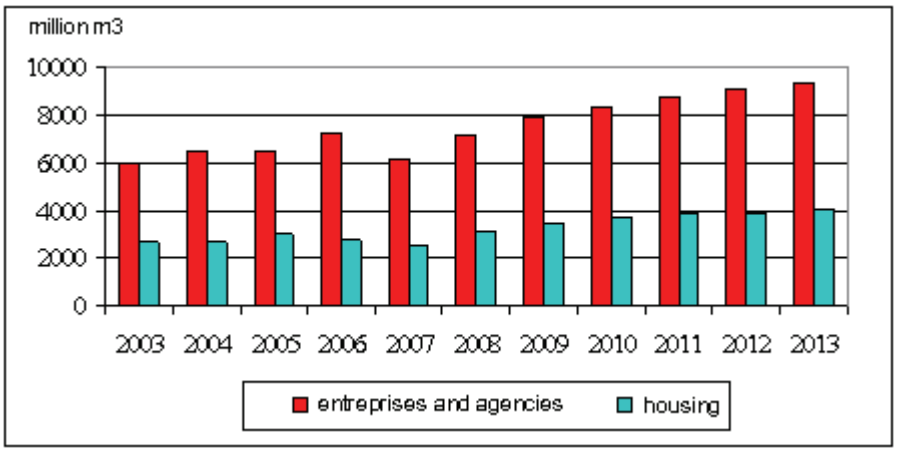


Figure 4.1-3. Projections of natural gas consumption

Consumption of electricity and natural gas carbon gas emissions will increase by 2.8 million tons in 2013 as compared to the level of 2003. (Figure 4.1-4)

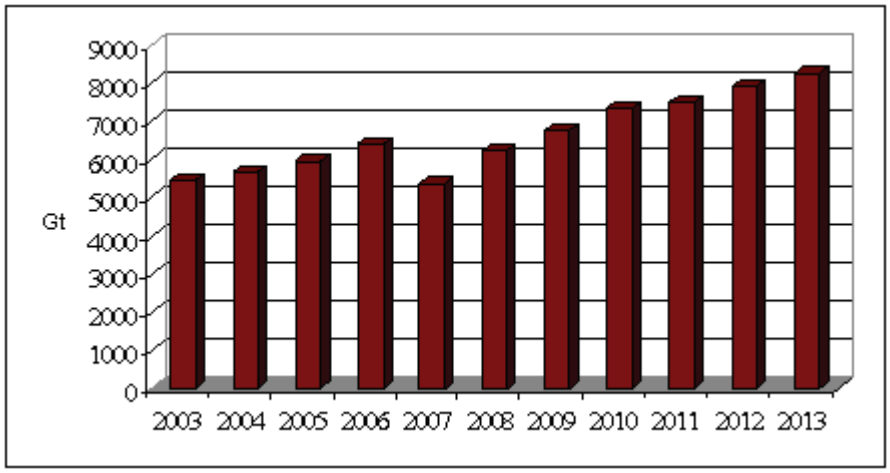


Figure 4.1-4. CO_2 emissions from the consumption of electricity and natural gas

Consequently, the level of GHG will also increase. In order to abate the problem, energy effectiveness must be enhanced, energy saving must be promoted, a shift from old technologies to new ones must be made, and alternative energy sources must be developed.

4.2. ACTIONS FOR NATIONAL GHG ABATEMENT

After Azerbaijan ratified the Climate Change Framework Convention in 1995, it committed to the preparation and implementation of national and regional programmes and projects towards the mitigation of global climate change effects and dissemination of reports on these activities to the public. The State Commission on Climate Change was established in 1997 by a resolution of the President, composed of representatives of all related institutions and ministries. In 2000 the Kyoto Protocol was ratified. For the purpose of coordination, a Center for the Ozone Layer was established under the Ministry of Ecology and Natural Resources.

The first project in this area was the Initial National Communication of the Republic of Azerbaijan, completed under financial and technical support of the Global Environmental Facility and UNDP.

As part of a project on Capacity Building on Climate Change in Priority Areas of the Economy, measures intended for GHG abatement were evaluated.

A number of laws, state programmes and regulatory acts concerning the Convention and related international documents have been adopted, the majority of which support the mitigation of climate change effects (Table 4.2-1).

Table 4.2-1. Laws and regulatory acts adopted in Azerbaijan

#	Title of the document	Date of adoption
1.	Measures to ensure the fulfillment of commitments under UNFCCC ratified by the Republic of Azerbaijan on 10 January 1995	30.04.1997
2.	Law on Production and Municipal Wastes	30.07.1998
3.	Law on Gas Supply	30.06.1998
4.	Law on Energy	24.11.1998
5.	Law on the Generation of Energy	01.02.1999
6.	Law on Heating and Energy Stations	28.12.1999
7.	Law on Environment Protection	08.07.1999

8.	Law on Air Protection	21.03.2001
9.	Law on Environmental Public Education and Awareness Raising	10.12.2002
10.	Law on Mandatory Environmental Insurance	12.03.2002
11.	National Programme on Environmentally Sustainable Social Economic Development	18.02.2003
12.	National Programme on Forest Rehabilitation and Forestation	2003
13.	Law on Export Control	26.10.2004
14.	State Programme on Use of Alternative and Renewable Sources of Energy in Azerbaijan	November,2004
15.	State Programme on Social Economic Development of Remote Areas	
16.	State Programme on Development of Fuel and Energy Complex in Azerbaijan in 2005-2015	14.02.2005
17.	Resolution of the President on the Approval of Complex Action Plan for 2006-2010 on the Improvement of a State of Environment in Azerbaijan	21.09.2005
18.	Resolution of the President on Enhanced Measures Concerning Issues Arising from International Environmental Conventions and Agreements signed by the Republic of Azerbaijan	30.03.2006

In addition, memoranda of understanding were signed between the Republic of Azerbaijan and the Governments of Denmark and Germany on expanding the vegetation cover, and on capacity-building towards GHG abatement. Azerbaijan has also participated in various international and regional programmes. (Table 4.2-2).

Table 4.2-2. Programmes in which Azerbaijan has taken part

Organizations	Programmes
CIDA (Canada)	Training programmes on the reduction of GHG in the Caspian littoral States (2004-2005)
EU TACIS	Technical Assistance to the Caucasus Countries and Moldova on the Fulfillment of Commitments on Global Climate Change (2004-2006)
UNDP	Capacity Building on the Enhancement of GHG Inventory (2003-2005)
UNDP	Preparation of Initial and Second National Communications
ECON, NORSK Energy (Norway)	CDM Prospects on Industrial Development and Poverty Reduction (2006-2007)
UNDP	Capacity Building on CDM in Azerbaijan (2006-2008)

By a resolution of the President on 1 April 2005, the Ministry of Ecology and Natural Resources was appointed as National Focal Point (NFP) for enhancing participation of Azerbaijan in the Clean Development Mechanisms of the Kyoto Protocol.

4.3. POTENTIAL FOR GHG REDUCTION

GHG reduction has already taken place in the country. While the level of pollution equated to 71.1 million tons of CO_2 eq in 1990, in 2005 this figure fell to 50.6 million tons or 29.4% less than the baseline level.

As for the *shares* GHG emissions types, they were found in equal proportion in 1990 and 2005.

The distribution of GHG emissions in 2005 was as below (Figure 4.3-1).

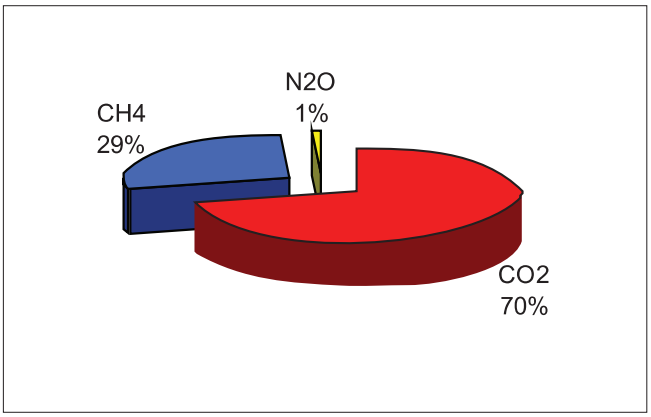


Figure 4.3-1. Distribution of GHG emissions in 2005

In general, there is potential for greater GHG reduction in Azerbaijan. Since 2000 the tempo of economic development has started to grow, but the replacement of electric energy in the network by other sources, particularly alternative energy sources, could lead to a considerable reduction of emissions.

4.3.1. Energy sector

Energy production in Azerbaijan is based on natural gas, fuel oil and water resources. The system comprises 10 TESs and 6 HESs, with a total output of about 4000 MWt. 450 MWt of that comes from modular-type stations. TESs account for 89% of output, while 10% is contributed by HESs and only1% comes from renewable sources.

From 2001 to 2007, the amount of fuel used for generation of one kWt per hour of energy was reduced from 415 to 355 gr of coal equivalent. Over 50% of power came from AzDRES and 20% from Ali-Bayramli TES. Upon completion of reconstruction, the production capacity of AzDRES will be increased up to 600 MWt. Within 2 or 3 years, following the reconstruction of Sumgayit, Sangachal, Guba, Shimal-2 electric stations and Azerbaijan TES, the output of the electricity supply network will increase by 3000 MWt.

The construction of Qarb and Ali-Bayramli, Shimal-2, Sumgayit electric stations and the reconstruction of AzDRES will make it possible to increase efficiency co-efficient from 33% to 45% in 2010, and raise output to 10000 MWt.

In 2007, the total amount of natural gas and fuel oil used for generation of electric power was 4.5 billion cubic meters and 1.2 million tons, respectively. Some 352.8 gr of CE was used for generation of 1 kWt per hour of energy and 183.6 kg of CE was required for generation of 1 Kcal of thermal energy.

Azerenerji OSC, under the Ministry of Industry and Energy, is responsible for the production of electric and thermal energy. As from 2007, part of the energy is delivered to consumers through Baku Electric Network and Sumgayit Electric Network under the Ministry of Economic Development. Energy exchange is also carried out with Russia, Iran, Turkey and Georgia.

The territory of Azerbaijan has high potential for alternative energy development. Potential wind and small hydro stations in the Absheron peninsula along the banks of the Kura River, and in the Nakhchivan Republic were estimated at 2070 MWt and 5 billion kWT per hour, respectively. The output of the existing hydroelectric stations is 1020 MWt, and that of the 11 small hydroelectric stations is 27.7 MWt. The 5 hydroelectric stations currently being constructed will generate 572 MWt. According to the plan prepared by the Ministry of Industry and Energy, 300 more small hydroelectric stations will be built, 5 of them by 2012.

In order to enhance the quality of production and consumption of electric energy, the State Programme on the Development of Fuel Energy Complex of the Republic of Azerbaijan (2005 to 2015) was adopted. Measures in this programme are aimed at GHG abatement (Table 4.3-1).

Table 4.3-1. Projects on GHG reduction under State Programme on Development of Fuel Energy Complex

#	Project (action) title	Main implementing agency	Period of implementation (years)
1.	Modernizing the gaslift system at Gunashli field, reconstruction of a system for the collection of low pressure gas and its transportation to the shore, construction of a pipeline for transportation of high pressure gas to Neft Dashlari, modernizing a system of electricity supply to deep water stationary platforms	MIE, SOCAR	2005-2007
2.	Construction of automatic oil and gas control junctions for optimizing control over oil and gas collection and transportation	MIE, SOCAR	2005-2008
3.	Modernizing Khazardenizneftdonanma Department and equipping it with modern vessels to enhance the quality of marine transport	MIE, SOCAR	2005-2015
4.	Azerneftyag Oil Refinery: Construction of a complex of refining with hydrogen for the production of fuel for diesel and reactive engines to European standards (EVRO-2005)	MIE, SOCAR	2010-2015
5.	Heydar Aliyev Oil Refinery: Improvement of a thermal exchange scheme of initial oil refining facility ELOU-AVT-6 and its further modernization to enable waste treatment, product quality enhancement and reduction of losses	MIE, SOCAR	2005-2007
6.	Azerbaijan Gas Refinery (AGR) OSC: Application of a propane-based cooling system to increase the depth of gas refinery	MIE, AGR OSC	2005-2008
7.	Construction and reconstruction of an automatic control and metering system at dry gas delivery points, metering junctions and production sites	SEN, AGR OSC	2005-2008
8.	Construction of a modern gas refinery facility with a capacity of 2.5 billion cubic meters per year for increasing the depth of refinery	MIE, AGR OSC	
9.	Installation of gas meters at consumers' houses	Azerigaz CSC	2005-2008
10	Construction of a second energy block with a capacity of 400 MWt at Shimal SRES	MIE, Azer-enerji OSC	2005-2008
11	Substantial repairs of the 1st through 8th units at Azerbaijan SRES	MIE, Azer-enerji OSC	2005-2008
12	Feasibility studies on the construction of a 380 MWt Tovuz HES 380	MIE, MED, Azer-enerji OSC	2007
13	The launch of the existing TES in Nakhchivan AR by shifting its liquid fuel-based operation to gas-based ones	MIE, Azer-enerji OSC, Cabinet of Ministers of Nakhchivan AR	2005-2006

Around the world, the highest priority is being given to alternative energy sources for the sake of energy security, environmental protection, global climate change mitigation and other problems. To this end, the State Programme on the Use of Alternative and Renewable Energy Sources was signed by the President in 2004.

Negotiations were initiated with various international organizations and developed countries in this area. With the Republic of South Korea, an agreement was reached on the construction of a 60 MWt wind electric station in Gobustan.

4.3.2. Oil and gas sector

As an oil- and gas-rich country, Azerbaijan has been extracting these resources for industrial purposes for more than 130 years. The extraction of oil has increased for the past 5 years. There is one gas and two oil refinery plants in the country. The capacity of the oil refining plants is about 20 million tons. However, since these plants have become obsolete, the level of oil production has slumped. At present, most crude oil extracted in the country is exported to foreign countries. There are three pipelines intended for oil export: Baku-Novorosiysk, Baku-Supsa, and Baku-Tbilisi-Ceyhan. In 2007, the Baku-Tbilisi-Erzurum pipeline was launched for facilitating gas export.

Presently, there are 57 oil fields in Azerbaijan, of which 18 are located in the Azerbaijani share of the Caspian Sea.

The potential sources of GHG in the oil and gas sector are Azneft Production Unity, Heydar Aliyev Oil Refinery, and AzerNeftYag Oil and Gas Refinery, all of which belong to SOCAR. A number of operational companies and joint ventures are also sources of GHG.

Due to the lack of relevant technologies, 750-800 million cubic meters of low-pressure associated gas from SOCAR's offshore oilfields is released to air every year without being burnt. On each of the land-based fields, 2-5 million cubic meters of associated gas is extracted annually.

Three million tons of GHGs in CO_2 eq are emitted by SOCAR, Operating Companies and Joint Ventures in Azerbaijan on an annual basis. Of this amount, about 1.3 million tons are associated gas. As a result of actions by SOCAR, 600 thousand tons of emissions will be utilized as from the end of 2009. A major part of these associated gases come from BP.

By taking appropriate actions, GHG emissions in this sector can be reduced by 1.2 million tons.

4.3.3. Industrial sector

At present 400 thousand tons of cement is produced in the country, and a second cement plant (dry process) is now being constructed. It is possible to reduce emissions from these plants through optimization of clinker production and burning processes.

Emissions from production of lime, sodium, metal, steel and aluminum is still low. As a result of development of these areas, however, their emissions will likely increase.

Other sources of GHG in the industrial sector include metallurgy, petro-chemical and chemical industries. Since these industries are still in crisis, no increase in their emissions is expected in the near future.

4.3.4. Agriculture

Agriculture plays a significant role in the economy of Azerbaijan. In the baseline year the share of agriculture in GDP was 25%.

Agriculture also brings about a considerable amount of waste. Apart from individual farmers, there is no uniform system for the collection and use of agricultural wastes in Azerbaijan. The management of agricultural wastes cannot meet environmental requirements due to a lack of technical facilities. The dispersal of wastes to surroundings leads to the pollution of the environment, particularly air and water.

In 2005 GHG emissions generated by domestic animals equated to about 5.1 million tons in CO_2 eq. About 0.5 million tons of this come from manure.

The Ministry of Ecology and Natural Resources installed biogas facilities in 4 regions of Azerbaijan as part of pilot projects for public awareness-raising purposes.

At present a uniform project proposal uniting a number of farming facilities on the production of biogas from manure has been developed by the Ministry of Agriculture.

In addition, GHG emissions can also be reduced as a result of processing dry wastes generated from agricultural plants.

4.3.5. Municipal and industrial wastes

In Azerbaijan wastes have always posed a critical environmental problem. Collection, transportation and land filling of wastes pose a serious sanitary problem to the environment including pollution of water, soil and air. The present tempo of economic development, urbanization and population growth have brought about an increase in the amount of wastes.

According to estimations, the amount of wastes will reach 13 million tons in 2025. At present there are 200 landfills in Azerbaijan, with a total area of over 900 hectares.

About 1.5 million tons of municipal waste is generated in Azerbaijan, 50% of which is produced in and around the capital city. There are 4 designated litter disposal sites around Baku. The largest of them is Balakhani litter disposal site.

Presently, a number of projects on waste management are being implemented. A contract has been signed with the Japanese company Mitsui on the construction of a waste incineration plant near the Balakhani landfill.

Along with solid wastes, the issue of methane gas generated by wastewater remains problematic.

4.3.6. Forest sector

Forests play an important role in the improvement of the quality of soil, air and water. At present, the total area of forests in Azerbaijan is 1178.5 thousand hectares, or 11.6% of the country's land area. The per capita share of forest area equates to 0.14 hectares, or 2.3-3 times less than international standard. According to a 2005 assessment, some 2947 kt of carbon per year was absorbed by forests.

In compliance with the National Programme on the Rehabilitation and Expansion of Forests, adopted by a resolution of the President on 18 February 2003, forestation of 69000 hectares was called for. This comprises 44700 hectares of new forests, natural recovery actions in an area of 25000 hectares, and 14300 hectares of forest strips outside forestry lands, i.e., along new highways and railways, in lowlands, around water ponds and along coastal areas.

With a view to expanding this area further, three million manats have been allocated by a decree of the President for forest rehabilitation and forestation.

4.4. PARTICIPATION IN THE CLEANER DEVELOPMENT MECHANISM OF THE KYOTO PROTOCOL

The National Parliament ratified the Kyoto Protocol to the UN Framework Convention on Climate Change on 18 July 2000. Azerbaijan voluntarily participates in CDM activities under this Protocol as a non-Annex 1 member of the Convention.

By a resolution of the President dated 1 April 2005, the Ministry of Ecology and Natural Resources was appointed as Designated National Authority (DNA) for the Kyoto Protocol. The Republic declared its voluntary participation in CDM and support for international initiatives in this area. In order to enhance effectiveness of actions under CDM projects prescribed by the Kyoto Protocol, proposals on amendments and additions to the environmental legislation were prepared and submitted to the Cabinet of Ministers. As DNA , the Ministry of Ecology and Natural Resources signed memoranda on international cooperation on CDM with the governments of Denmark and Germany, and UNDP. Discussions concerning cooperation in CDM were also held with other countries.

After the Kyoto protocol took effect in 2005, interest in CDM projects has risen in Azerbaijan. Presently, a number of projects have been prepared on GHG reduction in various sectors in Azerbaijan (Table 4.4-1).

Table 4.4-1. Project proposals on CDM registered by NFP

#	Sector	Number of project proposals	GHG reduction rate, thousand tons/year CO_2 eq.
1	Energy, including	17	13675,4
2	Alternative energy	9	1775,0
3	Agriculture	2	3331,0
4	Wastes	3	287,1
5	Forestation and afforestation	3	62,7
	Total	**34**	**19131,2**

The Ministry of Ecology and Natural Resources has submitted Endorsement Letters on 21 CDM projects from various ministries and agencies and a Letter of Support on one project. Three new methodologies in the Energy sector were prepared and approved by the Executive Council on CDM.

34 CDM project proposals that were prepared in the Energy, Agriculture, Forestry and Waste sectors and submitted to NFP for approval are presented in Table 4.4-2.

Table 4.4-2. CDM projects registered by DNA

Registration №	Project title	Project proponent	Expected SER (thousand t CO_2 eq)	Project status
1	2	3	4	5
1.	Collection of methane gas from Sumgayit landfill	ADES company	75	PIN
2.	Forest planting in the territory of Azerbaijan	Forestry Development Department	42	PIN
3.	Use of thermal waters in Khudat for heating	Shollar Thermal Resort MMC	10	PIN
4.	Enhancement of power generation capacity of Azerbaijan SRES	Azerenerji OSC	820	PDD, LoA
5.	Construction of "Ordubad" HES	Azerenerji OSC	173	PDD
6.	Reduction of natural gas from compressor stations and gas distribution pipelines	Azerigaz CSC	51.2	PDD
7.	Reduction of carbon emissions by the capture of methane gas generated from landfills	Azerbaijan-German joint venture	127.1	PIN
8.	Collection of gases generated from grifons in the Caspian Sea	Aysberg	8800	PIN
9.	Collection of associated low pressure gas from "Gunashli" field	SOCAR	600	PDD
10.	Collection of gases from decommissioned wells at "Balakhanı" oil and gas field	SOCAR	6,1	PIN
11.	Collection of associated low pressure gas at Puta-Qushkhana Oil-Gas Mining Department named after A.Amirov	SOCAR	0,8	PIN
12.	Power transmitting system	Azerenerji OSC	500	PIN
13.	Construction of Sumqayıt TES	Azerenerji OSC	700	PDD, LoA
14.	Collection and transportation of associated low pressure gas from «Neft Dashlary » field	SOCAR	400	PIN, LoE
15.	Collection and transportation of associated low pressure gas from «Palchyg Pilpilasy » field	SOCAR	31.0	PIN, LoE
16.	Reconstruction of «Azerneftyag» Oil Refining Plant	SOCAR	52	PIN, LoE
17.	Modernizing the kiln at H. Aliyev Baku Oil Refining Plant	SOCAR	179.1	PIN, LoE
18.	Modernizing Garadag OJSC	SOCAR	11	PIN, LoE
19.	Recovery of oil contaminated lands at oil fields of SOCAR in the Absheron peninsula	SOCAR	15	PIN, LoE
20.	Collection and transportation of gas from abandoned wells of oil fields of SOCAR	SOCAR	7	PIN, LoE

21	Construction of a municipal waste processing plant	Baku city Executive Power	85	PIN
22	Construction of Khudafarin Water Junction and Hydro-Electric Station	Azerenerji OSC	35	PDD
23	Construction of 10 MWt Sangachal Wind Energy Park	Azerenerji OSC	31	PIN
24	Generation of biogas from animal husbandry	Ministry of Agriculture	61	PIN
25	Construction of Giz Galasi Water Junction and Hydro-Electric Station	Azərenerji	21	PIN
26	Application of alternative energy technologies at agencies of MENR (wind and solar)	MENR	1200	PIN
27	Heating houses with biogas generated from wastes at non-gasified villages of Samur-Yalama economic zone	MENR	3270	PIN
28	Collection of associated gas at Bibiheybat oil field	SOCAR	2,2	PİN
29	Implementation of carbon gas removal from GHG through forestation of 15 hectares in the territory of Bobla municipality of Lerik region	NGO	0,7	PIN
30	Forestation in the basin of the Kura-Araz river	MENR	20	PIN
31	Construction of Mil Hydro-Electric Station	Azerenerji OSC	103	PIN
32	Construction of Gilanchay Hydro-Electric Station	Azerenerji OSC	173	PIN
33	Construction of Khizi Wind-Electric Station	Solar Energy private Co.	29	PIN
34	Sustainable use of electric and heating energy at electric stations	Azerenerji OSC	1500	PIN

5. ASSESSMENT OF VULNERABILITY TO CLIMATE CHANGE AND ADAPTATION MEASURES

5.1. CLIMATE OF AZERBAIJAN AND ITS CHANGE PROJECTIONS

In the Fourth Assessment Report of Intergovernmental Panel on Climate Change, published in 2007, observations on all continents and in many of the oceans showed that many natural systems including hydrological cycle, water availability, water quality and water supply, are impacted by human-induced climate change. Air composition also changes as a result of human activities.

In parallel with naturally-occurring climate change, the rate of these changes is accelerating.

The report finds that climate change in Europe, the Caucasus and Central Asia is likely to bring about high temperatures, droughts and depletion of water resources, as well as a decline in the potential of hydroenergy, summer tourism and horticulture.

Economies in transition and least-developed countries are being disproportionately impacted. They are also having a hard time carrying out adaptation measures due to their relative poverty.

The report calls on countries to develop a national strategy on adaptation and integration of climate change aspects into activities that engage all national stakeholders.

Temperature data from the National Hydrometeorology Department of MENR for 1991-2000 showed that the mean temperature had risen by 0.41^0C–three times higher than that of the longer period 1961 to 1990 ($+0.34^0$C). This finding is consistent with the results derived from climate modeling.

The Climate Change and Ozone Center analyzed average annual temperature and precipitation anomalies for the period 1991 to 2000 in 7 regions: Kura-Araz, Guba-Khachmaz, Shaki-Zagatala, Ganja-Gazhakh, Lankaran-Astara, Nakhchivan, Absheron. Data from 28 stations were used for the assessment of average annual temperature and rainfall anomalies.

Compared to the level of 1961-90, for the past 10 years, temperature anomalies in the Kura-Araz Lowland ranged from -1.12^0C (Bilasuvar, 1993) to $+1.91^0$C (Mingachevir, 2000). The average temperature anomaly in Kura-Araz lowland was $+0.49^0$C.

Temperature anomalies in Guba-Khachmaz region ranged from -1.16^0C (Guba, 1993) to $+1.72^0$C (Guba, 2000). The average annual temperature anomaly was about $+0.48^0$C.

In Shaki-Zagatala, temperature anomalies ranged from $–1.26^0$C (Maraza, 1992) to $+1.63^0$C (Oghuz, 1999), for an average of $+0.48^0$C.

Temperature anomalies in Ganja-Gazakh region ranged from -1.1^0C (Gadabay, 1993) to $+1.84^0$C (Ganja, 1998). The temperature difference from the norm level was about $+0.74^0$C.

In the Southern region, temperature anomalies ranged from -1.08^0C (Astara, 1993) to $+1.37^0$C (Goytapa, 1998). The average was about $+0.43^0$ C.

In **Nakhchivan** anomalies ranged from –2.07°C (Nakhchivan, 1993) to +1.78°C (Ordubad, 2000), for an average of $+0.47^0$ C. (Figure 5.1-1).

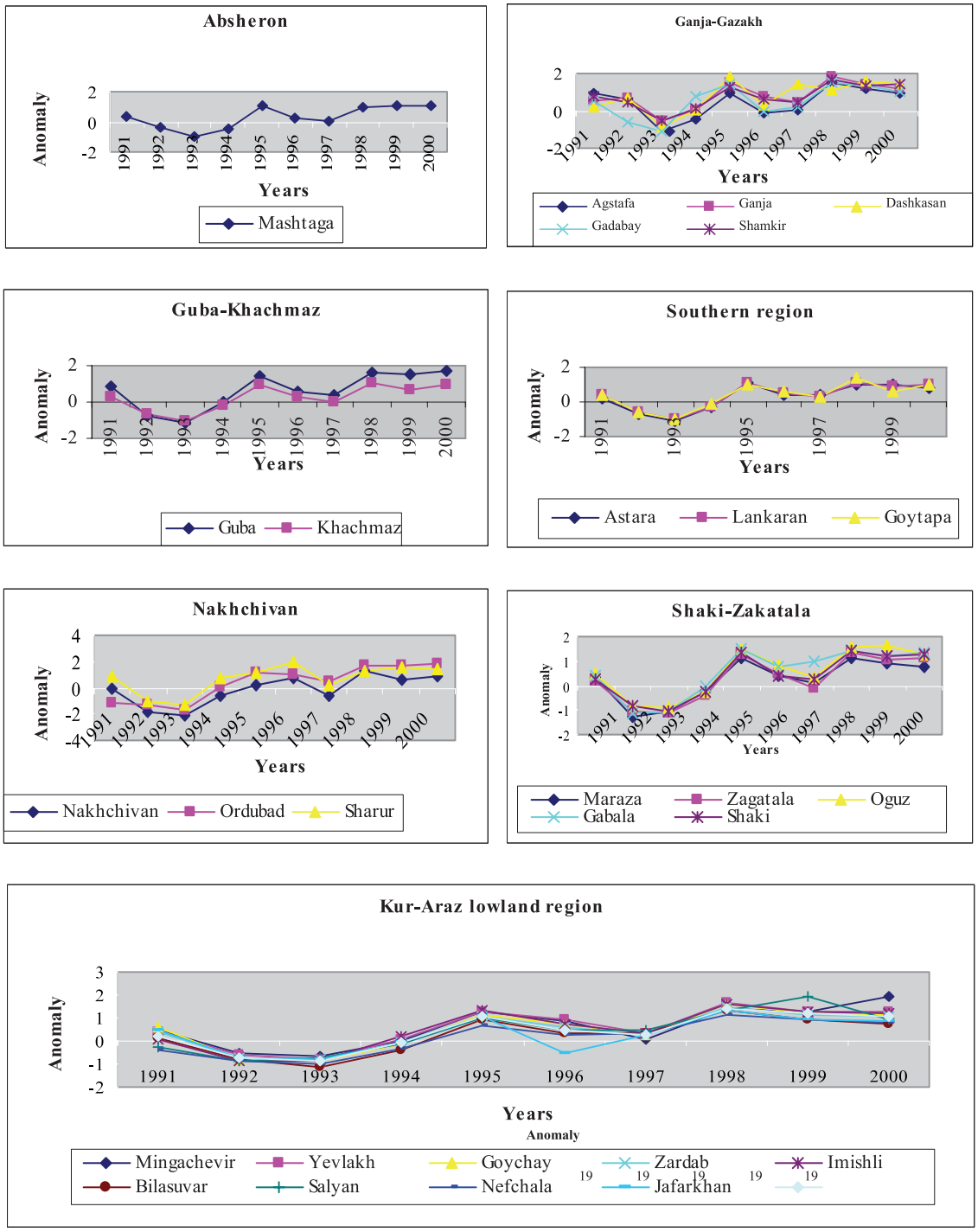


Figure 5.1-1. Temperature anomaly in Azerbaijan for the period 1991-2000 (compared to the level 1961-1990 taken as norm)

The figure shows an increase in the average annual temperature throughout Azerbaijan after 1995 and a drastic increase took place in 1998-2000. The highest level was observed in 1998.

For the past 10 years the average annual rainfall level was below the norm by 14.3% in Kura-Araz Lowland, by 2.6% in Guba-Khachmaz region, by 6.4% in Shaki-Zagatala region, by 17.7% in Ganja-Gazakh, by 17.1% in Nakhchivan and by 1.2% in the Southern region (Figure 5.1-2).

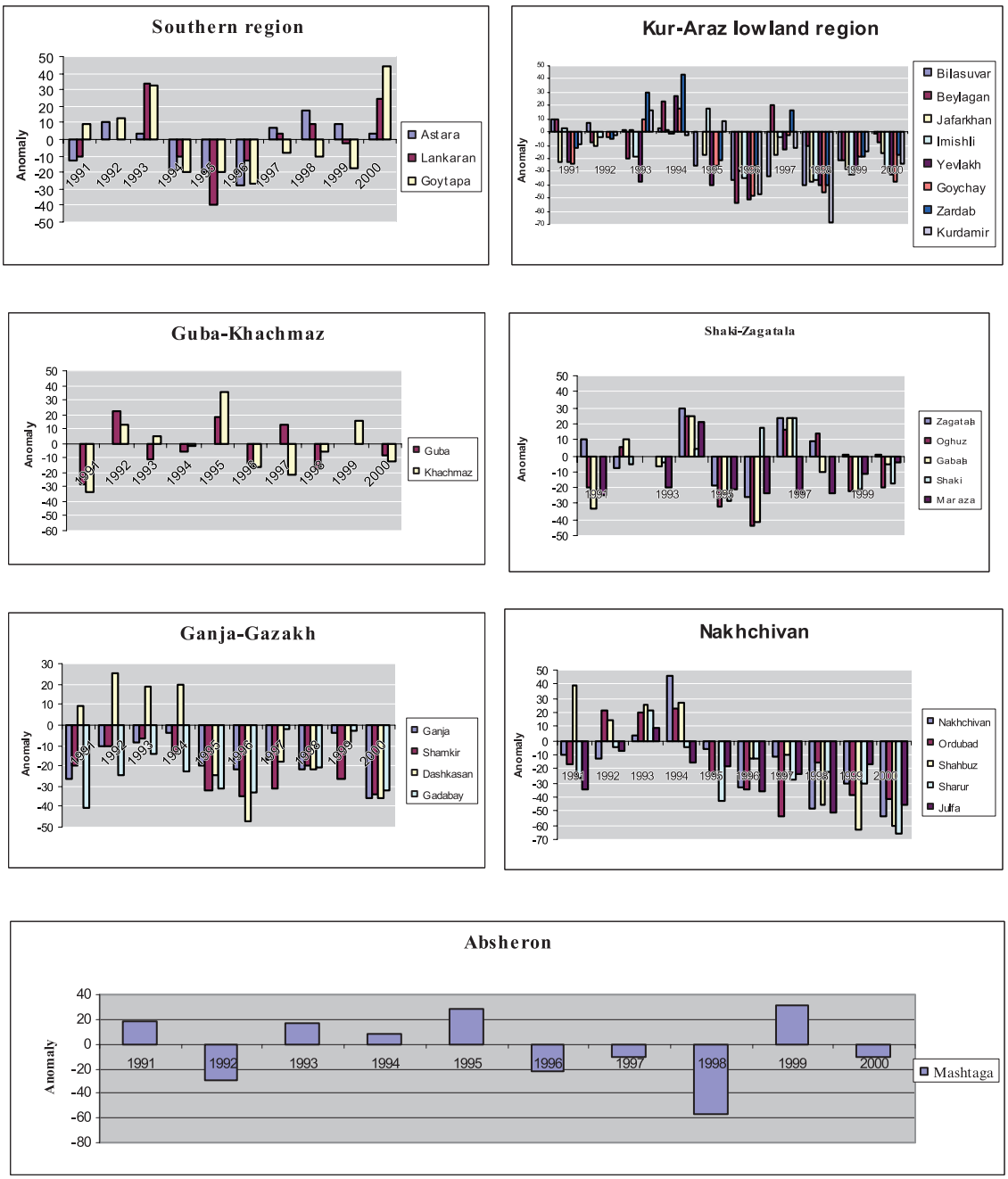


Figure 5.1-2. Rainfall anomaly in Azerbaijan for the period 1991-2000 (compared to the level 1961-1990 taken as norm)

In summary, for the past 10 years the rainfall level in the country area reduced by 9.9%.

5.2. CLIMATE SCENARIO

The climate scenario was prepared based on the «PRECİS 1.4» (Providing Regional Climates for Impact Studies) modeling system developed by the UK's Hadley Centre for Climate Change.

Options were developed for Azerbaijan given a variety of emissions scenarios determined based on current Global Circulation Models, IPCC recommendations and the Hadley Center's expertise with PRECIS modeling in Turkey, Georgia, Azerbaijan, Armenia. The present ECHAM4 data were selected as boundary conditions for the period 1960-2100 according to the A2 General Circulation

Model developed by Max Planck Institute. An assessment was made for 3 periods, based on the following boundary conditions:

- First period, covering 1960-90, baseline climate year;
- Second scenario period, 2020 to 2050;
- Third scenario period, 2070-2100.

For the first time, as a result of the assessment, data widely characterizing past and future climate were derived. The data were analyzed by means of special visualization systems (XCONV, VCDAT, IDV, GRADS, etc.).

The IPCC's Special Report on Emissions Scenarios specifies scenarios in declining order as A1FI, A2, B2 and B1. Emissions scenarios were primarily developed with relevance to demography, economy, technology, energy, agricultural development (Figure 5.2-1). According to the emissions scenarios if CO_2 emissions double, the global temperature will rise from 2^0C to 5^0C. Due to its geographical position the mean temperature increase in Azerbaijan will be almost equal to the global temperature rise.

5.2.1. Climate of the baseline 1961-1990 period and verification of the model

The verification of the model was made based on data for the period 1961-90. Due to elevation, a decrease in temperature is observed in the Greater Caucasus, Lesser Caucasus and Talish mountains. In higher mountain zones, the temperature falls to -2^0C and -5^0C. In lowlands, the temperature is 14^0C to 16^0C, which is consistent with observations. However, in some areas even higher temperature levels are observed. The verification of the model in the region was made based on CRU (Climatic Research Unit, //www.cru.uea.ac.uk./cru/data) data as recommended by Hadley Center.

The difference between CRU data on Azerbaijan, and the Caucasus as a whole, varies from -0.5^0C to +1.5^0C. This means that the PRECİS model produces slightly higher temperatures than what is observed in reality within country's boundary conditions. This difference is greater on the eastern coast of the Caspian Sea (–3^0C- +4^0C). In Absheron in the East, in the Central lowland areas and in parts of Gazakh-Ganja zone, the temperature difference in comparison with modeling data is +1.5^0C. In other parts of the country the difference is +0.5^0C.

The distribution of rainfall almost matches the model data. The lowest precipitation level is observed in Absheron-Gobustan and Nakhchivan AR. Rainfall increases in mountainous and foothill regions. The maximum level of rainfall is observed in Lankaran-Astara zone and the southern slopes of the Greater Caucasus. The quantitative data for precipitation are consistent with climate data. The level of rainfall is 300mm in the Absheron-Gobustan zone. In lowland areas it varies between 300 and 600mm. In the Greater Caucasus the rainfall level is considerably higher than the norm (1500-1800mm). In Talish zone the rainfall level is very low. Rainfall in Lankaran-Astara zone was not taken into account.

In summary, the climate of the baseline period (1961-1990) was quite accurately simulated by the PRECİS model.

5.2.2. Climate scenario for 2021-2050

According to the PRECİS model, the average annual temperature increase in 2021-2050 will amount to 1.5^0C -1.6^0C (Figure 5.2-1). In the coastal zone and the western part of Nakhchivan AR, the increase will be 1.7^0C. The temperature increase in the first half of the century might be about 0.3^0C per decade. Since the actual temperature rise in Azerbaijan 1990-2000 was about 0.4^0, the data provided by the model are consistent with observed reality.

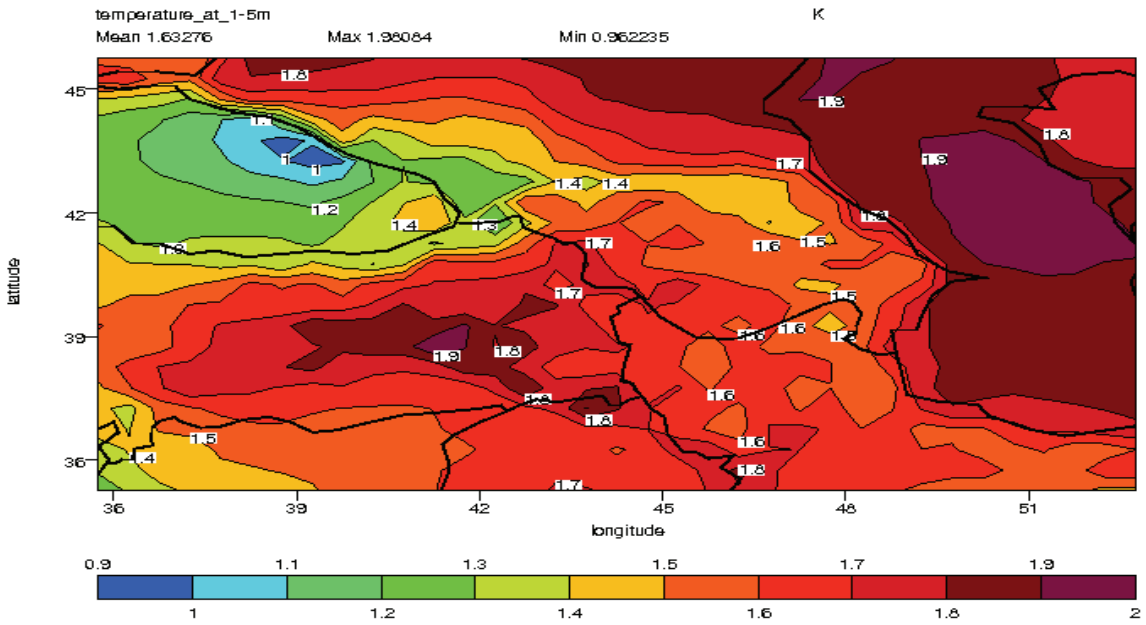


Figure 5.2-1. Average annual temperature increase in the region (difference between 2021-2050 and 1961-1990)

Rainfall in 2021-2050 will increase by 10-20% compared to the period 1961-1990. This includes increases of 0-10% in Nakhchivan AR and 20% in the eastern part of the country. No decrease in rainfall takes place in the Kura-Araz basin (Figure 5.2-2).

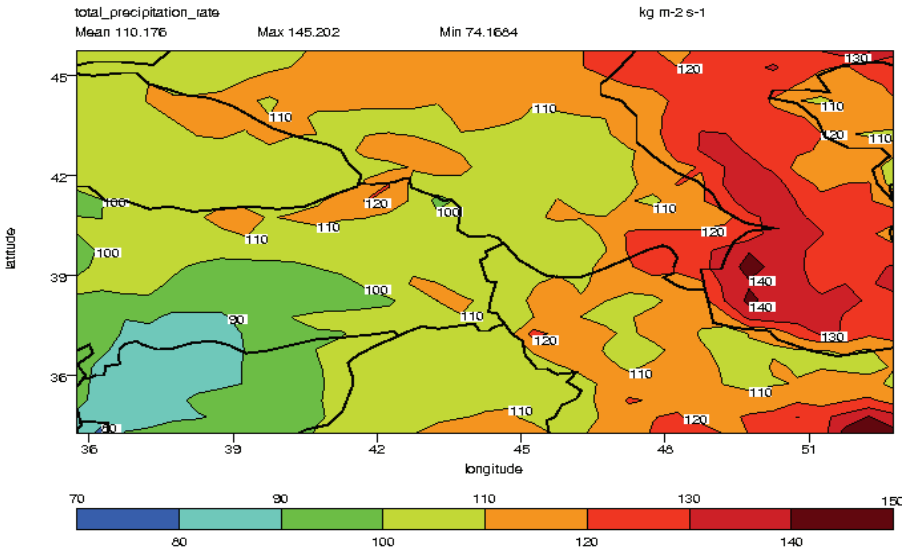


Figure 5.2-2. Rainfall changes (2021-2050 compared to the 1961-1990 period, in percent)

According to this scenario, the difference between rainfall and potential evaporation will increase from 0.4 to 1.2 mm per day in the entire Kura-Araz basin. Water supply increases in the 2050s and starts to decrease afterwards.

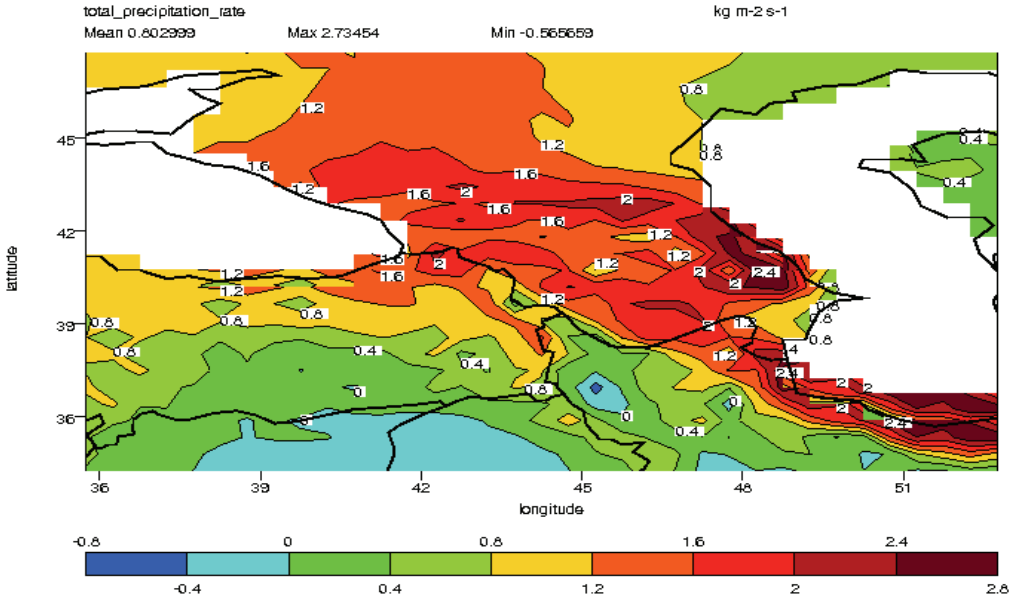


Figure 5.2-3. Change in the difference between rainfall and potential evaporation within the scenario period compared to the baseline period (mm per day)

5.2.3. Climate scenario for 2071-2100

According to the PRECİS model, temperatures simulated for 2071-2100 rise by 3^0C - 6^0C, while in most parts of the country's area the temperature rises by 5^0C compared to temperatures in 1961-1990. In Nakhchivan AR the rise is even higher, at 5.4^0C – 5.7^0C.

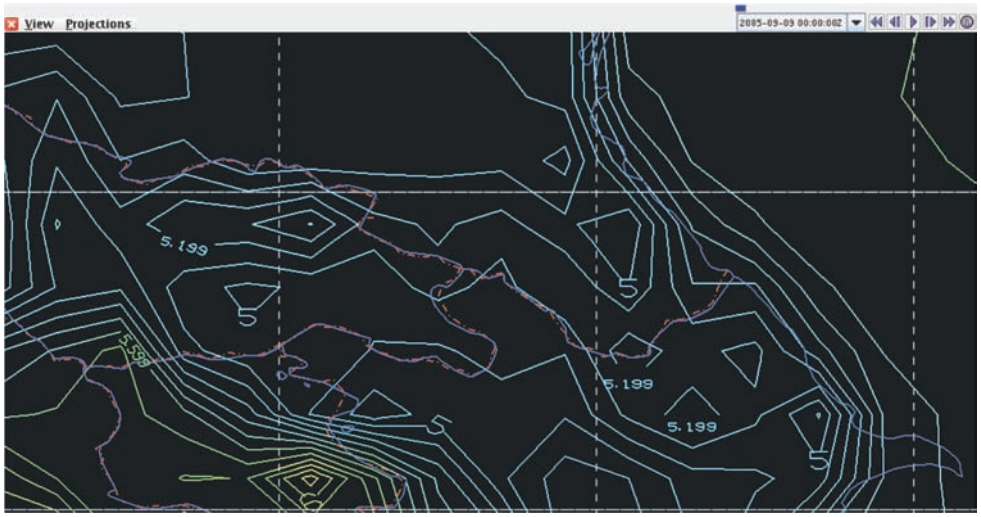


Figure 5.2-4. Average annual temperature increase in the region (in 2071-2100 compared to the 1961-1990 period)

Maximum temperatures rise by 2-7^0C. If at present the maximum temperatures equate to 44-46^0C, during the period in question they might accordingly rise to 47-53^0C. Changes in rainfall are presented in Figure 5.2-5.

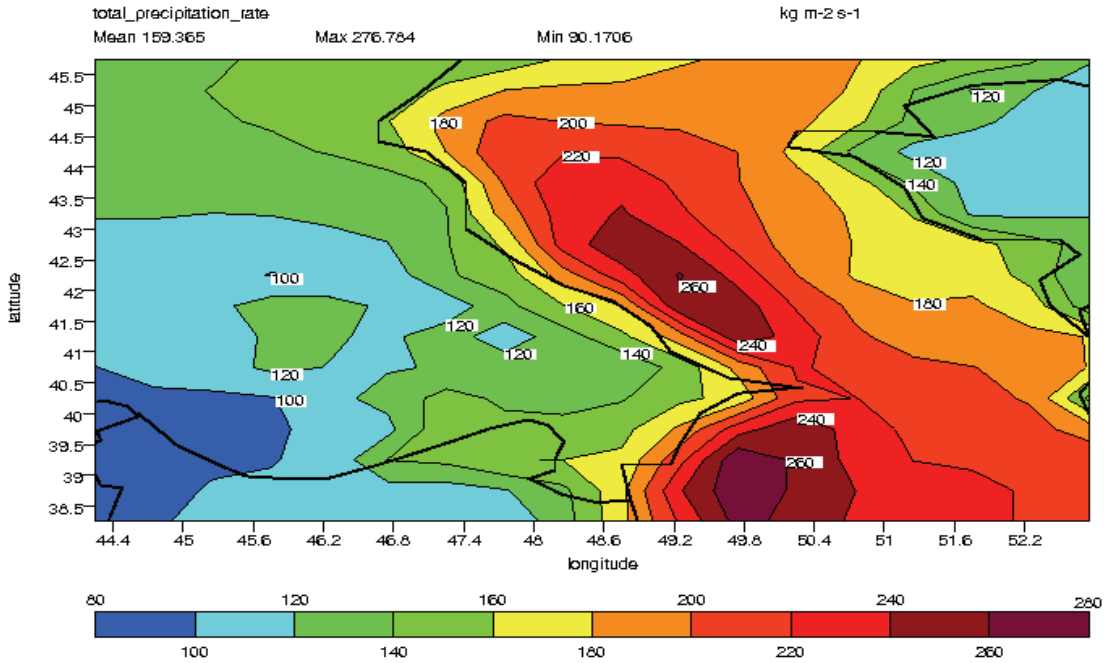


Figure 5.2-5. Changes in rainfall (in 2071-2100 compared to the baseline period, in percent)

The level of rainfall in the country area increases from West to East by 20% to 80%. Only in Nakhchivan AR the level of rainfall is forecast to fall, by 20%. Model rainfall increase data on the Caspian Sea and surrounding regions raises some doubts. Therefore, other boundary conditions should necessarily be applied to the rainfall scenario.

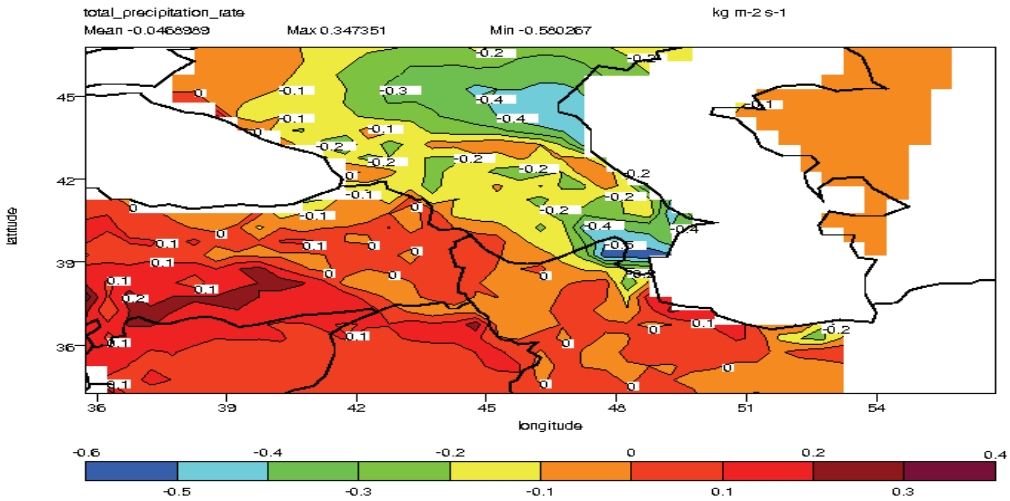


Figure 5.2-6. Change in the difference between rainfall and potential evaporation in the region within the scenario period compared to the baseline period (mm per day)

5.3. ASSESSMENT OF VULNERABILITY TO CLIMATE CHANGE AND ADAPTATION MEASURES

The assessment of vulnerability to climate change and adequate adaptation measures were developed based on data from various sources: the Initial National Communication on Agriculture, Caspian Sea Areas and Human Health, other existing literature, evaluations by experts and the accepted PRECİS 1.4 model.

5.3.1. Water resources

5.3.1.1. Present status of water resources of the country

Water resources of the country amount to about 39 km^3. About 29.3 km^3 of these are surface waters and 8.8 km^3 are groundwater. Although surface waters are now widely used for various purposes, the potential of groundwater is not widely exploited. The various lakes found in the country, the water impoundments regulating between high and low seasons, and glaciers can play an important role in the resolution of water crises likely to occur as a result of increasing demand for water and climate change effects. Their use should become part of adaptation measures.

Surface waters. Only 25-30 % of the country's surface water resources originate from within its borders. The per capita share of water resources is about 1000 m^3 per year, which places Azerbaijan among countries with the lowest available water resources.

Water resources play an important role in the country's economy. For agriculture alone, 10-12 km^3 of water is annually drawn from the rivers. Most parts of the country experience shortages of water, largely due to uneven seasonal and geographical distribution. During the vegetation period, the flow of rivers falls by 5-20%, depending on the region. While water shortfall is observed during low water seasons, in high water seasons, inundations and flash floods often take place. In recent years the number of these disasters has increased. (Figure 5.3-1).

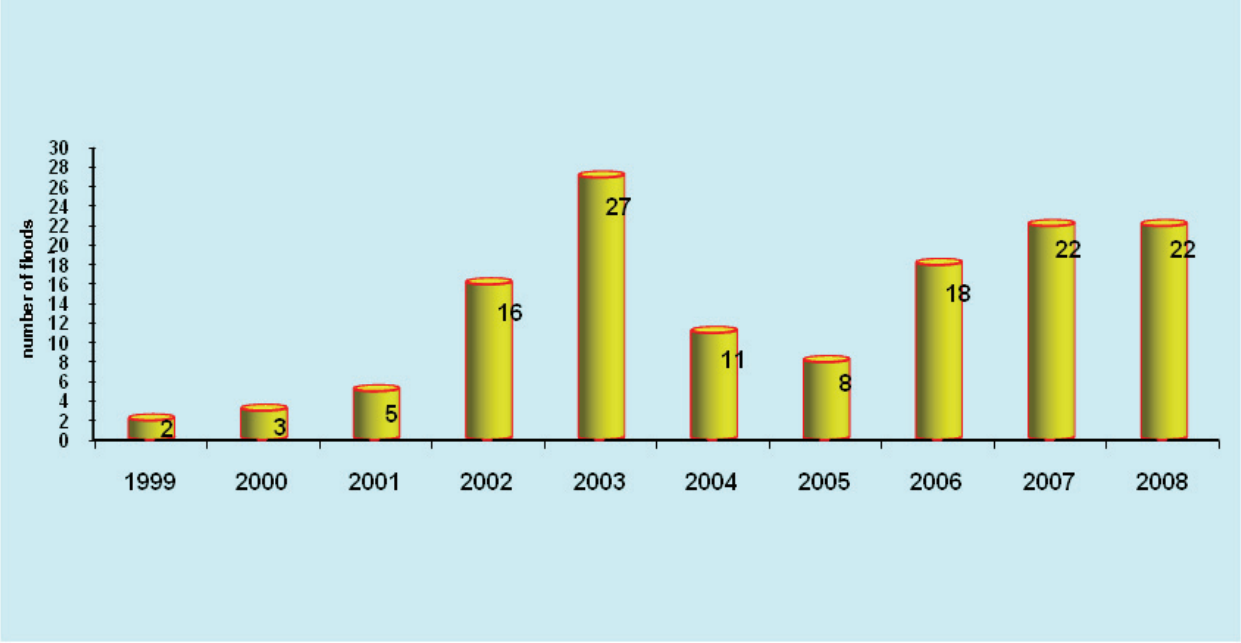


Figure 5.3-1. Trend of floods in 1999-2008

After 1993, a rise of groundwater (a direct result of fluctuations of the Caspian Sea level) caused flooding along the Kura River encompassing a distance of 200 km from the stream bed. The villages located along the river bank and riparian areas of Salyan, Neftchala, Sabirabad and Shirvan are subject to regular inundations. Serious damage is often caused to large industries of national importance, farming facilities, gardens and housing (Figure 5.3-2).

Figure 5.3-2. Flood of the Kura river observed in the territory of Salyan region in 2003

The Greater and Lesser Caucasus mountain systems, which occupy about half of the country's area, belong to the category of world areas with the highest incidents of flooding. Floods are most prevalent on the southern slope of the Great Caucasus and high mountainous zone of Nakhchivan AR. Flood damage estimated at 18-25 million US dollars is caused to the country's economy annually. Impending climate change could increase the recurrence rate of inundations and cause serious hardship in the future.

Glaciers. The main glacier areas in Azerbaijan are found in the Gusarchay Basin in the Greater Caucasus (Figure 5.3-3 and Figure 5.3-4). Over the last 110 years the area of glaciers has decreased from 4.9 km^2 to 2.4 km^2 and their lower boundaries are 3500 m above the sea level on average.

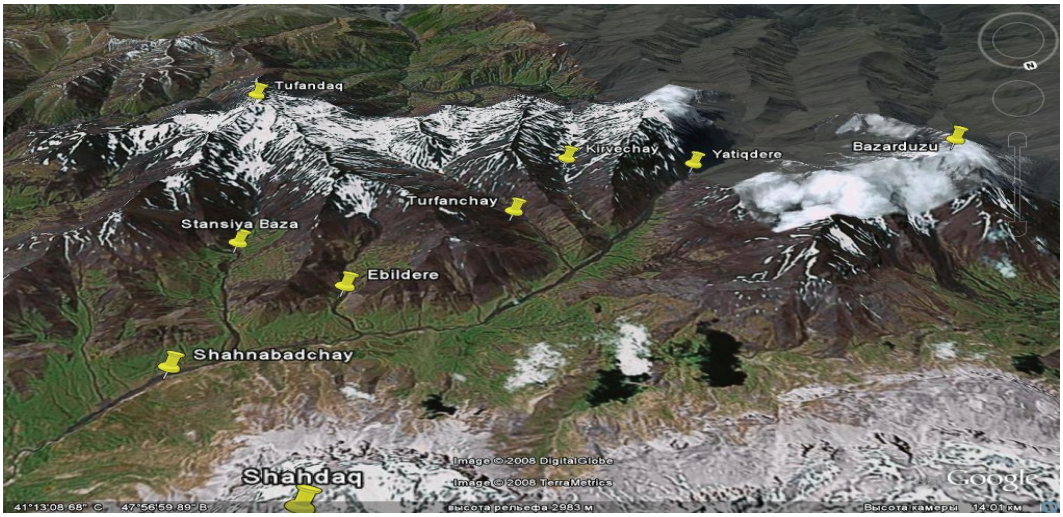


Figure 5.3-3. View of glaciers of Gusarchay basin from satellite

Figure 5.3-4. Lower part of Mahmuddara glaciers (3300 m above sea level)

Groundwater originates in foothill areas of the Greater and Lesser Caucasus and lowland areas, Nakhchivan AR and Talish zone and constitute 24 million m^3 per day (8,8 km^3 per year). Presently, only 5 million m^3 per day or 20% of these resources are tapped, suggesting high potential for groundwater use in low water seasons.

5.3.1.2 Water resources impact assessment and adequate adaptation measures

Vulnerability of water resources to climate change, as shown in the Initial National Communication, was simulated for 2021-2050 and 2071-2100 based on the PRECİS 1.4 model and recently-updated statistical models that reflect the dependence of river flows on meteorological factors. Natural water resources are gradually diminishing, leading to more frequent water shortages, and this trend will continue. Water shortages today happen mostly through leakages in distribution systems. If these are not mitigated, the situation might be aggravated in the future. According to the simulated data, the volume of natural water resources will not change significantly. The reduction of water resources in the Araz Basin will be compensated for by an increase in flows into the Caspian Sea from rivers in the eastern part of the country. In 2071-2100, water resources will be reduced by 10%, for a total of 26.3 km^3. The shortage will amount to 4.0 km^3 in the first period and 10.3 km^3 in the second, 1.5- 3.0 times higher than the baseline level. The growth in population by 1.5-2.0 times will significantly constrain the water supply for the population.

The increase of precipitation during 2021-2050 and 2071-2100 shown by the PRECIS 1.4 model (particularly in the East) is the cause of some doubt. Other models indicate a future 15-20% reduction of water resources, which is confirmed in analyses of long-term trends in precipitation and run-off by regional specialists.

As is the case today, in the future the categories of agriculture, hydroenergy and water supply will be the most vulnerable:

- Taking contemporary water use as a basis, scarcity will be expected in the area of 250-300 thousand hectares, and this might result in the fall of crop yields;
- Declines in river flows might reduce energy production at HESs by 20%;
- The share of water per capita will fall by 1.5 times, and pollution will aggravate the situation.

Adaptation measures. In order to mitigate adverse effects of impending climate change, the following adaptation measures are proposed:

- reducing water leakages in water management facilities;
- introduction of additional sources of water;
- use of hydrologic cycle water, including groundwater;
- regulation of flows;
- taking protective engineering measures in stream beds of lakes and rivers against floods;
- building small HESs on mountain rivers and construction of new water impoundments;
- building small HESs on existing irrigation channels;
- clean-up of river channels, etc.

The variation of water flow by 30% (20 km^3) between seasons should be taken into account through long-term hydrology prognoses.

Table 5.3-1. Possible adaptation measures

Water balance indicators	Water volume, million m3		
	Present	2021-2050	2071-2100
Water shortage	- 2600	- 4600	- 7500
Increase in the use of groundwater	3000	3000	3000
Enhancement of water distribution system	3000	3500	3500
Treatment and use of 40% of wastewater	2000	2500	2500
Covering water shortage as a result of measures	+5400	+4400	+1500

As is seen in the above table, as a result of adaptation measures, the water shortage problem can be contained.

5.3.2. Agriculture

Of the total 8.6 million hectares of land in Azerbaijan, 4.756 million (55%) are suitable for agriculture. Of the latter, some 1796 thousand ha are under crops, with a further 221 thousand ha under perennial plants and 2694 ha thousand under sown pastures and grasses. 30% of lands in agricultural use (1429 thousand ha) are irrigated. Cereals constitute 90% of crops and 50% of perennial plants are grown in gardens.

Agriculture is the sector of economy most dependent on climate conditions.

Located in the northern end of the Earth's subtropical zone, the major part of Azerbaijan's territory is characterized by mild winter conditions and moisture shortages in summertime, with continuous droughts. Of 11 main types of climate, eight are found in Azerbaijan: from semi-desert and dry lowlands and foothills to mountain tundra in high mountainous zones [6].

The importance to agriculture of climatic conditions necessitates an assessment of the impending climate change. Agroclimate data calculated based on scenarios of the baseline year (1961-1990), GİSS, GFDL-3 and expert scenarios were thoroughly reviewed in the Initial National Communication. The present report considers data from the PRECİS 1.4 model and climate change scenarios developed for 2021-2050 and 2071-2100. Probable future crop varieties change has not been taken into consideration.

5.3.2.1. Assessment of agroclimate resources

Warming resources. It is forecast that in 2021-2050 the total of daily mean temperatures above 10^0C will rise by 100-700^0 in comparison with the baseline period, and that the number of such days will increase by 10 to 35. The highest rise will be observed in the middle and higher mountainous zones of the Great Caucasus.

In 2071-2100, the total of daily mean temperatures over 10^0C might rise by 1100-1500^0 in comparison with the baseline period and the overall duration of such days will extend by 25 to 80. The rise might be observed almost in every part of the country in this period.

As a result of these changes, the borders of the warm weather zone might move up in elevation by 150-300 m and a further 450-950 m in the first and second periods, respectively.

Moisture resources. Azerbaijan is well provided with warming resources. However, the insufficient level of precipitation and its uneven distribution during the year cause considerable problems to agriculture. This is why 85-90% of agricultural products are grown on irrigated lands.

Corrections were made to the climate scenarios in view of the vulnerability of agricultural sector to moisture conditions and taking account of uncertainties arising from the application of scenarios developed based on PRECİS 1.4 model. The Azerbaijani expert scenario for 2021-2050 from the Initial National Communication is thought to best reflect future evaporation potential.

Evaporation is forecast to rise by 15% of the baseline year level in 2021-2050. However, a simultaneous rise in rainfalls by 10 to 20% will reduce the shortage of humidity during the vegetation period (climatic water balance) by 85 to 260 mm as compared to the baseline year.

In 2071-2100 the level of precipitation is forecast to rise by 20 to 40% in most irrigated areas, while in Nakhchivan AR the rise will likely be 10-20%. The rise in the level of rainfall in the coastal zone will not exceed 40%. Taking account of the rise in air temperature and evaporation potential, the annual norm will increase by 40-180mm (20-100mm during vegetation) compared to the baseline period level.

5.3.2.2. Assessment of impact on agricultural lands and adaptation measures

Cotton. Cotton is one the primary agricultural plants of the country, but the area of cotton plantations diminished by 3 times in 2006 compared to 1985, constituting 102.8 thousand hectares. Productivity in cotton was halved compared to 1985.

The rise of warming resources during the vegetation period by 450^0 in 2021-2050 and the extension of the period with air temperature above 10^0C by 10-15 days might have a favorable impact on this crop. Presently-cultivated medium-ripening varieties might be replaced with better quality late-ripening long fiber ones. The decrease in moisture shortage during the vegetation period might contribute to productivity growth.

In 2071-2100 warming resources in cotton regions may rise by another 800-900^0, or 1200-1350^0 higher than the baseline period. This will provide conditions for the cultivation of heat-loving, late-ripening and more valuable varieties. However, a 40% increase in precipitation level is also forecast in the southern part of Kura-Araz lowland, and if part of it coincides with the product's ripening period, this will result in a loss. The forecast moisture shortage would necessitate irrigation. The productivity of cotton plantations is expected to grow by 4-5% compared to the first period.

Today's low productivity in cotton is not linked to climate change. Presently, few farmers have access to adequate fertilizers, high quality seeds, chemical substances, and equipment, and in most

areas soil conditions and water supply are unsatisfactory. The low market price for cotton further decreases farmer interest. If these bottlenecks are eliminated, future climate conditions will contribute to the development of highly productive cotton growing.

Winter wheat. Despite the fact that the duration of potential vegetation in conventional areas of cereals growing will extend due to global warming, the actual plants' vegetation will shorten by 10-15 or 20-25 days. This will make it possible to grow cereals in wider areas. In addition, early harvest of wheat followed by sowing of forage, melons, greens, etc. will make it possible to harvest two and three times a year, raising overall productivity. However, this will be greatly dependent on water supply.

In 2071-2100 both warming resources and the duration of the potential vegetation of cereals will decrease compared to the preceding period. During this period, the duration of vegetation might shorten by a further 20-25 days.

While during the baseline period warming resources met cereals-growing needs in the mountains at heights of 1600-1800m, in the future it will become possible to grow wheat at even higher altitudes. This effect will be limited in practice because of the lack of suitable lands in these areas.

As in the first period, in this period a subsequent sowing after wheat harvest might significantly raise the productivity of horticulture.

Vineyards. Although in the baseline period the upper boundary of vineyards extended to 1100-1300m, in accordance with thermal conditions of vegetation most industrially significant vineyards were located at heights of 800-900m. In 2021-2050 the borders of vineyards of industrial importance may, dependent on region, move up another 200-450m from the present 800-900m elevation. In 2071-2100 favorable conditions for plants will be available at 1400-1700m. Again, the lack of suitable lands will limit the growth of vine cropping.

Harvest on fallow vineyards is expected to rise by 4-5 times in the first period. The level of sugar in grape juice will likely rise 2-3% in the first period and 6 to 7% in the second. In both periods a slight rise (up to 1%) in the level of acid in grape juice is expected to take place.

Winter pastures. Despite the fact that climate change will be quite favorable for winter pastures, their area will not expand, and might even diminish. This will be mainly caused by soil erosion and an increasing use of lands for crops. At present, the productivity of winter pastures in the country is dependent on the natural moisture level. Therefore, future productivity has also been evaluated from the viewpoint of the forecast precipitation level.

In both periods, as a result of increased rainfall, there might be some rise in the productivity of winter pastures both in winter and spring grazing.

Despite the fact that the level of rainfall in the second period will be higher, due to an increased moisture deficit, the growth in productivity will not be higher than that of the first period. It will constitute 2-3% in both periods. An increase is also expected in spring grazing. As a result of temperature rises, the number of non-grazing days in 2021-2050 will fall to zero, and only in areas with relatively cold winters will they shorten (by 5-15 days vs. the baseline), and their number will vary between 15-35 days. In 2071-2100 the number of non-grazing days will shorten to constitute not more than 5-15 days.

Summer pastures. In both periods, the area of pastures might expand. However, due to limited availability of suitable lands in these areas this will not be a great change. The expected rise in rainfall level in these areas with humid or extremely humid conditions will have little effect on productivity growth. However, if anthropogenic pressure is not reduced, erosion processes observed there will be more intensive as a result of the rise in rainfall.

In order to mitigate the adverse effects of climate change the following adaptation measures should be taken:

- Continued work on selection and introduction of drought resistant and highly productive winter wheat varieties;
- Continued work on selection and introduction of heat-loving, drought resistant and highly productive cotton varieties;
- Restoration of conventional vineyards and expansion of their area by planting new vineyards on mountain terraces;
- Restoration of conventional tea plantation lands and creation of new plantations on favorable lands;
- Continuation and expansion of measures to prevent soil erosion and salinity, and of drought response;
- Application of water-saving technologies in irrigated lands;
- Development and implementation of government programmes to facilitate growth in the manufacture of competitive products by processing plants in the agricultural sectors;
- Creation of small processing plants for fast-rotting products in villages;
- Improvement and expansion of the existing storage system (warehouse, refrigerators, etc.) of agricultural products.

5.3.3. Climate change impact on coastal areas

The length of the Azerbaijani coastline on the Caspian Sea is 850 km. (During an extreme rise of the sea level it constituted 738.1 km.) Presently, ten administrative regions of Azerbaijan (including the Absheron Peninsula) are situated on the coast, and according to unofficial data, 4 million people are settled there. The largest cities of Azerbaijan, Baku and Sumgayit, and more than 75% of industry are situated along the coast.

Sea level fluctuations are a major cause of concern. Direct climate processes in the sea catchment area have caused fluctuations from -20.00 mBS to -34.00 mBS (absolute level) over the past 3500 years.

Analysis of various long-term prognoses of sea level fluctuations has found that none of them is particularly reliable. According to instrumental observations, the sea level has fluctuated -25.00 to -30.00 mBS since 1830 (Figure 5.3-5).

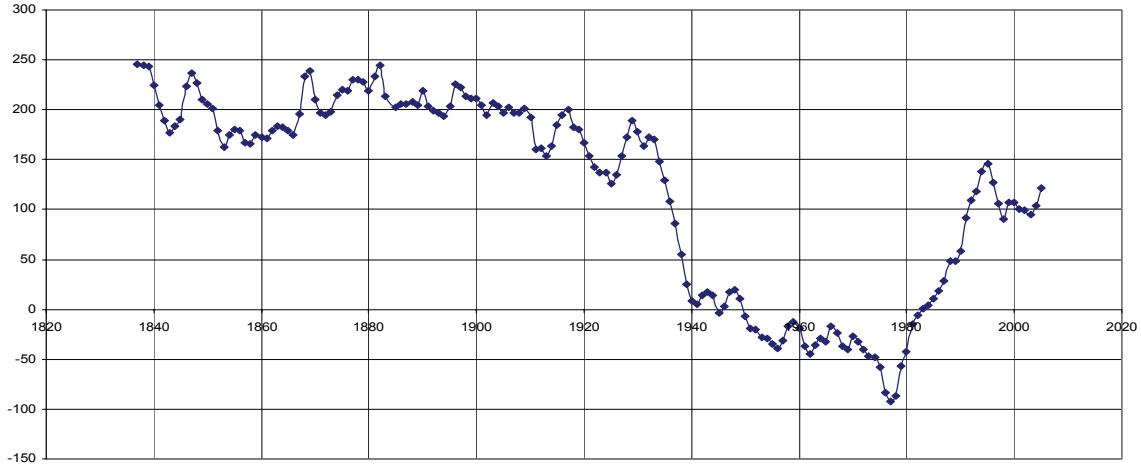


Figure 5.3-5. Results of instrumental observations over the Caspian sea level

The above sea level extremes (-25.00 and -30.00 mBS) can be accepted as the highest and lowest levels of the sea in the immediate future. A level of -28.00 mBS was taken as the zero level of the Caspian Sea by the USSR starting in 1961.

Upper level: -25.00 mBs. As the sea level rises, the more area will be inundated on the eastern shores, and consequently, the surface will expand and evaporation will increase by 25-30 km^3 annually. As a result, the sea level will fall by 7-8 cm annually. In other words, the sea level will be regulating itself. Rivers flowing into the Caspian Sea will lose 20-25 km^3 of water annually as a result of anthropogenic impact, mainly because of water irreversibly drawn for various purposes. In these circumstances a rise in sea level above -25.00 mBS is improbable.

Lower level: -30.00 mBS. Research on developments in atmospheric processes above the Caspian Sea basin shows that current inflow levels will continue for another 30-40 years. Forecasts also show a rise in rainfall in the basin until the end of this century. Thus the sea level will probably not fall below -30.00 mBS.

Based on the above findings, it might be expected that in 2030-2040 the Caspian Sea level will reach a threshold of -25.0 mBS. Even with the projected increase in precipitation in 2071-2100, it can be concluded that the sea level will not breach this threshold.

The 500 km^2 of land that has been subjected to flooding since 1978 contains 50 human settlements, 250 industrial plants, 60 km of roads, 10 km of railway, 40 thousand hectares of winter pastures, 10 thousand hectares of irrigated lands, and resorts and recreation centers for a total of 200 thousand people. The damage caused to economy by flooding is estimated at 2 to 2.5 billion US dollars since 1978. [3, 8, 9].

The rise of the sea level has also had negative effects on demography and social processes. Inundation of human settlements on the Absheron Peninsula has led to recurrent pollution, and consequently, to bioresources reduction and a decline in biocenosis. The expected sea level rise in the future might aggravate the problem further. The warming of the sea water because of climate change might diminish spawning areas of fish in riverbeds and coastal areas and push forward the start of the spawning period. Given the adaptation ability of fish, it can be expected that there would be no threat posed. [7]

If the Caspian Sea level reaches its top (- 25.00 mBS), this might result in the inundation of another 825.1 km^2 of coastal areas. Estimations of the area of inundated lands at a sea level of -26.5mBS (observed in 1995) and a forecast sea level (-25.0mBS) in the coastal zone are given in Table 5.3-2.

Table 5.3-2. Area of inundated lands at two different levels of the Caspian sea, by zones

Zone	Length of the coastline, km	Inundated area, km^2	
		-26.50 mBS	-25.00 mBS
From the Samur river to the Absheron peninsula	152.4	42.3	71.7
Absheron peninsula	289.6	38.2	60.1
From the Absheron peninsula to the Kura river mouth	208.3	372.3	1118.0
From the Kura river mouth to the Astara river	87.7	31.7	59.8
Total	**738.1**	**484.5**	**1309.6**

The maximum projected rise in the Caspian Sea level (-25.0mBS) would likely cause damage to the economy in the amount of US$ 4.1 billion. Thus the following adaptation measures are recommended:

- No further construction shall be allowed in the coastal zone, and existing operations shall be brought to the minimum possible scale. Construction of complex and expensive protective structures is only justifiable for existing facilities of national importance.
- To the greatest extent possible, industrial, recreational and other facilities including human settlements shall be relocated to secure areas.
- Construction of protective installations shall ensure local or total coverage of the area. Economically more feasible option is to construct local protective installments for the settlements.
- In the case protective installations engineers are established following principles are to be followed:
    - All protection measures shall follow low-cost high damage reduction principle;
    - All constructed installations shall have high level of durability and reliance;
    - Protection measures shall be of complex nature;
    - Installations shall play the role of filter from slops coming from the Sea and flooded areas.

5.3.4. Human health

The most common diseases in Azerbaijan are those that affect respiratory organs, blood circulation, and infectious and parasitic illnesses. Among diseases causing mortality, blood diseases rank first. Climate change has potential impacts on human health and living conditions by increasing incidence of disease and causing disastrous hydro-meteorological events (inundations, flash floods, hurricanes, etc.).

Extremely hot weather and human health. In recent years, extremely hot weather in summertime in Azerbaijan has become the norm. Heat islands in Baku and other large cities exacerbate the problem for residents. In April through September of 2003-2006 it was found that a rise of temperature in Baku of 1.5^0C resulted in an increase in the number of calls for first aid by 21.5%. Complaints related to blood, respiratory and neural diseases increased by 34.1%, 22.8% and 19.9%, respectively. In comparison with a number of European capitals, the general mortality rate in Baku is not high (3.4%), but this figure was higher for some diseases; deaths from myocardial infarction and stroke increased by 26% and 56%, respectively. If effective adaptation measures are not taken, the elevated rates of blood, respiratory and neural diseases is forecast to continue in 2021-2050, and in 2071-2100 they might significantly increase.

The increase in the elderly population in the future and the occurrence of urban heat islands might exacerbate the ill effects of the hotter weather.

Adaptation measures against extreme hot weather are as follows:

- Enhancement of the emergency response capabilities of health service systems;
- Taking account of the existing heat island effects and upcoming climate change in urban planning;
- Greening the cities in a more rapid way and planting vegetation in large areas around the cities;
- Installation of air conditioning systems in buildings and vehicles;
- Compliance with construction standards related to the environment;
- Enhancement of the extreme hot weather warning system;
- Education of the public on proper behavior during hot weather (level of activity, nutrition, clothing, etc.) and first aid response to sunstroke by means of mass media.

Infectious diseases and transmission. Malaria. Azerbaijan is one of the countries with natural hotbeds of malarial disease [10]. (Figure 5.3-6). Measures to be taken should be directed to the treatment of the remaining hotbeds of three-day malaria.

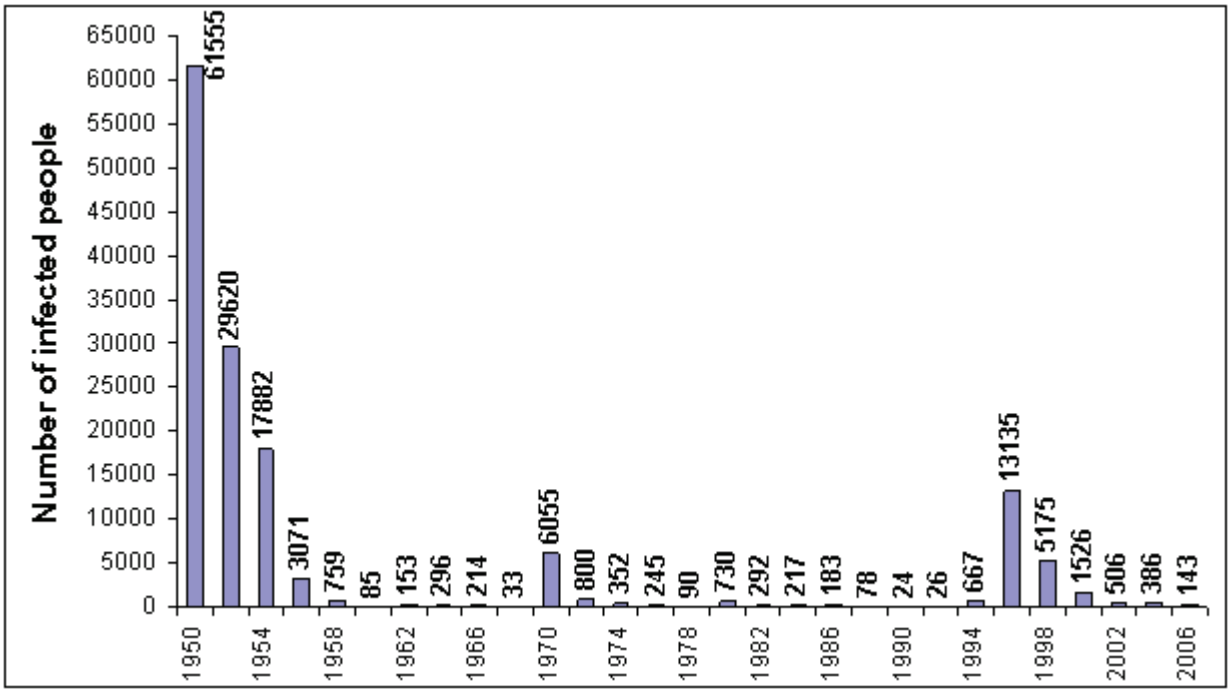


Figure 5.3-6. The number of people in Azerbaijan first time infected with malaria

The endemic malaria zone stretches from the shores of the Caspian Sea up to heights of 1000-1200m. In Nakhchivan AR, it stretches from the Araz riverbanks up to heights of 1500-1700m.

The epidemic malaria zone encompasses an area from heights of 1000-1200m up to 1500-1600m and in Nakhchivan AR from heights of 1500-1700m up to 2000m. In the latter, due to temperature conditions, long-term persistent hotbeds are impossible.

Areas higher than this are malaria-free; the air temperature is not favorable for the completion of sexual development of *Plasmodium* species.

The boundaries of both endemic and epidemic malaria will likely move to higher elevations, and the length of the epidemic season might extend, particularly in mountainous areas. Temperatures that supported sporogony in 1961-1990 were again observed in 2003-2007 at heights where this was not previously the case.

In 2003-2007, the portion of the annual epidemic season that is hotter than the accepted climate threshold was observed to have extended. The length of the extension depended on location: 5-10 days in the Kura-Araz lowland, 10-15 days along the banks of the Araz River in Nakhchivan AR, and 15-30 days at heights of 500-1200m. Throughout the period, at heights of 1200-1500m, the air temperature was favorable for sexual development of the *Plasmodium* species.

Some species of *Anopheles* mosquito are found in Azerbaijan up to a height of 2000m [11]. Impending climate change may cause the habitat boundaries to rise in elevation for heat-loving species, and the rise in temperature might lead to longer epidemic seasons. However, extension of the habitat boundaries is not the major behind this issue. This issue is best explained by the sharp decrease in the duration of the gonotrophic period and increase in the number of days above the critic temperature required for the growth of plasmodium in the Anopheles mosquito. Rise in temperature for malaria-free zones with anopheles species is more dangerous. Therefore rise in temperature in Azerbaijan can have negative impacts, especially in mountainous areas.

In 2021-2050, as a result of the rise of temperature by 1.5-1.6^{0}C, the malariagenic climatic conditions will be similar to those in 2003-2007. However, a further rise of temperature in 2071-2100 will provide conditions for the expansion of the malariagenic areas and extension of epidemic periods. On the other hand, since only 1.2% of the population lives above 1500m [12], the occurrence of new malaria hotspots there is unlikely.

Failure to take prophylactic measures, treat the disease, and detect pathogenic cases in a timely fashion significantly affects the level and spread of disease transmission. However, there is still a high probability of reducing or completely eliminating the disease through the following adaptation measures:

- Improvement of the malaria control system and adoption of long-term programmes on observation, prophylaxis and control;
- Enhancement of clinic and laboratory diagnosis and ensuring supply of effective medicines;
- Prognosis of possible epidemics, enhancement of early warning systems and elaboration of a plan on the prevention of epidemics;
- Implementation of measures on combating infection-transmitting *anopheles* mosquitoes;
- Active involvement of communities in prevention campaigns in malaria-affected or potential malaria zones, and education of community members on prophylactic measures (lectures, discussions);
- Implementation of actions on preventing the transmission of malaria from other countries.

General acute gastrointestinal infection. These rank first among infectious and parasitic diseases; annually, over 11 thousand people in Azerbaijan suffer from general acute gastrointestinal infections. Transmission mainly depends on the quality of water (both at sources and in pipelines) and food products. While these diseases were in decline for a long period, there has been a recent resurgence due to rising in air temperatures, poor-quality drinking water, flooding of human settlements and destruction of a sewerage system.

Adaptation measures against water- and food-borne diseases:

- Strengthening the system of control over water quality, water purification and enhancement of water quality;
- Increasing flood preparedness and mitigation;
- Continuation of actions on the improvement of quality drinking water supply;
- Strengthening the subsystem of control over compliance with regulations on storage of food products;
- Enhancement of public awareness-raising on sanitary issues.

Speaking about the gaps of climate change on public health it should be noted that existing studies do not encompass all sectors and data available is mainly of qualitative nature. Therefore, there is a need for thorough research in all health related areas with aim to obtain more figurative data.

Table 1.3. Main preventive adaptation measures against climate changes

Area	Goal	Measures	Approximate cost, mln. USD	Expected output
1	2	3	4	5
Water resources	Reduction and elimination of losses in power stations	Modernisation of the operational small hydropower stations (Varvara, Gusar, Guba, Sheki, Zurnabad and Mugan) and reconstruction of 3 HPS ruins (Balakan, Nugedi and Leninkend)	29.61	Production of additional electricity power of 3.08 MWts
		Construction of small HPS on the existing irrigation canals	67.3	Production of additional electricity power of 1.132 MWts
	Regulation of river currency	Construction of hydropower stations and new water reservoirs on 17 mountainous rivers in Azerbaijan (total number of 32 small HPSs)	142.0	Production of additional electricity power of 1.98 MWts
	Elimination of losses of the existing resources and their effective use	Modernisation of potable water treatment system in large cities	Wil be identified in projects	Saving potable water, improving its quality
		Identification of water losses in water pipeline systems and their repair	Wil be identified in projects	Saving potable water
		Reconstruction of main channels and irrigation systems	2450.0	
	Development and implementation of a national action plan on fighting floods	Carrying out engineering-protection measures in watercourses and flood currents of rivers	120.0	Protection of 250 places of residence, construction of infrastructure and protection of agricultural areas from erosion will be ensured

Agriculture	Increasing productivity of agricultural crops and their effective use	Continuing works on selection, introduction and the use of varieties of high-productivity agricultural crops sustainable for the expected climate changes in the farms	Wil be identified in projects	Introduction of varieties of high-productivity agricultural crops, restoration and putting into exploitation of eroded lands and collector-drainage system, continuing and enhancing melioration measures underway, ensuring storage of the output produced
	Improving the melioration status of arable lands, increasing productivity	Complex reconstruction of the melioration system	1520.0	
		Restoration of ruined forest shelter belts and plannting new ones in the area of 34 thousand ha	61.2	
	Increasing effectiveness of agriculture	Establishing small processing facilities in rural areas for perishable products	Wil be identified in projects	
		Improving and enhancing the existing storage system (storehouses, refrigerators, etc.) for agricultural products	270.0	
Coastal area	Protection of places of residence, industrial and other facilities and the infrastructure in the areas affected by the sea	Move of places of residence and industrial facilities from the areas with a risk of flood	252.0	Protection of coastal areas, places of residence, industrial and other facilities from the risk of flood and destruction; improving ecological status
		Application of engineering-protection measures for protection of recreational facilities	85.0	
	Improving ecological status of coastal areas	Cleaning the Baku bay from oil	200.0	

		pollution and solid wastes		
		Cleaning areas polluted with oil	74.0	Reducing disease and mortality cases emerging from warming of the climate to a possible extent, preventing malaria epidemy
Population's health	Cushioning negative effect of a very hot weather to human body	Planting of greenery in cities and suburbs	Wil be identified in projects	
	Prevention of malaria disease	Improving the system of measures against malaria and adoption of sustainable programs on surveillance, prevention and control.	Wil be identified in projects	
		Improving clinical and laboratory diagnostics of malaria and provision of effective preparations	Wil be identified in projects	
		Carrying out hydrotechnical and forest-melioration measures for elimination or diminishing the size of permanent and temporary water ponds	Wil be identified in projects	
		Carrying out relevant measures in permanent and temporary water ponds, which are the areas for reproduction of *anopheles* mosquitoes, transmitters of infections	Wil be identified in projects	

6. SYSTEMATIC OBSERVATION AND RESEARCH

6.1. SYSTEMATIC OBSERVATION OVER CLIMATE CHANGE

In Azerbaijan, as in any party to World Meteorological Organization, hydrometeorological observations are conducted; forecasts are made; climate, agro-climate and water resources are assessed; and changing trends are monitored.

Meteorological, agrometeorological, hydrological and oceanographic observations are conducted by the National Hydrometeorology Department of MENR. Environmental pollution observation (soil, water and air) is conducted by the National Monitoring Department of MENR. Hydrological observation of large and small lakes is conducted by the State Amelioration and Water Management OSC.

The first stationary observations in Azerbaijan were made in the 19th century. In 1830-1847 meteorological stations were opened in Baku, Nakhchivan and other areas, and climate observations started at that time. Climate data on Baku city have been available since 1848. Caspian Sea level observations have been conducted since 1830 and Kura River hydrological observations have been recorded since 1888.

In 1965, booklets on the climate of Azerbaijan were published. Observations covering the period 1880 to 1960 were included in that booklet. Data on observations throughout 1961 to 1990 were elaborated phase by phase.

6.2. PARTICIPATION OF AZERBAIJAN IN INTERNATIONAL OBSERVATION SYSTEMS

After Azerbaijan joined WMO and acceded to a number of conventions, it became eligible to take part in various international observation systems. Five stations are now linked to the Global Observation System and 18 are part of the global climate observation system. One station in Astara (GJOS/GSN) has access to the Global Surface Observation Network.

All information received from these stations is submitted to WMO and other international information centers.

Azerbaijan is also a member of the CIS intergovernmental hydrometeorological network, and agreements on hydrometeorological data exchange have been signed with neighboring countries.

6.3. STATUS OF EXISTING HYDROMETEOROLOGICAL OBSERVATION SYSTEMS AND COMPLIANCE WITH BEST PRACTICE

The meteorological surface observation network of Azerbaijan is composed of 78 stations, of which 12 are located in the territory now occupied by Armenia and are not in use. Data obtained from observations at the 58 stations presently operating are used to inform the public.

All observations conducted at meteorological stations are based on the best available practice of WMO.

In 1961-1990 the relocation of 17 stations was carried out. Weather forecast, climate and other operational data are still processed by hand; the lack of a reliable computer network between the stations makes it complicated to ensure automatic control and operational data entry into a database. A computer database contains meteorological data from 50 stations covering the period 1935 to 2000. A CLICOM system has not been introduced and there is almost no system of data use.

Data from coastal and sea-based stations are processed by computers. There are gaps in both monthly and yearly databases. Caspian Sea level serves as an indicator for monitoring change in humidity over an area of about 4 million km^2.

Glacier observations. Studies of the Bazarduzu and Shahdagh glaciers (4100-4466m) were carried out in 1936 and 1956-1959. Observation and other actions will again be taken in this area.

CO_2 emissions observations are not conducted in Azerbaijan.

Hydrological observation. Of a total of 102 stations, 75 are based on rivers, nine on water impoundments, two on lakes and one on a channel. The remaining 15 stations are located in the area occupied by Armenia. A wide range of observation data are published in the State Water Cadastre.

Space-based observations. Azerbaijan does not have its own satellites and does not finance the development of joint space programmes. Data from satellites designed for cloud analysis are received through volunteer international programmes and recorded.

Most hydrometeorological data is provided in monthly and yearly bulletins. Databases on meteorology, Caspian meteorology, water cadastre, hydrology, air pollution and agrometeorology were created starting in 1992.

Agrometeorological observations are conducted at 28 stations and 10 facilities. Data from these stations and facilities are stored as written records and their conversion to digital form is planned.

Aerial observations have been conducted at the Mashtagha station since 1936 and in Lankaran since 1953. For the past ten years, due to lack of technical capacity, there have been significant gaps in these observations. Observations at the Mashtagha station resumed in 2003.

Chemical content of rainfall has been recorded since 1991. Presently, observations are carried out at 18 stations.

Quality of atmospheric air is monitored at 27 stations in eight cities. Dust, CO_2, HOx, CO, CL, phenol and other harmful substances has been kept in computer database since 1993.

6.4. DEVELOPMENT PROJECTIONS OF SYSTEMATIC CLIMATE OBSERVATION

Some forms of terrestrial climate observation are not yet conducted in Azerbaijan, including on CO_2 emissions, snow level change, and growth of biomass and forests. Existing infrastructure would enable the development of these given the requisite financial, technical and methodological support.

Technical facilities are required for receiving coded data from satellite and for processing aerospace data in an appropriate format. To build capacity in this area, the National Programme on Development of Hydrometeorology was approved by a resolution of the President. It outlines prospects for the hydrometeorological service, strengthening capacity of climate monitoring systems for decision makers and the public. Particular attention is given to the purchase of devices and equipment meeting contemporary standards.

7. EDUCATION AND AWARENESS-RAISING

One of the most important activities in environmental protection and mitigation of climate change effects is public education and awareness-raising. Human activities can play an important role in the mitigation of GHG inducing climate change. Work is already underway in this area.

In preparation for the development of this document, representatives of media agencies, government ministries, and non-government organizations were engaged with workshops and supplied with informational materials. They were also engaged to help inform the process.

Since the preparation of the First National Communication, a number of international institutions have engaged in education and awareness-raising on climate change issues for the environmental protection sector. These have included the Canadian International Development Agency assistance to the Caspian Littoral States and regional technical assistance projects by TACIS for the implementation of commitments arising from the Kyoto Protocol. Outcomes of these projects have been published on the MENR website.

7.1. ENVIRONMENTAL ISSUES IN THE EDUCATIONAL SYSTEM

Environmental subjects have also been included into the primary, middle, middle technical and higher schools.

Specialists in climate studies and scientific basics of climate change are educated at the Geography department of Baku State University. Environmental protection programmes are also offered in other universities and institutes, particularly in technical universities and institutes.

7.2. ROLE OF THE PUBLIC AND MASS MEDIA IN PUBLIC EDUCATION AND AWARENESS-RAISING

Discussion of climate change issues at higher international fora has raised an interest in this topic in Azerbaijan. Climate change issues are addressed in nearly all the mass media, and MENR specialists and NGOs representatives have solicited ideas and proposals from the public to address the problem.

A number of companies have already started to take part in public education and awareness-raising in this area. In May 2009 International Conference on Climate Change and Management of Greenhouse Gases in Azerbaijan was organized by SOCAR under the support of MENR and the World Bank. In addition, BP, Statoil and other companies held various trainings and seminars on raising public awareness about work in this area.

7.3. MAIN REQUIREMENTS IN EDUCATION AND AWARENESS-RAISING

There remains a need to carry out a variety of education and awareness-raising activities:

- Ensuring continuous environmental education (particularly on climate change) throughout all stages of education;
- Adaptation of technical capacity to contemporary needs;
- Setting up an environmental laboratory;
- Human resources development for enhancing environmental education at middle schools;
- Creation of a resources database by expanding access to computers and internet;

- Organization of trainings for upgrading the level of experts' knowledge on climate change and preparation of programmes, manuals and visual facilities;
- Providing regular access to information for the public, to officials and institutions responsible for decision-making on climate change issues;
- Translation of the text of conventions, guidelines, resolutions, and major publications in this area into the Azeri language.

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