Ministry of Natural Resources and Environmental Protection
Republic of Belarus

FIFTH NATIONAL COMMUNICATION OF THE REPUBLIC OF BELARUS

UNDER THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

Minsk 2009

CONTENTS

LIST OF ABBREVIATIONS

UN	United Nations Organization
UNFCCC	United Nations Framework Convention on Climate Change
KP	Kyoto Protocol
IPCC	Intergovernmental Panel on Climate Change
GHG	Greenhouse gas
Belstat	National Statistic Committee
MNREP	Ministry of Natural Resources and Environmental Protection
NASB	National Academy of Sciences of Belarus
RUE Bel SRC «Ecology»	Republican Unitary Enterprise Belarusian Scientific Research Center «Ecology»
SPA	State production association
R&D	Research and development
QA	Quality assurance
QC	Quality control
LULUCF	Land use, land use change and forestry
MSW	Municipal solid waste
CO_2	Carbon dioxide
CO	Carbon monoxide
CH_4	Methane
N_2O	Nitrous oxide
NO_x	Nitrogen oxides
HFC	Hydrofluorocarbons
PFC	Perfluorocarbons
SF_6	Sulfur hexafluoride
NMC	Non-methane hydrocarbons
VNMOC	Volatile non-methane organic compounds
GDP	Gross domestic product
FER	Fuel and energy resources
RES	Renewable Energy Sources
SER	Secondary energy resources
STER	Secondary thermal energy resources
HPP	Hydroelectric power plant
t.r.f.	Ton of reference fuel
dt/ha	hundreds kilograms per hectare

PREFIXES AND MULTIPLYING FACTORS

Prefix	Symbol	Multiplicity
kilo	k	10^3
Mega	M	10^6
Giga	G	10^9
Tera	T	10^{12}
Peta	P	10^{15}

EXECUTIVE SUMMARY

With approximately 9.7 million of population, the Republic of Belarus located in the Central and Eastern Europe covers an area of 207.6 thousand square kilometers and is categorized as an economy in transition.

The Republic of Belarus signed the United Nations Framework Convention on Climate Change (UNFCCC) on June 11th 1992, ratified it on May 11th 2000 and became a Party to the UNFCCC on August 9th 2000.

On August 26th 2005, the country signed the document on joining the Kyoto Protocol to the UNFCCC and on November 24th 2005 became a Party to the Protocol.

Proposal of Belarus on making an amendment to Annex B of the Kyoto Protocol is included in the Decision 10/CMP.2 and approved by the second session of the Conference of the Parties serving as the Meeting of the Parties in Nairobi 6-17 November 2006.

In 2003, Belarus submitted the First National Communication covering the period from 1990 to 2000, and the Fourth National Communication (4NC) covering the period from 2003 to 2005 - in 2006.

The Fifth National Communication contains the results of implementation of the UNFCCC and Kyoto Protocol from 2006 up to 2009 and includes the following information: national circumstances; generalized data on inventory of the GHG emissions and removals in sectors: energy, industry, agriculture, land use change and forestry, waste; policies and measures on decrease in GHG emissions and their forecast indicators, assessment of vulnerability and adaptation of the national economy to climate change; data on newly adopted normative and legal documents in the country; data on the National Registry of Carbon Units; information on current R&D helping to reduce GHG emissions and prevent their impact on climate change.

Currently, subject to the National Strategy, the GDP growth rate across sectors of the Belarusian economy is expected to be 8 - 12% a year with outstripping growth rates in the service sphere. The economy of Belarus is characterized by a high level of the GDP energy intensity. Energy intensity is a ratio of energy equivalent to the GDP in comparable prices, which reflect actual price proportions between production and consumption.

The GDP energy intensity (according to the Concept of Energy Safety) is planned to be reduced by 31% by 2010, by 50% - by 2015 and by 60% - by 2020 compared to 2005.

Referring to Figure 1, the GDP structure has not changed considerably over the period from 2000 to 2008:

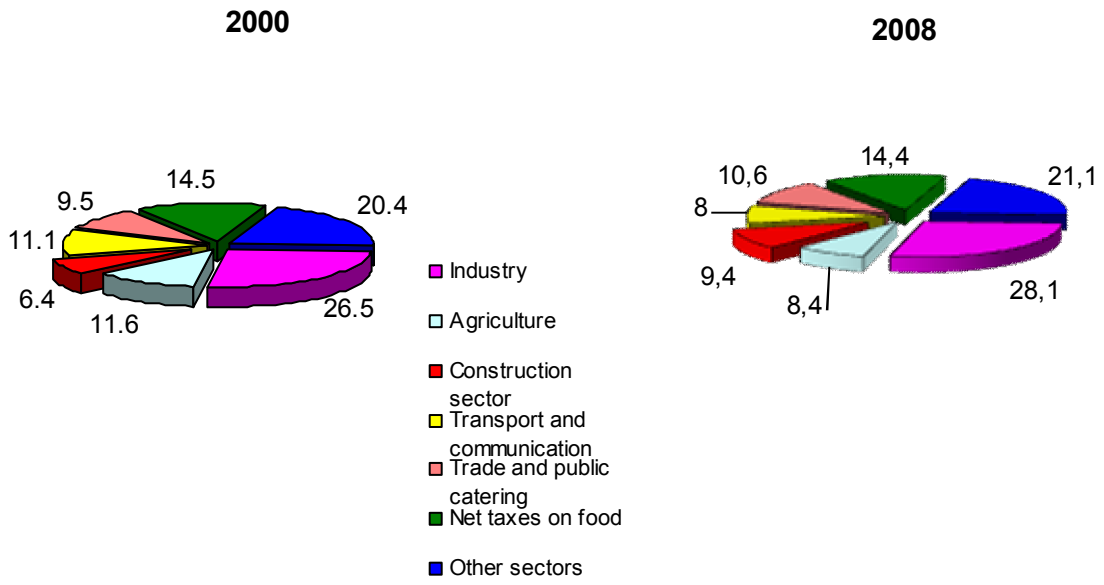

Figure 1 – Sectoral structure of the Gross Domestic Product (percentage to total)

Energy

The structure of the gross consumption of fuel and energy resources in the Republic of Belarus for the period after submission of the Fourth National Communication in 2007 has insignificantly changed, however, the trend toward the growth in use of renewable energy sources (RES) for heat and electric power generation continued.

Table 1 – Gross consumption of fuel and energy resources in 2005-2007

Types of FER	**Consumption (ths trf)**		
	2005	2006	2007
Gross FER	**37,049.0**	**40,043,0**	**38,890,0**
Boiler and furnace fuel, total	27,105.8	28,092,6	27,254,0
Fuel wood	1,078.3	1,363.6	1,355.0
Production waste (wood)	302.5	357.9	375.8

Combustible SER	148.2	155.6	162.9
Others	135.0	144.2	170.3
STER	779.3	819.7	896.5
Excessive pressure SER		20.4	27.7
HPP		6.7	6.6
RES percentage to consumption of boiler and furnace fuel	6.6%	7.2%	7.7%

Transport

The passenger traffic structure by modes of transport has substantially changed. It is noteworthy that a share of the railway transport has reduced in the total passenger turnover from 48.1% in 1995 to 37.8% in 2008, while the share of the automobile and air transport has increased from 35,8% and 4.7% to 38.0% and 5.9% respectively over the same period. The freight turnover structure by main modes of transport has insignificantly changed. The railway (68.1%) and automobile (31.6%) transport dominates in it.

Industry

The machine-building (34.2% of the industrial product cost), consumer goods (17.2%), food (14.9%), and also chemical and petrochemical (9%) sectors were leading sectors in 1990.

Currently, proportions in the industrial output structure are as follows: the machine-building and metal working sectors account for the largest share – 23.2%, fuel industry – 21.3%, food industry – 14.6% and chemical and petrochemical industries – 13.4%. A share of electric-power industry substantially reduced from 13.8% in 1995 to 5.5% in 2008.

Agriculture

The yield capacity of cereal and leguminous crops reduced from 27.2 dt/ha of crop area in 1990 to 19.4 dt/ha in 2000, and then it has been gradually increasing to reach 28.5 dt/ha in 2007 and to 35.2 dt/ha in 2008. The situation is the same with other crops.

The agricultural livestock population considerably reduced in 2008 compared to 1990: cattle - by 42.4%, pigs - by 28.8% and goats/sheep - by 75.3%. Since 2006, the trend toward expansion of cattle, pigs, small cattle and poultry population has emerged.

In general, a tendency of key GHG source reduction is observed due to some recession in agricultural production.

Waste

The main sources of GHG emissions in the «Waste» sector are as follows: solid waste disposal sites and also industrial/municipal waste water treatment processes.

According to the data of the Ministry of Housing and Municipal Services 171 solid municipal waste landfills were available in 2007 in the country. 4.5 thousand mini solid municipal waste landfills are also on the books of the organizations of housing and municipal services covering an area of about 3.5 thousand hectares.

Increase in GHG emissions in 2007 compared to 1990 is explained by the fact that the volume of solid municipal waste was constantly growing in the country (in 2007, it amounted to 4,025.5 thousand tones) due to both development of modern production of household goods and foodstuff and increase in their consumption and to improvement of waste inventory system (improvement of the legislation regarding waste disposal, tightening control over waste disposal and increase in standards of waste generation).

Land Use Structure Change and Forestry

Over the last 18 years, the total area of agricultural lands has reduced by 470.1 thousand ha, streets, squares and other public places land - by 190.0 thousand ha and also disturbed and other lands - by 38.8 and 385.4 thousand ha respectively. The wetland area has somewhat reduced (by 54.7 thousand ha).

Over the same period, the area of forest and other wooden land which includes forest land and land covered with trees and shrubs has significantly increased (by 805.8 thousand ha), buildings and yards land increased by 257.0 thousand ha. Roads, passages, clearings and pipelines land somewhat increased (by 64. 8 thousand ha) as well as water-covered land (by 11.7 thousand ha).

Reforestation is a positive factor in the forest management development, with an area making up 50.0 thousand ha in 2008, including 43.1 thousand ha of tree planting and sowing and the forest management was conducted on an area of 1,139 thousand ha. Increase in the forest area due to the young plantings contributes to higher carbon dioxide absorption.

Assessing the land resources potential as rather high in Belarus, it should be noted that the increase in the area of city buildings land, allocation of land plots to individuals, condemnation of land for construction of various industrial and household facilities increase GHG emissions, while restoration of forest land and wetland contributes to carbon dioxide absorption.

National GHG Inventory System

The Ministry of Natural Resources and Environmental Protection of the Republic of Belarus is responsible for planning and managing the GHG inventories.

The GHG Inventories Group of the Department of International Conventions and Agreements of RUE Bel SRC «Ecology» is directly involved in conducting inventory and maintaining the GHG cadastre.

The National Statistics Committee of the Republic of Belarus is the main source of information and it collects and provides the most complete data on all sectors of the national economy. Other ministries and departments, including concerns and enterprises also provide additional information, with their activities being regulated by normative and legal documents, i.e. Resolutions of the Council of Ministers and Orders of the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus.

Information about calculations and methodologies and emission factors used and also baseline data are archived as calculation Tables in the Excel format for every year of the reported period. This archive is stored on a hard disk in the RUE Bel SRC «Ecology».

The national inventory system provides transparency, consistency, comparability, completeness and attainable accuracy of GHG emission calculations.

National Registry

Given the fact that the Republic of Belarus is not included in the Annex B to the Kyoto Protocol to the UNFCCC, the country is not eligible to use flexibility mechanisms of the Kyoto Protocol. Over the recent years the experts responsible for the National Registry of Carbon Units of the Republic of Belarus (RB NRCU) have been involved in preparing it for initiation and adequate functioning, namely:

- server equipment has been purchased;
- three copies of *Windows 2003 Server* operational system have been purchased;

- *Seringas* software for managing the NRCU has been purchased;
- a plan for initiating the NRCU has been developed upon ratification of the «Belarusian» amendment;
- observance of the international requirements for Registry safe functioning based on the DES technical document (Data Exchange Standards) has been reviewed and assessed;
- commercial offers from the companies involved in the network safety and development of engineering specifications required for full NRCU initiation and functioning have been preliminary collected.

Policies and Measures

Fundamental documents include as follows: National Program of Measures to Mitigate the Consequences of Climate Change for 2008-2012, Strategy for Reducing Emissions and Enhancing Removals of Greenhouse Gases by Sinks in the Republic of Belarus for 2007-2012; and National Strategy for Introduction of Integrated Environmental Permits for 2009-2020. These documents are aimed at reducing GHG emissions and increasing GHG absorption by sinks through drawing up the program of synergic measures for various sectors of the national economy.

In the **energy** sector the policies and the measures adopted by the government are aimed at modernizing and building up energy capacities, developing an energy infrastructure and diversifying energy resources deliveries, increasing efficiency of fuel and energy resources use and expanding the use of local fuels, nonconventional and renewable energy sources.

The Government of the Republic of Belarus takes measures to technically re-equip and modernize various production units by implementing advanced energy and resource-saving ecologically clean technologies. The key actions to increase efficiency and save resources are implemented within the framework of the State Program of Innovative Development of the Republic of Belarus for 2007-2010.

In the **transport** sector the Program of Development of Automotive Sector of the Republic of Belarus for 2007-2010 and Program for Reducing Negative Impact of Transport on Environment of the Republic of Belarus for 2006-2010 have been adopted and helped to reduce emission of air pollutants by 14.2 thousand tons in 2008.

The Law of the Republic of Belarus «On Waste Management» defines legal fundamentals for waste management and regulates actions to reduce volumes of waste generation and prevent its adverse environmental and health impact.

Currently, the Law of the Republic of Belarus «On Climate Protection» is being drafted to define the legal nature of carbon units and quotas, framework for GHG emissions quotas trading and also to regulate property rights GHG emissions and their reduction.

Projections

It is expected that GHG emissions due to the actions on incleasing energy efficiency, replacing of gas and fuel oil with local fuels, using alternative energy sources are to be reduced as follows:

Table 2 – Expected GHG emissions reduction due to different measures

Sectors of National Economy	**'000 Tones in CO_2 Equivalent**
Industry	1,978
Agriculture	1,008
Construction and building materials	864
Fuel and energy complex	5,020
Housing and municipal services	1,461
Social and state-financed spheres and other sectors	2,459
Total	**12,790**

Reduction in GHG emissions due to use of renewable energy sources is to be estimate as follows (tons):

Table 3 – Estimation of GHG emissions reduction due to use of renewable energy sources

Renewable Energy Sources	**CO_2**	**CH_4**	**N_2O**	**NO_x**	**CO**	**SO_2**	**VNMOC**
Hydroenergy	393,821.3	23.5	2.4	3,528.8	469.6	1,085.8	117.4
Turboexpanders	94,517.1	5.6	0.6	846.9	112.7	260.6	28.2
Windpower plants	4,185.5	0.2	0.0	37.5	5.0	11.5	1.2
Biogas	256,895.8	15.3	1.6	2,301.9	306.3	708.3	76.6
Solar energy	10,115.3	0.6	0.1	90.6	12.1	27.9	3.0
Municipal waste	160,559.9	9.6	1.0	1,438.7	191.4	442.7	47.9
Biomass and wood waste	3,692,877.6	220.2	22.6	33,089.9	4,403.2	10,181.6	1,100.8
Plant-growing waste	40,140.0	2.4	0.2	359.7	47.9	110.7	12.0

Secondary thermal resources	1,353,519.9	80.7	8.3	12,128.2	1,613.9	3,731.8	403.5
Total	**6,006,632.4**	**358.1**	**36.7**	**53,822.2**	**7,162.0**	**16,560.9**	**1,790.5**

The GDP growth rates for the 1995-2008 period were taken as per statistical reporting. Projected values for the period after 2008 were determined based on the Energy Safety Concept of the Republic of Belarus approved by Decree No. 433 of the President of the Republic of Belarus dated 17 September 2007 in which following figures are provided:

- 2006-2010 – 156%;
- 2011-2015 – 147%;
- 2016-2020 – 139%.

The analysis of various projection scenarios of GHG emissions reduction shows that Belarus has exhausted the potential of relatively low-cost actions for reduction of these emissions. Any other emissions reduction measures and also mechanisms for support of environmentally sensitive actions require substantial investment of funds which are not available in the country, specifically in the crisis situation. The resources the country needs could be partially raised by selling available emissions quotas in 2008-2012. However, the fact that the amendment to the Annex B of the Republic of Belarus stipulating quantitative obligations and providing opportunities for using flexibility mechanisms has not so far been ratified by the necessary number of the Parties to the Kyoto Protocol poses an obstruction to this.

Adaptation

Measures to adapt the national economy to new climatic conditions are primarily aimed at adapting to extreme situations (heat, cold, droughts and torrential rains). Basic adaptation measures should be implemented in such sectors of the national economy as the energy, industry, agriculture and forestry, transport and municipal services. The Communication reports planned or current measures in the agriculture and forestry.

Adaptation measures in the agricultural sector include as follows:

- restructuring agricultural and plowing land;
- developing moisture-conserving technologies in agriculture;
- protecting soils, including erosion control;
- developing biotechnologies and selecting novel crops adapted to changing climate;

- changing the periods for performing secondary tillage processes;
- controlling pests and locusts;
- increasing the yield by improving efficiency of use of fertilizers and plant-protecting agents.

It should be noted that in 2009 the program of forestry adaptation to predicted climate changes in the Republic of Belarus was developed.

Implementation of adaptation measures would help enhance stability of the national economy to climate changes and, particularly, to abrupt changes in weather and climate conditions and avoid unnecessary losses.

Research and Systematic Observation

To address the problems of integrated management of climatic, current and on-line data for servicing users of diverse hydrometeorological products by using advanced facilities for data transmission via public data networks, a more sophisticated CLIWARE hydrometeorological data management system has been installed in the National Meteorological Center.

The research being conducted by the State Hydrometeorological Service of the Republic of Belarus demonstrates that, currently, climatic conditions are changing in Belarus and trends of these changes would persist in the near 5-10 years. These conclusions are proved by the research findings of other Belarusian scientists, specifically, the Academy of Sciences of Belarus, and the research by the majority of foreign specialists.

Education, Training and Public Awareness

To develop ecological culture of citizens and foster an attitude of care towards nature among them, the public environmental awareness is enhance subject to Article 77 of the Law of the Republic of Belarus «On Environmental Protection» by disseminating ecological information, including the ecological safety information, and also the knowledge about a composition of ecological information, procedures for its generation, dissemination and provision to environmental protection/climate change entities.

The objective of the ecological education in the country is to establish a social framework to implement concepts of a sustainable development by fostering responsibility to nature, perceiving necessity of its protection and rational management

and enhancing moral qualities of people to the level corresponding to the scale of changes in the modern world.

Recently the focus of attention has been given to holding national and international seminars and workshop conferences to address problems of nature protection and climate change as an important factor of the educational campaign.

The data provided by the NASB researchers Pugachevsky A.V. and Ermeshin M.V. have been used for preparing the Fifth National Communication.

Section 4 *Projections and Total Effect of Policies and Measures and Supplemenarity Relating to the Kyoto Protocol Mechanisms* has been prepared by experts Grebenkov A.Zh. (TACIS Project for implementation of the Kyoto Protocol in the CIS countries), Shinkevich O.S. (RUE *Belinvestenergosberezhenie*), Yakushev A.P. and Nikitin S.N. (NASB).

The data from the book of Academician Loginov V.F. «Global and Regional Climate Changes: Causes and Consequences» have been used in Section 5 *Vulnerability and Adaptation*.

Specialists of the RB Hydrometeorological Center Melnik V.I. and Komarovskaya E.V. prepared the data for Section 6 *Research and Systematic Observation*.

In general, the Fifth National Communication has been prepared by the employees of the RUE Bel SRC «Ecology»:

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1 NATIONAL CONDITIONS THAT RELATE TO EMISSION AND ABSORBTION OF GREENHOSE GASES

1.1 Geographical Position and Relief of Belarus

The Republic of Belarus is a European state with medium area and population size. By its geographical position it is located in Central and Eastern Europe (latitude 56 10' and 51°16' N, longitude 23°11' and 32°47' E). Its territory extended from north to south at 560 km, from west to east - 650 km. As of January 1, 2009 the population of the country was 9,672 million persons, area - 207,6 thousand sq km, including 41% - lands of the state forest reserves, 6,6% - marshes and water objects, 43,1% - agricultural lands, 9,3% - other lands. Average population density is 47 persons per 1 sq km.

The capital of the Republic of Belarus is Minsk. The city is situated in the middle of the country, at the intersection of the main traffic arteries.

Republic of Belarus is bordered by five states: Russian Federation to the north and east (the boundary measures 990km - 33,4%), Ukraine to the south (975km - 32,8%), Poland to the west (399 km - 13,4%), Lithuania and Latvia (143km - 4,8%) to the north-west (462 km - 15,6%). International boundary measures - 2969 km. Belarus does not have any outlet to the sea.

As for geological location, Belarus is situated within the East European platform, physical and geographical peculiarities of the country are stipulated by its location to the west part of the East European Plain. The territory of the republic is a watershed of the Baltic Sea and Black Sea Basins that confirms its deep continental location. The surface is mainly flat with typical elevated, plain areas and lowlands with marshes and lakes. Main features of the modern relief are to a great extent stipulated by continental glacierization of the Quaternary period.

The most important peculiarities of Belarusian geographical position are its compact territory, central location and transit opportunities. Belarus is a kind of crossroads, where the most important transeuropean railway main lines and highways, oil- and gas pipelines, air routes and waterways between economically development West Europe and Asia, rich in natural resources, converge. The shortest routes from central and eastern Russian regions to Western Europe, as well as between the Baltic and Black seas, go through Belarus.

So, in the ecological and geographical worldwide space Belarus is a country of considerable importance for European region. Consequently, it has an impact on ecological situation in Europe through the system of cross-border air and water flows.

1.2 Government and Legislation of the Republic of Belarus

In accordance with the Constitution, the Republic of Belarus is a unitary democratic social and law-based state. The head of the state is the President of the Republic of Belarus. State governmental bodies are the Parliament, the Government, the President Administration, the courts, the Prosecutor's Office and the Committee for State Control. The Parliament, which is called the National Assembly, is a representative and legislative body. It is divided into two houses: House of Representatives and Council of the Republic. The Government, the Council of Ministers of the Republic of Belarus, is an executive and the central governmental body.

The system of state administration is based on functional-branch and territorial approaches and comprises 25 ministers, 14 branch committees, 6 region and 118 district executive committees as well as city, town and rural executive committees.

The system of governmental authorities in the sphere of environment protection encompasses the President of the Republic of Belarus, National Assembly, Council of Ministers as well as local authorities. The local authorities execute state and regional nature protection projects directly. The body of special authority is Ministry of National Resources and Environment Protection that reports to the Council of Ministers. Besides, the rights to control environment conditions have as follows: Emergency Control Ministry, Ministry of Public Health, and State Property Committee of the Republic of Belarus. Certain functions related to environment conservation are fulfilled by: Forestry Ministry, Ministry of Inner Affairs, State Customs Committee, and Administrative Department of the President of the Republic of Belarus.

1.3 Climate Change in the Republic of Belarus

1.3.1 Air Temperature

Through most of the XX century till the end of the 80s, short-term periods of warming were alternated with the periods of fall in temperature of similar size and duration. Warming that has no equal for duration and intensity started in 1988 and was followed by sharp temperature rise in winter time of 1989. In January and February of

this year average temperature rate level was exceeded by 7-7,5 °C, in March and April – by 3-5°C. In whole this year turned out to be the warmest one during the hundred-year period exceeded the rate level by approximately 2,0°C. In 1990 in January-March an average annual temperature in Belarus was by 6-8,5 °C higher than the rate level.

The warming is still continuing till the present time. The exception was only 1996 when average annual temperature in Belarus was by 0,4°C below the rate level. Meanwhile, average annual warming was higher to the north of the country (+1,2°C in Vitebsk region) and little less to the west (+0,8 °C in Brest and Grodno regions).

Six out of seven highest positive temperature anomalies happened within the last 20 years.

Temperature rise occurred mainly in the first four months of the year. Positive anomaly was maximal in January (about 3,5°C), then went down slowly and was equal to +2,0°C in April. These months' temperature in Minsk corresponded approximately with average annual temperatures in Lvov and Kiev (Ukraine).

On the whole summer months turned out to be warmer as well (positive anomaly was +0,7°C in July and +0,8°C in August), temperature rise is most pronounced in summer within the last decade.

In 1999, 2000 and 2002 temperature rate level was exceeded on the average by 2°C that is similar in size to the anomalies of the cold period of the year.

In the last decade (1998-2007) all temperature anomalies were positive during all the seasons, however winters became colder as compared with the previous decade (1988-1997). It is important to note that in 1988-1997 the summer temperature exceeded the rate level and in autumn it was even little lower than the rate level, but during the last decade the temperature was significantly higher than the rate level in autumn and especially in summer.

The current warming is most pronounced in the most months of the cold period of the year. It turned out to be more powerful than the previous one; in some months of the cold period of the year the temperature rose by several grades within 30 years. The largest warming was in January. Within the last 20 years (1988-2007) there was only one cold winter (1996). The last positive temperature fluctuation was the most powerful in the whole history of instrumental observation period. Probability of randomness of the same continuous positive temperature anomalies is less than 5%. The great majority of the largest positive temperature anomalies ($\Delta t > 1,5°C$) happened during the last 20 years. Other details of climate change in Belarus in recent years are as follows.

On average during the period from 1988 till 2007 the temperature was higher than the rate level by 1,1°C. The warming was most pronounced to the north of the republic that conforms to the main conclusion of the numerical modeling of temperature testifying large temperature rise in high latitudes.

The warming of 1988-2007 resulted in changes in heating season schedule. Its duration, for example, in Minsk decreased by 10-12 days, and average air temperature during a heating season increased by 1,5-1,7°C.

Long-lasting anomalies of the first spring months led to earlier loss of snow cover and passing of temperature through 0°C and upwards. During the period under review this passing occurred, on average, 13 days earlier than long-term annual average rate – in the beginning of March in Brest region and in the middle of March in Vitebsk and Mogilev regions. Over a period of years the passing through 0°C was registered in February; in 1989, 1990 and 2002 - in January. Early stable passing through 0°C served soil to achieve soft-plastic consistency and the beginning of agricultural process. Vegetation period started 10 days earlier. Effective heat sum above 5 and 10° increased on average by 110 and 60°, and isoline of these temperature sums moved approximately 100 and 60 km to the north.

Negative anomalies of May raised the hazard of late spring frosts, which had happened during active vegetation period of plants. It occurred that the temperature in the first ten-day period of May was by 3-7°C below the temperature of the third ten-day period of April. Registered May frosts damaged considerably agricultural process.

1.3.2 Precipitation

The first third of 20th century is characterized by larger amount of precipitation that exceeds the average rate of the period to follow by approximately 60mm (10%). River run-off of this period complies with the above fact.

On average, no positive or negative anomalies of precipitation were registered at the territory of the republic during the last warming period. The only exception was a positive anomaly of precipitation in 1998.

Active warming during the last two decades of 20th century reflected little on average annual precipitation falling in Belarus, close to the rate level were average rainfalls of both warm and cold periods of the year as well.

Precipitation fallen in Brest and Mogilev regions during cold and warm periods of the year and in Minsk region during the warm period turned out to be little less than the rate level.

Observation of rainfall showed that the precipitation level during both cold and warm periods of the year was higher than the rate level to the north of the country (Vitebsk and north part of Minsk regions), and lower than the rate level to the south-west (Brest and south part of Minsk regions).

Change in amount of precipitation at the territory of Belarus differs by larger time-space variability as compared with temperature. Diagrammatically, changes in rainfall can be marked by two zones: a north-eastern zone (I) with growth of precipitation and a south-western zone (II) with decrease of precipitation. Besides, abnormal zones are distinguished (III): Lelchitsy, Zhitkovichi, Kostyukovichi districts, where the amounts of precipitation are increasing.

If to compare the amounts of atmospheric precipitation over a period of modern warming started in 1988 and previous period (1966-1987), more difficult space structure of variation in precipitation can be noticed: the growth in precipitation was registered in the eastern part of Vitebsk, Mogilev and the great part of Gomel as well as Grodno regions. The largest precipitation reduction over a period of climate warming took place in Brest and the north-western part of Vitebsk regions.

1.3.3 Change of Agro Climatic Zones and Their Impact on Economy

During the last two decades there were years registered as more wet ones. So, in 1998 the rainfall was abundant during the whole year, but June and July were especially humid. This caused significant flooding of Polesie's territories, as well as flooding of crops at heavy soils of the republic.

At the present time the borders of agro climatic zones have been displaced by 60-150km due to changes of climatic parameters. Change on borders of agro climatic districts of Belarus as a result of warming is shown at picture 1.1. North agro climatic zone has split as a result of warming and a new warmer agro climatic zone appeared to the south of Polesie (zone IV). The shortest and warmest winter and the longest and warmest vegetation period are features of this zone.

It stands to mention that for the countries with cold climatic conditions, like Belarus, global warming has both positive and negative impacts on economy and public health.

Positive impact is saving of thermal energy due to reduction of heating season and heat losses of buildings; growth of vegetation period of agricultural plants and improvement of overwintering; thermo supply of plants by sufficient moistening of theterritory and efficiency growth of agricultural products.

Negative impact: destruction and damage of agricultural crops as a result of drought at significant territories; public health decline caused by emergency situations (hurricane, squalls, heat etc.); increase in amount of mosquitoes and other insects as a results of floods of territories during showers that increase the risk of diseases and spread of infections.

Air temperature sum is above 10^0C

1 - Less than 2200
2 - 2200-2400
3 - 2400-2600
4 - More than 2600

Change of agro climatic borders of Belarus
a) borders of agro climatic zones under A.Ch. Shklyar (1973)
b) borders of agro climatic zones under V.I. Melnik during the period of 1989-2005 (1973)
Agro climatic zones: I – North, II – Central, III – South, IV – New.

Figure 1.1 - Change of agro climatic borders of Belarus

1.3.4 Wind Speed Change

Since the 70-s of the XX century it was registered a reduction in wind speed in Belarus as well as some districts of European part of Russia and West Siberia. If in 1940-1970 average wind speed was 3,6m/s, it decreased till 3,1m/s during the last warming.

Average values of wind speed (m/s) during instrumental observations for separate periods are as follows: 1940-1970 - 3,6; 1971-1980 - 3,2; 1981-1990 - 3,1; 1991-2001- 3,1.

It is known, that in the formula of wind load and wind energy, the wind speed is included squared and cubed, that is why registered reduction in wind speed is quite important. It may in particular mean 1,5 times decrease of transferring energy.

Today there are no well-founded forecasts of changes in wind speed during the nearest decades. But this fact is to be taken into consideration by corresponding estimations and in particular by development of wind energy usage.

Reduction in wind speed is registered during both cold and warm periods of the year.

1.4 Water Resources

Water resources of the Republic of Belarus are comparatively favorable. Available natural waters resources are of fair quantity to satisfy modern as well as future needs. There are large number of water objects presented by rivers (20,8 thousand), lakes (10,8 thousand), water-collecting areas (153) and pounds (1,5 thousand) on the territory of the Republic of Belarus. Overall length of the rivers is 90,6 thousand km. About 55% of the annual river runoff falls at the Black sea basin (Dnieper, Sozh, Pripyat), 45% - the Baltic Sea basin (West Dvina, Neman, Vilia, West Bug).

River runoff, which is a basis of surface water resources, is 57,9km^3 in an average water content year. In high-water years an overall river runoff is increasing till 92,4km^3, and in law-water year (95% of supply) is reducing till 37,2 km^3 per year. Great part of a river runoff (34 km^3 or 59%) is formed within the country. Water inflow from other territories (Russia and Ukraine) is 23,9 km^3 per year (41%).

Great part of the large rivers flowing through Belarus are transboundary ones. Their water resources are partly formed beyond the country on the territory of the Russian Federation (Dnieper, Sozh, West Dvina), Ukraine (Pripyat, West Bug), Poland (West Bug). Crossing Belarusian borders the large transboundary rivers flow through the territory of Ukraine (Dnieper), Lithuania (Neman and Vilia), Latvia (West Dvina).

It is amounted more than 10 thousand lakes that are concentrated in Poozerie (more than 4 thousand) and Polesie (about 6 thousand). The most deep and picturesque lakes with various margins of coast are located at Belarusian Poozerie. The largest lake is Naroch (80 km^2). 75% of the lakes' surface area is less than 0,1km^2 and are classified as small ones.

153 reservoirs have been constructed, their overall volume is 3,1km^3, and useable volume is about 1,24km^3. Reservoirs' water resources are used for melioration (irrigation), for water supply of cities, (Vileika and Soligorsk reservoirs), as water reservoir-coolers (Lakes Beloe and Lukomlskoe).

Belarus has significant underground water resources - fresh drinking (salt content is less than 1g of dissolved solids in 1^3 of water), mineral (table water and for balneological procedures), as well as salt brines with a concentration of dissolved solids from 35 till 500 g/dm^3. Renewable (natural) resources of underground waters amount to 15,9km^3 per year, prospective - 18,1km^3 per year. Fresh underground waters are the main source of utility and drinking water supply. Natural resources of underground fresh waters are equal to 43560 thousand m^3/24 hours. So far there are 264 underground water deposits with overall exploitable volume of 6, 7mln m$^{3\ per}$ 24 hours.

Drinking water consumption per head of population in Belarusian cities and towns are 180-370 l/24 hours, that is considerably higher level than in the most countries of Europe (120-150 l/24 hours). It is typical that individual water consumers, who have water consumption meters consume 150-190 l/24 hours, and by group metering - 350-390 l/24 hours. The largest coefficient of utility and drinking water demand is registered in Minsk, Brest, Grodno, Bobruisk and Mogilev. Republic of Belarus differs from a series of countries having the highest level of fresh water economy.

Available water supply with locally formed waters per habitant is 3,6thousand m^3, including underground waters 1,4 thousand m^3. It is more than in England (2,6 and 1,0 respectively), Netherlands (0,7 and 0,25) and Ukraine (1,0 and 0,2) but less than in Norway (89,0 and 27,5) and Russia (9,0 and 2,0).

At the present time 26 hydroelectric power plants including mini hydroelectric power stations are being operated in Belarus, they produce about 3% of economical hydropower potential of the country. Their gross installed capacity is about 11,3MW or 0,15% of gross installed capacity of operating power plants of all types.

Reserves of hydro power resources in Belarus are equal to 1,3bln. kW per year. It is less than in Lithuania - 1,5, Poland - 7,0, Ukraine - 19,0 bln. kW per year. The territory of Belarus is mainly plain that is why it is only expedient to use low pressure hydraulic engineering installations. Construction of Dnieper and Pripyat hydroelectric power plants will lead to inundation of huge areas. There are conditions to create enough economic and ecological safe hydroelectric power stations at West Dvina and

Neman basins. In prospect the Belarusian hydroelectric engineering may be developed in the line of construction of multiple-use hydroelectric complexes: to regulate runoff, power system, water supply, water transport, melioration, water protection and economy.

It is reasonable to construct mini hydroelectric power stations at minor streams (with capacity less than 100 kW). They would provide the nearest populated areas with electricity supply.

1.5 Mineral Resources and Raw Materials

At the modern stage of geological exploration it has been identified more than 4 thousand mineral deposits that represent about 30 types of minerals in the interior of Belarus.

The most part of the deposits have been proved and included into the balance of mineral reserves of the Republic of Belarus. Due to development of own mineral fields Belarus provides annual output of 1,8 thousand T oil; 250 mln. T associated gas; 2,9 blr. T peat; 28-32 mln. T potash ore, of which 4 mln. T potash fertilizers are being produced; 1,35 mln. T edible, cattle and technical salt; 3,2 mln. T dolomites; 3,6 mln. T chalk; 1,02 mln. T marl; 3,1 mln. m^3 building stones; 10,2 mln. T building sand and sand-and-gravel materials; 2,0 mln./m^3 clay materials used for the production of bricks and lightweight aggregates; 170 thousand T glass sand; 500 thousand T molding sand; more than 1000 mln.m^3 fresh underground waters and 350 thousand m^3 mineral waters.

Developed mineral reserves allow providing the country's needs in potassium and sodium salts, dolomite, limestone and cement raw materials, high-melting and glass-pot clay, building and molding sands, sand-and-gravel materials, building stone, peat and putrid mud, fresh and mineral underground waters as well as other types of raw materials.

However, the republic imports from other regions considerable quantity of raw materials including oil, gas, coal, oil shale, glass-melting sand, molding clay, tripoli, gypsum, kaolin, caustic ash, raw materials for production of mineral fertilizers, stone blocks for cover plates, high-strength crushed aggregates etc because of limited mineral resources base, insufficient development of some deposits.

Belarusian needs in fuel and energy resource are not secured as well, although there are some reserves of oil, associated gas, peat, brown coal and pyrshale. Modern industrial oil reserves are equal to 65 mnl. T and forecast reserves - 189 mln. T. Till the

present time it has been made more than 100 mln. T oil. Developed reserves of associated gas are estimated at 8,1 bln.m^3, and annual production is about 250 mln. m^3. Forecast reserves of brown coals are estimated at more than 1,3 bln. T, industrial ones - 124,4 mln. T. Deposits of brown coals are available to be produced by open-cast mining in order to provide inhabitants with household fuel fully, however now they are not being developed due to ecological and economical reasons. Forecast reserves of oil shales at the territory of the Republic Belarus exceed 10 bln. T. Oil shales have high ash volume and the deposits are not being developed currently because of economic inefficiency.

One of the most widespread and operating raw materials in Belarus is peat, which is widely used for agricultural needs and as municipal and household fuel. More than 9 thousand peat deposits are known, of which about 100 are in operation with annual production of 2,9 mln. T.

Sapropel reserves have been discovered in more than 500 lakes of the republic as well as under peat beds and are about 3,8 bln. m^3.

Potassium salts are one of the most important types of Belarusian raw mineral materials. Overall reserves of proved fields, Starobinsk and Petrikov, are 6,7 bln. raw potash salts or 1194,0 thousand T potassium oxide. Starobinsk field with 5698,0 mln. T raw potash salts is being developed, which is the base for 'Belaruskali' Production Association to operate, which annual capacity is 4,0 mln. T potassium fertilizers. The enterprise provides fully domestic needs in potassium fertilizers and fulfills export deliveries to the CIS countries and outside of the Commonwealth of Independent States.

Three sodium salt deposits have been developed – Mozyr, Davydovsk and Starobinsk, which ultimate reserves exceed 22 bln. T, i.e. they are almost inexhaustible. At Mozyr deposit a salt extracting complex is operating, its capacity exceeds 360 thousand T salt per year.

In Vitebsk region a large dolomite deposit Ruba has been developed with industrial reserves to exceed 900 mln. T; it is a raw material base of 'Dolomit' Production Association producing dolomite powder for lime application of acid soils.

Significant reserves of building stones have been discovered in the Belarusian subsurface - 561,5 mln. m^3, cement raw materials – 460 mln. T., building sands - 800,0 mln. m^3, sand-and-gravel and carbonate materials - 685,4 mln. m^3 and 945 mln. m^3 respectively.

Belarus is reach in mineral brines of which iodine, bromine, potassium, magnesium and other rare and trace elements. There are prerequisite to discover industrially important deposits of glauconite, pyrophyllite, and materials used for the production of mineral fibres, amber, diamonds, rare and nonferrous materials.

In accordance with the forecast the provision of main types of raw materials that are currently under development or prepared to industrial development for the currently operating enterprises are as follows: oil (as per production capacity of 2000) - 34 years; potassium salts - up to 17 years at the 1st mine group and up to 101 year – at the 4th; mine salts - almost inexhaustible; dolomite - more than 50 years; peat – more than 50 years; sapropel – more than 60 years; needs of operating enterprises in molding materials are completely provided; window-glass and container glass production is provided with the sands for more than 50 years; cement materials – provision of operating cement plants is for long-term perspective; building stones – developed deposits allow expanding production capacities for high-strength crushed aggregates are up to 15-20 mln. m^3/year; chalk reserves for lime production - will be enough for more than 50 years; hard clay – for more than 30 years; soft clays – up to 25 years; building sands – up to 118 years; sand-and-gravel materials – up to 25 years.

1.6 Soils and Land Resources

Contemporary coil landscape of the territory of the Republic of Belarus is determined by the following main factors: soil constitution and structure, climate peculiarities, type of vegetation cover and fauna, surface relief, geological age of superficial deposit, character of operating activity of a person.

Main soil types in Belarus are: sod-podzol, sod-podzol-watelogged, sod, calcareous, calcareous-waterlogged, peat-bog and flood plain sod soils.

Mechanical composition of soil-forming materials is quite heterogeneous, however, sabulous soils - 42,5%, prevail among croplands, loam and clay soils are 37,6%, sandy - 13,6% and peat soils - 6,3%.

Overall supply of land of the Republic of Belarus at 2008 year-end is equal to 20759,8 thousand ha, of which agriculture lands occupy 8944,7 thousand ha, of which croplands - 5516,4 thousand ha. However, the structure of supply of land, including purpose of use and types of lands undergoes certain changes.

The structure of supply of land in 2008 is represented in table 1.1. by land categories, landowners and land-users, and in table 1.2. by types of land.

Table 1.1 Structure of Land Supply in Belarus by Land Categories, Landowners and Land-Users and Its Dynamics

Type of Land	Area, thousand ha					
	1990	1995	2000 г.	2005	2008	Changes within 1990-2008
Lands of agricultural organizations and individuals	12096,0	11894,0	10741,1	10204,4	10148,8	-1947,2
Lands of state forestry organizations	6812,7	6873,3	7770,0	8299,5	8422,4	+1609,7
Industry, transport, defense, communications and other special-purposes lands	1056,8	914,0	808,5	690,1	598,0	-458,8
Lands used for nature protection, health-improving, recreation and historical and cultural purposes	338,8	477,8	817,4	879,2	886,8	+548,0
Lands under waterworks and other water facilities	39,4	36,4	35,0	39,9	39,3	-0,1
General-use lands in population areas	247,5	377,7	364,9	355,2	351,8	+104,3
Reserve lands	168,3	186,4	223,0	291,5	312,7	+144,4
Overall	20759,5	20759,6	20759,9	20759,8	20759,8	+0,3

Within the last 18 years (1990-2008) there occurred a considerable decrease of lands used by agricultural organizations and individuals - by 947.2 thousand ha. The portion of land of this category has decreased from 58.3 till 48.9% to the overall area of land supply of the Republic of Belarus. The decrease happened as the lands were passed to the state forestry enterprises, allocated for construction and industry, moved to the category of nature protection lands as well as a result of hayfields and pasture bushing at overflow land and by other reasons. Within this period a decrease of industry, transport, defense and communications, and other special-purposes lands has taken place - by 458,8 thousand ha. At the same time the area of the lands used by state forestry organizations increased by 1609,7 thousand ha, and lands used for nature protection, health-improving, recreation and historical and cultural purposes – by 548,0 thousand ha. Area of the land parcels not given for a possession and not privatized

(general-use and reserve lands) have increased as well. Area of the lands under waterworks and other water facilities has decreased insignificantly - by 0,1 thousand ha.

It is necessary to note that within the last 18 years a significant decrease of the following types of the lands has taken place: overall area of agricultural lands (by 470,1 thousand ha), lands under the streets, squares and other public accommodations - by 190,0 thousand ha, as well as disturbed and other lands (by 38,8 and 385,4 thousand ha respectively). Marshes have decreased slightly (by 54,7 thousand ha).

Within the same period the forest and forest covered lands including tree and shrub areas have increased significantly (by 805,8 thousand ha), the lands under structures and yards increased by 257,0 thousand ha. Lands under roads, glades, pipelines (by 64,8 thousand ha), as well as areas under water - by 11,7 thousand ha.

Table 1.2 Structure of the Land Supply in Belarus by Types of Lands and Its Dynamics (the Data Is Given According to the State Property Committee of the Republic Of Belarus)

Type of Land	Area, thousand ha					Changes within 1990-2008
	1990	1995	2000	2005	2008	
Overall area of the land	20759,5	20759,6	20759,9	20759,8	20759,8	+0,3
Agricultural land, total	9414,8	9338,8	9257,7	9011,5	8944,7	-470,1
Forests	8229,2	8277,5	8436,8	8892,3	9035,0	+805,8
Marshes	948,8	957,6	964,3	900,1	894,1	-54,7
Under water	458,1	473,2	475,2	476,7	469,8	+11,7
Under roads, glades, pipelines	326,9	350,2	358,1	364,4	391,7	+64,8
Under streets, squares and other public accommodations	338,9	190,7	154,7	148,3	148,9	-190,0
Under structures and yards	73,7	295,5	328,7	323,9	330,7	+257,0
Disturbed	44,6	42,1	24,1	5,9	5,8	-38,8
Other	924,5	834,0	760,3	636,7	539,1	-385,4

In whole the dynamics of agricultural lands in Belarus, including croplands, as well as drained and irrigated lands within the last 30 years are given in tables 1.3 and 1.4.

Table 1.3 Dynamics of Agricultural Lands , thousand ha

Agricultural lands	1975	1980	1990	1995	2000	2005	2008
Total	9892,9	9727,9	9414,8	9338,8	9257,7	9011,5	8944,7
Including croplands	6154,5	6211,3	5637,4	6232,0	6133,2	5542,3	5516,4

Table 1.4 Dynamics of Drained and Irrigated Lands, thousand ha

Type of melioration lands	1975	1980	1990	1995	2000	2005	2008
Drained lands	2282,6	2716,7	3229,3	3394,6	3416,0	3411,7	3423,7
Irrigated lands	139,4	161,9	148,9	114,7	115,0	114,1	52,9

As Table 1.4 shows, the reclamation works have decreased within the last years. If during the period from 1975 till 2000 there was a significant extension of drained lands, but within the last 3 years their area has increased by only 12,0 thousand ha, and the area of irrigated lands within the same period decreased at 61,2 thousand ha.

At the present time the area of drained lands of the republic is 3423,7 thousand ha (16,5% of the territory). Out of the drained lands the agricultural lands are 2913,1 thousand ha, of them croplands are - 1256,5 thousand ha (43,1%), hayfields and pastures - 1654,3 thousand ha (56,8%), as well as the lands used for permanent crops - 2,4 thousand ha (0,1%). The largest specific gravity of the drained lands is typical for areas of Belarusian Polesie.

It is not only necessary to provide state's support to the drained lands, but to the territories of natural marsh ecosystems preserved for the present time as well, wherefore further fulfillment of the National strategy and activity plan on use, restoration and defense of marshes, peat deposits is planned as well as activities to fulfill the UN Convention to Combat Desertification.

Due to continuous growth of population of Belarusian cities there is a tendency of urban boundaries to expand. The process is not only connected with the increase in areas covered by multi-storey apartment blocks (so called 'bedroom suburb'), but also with creation of suburban areas with individual houses (so called villa construction), for which agricultural lands and, in a less degree, state forestry lands are being allocated. In future the intensity of the process will grow because of increase in car fleet and

economic development, which encourage push and pull migration. It is necessary to note that the above tendencies are actual ones for other European countries. Growth of building density within city limits will be observed in future. Such processes will result in increase of greenhouse gases emission.

So, estimating land and raw materials potential of Belarus as quite a high one it is necessary to note that changes in the structure of the land supply within the last years are connected with the restoration process of natural and household potential of lands, provision of population with land parcels, transfer of low production agricultural lands to forestry enterprises, optimization of agricultural land use, allocations for all kinds of construction etc. In 2008 agricultural land development was approximately 40,0%, and percentage of plowed fields - 27,0%; it certifies quite a high degree of anthropogenic reclaiming of the country's lands. Area of the environment stabilizing lands (forests, natural meadow, tree and shrubbery vegetation, marshes and water) accounts for 50% of overall area of the lands. In comparison with West European countries Belarus is characterized by greater safety of woodlands and marshes. Besides, the provision with agricultural lands per 1 inhabitant is higher here, including croplands (accordingly 0,92 and 0,57 ha). The tendency will be kept in the future. The changes in the use of land have double influence on emission and absorption of greenhouse gases. So, urban development, provision of population with land parcels, land allocation for construction of household and municipal objects facilitates growth of greenhouse gases. While recreation of forests and marshes v.v. leads to carbon-dioxide absorption and facilitates emission reduction of greenhouse gases in whole.

As a result of catastrophe at Chernobyl NPP 1,8 mln. ha agricultural and more than 2,0 mln. ha forest areas were subject to radioactive contamination. As of 01.01.2008 248,7 thousand ha have been taken out of the agricultural use. The greatest part of contaminated areas is in Gomel and Mogilev regions.

Specially Protected Areas

In 2008 specially protected natural areas (SPNA) in Belarus were amounted to 1288 (not including Polesie Radiation-Ecological Reserve), their area was 1595,5 thousand ha or 7,7% of the country's area (table 1.5). In future it is planned to increase the area of SPNAs up to 9 - 10% of the country's area.

Table 1.5 Belarusian Specially Protected Natural Areas (as of 01.01.2009)[1)]

Protection Status	Quantity	Area, thousand ha	Proportion to the Overall Area of SPNA, %
Reserves[2)], National parks	5	480,9	30,1
Wildlife Reserves, total	435	1100,2	69,0
including: Republican wildlife reserves	84[1)]	834,6	52,3
Local wildlife reserves	351	265,6	16,6
Monuments of nature,total	848	14,4	0,9
including: Republican monuments of nature	305	3,2	
Local monuments of nature	543	11,2	
Overall	1288	1595,5	100

Note: 1) Total amount of reserves, national parks and republican wildlife reserves is given allowing the fact that the Beresino Biosphere Reserve, the National Park of the Belovezhskaya Pushcha, the Narochansky National Park and 3 Republican wildlife reserves are located in 2 and more regions.

2) Not including the Polesie Radiation-Ecological Reserve.

SPNAs represent forest ecosystems - 32 objects (the National Park of the Belovezhskaya Pushcha and 31 wildlife reserves) with total area of 273,4 thousand ha or 21,7%. 16 SPNAs with total area of 306,7 thousand ha (24,4%) have been created to protect forest-and-lake ecosystems. Among them are the such national parks as Narochansky and Braslav Lakes, the unique objects like Rychy, Dolgoe, Krivoe, Osveya, Selyava Lakes and others.

SPNA base are national areas, of which importance is recognized at the international level. Among them are the National Park of Belovezhskaya Pushcha (the monument of world heritage, transboundary biosphere reserve) and the Beresino Biosphere Reserve. The status of Ramsar site of international importance was given to the Olmansk Marshes Republican Landscape Sanctuary and the Mid Pripyat Reserve as well as the Sporovsky Biological Reserve.

In the Republic of Belarus the amount and area of the specially protected areas is regularly developed (table 1.6).

Table 1.6 Total Amount and Area Dynamics of Republican Specially Protected Areas, 1980 - 2008 (Not Including the Monuments of Nature)

Index	Year							
	1980	1985	1990	1995	2000	2004	2005	2008
Amount of objects	58	63	67	80	102	102	104	89
Area, ha	884,6	882,9	900,7	799,3	974,4	1258,1	1416,4	1315,5
% of area	4,2	4,2	4,3	3,8	4,7	6,1	6,8	6,3

1.7 Biological Resources

Belarusian biological variety has large national and international importance, because it supports global ecological balance and conservation of the biosphere's genetic systems. Belarusian natural and socio-economic conditions facilitate to generate and protect at its territory a great number of rare ecosystems and animal and plants species, which have disappeared or are threatened with extinction in Europe. Sufficient areas of natural landscapes (resources of valuable genetic fund) have survived in Belarus.

Belarus has considerable potential of biological diversity of both flora and fauna resources.

Today natural vegetation occupies 62,2% of Belarusian territory. Flora is represented by forests, meadows, bushes, mire and aquatic vegetation. Plants are the most important natural component forming Belarusian landscapes and influencing micro- and mesoclimate, developing significant part of country’s natural resources.

Biological diversity indicator is availability of about 11,5 thousand plant species, including higher plants – till 2100, inferior plants - 9000-9400 species. Till the present time it is known 1638 species of vascular plants with absolute dominance of herblike species (1550). Among woody plants there are 107 wild-growing indigenous species, of which 28 are trees, and the rest are bushes, sub-shrubs and under- shrubs. It is known 430 bryophytes, 477 lichens, algae - more than 2200, fungi - up to 7000 species.

Forests are the natural wealth of Belarus; they are one of the main natural resources of the country. Pine (50,2%) and spruce (10,0%) forests prevail in the structure of a forest. Small-leaved forests are mainly presented by birch (20,8%), black

alder (8,2 %), white alder (2,3%) and aspen (2,1%) formations. Portion of broad-leaved forests amount to 3,9%, including oak - 3,3%.

The Republic of Belarus is well-provided with forest resources. The Belarusian forests are state property. The main part of the forest is under jurisdiction of Belarusian Forestry Ministry. A part of the forests is assigned to reserves, national parks and other departments. Forest resources include forest and non-forest lands. Forest lands are the lands covered by forests and land not covered by forests but intended for its recreation (glades, burned-out forests, failed forests, light forests, wastelands and open forest communities). Non-forest lands are lands used for agricultural purposes, glades, roads, reclamation network etc., as well as other lands of a forest fund (wetlands, reservoirs, watercourses other areas unsuitable for forest growing) given for the needs of forestry. Dynamics of forest resources is characterized by stable increase. In Belarus there is a tendency of forestry growth; as of January 1, 2008 it was 38,1%.

Belarus is a part of the sixth group of the countries (the largest one) in terms of forest resources. Forests are the essential part of the country's recreational resources.

However, forestry has a number of unsettled problems. Species composition of the forests is not optimal yet. Areas of hardwoods are 1,5-2,0 times less than they could really be. Percentage of soft-wooded broadleaved species is high enough, the woodland is heterogeneous. Average reserves of mature forests per 1 ha as well as their average density is 50-60% of optimal. Intensity of use of forest resources is not high: about 1% of total reserve and about 50% of average annual growth. Although, rated wood cutting areas are not fully cultivated, its cultivation is increasing from year to year. Such increase is a result of active work of forestry and economic development of the country. The increase of rated wood cutting areas is the result of the natural growth of forest range and its attainment of the established cutting age. Rated wood areas of final felling were as follows: 7,985 bln.m^3 in 2008, 8,571 bln.m^3 in 2009.

In 2010 the rated wood cutting areas will be 8,897 bln.m^3, and by 2020 the forecasted rate will be 12-15 bln.m^3.

Volume and efficiency of carbon absorption is influenced by organization of forest exploitation, species composition and forest age. The best carbon absorbent is young deciduous forest; however, coniferous forest prevails in Belarus.

The positive factor of forest use is reforestation, which areas amounted to 50,0 thousand ha in 2008, including forest planting - 43,1 thousand ha, areas of forest

regulation - 1139,0 thousand ha. Increase of forest areas by means of the young stand will facilitate growth of carbon dioxide absorption.

Belarusian forests are of high fire hazard. So, in 2008 it happened 673 fires covering the area of 411 ha, in 2007 it was 1079 fires with areas of 613 ha, in 2006 - 3252 fires at the area of 2508 ha. The large amount of fires in 2006 is explained by the following factors: high temperature conditions, dry summer that resulted in extreme fire hazard. Forest fires damage environment badly, influence it negatively and they result in additional emission of the greenhouse gases.

Felling is the most considerable form of forestry management to impact on forests. In 2008 by means of all types of felling 488 thousand ha were deforested and 15054 thousand m^3 of merchantable wood were harvested including final fellings - 24,4 thousand ha and 5465 thousand m^3 (36,3%) of merchantable wood were harvested. The structure of felling has changed: starting from 2000 final felling has decreased considerably, at the same time intermediate fellings (improvement thinning, reconstruction, sanitation cutting) and other types of felling, which provide more than 60% wood, have increased.

Shrub vegetation is represented by the groups of hydrophytic willow-shrubs (52,5%) being formed at wetlands, xerophitic juniper bushes confined to heathlands and uniquely rare blackthorn (34,2%), as well as flood plain shrubs (13,3%).

Meadow vegetation of Belarus is represented by wide spectrum of herbal communities of upland, bottomland, river and lake valleys. The meadows, with the exception of flood plain meadows, are secondary. Without practical use – haying, pasturing, and maintenance - they brush, grow over, swamp. Poium's ecological role is to create favorable conditions to exist for numerous plants and animals, which need open space, including rare and endangered, as well as useful for agriculture species. Mosaic of forest and non-forest (meadows and marshes) areas create auspicious ecological and aesthetic conditions, increase environment's biotopical capacity. Under meadow grass-cover a peaty sod soils are formed. They play significant erosion-preventive and water protection role that used by bioreclamation of disturbed soils.

Water vegetation is mainly typical for Belarusian Poozerie. In rivers, lakes, reservoirs and ponds there are beds of bur reed, rushes and arrowhead. Macrophytes form trails of various widths along coastlines. In the mid-water, at the bottom of water bodies hundred species of algae are widespread.

Among mire vegetation prevail eutrophic bog formations that account for 61,1% of total area; they are followed by mesotrophic (transition) bog - 20,7% and oligotrophic bog - 18,2%. Eutrophic bogs prevail at Polesie, oligotrophic – at Poozerie, and mesotrophic bogs are mainly typical for the central part of the country.

Mire vegetation has changed significantly within the last decades. Bogs were the main objects of drainage reclamation and further transformed to the agricultural lands. Upon this, the area of open bogs and carrlands has decreased considerably, and transition and oligotrophic bogs – in a less degree. The bogs of Belarusian Polesie and central part of the country have been intensively developed, where the area of open bogs and carrlands has decreased more than twice for 40 years. The area of oligotrophic bogs has decreased considerably in the result of the peat removal.

Within the last decade Belarusian bog landscapes, which fix carbon dioxide (CO_2) effectively, have been obtaining a discrete role because of the problem of global warming. At the same time, bogs withdrawing carbon from the atmosphere produce methane and thereby affect the climate.

Oligotrophic bogs of Belarusian Poozerie are of especial value for the environment: the biggest ones (Elnya, Osveiskoe, Yuhovichskoe, Golubitskaya puscha, Domzheritskoe etc.) are part of existing and projectable reserves of the republican importance.

Belarusian fauna is presented by 453 species of vertebrates and more than 30 thousand species of invertebrates. Mammals are presented by 6 orders, of which insectivores include 10 species, bats - 16, predators - 16, duplicidentates - 2, rodents - 26, paridigitates - 6 species. There are 298 species of birds, of which 225 species build their nests at the country's territory. 46 species of vertebrates are in the Red Data List of IUCN, the nature complexes of the republic play discrete role in preservation of these species: aurochs, lynx, European otter, European mink, aquatic warbler, great snipe, ferruginous duck, white-tailed eagle, corncrake, greater spotted eagle, sterlet, vendace etc.

Ecosystems of open and forest bogs are represented by 31 object of SPNAs of total area of 2283,2 thousand ha or 22,5% of total area of republican SPNAs. This group includes the most territorially important objects, such as the Beresino Biosphere Reserve, the hydrographical nature reserves Elnya (23200 ha) and Dikoe (9800 ha), the Olmansk Marshes Republican Landscape Sanctuary (94219 ha) and others.

1.8 Population

Stable social and economic development of the country is determined by its population size and quality, labour potential, professional and qualification manpower balance, manpower needs, and its competitiveness at labour-market.

As of January 1, 2009 the population was 9671,9 thousand, average population density was 47 persons per km^2, urban population - 73,9%. Demographics dynamics is presented in table 1.7.

Table 1.7 Demographics (as of January 1 for Each Year)

Index	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008
Population, mln. persons	10,2	10,2	10,0	9,9	9,9	9,8	9,8	9,8	9,7	9,7	9,7
Urban population mln. persons (%)	6,7 (66,1)	6,9 (67,9)	7,0 (69,7)	7,0 (70,2)	7,0 (70,6)	7,0 (71,1)	7,0 (71,5)	7,1 (72,0)	7,1 (72,4)	7,1 (72,8)	7,1 (73,9)
Natural movement, %	+3,2	-3,2	-4,1	-4,9	-5,9	-5,5	-5,2	-5,2	-4,3	-3,0	-2,7

Life-sustaining activity of population is accompanied by generation of solid domestic waste and water polution, of which breakdown and treatment result in emission of greenhouse gases. Use of fuel resources, wood and agricultural raw materials for life-sustaining activity result in emission of greenhouse gases as well. Population decline by 0,5 mln persons during the period from 1990 till 2008 facilitated the increase of greenhouse gases emission.

Over a period of last 18 years demographic crisis is observed in Belarus. First of all, it is shown by decline in birth rate, rise in mortality, and resulted in drop in population. Natural loss is caused by two factors: aggravation of social and economic crisis in mid 1990th and worsening of reproduction quality of age structure of population that resulted in birth decline and rise in mortality. The present tendency is typical for both rural and urban population. However, there is a growth of population in cities because of migration inflow.

Urban population is characterized by high concentration. There are 1,8 mln persons in Minsk (25,2 % of urban population). Five regional centers (big towns with population from 250 thousand up to 500 thousand) concentrate 25,6 % of urban

population. There are 9 towns with population from 100 thousand up to 250 thousand, that is 17,6% of urban population. It is amounted 14 towns with population of 100,0 thousand and more and 197 small and medium urban settlements with population of less than 100,0 thousand per each in Belarus.

Expected lifetime in the Republic of Belarus in 2008 was 70,5 years, that is by 0,6 year less than in 1990. Expected lifetime of rural population is still less than urban one.

In the nineties the so called 'ageing from above' process was in progress due to the relative growth in number of old people. In accordance with the UN scale the country's population is considered old, if more than 7% of its population is 65 and older. In Belarus in 2008 this index was 14,1%, thereby twice as much.

The influence of urbanization on change in greenhouse gases emission cannot be estimated unequivocally. On the one hand, rural population is the main consumer of firewood, peat bricks and other stove fuel used by individual households and is characterized by lower efficiency as compared with exploitation of city thermal power plants. Besides, production of household fuel for rural population is connected with negative impact on the sinks of greenhouse gases (forests, peat bogs). On the other hand, urban population use transport services more actively, have higher income rates, and economically urban population demand stimulate larger use of fuel resources and agricultural goods in the republic and as a consequence increase in emission of greenhouse gases.

In 2008 occupied population was 4594,4 thousand persons against 5151 thousand persons in 1990 and 4441,0 in 2000, that is occupied population declined by 10,8% and 3,5% respectively. Occupational pattern has changed. In the first half of 1990th there was an enlargement of service sector and reduction of portion of industry and construction, and in the second half of the 1990th an increase of population engaged in the service sector was accompanied by stabilization of employment level of the population engaged in industry and decrease of agricultural employment.

Labor Resources are the base that provides stable development. Belarus has a considerable labor potential. In 2008 labor resources achieved 6,2 mln. or 64,6% of total population. Adaptation of economy to the market relations was followed by labor demand reduction while its supply grew. In 2008 economically active population was

4638,1 thousand and employment rate was quite high - 73,5% of able-bodied population.

In modern terms the state policy's aim is to preserve the capacity of the workforce and support maximal employment that results in a constantly low rate of registered unemployment as compared with EIT countries; this figure was 0,8% of economically active population of the country in 2008.

Contrast growth in the distribution of population at the territory of the country with concentration increase at the areas of large cities, on the one hand, and reduction of remote areas population, on the other hand, will act as a fillip for analogous changes in spatial load distribution on the environment.

Upcoming expansion of the areas with very low population density within the country will complicate the practical use of natural-resources potential, but provide more favorable conditions to preserve biological and landscape diversity and form specially protected areas.

1.9 Economy

The Republic of Belarus is a country with economics in transition from administrative model to market economy. Starting from 1996 Belarusian economy has settled down to a course of stable development after continuous crisis. However, financial and economical crisis that started at the end of 2008 will undoubtedly affect the economic and social development indexes of the country. Though, as per Belarusian Statistical Yearbook for 2008, GDP volume, industrial production and investments have increased for the last years, as well as indexes of the standard of living have improved. Table 1.8 shows that there is a tendency of GDP growth.

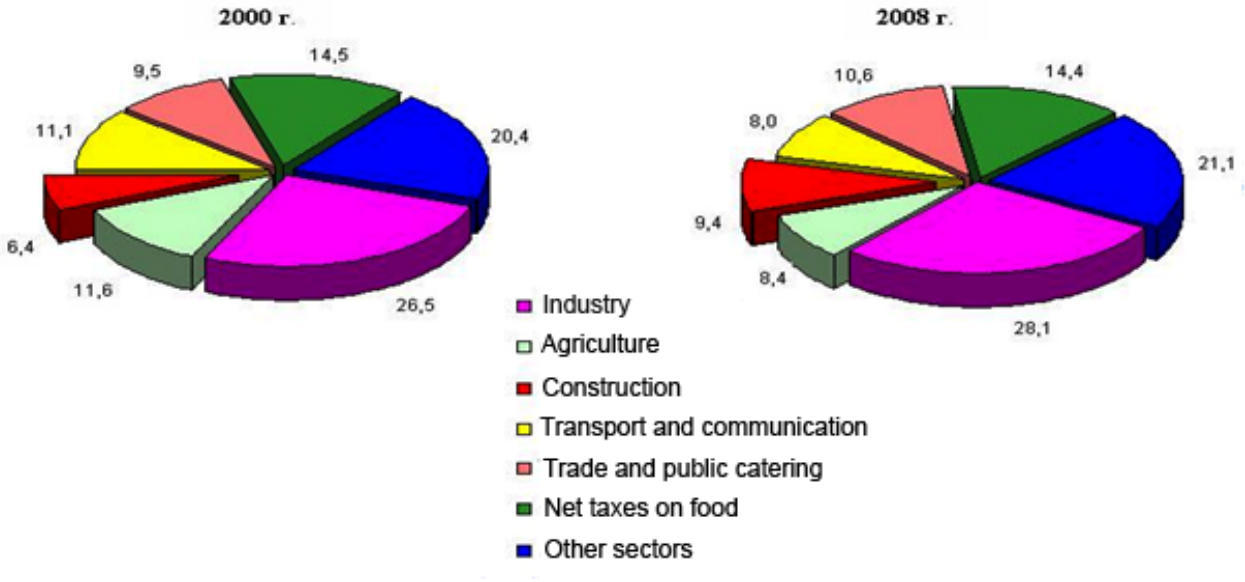
Table 1.8. Production of Gross Domestic Product (GDP) 1995-2008

	1995	**2000**	**2001**	**2002**	**2004**	**2004**	**2005**	**2006**	**2007**	**2008**
GDP in current prices, bln. rubles	121403	9134[1]	17173	26138	36565	49992	65067	79267	97165	128829
In comparable prices, % to the previous year	89,6	105,8	104,7	105,0	107,0	111,4	109,4	110,0	108,6	110,0
Per capita GDP, thousand rubles	11909	913[1]	1722	2634	3703	5088	6656	8145	10015	13308

[1]Taking into account the denomination of 2000 (1000 times decrease)

GDP breakdown has not changed much over a period from 2000 till 2008 (Figure 1.2)

Figure 1.2 GDP Industrial Structure (% to the Total)



There are improvements in the construction sector of the country: annual average volume of sub-construction works and constructions materials industry increased by 10%.

Development rate of the agricultural complex was lower because of the considerable influence of natural conditions of reproduction. Within the period from 2001 till 2008 a further deepening of specialization of agricultural production took place in the agricultural sector, organization and economic mechanism was improved, material and resource base was strengthened, unprofitable agricultural organizations were reformed with debt restructuring, cooperation and integration were developed.

The development of Belarusian economy enabled to continue raising the living standard. The maintenance of relatively high consumption standard of industrial goods was facilitated by state policy aimed at agricultural production support by means of economic subsidies. Today it has significant social importance. The country's economy depends on external processes, which is stipulated by the high level of its openness. The average rate of openness level for the world's economies is about 40% (relation of external turnover to GDP), but for Belarus this index was equal to 55,9% in 2008. In

2000 foreign trade volume amounted to 15 972 mln. USD. Export was equal to 7326 mln.USD, import - 8646 mln. USD; the balance of foreign trade was negative in the amount of 1320 mln.USD. In 2005 the foreign trade volume was accordingly 32687 mln. USD, export - 15979 mln. USD, import - 16708 mln. USD, balance was still negative -729 mln. USD. In 2008 foreign trade volume already was 71952 mln. USD respectively, that is 2,2 times more than the level of 2005 and 4,5 times – the level of 2000. The export amounted to 32571 mln. USD, import - 39381 mln. USD, the balance was still negative - 6810 mln. USD. Russia is the main foreign trade partner of Belarus. In 2000 65% of import and 51% of export of Belarusian goods fell on Russia, and in 2005 - 61% of import and 36% of export. In 2008 foreign trade turnover with Russia was 47,3%, import - 59,7%, export - 32,4%. In 2008 mineral commodities (37,5%) dominated in the export structure, among which stand out potassium fertilizers (2,8 mln. T); chemical products (19,0%); goods of machine-building industry (18,9%). Principal imports are mineral commodities (36,4%) and first of all oil (21,5 mln. T) and natural gas (21,1 bln. m3); machinery, equipment and transport facilities (24,3%), as well as goods of chemical industry (11,8%).

1.10 Energy

Main source of greenhouse gases is carbonaceous fuel consumption. By fuel combustion carbon dioxide (CO2), carbon oxide (CO), nitric oxide (NO_2), water (H_2O) and other substances of direct and indirect greenhouse effect are released. Gross overall consumption of fuel-and-energy resources had steady tendency to reduction till 1995, following which stabilized at the level of 35-37 mln. TFOE. Main problem of the energy supply sector development is its high dependence upon the import. Growth of raw materials import causes energy tariffs growth, that in turn aggravates the payment defaults, and as a result there is a heavy deficit of intra-branch fixed capital expenditure of the fuel-and-energy sector.

Over a period from 1990 till 2008 the structure of fuel-and-energy resources used for power engineering needs has changed. Natural gas has become a dominated source of energy, having supplanted oil residue. The portion of coil used for heat development has decreased. Specific character of Belarus is that considerable volume of peat and peat bricks are used for energy supply (about 2 mln. T of reference fuel in total). Another specific character of the country is low provision with hydropower resources. The pattern of fuel consumption upon main directions has not changes considerably. Fuel

resources are mainly used to develop heat and electric power, and as a process fuel in industry. At fuel consumption the portion of population's consumption has increased which is connected to the housing stock enlargement.

Fuel-and-energy sector includes extraction, transportation, storage, and primary processing of fuel, production and transportation of electricity and heat. Main source of greenhouse gases is a process of fuel burning for heat and electric power production. For this purpose natural gas and residual oil are mainly used in the republic, however small boiler houses use all kinds of fuel.

Additional source of greenhouse gases at the fuel-and-energy sector is the escape and emission of methane and non-methane volatile organic compounds (NMVOC) during transportation and storage of gas and fluid fuel, oil-processing. Transportation is mainly carried out via pipelines (total length is 7421 km, 52041,7 thousand T was transported) and oil pipelines (2984 km - 85072,1 thousand T),as well as via oil-products pipeline (1107 km - 9174,4 thousand km). Main sections of pipelines are in operation for more than 30 years and there are defects in some of them. Oil-products are produced at two oil-processing plants: Mozyr Oil Refinery and Novopolotsk Naftan Production Association. Intermediate distribution of oil products is chiefly carried out by railway transportation to petroleum storage depots and final - by vehicle transportation to filling stations.

The pattern of overall consumption of fuel-and energy resources of the Republic of Belarus over a period after the Fourth National Communication (4NC) has changed to a little degree, although there was a tendency of renewable energy sources (RES) growth during production of heat and electrical power (table 1.9):

Table 1.9 Overall Consumption of Fuel-and-Energy Resources, 2005-2007

Types of Fuel-and-Energy Resources	Consumption (thousand T of Reference Fuel)		
	2005	2006	2007
Fuel-and-Energy Resources, overall	**37049,0**	**40043,0**	**38890,0**
Boiler and furnace fuels, overall	27105,8	28092,6	27254,0
Wood fuel	1078,3	1363,6	1355,0
Waste (wooden)	302,5	357,9	375,8
Secondary Fuel Energy Resources (SFER)	148,2	155,6	162,9

Other	135,0	144,2	170,3
Secondary Thermal Energy Resources (STER)	779,3	819,7	896,5
Secondary Energy Resources of overpressure		20,4	27,7
Hydroelectric power station		6,7	6,6
Percentage of renewable energy sources (RES) to the consumption of boiler and furnace fuels	6,6%	7,2%	7,7%

There was some headway in the development of local hydro resources. Over a period from 2006 till 2008 a number of hydropower stations with total capacity of 1.27 MW were set in operation (table 1.10). It is supposed that some 4450080 kW electrical energy per year will be produced and this will result in reduction of natural gas consumption for the production of electrical energy in the volume of 1424,02 T of reference fuel per year. Annual decrease of greenhouse gases emission can be expected by 2228 T of CO2 equivalent.

Table 1.10 List of Electric Power Plants Set in Operation within 2006-2008

Projects	**Capacity, MW**	**Executers**	**Set in Operation, Year**		
Zelva Hydroelectric Power Station	0.15	Ministry of Energy ('Belenergo' State Production Association)	2006		
Minichi Hydroelectric Power Station	0.11			2007	
Mini Hydroelectric Power Station at NS No6 (v. Krivoe Selo)	0.055	Minskzhilkomhoz ('Minskvodokanal' Unitary Enterprise)	2006		
Mini Hydroelectric Power Station at TPP-2 reservoir	0.15			2007	
Mini Hydroelectric Power Station at Soligorsk reservoir	0.15	Minsk District Executive Committee ('Assosiation Minskmeliovodhoz', State Institution)		2007	
Sakovschina Mini Hydroelectric Power Station (r. Berezina, Volozhyn district)	0.225				2008
Voikovo Mini Hydroelectric Power Station	0.1				2008
'Dnepr-Bug Waterway' RUESP (Brest region, v. Duboi)	0.33	Ministry of Transport			2008
Overall, MW	1.27		0,205	0,410	0,655

1.11 Transport

The functioning of transport complex is followed by CO_2, CO, CH_4, N_2O, NOx and NMVOCs emission. Belarusian transport complex encompasses railway, auto, inner water and air transport. Since 1995 till 2008 passenger turnover for all types of transport decreased by 16,7%, and cargo turnover increased twice as much.

The structure of passenger traffic has changed significantly for all types of transport. So, in general passenger turnover, the portion of railway transport decreased from 48,1 % in 1995 till 37,8 % in 2008, and specific weight of bus and air transportation for the same period increased from 35,8% and 4,7% till 38,0% и 5,9% respectively. The pattern of cargo turnover for all types of transport has not changes considerably. Railway (68,1%) and auto (31,6 %) transport dominates there.

1.12 Industry

Greenhouse gases are formed in industry as a by-product of certain technological manufacturing cycle. Industry branches generating greenhouse gases of technological origin are metallurgy, machinery, and metalworking (electric smelting, rolling and pipe production, foundry casting work, production and repair of refrigerating engineering), petrochemical industry (ammonia, nitric acid, caprolactam and ethylene production), industry of construction materials (cement, lime production), woodworking and pulp-and-paper industry, glass industry. Greenhouse gases are formed as a result of fuel burning in process furnaces to reach high-grade heat and during chemical and thermal transformation of materials. In the above processes CO_2, CO, N_2O, NOx, NMVOCs and hydro fluorocarbons (HFC) are formed. In 1990 key industries were machinery manufacture (34,2% of industrial products value), consumer goods (17,2%), food processing (14,9%), as well as chemical and petrochemical industry (9%). By 1995 there was a significant growth of specific weight of electrical energy industry (from 2,6 till 13,8%), chemical and petrochemical industry (from 9,0 till 14,3%), as well as ferrous metal industry (from 0,9 till 2,4%) in the industrial pattern, that was caused by the increase in import prices for raw materials of the above industries. Today the industrial pattern is as follows: the largest portion is at machinery manufacturing and metal working - 23,2%, fuel industry - 21,3%, food processing industry - 14,6%, chemical and petrochemical industry - 13,4%. The portion of electric power industry has dropped considerably from 13,8% in 1995 till 5,5% in 2008.

From the second part of 1990th the industrial growth started due to government credit financing of current assets and more effective use of plants capacities, and at the end of 1990th it was facilitated by devaluation of Belarusian ruble and reduction in labor costs. From the second half of the 1990th the stabilization or surplus in physical indicators was noted for main industrial products. Main problems of industry are aging of basic production assets, technological inferiority of the goods at external markets, lack of investments.

1.13 Agriculture and Forestry

Main source of the greenhouse gases of non-energy origin is agriculture. In animal husbandry greenhouse gases (mainly methane) are formed in the process of animal digestive fermentation and manure decomposition. Main sources of the greenhouse emission in farming are introduction of organic and mineral fertilizers into the soil, biologically fixed nitrogen, water from the fields, crop residues and cultivation of reclaimed lands. During the above processes N_2O, CO_2, CH_4 are released. Over a period 1990 -2000 agricultural production has slightly decreased, and from 2001 till 2008 the volumes of agricultural goods started to grow. In 2008 the seeding structure has slightly changed to compare with 2000.

Chief figures of agricultural operation are given in tables 1.11, 1.12.

Corn and grain legume yield decreased from 27,2 hundreds kilograms per hectare in 1990 till 19,4 hundreds kilograms per hectare in 2000, and then increased gradually amounting 28,5 hundreds kilograms per hectare in 2007, and in 2008 - 35,2 hundreds kilograms per hectare. The situation is the same for other crops. Starting from 2001yield grows was facilitated by the increase in the volume of fertilizers introduced into the soil.

Table 1.11 Bulk Yields of Basic Crops, thousand T

Year	Corn and grain legume	Potato	Vegetables	Sugar beet
1990	7035	8590	749	1479
1995	5502	9504	1031	1172
1996	5792	10881	1204	1011
1997	6420	6942	1177	1262
1998	4831	7574	1201	1428
1999	3645	7491	1302	1187
2000	4856	8718	1379	1474
2001	5153	7768	1425	1682

2002	5990	7421	1507	1146
2003	5459	8649	2002	1920
2004	7016	9902	2035	3088
2005	6421	8185	2007	3065
2006	5923	8329	2173	3978
2007	7217	8744	2153	3626
2008	9015	8749	2295	4030

Livestock inventory significantly decreased in 2008 in comparison with 1990: cattle by 42,4%, swine by 28,8%, small cattle 75,3%. Starting from 2006 there appeared a tendency of cattle, swine, small cattle and bird population growth.

Table 1.12 Livestock Population

Year	Thousand of Heads				Million of Heads
	Cattle	Swine	Sheep and Goats	Horses	Birds
1990	6975	5051	445	217	50,6
1991	6577	4703	424	212	51,7
1992	6221	4308	381	215	48,9
1993	5851	4181	323	215	33,2
1994	5403	4005	284	220	30,9
1995	5054	3895	262	229	26,4
1996	4855	3715	214	232	27,4
1997	4802	3686	186	233	27,5
1998	4686	3698	162	229	28,1
1999	4326	3566	150	221	27.4
2000	4221	3431	154	217	27,4
2001	4085	3372	149	209	26,2
2002	4005	3329	137	202	25,2
2003	3924	3287	126	192	24,5
2004	3963	3407	125	181	25,1
2005	3980	3545	121	168	28,5
2006	3989	3642	122	156	28,7
2007	4007	3598	124	147	29,4
2008	4131	3705	126	137	31,2

In whole, there is a stable tendency of the greenhouse gases reduction caused by some decline in agricultural production.

1.14 Waste

Main source of the greenhouse emission in the 'Waste' branch is solid waste landfill, as well as refining processes of run-off waters (industrial and household).

In the Republic of Belarus the issues concerned with the wastes are regulated by the Law on Waste Management adopted by July 20, 2007, which contains general principals of municipal waste management with the purpose to reduce their negative influence on the environment and to involve secondary raw materials into economic circulation.

Industrial wastes in Belarus are stored at communal waste and industrial landfills. Greenhouse emissions from industrial landfills are usually insignificant or absent if they do not contain degradable organic matters.

According to the data from Minzhilkomhoz for 2007 171 landfills of solid communal waste are registered in the republic. On the balance sheet of housing and communal services there are 4,5 thousand mini-landfills beside the large ones; they occupy approximately 3,5 thousand ha.

Total area of land allocations for placement of solid communal waste landfills is about 900 ha, of which till 60% is occupied by wastes. Up to about 30-50% of some types of production residues are buried at the same objects, including industrial wastes similar to solid household wastes (industrial and household wastes etc.). Some waste landfills comply with modern requirements to their arrangement and exploitation (impermeable membranes, circular grooves or diversion ditches, monitoring wells, ecologically-friendly technology for waste storage etc).

In Belarus there are some sorting and transfer stations and sorting points, where about 4% of solid communal wastes are recycled. In 2007 approximately 40% of urban population was encouraged to collect communal wastes separately.

In 2007 the growth of greenhouse gases emission as compared with 1990 is explained by the fact that the volume of solid communal wastes in the republic is constantly increasing (in 2007 - 4025,5 thousand T), which is connected both with the production of household goods and foodstuffs and their increasing consumption as well as with the improvement of waste administration system (improvements of legislation in the sphere of waste disposal, strengthening of the control over waste disposal, increase in waste generation rates).

2 GREENHOUSE GAS INVENTORY INFORMATION, INCLUDING INFORMATION ON NATIONAL SYSTEMS AND NATIONAL REGISTRIES

2.1 General Information on Emissions of Greenhouse Gases in the Republic of Belarus

The main greenhouse gas in the Republic of Belarus is carbon dioxide (CO_2), contributing 66.8% of total GHG emissions in 2007 (excluding net CO_2 emissions/removals in 5 LULUCF sector), followed by the methane (CH_4) - 16.1% and nitrous oxide (N_2O) - 17.1%, the share of HFC, and SF_6 is around 0.04%.

The largest contribution of greenhouse gases were from *1 Energy sector* - 64.7%, *4 Agriculture sector* - 24.5%, *6 Waste* - 6.1% and *2 Industrial processes* - 4.6%, the emissions from *3 Solvents and Other products use* amounted to 0.1%.

Total greenhouse gas emissions excluding LULUCF sector were 87536.93 Gg CO_2 equivalent and decreased by 37.8% in 2007 in comparison with 1990 (140703.82 Gg CO_2 equivalent). (1995 was assigned as the base year for the calculations of HFC, PFC and SF_6 emissions).

Table 2.1 shows trends of total greenhouse gas emissions in CO_2 equivalent.

Table 2.1. – Total GHG Emissions 1990-2007, Gg CO_2 eq.

	1990	2000	2005	2007	Trend 1990–2007, %	Share in Total Emissions (exl. LULUCF) 2007	Share in Total Emissions (exl. CO2 removals in LULUCF) 2007
Energy	102 236.84	52 681.63	55 309.44	56 601.86	-44.6	64.7	63.9
Industrial processes	3 925.49	2 805.26	3 672.87	4 040.16	2.9	4.6	4.6
Solvent and Other Product Use	74.40	76.04	69.19	72.56	-2.5	0.1	0.1
Agriculture	31 892.35	20 510.88	21 037.87	21 485.33	-32.6	24.5	24.2
Waste	2 574.73	2 955.57	4 620.24	5 337.02	107.3	6.1	6.0
Total (excluding LULUCF)	140 703.82	79 029.37	84 709.61	87 536.93	-39.8	100.0	98.8

Net emissions/removals in LULUCF	-22 028.43	-27 248.32	-25 088.20	-24 941.85	13.2		
Removals	-25 095.50	-28 201.71	-26 413.14	-26 024.12	3.7		
Emissions	3 067.07	953.39	1 324.94	1 082.27	-64.7		1.2
Total (including LULUCF)	118 675.39	51 781.05	59 621.42	62 595.09	-47.3		
Total (excluding CO2 removals)	143 770.88	79 982.76	86 034.56	88 619.21	-38.4		100.0

The main contributors of greenhouse gases emissions in the Republic of Belarus are Energy, Agriculture and Waste sectors.

In LULUCF sector net emissions/removals increased between 1990 and 2007 by 13.2% mainly due to the decrease of emissions in the categories 5 B - Croplands and 5 D - Wetlands.

The recalculations of GHG emissions estimates have been implemented for the preparation of the Fifth National Communication of the Republic of Belarus in order to continuously improve estimates of emissions, the quality of GHG inventory submissions of the Republic of Belarus, as well as the implementation of recommendations of the expert review team, which were produced under annual review process of national inventories, so the data on emissions of greenhouse gases, as presented in this communication, differ from recent National GHG Inventory Report of the Republic of Belarus 2007, which was submitted in 2009. The recalculations and reasons are presented below in chapter 2.4.2.

2.2 GHG Emissions Trends

Table 2.2 shows trends of GHG emissions.

Table 2.2 – GHG Emissions, Thousand Tons CO_2 Equivalent

Gas	1990	1995	2000	2005	2007	Share in Total Emissions in 2007
Carbon dioxide	104 111.70	57 794.25	53 517.41	56 855.92	58 464.40	66.8%
Methane	15 404.27	11 575.65	11 401.29	13 249.02	14 095.68	16.1%
Nitrous oxide	21 187.84	13 690.94	14 100.91	14 577.01	14 943.51	17.1%

HFC		2.84	9.35	26.19	31.08	0.04%
SF6		0.01	0.41	1.48	2.27	0.003%
Total (excl. LULUCF)	140 703.82	83 063.69	79 029.37	84 709.61	87 536.93	100.0%

2.2.1 Carbon Dioxide (CO_2)

Carbon dioxide is the main greenhouse gas in Belarus. Total CO_2 emissions (excluding net emissions/removals in LULUCF) in 1990 amounted 104111.7 Gg or 74% of the total GHG emissions. By 2007 CO_2 emissions decreased by 43.8% to 58464.4 Gg and amounted to 66.8% of total GHG emissions in 2007.

CO_2 emissions from combustion of fossil fuels are the main source of GHG in the Republic of Belarus. In 2007 93,2% of total CO_2 emissions in the Republic of Belarus were caused by the combustion of fossil fuels in transport, energy industry and manufacturing industries, as well as commercial, agricultural and residential sectors. Thus, one could argue that the decline in CO_2 emissions since 1990 is mainly caused by the following reasons:

- structural changes in GDP due to the increased share of less energy-intensive industries;
- using natural gas as a fuel instead of coal and residual fuel oil;
- more intensive use of biomass as a fuel in the residential and industrial spheres sectors;
- development of energy-saving technologies in recent years.

Changes in carbon stocks in forests and soils are also taken into account when estimating CO_2 emissions. Calculations are based on data on the land use from Forest and Land Cadastres and other additional data provided by the Ministry of Forestry of the Republic of Belarus.

2.2.2 Methane (CH_4)

Methane (CH_4) is the second gas in contribution to total GHG emissions of the Republic of Belarus. Emissions amounted to 15,404.3 Gg in CO_2 equivalent in 1990, or 11% of total GHG emissions. By 2007, CH_4 emissions decreased by 8.5% to 14095.7 Gg in CO_2 equivalent, and amounted to 16.1% of total emissions of greenhouse gases in 2007.

CH_4 emission rate is mainly attributed to the internal fermentation, domestic waste decomposition as well as natural gas leakage from the transfer and distributing systems. Main decrease of the methane emission is observed in the internal fermentation emissions in the agricultural sector. In 2007 these emissions amounted to 6218,8 Gg in CO_2 equivalent, that is by 38% lower compared to 1990. Such tendency is associated with the livestock population reduction compared to 1990. However there has been a certain increase in CH_4 emissions since 2004 which is mainly attributed to the gradual growth of the cattle stock.

CH_4 fugitive emissions from natural gas and the decomposition of domestic waste have increased compared to 1990 by 29.9% and 117.5% respectively. Such rise in emissions is associated with an increase in natural gas transmission through a system of transportation and distribution, and with increasing volumes of municipal waste due to increased level of consumption of modern commodities and food.

2.2.3 Nitrous Oxide (N_2O)

Total N_2O emissions in 1990 amounted to 21190.7 Gg in CO_2 equivalent, or 15.1% of total emissions of greenhouse gases. By 2007, N_2O emissions decreased by 29.5% to 14954.1 Gg in CO_2 equivalent and accounted for 17.1% of total emissions of greenhouse gases in 2007.

The main sources are the agricultural soils and manure management systems in agriculture, wastewater treatment, combustion of fuels in the energy sector. These two categories cover 97.1% of total national emissions of N_2O. There is a decrease of emissions in 1990 in both categories. This is due to reduced use of mineral fertilizers, as

well as a decrease in livestock population. But compared to 2005 there was a slight increase in GHG emissions due to N_2O, which is associated with some increase in mineral fertilizers use.

2.2.4 Fluoridated Gases (HFCs, PFCs, SF_6)

Emissions of fluorinated gases in the Republic of Belarus are small compared with emissions of other greenhouse gases. In accordance with paragraph 8 article 3 of the Kyoto Protocol, 1995 was chosen as the base year for calculating emissions of hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride.

In 1995, emissions of fluorinated gases amounted to 2.9 tons in CO_2 equivalent, or 0.003% of total national emissions of greenhouse gases. By 2007, emissions had increased to 33.3 Gg CO_2 equivalent and amounted to 0.04% of national emissions.

The main source of PFCs emissions is the consumption of these gases in the stationary refrigeration equipment. Perfluorocarbon emissions rose by more than 10 times from 2.8 tons in 1995 to 31.1 Gg CO_2 equivalent in 2007. This is due to increased number of commercial and industrial refrigeration equipment in the country.

Sulfur hexafluoride is used mainly in industry for the production of semiconductors and filling the electrical equipment. Emissions of this gas have increased from 0.01 Gg in 1995 to 2.27 Gg CO_2 equivalent in 2007, which is associated with rise of consumption of these gases in the respective industries.

2.3 Emission Trends by Source Categories

Table 2.3 shows GHG emissions against their sources.

Table 2.3 – GHG Emissions by Source Categories, Gg CO_2 eqv.

Sector	1990	1995	2000	2005	2007
Fuel combustion:					
Energy Industries	65 307,3	33 569,7	30 751,2	32 121,3	30 515,1
Manufacturing Industries and Construction	7 238,5	6 447,0	6 767,5	8 142,4	8 701,9
Transport	13 074,0	4 841,0	3 132,6	4 488,2	5 673,6
Commercial/Residential and Agriculture	14 792,1	10 547,4	9 710,6	8 312,8	9 431,1
Others	590,9	617,9	858,0	654,5	676,6
Fugitive emissions from Fuels	1 234,1	1 233,1	1 461,8	1 590,3	1 603,6
Agriculture	31 892,4	21 374,0	20 510,9	21 037,9	21 485,3

Industrial Processes and Solvent Products Use	3 999,9	2 296,0	2 881,3	3 742,1	4 112,7
LULUCF (including removals)	-22 028,4	-26 673,8	-27 248,3	-25 088,2	-24 941,8
Waste	2 574,7	2 137,6	2 955,6	4 620,2	5 337,0
Total including LULUCF	118 675,39	56 389,93	51 781,05	59 621,42	62 595,09

Figures 2.1 – 2.3 show the contribution of each source of emissions in 1990-2007

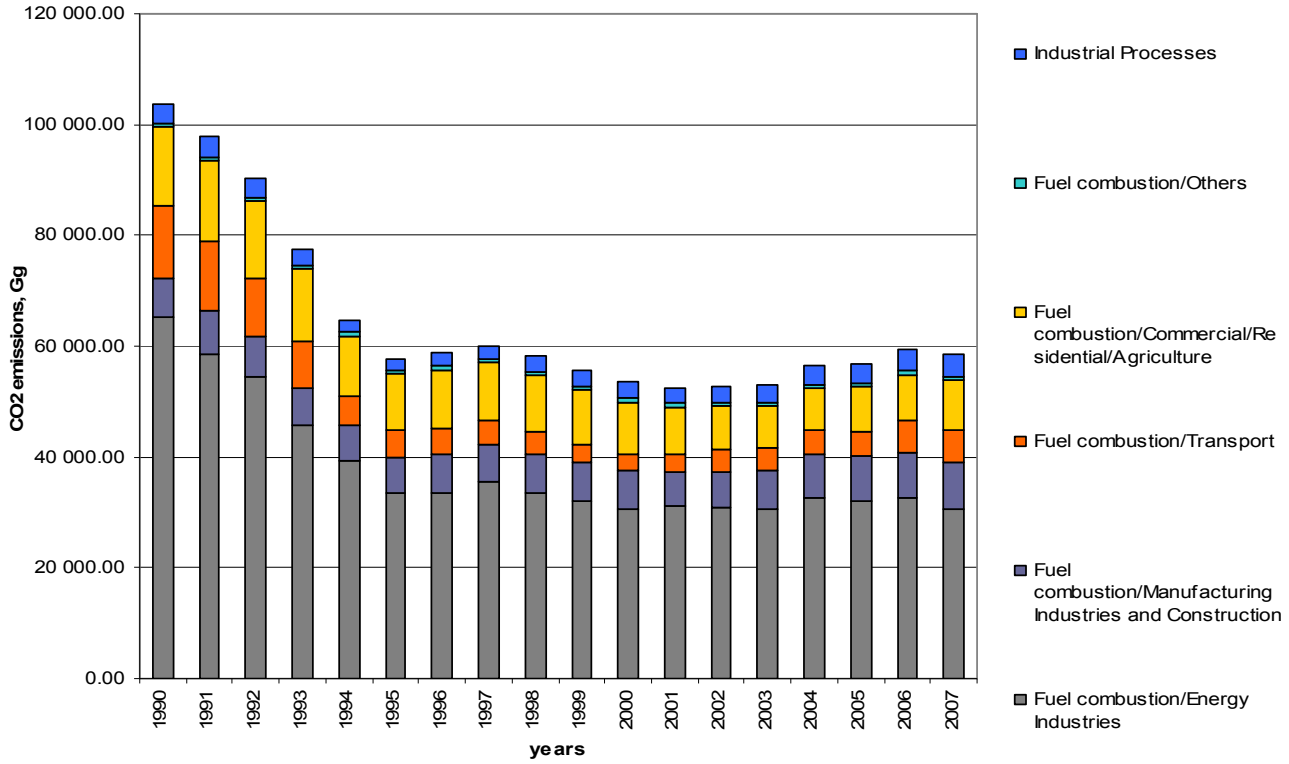


Figure 2.1 – Trends of CO_2 Emissions by Source Categories, Gg 1990-2007 (Excluding Net Emissions/Removals in LULUCF)

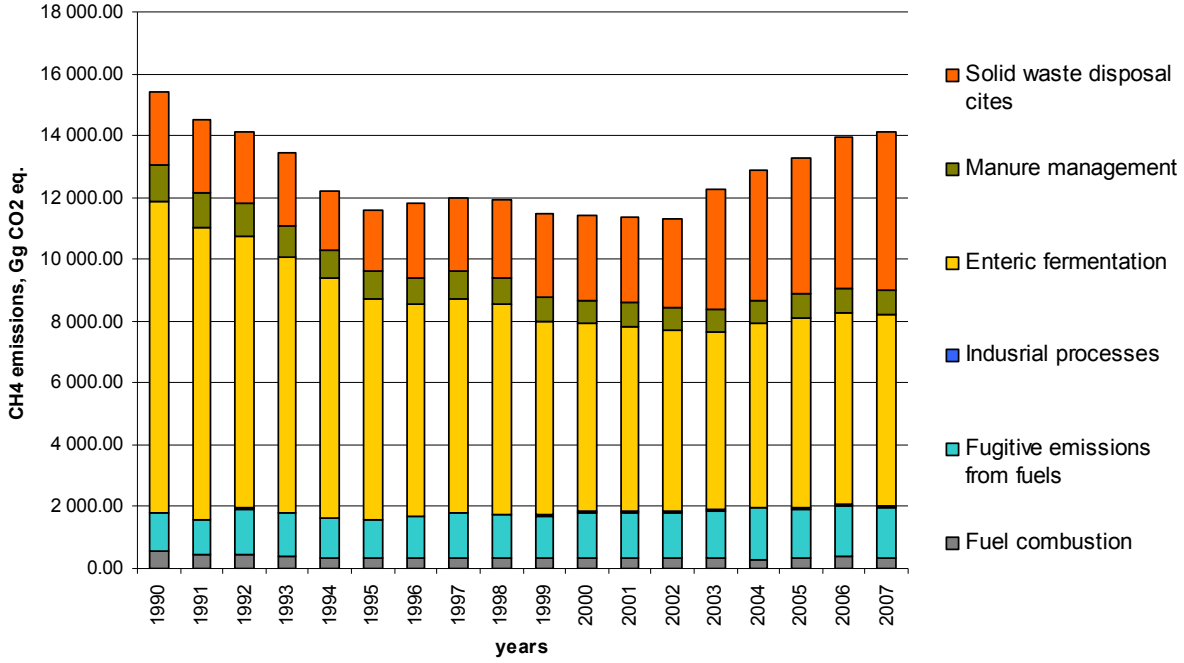


Figure 2.2 – Trends of CH_4 Emissions by Source Categories, Gg 1990-2007

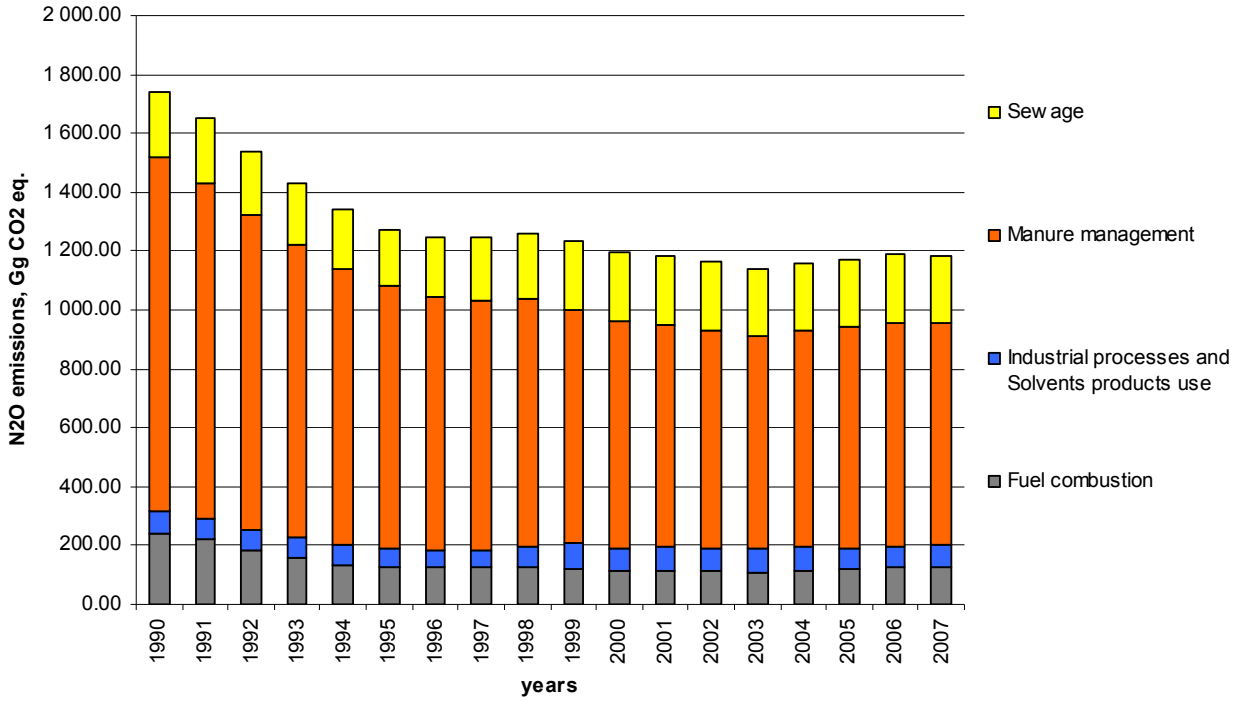


Figure 2.3 – Trends of N_2O Emissions by Source Categories, Gg 1990-2007

2.3.1 Energy

In 2007, the most important category of the GHG sources was the energy industry, where fossil fuels were used to produce electricity and heat, and their emissions amounted to 30 515 Gg CO_2 equivalent, or 34.9% of total national emissions, that is by 53.3% lower than in 1990 - 65 307,3 Gg CO_2 equivalent. In 2007 the republic produced 31.829 billion kW/h of electricity, of them 31.793 billion kW/h were produced by thermal power plants, 35 million kW/h – by hydroelectric plants and 1 million kW/h – by wind turbines. There are no nuclear power stations in Belarus.

Emissions from fuel combustion in the manufacturing industries and construction amounted to 8 702 Gg in CO_2 equivalent (9.9% of total emissions). Compared to the level of 1990 (7 238.5 Gg CO_2 eq.), emissions increased by 20%. Starting from 2003 the GHG emissions in this category have been growing. This fact can be attributed to the rise in the housing construction during this period (from 3 019.2 ths.m^2 per year in 2003 to 4 665.1 ths.m^2 per year in 2007). Also, this category includes emissions from equipment used at construction sites. Emissions from non-energy use of fuels are taken into account in the Industrial Processes sector.

Fossil fuels used for central heating and water heating in commercial, agricultural and residential sectors are accounted for 9 431 Gg CO_2 equivalent, or 10.8% of total national emissions. This is by 32% lower than in 1990 (14 792 Gg CO_2 eq.). Emissions in this category significantly depend on climatic and economic conditions. In the Republic of Belarus biomass is mainly used for house heating in countryside. This category also includes emissions from equipment used in agriculture and forestry.

Emissions from transport in 2007 amounted to 5 673.6 Gg in CO_2 equivalent, or 6.5% of total emissions, that is by 56,6% less than emissions in the transport sector in 1990, that was 13 074 thousand tons in CO_2 equivalents.

Emissions from other sources include emissions from fossil fuels consumed for the needs of communication services. They are very small and amounted to only 676 thousand tons in CO_2 equivalent, or 0.8% of national GHG emissions.

2.3.2 Industrial Processes

In 2007, emissions from industry amounted to 4 040.2 Gg CO_2 eq. or 4,6% of total national emissions, and were by 2,9% higher than the emissions from this source category in 1990, which amounted to 3 925.5 thousand tons in CO_2 equivalents.

The GHG emissions trend has changed during the reporting period. Minimum value was recorded in 1995 as a result of a general economic recession in 90's. Since 1995, emissions have begun to rise gradually, but from 1999 to 2001, there was a decline, caused by the decrease in cement and lime production. Over the following years, emissions from industry have been steadily rising, due to an overall increase in production levels in the country.

2.3.3 Agriculture

GHG emissions in 2007 in the agriculture sector amounted to 21 485.3 Gg CO_2 eq. or 24,5% of the total emissions of greenhouse gases in the Republic of Belarus (excluding LULUCF). From 1990 to 2007 there was emission reduction by 32,6% in this sector due to the fall in agricultural production.

Current emissions changes are related mainly to changes in CH_4 emissions from livestock as well as N_2O emissions from agricultural soils.

2.3.4 Land-Use, Land-Use Change and Forestry

Net emissions/removals in the Republic of Belarus increased slightly by 13.2% in 2007 compared with base year mainly due to the decrease of emissions in the categories 5 B - Croplands and 5 D - Wetlands.

As follows from Table 2.4 LULUCF is a net removals sector in the Republic of Belarus. Category 5 A Forest Lands, in particular sub-category 5 A 1 Forest Lands Remaining Forest Lands makes the greatest contribution to the GHG absorption.

Table 2.4 – GHG Emissions and Removals in Gg CO_2 Equivalent in LULUCF Sector, 1990-2007

Years	GHG Emissions and Removals in Gg CO2 Equivalent			
	Total	5 A Forest Lands	5 B Croplands	5 D Wetlands
1990	-22 028.43	-25 088.50	2 297.33	762.74
1991	-24 141.50	-26 858.61	2 033.46	683.65
1992	-23 187.05	-25 640.43	1 804.75	648.63
1993	-24 626.00	-26 681.08	1 462.91	592.17
1994	-26 268.65	-27 617.55	812.11	536.80
1995	-26 673.76	-28 101.92	918.50	509.67
1996	-26 472.37	-27 887.30	939.36	475.57
1997	-24 981.45	-26 488.62	1 129.88	377.30
1998	-25 744.30	-27 105.37	1 009.80	351.27
1999	-26 880.58	-27 916.19	714.78	320.83
2000	-27 248.32	-28 188.00	641.21	298.47
2001	-27 200.32	-28 187.31	706.86	280.13
2002	-25 764.59	-26 841.93	821.04	256.30
2003	-24 124.30	-25 249.75	909.48	215.97
2004	-23 711.56	-24 868.86	974.34	182.97
2005	-25 088.20	-26 401.33	1 099.56	213.57
2006	-26 008.48	-27 162.81	997.26	157.07
2007	-24 941.85	-26 009.96	920.08	148.03
Trend 1990 – 2007, %	13.2	3.7	-60.0	-80.6

GHG emissions from croplands decreased by 60% in 2007 compared with 1990 due to a reduction of lime applied to soil.

Lands under peat deposits are considered in the category 'Wetlands'. In 2007 GHG emissions from developed peat deposits decreased by 80.6% compared to 1990, due to the reduction of land used under peat deposits.

2.3.5 Waste

Total greenhouse gas emissions from waste treatment in 2007 were 5 337 tons CO_2 equivalent or 6.1% of the total emissions of greenhouse gases in the Republic of Belarus (excluding net emissions/removals in LULUCF).

In 2007, emissions from this source category doubled the level of the base year. CH_4 – 95.7% of total emissions in the sector.

Increase in GHG emissions in 2007 compared with the base year caused by quantity of solid waste which is constantly growing due to the development of modern domestic commodities and food products, increase of their consumption as well as improvement of the waste accounting system (the improvement of waste disposal legislation, increasing control over waste deployment, increase of the waste generation rate).

2.4 National Greenhouse Gas Inventory System

2.4.1 National Greenhouse Gas Inventory System, Including Institutional Mechanism

The main legal documents regulating the inventory and the preparation of GHG inventories in the Republic of Belarus are:

- Resolution of the Council of Ministers of the Republic of Belarus of 10.04.2006, N485 «On Approval of the Regulations on the Procedure of the State Inventory of Anthropogenic Source Emissions and Greenhouse Gases Sinks Absorption»;
- Resolution of the Council of Ministers of 4.05.2006, N585 «On Approval of the Regulations on National Greenhouse Gas Inventory System»;

- Order of the Ministry of Natural Resources and Environment N417 of 29.12.2005 on the Appointment of RUE Bel SRC «Ecology» as a GHG Inventory Center.

RUE Bel SRC «Ecology» under the supervision of the Ministry of Natural Resources and Environment of the Republic of Belarus is developing greenhouse gas inventories to provide information on compliance with international obligations of Belarus in accordance with the UN Framework Convention on Climate Change and the Kyoto Protocol.

Annual preparation of GHG inventory includes collecting activity data, the appropriate choice of methodologies and emission factors, estimating anthropogenic GHG source emissions and sinks absorption, the analysis of key categories, assessment of the uncertainties as well as quality assurance and quality control (QA / QC).

Collection of initial activity data is carried out based on the distribution of official letters of information request through the Ministry of Natural Resources and Environment Protection to the relevant ministries and agencies that have statistical information. The main source of information is the National Statistical Committee of the Republic of Belarus, which collects and provides the most complete data on all sectors of the national economy. Furthermore, additional information is provided by other ministries and departments, including groups and companies on the basis of official requests.

System of activity data collection also includes:

- Review, study and use of published statistical compilations, methods, reference materials, ecological passports of enterprises, research reports containing information on GHG emissions and waste, as well as other sources and documents containing information on GHG emissions;
- Consultation with experts and expert evaluation of indicators needed for the calculation of GHG emissions, which are absent in the public and departmental statistical reporting;
- Choice of the GHG emission factors.

For the proper documentation of information on GHG inventory there is an archive of worksheets with calculations of emissions and initial activity data for the relevant calculations for all years starting from 1990. This archive is located on the hard drive and consists of a set of folders, each of them belongs to a particular year and contains a corresponding set of tabular data format of Excel. Also currently Bel SRC «Ecology» develops united database of initial activity data needed for emissions calculations. The database is created in MS Access environment, and contains AD for the entire time series from 1990 to 2007 with information on the sources of AD.

Greenhouse gas emissions inventory of the Republic of Belarus is carried out in accordance with the Revised Guidelines for National Greenhouse Gas Inventories, IPCC, 1996, Guidance on good practice and uncertainty, the IPCC, 2000, Guidance on good practice for the Land Use, Land-Use Change and Forestry sector. Detailed information on the methodologies of emission estimates and emission factors is presented in the National Inventory Report of the Republic of Belarus 2007.

2.4.2 Recalculations

For continuous improvement of emissions estimates, quality of GHG inventory information and implementation of the expert review team recommendations, appropriate recalculations in energy sector, industrial processes sector and agriculture sector have been performed. The result of recalculations was an increase of GHG emissions estimates in CO_2 equivalent in 1990 for 9.0% and in 2007 for 9.4% respectively. To ensure time series consistency, recalculations were performed for the entire period from 1990 to 2007.

Energy

The reasons for recalculations in energy sector were the following:

- Appearance of the activity data for the Bitumen fuel category;
- Use of national NCVs for fuels for the whole time series emissions calculations;
- Use of the IPCC Good Practice Guidance for calculations;

- Correction of errors or inaccuracies in the calculations.

Recalculations have been performed for the entire period from 1990 to 2007 to ensure time series consistency. The result was a slight increase in emissions by 1.2% from 55 946 Gg up to 56 602 Gg in CO_2 equivalent for 2007. Emissions in 1990 remained unchanged.

Industrial Processes

The reasons for recalculations in industrial processes sector were the following:

- Application of the IPCC Good Practice Guidance for calculating emissions from lime production;
- Calculation of emissions from ammonia production by tier 2 methodology;
- Detection of an error in calculations of emissions from asphalt production;
- Calculation of emissions from the asphalt roofing production;
- Calculation of emissions from the production of methanol;
- Calculation of emissions from the paper and pulp production;
- Calculation of emissions from the production of sheet glass;
- Correction of errors or inaccuracies in the calculations.

Where necessary, recalculations were performed for the entire time series 1990 - 2007 to ensure consistency. The result was an increase in emissions for 74.3% from 2 252,6 Gg to 3 925.5 Gg in CO_2 equivalent for 1990, and for 2007 emissions increased by 25.5% from 3 220.1 Gg up to 4 040.2 Gg in CO_2 equivalent. Mainly, this increase was due to the emissions from ammonia production. In Belarus, carbon dioxide, obtained in the production of ammonia, is used for production of urea and dry ice. However, in accordance with the IPCC Good Practice Guidance it is considered as a short-term storage of CO_2, and CO_2 emissions should be included in the calculations.

Agriculture

To improve estimates of emissions in the agriculture sector the following recalculations were made:

- When evaluating CH4 emissions from internal fermentation of the dairy cattle emission factors were corrected depending on milk production in the republic.
- During QA/QC checks an error associated with the units of measurement in calculations of N2O emissions from storage and use of manure was corrected.
- In assessing the N2O emission from crop residues returned to the soil, the following types of cultures were added: triticale, millet, buckwheat, canola, vegetables, lupine, vetch.
- In assessing the N2O emissions from pastures proportion of manure remaining on the pasture was adjusted in accordance with national estimates, which ensures consistency of the data presented in Tables 4B (b) and 4Ds1 CRF.
- In assessing the N2O emissions from cultivation of organic soils the data on the area of organic soils under cultivation have been revised.

Activities related to the burning of crop residues on fields, do not occur in the Republic of Belarus and prohibited by the Code of Administrative Violations of 6 December 1984 N 4048-X, as well as the Law on Environmental Protection dated 26 November 1992 N 1982-XII. This activity was excluded from the estimates of GHG emissions.

As a result of recalculations, GHG emissions in the agriculture sector have increased by 45.0% and 40.4% in 1990 and 2007 respectively. Recalculations were performed for the entire period 1990 to 2007 to ensure consistency of the time series.

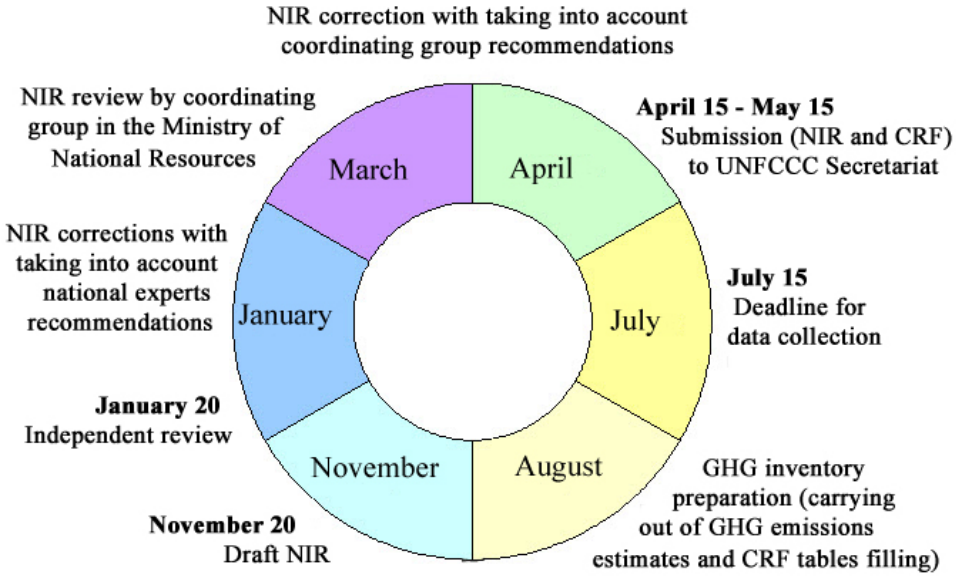
2.4.3 Brief Description of the Existing QA/QC System

Activity related to QA / QC is a very important element in the preparation of national inventories. On the first stage of the QA/QC activity completeness, comparability and time series consistency of data from the National Statistical Committee of the Republic of Belarus, other ministries and organizations, that provide background information, are checked.

QC procedures are performed by staff involved in GHG inventory preparation. Besides activity data checks, correct application of emission factors and methodology used for the calculation of emissions is controlled.

The second step is the verification of the calculations and results and preparation of the inventory. Quality control of calculations and inventory is carried out by group members. Then, in accordance with established practice, RUE Bel SRC «Ecology» sends a draft National Inventory Report (NIR) of greenhouse gas emissions to national experts who are specialists in narrow sectors and do not participate in preparing the inventory. Independent experts verify the correctness of the original statistical data, emission factors, calculation methodology chosen, the quality of the description of trends of GHG emissions and sinks. After that NIR is corrected accordingly to recommendations of national experts and, if necessary, additional calculations are performed.

Then GHG Inventory is submitted to the Ministry of Natural Resources and Environment for consideration and approval. The Ministry of Natural Resources has established a coordinating group, which is not directly involved in preparing the national report on greenhouse gas emissions and is responsible for final checks before submission to the UNFCCC Secretariat. Based on recommendations of the coordinating group RUE Bel SRC «Ecology» is making appropriate amendments to the National GHG inventory report, and then is finally submitted to the Ministry of Natural Resources and the UNFCCC Secretariat.



2.5 National Registry of Carbon Units

Due to the fact that Belarus is not included in Annex B to the Kyoto Protocol to the UN Framework Convention on Climate Change, the flexibility mechanisms of the Kyoto Protocol can not be used. During recent years, the specialists responsible for the National Registry of carbon units of the Republic of Belarus (NRUE RB) are preparing it for the launch and the full functioning.

In accordance with the plan of preparation of national communications provided by the UNFCCC Secretariat, chapter 3D «National Registry» we can provide answers to paragraphs «a» and «h», as well as provide information, which from our point of view may be useful.

2.5.1 Characteristics NRUE RB

The operator of the National Registry of the Republic of Belarus is the RUE Belarusian Scientific Research Center «Ecology» (e-mail: climate.by@tut.by, tel. / Fax: +375 17 247-58-81).

National Registry is physically located on servers with the following characteristics: two servers with two processor Intel Xeon 3.6 GHz, 3 Gb RAM, two hard drives SCSI 72,8 Gb, connected in a RAID 1+0 array and 1 server with similar

characteristics, except for RAM, which is 2 Gb. Two more powerful servers are connected via fiber optic cable to the storage HP MSA1000, which consists of 6 hard drives Ultra320 SCSI to 72,8 Gb, connected in a RAID 5 array, and the sixth disc is in the Hot Spare, that is, at a failure of one of the hard drives, it will be automatically put into use, thus replacing the non-working ones. Those two servers are connected to a backup device HP Digital Data Storage DAT72 via SCSI cable. All servers and equipment are connected to two HP R3000XR UPS for the power backup.

To access data from the Internet the domain www.registry.climate-by.com is registered. When addressing this url on the Internet, the query is redirected to a server which is physically located inside the RUE Belarusian Scientific Research Center «Ecology», so the confidential data contained in the registry database are located not on the remote hosting companies, but directly in a secured room in the RUE Belarusian Scientific Research Center «Ecology», that significantly increases the reliability of data storage and protects server hardware against unauthorized access.

In addition to limited physical access to the server, the system of protection of the National Registry will be implemented at two mutually independent software levels:

- Protection against unauthorized access to the SERINGAS software, that denies access for users who have not confirmed their right of access by entering the appropriate login name and password.
- The system of protection of the server itself from intrusions from the Internet, by filtering incoming requests.

The first component of the protection of the National Registry will be organized on the basis of authorization of access to SERINGAS software by entering a login name and password.

When logged to SERINGAS for the first time, password needs to be changed. It should not be shorter than 10 characters and must contain at least 1 digit and 1 letter, as well as an answer to the secret question (the answer will be used in case the password is lost). Every 60 days user will be offered to change his password.

When the system administrator enters the system, he is automatically redirected to the participants control page. There are 5 main functions: Participants, Settings, Accounts, National Allocation Plan and Transactions. In accordance with these main functions, 3 menus are devoted to reports and technical or administrative management.

It is also important that data from the National Registry will be transferred through the Internet using the SSL protocol. The SSL protocol is a protocol for transmission of important documents over the network and the Internet and is used to transfer confidential information. SSL provides improved security for the network connection with a private key, which allows to encrypt transmitted data.

The second level will include:

- Proxy Server. It protects the network from external access, the local computers will communicate with external resources only through it, and external computers would not be able to access local ones at all (they will «see» only the proxy);
- Firewall id a hardware and software system that provides the ability to filter and limit transfer of certain information through the equipment connected to the Internet. Firewall is nothing but the analyzer of traffic, which passes through a particular interface. Firewall analyzes the contents of packages passing through it and in accordance with prescribed rules determines what information has the right to pass through it, and what will be rejected. In addition, Firewall hides the internal organization of the network from the outside world and increases the reliability of it;
- DMZ (demilitarized zone). Allows to protect not only the server of Web applications, but also the highly important databases. Only HTTP / HTTPS traffic is allowed to the DMZ Web-server, and from DMZ Web-server to the database - only SQL traffic is allowed.
- Antivirus software. Allows to suppress the possible impact of malware and viruses.

2.5.2 Software NRUE RB

The process of preparing the environment for the National Registry of carbon units of the Republic of Belarus, it was decided to use the Windows 2003 Server, but due to the presence of four of its various editions it was necessary to analyze and compare them.

After the analysis of information, as well as a study of the technical documentation attached to the SERINGAS software, decision focused on two editions of the operation system - Windows 2003 Server Standard Edition and Windows 2003 Server Web Edition.

Windows Server 2003 Standard Edition was selected for the installation of Microsoft SQL Server 2000, due to the fact that this operating system provides a high level support for:

- Enhanced authentication services on the Internet (IAS), network bridge;
- Two-way symmetrical multiprocessing (SMP);
- 4 GB of RAM;
- Support and availability of all the necessary networking technologies and security tools.

As a result of testing the different versions of Windows Server 2003, and in accordance with the recommendations of the French developers of SERINGAS software, Windows Server 2003 Web was chosen for installation of SERINGAS. This operation system is designed for building and hosting Web applications, Web pages and Web services, XML, specially designed for the Internet service providers (ISP), application developers and other specialists who want to use the advanced features of the web environment. Windows Server 2003 Web Edition takes full advantage of advanced server systems, Internet Information Services 6.0 (IIS 6.0), Microsoft ASP.NET and Microsoft. NET Framework. As a result of comparative tests of various antivirus programs with the aim to protect information from the web threats the Kaspersky Business Space Security was selected.

Kaspersky Business Space Security protects workstations and file servers from all types of viruses, Trojans and worms, prevents virus outbreaks, and provides safety of information and instant user access to the network resources. This product is designed to meet the increasing demands of servers operating under high loads.

The process of preparing the environment for the National Registry of Carbon Units of the Republic of Belarus various antivirus software products such as NOD32, Dr.Web, Symantec Antivirus, and Kaspersky have been considered, but eventually the Kaspersky Anti-Virus was chosen due to several advantages and additional characteristics available.

2.5.3 Preparing to NRUE RB Initialization

Within the framework of the National Register of Carbon Units of the Republic of Belarus the following steps have been performed:

- The analysis and assessment of compliance with international safety requirements of the Registry on the basis of a technical paper DES, containing the necessary technical requirements to all the registry entries used for the implementation of flexibility mechanisms of the Kyoto Protocol and connection to the ITL and CITL.
- The work on the preliminary collection of bids from the companies that provide network security and creation of technical documentation necessary to launch and operate the Registry.
- The preparation of plan of actions to launch and maintain the National Registry of carbon units of the Republic of Belarus after the ratification of amendment to Annex B of the Kyoto Protocol.

3 POLICY AND MEASURES

3.1 Principal Directions for the Development of Policy and Measurers on Cutting Greenhouse Gases Emissions

The government of the Republic of Belarus attends to the problem of climate change. The arrangements are being made for stabilizing the quantity of emissions and installing more greenhouse gases drains in the period of economy growth. In this connection the measures on quality improvement of sinks and tanks for greenhouse gases are very important. In Belarus, with woods occupying 40% of its territory, it is especially important to see to the potential carbon dioxide absorption from the atmosphere by the forest ecosystems.

Energy consumption of the national GDP is still relatively high, that is why the main share of the greenhouse gases cut will be gained through the modernization of the out-dated industrial and energetic objects. The modernization activities on the energy objects with simultaneous replacement of the part of fossil fuel with biomass in 15 years-term can lead to reduction of the greenhouse gases emissions in volume of more than 24 million tones (of CO2 equivalent), which will be more than 6% of all energy emissions during the abovementioned period of time.

The results of these activities can actually ensure the progressive and steady development of the country's economy in the midterm with simultaneous reduction of greenhouse gases emissions. In other industries, where unit costs for the reduction of greenhouse emissions can be high, policy of new technologies implementation with attracting investments within the Kyoto protocol mechanisms will be carried out, first of all, on mechanisms of joint implementation and international quotas trade.

In 2008 the Government continued work on pursuing the goals and achieving the objectives, defined by the National strategy of stable social-economic development of the Republic of Belarus for the period of time until 2020 and the Program of social-economic development of the Republic of Belarus for 2006-2010.

After the Governmental program of innovation development of the Republic of Belarus for 2007-2010, which was approved by the Decree of the President of the Republic of Belarus on March 26th 2007, under number # 136, a dramatically new way – systematic and MBO-based -- has been adopted for the implementation of innovations, which will allow for the national economy transfer to the mode of intensive

development as part of the Belarusian economic model. In addition, more than 80% of all planned innovations will be based on domestic projects.

The main purpose of the program is creation of innovative, competitive on the world market, science-driven, resource-saving, socially-oriented economy of the Republic of Belarus, which would ensure a social-economic development of the country, improvement of the quality of life of the Belarusian people, as well as environment protection.

Studies on the basic directions of climate activities are carried out both as part of the approved governmental scientific, technological, fundamental and industrial programs, and separate scientific and technological works and projects.

3.2 Principal Measurers Taken by the Government in the Sphere of Climate Change

In discharge of international obligations of the Republic of Belarus under the UN Framework Convention on Climate Change and Kyoto protocol, the National program on climate change mitigation measures for 2008-2012 has been developed for the UN FCCC and approved by the Council of Ministers of the Republic of Belarus on August 4th 2008, under #1117.

The National Program is an important step in solving the problem of climate change, it provides for the continuation of the Strategy of emission cut and increase of greenhouse gases absorption by sinks in the Republic of Belarus for 2007-2012 as well as measurers which be carried out in 2008-2012. This program specifies the following measurers:

- climate situation and climate changes monitoring;
- reduction of the emissions by sources and increase of the greenhouse gases absorption by sinks;
- industries adaptation to climate change;
- international co-operation in the field of climate change mitigation.

The National program is aimed at ensuring control of emission growth and increase of greenhouse gases absorption by sinks through developing a program of interconnected measurers for industries which produce emissions by sources and provide greenhouse gases absorption by sinks.

Implementation of the National Program allow to improve the system of collection and analysis of information of climate change, anthropogenic reasons and

causes of these changes through creation of automated information systems. Development and implementation of precautionary measures to prevent a possible serious damage to any of the climate change dependant branches of industry of Belarus, is a very important component of the Program.

Climate change mitigation measures according to the conducted Program can be divided as follows:

- measurers on improvement of climate change monitoring;
- mitigation measures;
- measures on adaptation to climate change;
- measurers on improvement of the normative legal and institutional base;
- measures on development of international co-operation;
- measures on improvement of information support and personnel training;
- measures on ensuring fulfillment of obligations under international climate agreements;
- measures on developing scientific knowledge about problem of climate change.

3.2.1 Measures for Improvement of Climate Change Monitoring

Hydrometeorological surveys are currently done at 52 stations, 8 aviameteorological stations, 2 aerologiocal stations, 3 radio meteorological locators, 137 hydrological posts. Current density of hydrometeorological survey sites (1 site per 3,900 square km) in general complies with the requirements of the World Meteorological Organization concerning the objective coverage of the territory of the country by hydro metrological parameters and climate characteristics.

The State Program of the development of state hydrometeorogical service for 2007-2010, approved by the resolution of the Council of Ministers of April 11th 2007 under #463, provides for use of new surveillance technologies and technical re-equipment of state network of hydro meteorological surveys, so as to improve the climate monitoring.

Following points of the Program, which has been already started, are being paid special attention to:

- improvement of system of monitoring the ecosystems, that are most likely to be affected by climate change;

- installation of automated meteorological systems at the stations, included in the regular exchange of international climate information;
- improvement of system of climate data monitoring (air temperature, rainfall, wind, humidity etc), analysis of their changes and data compilation;
- improvement of prediction methods, including prediction of changes of basic climatological data for a short term and long-term perspective;
- preparation and distribution of the annual reviews of climate situation and climate change on the territory of the Republic of Belarus for perspective planning of economic activity.

3.2.2 Climate Mitigation Measures

Basic mitigation directions and measures follow the Strategy of emission cut and enhancement of greenhouse gases absorption by sinks in the Republic of Belarus for 2007-2012. The most crucial of them involve raising efficiency of using fuel and power resources in all spheres of business activities.

Considering planned GDP growth rate, lowering of GDP energy-output ratio and ensuring the energy safety of the county the structure of consumed fuel will be changed so as to decrease the share of natural gas and increase the share of coal and other solid fuels. Growth of consumption of boiler and furnace fuels and planned changes in its structure will lead to increase of greenhouse gases emissions from power and industrial installations. To compensate increase of emissions it necessary to take measures on lowering anthropogenic effect on climate, the most effective of them being power-saving, implementation of renewable power sources and increase of greenhouse gases absorption by sinks.

The priorities of the National Program for the next term are as follows:

- expanding usage of nontraditional and renewable power sources;
- activation of power-generated equipment in boilers, construction of mini-HES, based on renewable power sources;
- utilization of high- and mid-potential secondary power resources through usage in heat-supply schemes;
- utilization of methane from solid wastes landfills with power generation;
- installation of biogas technologies in the process of handling organic wastes, including liquids;

- developing and enhancing effectiveness of forest management, including artificial and natural reforestation, wild fire suppression, forest management activities (forest renovation, rational usage of forest biomass);
- performing secondary bogging of cutover bogs and swamp restoration on non-used meliorated lands.

3.2.3 Measures for Adaptation to Climate Change

The main purpose of policy and measures on adaptation to the changing climate is mitigation of negative effect of climate change on national economy and people's healthcare and use of potential positive effects of global warming.

For carrying out effective policy on adaptation to changing climate it is necessary to estimate the vulnerability of industries and study the changes in existing ecosystems, caused by climate change.

In Belarusian economy agricultural production in the utmost depends on possible climate changes. Thus, the increased fear of poor crops as a result of increase in frequency and recurrence of draughts on the territory of a number of regions, crop loss caused by increase in frequency of undesired hydro meteorological events can constitute the highest threat.

The second most vulnerable to climate change industry of the Belarusian economy is forestry. In 2009 a program of adaptation of forestry to the predicted climate change was developed, which includes the set of actions aimed at adaptation of the industry to such change.

Water resources also have high sensitivity to climate change. Carrying out water-supply activities requires long time. Therefore big water management activities are planned early and put into operation in advance of 10-15 years in water demand.

Certain consideration in part of adaptation to climatic change will be taken in such branches of economy as industry (including energy generation), housing and public utilities sector, construction and transport.

To increase the potential in the sphere of estimation of vulnerability and adaptation to the changing climate a wide scope of work is required, aimed at formation scientific and technological base, defining and implementation of practical measures, preparation of management decisions in this field, including nation-wide measures on adaptation to the changing climate.

3.2.4 Measures for Improvement of the Normative Legal and Institutional Base

Improvement of normative legal base, development of institutional and organizational structure is a permanent element of climate policy and is based on:

- preparation of proposals on strengthening the role of the state in the process of climate policy formation and implementation;
- improvement of state climate control system;
- development of new and improvement of existing normative legal acts concerning different directions of climate change;
- creation of procedural framework in the field of climate change, development of technical normative legal acts;
- providing conditions for formation and improvement of institutional potential in the sphere of climate change;
- providing conditions for foreign investments attracting, including those under Kyoto protocol mechanisms.

3.2.5 Measures for Development of International Cooperation

International cooperation is a fundamental element of policy of the Republic of Belarus in the sphere of climate change. It facilitates the implementation of basic provisions of the national climate policy, as follows:

- enhancing potential of the Republic of Belarus in climate-change activities;
- increasing the degree of awareness of foreign partners on fulfillment of obligations by the Republic of Belarus under UN FCCC and Kyoto protocol, including the national policy and measures;
- expanding interaction with foreign and international partners on implementation of the UN FCCC and Kyoto protocol, including preparing for participation in the Clean Development Mechanism.
- attracting foreign investment in the implementation of climate projects;
- harmonization of the national legislation, regulatory and procedural framework and institutional infrastructure in the sphere of climate change with leading countries.

Expanding of cooperation in the sphere of climate change is carried out together with such international organizations such as: the UN Office in Belarus (UNDP), UN

Environment Program, the Economic Commission for Europe, the Organization of Economic Cooperation and Development, the Intergovernmental Group of Experts on Climate Change, the World Meteorological Organization, the Organization for Security and Cooperation in Europe, the CIS Inter-State Environmental Council.

The main measures taken by the Republic of Belarus on the development of international cooperation are as follows:

- development of contacts with the UNFCCC Secretariat, establishing interaction on climate issues with other environmental conventions;
- enhancing cooperation and raising funds for the implementation of climate projects from international financial organizations, such as the World Bank, the European Bank for Reconstruction and Development, the Global Environment Facility (GEF), UNDP, TACIS Program (EU Neighborliness Program), and investor states on a bilateral basis;
- establishing contacts, searching for partners and stakeholders to promote interests of the Republic of Belarus under the international climate agreements.

3.2.6 Measures for Improvement of Information Support and Personnel Training

Providing information and training of personnel on the issue of climate change are carried out in accordance with the Article 4(i) of the UNFCCC, which requires countries – participants of the Convention to provide mutual assistance and cooperation in the field of education, training and instructing population on climate issues as well as to encourage active participation in this process, by both governmental and non-governmental organizations. Further progress in providing information and training of personnel is among the planned activities of the climate policy. It includes the following issues:

- Providing public access to information on climate change and its consequences;
- Conducting training of scientific, technical and managerial personnel on climate change;
- Organizing and conducting seminars and courses on climate change and its socio-economic consequences;

- Regularly preparing and publishing in electronic and print media press releases on climate change and analysis of its causes;
- Organizing speeches and broadcasts on radio and television, publishing and distribution of visual materials on climate change;
- Integrating climate change issues in education program of institutions of secondary and higher education;
- Developing of educational programs on climate change in specialized higher educational establishments.

The problem of climate change and adaptation to climate change becomes a constituent part of environmental programs and seminar plans for various forms of education (secondary and higher education, training, retraining and further professional training of teachers and professionals), first of all, ecological services, as well as branches of economy, known for significant emissions of greenhouse gases: (industry, energy, transport, agriculture, housing and public utilities sector.

3.2.7 Measures for the Fulfillment of Obligations under the International Climate Agreements

The basic measures taken by the Republic of Belarus under its obligations as a member of international agreements on climate change are as follows:

- Development and implementation of domestic policies and measures aimed at reducing the impact on the climate;
- Formation and development of the national system for collecting source data and estimation of anthropogenic emissions made by sources and absorption of greenhouse gases by sinks;
- Creating and maintaining a national registry of carbon units;
- Annual reporting of greenhouse gas emissions inventory, including a national inventory report to the secretariat of the UNFCCC;
- Submission of additional information in the annual national reports in line with decisions of the Conference of the Parties of the UNFCCC.

3.2.8 Measures for Development of Scientific Knowledge on the Climate Change Problem

Scientific and technical activities in the field of climate change are in the stage of development and include the following aspects:

- Studying processes of climate change at global and national levels with upgrading the climate observing system;
- Assessment of the impact of the global warming on the environment and socio -economic sphere;
- Upgrading the national greenhouse gases inventory system;
- Development of methods of environment and anthropogenic systems adaptation to the circumstances of climate change;
- Development of the necessary scientific basis for the practical implementation of activities aimed at reducing greenhouse gas emissions and increasing of greenhouse gases absorption by sinks.

The main measures of scientific and technological activities in the field of climate change include:

- Creation of a modern system of climate data management using new technical means and modern software;
- Conducting researches aimed at improving the climate observing system and climate change monitoring;
- Development of a methodological base to create a system of forecasting and environmental risks management considering climate change;
- Improvement of technologies, means and methods of reproduction, saving and protection of forests, as well as their adaptation to climate change;
- Development of the theory and justification of methods of ecological rehabilitation of disturbed swamps, degraded peat soils;
- Assessment of the yield factors and structure optimization of sown areas under various crops in the context of modern climate change;
- Analysis of the main categories of emission sources and sinks of greenhouse gases in order to improve the data collection, as well as development of ways to cut greenhouse gas emissions;
- Development of activities and recommendations to ensure mitigation and adaptation to climate change;

- Development of strategic forecast of climate change in the Republic o
- Belarus for a long- and mid-term and its impact on economic sectors;
- Further development of scientific and technical bases and conditions of use for implementation of economic mechanisms of the Kyoto Protocol, as well as other mechanisms of carbon finance in the country.

Implementation of measures under the National Program considering the balanced GDP growth will allow reducing greenhouse gas emissions and increasing their absorption by sinks. Funds for carbon finance will be spent on the introduction of new, climate-friendly technologies and equipment (renewable energy sources, secondary logging, etc) that will create new jobs, increase potential of professionals employed at the productive and non-productive economy sectors, promote energy independence, conservation and expansion of biodiversity.

To implement the development of a complex approach to prevention of negative impact of economic and other activities on environment, to raise effectiveness of planning and implementation of environmental measures the National Strategy for implementation of complex environmental permits for 2009-2020 was developed (approved by the Resolution of the Council of Ministers of the Republic of Belarus of July 25, 2009 under number 980).

The most important components of the ecological safety of the country include prevention of air pollution. On December 16, 2008 the House of the Representatives of the National Assembly of Belarus adopted the Law of the Republic of Belarus «On Protection of Atmospheric Air». The purpose of the Law is to preserve and restore the quality of air in order to provide ecological safety. It allows for actual regulation of emissions of pollutants into the air, simplification of the regulatory system and associated administrative procedures, defining the achievable figures for reducing the emissions of pollutants into the air for further planning and implementation of relevant activities and ensuring air quality standards.

Implementation of more than 1920 technical solutions aimed at reducing emissions of pollutants into the air from stationary sources over the past 5 years has reduced emissions by 88.4 tons. During just 2008 more than 435 activities were carried out to reduce emissions of pollutants into the air by enterprises that make major air pollutants in cities.

Each year, more than 200 gas treatment plants on average are put into operation and are being reconstructed, which helps to prevent the release into the atmosphere of about 600 tons of contaminants, hazardous to human health.

In 2009, the Ministry of Natural Resources and Environmental Protection of Belarus developed the Concept of the Draft Law of the Republic of Belarus «On Protection of Climate», which will:

- Determine the legal nature of carbon units and quotas on the greenhouse gases emissions;
- Regulate the property rights issues concerning the greenhouse gases cut, as well as the right to the emissions of greenhouse gases;
- Determine the legal framework for trading the greenhouse gas emissions quotas, the legal opportunities of issuing certificates and the directions of adaptation and mitigation of negative effect on environment;
- Create legal preconditions for the implementation of tax activities related to greenhouse gas emissions, economic incentive to reduce emissions and removals of greenhouse gases;
- Create conditions for the simplification of the project cycle, project co-implementation (JI) and voluntary emission reduction projects (DSV).

3.3 Policy and Measures Adopted by the State to Reduce Greenhouse Gas Emissions by Sector (Summary Table)

General policy and measures adopted by the Republic of Belarus to reduce emissions, as shown below (Table 3.1).

Table 3.1 – General Policy and Measures Adopted by the State to Reduce Greenhouse Gas Emissions by Sector

Policy and Measures	Examples/Comments (Year of Approval)
	• The strategy for cutting emissions and increasing greenhouse gases absorption by sinks on the territory of the Republic of Belarus for 2007 - 2012 (2006); • State program of innovation development in the Republic of Belarus, 2007-2010 (2007); • The national program of mitigation of climate change consequences for 2008-2012 (2008); • The Law of the Republic of Belarus «On Protection of Atmospheric Air» (2008);

	• The Provision on the procedure of submission, review and monitoring of projects on voluntary reduction of greenhouse gases emissions (2009); • The Law of the Republic of Belarus «On Protection of Climate» (2009); **The Decree of the President:** No. 205 of 30 April 2007 on the adoption of amendments to Annex B to Kyoto Protocol to the United Nations Organization Framework Convention on Climate Change; **Resolutions of the Council of Ministers:** • of May 4, No. 585, 2006, on approval of provisions on National Greenhouse Gas Inventory System; • of April 10, 2006 N 485, on approval of provisions on the state inventory of anthropogenic emissions from sources and greenhouse gases absorption by sinks; • of August 25, 2006 No. 1077, on the National Register of carbon units of the Republic of Belarus; • of September 5, 2006 No. 1144, on approval of provisions on the procedure of submission, review and monitoring of projects designed for joint implementation; • of September 5, 2006 No. 1145, on the establishment of the state Commission on problem of climate change; • on April 14, 2009 No. 466 «On the Order of Presentation, Review and Monitoring of Projects for the Voluntary Reduction of Greenhouse Gas Emissions»; **The Order of the Ministry of Natural Resources and Environment Protection of the Republic of Belarus** of December 29, 2005 No. 417 «About an Inventory Center for Greenhouse Gases; **The Resolution of the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus** of January 22, 2007 No. 4 on approval of the instructions on the procedure of formation and maintenance of the National Registry of carbon units of the Republic of Belarus.
Policy and Measures by Sectors	
Energy sector	• The Directive No. 3 «Economy and Thrift as Main Factors of Economic Security of the State» (2007); • The concept of energy security of the Republic of Belarus (2007);

	• The Law of the Republic of Belarus «On the Use of Nuclear Energy «(2008); • The Draft Law of Belarus on alternative and renewable sources of energy;
Industry	• The Program of technical re-equipment and modernization of foundry, thermal, galvanic and other energy –consuming productions for 2007-2010 (2007); Regulations on State Supervision in the field of industrial Security (2008);
Transport	• A range of measures on exploitation of cars, equipped with a compression ignition engines, on the territory of the Republic of Belarus in line with requirements of the UNECE Regulations under number 49 (04) B1 (Euro-4) and number 49 (04) B2 (Euro 5) / Revision 3, concerning the emissions of pollutants, on the territory of the Republic of Belarus (2006); • The Air Code of the Republic of Belarus (2006); • The State Program for Development of Civil Aviation of the Republic of Belarus in 2006-2010 (2006); • The Program of development of the automobile industry of the Republic of Belarus in 2007-2010 (2007); • The State Program for the production of biodiesel in the Republic of Belarus for 2007-2010 (2007); • The State Program for the constructing in towns and cities urban electric transport in 2009-2013 years (2009);
Agriculture	• The Draft Law «On Agro Industrial Production»; • The Program of development of scientific-practical centers of the National Academy of Sciences of Belarus on agriculture, animal production, potato growing and horticulture, mechanization of agriculture and food supply for the 2006-2010 years;
Land use, change of land use and forest industry	• The State Program «Conservation and Use of Reclaimed Land, 2006-2010 «(2005); • The Program of Development of Forests in 2007-2011 (2006); • The Regulation on aviation protection of forests (2006); • The Provision for procedure of forest monitoring and use of its data under the National Environmental Monitoring System in the Republic of Belarus (2007); • The Project «Re-naturalization and sustainable management of peat marshes to prevent land degradation, climate changes and the conservation of globally significant biological diversity « Section « Sustainable use, restoration and protection of degraded peat lands «(2008); • The Law of the Republic of Belarus «On Lands Reclamation»

	(2008);
Waste	• The Law of the Republic of Belarus «On Waste Management» (2007); • The State Program for construction of protective buildings on existing dumping sites of municipal waste, in order to prevent pollution of environment with waste products and products of their interaction and (or) decomposition for 2008-2014 year (2008); • The State Program for collecting (storing) and processing of secondary raw materials in the Republic of Belarus for 2009-2015 (2009).

3.3.1 Energy

The President of the Republic of Belarus signed the Directive No. 3 «Economy and Thrift as the Main Factors of Economic Security of the State» on 14 June 2007.

According to the Directive, the following measures are assumed:

- decision on involvement of nuclear fuel in the energy balance through the construction of NPP;
- implementation of the State Program for the production of diesel biofuels; work on the restoration of small HPP;
- construction of wind turbines with the capacity of 1.5 MW (will be put into operation in 2010).

Ecological effects of implementing the energy efficiency measures in relation with operating equipment, replacement of gas and fuel oil to local fuels, the use of the alternative sources and reduction of greenhouse gas emissions are presented in Table 3.2.

Table 3.2 - Reduction of Greenhouse Gas Emissions through the Introduction of Energy Saving Measures in 2006-2010

Sectors of National Economy	Thousands of Tons in CO_2 Equivalent
Industry	1 978
Agriculture	1 008
Construction and construction materials	864
Fuel and energy complex	5 020
Housing and public utility sector	1 461

Social and budget spheres and other sectors	2 459
Total	12 790

For example, only the actions taken by the concern GTO Belenergo, described in the Program of modernization, will ensure the reduction of greenhouse gas emissions by 5 - 10 million tons of CO_2 eq. for the period of 2008-2012. Implementation of activities under the National energy conservation program for the period of 2006-2010 would reduce greenhouse gas emissions by improving fuel efficiency in all sectors of economy using the energy saving measures. Expected ecological effect from its implementation across the country, without regard to the objects of the Ministry of Energy in the period of 2008 –2012, will be cutting greenhouse gas emissions by at least 6.5 million tons of CO_2 eq.

In order to diversify the fuel and energy balance of the domestic energy system five local fuel-oriented energy sources were put into operation. In addition, the first bio-gas plant was put into service. Work is carried out under the Target Program of providing not less than 25% of the total national production of electricity and heat through the use of local fuels and alternative energy sources for the period till 2012.

3.3.1.1 Nuclear Energy

The policy document, which defined the development of nuclear energy in Belarus and provided for intensifying energy independence of the country, was the Law «On the Use of Nuclear Energy», adopted by the House of the Representatives of the Republic of Belarus on January 31, 2008 № 426-N. The law defines the relations concerning location, design, construction, commissioning, operation, limitation of operating characteristics, the extension of the operation and decommissioning of nuclear installations and (or) of storage site, as well as the relations concerning the handling of nuclear materials during operation of a nuclear installation and (or) of the storage of used nuclear materials and (or) operational radioactive wastes, and other relations in the sphere of nuclear energy use.

By 2020 nuclear fuel will take approximately 14-16% of the energy balance of Belarus. Including new types of fuel in the balance of Belarus will significantly reduce the proportion of natural gas. At present it constitutes about 80%, and by 2020 it is expected to be reduced to 50-60%. At the same time the share of nuclear fuel for electricity production in the balance of the Belarusian energy will be about 26%. The

cost of nuclear fuel today is much cheaper compared to organic fuel, so it could be stored now at stations for several years ahead. With the commissioning of two nuclear power plant units by 2020, nuclear fuel in the fuel and energy balance of Belarus will be approximately 4 million tons of reference fuel.

3.3.1.2 Alternative and Renewable Energy Sources

Currently the Government of the Republic of Belarus is working on the draft law on alternative and renewable sources of energy. As alternative sources of energy, considering the natural, geographical and meteorological conditions of the country, the following options are considered:

- Hydropower. Unit capacity of hydro generators will be in the range from 50 to 500 kW. Preference will be given to quick-repair capsular-type hydroelectric sets;
- Wind power potential. Using only the zones with high wind activity can guarantee the production of wind energy by wind turbines up to 6,5-7,5 billion kWh which would replace fossil fuels in the amount of 1,9-2,0 mln tons of reference fuel. Results of operation of wind turbines with capacity 270 kW and 600 kW, installed in the village «Druszhnyi» in Myadzel district, Minsk region, confirm the efficiency of bladed wind turbines in the Republic of Belarus;
- Biomass. Fundamentally new approach allows to use biogas plants at sewage stations in cities, thus reducing the stations' need in energy resources by 60-70%;
- Solar energy. The Republican unitary enterprise « NAS Scientific and Practical Centre of Belarus on Bringing Mechanization to Agriculture» designed helio air heaters GPV–240, which were approved after the state acceptance tests and recommended for production. Their design provides active ventilation which raises the productivity of technological process in 2 times and make 15 % more of hay containing fodder units compared to the hay made with use of non-heated air. At the same time the electric power expense decreases by 45 %. Considering the volume of hay final drying being approximately 600 thousand tons across the country, the use of helio air heaters will save about 27 million of kw/h annually. These helio air heaters can be used in drying of seed grain, aromatic plants as well

as for heating heat-carriers in the process of complex reproduction and young fish breeding at fish farms of the Belarus. Practical application of helio air heaters in a number of farms has confirmed their high efficiency;

- Natural cold. It is a highly promising source of renewable energy for Belarus. According to the Republic Hydrometcenter of the Republic of Belarus, at least 150 days a year the average daily air temperature does not raise higher than + 4 ° C. Using the equipment that operates with natural cold during the winter season for such purposes as cooling milk, meat and other products, will save 160-180 million kilowatt hours of electricity per year. The device «OMC-12»for cooling milk using the natural cold for dairy farm of 200 heads, which passed state acceptance tests and was recommended for production, during the period from October to April can save up to 7-12 thousand kWh of energy and provides the extension of the work of refrigeration equipment to 60-80%;
- Municipal solid waste;
- Biodiesel based on rapeseed oil bypass products. Biodiesel fuel manufactured on the base of rapeseed oil bypass products decreases the opacity of exhaust gases and nitrogen oxide emissions by 20-22 cent. Its emissions are free from carbon monoxide, hydrocarbons and sulfur compounds, which makes it possible to install the exhaust gases neutralizer. In addition, biofuels when getting into the environment, completely decompose in 10-15 days into non-aggressive to nature components. CO_2 - the balance of biofuels is more environment-friendly than that of diesel fuel. Detailed calculations show that if we substitute 1 liter of diesel fuel by biofuels, greenhouse gas emissions will decrease by more than 3,5 kg in CO_2 equivalent. There are 6 big companies which produce rapeseed oil, the basic raw material for biofuel production. However, the capacity of these companies is not enough for wide spread of a new type of motor fuel;
- Plant growing wastes;
- Livestock wastes. Livestock and poultry stocks are dangerous to environment. Anaerobic method of processing these sorts of wastes is the least power-consuming. Anaerobically digested wastes are environmentally safe and make valuable organic fertilizers. Additionally

60-70% of methane is produced; complex chemical compounds are decomposed into simple units, which are easily absorbed by plants, with complete extinguishing of unpleasant odor. Anaerobic processing of all sewage wastes ensure the biogas output in the volume of 450 million m3 per year with energy equivalent (at 65% of methane content in biogas) of approximately 380 thousand tons of reference fuel per year.

General policy on raising the energy efficiency of the economy of the Republic Belarus is shown in the Table 3.3.

Table 3.3 Policy on Raising the Energy Efficiency of the Economy of the Republic of Belarus

Name	Greenhouse Gas	Instrument Type	Status	Authorities, Responsible for Implementation
Directive No.3 «Economy and Thrift as Main Factors of the Economic Security of the State»	CO_2, CO, N_2O, NO_x, CH_4, SO2, NMC	Directive	In the process of implementation	The Council of Ministers of the Republic of Belarus, the National Academy of Sciences of Belarus, the Ministry of Housing and Utility sector.
«On Use of Nuclear Power»	CO_2, CO, N_2O, NO_x, CH_4, SO2, NMC	Law	In the process of implementation	Ministry of Energy sector of the Republic of Belarus, the Emergency Situations Ministry of the Republic of Belarus
«State Comprehensive Program of Modernization of Basic Production Capacities of The Belarusian Energy System, Energy Saving and Raising the Proportion in Using Local Fuel-Energy Resources in the Republic for the Period until 2011»	CO_2, CO, N_2O, NO_x, CH_4, SO2, NMC	State Program	In the process of implementation	Ministry of Energy and organizations within its jurisdiction, Ministry of Construction and Architecture, Ministry of Industry, Agriculture and Food Ministry, Ministry of Housing and Public Utilities.
«On Alternative and Renewable Energy Sources»	CO_2, CO, N_2O, NO_x, CH_4, SO2, NMC	Draft Law	In the process of preparation	Ministry of Environment

3.3.2 Industry

Local stocks of energy resources are limited and the necessity to import them makes Belarusian economy dependent on foreign suppliers and vulnerable to dramatic fluctuations of energy prices. In accordance with the Directive of the President of the Republic of Belarus No. 3 on the maximum use of local fuels and defined task to transfer residual oil boilers in the settlements with the population of up to 20 thousand people to usage of local fuels in 2008, in 2007 a technology and equipment were developed for production of fine-blended fuel mixtures based on fuel oil using wastes and local fuels, such as watered with fuel oil, oily wastes; lower alcohols, fusel, rapeseed oil, used oil and cooling lubricants; oil-slag wastes, peat, coal and wood wastes. Production of fine-blended fuel mixtures can reduce the amount of harmful emissions into the atmosphere by 35-40%.

The agro-industrial complex of the country annually produces up to 700 thousand tons of oily wastewater, up to 30 tons of waste and fusel oils. There is already about 1 million tons of waste (fine powdered) peat, coal and more than 500 thousand tons of oil-slags. It should be noted that the installation of 15 sets of special equipment will save up to 20% of conventional liquid fuels consumed by agro-industrial complex, and thus will reduce the amount of harmful emissions into the atmosphere by 35-40% by burning fuel mixtures with these wastes. In order to control the process of fulfillment of industry safety requirements by organizations and individual entrepreneurs, who use hazardous industrial facilities and other potentially dangerous objects, to prevent and suppress violation of the industrial safety requirements, and also to prevent accidents and catastrophes of technogenic nature, the Council of Ministers adopted the Regulation on State Supervision in the field of industrial safety on December 31, 2008 № 2056.

3.3.3 Transport

3.3.3.1 Automobile Transport

By the Resolution of the Council of Ministers of the Republic of Belarus of December 18, 2007 No. 1777 the Automobile Industry Development Program of the Republic of Belarus for 2007-2010 was approved.

The activities under the Program aimed at reduction of harmful effects of transport on the environment of the Republic of Belarus for 2006-2010 made possible in 2008:

- to transfer over 2000 vehicles to compressed and liquefied natural gas;

- to replace 10% of road transport vehicles with modern and environmentally friendly versions.

Since the start of the Program the amount of emissions of pollutants into the air has decreased by 14,2 thousand tons (1,2%) with an increase of motor vehicle fleet from 4 to 7% per year. Fleet of the most polluting cars of CIS production has decreased by 11,954 cars, or 3.5%, and it is still steady reducing.

Resolution of the Council of Ministers of the Republic of Belarus of December 31, 2006 No. 1804 adopted a range of measures on exploitation of cars, equipped with a compression ignition engines, in line with requirements of the UNECE Regulations under number 49 (04) B1 (Euro-4) and number 49 (04) B2 (Euro 5) / Revision 3, concerning the emissions of pollutants, on the territory of the Republic of Belarus.

The top-priority actions in resolving this issue are the following:

- Organization of production of cars complying with the Euro-4 requirements;
- Investigation of production method of the reagent AdBlue, which is used for cutting emissions of harmful substances in exhaust gases of cars in Western Europe, studying the experience of companies engaged in delivery of systems for the reagent storage and charging;
- Ensuring quality control at state technical inspections of ecological parameters of cars for compliance with the requirements of Euro-4 and Euro-5 standards and technical normative legal regulations of the Republic of Belarus in the sphere of environmental protection;
- Limitation of used motor vehicles import based on ecological requirements.

The Resolution of the Council of Ministers of the Republic of Belarus of December 17, 2007 No. 1760 approved the State Program for the production of biodiesel in the Republic of Belarus for 2007-2010.

The purpose of the Program is to improve environmental and energy security of the Republic of Belarus. In addition, the implementation of the Program will help to improve the ecological situation in Belarus: a reduction of toxic emissions substances in exhaust gases of motor vehicles is expected to fall by about 40 percent;

3.3.3.2 Civil Aviation

Article 67 (Protection of citizens and the environment from the harmful effects of aircraft traffic) of the Air Code of the Republic of Belarus of May 16, 2006 № 117-W determines the operating procedure of aircraft in accordance with global ecological requirements for civil aviation.

Executing in 2006-2010 activities described in the activities of the State Development Program Civil Aviation of the Republic of Belarus for 2006-2010б which were approved by the Resolution Council of Ministers of the Republic of Belarus of April 27, 2006 № 557, supports the maintenance and upgrading the core facilities at the industry in line with the requirements of ICAO and strengthens material-technical base of civil aviation.

General policy, implemented in the Republic of Belarus, to reduce emissions of greenhouse gases in the sector «Transport» is presented in Table 3.4.

Table 3.4 – Policy, Carried Out in the Transport Sector

Name	**Aim and/or Relative Activity**	**Relative Greenhouse Gas**	**Instrument Type**	**Status**	**Authorities, Responsible for Implementation**
Automobile Industry Development Program of the Republic of Belarus for 2007-2010	Automobile transport	CO_2, CO, N_2O, NO_x, CH_4, $NMVOC_s$	Program	In the process of implementation	The Ministry of Industry, the Ministry of Transport and Communications, the State Military-Industrial Committee, the Belarusian State Concern for Oil and Chemistry.
A range of measures on exploitation of cars, equipped with a compression ignition engines, in line with requirements of the UNECE Regulations under number 49 (04) B1 (Euro-4)	Automobile transport	CO_2, CO, N_2O, NO_x, CH_4, $NMVOC_s$	A range of measures	In the process of implementation	The Ministry of Transport and Communications, the Ministry of Industry, the Ministry of Natural Resources and Environmental Protection, the Ministry of Economy, the Belarusian State Concern for Oil and

and number 49 (04) B2 (Euro 5) / Revision 3, concerning the emissions of pollutants, on the territory of the Republic of Belarus					Chemistry, the State Customs Committee, the State Committee for Standardization.
State Program for the production of biodiesel in the Republic of Belarus for 2007-2010.		CO_2, CO, N_2O, NO_x, CH_4, $NMVOC_s$	Program	In the process of implementation	The Ministry of Transport and Communications, the Ministry of Economy, the Ministry of Industry, the Ministry of Natural Resources and Environmental Protection, the Belarusian State Concern for Oil and Chemistry, the State Customs Committee, the State Committee for Standardization.
Air Code of the Republic of Belarus	Civil aviation	CO_2, CO, N_2O, NO_x, CH_4, $NMVOC_s$	Code	In the process of implementation	Bodies of the Integrated system of air traffic management, bodies of air traffic service and flights management in specified zones and districts.
State Development Program Civil Aviation of the Republic of Belarus for 2006-2010	Civil aviation	CO_2, CO, N_2O, NO_x, CH_4, $NMVOC_s$	Program	In the process of implementation	The Ministry of Transport and Communications.

3.3.4 Agriculture

To create breakthrough innovative objects, obtain brand new scientific and practical results with regard to further accelerated introduction into agricultural production, as well as highly effective use of issued material and financial funds for science development, the Council of Ministers of the Republic of Belarus approved a program of development of scientific and practical centers of the National Academy of Sciences of Belarus for agriculture, animal breeding, potato growing and horticulture, mechanization of agriculture and food provision for 2006-2010 (the Resolution of the Council of Ministers of the Republic of Belarus of November 24, 2006 under number 1581).

Currently specialists of Agriculture Ministry, together with interested agencies work on finalizing the concept of the Bill «On Agricultural Production», making necessary changes. In December 2010 bill will be reviewed by the House of Representatives of the National Assembly.

Policy aimed at reducing GHG emissions in the sector Agriculture is presented in Table 3.5.

Table 3.5 - Policy aimed at reducing GHG emissions in the sector Agriculture

Name	Aim and/or Relative Activity	Relative Greenhouse Gas	Instrument Type	Status	Authorities, Responsible for Implementation
Program of Development of Scientific and Practical Centers of the National Academy of Sciences of Belarus for Agriculture, Animal Breeding, Potato Growing and Horticulture, Mechanization of Agriculture And Food Provision for 2006-2010	Agriculture	N_2O, CH_4	Program	In the process of Implementation	Agriculture and Food Ministry, scientific and practical centers for animal breeding, farming, mechanization of agriculture, potato growing and horticulture and food provision.
«On Agro-Industry»	Agriculture	N_2O, CH_4	Bill	In the Process of Preparation	Agriculture and Food Ministry

3.3.5 Land Use, Land Use Change and Forestry

3.3.5.1 Forestry

The total area of forest land in the republic as of Jan. 1, 2008 is 9.39 million ha. (Statistical Yearbook of the Republic of Belarus on the basis of Forest Inventory). It is mostly dominated by the young and middle-aged stands (71.3 percent), where felling to care for a forest is carried out as well as sanitary felling with obtaining mainly wood fuel and small merchantable wood. Maturity stands of tree species in forest lands, which influence the calculated felling rate and forest income constitutes 9 percent (with optimal rate of 15-20 percent).

Alignment of forest age structure is a long and complicated process, which is implemented through a set of forest management measures and through regulation of the final yield. In compliance with the predictive estimate the age structure of forests will be optimized not earlier than in 2015.

The Resolution of the Council of Ministers of the Republic of Belarus of December 29, 2006 No. 1760 approved the Development Program for Forest sector of the Republic of Belarus for 2007-2011, which defines the main directions, goals and objectives of forests development during next five years.

The program provides for increasing of volume and effectiveness of ongoing forestry activities for the improving species and age structure of forest, as well as raising the productivity of forest stands. Table 3.6 shows data on the area of forest activities.

Table 3.6 - Reforestation, Forest Breeding and Actual Wood-Felling

	2000	**2005**	**2006**	**2007**	**2008**
Total hectares	38318	51471	56217	54988	50005
Including:					
Forest planting, ha	33025	45031	48662	48069	43134
Facilitating of natural reforestation and preservation of young growth, ha	5293	6440	7555	6919	6871
Actual wood-felling (thousand of square meters of merchantable wood)	4303	5213	5447	6126	5465

Proportion of mature stands in the general area of wooded land in 2011 will be 10,5%.

To increase the amount of local fuels use in order to obtain electrical and heat energy, arrangements are being made for infrastructure of tree fuel felling, fuel chips production and shipping these products to consumers.

The main result of the planned activities of the Program will be the growth of forest reserves for the purpose of steady management of forests, their efficient use, conservation, protection and reproduction, raising environmental-forming, water protective, conservative, sanitary- hygienic, recreational and other functions of forests, the Council of Ministers of the Republic of Belarus on August 15, 2007 under number 1036 approved the Regulation on the conduct of the forests monitoring and exploitation of monitoring data as part of the National Environment Monitoring System in the Republic of Belarus.

This Regulation determines the procedure of conducting the forests monitoring and exploitation of monitoring data under the National Environment Monitoring System in the Republic of Belarus.

- Forest monitoring is carried out in the following main directions:
- The general condition of forests, including those under the influence of polluted air (monitoring of forest health);
- Forest health under the influence of pests and diseases (forest pathology monitoring);
- Forest health under the influence of land reclamation works (ecological-reclamative
  monitoring of reclaimed forest lands);
- State and dynamics of forest ecosystems in wetlands (monitoring of forest wetlands).

The Council of Ministers of the Republic of Belarus approved the Regulation on aviation protection of forests with the Decree of 16 March 2006 № 362. This Regulation, developed in accordance with the Forest Code of the Republic of Belarus, describes the procedure of fire protection of forests with the use of aviation.

3.3.5.2 Wetlands and Reclamation

Today we know that peat lands belong to the effective Earth's ecosystems which accumulate carbon from the atmosphere. Despite the large-scale land reclamation, still there is a large number of peat lands in Belarus, which make an integral component of natural landscapes. They occupy about 1 646 613. ha (including marshes located on forest land and 25 717 ha of wetlands restored under the Project of the Global Environment Facility, as described below), or 8,1% of the territory of the country, and still remain in their natural state (as compared to the average of 3,4% worldwide). Drained marshes belong to the major sources of dioxide carbon emissions in the atmosphere as a result of peat mineralization and CO2 salvo emissions during forest fires.

The UNDP, the Global Environment Facility (GEF) and the Ministry of Forestry of the Republic of Belarus launched a project «Renaturalization and Sustainable Management of Peatlands in Order to Prevent Land Degradation, Climate Change and Ensure the Conservation of Globally Significant Biological Diversity» which aims at restoring wetland ecosystem of 17 disturbed and developed peatland with total area of 40 thousand hectares. As a part of the project, arrangements are being made to develop a strategy for rehabilitation and sustainable management of degraded peat lands in order to create an integrated monitoring system of restored peat lands, which will help to prevent any mistakes in future while using the disturbed wetlands, as well as to reduce the possibility of peat fires and to provide conditions for recovery of disturbed flora and fauna.

The project will make a significant contribution to the fight against global climate change by reducing emissions of carbon dioxide in the Earth’s atmosphere under the Kyoto protocol. The result of cooperation was the preparation and approval of regulatory documents for further improvement of integrated ecosystem management on degraded peat lands and methods of solutions on their future usage. In particular, the project includes a section of the National Program of Action of the Republic of Belarus to combat land degradation «Sustainable Use, Restoration and Protection of Degraded Peat Lands». In addition, two technical codes of existing practice of method of usage of cutover peat lands and their restoration for secondary logging, were approved and came into force on 1 January 2009.

By July 2009 in line with this Program on the territory of Belarus 10 cutover peat lands had been restored.

Following positive results have been already obtained since the start of the project:

- Approximately 42 thousand hectares of peat land have been restored and a long-term program of their protection has been implemented;
- Risk of fire and radioactive contamination has been significantly reduced, sustainable fire management has been arranged;
- An integrated system for monitoring of restored peat lands has been created;
- The populations of globally significant biodiversity have been stabilized;
- CO_2 emissions have been reduced by at least 300 thousand tons per year;
- The sources of financing further work on rehabilitation of disturbed peat lands have been defined and a strategy for disseminating the results of the project has been developed.

Reclaimed lands make an important natural and anthropogenic resource and a national treasure of Belarus. Their effective use and protection influence a lot the whole ecological situation in the country. These lands currently produce more than a third of plant breeding and, in future, there can be significant growth of their productivity.

The nation-wide program «Conservation and Use of Reclaimed Lands in 2006-2010 «(approved by the Decree of the Council of Ministers of the Republic of Belarus of 5 May 2005 under number 459) and the Law of the Republic of Belarus «On Land Reclamation» (approved by the House of Representatives on 23 July 2008 No. 423-W) provide for creation and maintenance of optimal water, air, thermal, feeding regimes for agricultural plants, forests and other stands, as well as effective usage of reclamation systems and separate hydro technical constructions. The program aims to increase productivity of arable and meadow lands till 2010.

The basis of the protection and continued use of peat soils is the necessity to provide high, economically feasible productivity of cultivated crops with economical usage of organic substance stocks for obtaining maximum output for the entire period of use of valuable resource of peat, which accumulates moisture and produce nitrogen.

Floodplain lands with drained peat soils should be excluded from arable lands and used only for growing durable feed crops, conducting renovation with hydrophilic grass.

Peat and peaty-gley soils with satisfactory water regime should be used for growing legume-grass and grass durables.

Anthropogenically-converted organic-mineral soils (with content of organic substances from 15 to 30 percent) should be used in the system of crop rotation with grain-grass crop rotation with application of organic and mineral fertilizers.

Anthropogenically-converted mineral soils (with content of organic matter less than 15 per cent) should be used, as well as sod-podzolic sandy soils with mandatory application of organic fertilizers and sowing green manure crops.

Economic effect of these measures is achieved by improving of reclaimed land, improving the structure of sown areas, use of balanced doses of fertilizers and plant protection products, which will ensure yield growth and total yield of agricultural crops, provided the rational use of soil and water resources, as well as improving environmental conditions.

The general policy aimed at reducing greenhouse gas emissions in the sector «LULUCF» is presented in Table 3.7.

Table 3.7 -- Policy Aimed at Reducing Greenhouse Gas Emissions in the Sector «LULUCF»

Name	Aim and/or Relative Activity	Relative Greenhouse Gas	Instrument Type	Status	Authorities, Responsible For Implementation
Program of Forestry Development of the Republic of Belarus for 2007 – 2011	Forestry	CO_2, CO, N_2O, NO_x, CH_4, $NMVOC_s$	Program	In the process of implementation	Ministry of Forestry, General Affairs Department of the President of the Republic of Belarus, Defense Ministry, Emergency Situations Ministry, The National Academy of Sciences of Belarus.
Regulation on conduct of forests monitoring and exploitation of monitoring data as part of the National Environment Monitoring System in the Republic of Belarus.	Forestry	CO_2, N_2O, NO_x, CH_4, CO	Regulation	In the process of implementation	Ministry of Forestry and Ministry of Natural Resources and Environment Protection of the Republic of Belarus
Regulation on aviation protection of forests	Forestry	CO_2, N_2O, NO_x, CH_4, CO	Regulation	In the process of implementation	Emergency Situations Ministry in cooperation with fire departments of the Ministry of Forestry

Forest Code of the Republic of Belarus	Forestry	CO_2, N_2O, NO_x, CH_4, CO	Regulation	In the process of implementation	Ministry of Forestry, Ministry of Natural Resources and Environment Protection of the Republic of Belarus
Renaturalization and Sustainable Management of Peatlands in Order to Prevent Land Degradation, Climate Change and Ensure the Conservation of Globally Significant Biological Diversity	Land-use	CO_2, CH_4,	Project	In the process of implementation	UNDP, the Global Environment Facility Ministry of Forestry of the Republic Belarus
Nation-wide program «Conservation and Use of Reclaimed Lands in 2006-2010»	Land-use	CO_2, CH_4,	Program	In the process of implementation	Agriculture and Food Ministry of the Republic of Belarus
Law of the Republic of Belarus «On Land Reclamation»	Land-use	CO_2, CH_4,	Law	In the process of implementation	Agriculture and Food Ministry of the Republic of Belarus

3.3.6 Waste

The legal basis of waste management, aimed at reducing the volume of waste forming and prevent their harmful influence on the environment and public health, at the maximum involvement of waste into the civil market as secondary raw materials, regulation of storage and disposal of wastes and their decontamination, is defined in the Law of the Republic of Belarus of July 20, 2007 No. 271-W, «On Waste Management».

In order to increase the volume of the collection (storage) of secondary raw materials and meet demand of reprocessing plants, the Decree of the President of the Belarus of 22 June 2009 No. 327 approved the State program of collecting (storing) and processing secondary raw materials in the Republic of Belarus for 2009 - 2015 years.

To minimize the negative impact of municipal waste disposal facilities on groundwater and underground water, surrounding area and the air, the Decision of the

Council of Ministers on March 5, 2008 number 333 approved the State program on construction of municipal waste protective facilities, which would prevent pollution of environment with wastes, product of wastes' interaction and (or) decomposition, for 2008 – 2014.

This ecological program pursues the following goals:

- construction of municipal waste protective facilities, which would prevent pollution of environment with wastes, products of wastes' interaction and (or) decomposition, according to Annex 1;
- operation of municipal waste disposal facilities after January 1, 2015 in accordance with the requirements of the Article 31 of the Law of the Republic of Belarus «On Waste Management»;
- ensuring control and monitoring of the impact of dumping sites on the groundwater and underwater;
- preventing municipal waste entering the environment.

Policy of the Republic of Belarus to reduce emissions of greenhouse gases through waste is presented in Table 3.8.

Table 3.8 - Waste Management Policy

Name	Aim and/or Relative Activity	Relative Greenhouse Gas	Instrument Type	Status	Authorities, Responsible for Implementation
Waste management	Waste	N_2O, CH_4, NMVOC	Law	In the process of implementation	Ministry of Natural Resources and Environmental Protection of the Republic of Belarus and its local bodies, sanitary and epidemiological bodies and agencies of the Ministry of Health of Belarus, Emergency Situations Ministry of the Republic of Belarus, local executive and

					regulatory authorities
State program of collecting (storing) and processing secondary raw materials in the Republic of Belarus for 2009 - 2015 years.	Waste	N_2O, CH_4, $NMVOC_s$	Law	In the process of implementation	Ministries of the Republic of Belarus, Belarusian National Union of Consumer Societies, regional executive committees and the Minsk Municipal Executive Committee.
State program on construction of municipal waste protective facilities, which would prevent pollution of environment with wastes, product of wastes' interaction and (or) decomposition, for 2008 – 2014.	Waste	N_2O, CH_4, $NMVOC_s$	Law	In the process of implementation	Regional executive committees and the Minsk Municipal Executive Committee

4 PROJECTIONS AND THE TOTAL EFFECT OF POLICIES AND MEASURES AND SUPPLEMENTARITY INFORMATION RELATING TO THE KYOTO PROTOCOL MECHANISMS

4.1 Projections of Greenhouse Gas Emissions and Emission Reduction Measures

4.1.1 General Provisions

According to the UNFCCC Guidelines for the preparation of national communications (Decision 4/CP.5) and the Annotated Outline for the Fifth National Communications of Parties included in Annex I to the Convention, the primary objective of the projections section is to give an indication of future trends in GHG emissions and removals, given current national circumstances and implemented and adopted policies and measures, and to give an indication of the path of emissions and removals without such policies and measures.

In order to ensure consistency between projections and inventory data, the starting point for the with-measures and with-additional-measures scenarios should be the last year of inventory data (i.e. 2007 for the Fifth National Communication). The starting point for the without-measures scenario should be 1995 or an earlier year (e. g. 1990 or the respective base year).

The year 1995 is chosen as the starting point for this Communication, as the processes of financial and economic recession caused by transition from the Soviet closed administrative economic model to open market model were mostly terminated. Since then the purpose-oriented policies and measures have been adopted and implemented for improvement of energy efficiency, introduction of energy-saving technologies and use of renewable energy sources.

Below are the projections of greenhouse gas emissions for a baseline scenario without measures, excluding all policies and measures implemented, adopted or planned after the year of 1995, as well as projections for the three scenarios which provide for measures, encompassing currently implemented and adopted measures and their expected behavior. In addition, emission projections are presented relative to additional

measures that include further implementation of the energy-saving potential and other planned measures.

In order to ensure consistency between projections and inventory data for scenarios with measures and scenarios with additional measures, the starting year chosen is the last year of inventory, i.e. 2007.

4.1.2 Baseline Scenario

The baseline or reference scenario which provides for no measures is developed on the basis of standard assumptions, in particular the scenario excludes all policies and measures implemented, adopted or planned after the year chosen as the starting point for this projection (i.e. 1995). The projection of greenhouse gas emissions for all sectors is based on information about economy development and the absence of any specific measures aimed at the reduction of energy-intensity of GDP and other measures for reduction of the greenhouse gas emissions.

The following source data are taken into account:

A. GDP Growth Rate

For the period between 1995 and 2008, the GDP growth rate was given according to the statistic reports. Projections for the period after 2008 have been determined in compliance with the Concept of Energy Security of the Republic of Belarus approved by Decree of the President of the Republic of Belarus No.433 of September 17, 2007, which provides for the following targets:

2006-2010 - 156%;

2011-2015 - 147%;

2016-2020 - 139%.

B. Energy Sector

For the Energy sector, the greenhouse gas emission projection for the baseline scenario is based on the following assumptions:

- the fuel consumption structure by type is maintained at the 1995 level;
- for the Energy sector, the projection of greenhouse gas emissions directly connected with the amount of fuel consumed assumes that a notionally constant component accounting for 65-70% of energy resources used, i.e. electric and heat energy consumption for heating, lighting and some other needs, is not connected with the GDP growth;

- the major objective of the program of socio-economic development of the Republic of Belarus for 2006-2010 is «a faster growth of the service-producing industries and first of all education, public health, and culture as a foundation for perfection of the human assets». From the energy consumption standpoint, this implies that the portion of notionally constant expenses in the total consumption of boiler and furnace fuel will increase. With the current ~65% as estimated by experts, it will increase up to 70% by 2015-2020.

As to new capacities:

- a 400 MW CCP unit at the Minsk HPP is not constructed;
- the Grodno and the Polotsk Hydroelectric Plants are phased in;
- wind energy generating plants are not phased in;
- the 31 MW Minsk HPP-2 is removed from service ;
- commissioning of a 70 MW CCP at the Orsha HPP has been taken into account;
- the performance parameters (power, efficiency, etc.) of other plants remains the same as in 1995;
- it is expected to phase in a 900 MW CCP by the end of 2015 , and a 1800 MW CCP by 2020.

C. Industrial Processes

Growth rates in the real sector of economy is the same as that of GDP.

D. Agriculture

- by 2020 the cattle population will reach the level of 1990, i.e. will increase by a factor of 1.5 against 1995, or twice against the actual figure of 2005.
- the growth in the land area used by land users engaged in agricultural production will by insignificant – not more than 30%.

E. Forestry

The 1995 level maintains.

F. Waste

For Waste sector, the growth rate of greenhouse gas emissions complies with that of production in the real sector of economy and the growth of well-being (GDP growth rate). The results of calculations are presented in Figure 4.1.

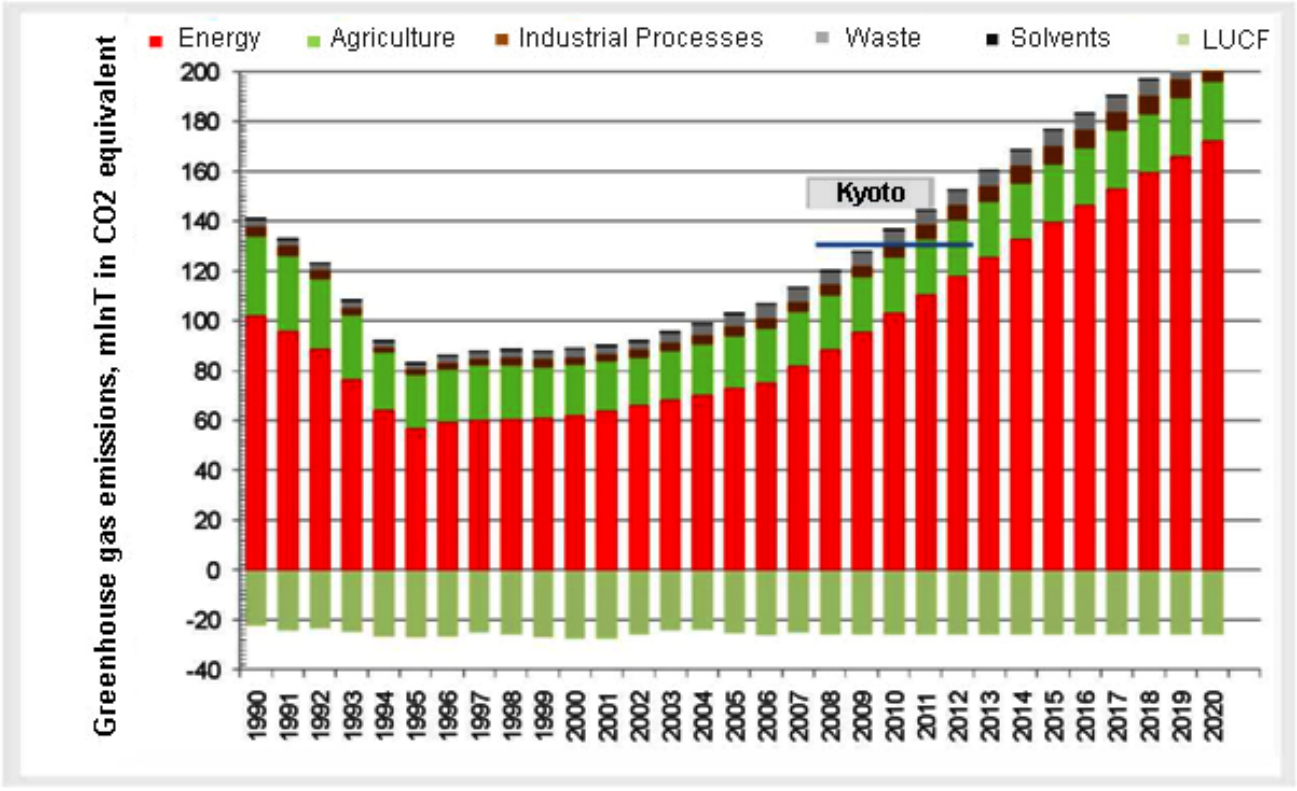


Figure 4.1 – Greenhouse Gas Emission Projection

The baseline scenario does not provide for emission reduction measures since 1995. For the period from 1990 to 1995, the actual emissions as reported in the National Report on Greenhouse Gas Inventory of the Republic of Belarus (see Section 3 of this National Communication) are presented.

4.1.3 Scenarios with Adopted Policies and Planned Measures

Policies and Measures

After the submission of the Fourth National Communication, the Republic of Belarus has developed and adopted several nation-wide programmatic documents that contain new or refined plans and targets relating to the increase in energy efficiency, enhancing the effectiveness of energy-saving policy and introduction of renewable sources of energy:

- Strategy of Greenhouse Gas Emission Reduction and Increasing Absorptions by Sinks in the Republic of Belarus for 2007 - 2012 (approved by Resolution No.1155 of the Council of Ministers of the Republic of Belarus dated 07.09.2006).
- Directive No. 3 of the President of the Republic of Belarus dated June 14, 2007 «Economy and Husbandry Are the Major Factors of the Economic Security of the State».
- Plan of action on implementation of Directive No. 3 of the President of the Republic of Belarus dated June 14, 2007 «Economy and Husbandry Are the Major Factors of the Economic Security of the State» (approved by Resolution No.1122 of the Council of Ministers Republic of Belarus dated 31.08.2007).
- The Republican Program on Conversion of boiler plants into small co-generation plants for 20072010 (approved by Resolution No.1225 of the Council of Ministers of the Republic of Belarus of 28.09.2007).
- Concept of Energy Security of the Republic of Belarus (approved by Decree No.433 of the President of the Republic of Belarus dated 17.09.2007).
- Comprehensive State Program of Rehabilitation of the Basic Production Assets of the Belarusian Energy System, Energy Saving and Increase in the Use of Domestic Resources of Fuel and Energy in the Republic up to 2011 (approved by Decree No.575 of the President of the Republic of Belarus dated 15.11.2007).
- The Republican Program of Energy Saving for 2006 – 2010 approved by Resolution No.137 of the Council of Ministers Republic of Belarus dated February 2, 2006 (approved by Resolution No.1817 of the Council of

Ministers of the Republic of Belarus dated 26.12.2007) has been amended and supplemented.

- The National Program on Mitigation of Climate Change Effects for 2008 - 2012 (approved by Resolution No.1117 of the Council of Ministers Republic of Belarus dated 04.08.2008).
- Strategy of Participation of the Republic of Belarus in Flexibility Mechanisms provided by the Kyoto Protocol to the United Nations Framework Convention on Climate Change (approved by Minutes No.43 of the meeting of the Council of Ministers of the Republic of Belarus dated 23.12.2008).

According to the above documents, the GDP growth rate will be:

- 2006-2010 - 156%;
- 2011-2015 - 147%;
- 2016-2020 - 139%.

As the International Energy Agency states, the GDP of Belarus amounted to USD 20.11 billion in 2006[1]. As the National Statistical Committee states, the structure of GDP of Belarus was as follows in 2000 and 2008[2] (Table 4.1).

Table 4.1 – Structure of GDP of Belarus in 2000 and 2008

	2000	**2008**
Industry	26.5	28.1
Agriculture	11.6	8.4
Construction	6.4	9.4
Transport	11.1	8
Trade and catering	9.5	10.6
Taxes	14.5	14.4
Other	20.4	21.1

By using IEA and the National Statistical Committee data as a basis, we have obtained the GDP values by sector for the period 1996-2008.

It is assumed that the GDP structure will vary insignificantly up to 2020 and the GDP growth rate by sector will equal that of the total GDP (see Figure 4.2).

[1] http://www.iea.org/stats/indicators.asp?COUNTRY_CODE=BY

[2] http://www.belstat.gov.by/homep/en/indicators/gross1.php

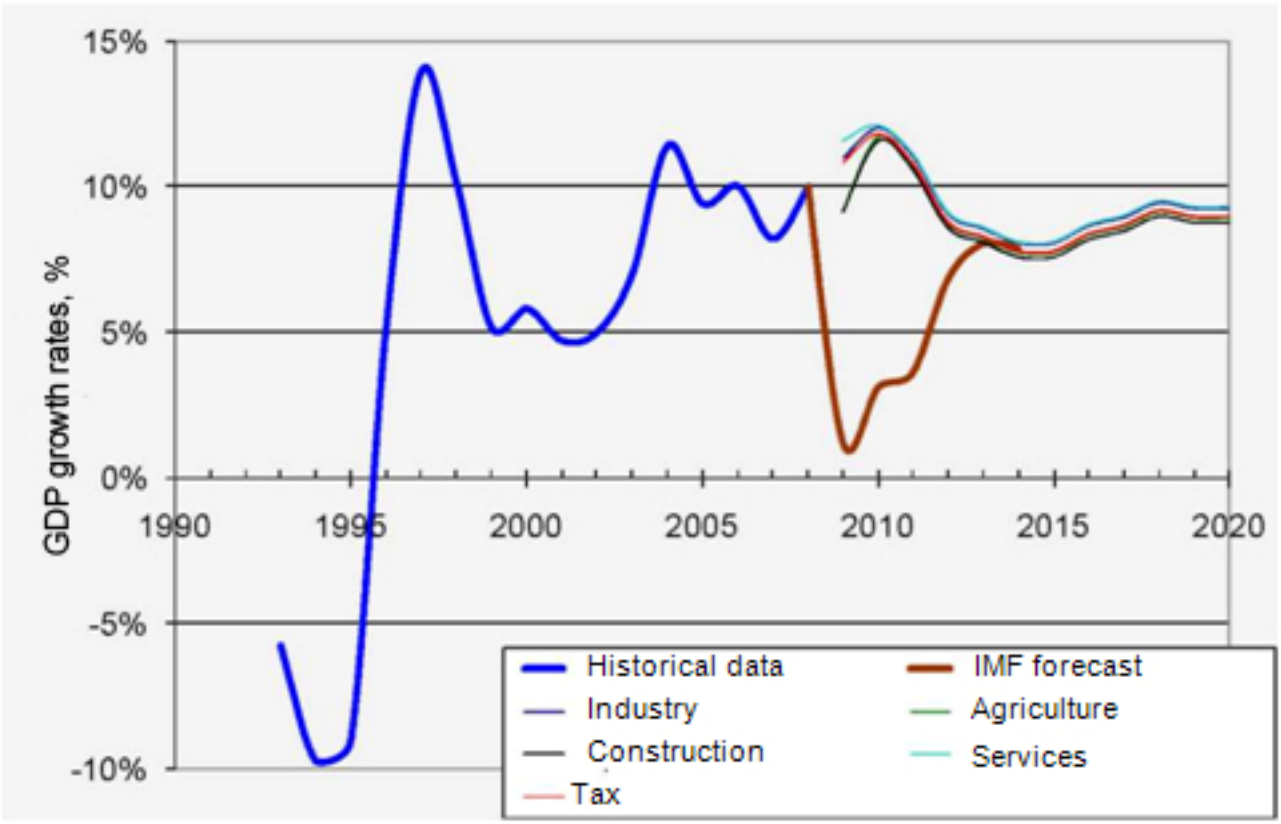


Figure 4.2 – GDP growth rate per sector of economy. Actual data are presented up to 2008

It has been assumed that GDP power consumption (according to the Concept of Energy Security) will decrease by 31%, 50% and 60% before 2010, 2015 and 2020, respectively, compared with 2005. As there are no data available on variation in the consumption of each individual energy resource and on its contribution to energy intensity reduction, it is assumed that energy intensity by sector will decrease proportionally with that of GDP power consumption (i.e. by 2020 electric intensity will decrease by 60% compared with 2005, and energy intensity of natural gas, residual fuel oil, and heat will also decrease by 60%).

Energy Sector

The LEAP software package has been used for Energy sector projections. For projection purposes the following versions of energy sector development have been considered:

1. The Combined Cycle Plants (CCP) Scenario

This scenario provides for implementation of the above-described policies and measures. It is assumed, in particular, that the planned measures for upgrading production assets of the Belarusian energy system, energy saving and increasing the proportion of domestic fuel and energy resources and renewable sources of energy in the republic that have already been taken to date will be implemented in the immediate future, namely:

- The Grodno HPP (17MW) will be put into service in 2011
- The Polotsk HPP (23MW) will be put into service in 2012
- A 5 MW WDPP will be phased in by the end of 2010;
- A 700 MW CCP will be phased in by the end of 2015, and a 1300 MW CCP will be phased in by 2020.

2. Scenario with NPP Construction (CCP+NPP)

This scenario differs from the CCP Scenario by the following:

- A nuclear power plant will be put into service: the first 1GW power unit by the end of 2016 and the second 1 GW power unit by the end of 2018;
- A 350 MW CCP will be put into service by the end of 2015. The CCP power will not be increased thereafter.

3. Scenario with Construction of Coal-Fired Plants (CCP+Coal)

This scenario differs from the CCP Scenario by the following:

- A 100 MW coal-fired plant will be put into service by the end of 2013;
- The first 300 MW unit of coal-fired GRES power plant will be put into service by the end of 2014 and the second unit of the same capacity will be put into service by the end of 2015;
- A 350 MW CCP will be put into service by the end of 2015, and a 700 MW CCP will be put into service by 2020.

4. Scenario with Additional Measures

This scenario reflects the following features:

- Commissioning of a 150 WDPP by 2020;
- Commissioning of a 250MW HPP by 2020;
- Commissioning of 50MW biogas-fuelled plants by 2020; and

- Introduction of new construction standards for residential and office buildings with energy consumption of 40 kWh/m2 since 2012;
- - An outright ban on the use of filament lamps since 2015.

5. Scenario with Account of Crisis in 2008-2010

This scenario reflects the impact of the current crisis on the GDP of Belarus. The scenario is based on the following assumptions:

- The GDP growth rate will be 1% in 2009
- The GDP growth rate will be 1.5% in 2010
- The GDP growth rate will be 2% in 2011
- The GDP growth rate will be 3% in 2012
- The GDP growth rate will be 4% in 2013
- The GDP growth rate will be 5% in 2014
- The GDP growth rate will be 6% in 2015
- The GDP growth rate of 6% will be maintained in the period 2016-2020;
- Reduction in the energy intensity will proceed the same way as in the CCP Scenario. The results are presented in Table П3 of the Appendix.

The calculations performed show that emissions in the Energy sector reduced by more than 80 million tons CO_2 equivalent compared with 1990 level due to implementation of measures on increasing the productivity of energy production and use as well as reduction in the consumption of residual oil fuel and increase in the use of natural gas for generation of heat and electric energy in the period 1995-2005. This was primarily achieved due to implementation of the Energy Saving Program for 1995-2000 and Energy Saving Programs for 2001 -2005.

The CCP Scenario reflects an optimistic forecast of national economy development. This scenario envisages that the development of the Republic of Belarus will continue at a fairly quick pace and the crisis developments in the global economy will not affect Belarus. Moreover, this scenario relies on unconditional accomplishment of targets set by the National Strategy of Sustainable Social and Economic Development up to 2020.

Scenario with Account of Crisis reflects the situation establishing in the economy of Belarus more realistically. This scenario envisages that the global crisis will materially affect the Republic of Belarus thereby entailing decline in industrial production and therefore decline in the consumption of electric and heat energy. At the same time, according to projections of the International Monetary Fund, the economy of

Belarus will successfully avoid recession. This scenario assumes that the Republic of Belarus will overcome the crisis developments only by the year of 2015 (see the Figure above). At the same time, it is assumed that the targets on reduction of the GDP power consumption will be attained. This will cause the greenhouse gas emissions in the Energy sector to be reduced by approximately 20 million tons CO2 equivalent by 2020 compared with the CCP Scenario mostly at the expense of the reduced consumption of primary energy sources.

The Concept of Energy Security of the Republic of Belarus considers construction of coal-fired power plants and combined heat and power plants of 700-800 MW total capacity as an option of diversification of consumption of fuel and energy resources. In case of implementation of such an option (the CCP-Coal Scenario), emissions in the Energy sector will increase by approximately 2.8 million tons CO2 equivalent by 2020 compared with the CCP Scenario due to partial replacement of natural gas with coal.

At present the Republic of Belarus has decided to construct a nuclear power plant of total capacity 2400MW, with the first unit to be commissioned in 2016 and the second unit in 2018. Commissioning of the NPP (the CCP+NPP Scenario) will make it possible to reduce emissions by 6.5 million tons CO_2 equivalent annually by 2020 compared with the CCP Scenario.

Other Processes Related to the Combustion of Fuels

The major source of greenhouse gas emissions in the industrial processes is the production of cement.

At present cement is produced by three cement mills in the republic and the total production amounted to 3820 thousand tons in 2007. Fuel consumption for cement production in the same 2007 amounted to 622618 tons fuel equivalent. In the period up to 2012, every plant plans to out one production line into operation. Taking account of the new lines commissioned, cement production will increase to 7.5 million tons by 2011 -2012, and up to 10 million tons in future.

The sector development program provides for switching to coal consumption in cement production up to 1 million tons coal per year up to 2010-2011 and further on all cement mills will switch to coal (~1.5 million tons per year).

Projections of greenhouse gas emissions for the Energy sector and Industrial Processes rely on the following volumes of cement production (Table 4.2):

Table 4.2 – Volumes of Cement Production

Year	2007	2008	2009	2010	2015	2020
Cement, thousand tons	3820	4000	4500	6000	10000	10000

Other components of the Energy sector related to the combustion of fuels have been assumed to grow in proportion to the GDP, with the base 2007 values of the greenhouse gas inventory being taken into account.

Other Sectors

It is assumed that other sectors have been developing in proportion to the GDP growth. In particular, the development of farming will further rely on intensification of production based on the introduction of the scientific and technological progress achievements and innovation rather than extension of arable area and livestock population. Provision is made for technical re-equipment and retrofitting, introduction of new technologies in plant-growing and stock breeding. It is expected that technological breakthrough will make it possible to resolve the production, economic and social problems of rural population. The growth of emissions from agriculture was projected to be of conservative nature: the growth of emissions is proportional to that of GDP, with the basic 2007 figures accounting of the greenhouse gas inventory data.

As is evident from expert estimations of greenhouse gas emissions in the Land Use, Land Use Change and Forestry sector (LULUCF), one cannot expect any significant change in this sector. The current (annual) increase of stem wood is 6.3 m3 /ha of forested land on the average. At the same time the average attrition equals to 1.8 m3/ha per annum, i.e. the average current change of stock is 4.5 m3 per hectare.

The annual wood growth in Belarusian forests is 35.3 million m^3 as a result. Taking into account the average annual volume of forest exploitation that recently averaged to 10.2 million m^3, the total current change of forest stock is 25.1 million m^3.

The trend forecast of wood stock and, accordingly, carbon in the forest stock of Belarus relies on the following key principles:

- optimization of forest age structure: attaining an approximately equal ratio of areas in each age category with a share of mature forest slightly above 20% and overmature – above 15%;
- wood replenishment in the forest stock by underutilizing wood growth.

As can be seen from Figure 4.3, the biomass stock will increase due to new stands planned. On the other hand, removals will be hindered by the transition of some forests to mature and overmature category. Moreover, there will be a reduction in felling mature forests and an increase in felling immature and ripening forests. Practically, both processes compensate each other [4].

Mire formation on drained and degraded peatlands provided by programmatic documents will make it possible to slightly increase the greenhouse gas sink in the medium-term outlook but in the experts' opinion the effect will be negligible taking account of uncertainty in absorption coefficients and insignificant area to be swamped anew.

Table 4.3 – Projections of Wood Increment up to 2070

Projections	**Average Annual Projections for 10 Years**						
	2010	**2020**	**2030**	**2040**	**2050**	**2060**	**2070 and on**
Current stock change, m per ha	4.66	4.82	4.97	5.13	5.29	5.45	5.60
Forested area, million ha	8.05	8.15	8.17	8.20	8.22	8.24	8.25
Current stock change in Belarus, million m^3	37.49	39.24	40.63	42.07	43.46	44.87	46.22
Volume of forest exploitation, million m^3	17.40	20.86	23.23	24.55	24.82	24.94	25.08
Increase in forest yield, million m^3/year	20.09	18.39	17.39	17.51	18.65	19.92	21.14
CO2 sink in forest stand increment, million tons	23.73	21.719	20.54	20.68	22.02	23.528	24.97

[4] Strategic Plan of Forestry Development in Belarus: Minleshoz of the Republic of Belarus. 1997, 179 p.

Based on the above estimates we can take a conservative projection that sinks will prevail in the LUCF sector but their importance will slowly decrease by 4-5% a year up to at least 2020.

4.1.4 Scenario with Additional Measures

Scenario with Additional Measures implies that within the framework of scenarios encompassing the adopted policies and planned measures the country will use the potential of renewable sources of energy to a maximum. In addition to the CCP Scenario, provision is made for commissioning up to 150MW wind-driven power plants and up to 250 MW hydroelectric plants (in particular, a cascade of hydroelectric plants on the Dnieper River and the Zapadnaya Dvina River). These capacities are included in various long-term plans of the Belenergo GPO and the Department for Energy Efficiency of the State Standardization Committee of the Republic of Belarus, however, they are not included in the programmatic documents due to difficulties in providing the adequate financing, lack of requisite legal acts, regulations and standards as well as uncertainty in estimation of the potential. This scenario assumes that the said barriers will be removed by a Belarusian Law on Renewable Energy to be possibly adopted in 2010 and by the Wind Energy Development Program. According to a draft law, a system of fiscal and tariff policy is to be introduced to promote the development of renewable energy in the country.

This scenario also implies that Belarus will support the decision of EU member-states and Russia to introduce a ban on the use of incandescent lamps. The construction sector will be forced to apply more stringent standards for construction of new residential and office buildings with energy consumption no more than 40 kWh/m^2 per year. Implementation of the above measures will make it possible to reduce greenhouse gas emissions by approximately 2 million tons CO_2 equivalent by 2020, compared with the scenario that encompasses the adopted policy and planned measures (the CCP Scenario).

From the analysis of the above scenarios it follows that the Republic of Belarus has exhausted the stock of relatively low-cost measures on reduction of greenhouse gas emissions. Other emission reduction measures as well as mechanisms of environmentally-oriented action support call for significant investment of finance which the country does not have at its disposal under conditions of accelerated growth in the economy and small share of direct foreign investment.

Thus the country could have raised funds requisite to overcome barriers created by slow diffusion of the best technologies available, lack of adequate experience and knowledge, and low profitability due to underdeveloped infrastructure by selling its emission quotas for the period 2008-2012. However, the fact that Belarus's Amendment to Annex B of the Kyoto Protocol that establishes quantitative commitments has not yet been ratified by the necessary number of Kyoto Protocol members prevents Belarus from benefiting the flexibility mechanisms. The same prevents enterprises of the Republic of Belarus from participation in the Clean Development Mechanism projects as an additional measure for benefiting from qualified emission reductions in order to meet future commitments.

Provision is made for creation of a domestic market of hydrocarbon units to promote the introduction of greenhouse gas emission reduction technologies which could be created after adoption of the Climate Protection Law of the Republic of Belarus. The concept of the law has recently been approved by the Government. At present it would be difficult to estimate the quantitative effect of the law.

4.1.5 Aggregate Projections

The below Figures 4.3-4.6 show the greenhouse gas emission projections with account of various scenarios chosen, adopted policies and planned measures as well as with account of additional measures. For the period between 1990 and 2007, the actual emission data are presented in accordance with the National Report on Greenhouse Gas Inventory of Belarus (see Section 2 of this National Communication).

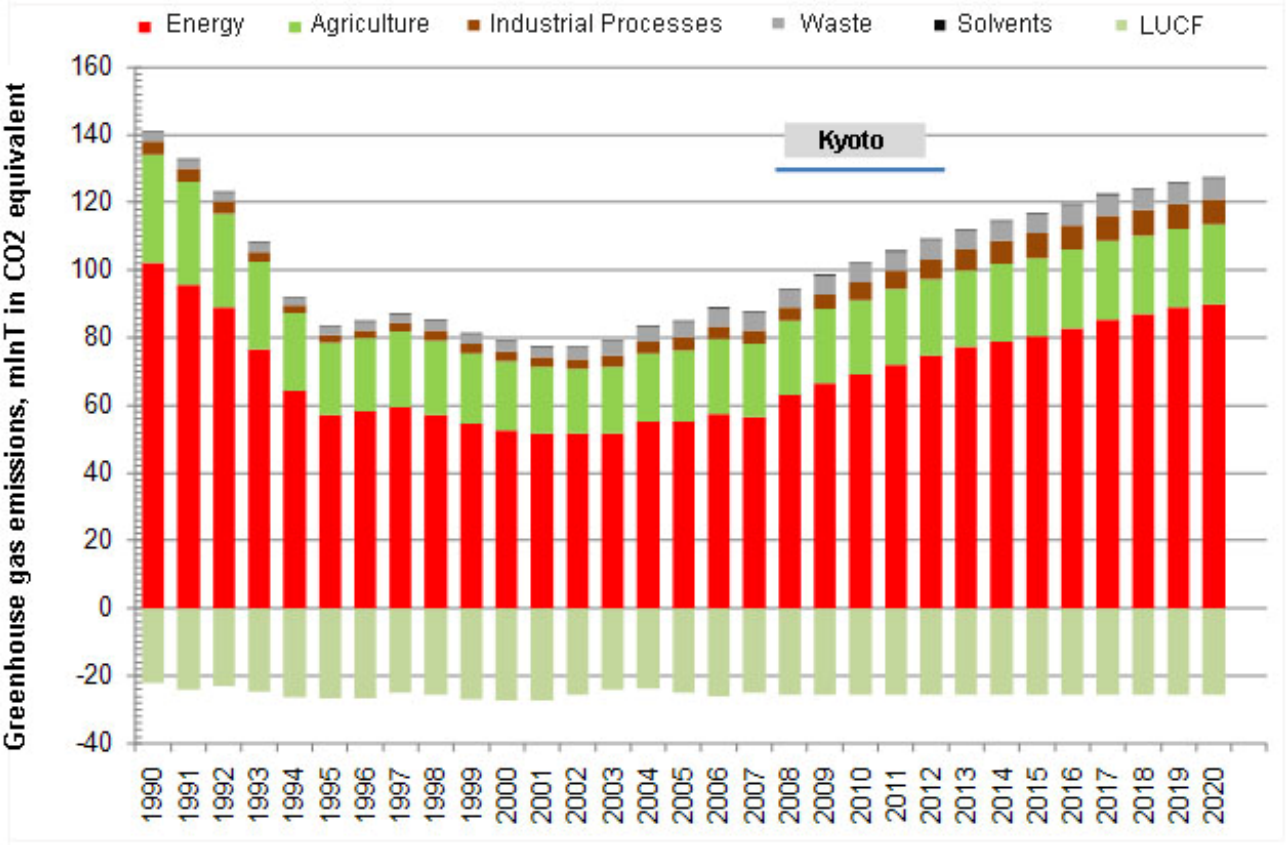


Figure 4.3 Projection of greenhouse gas emissions. Scenario «With Measures» – «CCP» version

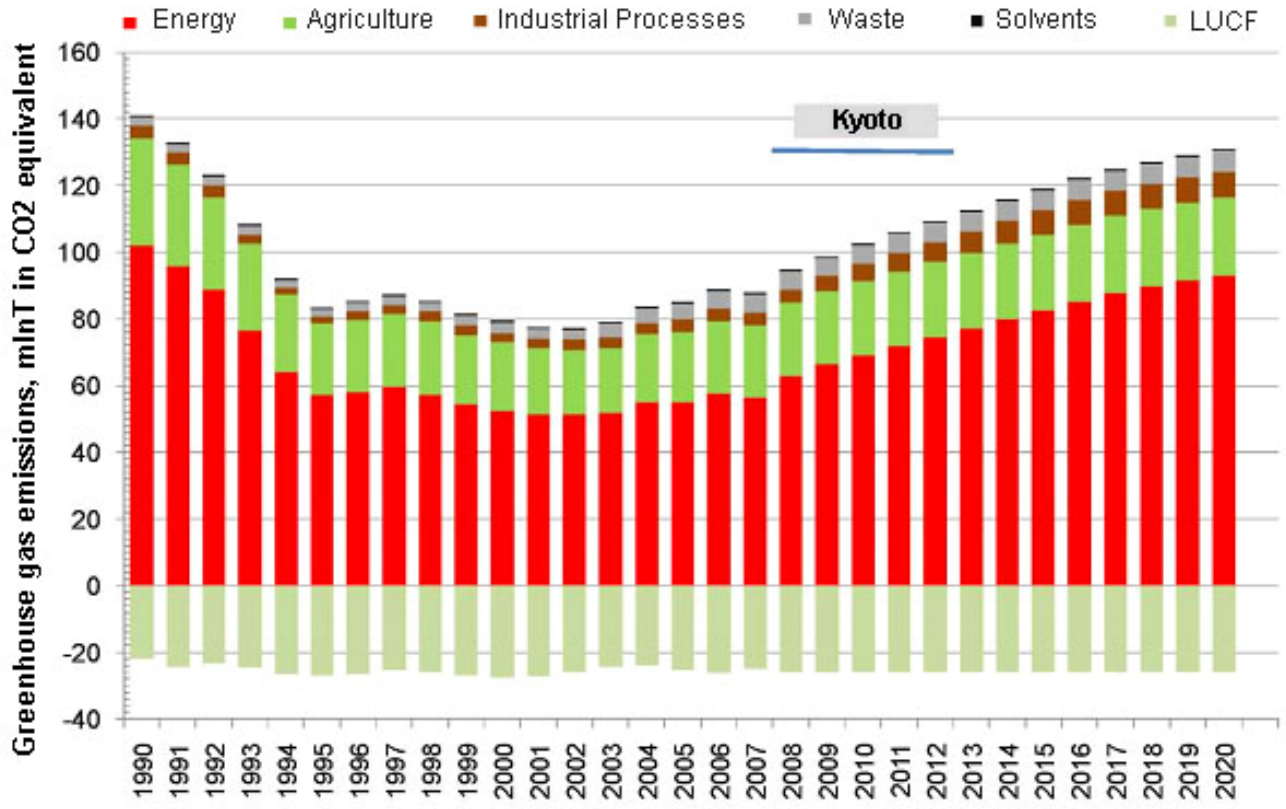


Figure 4.4 Projection of greenhouse gas emissions. Scenario «With measures» – «CCP+Coal» version

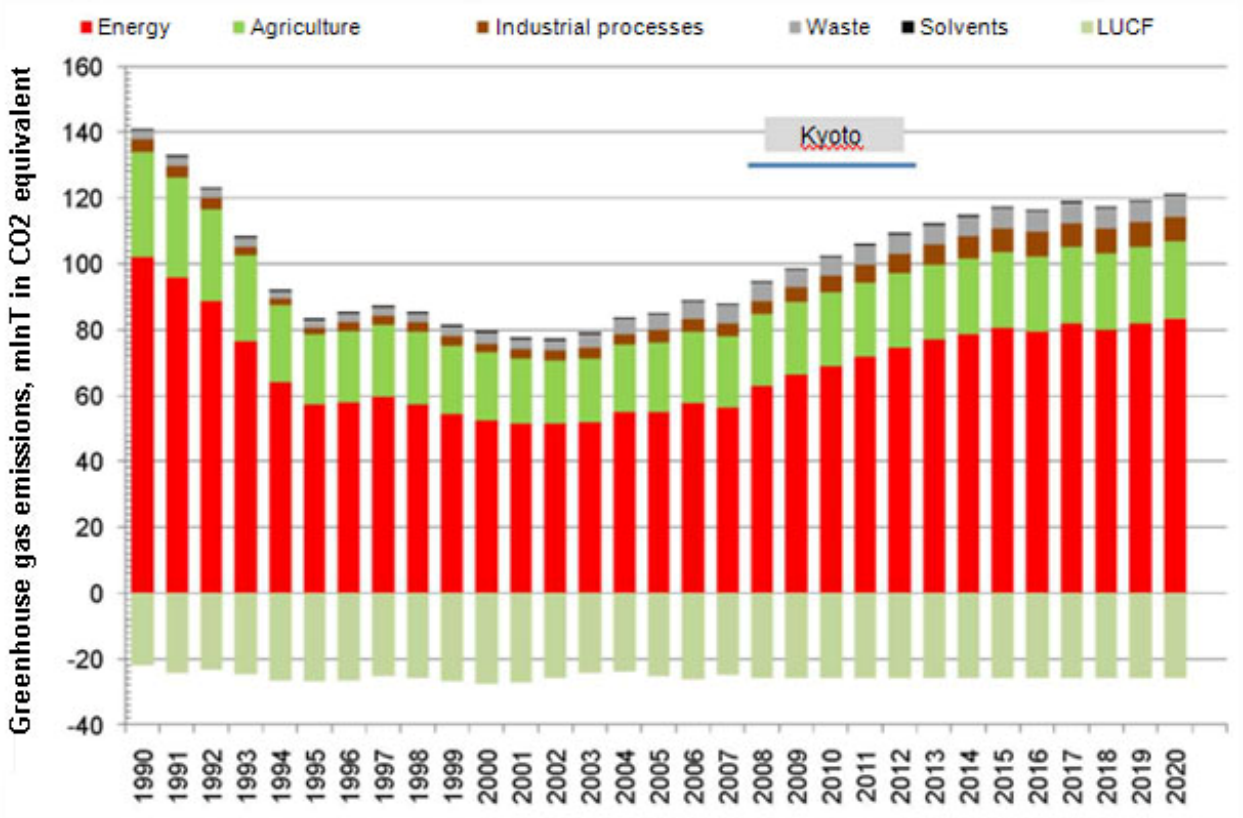
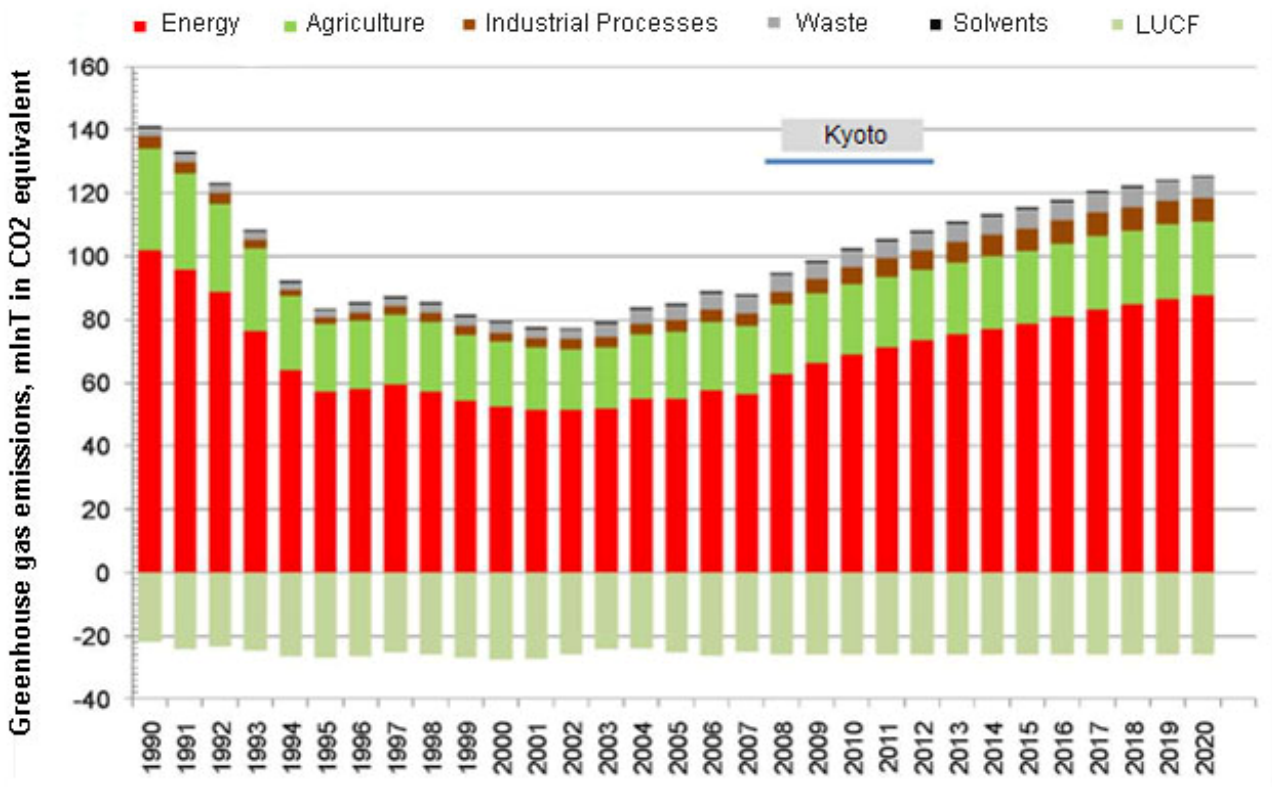


Figure 4.5 Projection of greenhouse gas emissions. Scenario «With Measures» – «CCP+NPP» version



Figures 4.6 Projection of greenhouse gas emissions. Scenario «With Additional Measures»

4.2 Assessment of Aggregate Effects of Policies and Measures

4.2.1 General

At present Belarus is considered to be a country with transitional economy. By early 1990s Belarus was one of the most industrially developed republics of the Soviet Union. It ranked among the top three leaders side by side with Russia and Latvia by percentage of industry in the occupational pattern of the population (35%) and production of net national product (47%). Equipment and tools used in the industry was newer than in other republics of the Soviet Union on the average. At the end of 1980s, the process of economic development slowed down, socio-economic contradictions sharpened which resulted in the escalation of inflation, scarcity of consumer goods and services and overproduction of capital goods. In 1991 the USSR dissolved thereby splintering the established economic ties of Belarus with other republics of the Union. A high level of specialization in machine building, chemical, petrochemical and light industries that existed in the USSR, strong reliance on Russia as a source of raw materials and a major sales market, political and socio-economic disturbances of 1991

contributed to accelerated economic crisis in the first half of the 90's. Economic parameters in that period were down across-the-board.

In 1994, the government adopted a Program of Urgent Measures on Economy Revival. In 1996, there were elaborated the 1996-2000 Main Areas of Socio-Economic Development of Belarus, the National Strategy of Sustainable Development of Belarus up to 2010, the 1996-2000 Economic Management Master Plan, and other strategic documents. They laid the foundation of the Belarusian model of socially-oriented market economy with active government influence. Among top economic priorities were the establishment of an efficient agro-industrial complex, heavy housing construction and building up an export potential. The implementation of this economic model enabled the country to reverse the slump, reach a positive dynamics of key macroeconomic processes, ensure annual GDP and industrial products growth, and stabilize the domestic consumer market. Further economic development was guided by the 2001-2005 Socio-Economic Development Program adopted by the Government and approved by the President. Experts generally noted that the economic situation stabilized in the period of 1996 - 2000. However, fixed capital expenditures dropped more than two-fold in 2000, compared with 1990 giving rise to concern. Deterioration of the active part of fixed assets is 70 - 75%.

Changes in the GDP structure in 2000 - 2005 are presented in Figure 4.7.

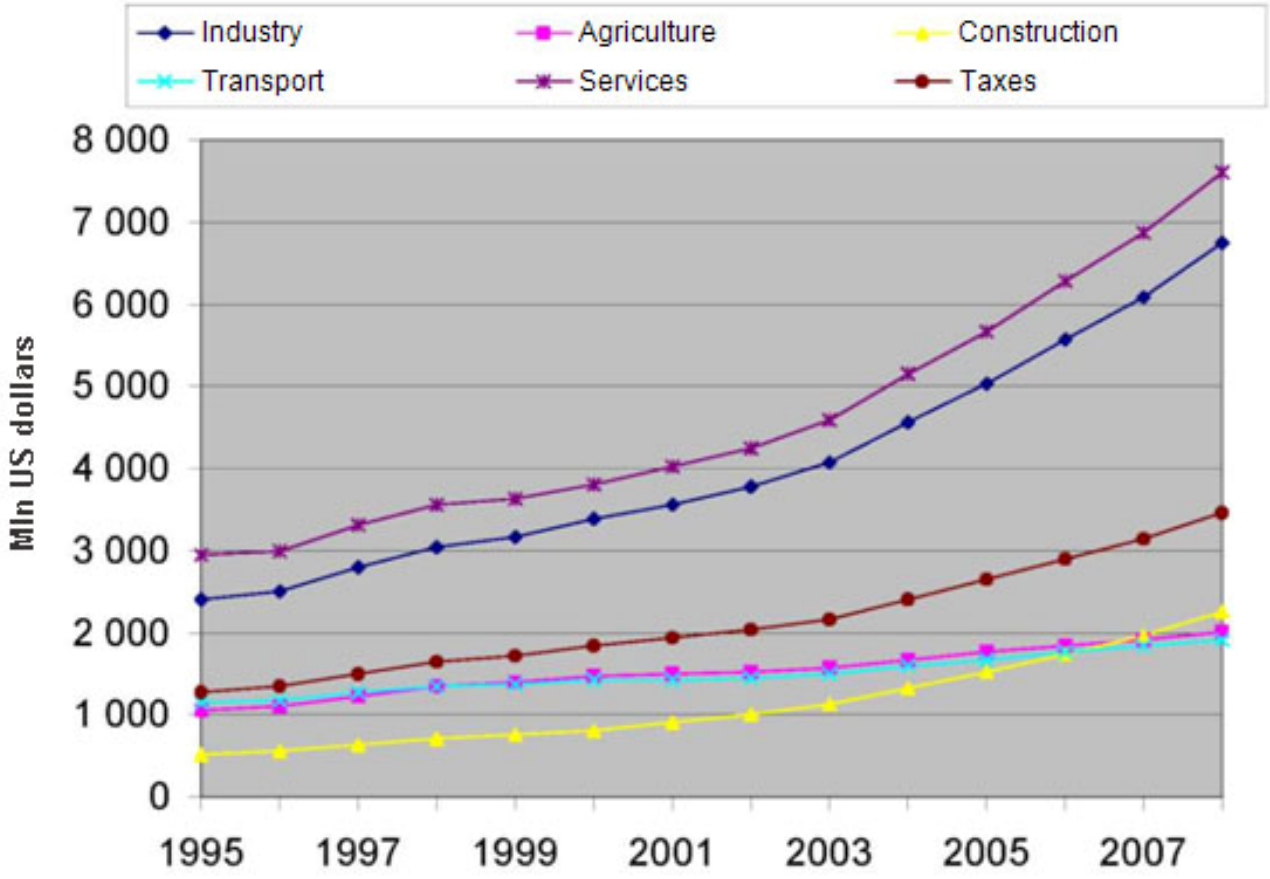


Figure 4.7 – Change in GDP structure

Agriculture which calls for reform of economic relations in the agro-industrial complex is still in deep crisis. However, the population of Belarus is better supplied with milk and meat products, eggs, and potatoes compared to large CIS countries (Russia, Ukraine, and Kazakhstan). The state policy of agricultural production support through subsidies helped to maintain a relatively high level of food consumption. At present it has a significant social value. The country's open economics largely depends on external processes. While the openness of economies around the world generally constitutes about

40 % (ratio of foreign trade turnover to GDP), for Belarus this parameter is over 55.9%. Russia is the key trade partner of Belarus. In 2008, Russia accounted for 47.3% of the foreign trade turnover, 59.7% of imports, and 32.4% of exports. In 2008, the export structure is dominated by mineral products (37.5 %), where potassium fertilizers have a prominent share (2.8 million t); chemical products (19.0 %), and products of

machine building sectors (18.9 %). Major imports are mineral products (36.42 %) and, first of all, oil (21.5 million t) and natural gas (21.1 billion cu m); machinery, equipment and vehicles (24.3%), and chemical products (11.8%).

In the period January-October 2009, the volume of gross domestic product amounted to 111.9 billion rubles in current prices, which is 1% lower than in January-October 2008 in current prices. According to Decree No.459 of the President of the Republic of Belarus dated August 29, 2008, the GDP growth projection is 10-12% for 2009.

In GDP the added value of industry is 25.6%, agriculture – 8.4%, construction – 11.6%, transport and telecommunications – 8.5%, trade and catering – 10.2%.

The National Sustainable Socio-Economic Development Strategy until 2020 was adopted in 2004. It was elaborated in accordance with the Law on Development of Socio-Economic Forecasts and Programs. The National Strategy projects 8-12% GDP growth per annum across sectors, with higher growth rates in services.

The key objectives and targets of socio-economic development of the Republic of Belarus for the period 2006 – 2010 are determined on the basis of the analysis of its socio-economic position, global development trends, projections of economic growth of neighboring state that are chief trading partners of Belarus, primarily the Russian Federation, Kazakhstan, Ukraine, as well as some EU states and other regional integration formations.

Socio-economic development of the Republic of Belarus for the period 2006-2010 focuses on further improvement of living standards of population by raising competitive capacity of the economy and creating a state beneficial for the whole people. To this end, it is necessary to ensure:

- growth of real money income of population, including wages, pensions, grants, allowances and other social payments;
- that any organ of state government operates in the interests of a man for want satisfaction;
- favorable conditions for intellectual, creative, labor, occupational and physical perfection of a man;
- accelerated development of service industries, and primarily education, public health, and culture as a foundation for human capital perfection;

- introduction of higher social standards in all spheres of social life;
- implementation of measures on improvement of demographic situation in the country;
- an increase in efficiency of the agro-industrial complex, further development of social infrastructure of in rural areas;
- innovation-oriented development of economy, enhanced mechanism of remuneration for the development and implementation of innovation projects to raise competitive capacity of economy, including restructuring, re-equipment and retrofitting as well as restructuring of enterprises;
- extension of mutually beneficial economic ties with neighboring and distant countries and first of all with Russia, other CIS states and EU;
- national security of the country.

4.2.2 Energy

The main source of greenhouse gases is the combustion of carbon-containing fuels. Burning of fuel releases carbon dioxide (CO_2), carbon oxide (CO), nitrogen oxides (NOx), water (H_2O) and other substances of direct and indirect greenhouse effect. Until 1995, gross fuel-and-energy consumption steadily tended to decrease, and then it stabilized at 35 - 37 million tons equivalent fuel. Rising import prices cause energy tariffs to grow, which in turn exacerbates the problem of non-payments. Consequently there is an acute shortage of intersectoral investment in the energy park's fixed assets. The extraction of domestic energy resources was dropping from 1990 to 2000: from 2.1 million tons to 1.9 million tons for oil, from 297 million cu m to 257 million cu m for natural gas, from 3.5 million tons to 2.0 million tons for peat.

The Belarusian economy is characterized by a high level of GDP energy intensity. Energy intensity is best described by the ratio of energy equivalent to GDP in comparable prices, which takes into account real price proportions between production and consumption. This indicator has been falling in the 90's. By 1995, the GDP energy intensity had dropped by 14% versus 1990 due to reduced energy consumption caused by the economic crisis. In the second half of the 90's, energy intensity dropped another

28% compared to 1995 because of economic recovery and energy saving policies pursued by the state.

An analysis of major economic parameters and fuel consumption volumes during the period under review makes it possible to identify two stages characterized by different tendencies of GDP energy intensity pattern and GHG emissions in Belarus.

Stage 1 covers 1990 - 1995. This period was marked by a sharp reduction of GDP and fuel consumption. What's more, the pace of consumption reduction outstripped that of GDP decline. The level of fuel consumption fell by 44%, and GDP – by 35%. This led to a reduced energy intensity of the economy. Naturally, GHG emissions generated by the energy sector over that period declined mainly as a result of lower fuel consumption and to a certain extent changes in the structure of fuel used.

Stage 2 covers 1996 - 2000. This is when the state undertakes serious steps to overcome the crisis and carry out energy saving policies as envisaged by the 1996-2000 Guidelines for Socio-Economic Development of the Republic of Belarus, Guidelines for Energy Policy for the Period Ending in 2010, and the National Energy Saving Program up to 2000. As a result, GDP increased by 36% over five years, with fuel consumption volume stabilized. So, energy intensity continued to decline. Between 1995 and 2000, there was a reduction in GHG emissions originating from the energy sector, albeit not as considerable as between 1990 and 1995. GHG emissions reduction was connected with, firstly, a 1.1% drop in fuel consumption, and, secondly, an increasing share of natural gas in the fuel structure.

The structure of fuel and energy resources used for energy generation purposes changed over a decade. Natural gas moved well to the foreground squeezing out residual fuel oil. A share of coal used for heat production decreased. Belarus typically uses a lot of peat and bricks produced thereof for energy purposes (totally, about 2 million tons equivalent fuel). Another distinguishing feature of Belarus is low supply of hydroelectric resources, which made up a mere 0.01% in 1990 and 0.02 % in 2000 in the primary energy consumption structure.

No major changes have occurred in the structure of fuel use by consumption area. Fuel resources are mainly used to generate heat and power energy, plus as a process fuel

in industries. A share of population in fuel consumption has considerably increased, as more and more people buy cars and build houses.

The energy park of Belarus includes fuel production, transportation, storage and primary processing, generation and transmission of electric power and heat (Table 4.4). Burning fuel to generate heat and electric power is the main greenhouse gas source. Belarus uses mainly natural gas and fuel oil for this purpose, but all possible fuel types are fired at small-scale boiler plants. 22 combined heat and power (CHP) plants and public district power plants (GRES), 25 Belenergo's district boiler plants, 8 isolated generating plants and 22 100 small boiler plants (of less than 10 Gcal/h in capacity) generate heat and electric energy in the country.

Methane and volatile non-methane organic compounds (VNMOC) leakages and emissions during transportation and storage of gaseous and liquid fuel and in the process of oil refining provide an additional GHG source in the fuel and energy complex. Gas pipelines (total length – 6,400 km), oil pipelines (3,007 km), and oil product pipelines are mainly used for transportation. Main pipeline sections have been operated for 30 years and are worn out in some places. Oil products are produced by two refineries. Oil products are delivered to intermediate tank farms by railway and to end-use gas-filling stations – by vehicles.

Table 4.4 – Key Indicators of Belarusian Energy System Performance

	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
GPO «Belenergo» Concern									
Electric power, million KWh									
Generation	26101	25063	26455	26627	31211	30961	31811	31829	35048
Import	9975	10989	10068	10818	7975	9091	10148	9406	7085
Export	2764	2718	3513	3987	4723	5055	5789	5062	5246
Heat power, million Gcal									
Generation	28.1	29.6	29.1	30.2	31.6	32.4	32.9	31.5	32.0
Municipal and industrial boiler plants									
Heat power, million Gcal									
Generation	38.1	41.4	39.5	39.4	37.5	41.1	41.5	38.2	35.5

The Comprehensive State Program for Modernization of Basic Production Assets of the Belarusian Energy System, Saving and Increased Consumption of Domestic Fuels for the Period Ending in 2011 has been developed with account of the Concept of Energy Security of the Republic of Belarus approved by Decree of the President of the Republic of Belarus No.433 of September 17, 2007, Concept of National Security of the Republic of Belarus approved by Decree of the President of the Republic of Belarus от No.390 of July 17, 2001 (National Register of Legal Acts of the Republic of Belarus, 2001, № 69, 1/2852), Directive of the President of the Republic of Belarus No.3 of June 14, 2007 «Economy and Husbandry are the Major Factors of Economic Security of the State».

The State Program focuses on various problems such as energy efficiency of production and energy utilization, diversification of fuels and suppliers of heat and energy resources, and increase of the share of domestic energy sources used.

The State Program aims primarily at identifying specific actions, their deadlines and requisite investments so as to ensure energy security of the Republic of Belarus, accelerated capital renewals, reliable and efficient energy supply to various sectors of the economy and population provided that ecological requirements are met.

The above aim shall be achieved through implementation of a range of activities, including:

- centralized management of all the stages of energy production, transportation, and consumption;
- state control over power and heat tariffs, and fuel prices;
- balanced modernization and development of power generators as well as power and heat transmission and distribution networks of the Belarusian Energy System;
- change of the age structure dynamics of the Belarusian Energy System's fixed assets, at first for stabilization of the achieved level, and then for their continuous renewal;
- organizational and economic mechanism stimulating an ultimate introduction of energy-efficient technologies and equipment in all the economic and social sectors;

- reduction of costs related to production (extraction, harvesting), transmission and distribution of all kinds of fuel, heat and power sources;
- development and enforcement of national sectoral and regional energy saving programs;
- gradual diversification of different fuels and their suppliers;
- maximization of the economically feasible volumes of local fuels, unconventional and renewable sources of energy in the fuel and energy balance.

The deadline for implementation of the State Program is 2006 - 2010. It is determined and substantiated by the dates of commissioning and mastering of specific entities and availability of unbiased source information on prices on energy sources and capital equipment.

Activities by regions and individual entities of the Belarusian Energy System as well as their associated volumes and sources of finance are reflected in the Plan of Construction and Rehabilitation of Fixed Assets of GPO «Belenergo» for the Period applied hereto.

Implementation of the State Program shall help:

The energy sector:

- to enhance energy security of the Republic of Belarus Belarus through renewal of the fixed assets of the Belarusian Energy System, efficient use of fuel and energy resources, and increased share of local fuels, unconventional and renewable sources of energy;
- to increase reliability of the Belarusian Energy System as a whole through renewal of its fixed assets.

The industrial sector:

- to increase production and consumption of local fuels to the level of 6.48 million tons of equivalent fuel by 2010, including:

Wood fuel and waste wood	2.1–2.24
Peat and lignin	1.18
Other types of fuel	0.69

Among them	
Woodworking waste	0.37
HPP	0.02
Secondary waste energy	1
Municipal and household waste and wind-driven power plants	0.01
Associated gas and domestic oil refining products	1.36

According to the Concept, in 2005 gross consumption of fuel and energy resources (hereinafter FER) amounted to 37.05 million tons equivalent fuel (in 2005 prices) and its demand for the year 2010 is expected to be 39.9 million tons equivalent fuel with the maximum GDP growth and ultimate reduction in energy intensity for GDP of 100 trillion rubles. This compares with reduction in GDP power consumption by 31% in 2010 against that of 2005.

The potential growth in consumption of residue fuel oil produced by the Belarusian refineries will allow gas fuel to be partially squeezed out and enhance diversification of energy balance by fuel type. However, as the majority of existing sources of energy can use both gas and residue fuel oil, the volume of fuel oil consumption will be determined by economic and environmental expediency in the long run. By enhancing oil processing and its depth, it will be possible to obtain small quantities of high-energy coke residue as a secondary energy resource in the near future.

In the long run, the fuel and energy balance provides for the use of coal in production of building materials and energy as well as nuclear fuel by construction of a 2400 MW nuclear power plant by the year 2020 (two power units of 1200 MW each).

The rehabilitation program suggests that the GPO «Belenergo» Concern will succeed in replacement of imported fuels by local non-conventional and renewable sources to a total of 296.8 thousand tons equivalent fuel in the period between 2006 and 2010 (Table 4.5-4.6):

Table 4.5 – Expected Structure of Boiler and Furnace Fuel in the Republic of Belarus up to 2011 (Million Tons of Equivalent Fuel)

Type of Fuel	Actual Year			Projected Year		
	2005	2006	2007	2008	2009	2010
Natural gas, including associated gas	23.41	23.9	24.2	24.6	25.2	25.2
including:						
Associated gas production	0.3	0.28	0.28	0.28	0.28	0.27
As raw material and for transport	1.52	1.72	1.75	1.78	1.79	1.8
Liquefied gas	0.35	0.36	0.32	0.31	0.31	0.39
Liquefied natural oil gas	0.63	0.74	0.45	0.45	0.45	0.76
Domestic furnace oil	0.09	0.09	0.09	0.09	0.09	0.09
Oil fuel	1.74	1.97	1.8	1.7	1.6	1.74
Coal, including coke and coke breeze	0.21	0.19	0.17	0.18	0.19	1.22
Other local fuels	2.51	2.72	3.16	3.47	3.8	4.31
including:						
peat, lignin	0.67	0.69	1.07	1.13	1.15	1.18
fuel wood	1.24	1.37	1.44	1.67	1.97	2.1 - 2.24
other fuels	0.6	0.65	0.65	0.67	0.68	0.69
use of refinery coke						0.2
Total boiler and furnace fuels	28.92	29.95	30.2	30.8	31.6	33.7
Raw materials	1.72	1.9	1.9	1.9	1.9	2.1
Without raw materials	27.2	28.1	28.3	28.9	29.7	31.6
Net energy imports	1.13	1.21	1.32	1.37	1.37	-
Total with raw materials	30.05	31.2	31.5	32.2	33	33.7
Heat energy, million Gcal	73.5	72.2	75.2	76.1	77	77.9
including heat wind-driven electric generating plants	0.8	0.88	0.91	0.93	0.98	1
Electric energy. kWh	35	36.4	37.3	38.1	39	39.9
Total local fuels with account of refinery coke and heat wind-driven electric generating plants	4.56	4.78	5.25	5.58	5.96	6.48
Percentage of local fuels in boiler and furnace fuel consumption without raw materials, %	16.8	17	18.6	19.3	20.1	20.5

Table 4.6 – Growth in the Fossil Hydrocarbon Fuel Replacement

Source of Energy	Growth in Fuel Replacement Volume by Year, thousand equivalent fuel					2006 - 2010
	2006	2007	2008	2009	2010	
Total growth in fuel replacement volume	25.5	37.2	46.9	60.6	126.6	296.8
including:						
Hydro power plants:	0.4	_	0.1	_	_	0.5
Turbine expanders:	1.9	2.4	.	6	.	10.3
Waste heat utilization plants:	_	1.2	11.	0.6	0.6	13.6
Boiler plants and co-generation units firing local fuels:	23.2	33.6	35.6	54	42	188.4
Other	_	_	_	_	84	84

4.2.3 Transport

As a greenhouse gas source, transport ranks next to heat and power engineering. Operation of the transport sector is accompanied with emissions of CO_2, CO, CH_4, N_2O, NOx and VNMOC. The Belarusian transport sector includes railway, road, inland water and air transport. The main modes of transport are railway and road transport. In the period between 1990 and 2005, the passenger turnover by all modes of transport reduced by 16.7^ and the freight turnover increase two-fold. Data on passenger and freight turnover is given in Tables 4.7 and 4.8.

In the period between January and October 2008, all modes of transport carried 203.4 million tons of cargo which is 4.3% less than in January-October 2008.

The structure of passenger traffic by all modes of transport substantially changed. Thus the share of railway transport in the total passenger turnover reduced from 48.1% in 1995 to 37.8% in 2008, while the share of bus and air transport increased from 35.8 and 4.7.9% to 38.0% and 5.9%, respectively, over the same period. The structure of freight turnover by key modes of transport changed very slightly. The railway (68.1 %) and road (31.6%) are dominant modes.

Table 4.7 – Freight transportation, million T-km

	1995	2000	2001	2002	2003	2004	2005	2006	2007
Total freight turnover by all public transport means	35242	41214	40037	45665	51306	54531	58753	61703	67292
including:									
railway	25510	31425	29727	34169	38402	40331	43559	45723	47933

road, including departmental	9539	9745	10241	11400	12710	13969	15045	15779	19200
inland water	133	26	41	59	160	182	90	109	93
air	60	18	28	37	34	49	59	92	66

Table 4.8 – Passenger transportation, million passenger-km

	1995	2000	2001	2002	2003	2004	2005	2006	2007
Passenger turnover of public transportation	25989	32449	30345	29281	28165	28171	24354	24108	23928
including:									
railway	12505	17722	15264	14349	13308	13893	10351	9968	9366
road (bus service)	9308	9235	9493	9397	9768	9382	9231	9343	9375
air	1228	513	546	553	565	674	684	754	975
inland water	2	2	2	2	2	2	2	2	3

Carriage of freight by road effected by special entities engaged in commercial transport operations amounted to 88.8 million tons in January-October 2009 or 102.3% compared with January-October 2008.

Carriage of freight by rail effected in January-October 2009 reduced by 9.5% compared with the same period of the previous year. Cargo handling reduced by 5.6% for the same period.

Between January and October 2009, passengers carried by all modes of transport (except municipal electric transport) amounted to 1110.3 million people, which is 3.3% less than in January – October 2008. Passenger operations by rail reduced by 4.2%, bus- by 3.2%, inland water transport - by 1%, and air - by 0.9%.

Between January and October 2009, passenger operations effected by self-employed entrepreneurs by regular bus service accounted of 4% of the total passenger operations effected by public bus service and the passenger turnover amounted to 3.8%.

The size and structure of the public and private fleet changed over the period in question.

The total number of vehicles increased 2.5-fold from 650.8 thousand units in 1990 to 10002.3 thousand in 2005 and 3456.4 thousand in 2007. This is attributed to swift growth of vehicle-to-population ratio.

4.2.4 Industry

The industry generates greenhouse gases as by-products of specific production cycles. The following industrial sectors generate process-related greenhouse gases: metallurgy, machine-building and metal-working (electric smelting, rolling, pipe manufacturing, metal casting, refrigerating equipment manufacture and repair), petrochemical industry (production of ammonia, nitric acid, caprolactam, and ethylene), construction materials producing industry (cement and lime production), woodworking and pulp-and-paper industry and glass works. Greenhouse gases occur through the burning of fuel in process furnaces to produce high temperature heat, and as a result of chemical and thermal processing raw materials. As a result, CO2, CO, N2O, NOx, VNMOC, and hydrofluorocarbons (HFC) are emitted.

In 1990, machine-building (34.2% of the industrial product cost), consumer goods (17.2%), food (14.9%) as well as chemical and petrochemical (9%) sectors were among leaders. A substantial growth in the share of power engineering (from 2.6% to 13.8 %), chemical and petrochemical industries (from 9.0% to 14.3 %), as well as ferrous metallurgy (from 0.9% to 2.4%) was observed in the industrial products pattern by 1995 caused by higher import prices for raw materials for the above sectors. The current proportions in the industrial output structure are as follows: machine building and metalwork (23.2%), fuel industry – 21.3%, food industry 14.6%, chemical and petrochemical industry – 13.4%. A share of electrical energy reduced considerably from 13.8% in 1995 to 5.5 % in 2008.

Since the middle of the 1990s, the industrial production began to increase as a result of the governmental crediting of current assets and more effective utilization of production capacities, and in late 1990s, Belarusian ruble devaluation and labor cheapening further promoted it. Stabilization of or increase in physical indicators was observed with respect to major industrial products since the second half of the 1990s. The industry's major problems include depreciation of fixed assets, technological inferiority of products at external markets and shortage of investments in the sector.

Between January and October 2009, the volume of products (works, services) in the current prices amounted to 101.2 trillion rubles. Physically, total industrial output is

95.5% compared with the same period of 2008. Figures 4.8 and 4.9 show the behavior of industrial output and stocks of finished products.

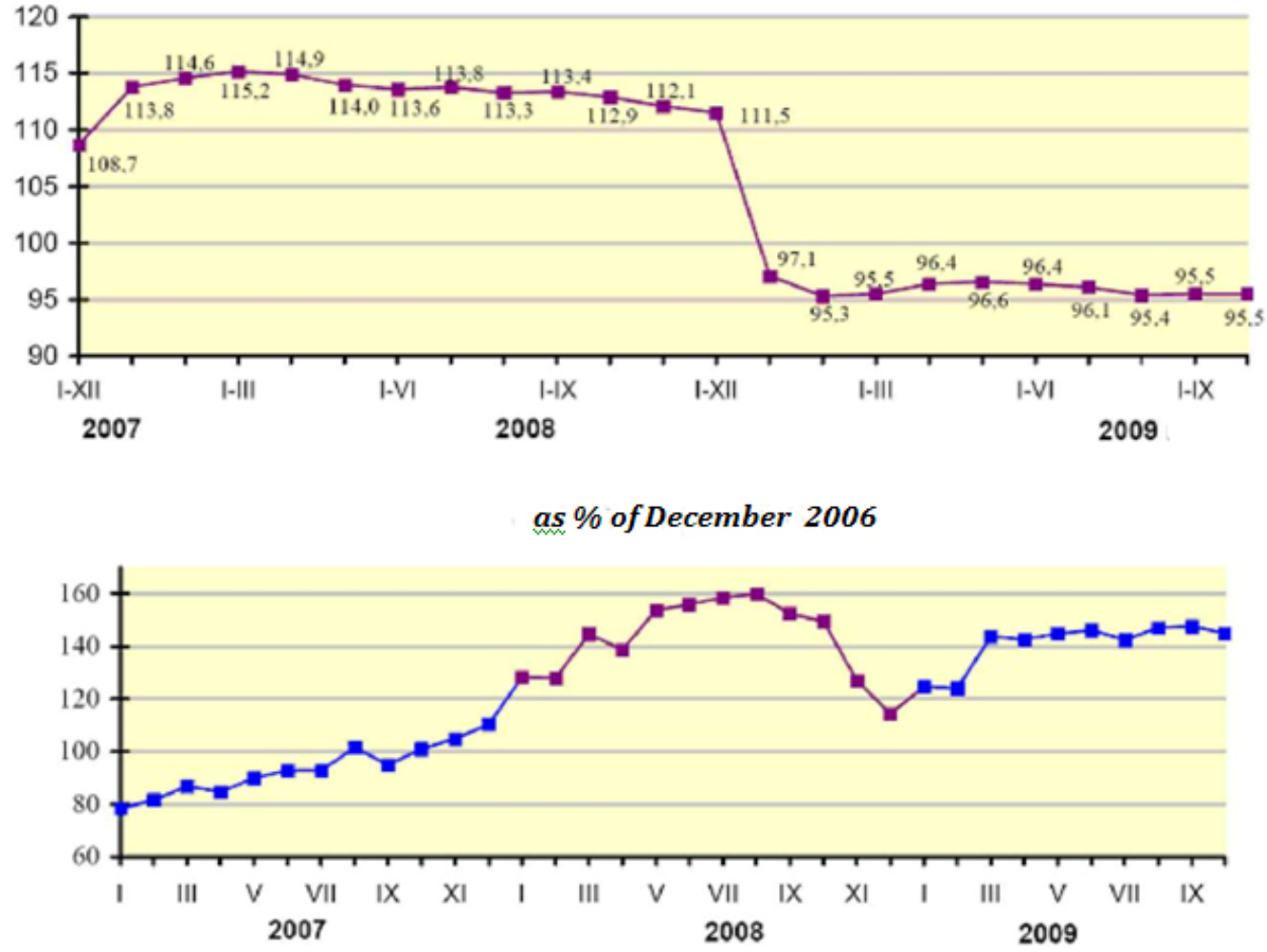


Figure 4.8 – Behavior of Total Industrial Output (in Comparable Prices as Percentage of the Same Period of the Previous Year)

In January-October 2009, the ratio of the stock of finished products and the average monthly industrial output accounted in the accordance with the current procedure amounted to 76.7% in actual prices (compared with 54.6% in January-October 2008).

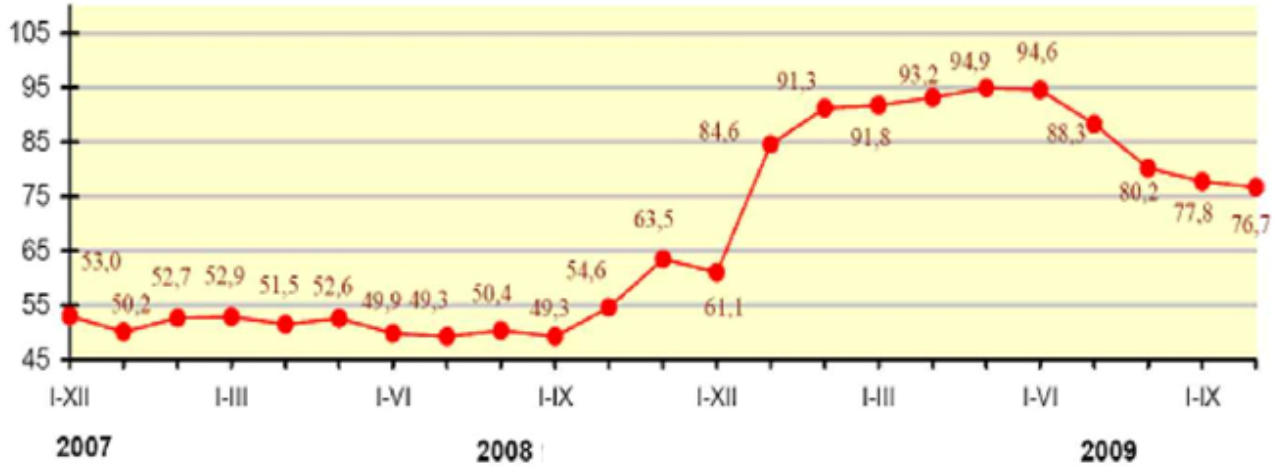


Figure 4.9 – Finished stock to average monthly industrial output ratio (%)

4.2.5 Agriculture and Forestry

Agricultural sector is the main source of non-energy-related greenhouse gases.

Enteric fermentation and manure decomposition produce greenhouse gas emissions (mainly methane) in livestock breeding. Application of organic and mineral fertilizers, biologically fixed nitrogen, field waste water and after-harvesting crop residue, greenhouses and reclaimed land tillage are the main sources of GHG emissions. They generate N_2O, CO_2, and CH_4.

For the period between January and October 2009, agricultural production in the current prices amounted to 24.6 trillion rubles for all categories of entities which is an increase by 1.1% compared with January-October 2008 in the comparable prices. For the same period, the volume of production by agricultural entities increased by 4.7%. In so doing, animal production increased by 8.2%, and plant production by 1.2%.

All regions failed to reach annual projections for the rate of agricultural production growth, and the Grodno region exhibited a reduction in the volume of production by 1.4 % compared with January-October of 2008.

As of November 1, 2009, the gross yield of potato gathered by agricultural entities amounted 741.5 thousand tons which is 23.7% lower than in the previous year. Its yielding capacity is 162 centners per ha against 206 centners in 2008. The yield of vegetables is 225.5 thousand tons which is 15.9% less than in the previous year with the average yielding capacity of 195 centners (191 centners in 2008). As of November 1, 2009, the gross yield of sugar beet gathered by agricultural entities amounted to 3.5

million tons which is 2.3% less than in the same period of 2008. Its yielding capacity exceeded the last year's level by 16 centners and amounted to 432 centners per ha. According to the final records, an area of 1461.8 thousand ha is rendered suitable for next year winter crops to be used for grain and green-cut fodder which is 0.3% less than the last year's area. The area for winter rape is increased by 8.7% and amounted to 422.8 thousand ha. As of November 1, 2009, sugar factories received 2.9 million tons of sugar beet on account of state requirements which is 82.8% of the target. Livestock farming. As of November 1,2009, the cattle population increased by 65.3 thousand heads (1.7%) in the agricultural entities of the republic compared with the same period of the previous year, including cows by 17.1 thousand heads (1.4%). The population of pigs in the same period increased by 88.4 thousand heads or 3.1%.

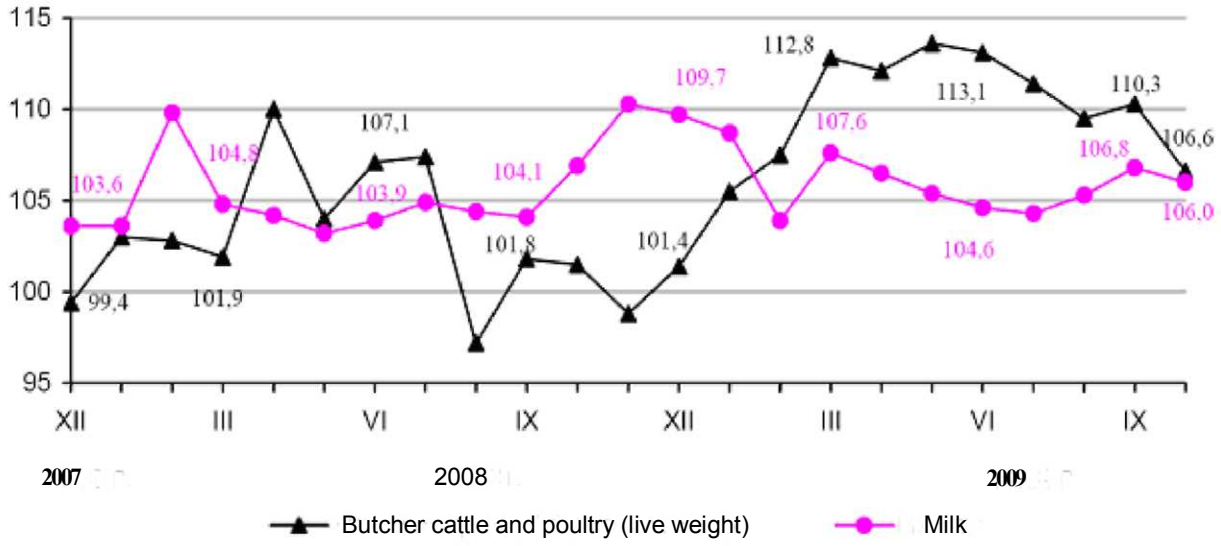


Figure 4.10 – Animal production by farm of any category (as % to the same month of the previous year)

The entities of all categories increased production of meat and milk in January-October 2009 compared with January–October 2008 in all regions. Egg production reduced by 1.4% in the Vitebsk region. Agricultural entities increase production (breeding) of livestock and poultry (live weight) by 8.8% in October 2009 compared with that of October 2008 (and by 10.9% in October 2008 as compared with October 2007), milk - by 8% (by 10.4%), egg – by 7.6% (by 2.9%). In January – October 2009, there was a positive change in the structure of livestock and poultry production (live weight) throughout the country compared with the same period of 2008: cattle (by 0.3%) and poultry (by 1.2%). However, pig production (breeding) reduced by 1.4% in

the same period. Sales of products on January-October 2009, sales of livestock, poultry and milk by agricultural entities increased compared with the same period of the previous year. For the said period, sales of butcher cattle and poultry (live weight) amounted to 951.6 thousand tons, milk – 4071.2 thousand tons (85% of the total volume of production).

Agricultural output somewhat reduced in 1990–2005. The sown area pattern has not changed substantially over that period. Cereal and leguminous crops (41.2%) and fodder crops (42.3%) dominate in it. The yielding capacity of cereal crops reduced from 26.6 cwt/ha of sown area in 1990 to 19.1 cwt/ha in 2000. The situation is the same with other crops – the yielding capacity is lower than in 1990. This is due to reduction in application of fertilizers. The agricultural animal population reduced considerably in 2008 as compared with 1990: cattle - by 42.4%, pigs - by 28.8%, and small-size cattle - by 75.3%. In general, a steady tendency of key GHG source reduction could be observed in farming industry.

Major carbon dioxide sinks in Belarus are forests. Forest management, species composition of stands and forest age influence the volume and efficiency of carbon removals.

The gross area in the republic was 9,329,000 hectares as of 1 January 2008. All Belarusian forests are state-owned. Percentage of forest land is about 40 per cent. The major part of forests is managed by the Ministry of Forestry of the Republic of Belarus. Part of forest area is managed by conservation areas, national parks and other departments. The dynamics of forest resources is characterized by steady increment. Approaches to sustainable forestry management are stipulated in the Strategic Forestry Development Plan formulated in 1997. It is planned to increase the percentage of forested land in Belarus to 40% by 2015. New large forest areas are to be created on lands withdrawn from the agricultural use because of low productivity and contamination resulted from the Chernobyl nuclear power plant catastrophe.

Between 1990 and 2005, positive changes took place in the way forest resources are used. Clear felling areas reduced by 27.9%. However, the total felling volume by felling type in 2005 remained the same as in 1990: 10738 and 10787 thousand cu m. The forest cutting structure changed: while in 1990 principal felling (clear cutting)

dominated – 52.2% of stacked wood, starting from 2000 about 60.1% of wood comes from intermediate cutting (improvement thinning, selective sanitary felling) and other types of cutting. Forestation by planting and sowing increased by 23.7% compared with 1990.

4.2.6 Energy Saving

The Comprehensive State Program of Rehabilitation of the Basic Production Assets of the Belarusian Energy System, Energy Saving and Increase in the Use of Domestic Resources of Fuel and Energy in the Republic up to 2011 provides for FER saving at least 7.55 million tons equivalent fuel through introduction of new energy-efficient technologies, equipment and materials, purpose-oriented measures on energy saving and organizational measures on energy supply optimization. Below are target figures by year:

- 2006 – 1.68 million tons equivalent fuel,
- 2007 – 1.61 million tons equivalent fuel,
- 2008 to 2010 - at least 1.4 million tons equivalent fuel per year.

Table 4.9 presents the minimum fuel and energy resource savings in the period 2006 - 2010.

Table 4.9 – Minimum Savings of Fuel and Energy Resources by Sector between 2006 and 2010

Entity	**Saving, thousand tons equivalent fuel**
Ministry of Construction and Architecture	375
Ministry of Industry	620
Ministry of Agriculture and Food	538
Ministry of Municipal Housing Economy	884
Ministry of Public Health	108
Ministry of Defence	50
Ministry of Education	260
Ministry of Telecommunications	29
Ministry of Transport	168
Entities Reporting to the Ministry of Energy:	
GPO «Belenergo»	1150
GPO»Beltopgaz»	61
OAO «Beltransgaz»	49

«Bellegprom» Concern	92
«Bellesbumprom» Concern	165
«Belneftekhim» Concern	1530
«Belbiopharm» Concern	31
«Belgospischeprom» Concern	163
Belkoopsoyuz	59
Other	1218
Total	7550

It is expected that reduction in greenhouse gas emissions through more efficient use of the current equipment capacity, switchover from gas and fuel oil to local fuels, application of alternative sources and the resulting GHG reduction will amount to (Table 4.10):

Table 4.10 – Expected Reduction in GHG Emissions

Sectors of economy	**Thousand Tons CO_2 Equivalent**
Industry	1978
Agriculture	1008
Construction and building materials	864
Fuel and energy complex	5020
Municipal housing economy	1461
Social and budget spheres and other sectors	2459
Total	12790

4.2.7 Renewable Energy Sources

Below is data on estimated reserves and utilization of local energy sources such as biomass, solar and wind energy and solid waste. Production of slate and brown coal is inexpedient due to low quality and economic consequences (Table 4.11).

Table 4.11 – Reserves and Utilization of Local Energy Sources

Type of Energy Source	Potential Reserves	Annual Utilization (Production, Extraction)	
		2006 (actual)	2006 - 2010
Wood fuel and woodprocessing waste, million tons equivalent fuel per annum	2.7	1.69	10.82
Water resources , million kWh	2270	24	190
Wind resources, million kWh	2400	3.04	26.84
Biomass, million tons equivalent fuel per annum	1620	-	66
Solar energy, million tons equivalent fuel per annum.	71000	-	6.3
Municipal waste, million tons equivalent fuel per annum	470	-	9.6
Phytomass, million tons equivalent fuel per annum	640	-	2
Lignin, million tons equivalent fuel per annum.	983	18.2	190.4
Ethanol and biodiesel fuel, million tons equivalent fuel per annum	1000	-	206.35

Wood Fuel

Wood fuel resources of the Republic of Belarus include wood harvested by principal, selection, sanitation, and other felling. Generally, utilization of wood fuel and wood waste in the republic amounts to 1.3 and 0.3-0.4 million tons equivalent fuel, respectively, a year. The limiting wood fuel resources of the republic can be derived from normal mean annual increment which is estimated to be 25 million cu m.

In 2007, the cost of 1 ton equivalent fuel of hog fuel delivered to the heat and electric power plants of GPO «Belenergo» at free customer's warehouse amounted to USD 82 per 1 ton equivalent fuel (without VAT) (or 175 838 rubles/ton equivalent fuel), the cost of 1 solid cubic meter is USD 21.8 (46 773 rubles/ton equivalent fuel). In future, the price of wood fuel can increase with account of economic necessity and proper substantiation.

Wood-processing waste mostly results from manufacture of products by entities of the Belarusian production and commercial concern of forest, wood processing and pulp-and-paper industry. Lumber waste in the form of saw dust and stud blocks

amounts to 250 thousand cu m in the system of the Ministry of Forestry. If is expected to bring the use of wood as fuel to 2.1-2.4 million tons equivalent fuel by 2010.

Water Resources

Water courses in Belarus have a potential capacity of 850 MW, of which technically available is 520 MW, and economically feasible – 250 MW. Developing small hydropower schemes would involve building new, and reconstructing or restoring existing hydro power plants. Erecting cascades of hydroelectric power plants on the Sozh, Dnieper and Pripyat rivers should be given special thought as radioactively contaminated areas are relatively close to the proposed areas of impoundment.

Hydropower units to be used would lie within 50 to 5,000 kW with preference given to capsule-type fast recoverable hydraulic units. With the use of hydraulic units of 50 -150 kW in capacity, it would be possible to widely use asynchronous generators as they are more simple and reliable in service. A hydroelectric power plant to be constructed on the Dnieper-Bug Channel will be 1000 kW in capacity.

Wind Energy

There are 1840 sites suitable for wind power plants that have been identified across the country, with a theoretical power output of over 1,600 MW. In 2006 the total installed power of wind-driven power plants amounted to 0.9 MW as a substitute for 0.33 thousand tons of equivalent fuel. Projected annual power output from wind power plants by 2010 is estimated at 7.34 million kWh (2.05 thousand tons equivalent fuel) with full installed capacity of 4.1million MW, while by 2012 – 9.31 million kWh(2.61 thousand tons equivalent fuel) with full installed capacity of 5.2MW. These values need to be adjusted on a yearly basis to allow for changing energy prices.

Biogas

The testing of biogas plants extracting biogas from livestock waste confirmed the need for an integrated assessment of their viability, because their biogas extraction alone is economically unfeasible compared to other types of fuel, but the combined effect of the resultant side products – fertilizers and better environment around the farms – make it worthwhile. It is expected to commission three pilot biogas-fuelled plants to a total capacity of 1.1 MW. The total production of commercially viable biogas by all the sources is estimated to be 160,000 thousand tons equivalent fuel a year.

Solar Energy

According to the weather service of Belarus, there are 250 overcast days, 185 cloudy days, and 30 clear days on the average in the country, while the annual average of solar energy, taking into account nighttimes and cloudiness, is estimated at 243 cal per m2 /day, which is equivalent to 2.8 kWh/ m2/day, and with the conversion efficiency rate of 12% it comes down to 0.3 kWh/ m2/day. Yet, based on the foreign experience, the specific investments into solar power plants and the prime cost of the generated power greatly exceed power generation costs of other sources. The technological progress in that area shall naturally reduce the costs, but for Belarus the share of solar energy will remain virtually unseen within the timeframe in question.

The main solar energy applications shall be solar water heaters and various solar dryers and heaters for agriculture and household purposes. Under favorable economic and production conditions, within the timeframe in question, solar energy can potentially replace organic fuels of about 5,000 thousand tons equivalent fuel a year.

Municipal Waste

The potential energy contained in solid waste, which is accumulated on the territory of Belarus, is equal to 470,000 thousand tons equivalent fuel. The bioprocessing of solid waste for gas extraction has the efficiency of no more than 20-25%, which is equivalent to 100,000-120,000 thousand tons equivalent fuel. Another aggravating factor is the existence of old landfills in all the major cities, which have

little room left for the incoming wastes. In the regional capitals annual conversion of solid waste would generate 50,000 thousand tons equivalent fuel of biogas, and up to 30,000 thousand tons equivalent fuel for Minsk alone. Efficiency of this technology is manifested not only in the amount of generated biogas, but also in the environment rehabilitation factor, which in this case would be decisive.

Phytomass

The phytomass of fast-growing plants and trees, which is considered to be a regularly renewable energy source, can be used as a feedstock for production of liquid and gaseous fuels. Under the climactic conditions of the country, one hectare of energy plantation can yield up to 10 tons of dry matter, which is equivalent to about thousand tons equivalent fuel. It is more reasonable to cultivate the raw material on depleted peat-lands. At present a program on cultivation of fast-growing plant species on depleted peat-land is being implemented. The program is to be completed in 2008.

Crop Residues

Using arable farming wastes as fuel is quite a new area in power generation policy in Belarus. Unlike countries that have gained some experience using them for this purpose such as Belgium and the Scandinavian states, Belarus has no experience at all. Plant residues in Belarus have total potential fuel capacity estimated at 1.46 million tons equivalent fuel per year. Decisions as to what amounts of these could be reasonably used as fuel should be decided on a farm to farm basis. The likely amount of plant residues to be put to use as fuel is estimated at 20-30 thousand tons equivalent fuel.

Waste Heat Energy Resources

The actual waste heat energy consumption amounts to 4.9 Gcal per year in 2006, and it is expected that it will grow up to 5.9 million Gcal per year by 2010. The biggest waste energy output (about 96.5%) is produced by the enterprises of the Belneftekhim Concern. The same is true for the entities of the Ministry of Construction and Architecture, and the Ministry of Industry.

With the required amount of financing of about 70 million USD, the use of waste energy can be enhanced by 2010 through installation of heat-recovery systems:

- high-potential systems equivalent to about 200,000 thousand tons equivalent fuel;
- medium- and low-potential systems equivalent to about 60,000 thousand tons equivalent fuel.

The main sources of waste heat energy are:

- Open Joint Stock Company GrodnoAzot;
- the Gomel Chemical Factory (sulphuric acid plants);
- Petrochemical Enterprise Naftan (including its hydrogen production facilities that generate significant amounts of waste heat energy);
- open joint-stock company Mozyr Oil Refinery.

The predicted increase in the use of waste heat energy can be ensured only if the long-term quantitative plans for oil refining and production of mineral fertilizers are fulfilled. Projected reduction in the greenhouse gas emissions through the use of renewable sources of energy is given below (Table 4.12):

Table 4.12 - Projected Reduction in the Greenhouse Gas Emissions through the Use of Renewable Sources of Energy, tons

Renewable Source of Energy	CO_2	CH_4	N_2O	NO_x	CO	SO_2	NMVOC
Water energy	393 821.3	23.5	2.4	3 528.8	469.6	1 085.8	117.4
Turbine expanders	94 517.1	5.6	0.6	846.9	112.7	260.6	28.2
Wind-driven power plants	4 185.5	0.2	0.0	37.5	5.0	11.5	1.2
Biogas	256 895.8	15.3	1.6	2 301.9	306.3	708.3	76.6
Solar energy	10 115.3	0.6	0.1	90.6	12.1	27.9	3.0

Municipal waste	160 559.9	9.6	1.0	1 438.7	191.4	442.7	47.9
Phytomass and wood waste	3 692 877.6	220.2	22.6	33 089.9	4 403.2	10 181.6	1 100.8
Crop residues	40 140.0	2.4	0.2	359.7	47.9	110.7	12.0
Waste heat resources	1 353 519.9	80.7	8.3	12 128.2	1 613.9	3 731.8	403.5
Total	6 006 632.4	358.1	36.7	53 822.2	7 162.0	16 560.9	1 790.5

4.2.8 Conversion of Boiler-Houses into Small Cogeneration Plants (CHPs)

The program of conversion of boiler plants into small CHPs aims at increasing the percentage of co-generated heat and electric energy in the country through more efficient utilization of fuels and provides for installation of gas-operated piston, gas turbine and steam power plants in boiler houses.

The Program focuses on the following:

- Enhancement of the efficiency of fuel and energy resources and creation of condition for switching the economy to more energy-efficient course of development.
- Increase in the generation of electric energy with specific fuel consumption of 150180 g equivalent fuel per kWh;
- Reduction in losses and waste of energy resources in transport through optimizing the operational modes of boiler plants, heat and electrical networks and elimination of long-distance heat lines.

Below are figures on annual fuel savings resulting from commissioning of small CHPs by responsible organizations (Table 4.13):

Table 4.13 – Fuel Saving from Introduction of Small CHPs

Responsible Organization	**Fuel Saving (tons equivalent fuel)**			
	2007	**2008**	**2009**	**2010**
Ministry of Energy (Minenergo)	0	25800	0	3905
Ministry of Construction and Architecture (Minstroiarhitektury)	5340	1850	1900	0
Ministry of Industry (Minprom)	2500	6051	0	0
Ministry of Transport (Mintrans)	0	222.7	0	0
«Belgospischeprom» Concern	560	800	340	0
«Bellegprom» Concern	0	600	600	0
«Belneftekhim» Concern	0	1570	0	0
«Bellesbumprom» Concern	5720	720.5	0	0
Ministry of Municipal Housing Economy (Minzhilkomhoz)	4791	12672	18597	42016

Emergency Control Ministry	0	0	830	0
Total	18911	50286.2	22267	45921
Total for the period	137385.2			

Ecological effect from introduction of small CHPs has been calculated both with account of the fuel balance and for the entire period of report. The estimates of GHG emissions reduction resulting from implementation of the program on conversion of boiler plants into small CHPs are summarized in Table 4.14:

Table 4.14 – Estimated Reduction of GHG Emissions, tons

Executant	CO_2	CH_4	N_2O	NOx	CO	SO_2	NMVOC
Ministry of Energy (Minenergo)	47 694.3	2.8	0.3	427.4	56.9	131.5	14.2
Ministry of Construction and Archinecture (Minstroiarhitektury)	14 594.9	0.9	0.1	130.8	17.4	40.2	4.4
Ministry of Industry (Minprom)	13 729.5	0.8	0.1	123.0	16.4	37.9	4.1
Ministry of Transport (Mintrans)	357.6	0.0	0.0	3.2	0.4	1.0	0.1
«Belgospischeprom» Concern	2 729.5	0.2	0.0	24.5	3.3	7.5	0.8
«Bellegprom» Concern	1 926.7	0.1	0.0	17.3	2.3	5.3	0.6
«Belneftekhim» Concern	2 520.8	0.2	0.0	22.6	3.0	7.0	0.8
«Bellesbumprom» Concern	10 340.9	0.6	0.1	92.7	12.3	28.5	3.1
Ministry of Municipal Housing Economy (Minzhilkomhoz)	125 358.7	7.5	0.8	1 123.3	149.5	345.6	37.4
Emergency Control Ministry	1 332.6	0.1	0.0	11.9	1.6	3.7	0.4
Total	220 585.5	13.2	1.3	1 976.5	263.0	608.2	65.8

4.2.9 Assessment of Aggregate Effects of Policies and Measures

The resulting projections of greenhouse gas emissions with and without various scenarios are presented in Figure 4.11.

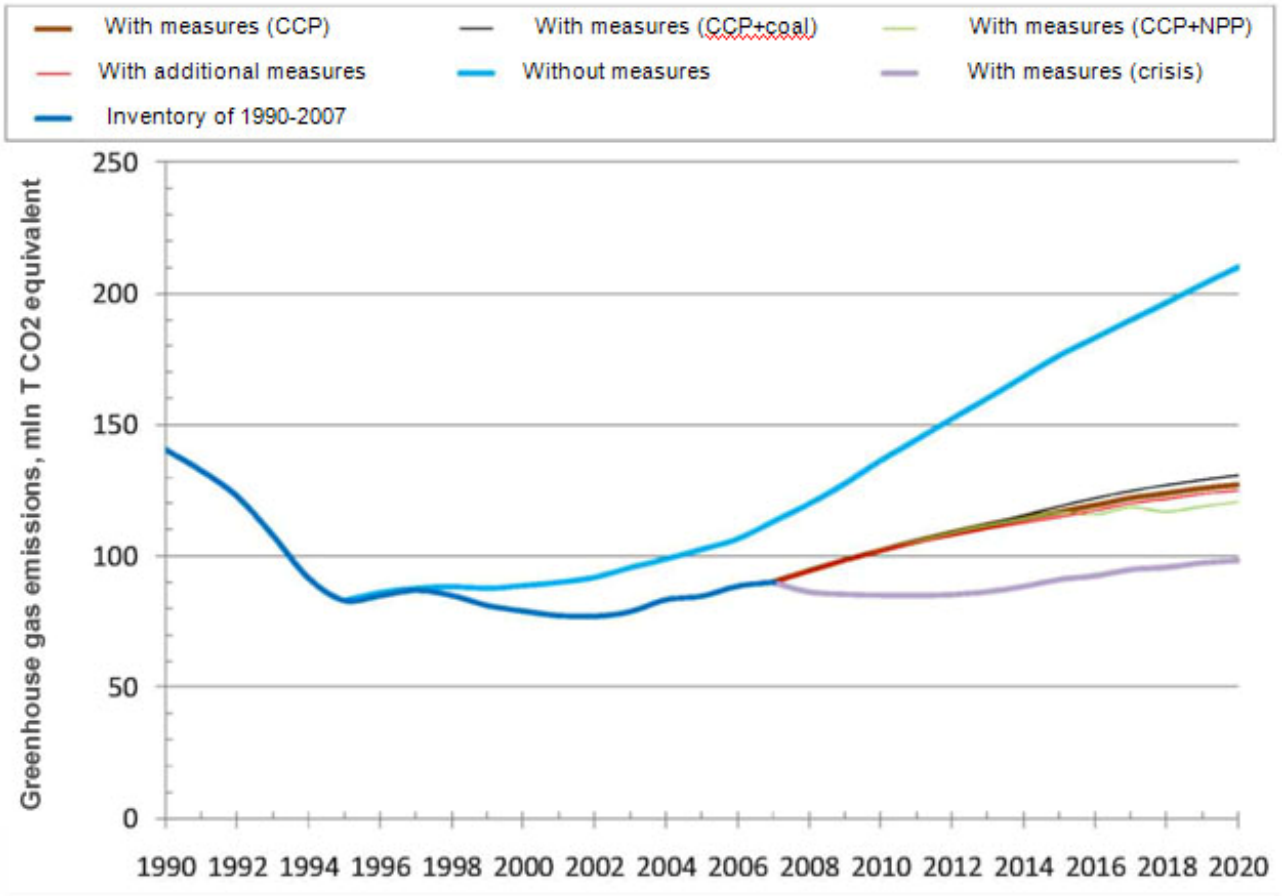


Figure 4.11 – Projection of aggregate GHG emissions for various scenarios

Based on the analysis of the diagram in Figure 4.11, we may state that policies and measures applied by the Government for reduction of greenhouse gas emissions are significant and efficient considering the national circumstances and the existing barriers. The total effect of special measures is estimated as 138 million tons CO_2 equivalent for the period from 1995 to 2007 inclusive compared with the baseline scenario without special measures. It is expected that the difference between the baseline scenario and a scenario with planned policies and measures of «CCP» type will amount to sequestered GHG emissions of 695 million tons CO_2 equivalent from 2008 to 2020 inclusive. The difference in emissions between the scenario with additional measures and the scenario with planned measures (the «CCP» type) will only amount to 17 695 million tons CO_2 equivalent of sequestered emissions for 13 years from 2008 to 2020 inclusive. This difference would be expected considering the already mentioned barriers in transfer of

new technologies and a relatively low network emission factor due to a high proportion of natural gas in the fuel and energy balance.

From the projections made so far it is evident that GHG emissions under the scenario with the planned measures and policies of the CCP type will be at least 90% by 2020 compared with the GHG emissions of 1990. The situation is not any better under the scenario with additional measures - with the scenario implemented emissions will amount to only 89% of 1990. The most favorable scenario for the country is the one accounting of financial and economic crisis as it provides for reduction of emission by 30% to 2020 compared with the level of 1990.

4.3 Assessment Methodology

LEAP Model

The top-down methodology was used for emission projections for the period up to 2020. The said methodology covers all greenhouse gases and all sectors represented in the inventory. The LEAP model was chosen for obtaining emission projections for the Energy sector and expert estimation for other sectors.

For obtaining emission projections and estimating the common policy and measures for Energy sector, the LEAP model developed by the Stockholm Environment Institute, Boston, was used. The LEAP model is a strategic planning program that falls in the category of E3 models (Economy-Energy-Ecology). It is based on simulation of scenarios that make it possible to thoroughly examine energy consumption, transformation and generation in any economy under various assumptions as to the rate of increase in population, economy and prices on various fuels both in the medium- and long-term run. Moreover, the LEAP model makes it possible to simulate fuel chains, the entire energy system and its impact on the environment.

Thus the LEAP model may be used to attain the following planning targets:

- A long-term emission projection;
- An energy policy analysis;
- An ecological policy analysis; and
- An analysis of complete energy chains.

The LEAP model is a convenient and descriptive tool for estimating various alternatives of fuel and energy balance variation as well as a set of policies and measures for implementation of various energy-efficient technologies and reduction of greenhouse gas emissions.

The LEAP model was used for more than 100 researches in more than 30 countries across the world for different purposes both for economical and ecological estimation of energy strategies and for global research in the field of energy and climate change.

5 VULNERABILITY AND ADAPTATION

5.1 Climate Impact on the Agricultural Crops Yield

The change dynamics of the yield capacity of agricultural crops reflects trends typical of agricultural machinery development and climate-related yield capacity fluctuations. Assessment of the above fluctuations resulting from the type of machinery used and depending on the territorial differences of the country is given in tables 5.1 – 5.2.

Table 5.1 – Territorial Differentiation of the Indices of the Grain-Crops Yield Capacity Fluctuations in the Republic of Belarus

Region	Winter Wheat		Winter Rye		Spring Barley		Oats	
	σ_a^2/σ^2	σ_m^2/σ^2	σ_a^2/σ^2	σ_m^2/σ^2	σ_a^2/σ^2	σ_m^2/σ^2	σ_a^2/σ^2	σ_m^2/σ^2
Brest	0,72	0,28	0,73	0,27	0,66	0,34	0,68	0,32
Vitebsk	0,52	0,48	0,57	0,43	0,28	0,72	0,37	0,63
Gomel	0,58	0,42	0,58	0,42	0,48	0,52	0,53	0,47
Grodno	0,77	0,23	0,76	0,24	0,72	0,28	0,74	0,26
Minsk	0,72	0,28	0,72	0,28	0,60	0,40	0,60	0,40
Mogilev	0,60	0,40	0,62	0,38	0,46	0,54	0,53	0,47
Belarus	**0,74**	**0,26**	**0,68**	**0,32**	**0,60**	**0,40**	**0,61**	**0,39**

*σ_m - climatic changeability of the yield capacity of agricultural crops (metric centner/hectare);
σ_a - yield capacity changeability (metric centner/hectare) resulting from the land cultivation mode;
σ- general changeability of the yield capacity (metric centner/hectare) for the years of 1960-2005.

Table 5.2 – Territorial Differentiation of Indices of the Yield Capacity Changeability of Spinning Flax and Tilled Crops in the Republic of Belarus

Region	Potatoes		Sugar-Beet		Spinning Flax		Maize for Silage	
	σ_a^2/σ^2	σ_m^2/σ^2	σ_a^2/σ^2	σ_m^2/σ^2	σ_a^2/σ^2	σ_m^2/σ^2	σ_a^2/σ^2	σ_m^2/σ^2
Brest	0,51	0,49	0,55	0,45	0,64	0,36	0,49	0,51
Vitebsk	0,36	0,64	-	-	0,35	0,65	0,29	0,71
Gomel	0,45	0,55	-	-	0,52	0,48	0,60	0,40
Grodno	0,63	0,37	0,65	0,35	0,55	0,45	0,67	0,33
Minsk	0,45	0,55	0,48	0,52	0,37	0,63	0,41	0,59
Mogilev	0,51	0,49	-	-	0,25	0,75	0,55	0,45
Belarus	**0,53**	**0,47**	**0,61**	**0,39**	**0,31**	**0,69**	**0,58**	**0,42**

The tables show that the index of the impact produced by climatic factors on the changeability of winter and spring agricultural crops, potatoes, and maize for silage acquires its maximum meaning (43-72%) in the northern part of Belarus and is of its minimum meaning (23-34%) in the country's western parts, in the Grodno region in particular. It is also seen from the tables that the proportion of weather-climatic

conditions among those other factors influencing the formation of general dispersion of the yield capacity of spinning flax is high in the eastern, northern, and central parts of Belarus (63-67%) and tends to be reduced in the Brest region (to 36%).

There may appear quantitative differences regarding the impact of the climatic conditions on the changeability of the yield capacity of crops depending on the high or low level of bonitet of arable lands. The indicator of the impact produced by the weather-climatic conditions on the fluctuations of the yield capacity of winter barley and spring grain-crops reaches 14-17% on fertile soil.

Thus, it becomes evident that the yield capacity of the major agricultural crops is determined by climatic changes, the capacity of agricultural machinery used (the land cultivation mode applied), and bonitet of arable lands. High-level land cultivation and, at the mean, high soil bonitet both reduce the impact of climatic conditions on the yield capacity fluctuations. The above is evidenced well by the situation in the agricultural production of the Grodno region.

Analysis of the Impact Produced by Different Factors on the Formation of the Yield Capacity of Agricultural Crops

The assessment of the above impact on the total yield of certain grains in all types of farming of the Republic of Belarus for 1997-2006 (in thousand tons) is given in table 5.3 (the data provided by V.V. Kolyada). In accordance with the related official statistics the total grain yield in 1996 in all types of farming amounted to 5791,7 thousand tons and already in 2006 it reached 5924,3 thousand tons; in other words, the increase in the total grain yield made 132,6 thousand tons. In the calculations including 9 crops and covering from 99,5 to 99,9 per cent of the areas under grain and leguminous crops at different times within the given period of time the above indicator was equivalent to 97,7 thousand tons. The major factor contributing to the increase in the total grain yield was agricultural machinery improvement which highly-positive contribution, however, was minimized due to the negative impact of the weather-climatic conditions and the reduction of cultivation areas. On the other hand, the negative effect of the latter factor was reduced due to the improvement of the structure of these cultivation areas, and, first and foremost, due to the increase in the areas under such crops as wheat, triticale, and maize.

It is necessary to underline that the role of agricultural machinery became noticeable at the beginning of the 21st century, which quantity increase occurred against some reduction in the number of cultivation areas and constant enhancement of the

structure of sowing because of the increase in the number of areas under wheat, maize, and millet.

Table 5.3 – Assessment of the Impact of the Factors on the Increase in Gross Harvest with Regard to Certain Grain-Crops in All Types of Farming of the Republic of Belarus for 1997 – 2006, in thousand tons.

Crop	Factor			
	Agricultural Machinery	Weather Conditions	Cultivation Areas	All in All
Winter wheat	188,2	-53,5	-62,8	72,0
Spring wheat	193,8	152,7	344,1	385,2
Spring rye	105,1	-65,8	-761,6	-722,3
Triticale	73,5	-174,1	913,4	812,8
Spring barley	606,1	-452,4	-515,5	-361,7
Oats	163,2	-122,0	-192,6	-151,4
Buckwheat	1,7	-9,1	-5,4	-12,9
Leguminous crops	90,1	-180,9	19,7	-71,1
Maize	41,0	-19,6	125,8	147,1
Total	1462,7	-1229,9	-135,0*	97,7

* for all (grain and leguminous crops) the assessment of the role of cultivation areas constitutes an algebraic sum of the impacting factors (-511,3 thousand tons) and the structure (376,2 thousand tons) of the whole number of cultivation areas.

5.2 Vulnerability Assessment and Measures of Agriculture Adaptation

What makes the development of agriculture specific is its evident dependence on climatic conditions. Assessment of the climatic impact on agriculture becomes, therefore, particularly necessary due to current climatic changes, and forms the basis of working out measures aimed at maintaining the ecological and food security of Belarus.

Examination of this climatic impact requires that natural climatic changes, including their anthropogenic component, be studied, their quantitative parameters and threshold meanings be established, possible scenarios of future climatic changes be considered, the vulnerability of this particular branch and the range of the needed possible economic adaptation be determined in order to take appropriate economic and political steps and to take appropriate decisions.

With regard to the climatic conditions of the Republic of Belarus 14 the most dangerous natural phenomena for its agriculture have been identified: rainless and rainy periods, high and low temperatures, drought, frost, thaw, icy cover, unfavourable autumn-summer conditions, heavy rain, thunderstorm, tornado, squall, and the so-called double-nuclear winters typical of the last decade.

5.2.1 Climate-Dependent Variability of Yield

The greatest weather impact is produced on agricultural crops during their vegetative period. Main losses of winter grain crops as well as of vegetable and horticultural crops occur under the influence of abnormal weather conditions of transition periods. The most devastating effect is produced by adverse winter conditions resulting in the full or partial perish of winter grain crops.

Climatic-related changeability of the region-dependent yield capacity makes 10--38% for spring barley, 9-28% for winter rye, 10-32% for potatoes. In the mean, relative changeability of the yield capacity of the above- mentioned crops arisen out of climatic conditions constitutes 20%, 15,3%, and 16,4%, respectively. The said climatic dependence increases in the eastern and southern-eastern directions. It is not so considerable on lands characterized as light-textured in accordance with their mechanical structure, and is the most considerable for oats. Evidenced negative correlation of climatic changeability with soil acidity and the degree of availability of flexible forms of phosphorus in it for barley, the degree of availability of flexible forms of phosphorus and potassium for winter rye and potatoes clearly indicates that there is a possibility of raising their yield capacity at the expense of optimization of the appropriate agrochemical parameters.

During the autumn vegetative period the influence of precipitation on the yield capacity of winter rye and the efficiency of mineral fertilizers approaches the line indicator for heavy-textured soil and differs substantially from that for soft-textured soil. The heaviest impact of precipitation on the yield capacity is registered in September. Its increase in September by 60mm raises the yield capacity of winter rye by 4,2-4,8 metric centner/hectare without recourse to fertilizers and by 4,3-11,0 metric centner/hectare when the dose of fertilizers used is $N_{60}P_{60}K_{60}$. Recoupment of fertilizers for loam and sandy loam soil and for soil bedded with moraine loam increases by 1,5-2 times. In case of poor sandy soil the increase in the yield capacity is the same, and fertilizer recoupment does not change whatever the precipitation quantity is. Contrariwise,

precipitation deficiency in September causes reduction in the yield capacity to 5-10 metric centner/hectare and decrease of the efficiency of mineral fertilizers.

The growing quantity of precipitation in October-November leads to the reduction of the yield capacity due to fertilizers, particularly nitrogen fertilizers, washed away, which becomes very noticeable in case of light-textured soil.

Standard precipitation fall-out (50-70mm) is optimum, taking into account considerable stocks of spring moisture; their increase leads to the yield capacity decrease, particularly in case of loam soil. But in June when stocks of moisture are exhausted the situation changes radically. Thus, excess of the monthly precipitation rate (70- 80mm) up to 110mm causes an inconsiderable rise of the yield capacity and the efficiency of fertilizers.

The results obtained make it possible to draw conclusions on the changeability tendency characteristic of the yield capacity of agricultural crops in Belarus against possible climatic changes; they emphasize the importance and the necessity of taking account of the impact produced by changing agroclimatic conditions. While doing this, it is expedient that all the existing circumstances be registered.

At present the heaviest losses in agriculture are met with in connection with the impact of some dangerous natural phenomena such as drought, frost, heavy shower, hail, etc. There are grounds to suggest that because of the growth of the average annual air temperature the reoccurrence of extreme levels of warmth and humidity will increase and this will most negatively tell upon the development of agricultural crops. Reduction of the yield capacity of major agricultural crops due to adverse weather conditions can predictably reach 50-60%, and in some years even more than that. Drought will lead to a most significant decrease of the yield capacity (particularly that of spring grain crops).

Because reoccurrence of warm winters over the last years has led to essential changes in the conditions of winter crops passing the winter, the likelihood of their being damaged through their getting oversoaked, rotted, and vulnerable to snow mould will increase.

In order to keep account of changing climatic conditions in agriculture it is primarily necessary to carry out research into the way extreme climatic parameters change and the impact the said changes may produce on agricultural production. Special attention should be paid to drought consequences, reoccurring most often and producing a negative impact on the yield capacity of grain crops (to 70% of loss). Research into the conditions of winter crops, grass, and fruit crops passing abnormally warm winters

is to be carried out; agroclimatic substantiation of the sowing time for spring crops under the conditions of abnormally early spring processes is to be elaborated.

5.2.2 Determination of Adaptation Options

In all cases of regulation whether it is passive, reactive, or pre-emptive regulation adaption will be necessitated both by negative and positive effects of climatic change. Autonomous regulation will be playing a particularly important role, perceived as a natural and immediate response to trend (background) changes. More radical action is necessary with regard to climatic changes resulted from intensive development of different types of large-scale atmospheric circulation producing extreme climatic phenomena. Depending on the level of spontaneity there may be distinguished put-in (physiological), standard (normal practice of reacting to climatic change), and tactical (certain measures to be taken in anticipation of a certain climatic change) regulation.

Structurally assessment of strategies of adaptation to climatic change is based on a number of coordinated goals and assessment principles. Among the most general goals one can mention those of contributing to constant development and reducing the level of vulnerability. They are to be further specified in each of the tasks set. To identify the most significant climatic impacts means to determine their positive and negative effects which process then leads to choosing adaptation methods with these effects in mind. In order to establish units of impact in a risky situation arisen out of climatic changes the level of vulnerability is to be assessed. The vulnerability level is taken to mean such a level of it at which a unit of impact breaks off or changes unfavourably. Vulnerable systems, activities, and regions (districts) are subject to planned adaptation.

Adaptation activities also include such procedures as examination of restrictions, determination of quantitative measures, formulation of alternative strategies, deciding upon tasks, evaluation of increment, and measures recommended to be taken.

The national system of adaptation to climatic change and development as well as to natural and industrial catastrophes and hazards has been established and has been functioning effectively over recent years. In the conditions of a moderately continental (transitional) climatic type adaptation to climatic change is carried out with the help of autonomous regulation levers at the levels of put-in, standard and tactical reaction of the agricultural branch to weather changes and particularly dangerous phenomena. The above activities are to a large extent regulated by normative acts.

Response to those climatic changes which may be perceived by the country as relatively favourable is unlikely to be beyond the framework of autonomous regulation, at least, in the nearest future.

Adaptation of Agricultural Production to Climatic Change

Listed above the major agroclimatic parameters require that appropriate systematic measures aimed at adapting agricultural production be worked out. These measures must be based on related research and investigation supported by the country's government. Indeed, a brand new strategy of agricultural production should be elaborated, the one that will take into account the new agroclimatic conditions.

Increasing duration and heat supply of the vegetative period will open up new perspectives for Belarus which are as follows:

- Cultivation of more high-yield late-ripening grain and vegetable crops;
- Shift in the sowing-time of spring crops to earlier periods which will make it possible to more effectively use moisture stocks getting accumulated in soil after snow-melting, will allow for these crops earlier ripening, and will provide broader opportunities for stubble-field agriculture (however, it will be necessary to take into account the risk of May frosts; the said crops, therefore, are to be frost-resistant);
- Extension to the North of the zone of cultivating heatloving vegetable crops such as onions and tomatoes;
- Extension of areas under spring rape.

In connection with drought becoming stronger it is necessary to:

- Improve work aimed at breeding new varieties of drought-resistant crops;
- Extend areas of irrigative and watering agriculture;
- Cultivate a greater number of drought-resistant crops;
- Develop the system of insurance against drought and its consequences;
- Extend sowing areas under maize.

Warmer winters will result in creating more favourable conditions for pests and agents of plant diseases to survive through them; warmer winters will also increase the growth of weed. All this will require the development of new measures of protection against weeds, agents of diseases, and pests.

In connection with the above, a lot of attention is attached to training and retraining of cadres. It is recommended that training programmes should cover studying of technologies of breeding new, non-traditional crops, effective use of fertilizers under new conditions, with a still greater focus concentrated on agrometeorological measures. An increasing changeability of weather and climatic conditions calls for the leader of any agricultural enterprise to independently make decisions on the best optimized time of carrying out agricultural work.

Possible rise in temperature entailing changes in the territorial dissemination of precipitation will necessitate reconsideration of the system of cadastral evaluation of lands as the agroclimatic conditions of the Vitebsk region will improve noticeably due to the above factor as well as to decreasing moistening of medium-textured and heavy-textured soil. The said climatic processes, on the other hand, will deteriorate the situation in Polesie particularly affecting its irrigated lands and sandy soil. On the whole, a considerable restructuring of the country's agricultural areas and arable lands will urgently be required. It is quite possible that the arable areas in southern Belarus will diminish in their size, with this process embracing both dominant mineral-enriched light-textured soil and irrigated pit lands. With the above borne in mind, large-scale arrangements to adapt the agricultural sector to climatic change will be urged.

5.2.3 Changes in Irrigated Agriculture

An unstable regime of natural moistening as well as rainless and drought periods that occur in Belarus from time to time dictate the hydrometeorologically substantiated necessity to water lands. In Belarus rainless periods from April to October occur annually. They are particularly dangerous for light-textured mineral-enriched lands in spring and summer. The total amount of rainless days during the vegetative period constitutes 58 days. 83% of rainless days are characterized by a rise in air temperature which may lead to atmospheric and soil drought. Provided high-quality agricultural machinery is exploited and watering is well arranged for the process of watering may be quite efficient. The yield capacity then may fluctuate from 10% to 100% depending on the level of moistening and the state of the machinery exploited. Under the circumstances described the time of capital investments recoupment reduces considerably in comparison with the normative index. The above refers, first and foremost, to the ability of obtaining high and stable vegetable, grass, and fruit harvests.

Grain crops watering will prove to be profitable in case the volume of stubble-field agriculture will increase.

In Belarus the sum total of precipitation fall-out has been decreased recently, with the said process becoming typical of southern Belarus. In accordance with the calculations of the Central Research Institute of Complex Water Resources Use, the process of watering may come into conflict with warmer weather conditions. First, the soil watering process may be hindered, entailing a larger degree of evaporation and, consequently, a lesser moistening effect. The water regulating capacity of reclaimed lands will be reduced. Second, the quantity of water in water sources used for forced delivery of water to fields may be also lessened. Arrangements aimed at regulating water flow, delivering water from outside sources, using drained water repetitively are seen as necessary for water supply of watering and watering-irrigating systems.

The above tendencies may produce a negative impact on the growth conditions of different crops, mainly early spring crops growing on light-textured mineral-enriched lands typical of the Brest and Gomel regions. Polesie may be endangered of being turned into the «zone of risky agriculture».

Alongside, watering equipment needs improving; the useful life period of the majority of irrigation-watering systems in the country has already been over and calls for reconstruction. Anticipated future climatic conditions most likely to establish, with air temperature being increased and the sum total of precipitation fall-out in the south of the country being decreased, dictate the necessity of considerable capital investments being placed into further development of agricultural watering, a more effective policy in the sphere of water provision and water supply being carried out, and irrigation-watering reclamation arrangements being improved. It should be stressed that precipitation fall-out has increased recently on a larger territory of the country, though such increase is not at all typical of the second half of the year.

5.2.4 Adaptation of Agricultural Machinery and Technology

The major goals with regard to adaptation of agricultural machinery and technology are as follows:

- Studying the impact of agrometeorological factors on the state, capacity and quality performance of agricultural machinery;

- Studying the impact of the above on sets as well as on their separate units and parts while producing new machines and tools in order to better select new materials to be further used for their design and technology;
- Studying issues related to their safety, construction of the optimum quantity of garages and roofs in regions with different weather conditions;
- Studying the effect produced by agrometeorological factors on anticorrosion cover and methods of protection of agricultural machinery and tools;
- Regulating the use of fuels and lubricants depending on agrometeorological conditions;
- Executing special statistical processing of information on climatic conditions for the purpose of identifying regions and areas categorized as homogeneous from the angle of weather and climatic conditions;
- Elaborating methods of evaluation and prognosis of agrometeorological conditions for carrying out major agricultural works (ploughing, sowing, planting, harvesting, etc.).

Effective use and improvement of agricultural machinery can hardly be possible without a detailed and a full evaluation of the impact produced by the agrometeorological conditions on the state of the machinery, their capacity and quality of work. Climatic trends and large-scale anomalies will require a quicker adaptation of agricultural machinery and technologies used for growing crops.

5.2.5 Perspective Sizes of Sowing Territories

In accordance with the estimates prepared by the Belarusian Scientific Research Institute of Agrarian Economy (BelSRIAE), the Republic of Belarus is able to supply herself with food, fodder, and technical grain provided grain and leguminous crops are sown in all types of farming, with the total cultivation areas amounting to 3-3,1mln hectares, those of agricultural enterprises making 2,6-2,7mln hectares, the yield constituting 48-50 and 50-52 centner/hectare per plough-land, respectively. The size of areas under certain crops in agricultural enterprises has been substantiated economically and is as follows: winter rye – 730-750 thousand hectares, winter wheat – 250-280 thousand hectares, spring wheat – 100-120 thousand hectares, barley intended for

different purposes – 700 thousand hectares, oats – not more than 300 thousand hectares, triticale (mainly winter triticale) – 100110 thousand hectares, buckwheat – 45-50 thousand hectares, leguminous crops – 350-400 thousand hectares. The problem of grain supply may be settled through cultivating early-ripening varieties of maize, with the yield capacity constituting 40-50 centner/hectare of grain. Belarus needs 300-400 thousand tons of fodder grain and 75-100 thousand tons of seed. To get the required amount the areas under grain corn should be extended to 100 thousand hectares.

To meet the needs of the country's textile industry for flax and to enable the country to export it in the required amounts areas under spinning flax should be extended to 110-120 thousand hectares, with the yield capacity of flax fibre making 10-12 centner/hectare. Getting stable yields of sugar-beet edible roots of 300-350 centner/hectare, with sugar-beet cultivation areas reduced to 50 thousand hectares, will enable sugar plants to meet their requirements for raw materials and will ensure their production capacity rise by 10-15%. To satisfy the needs for oil plants roughage it will be necessary to extend areas under rape to 100 thousand hectares, with the yield capacity amounting to 15-20 centner/hectare of seed.

Taking into account a growing market demand for potatoes in large cities and industrial centres of Russia and other CIS countries, it is economically expedient that areas under potatoes be extended to 120-130 thousand hectares, with the average yield capacity reaching 200-220 centner/hectare.

It is planned to allot 2100-2200 thousand hectares of arable lands to fodder crops (except for fodder grain), 100 thousand hectares – to root vegetables, 250 thousand hectares – to maize for silage and fodder grass, 550 thousand hectares – to annual grass and silage crops (excluding maize for silage), 1200-1300 thousand hectares – to perennial grass.

It is the Institute of Issues Related to the Use of Natural Resources and Ecology of the National Academy of Sciences of the Republic of Belarus headed by Academician V.F. Loginov which started elaborating climate-adaptation measures. At present a state climatic programme being developed in the Republic of Belarus the draft of which included four large blocks:

- Subprogramme of monitoring climatic changes providing for optimization of the existing surveillance net and its extension through sources and flows of green gases, natural and anthropogenic aerosols; foundation of the system of managing climatic data;

- Subprogramme of investigating climatic changes, covering issues related to the way anthropogenic activity influences the climate, establishing a scientific basis for predicting climatic changes and extreme climatic occurrences, elaborating methods intended for evaluating the impact produced by climatic conditions on different industries of economy and the sphere of life-activity, etc.;
- Subprogramme of making knowledge on climate applicable in different industries of economy for these industries to efficiently adapt to climatic changes;
- Subprogramme of developing a State Strategy and a system of measures aiming to reduce anthropogenic influence on the climate.

Within the framework of Subprogramme 3 it is envisaged to develop a short-term strategy and such-like measures (embracing 5-10 years) as well as long-term ones (embracing 15-20 years) that will enable different industries of economy to get adapted to changing climatic conditions. Primary importance is to be attached to agriculture, and particularly, to its plant-growing industries.

In the Republic of Belarus the National Programme of Measures Aimed at Mitigating Climatic Change Consequences for 2008-2012 has been worked out which covers a number of arrangements to implement measures aiming to mitigate consequences of climatic changes anticipated to occur in 2009-2012. These measures are as follows:

- Development and execution of arrangements to adapt the country's agriculture to climatic change (2009-2012);
- Development of recommendations to adapt the country's forestry to climatic change (2009-2012);
- Management of water resources, protection of surface and underground waters, including water supply (2009-2012);
- Elaboration and implementation of arrangements to adapt the national economy industries to climatic change (2009-2010);
- Development of a specialized program (subprogram) of measures to adapt to climatic change (2011-2012).

Adoption of such preemptive measures will allow for improving the economy's resistance to climatic change, in particular, to unexpected changes of weather-climatic conditions; for preventing unnecessary losses and for rationally using advantages of favorable climatic change.

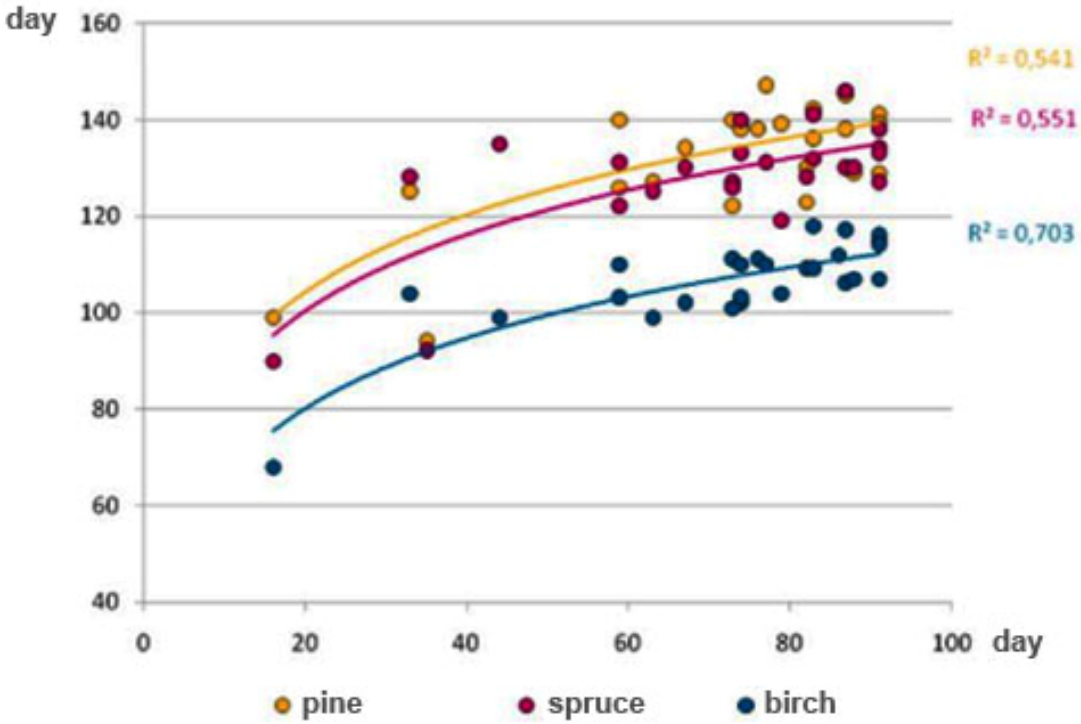
5.3 Climate Change Impact on Forestry

Sustainable change of climatic conditions directly or indirectly (through changes of the level of subsoil waters, fire, reproduction of forest pests and stimulation of woods diseases) leads to the changes in the composition and structure of cover crop.

The territory of Belarus is located along the border-line between the boreal zone and that of bread-leaved forests; one can find there the boundaries of areas occupied by three forest-forming kinds of wood – the spruce, the grey alder, and the hornbeam. One of the most unfavourable factors negatively influencing the forests is drought, the occurrence frequency of which as well as its intensity has increased recently. As a result, the boreal components of the cover crop get weakened and perish; the size of the taiga and the subtaiga zones is being reduced.

The process of the pine, birch, and spruce unfolding their leaf buds correlates closely with the stable dates of the average daily air temperatures reaching 0°C and rising above it (see picture 5.1).

Irrespective of the fact that the weather in February and March has become warmer after 1990, the dates of the average daily air temperatures reaching 0°C and rising above it have not changed considerably. Before the 1990ies the above-zero temperature established at the beginning of the third ten days of March, while after the 1990ies – at the beginning of the second ten days, though average indicators do not actually reflect the true situation.



Picture 5.1 – Dependence of the beginning of the process of unfolding leaf buds (axis of ordinates) on the dates of the average daily air temperatures reaching 0°C and rising above it (axis of abscissas).

Before 1989 the amplitude of fluctuations of the dates of the average daily air temperatures reaching 0°C and rising above it made 28 days, and since then it has increased to 75 days. The latest period remained the same – 91 days. The number of unusually warm days at the end of winter and at the beginning of spring has risen drastically.

In some years the average daily air temperatures reached 0°C and rose above it already at the end of January – February (1989, 1990, 1995, and 2002). In these years the average monthly air temperatures were above 0°C and the vegetative period of ligneous plants started earlier (almost a month earlier than the average monthly term).

On the one hand, the above contributes to the prolongation of the vegetative period and through this, to additional products. On the other hand, however, ligneous plants adapt themselves to suddenly changing environmental conditions quite slowly. Unexpected annual fluctuations of the temperature regime at the initial stage of the vegetative period actually produce a negative impact upon ligneous plants, weakening their resistance to external factors. Besides, an early beginning of the vegetative period raises sharply the possibility of newly-appeared shoots being damaged by spring frosts.

The time of the other phenophases of ligneous plants and bushes has also changed. Pines, spruces, birches, grey alders, black alders, hazels, and bird-cherries

started blossoming at earlier dates in certain years. There has also been observed a stable tendency of prolonging the term of the end of the fall of the grey alder's and the black alder's leaf.

Increase in the duration of the vegetative period in certain years makes 20-40 days more in comparison with the average indicator. Taking into account that this increase becomes possible due, first and foremost, to an earlier beginning of the vegetative period, in such years, provided there is enough moisture, one can expect the productivity of plantations to go up by 10-20% (see picture 5.2).

The fact that the weather has become warmer over the last two decades has destroyed the Northern agroclimatic zone (Melnik, Komarovskaya, 2007). The territory with the temperature above 10°C, with the total temperature sum making 2000°C, occupies now only the very northern region of Belarus (the Verchnedvinsky and the Rossonsky districts, the northern part of the Polotsk district and the Gorodoksky district). Earlier the said zone occupied the whole territory of the Vitebsk region and the northern part of the Minsk region. A new agroclimatic zone appeared in the south of Polesie (with the total temperature sum of 2600°C).

Change in the average yearly air temperature by 1°C (during the whole period) leads to the extension of the vegetative period by 10 days and the increase of the total temperature sum approximately by 200°C which fact may be regarded as a territorial shift along the latitudinal direction by 150-200km.

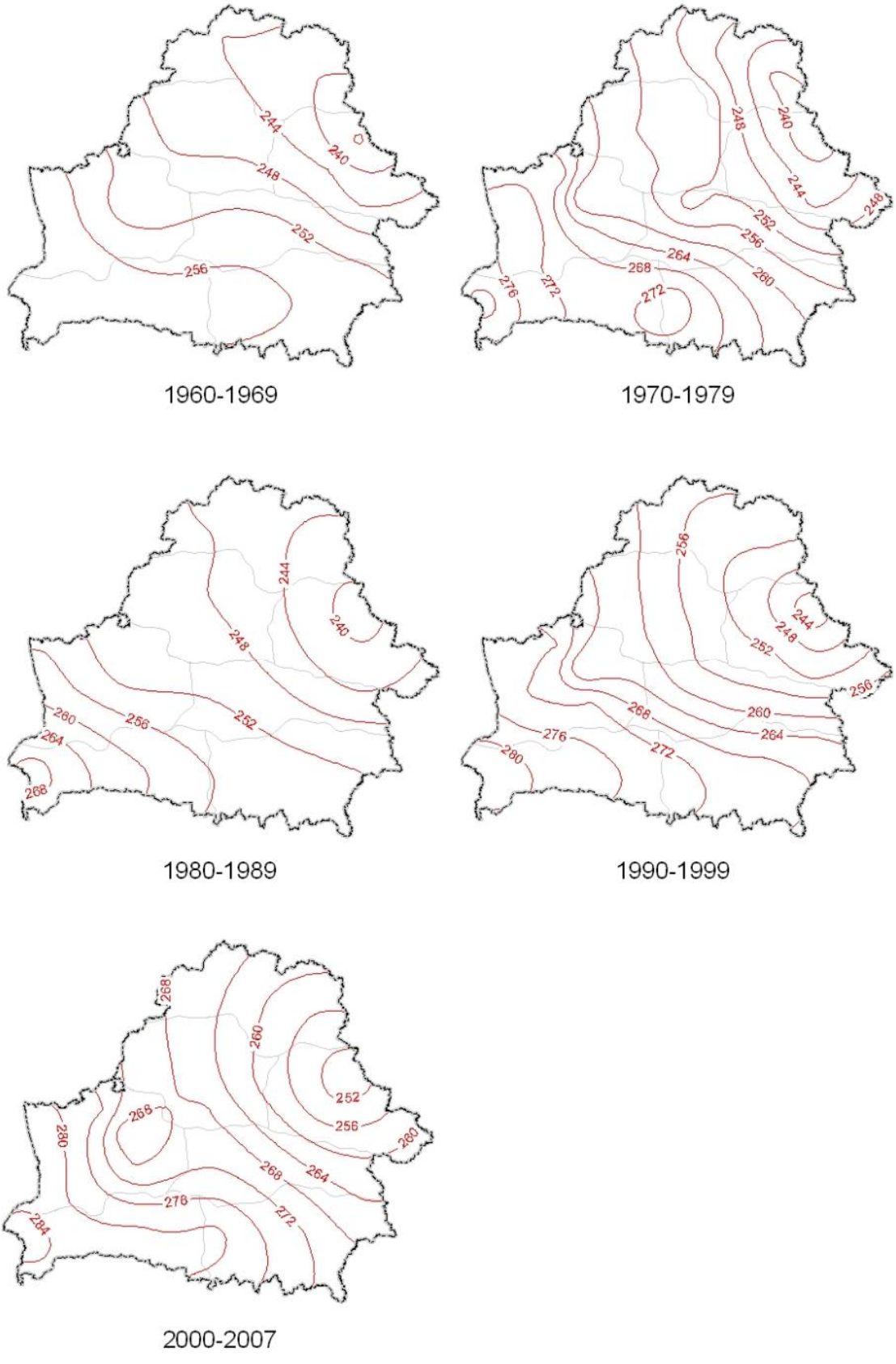
Accordingly, the duration of the vegetative period has also changed. In 2000-2007 its duration became 13-23 days longer than in 1960-1969. The most noticeable changes have occurred in the south-east of Belarus, while the least ones – in the east of the country. Simultaneously, the total temperature sum has gone up sharply. And though in the 1990ies the duration of the vegetative period was longer than in 2000-2007, the total temperature sum currently exceeds the said indicator for the previous ten years by 125-325°, and this is a very sharp rise. The described above made the isolines of the total temperature sum shift 200-250km to the north. At the same time the total temperature sums for the temperatures above 5°C and 10°C also changed within the specified period of time.

Such considerable redistribution of heat supply if it remains stable will inevitably produce a huge impact on the areas of spreading of both grasses and ligneous plants. The territory of Belarus embraces the zones of spreading of three forest-forming kinds

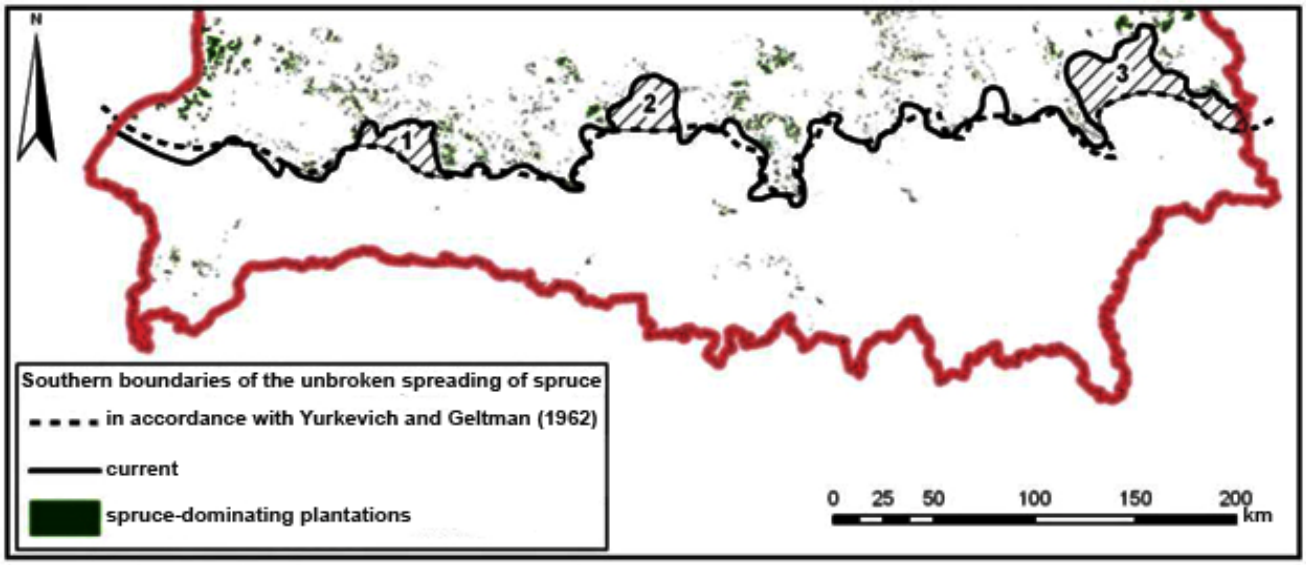
of wood – the European spruce, the European hornbeam, and the grey alder. Their spreading is directly linked to the degree of heat supply of the territory.

In Polesie where the total temperature sum of the temperature above10°C makes 2480° unbroken dispersal of the spruce is no longer registered (Geltman, 1982). Recently this isoline has shifted 250-300km to the north and actually passes along the boundaries of the subzone of oak-dark coniferous forests. If the above tendency continues the boundaries of the spruce-tree zone are expected to be shifted in the northern-eastern direction.

Overall reclamation of Polesie soil has already led to the shift of the said boundaries in some places 20-30km to the north in comparison with the 60ies of the previous century (see picture 5.2). Continuing rise of the average monthly temperatures increases the possibility of drought occurrence during the vegetative period, with the level of subsoil waters being reduced. As a result the spruce-tree area may be diminishing in its size. At the same time man-planted spruce-tree forests in Polesie covering the lands of standard moistening will constitute groups of risk as they will be the least resistant to shriveling up (picture 5.3).



Picture 5.2 – Isolines of the Duration of the Vegetative Period



Picture 5.3 – Change of the southern boundaries of the spruce unbroken spreading in Belarus (the shading and the figures in it show the largest territories where spruces no longer constitute part of the forest cover)

In Belarus the northern boundary of the hornbeam area and the southern boundary of the grey alder area come close to the isolines of the total temperature sum of the temperature above 10°C making 2200° (Geltman, 1982). In 2000-2007 the whole of Belarus was already reported to be located at the territory the heat supply of which was higher than the above threshold indicator. The tendency to change the boundaries of the areas of the said kinds of wood has become all too evident. But ligneous plants are known to have a long life cycle and are resistant enough to changing environmental conditions. To shift the boundaries of their areas, therefore, change in the heat supply of the region shall be continual within not just decades but centuries.

Grass vegetation contrary to woody vegetation is far quicker to respond to change. The state of it will more quickly and clearly reflect high-frequency fluctuations of exogenous factors, and to a considerable extent – those of the climatic conditions.

With regard to bottomland meadows the most considerable impact on them is produced by the duration of spring freshets and the quantity of precipitation. Long-time floods in combination with higher temperatures affect very favourably the varieties composition, structure, and productivity of cenoses. This is not to be the case with low temperatures. At the same time high air temperatures accompanied by a low degree of moistening lead to the degradation of the bottomland meadows cenoses.

Because of higher average monthly temperatures in January and February it is expected that snow cover will become thinner, the intensity of spring freshets will lower

down, and the dates of them will be shifted. In certain years floods may become even hardly noticeable due to gradual snow melting during the winter months. As a result degradation of bottomland meadows and their getting overrun with bushes and woody vegetation may become a reality, and the said process is already underway in the flood beds of some rivers.

Natural grass stands growing in dry valleys will to a larger degree depend on the quantity of atmospheric fall-out during their vegetative periods as in dry valleys moisture is not so easily retained and the process of soil drying up and getting warmed is more intensive. The above situation will entail a quicker xerophytization of cover crop.

However, with no haymaking and grazing the natural ecballium process under the said conditions will be followed first by the spread of bushes and then – by the recovery of woody vegetation. All this will most negatively affect meadows communities. The process of their getting overrun with bushes and woody vegetation will speed up leading finally to their total disappearance and to the appearance of forests as primary formations.

Vegetation communities on low ground marshes are particularly subject to being affected by late spring frosts. As a result plants themselves get damaged and in the future the growth of sedge and plant species diversities (first of all, of bogbean) may be slowed down. Bogbean becomes especially vulnerable to frosts in places distanced from water flows and characterized by a low or a thin upper layer, with bogbean constituting the major part of the biomass. Simultaneously, warmer climatic conditions accompanied by stable moistening increase the growth of grass vegetation, thus raising the productivity of meadows communities.

So, climatic factors become one of the most influential factors determining the growth of vegetation. Deviation of climatic change indicators (such as temperature, moistening, and lighting) from the norms immediately results in changes in the composition and productivity of communities irrespective of the influence of other (natural and anthropogenic) factors. Being aware of how plants react to changes, for example, in precipitation and temperature, it may be possible if not to repair then, at least, to reduce damage arisen out of unfavourable climatic conditions.

5.4 Assessment of Vulnerability and Measures of Forestry Adaptation

Results of some research work carried out in regions with natural-climatic characteristics similar to those of Belarus show that the overall impact of global melting on forestry is favourable. By 2050 the growth of standing timber is expected to be more than by 10%. Anyway, for Belarus such assessment is not to be that one-sided.

Climatic change and accompanying irrigation lead to the total reduction of the level of subsoil waters which fact tends to considerably influence the growth of standing timber, particularly in the areas of unstable subsoil waters supply. The same happens in perennial forests growing on low ground marshes. Black alder and ash forests in Polesie are degrading as a result of a large-scale reclamation further aggravated by precipitation shortages registered over a number of years during the 90ies of the last century. On the other hand, in forests growing on transition marshes the above may result in the increase of the productivity of pubescent birch standing timber, and may simultaneously lead to the standing timber being structurally improved due to economically more valuable kinds of wood such as the pine, the spruce, the oak, and the ash.

The cycle of substances in forest ecosystems increases, in particular, the rate of decomposition of forest falling and litter quickens. Theoretically, the above process may contribute to some increase in the productivity of standing timber.

Research carried out on the basis of the Belarusian kinds of wood (the pine, spruce, oak) stresses the complex character of the interconnected impact of temperature rise and precipitation fall-out on the changeability of the radial increment. The above impact will depend both on the kind of wood and on the characteristic features of this or that region of Belarus. Increase in the number of summer precipitation impacts favourably the radial increase of trees growing on automorphic lands all over Belarus.

Besides direct climatic factors influencing the productivity of phytocoenoses (temperature, moisture, etc.), there are other factories, which themselves depend on the climate or are indirectly linked to it through complex inverse ties. One can mention here the aforesaid increase in the number of pets, the increased level of drought, etc. as well as changes in the concentration of the green gases, aerosols, and ozone, with some of these being able to considerably reduce the possible rate of the plant productivity increase.

The growth of productivity of phytocoenoses occurring through the reduction of the CO_2 content due to the increase of the latter's concentration in the atmosphere may be only evaluated by using specific mathematical models for identifying dynamics of the

CO_2 content in the atmosphere and the «response» of crop cover to the content change. Preliminary assessment of measuring the CO_2 content in the atmosphere is quite contradictory and varies from considerable reduction of areas covered by forests in the zone of moderate climate to an increase in the forest productivity by 25%.

Among other factors negatively impacting the productivity one can mention current increase in the concentration of aerosols and ozone. Besides the influence of the above on the penetration radiation through its weakening, aerosols and ozone produce a negative impact on the physiological processes occurring in plants during their vegetative periods. In accordance with the model assessments of Russian scientists only due to the anthropogenic increase of the near-earth concentration of ozone, the reduction of the increment of the biomass of leaf-bearing forests in the first half of the 90ies of the previous century in certain countries of Western and Central Europe reached 15%. For Belarus this reduction amounts to 7-9%.

The established models of interconnection between *climate* (average monthly temperatures and monthly rates of precipitation)-*radial increase of trees* display an enormous variety of the climatic indices characteristic of certain months influencing the increment of different kinds of wood from different regions of Belarus.

On the whole territory of Belarus, except for its northern part, the quantity of precipitation and the temperature index of the summer months particularly those of June and July turn out to be one of the most limiting factors. It is just at this period of time that the increment of spruce timber is exceptionally noticeable. It is also necessary to mention a favourable impact of early spring temperatures (in March and April, and in the southern part of Belarus – in February) on the increment of the spruce and the pine throughout the country which fact results in the duration of the vegetative period being prolonged.

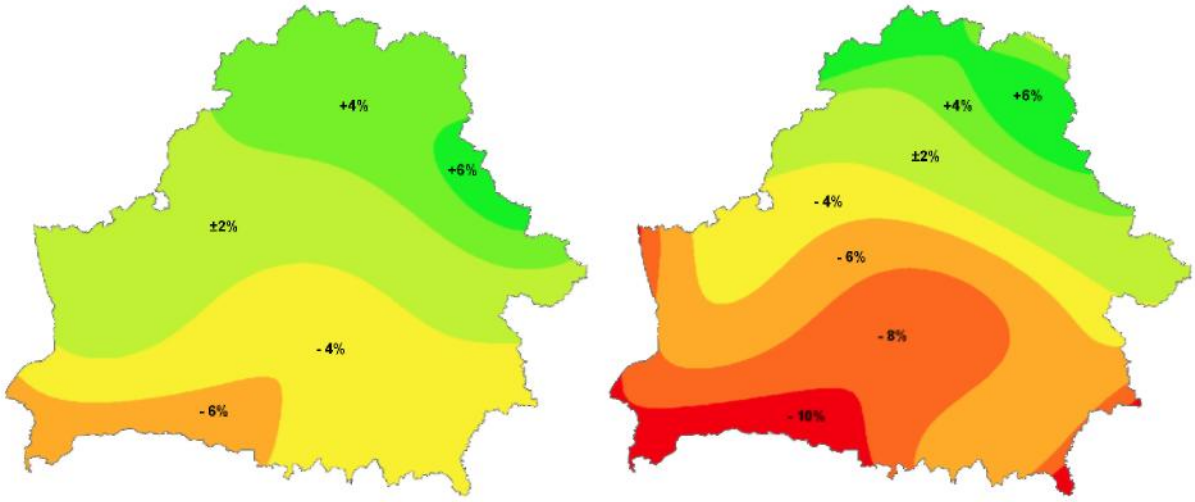
High heat supply in the southern-western part of Belarus causes a situation when a direct interconnection between the said increment and the quantity of precipitation in June is impacted negatively by this month's temperature. Precipitation deficiencies alongside with high air temperatures during an intensive vegetative period will limit the increment of timber. On the whole, in Belarus the influence of high temperatures on the increment of timber increases while that of the quantity of precipitation decreases proportionately to the territorial shift to the north.

On excessively moistened lands dependence on meteorological factors becomes less distinctive. Thus, precipitation dependence is low as due to the high level of subsoil

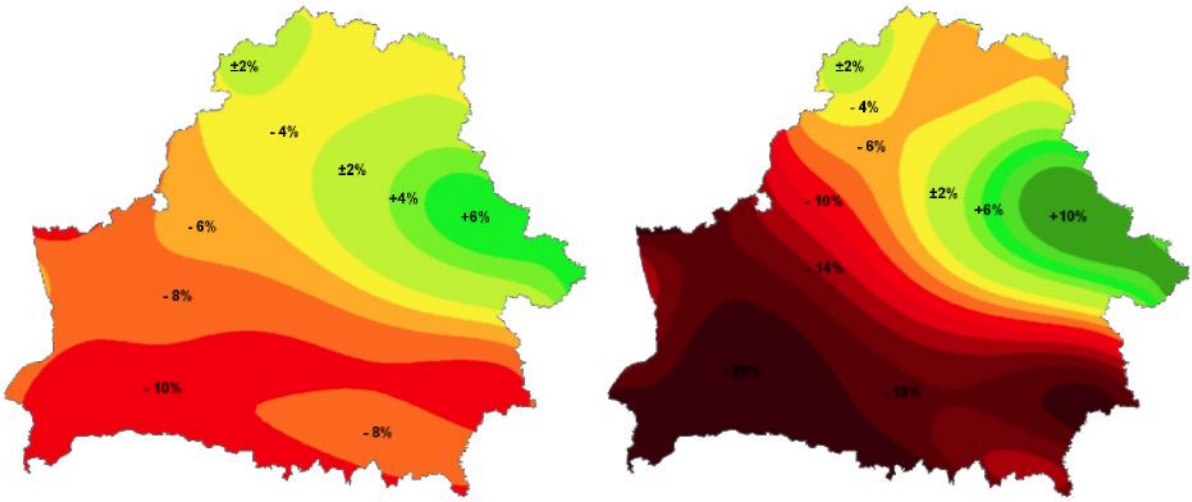
waters plantations are supplied with accessible moisture during the whole length of their vegetative period. Their dependence on the summer temperatures proves to be very much the same as that on automorphic lands.

The radial increment of oak trees is favourably influenced by early summer temperatures when the larger part of the yearly ring is formed. A positively characterized dependence on winter temperatures and a negatively characterized dependence on April temperatures may be easily explained by the fact that the oak-tree is particularly vulnerable to winter and spring frosts. This vulnerability leads to the reduction of the increment during the vegetative period. A negatively characterized dependence on June temperatures is due to the oak-tree vulnerability to strong drought occurring during the period of the oak-tree most intensive growth.

By using these models as well as the estimated indices of climatic change and that of the formation-typological structure of forests the authors have carried out an assessment of possible change in the productivity of forests for 2025 and 2050 in comparison with the period of 1961-1990 (pictures 5.4-5.5).



Picture 5.4 – Change in the productivity of pine-tree forests for 2025 and 2050 in comparison with the period of 1961-1990 in case the climate changes in accordance with the most likely predictions



Picture 5.5 – Change in the productivity of spruce-tree forests for 2025 and 2050 in comparison with the period of 1961-1990 in case the climate changes in accordance with the most likely predictions

It appears that for different regions of Belarus change in the productivity will be of a multi-direction character. The changeability gradient of productivity in the south-east direction, i.e., in the direction of the climatic gradient, is particularly evident. In the country's southern regions by already 2025 one may expect the decrease in the increment of pine-trees by 4-6%, and by 2050 – by 8-10%, with the prolongation of the vegetative period due to an early beginning of the vegetative period not compensating for dry periods in the middle of the vegetative period. On the other hand, the rise in productivity by 4-6% in the northern regions of Belarus is possible. However, if in 2025 the zone of the increment reduction will only cover Polesie, by 2050 its northern border may shift to the north of Minsk.

The anticipated changes will most unfavourably influence spruce-tree forests. Thus, by 2025 their increment will be reduced by 8-10% in the southern part of the country, while by 2050 this indicator will reach 20% and even in the north increment losses may extend to 6%. The situation may be further aggravated due to the increasing possibility of drought occurrence in summer entailing the demise of spruce-tree plantations; the south-western region of Belarus, therefore (inclusive of the whole Brest region and the southern part of the Grodno region) will turn into zones of risky spruce-tree growing. Natural spruce-tree forests growing isolated alongside the edges of the marshes and around the water currents on the lands of excessive moisture in Polesie will become exceptions to the general picture. The only region where the spruce-tree increment is expected to increase is the eastern part of the country characterized by a

strong continental climate. And even in the said region there may appear certain contradictory features: on the one hand, the possibility of the increment is quite evident; on the other hand, summer drought is very likely to occur there. As a result the average increment may turn out to be less than the one registered now.

One of the very few kinds of wood which will not only preserve its current increment but will also somewhat rise it (to 5%) is the oak-tree, with no essential differences in its sensitivity to climatic change having been discovered regarding the northern and southern parts of Belarus.

So the process of the expansion of the mineral complex and the outing of the boreal complex is backed by experimental results.

Principles Pursued and Approaches Undertaken by the Forest Industry to Get Adapted to the Anticipated Climatic Changes

The Programme of the forest industry adaptation to the anticipated climatic changes was elaborated in 2009 within the framework of SNTP «Forest Management and Rational Forest Use».

The realization of the Programme of the forest industry adaptation to the anticipated climatic changes is hardly possible without carrying out quantitative prognosis of the changes in the composition and structure of forest cover to follow up.

As the cover crop we have now was formed in historically established landscapes, soil-subsoil and climatic conditions, any climatic change will inevitably reduce the stability of vegetation communities. The above circumstance, in its turn, will result in an increased possibility of emergency situations which may mean that the forest industry production and the resources of subordinate forest use will be ruined. In connection with the above the necessity to adjust the forest industry functioning to the requirements of the day becomes apparent. In some cases such adjustments may be very essential, as, for example, those that were implemented in a number of forestries at the end of the 90ies of the previous century – beginning of the current century when thousands of hectares of spruce-tree forests withered.

Notwithstanding the climatic changes and the following shifts in typological and formation structures of the country's forests, the major role in the dynamics of all forest formations belongs to man and his economic activities. And the character of these economic activities is specified by state needs, first and foremost, by the need to have valuable and high-quality timber. Man so strongly interferes with the natural dynamics of forest growth that this interference often radically changes this dynamics and almost

completely eliminates the occurred climatic changes. Execution of all sorts of felling and planting of forests of economically valuable kinds of wood often provokes the formation of biocoenosises, compositionally and spaciously homogenous, characterized by impoverished elements. Biodiversity reduces due to the removal of certain specific microformations from forests, such as dead wood and windfallen wood, both constituting an integral part of the natural dynamics of vegetation communities.

In accordance with the Programme of Adaptation, therefore, primary importance is attached to the future formation-typological structure of forests both from the view-point of climatic change and methods of managing forestries as these are capable of changing the dynamics of forest development in a most radical way.

The measures provided for by the Programme of Adaptation are aimed not only at surpassing possible negative consequences of climatic changes but also at using their possible benefits to the fullest extent possible.

By the character of the adaptation arrangements envisaged by the Programme of Adaptation these may be further subdivided as follows: *planned-ordered arrangements*, including the elaboration of the forest industry strategy and the development of target programmes of adaptation to new climatic changes; critical reconsideration and introduction of alterations into the basic normative-legal acts and reference literature dictated by the climatic changes; *organizational-economic arrangements*, covering a whole set of measures determined on the basis of the forest industry strategy and the Programme of Adaptation, intended for execution by the Ministry of Forestry, by certain regional production forestry associations, and by forest industry enterprises (forestries, establishments); *educational and scientific-research arrangements*, including as follows: introduction of alterations and additions into the curricula of higher educational establishments and specialized schools, preparing cadres for the national forest industry; arrangements for target retraining courses at the sectoral study centre of the Ministry of Forestry; preparation of appropriate educational-methodical materials for their further use in forestries for raising the qualifications of the forest industry employees, etc.

Climatic changes dictate the necessity to, first and foremost, adapt the species composition of forests in order a) to prevent mass reproduction of pests and to raise the total resistance of forest ecosystems; b) raise the level of fire safety of forests. Adaptation of the national forestry to climatic change is aimed primarily at the optimization of the species composition of forests by way of introducing alterations into the current normative acts, the Instructions on Forest Restoration and Forest Growing in

the Forests of the Republic of Belarus and the Rules of Forest Felling in the Republic of Belarus.

Taking into account the arrangements to adapt the forest industry to climatic change the overall area occupied by coniferous trees may increase by 3,1% by 2025 and by 12,4% by 2050 in comparison with the accounting period. In the northern and central parts of the country the major increase will be due to the growing size of areas under spruce-tree forests, while in Polesie – under pine-tree forests. An increase of areas under oak-tree forests to 7,7% in 2025 and to 11,6% in 2050 is regarded as possible and it may become possible due, first and foremost, to transforming part of small-leaved forests and spruce-tree forests into mixed spruce-tree-bread-leaved forests. By 2050 areas occupied by ash-tree forests may increase by five times (from 0,4% to 2,1%). Simultaneously, in accordance with the Programme of Adaptation the areas occupied by derivatives of small-leaved communities, such as birch groves, asp groves and grey alder groves will decrease to 9,5%, 0,4%, and 0,4%, respectively (see table 5.4).

Table 5.4 – Anticipated Change in the Structure of Forests Based on the Arrangements to Adapt the forest Industry to Climatic Change

Forest Formation	Year Forest Rate, %		
	2005	2025	2050
Pine woods	50,7	52,5	54,4
Spruce groves	10,6	11,9	12,4
Oak forests	3,7	7,7	11,6
Ash forests	0,4	1,3	2,1
Maple groves, lime groves, elm	0,1	0,1	0,1
Hornbeam groves	0,1	0,1	0,0
Birch groves	21,4	15,3	9,5
Black alder groves	8,0	8,3	8,6
Grey alder groves	2,5	1,4	0,4
Asp groves	2,1	0,9	0,4
Total	100,0	100,0	100,0

The above changes in the structure of the forest fund will allow for increasing the rate of economically valuable forests, primarily, bread-leaved forests, with simultaneously increasing the ability of forest plantations to resist unfavourable environmental factors, both climatic and anthropogenic.

Besides the changes concerning the exploitation of forests and forests restoration process, the Programme of Adaptation also covers as follows: adaptation of the system of forest husbandry and planning of forestry action; adaptation of the system of fire

safety; peculiar features of forestry action on reclaimed and excessively moistened lands; adaptation of the system of forest protection based on changes in the group of main insects-pests and their ability to harm as well as on anticipated changes in phytopathologic situations in forests; adaptation of the system of preparing cadres for the national forestry and forest science. Execution of the whole complex of measures and arrangements will enable the system of forestry to efficiently get adapted to the anticipated climatic changes; will make it possible to increase resistance of forests to the above changes, to maintain forest biodiversity, and to simultaneously increase the economic worth of forest plantations.

5.5 Climate Change Impact on Water Management and Its Adaptation

There has been carried out risk analysis with respect to flooded territories, hydro-electric engineering, and water transport.

5.5.1 Flood Hazard Analysis

When the climate changes the riskiest situations usually arise out of floods. The analysis of the data related to the floods of 1845 and 1931 shows that the possibility of even more devastating freshets and floods on the territory of Belarus is very high. This may happen in case of strengthening the anthropogenic burden on water collection and is caused, from the point of view of hydrology, by essential changes in the conditions of water drain.

A constantly increasing economic worth of flood lands because of their irrigation, the growth of the yield capacity of agricultural crops, further development of settlements and transport communications mean that the level of average multiyear damage caused by floods will increase. Moreover, constant losses may be predicted due to the fact that potentially high productive agricultural areas completely fall out of intensive economic activities (as the possibility of these areas of being flooded is extremely high).

Climatic factors influence considerably functioning of the country's water transport. When summer is hot the water level is low and this makes delivery of goods by water transport unprofitable. In order to decrease the influence of climatic factors on functioning of the country's water transport such measures are required which will allow for steering vessels when the water level is low and will connect Belarus with the Black and the Baltic Seas.

The most significant consequences of floods are typical of Polesie because the local relief is characterized as flat and the degree of the local rivers cutting into the banks is low, hence, the rivers' slopes are not high and the carrying capacity of their beds is low, too.

If the climate becomes warmer this will necessitate irregular watering. With regard to reclaimed areas this may result in the reduction of the average multiyear water-regulating effect produced by irrigatory improvement. The quantity of water in sources normally used for compulsory delivery of water to the fields may also be reduced. To provide for water supply for irrigating and drying up-moistening systems it will be necessary to work out measures aimed at regulating surface-soil and subsoil water drain, driving water from outside sources, and repeatedly using drainage water.

Increase in the rate of repeatedness and duration of dry periods will result in the water level in the rivers, lakes, and water reservoirs going down, which fact in its turn will worsen the quality of water. In connection with the above additional cleaning of the sewage delivered to these sources as well as the removal of all pollution-producing elements from water protected zones is required.

Reduction of water levels and water consumption during the period of land surveying may influence negatively the performance of the water transport inside the country, the running of HEPS, and the state of radiation of the surface waters in the Gomel and Mogilev regions. Changes of the local flora and fauna are anticipated due to the above.

5.5.2 Determination of Adaptation Options

To mitigate the negative impact of water resources change a programme of flood-protective measures is to be elaborated, first and foremost, for Polesie, taking into consideration the peculiar features of river drain on the territory of the Ukraine, and in connection with the above – creation of a reliable system of hydrometeorological monitoring, a wide use of radar and sputnik information to assess snow cover characteristics and to plan water-economy arrangements.

Assessment of how water drainage is formed proves that climatic change will increase the changeability of drainage and will raise the probability of extreme occurrences to repeat again and again (droughts, intensive floods).

The most effective method to combat water erosion flows is to persistently hold forest-reclamation activity in the river beds.

It is expedient that the possibility of constructing underground water reservoirs in some parts of the country be investigated which will allow for regulating water in accordance with the requirements specified by water consumers; in other words, to settle the problem of water supply is to guarantee the waterfull of water resources.

A lot of time will be needed to execute the above arrangements on water supply.

Projecting, construction, and putting structures in operation normally take about 10-15 years. Large-scale water-system arrangements should be planned 25 years in advance, and their putting into operation should overtake water demand by 10-15 years.

When planning strategically, it is necessary to take into account the vulnerability of surface-soil water and a certain degree of adaptation measures limitations; getting attached to anticipated dates of climatic changes is not required. Adaptation of economic activity is taken to mean, first and foremost, such measures as water saving, a wide use of water-intensive technology, and a broader irrigation of agricultural lands. It is high time that transition to basin-based management of water resources used and protected be made.

The current use of the resources of river and underground waters and a possible aridization of the climate calls for planned adaptation. In connection with this the strategy of reorganizing the country's water system is to include as follows:

- Rearrangement and reorientation of the strategy of developing the water system aimed at using effectively the water resources available;
- Wide introduction into practice of water-saving technologies in water-consuming industries, agriculture, and by public utilities enterprises;
- Transformation of the currently exploited hydro-reclaimed systems into technologically advanced ones based on the optimum consumption of water for the production purposes;
- Transition to a waste-free system of using water resources; possible artificial replenishment of underground water resources.

5.6 Assessment of the Impact Produced by Climate Change on Man

While carrying out research into the issues of influence produced by climatic change on the social spheres, much attention is to be paid to the assessment of the above influence on the state of health of the country's population. Hence, comfortable living, working, and recreation conditions acquire primary importance.

The current climatic change is accompanied by a growing number of force-majeure circumstances (floods, hurricanes, squalls, etc.), in the result of which people may get traumas or may suffer from post-trauma shocks.

Natural disasters entail indirect occurrences – an increased number of mosquitoes due to floods; activation of mites and other carriers of infectious diseases; the prolonged period of their potential infectious danger; failures of water-supply and sewage systems. In connection with the above the risk for people to catch intestinal infectious diseases may increase. In accordance with expert opinion [26, 27], that the climate is getting warmer will contribute to the spread of infectious diseases carried through water and by insects. While in cold climatic conditions agents of infections getting out of an infected man's body to the external environment cannot exist in it, in warm climatic conditions the situation changes drastically. Infectious diseases may be divided into three major groups: 1) diseases passing on through water and foodstuffs; 2) diseases spread by mosquitoes, and 3) diseases spread by mites.

The number of people catching intestinal infectious diseases depends considerably on the quality of water (both in the source of water supply and in the plumbing system) as well as on the degree of foodstuffs being infected with a disease.

The environmental temperature is a major factor impacting directly the man's organism. The frequency and depth of breathing, the rate of blood circulation, the character of blood formation, and the supply of cells and tissues with oxygen – all depends on temperature.

One of the consequences of the weather getting warmer is the increased number of days with an abnormally high temperature. Even a short-term temperature rise may become a reason for an increased rate of mortality of the population due to acute attacks of different diseases (ischemia, diabetes, diseases of the organs of breathing), accidents, suicides, and murders. Temperature rises are particularly dangerous for old people, handicapped people, and people with low incomes. On days with a higher temperature the level of air pollution also rises.

The most favourable for people and suitable for carrying out climatic therapy in Belarus is the temperature regime established during the warm period of the year when the average daily temperatures reach 15,0-25,0°C. In connection with the above the most favourable for people's health are summer months: June (the average temperature makes 15,0-17,0°C), July (17,5-18,5°C), and August (16,0-17,5°C). Temporary temperature changeability in summer reaches its minimum indicator. Sharp temperature fluctuations produce a considerable impact on the rate of morbidity and mortality.

The state of the man's body is greatly impacted by the air humidity regime. The most favourable conditions in this respect are to be the ones when the indicator of air humidity reaches its average meaning (50%) and no sharp fluctuations of it are registered.

Belarus is characterized by a higher level of humidity all year round. Under the conditions of excessive humidity and in accordance with the regime of relative humidity the most favourable period for people's health is registered in spring – summer (May – August).

In the framework of the complex impact of climatic change on the man's body a truly key importance is attached to the intensive character of weather change. Very sharp changes in the atmospheric pressure result in breakdowns of the breathing process, decreased supply of blood and tissues with oxygen, which fact leads to the increase in the number of heart-vascular diseases. Meteorological reaction aggravates the cause of chronic diseases, brings about unpleasant changes in the way people feel, worsens their mood.

To settle the issue of adapting the man's organism to climatic change measures should be taken at the governmental level aiming to widely use the peculiarities of the local climate (sun radiation, air characteristics, relief characteristics, etc.) with the help of which it is possible to further develop the adaptive abilities of the man's organism through increasing and improving its protective mechanisms.

Belarus possesses natural resources which create favourable conditions for agro- and ecotourism, becoming nowadays more and more popular and called for.

6 RESEARCH AND SYSTEMATIC OBSERVATION

6.1 General Policy on Research and Systematic Observation of Climate Change and Funding

6.1.1 National Policy

Progress in research of climate change and its prediction of climate impact assessment, the application of knowledge about the climate when making economic decisions is entirely dependent on the availability and quality of climate data. Time series data with sufficient spatial resolution and coverage needed for planning and management of agricultural production, water and forest resources, other sectors sensitive to climate impacts. Development of Belarusian Economy requires detailed study of climatic resources in order to optimize agricultural production, to broaden climate record and usage in energy sector, construction, and, ultimately, the development of appropriate response strategies for industrial and agricultural production to climate change.

Legal basis of hydro-meteorological activities defined by Law On Hydro-Meteorological Activity (National Register of Legal Acts of the Republic of Belarus of 2007, №170, 2/1344). This Act aims to provide government agencies, other organizations and individuals with actual and forecasted hydro-meteorological information.

By the Resolution of the Council of Ministers of January, 23, 2007 № 75 study of regional climate change was included in the list of activities of national importance in the field of hydro-meteorological activities.

By the Resolution of the Council of Ministers of October, 4, 2006 № 1301 the Statement on the National Climate Inventory was developed and approved. This Statement determines the composition of the state of climate inventory data, the order of reference, as well as the procedure for providing the climatic inventory data to state government agencies, different organizations and individuals. National climate inventory is a systematic set of data, based on hydro-meteorological information about the combination of atmospheric conditions, typical for a certain area because of its

geographical position, that vary during the year, ranging within certain limits from year to year, but slightly varying from one multi-year period to another.

The National Climate Inventory data is used for:

- Accounting the knowledge of climatic characteristics while planning activities of different sectors of National economy as well as rational distribution of productive forces;
- Agroclimatic zoning, locating the crops, planning the cultural operations;
- Industrial, transport, energy, water and civil construction design, planning and building of human settlements;
- Development of state standards for technical products, work clothing, fuel and other state and department standards;
- Design of health facilities, bioclimatic justification of creating the recreation and tourism areas;
- Development of measures on air protection against pollution and on improvement of environment;
- Climate change assessment, including the change under the influence of anthropogenic factors;
- Maintenance of other state natural resource inventories;
- Other needs, prescribed by law.

Currently the development of the system of measures to mitigate the negative impacts of climate change on the economy and public health is of great importance. An important step in solving this problem is the National program of measures for mitigate climate change consequences mitigation for 2008-2012.

6.1.2 International Cooperation

Weather and climate do not have national boundaries. Therefore, international cooperation at the global level is essential for the development of meteorology and operational hydrology.

Observation of weather and climate networks, and international cooperation in meteorology began to develop in the XIX century and currently operates on a global level. World Meteorological Organization (WMO) coordinates this work. The Republic of Belarus is a member of this organization since 1948.

Extension of cooperation within the area of the climate change is carried out jointly with such international organizations as: United Nations Development Program, UN Environment Program, the Economic Commission for Europe, the Organization for Economic Cooperation and Development, the Intergovernmental Panel on Climate Change, World Meteorological Organization, the Organization for Security and Cooperation in Europe, the CIS Inter-State Environmental Council, the Environment Program of the United Nations, the Swedish Environmental Protection Agency, the Danish Environmental Protection Agency, the World Bank, European Bank for Reconstruction and Development, Global Environment Facility, the TACIS Program.

Republic of Belarus takes part in many international projects. Implementation of joint programs by the National Hydro-Meteorological Center and Russian Hydro-Meteorological Center allowed introducing new technologies and software systems for collecting, accumulating, processing operational and regime hydro-meteorological information in the Department of Hydrometeorology, as well as to create the ability to use new instructions and guidelines developed by leading research universities of RusHydromet.

Currently, the project BALTRAD is being in progress – improving the network of meteorological radar stations in the Baltic Sea region.

Accurate and timely weather forecasts warn of dangerous conditions, such as: storm, snow, hail or flood, they help to save lives and property, and they can help to optimize actions in some sectors of the economy. Weather radars are able to detect rain, snow, hail on large geographic area with high resolution in space and time. Some of the systems can be combined to cover the countries, regions and, ultimately, continents.

The purpose of this project is to create a modern network of the real-time weather radars in the Baltic region. The method of achieving this result is a project BALTRAD,

which will be created by expanding the existing radar network NORDRAD, combining meteorological radars of Sweden, Norway and Finland.

Participants of the project are national weather services in Finland and Denmark, as well as meteorological and hydrological services in Sweden, Estonia, Latvia, Poland, Russia and Belarus. This weather services have their own network of weather radars, which guarantee the successful operation of BALTRAD.

An important feature of the project - the creation of functional treatment of primary radar data (radar reflectance, the height of the upper/lower limit of radio, etc.) using a unified and coherent methodology for the whole Baltic Sea region, giving each country an opportunity to process its own data and other weather radars of the network according to their own needs.

These methodologies can be implemented in a single radar network to improve the receipt and processing of raw radar data, or clarify the criteria of radar detection of meteorological phenomena, as well as to provide support to meteorology professionals and end users.

The result of this project is a new element of regional infrastructure of the Baltic Sea – the network of weather radars and the establishment of common standards for exchange and processing of radar data that satisfy both the national weather services and regional interests. The technology developed for the Baltic region can also be used outside the region - in the rest of Europe, as part of the information system of the World Meteorological Organization.

The total project budget estimates €2 215 055.

Being aware that in the interest of mankind at large Antarctica should continue forever being used exclusively for peaceful purposes and shall not become the scene or object of international discord, the Republic of Belarus has acceded to the Antarctic Treaty (Act, dated July 19, 2006 № 157-3 On Accession of the Republic of Belarus to the Antarctic Treaty). National Hydro-Meteorological Service of the Republic of Belarus is also the primary developer and executor of the state target program «Monitoring of the Earth's Polar Regions and Maintenance of the Arctic and Antarctic Expeditions in 2007-2010 and the period until 2015» approved by the Resolution of the

Council of Ministers of the Republic of Belarus of August, 31, 2006 №1104. Within the framework of this Program a system of hydro-meteorological observations and measurements and observations on the state of the environment in the region of location of Belarusian Antarctic Station (environment observation complex) will be created. Hydro-meteorological observations and activities in the area of location of the Belarusian Antarctic station will be intended to provide scientific and economic interests of the Republic of Belarus in the unexplored regions of the Earth and will include both scientific research and expeditionary services for the national polar expeditions. In the future they will be used to study climate change.

6.2 Research

6.2.1 Climate Process and Climate System Studies

The results of all types of hydro-meteorological observations do not lose their value over time. They are constantly used for developing methods of hydro-meteorological projections, drawing generalizations (handbooks, atlases, yearbooks), making up climatic description of areas, calculating the statistical parameters of meteorological elements, etc. Therefore, observational data must be constantly kept and ensure the possibility of multiple applications. That's why the data of hydro meteorological observations is recorded on storage media.

Hydro meteorological stations are the basis of ground network, subdivided on the meteorological, hydrological, agro meteorological, marsh, lake and background monitoring. Meteorological stations observe temperature and humidity, soil (water) temperature, atmospheric pressure, wind speed and direction, horizontal visibility, shape, amount of clouds and their height over the bottom border, type, quantity and intensity of precipitation, atmospheric phenomena. Observations at stations within the international network are carried out simultaneously in the main (00, 06, 12, 18 hours Greenwich Mean Time) and additional (03, 09, 15, 21 hours), synoptic time. Temperature measurement error is within 0,1-0,3 ºC. Pressure is measured with an accuracy up to 0,1-0,2 GPa. The average wind speed and direction in the observation

period is measured mostly at an altitude of 10 meters with an accuracy up to 0,5 m / sec. and 5 º.

Currently twenty-four-hour meteorological observations at the territory of the Republic of Belarus, the continuous monitoring of dangerous and unfavorable hydro-meteorological events and transfer of information are provided at the following stations:

- **Vitebsk region** - Verkhnedvinsk, Vitebsk, Dokshytsy, Ezerische, Lepel, Lyntupy, Orsha, Polotsk, Tolochin, Sharkovschina;
- **Minsk region** - Berezino, Borisov, Vileika, Volozhin, Luban, Maryina Gorka, Minsk, Naroch, Slutsk, Stolbtcy;
- **Grodno region** - Volkovysk, Grodno, Lida, Novogrudok, Oshmiany, Shchuchin;
- **Mogilev region** - Bobruisk, Gorki, Krichev, Kostiukovichi, Mogilev, Mstislavl, Slavgorod;
- **Brest region** - Baranovichi, Brest, Vysokoe, Gantsevichi, Drogichin, Ivantsevichi, Pinsk, Polesskaya, Pruzhany;
- **Gomel region** - Bragin, Vasilevichi, Gomel, Zhytkavichi, Zhlobin, Lelchitsy, Mozyr, Oktyabr, Chechersk.

Belarusian Meteorological Observation Network consists of the World Meteorological Organization (WMO) network of stations (31), the stations of the IAEA (8), the stations that transmit information about «ROSS» (10) and regional exchanges (21), the stations that transmit information to the Russian Hydro-Meteorological Center (31), as well as sending «Climate» telegrams to WMO (12) and Russian Hydro-Meteorological Center (16) for regional purposes (51).

Upper-air stations carry out vertical sounding of the atmosphere using radiosondes, which give systematic mass data on pressure, temperature, humidity, wind speed and direction to a height of 30 km. Radiosounding of the atmosphere is done rarely due to the lower temporal variability of meteorological figures. The main periods of observations at upper-air network stations are 00 and 12 hours Greenwich Mean

Time, and additional - 06 and 18 h. Currently two upper-air complex in Gomel and Brest are being administered by the State Hydro-Meteorological Service of Belarus. Construction of upper-air complex in Minsk has already begun.

Belarussian State Hydro-Meteorological Service's studies show that the current climatic conditions on the territory of Belarus has changed, and trends of these changes will be preserved during the next 5-10 years. These findings are confirmed by results of other Belarusian scientists, in particular the National Academy of Sciences of Belarus, and most studies of foreign experts.

Climate changes observed on the territory of the Republic of Belarus are characterized by a significant increase in the temperature of the cold seasons of the year, growth of volatility, while maintaining and even reducing the amount of rainfall during warm season, an increase in the frequency of droughts, changes in annual river runoff and its seasonal redeployment. These trends, as well as many other features of the changing climate of different parts of the country, have a significant impact on the living conditions of citizens and socio-economic activities.

Consequences of rapid climate variability manifested in the growing frequency of severe weather events (floods, storms, squalls and other phenomena), and an increase of adverse sudden weather changes, which lead to serious social and economic losses, directly influence the effectiveness of such vital important sectors of economy, as energy (primarily hydropower), agricultural production, water use, forestry, and housing.

Reports of the Intergovernmental Panel on Climate Change (IPCC) has repeatedly stressed the need for detailed research of the current and anticipated future regional climate changes. Detailed regional assessments of the observed and projected climate changes are very important for Belarus.

Existing estimations of climate changes on the territory of Belarus do not contradict the concept of global warming. A strong tendency of warming has been clearly outlined in the recent decades, especially in winter and spring months (I-IV). The longest period of warming over more than 120-year period of systematic

instrumental observations in our country (Figure 6.1-6.2) was marked at the end of XX - beginning of XXI.

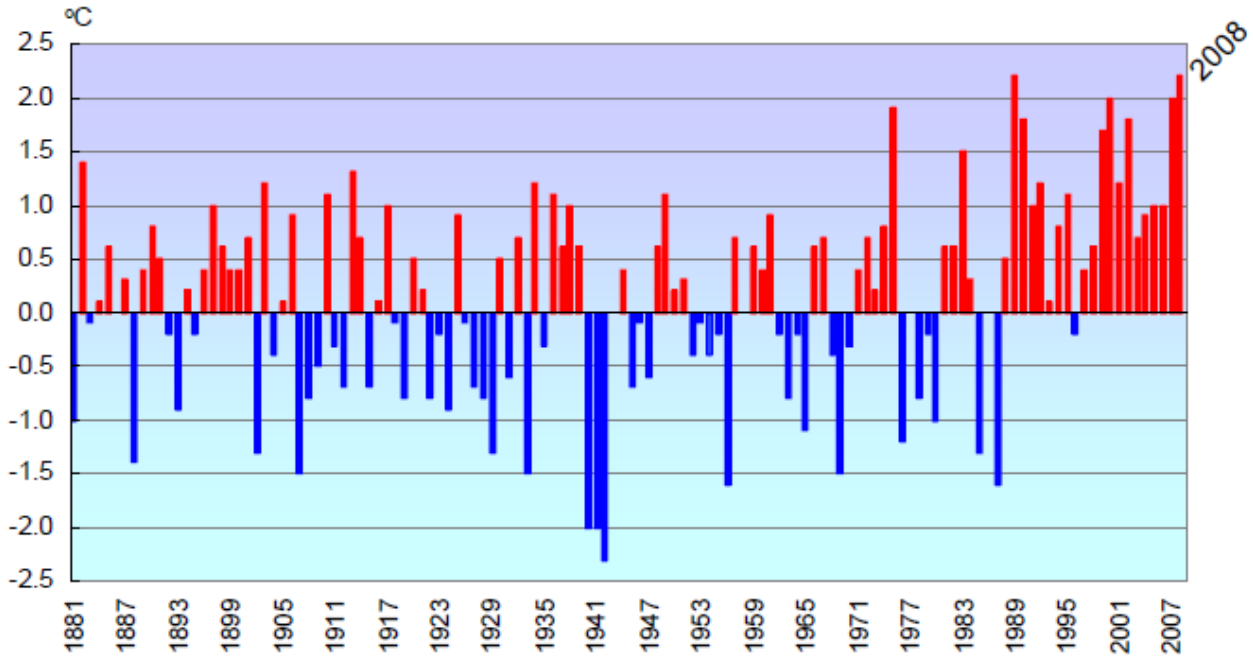


Figure 6.1 - The mean of Belarus annual air temperature from climatic norms for the period 1882-2008

The peculiarity of climate change over the past decade is the increase of extreme hydro-meteorological phenomena. According to the WMO, more than 70% of material and up to 90% of casualties in the world are provoced by the element, caused by meteorological or hydrological reasons. Preliminary estimations of statistical data on the damage inflicted on the economy of the Republic of Belarus by dangerous hydro-meteorological phenomena, made by World Bank experts showed that each year an average sum of about 90,0 million U.S. dollars (in 2005 prices) is lost. By 2012 and until 2020 projected climate changes will have both positive and negative impacts on various sectors of the energy industry, housing and health of the population of the Republic of Belarus.

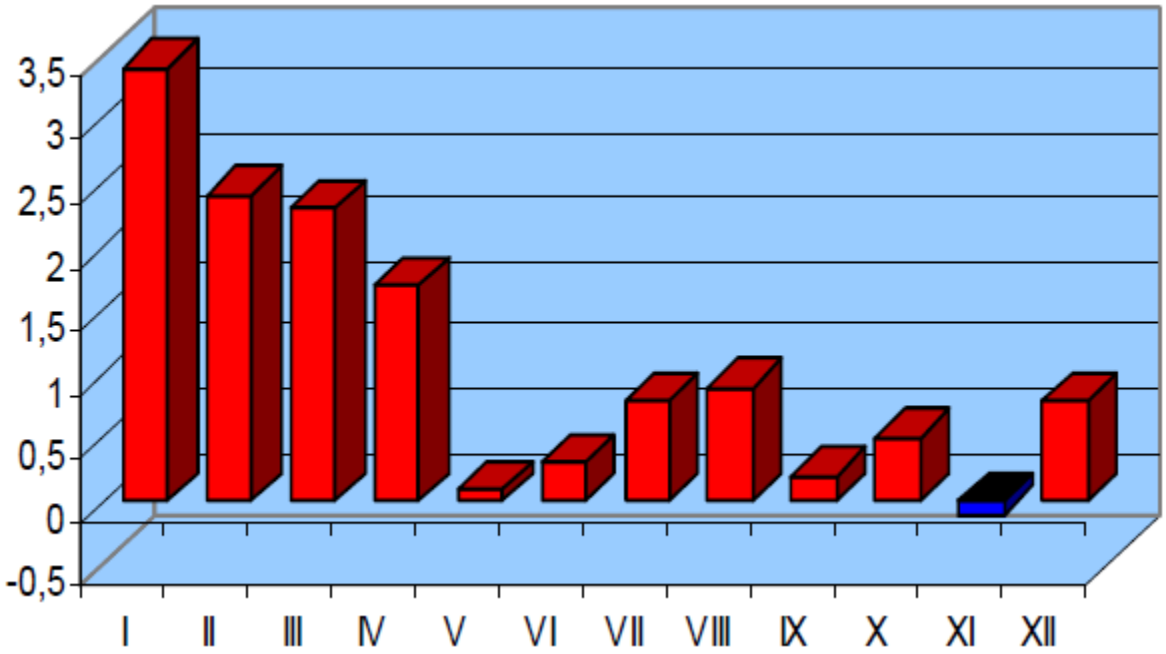


Figure 6.2 – Deviation of average monthly air temperature for the period 1989-2008 from the average long-term values of the Republic of Belarus

The number of days with high air temperature is expected to increase in the summer months at territory of the Republic of Belarus in the period till 2020. It will be followed by a considerable increase of the probability of extremely long periods of critical values of air temperature, the so-called «heat waves» (annual maximum duration of such periods will increase by 1,1-1,5 times by the year 2020). This will worsen conditions for the heat absorption systems functionality at power stations, as well as increase the cost of air conditioning of buildings. In addition, the increase of extremely long periods of critical values of air temperature, especially in large cities, could adversely affect the health of the citizens.

Agriculture in the Republic of Belarus is dependent on climatic conditions and their changes.

Analysis of rainfall for standalone years also shows their extremeness: frequent dry periods alternating with excessively wet ones. Decrease of precipitation mainly in the southern, ameliorated part of the republic is detected. In the northern part a slight increase in precipitation is noted. Over the last twenty years during the warm season precipitation shortfall is noted in April, June, and especially in August - they fell respectively 91%, 93% and 88% of normal (Figure 6.3). A bit more than normal level of precipitation was observed in February, March and October.

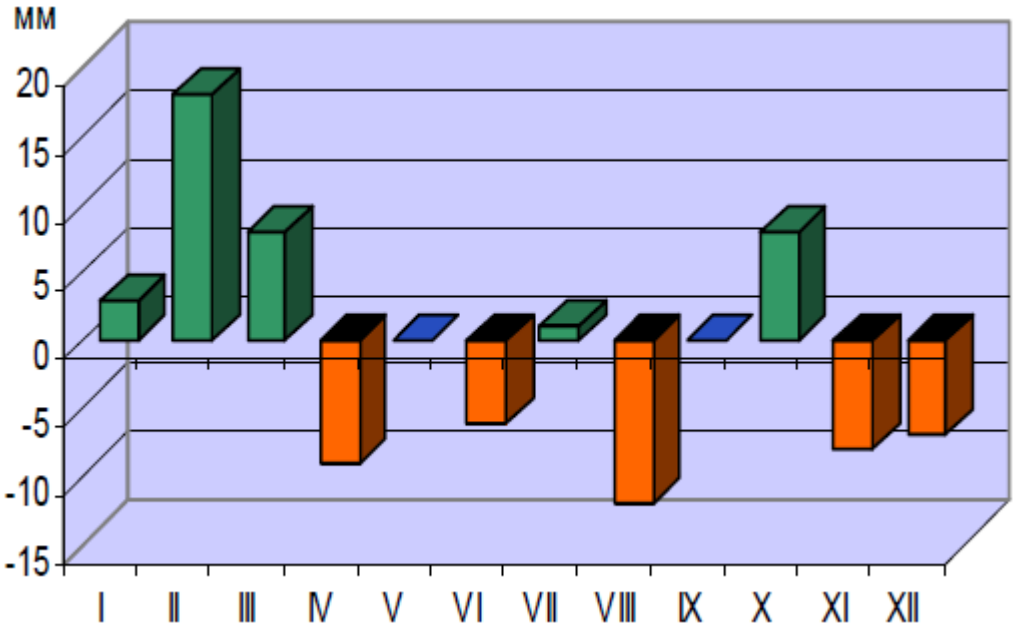


Figure 6.3 - Deviation of the monthly sums of precipitation for the years 1989-2008 from climatic norm for Belarus

6.2.2 Modeling and Forecasting

It is hard to predict the qualitative consequences for Belarus as a result of global warming because of the uncertainty of many natural changes. According to expert estimations, the impact of global warming on agriculture will be uneven, the negative effects can be combined with the positive ones.

The general tone of the available forecasts in Belarus is positive, they predict positive results of global warming on agriculture of Belarus. Among the positive consequences of climate change for agriculture are the following:

- increase in yield of grain crops;
- increase in length of the growing season;
- increase in heat supply of agricultural crops;
- improving conditions for wintering of field and horticultural crops.

However, realization of potential may be limited by several factors: social, environmental, economic and institutional.

The role of the World Meteorological Organization (WMO) and National Meteorological and Hydro-meteorological Services, including the State Hydro-meteorological Service of the Republic of Belarus is crucial in solving problems related to the problems of climate variability and change, since accurate and timely information related to weather, climate, water and the concentration of greenhouse gases in the atmosphere is a prerequisite for the successful formulation and implementation of

policies and measures of adaptive response, especially in extreme climatic and weather conditions.

In this regard, efforts should be intensified to improve and upgrade ground- and space-based meteorological observations, as well as relevant national networks and climate data banks in order to contribute to their suitability for different concerted regional and global strategies, including the Millennium Development Goals of the UN Millennium Declaration.

6.2.3 Socio-Economic Analysis

Republic of Belarus has a wide range of natural and socio-economic resources, allowing its sustainable development. Issues of sustainable development of the country have acquired special relevance in the last quarter of the twentieth century, when the climatic, agroclimatic and water resources began to experience significant anthropogenic impacts of different spatial and temporal scales.

While developing measures for countries' sustainable development in changing climate it is required to have a joint consideration of regional differences of climate change and the characteristics of the structure and directions of development of economic and social sphere in the regions of the Republic of Belarus. For each of the spheres of economy and social life in specific areas the projected climate changes can have both positive and negative effects. Maintaining and even strengthening of the observed trends of climate change in different regions of the Republic of Belarus, expected for the next period (at least for the next 5-10 years), must be considered now in the weather-dependent sectors of economic activity, in development of social infrastructure.

The positive effects of the expected by 2020 climate changes, primarily, include the reduction of the heating period and significant, therefore, fuel and energy resources saving (Figure 6.4).

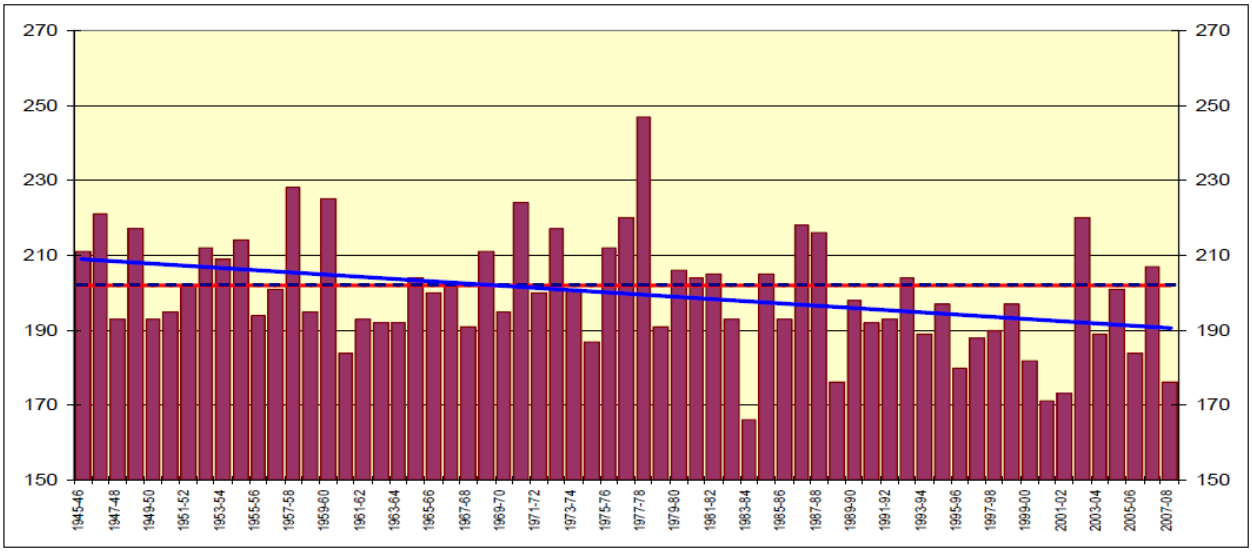


Figure 6.4 – Change in the duration of the heating period

One of the major socio-economic impacts of climate warming is saving of energy resources for heating needs by reducing of the heating season duration and increase of average temperature of heating season. Basic duration of the heating period in Belarus is approximately 6.5 months. Increase of average annual air temperature from 0,5 to 3 °C will lead to decrease of heating period, respectively, from 6 to 36 days.

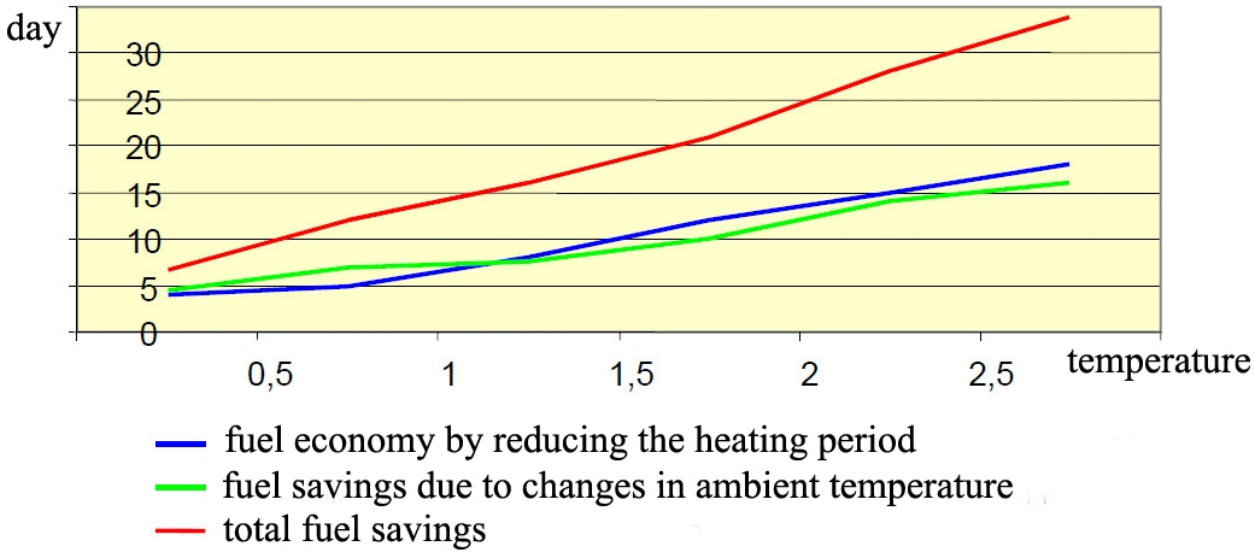


Figure 6.5 - Savings of fuel, depending on the temperature rise

Climate warming will lead to improved thermal conditions of buildings at a constant level of fuel consumption. The thermal resistance of walls of buildings in cities, which depends on the temperature of the coldest 24 hours and the coldest five

days, will increase, leading to the maintenance of the desired temperature inside the buildings with less fuel consumption.

Despite the reduction of the average length of heating period, policy makers should take into account the natural variability, manifested in the fact that in some years prior to the 2012-2020 in certain regions of the Republic of Belarus real length of the heating period may exceed the current established regional average duration. It may also affect the upward trend of climate variability, which manifests in deviations of real demand for heating from the average duration of the heating period.

Projected climate changes will have both positive and negative consequences for agriculture of the Republic of Belarus. The positive effects are related mainly to the anticipated warming.

One of the most important consequences of climate warming at present period is the significant decrease in the frequency of winters with minimum temperature of the soil threatening winter crops.

Adverse effects are associated with increase in the draught, as well as with the observed trend of increasing probability of extreme meteorological conditions, which may be detrimental to agriculture.

In case the current continue by 2020, the anticipated climate changes will lead to significant changes in the agro-climatic conditions of cultivation of agricultural crops. Area heat supply will increase everywhere. The growing season and frost-free periods will extend for 10-20 days, improving conditions for agricultural activities and reducing the loss of production during harvest. The border of mid-season maize cultivation and late-season varieties of sunflower would move to the north of the country. Conditions for the wintering of winter crops will continue to improve; the cost of livestock housing will reduce, caused by higher temperature conditions in winter and early spring month's period; the spring processes and the spring crops seeding time will begin earlier as well as the acceleration of ripening crops and timing of their harvest. At the same time the conditions of growth and yield formation of medium and late varieties of potatoes, flax, vegetables (cabbage), the second mowing of grass will worsen. In order to use additional heat resources it is reasonable to increase the proportion of more

thermophilous and drought-resistant crops (maize, millet, sorghum, sunflower, etc.), to introduce more late-ripening varieties (hybrids), which make better use of the increasing thermal resources of the territory, expanding stubble (postcut) crops.

On the one hand climate warming will lead to the increase in productivity of the boreal forest, on the other hand it will lead to an overall increase of fire danger to the forests and peat bogs, the disruption of the ecological balance, displacement of some species by other, in particular, to the increase of the possibility of mass outbreaks of the forest pests.

Major negative feature of the expected climate change is the increase of aridity which accompanies the warming process almost everywhere.

In the zone of high probability of the aridity strengthening (southern part), adaptation measures should be aimed at the expansion of more drought-resistant crops - primarily corn, sunflower, millet, cultivation of winter drought-resistant crops. These regions need significant advance irrigation as well as implementation of measures aimed at the rational use of water resources and the wider implementation of the water-holding technology.

6.2.4 Research and Development of Mitigation and Adaptation Technologies

Current global climate changes require the development of adaptation strategies for the economies of both countries, according to their regional specific conditions. Implementation of a joint program of the Union State «Improvement of the System of Providing Information to the Population and Industries of Russia and Belarus on Existing and Projected Climatic Conditions, the State and Pollution of the Environment» for 2007-2011 under Section 3 allows us to give projections of expected changes, primarily temperature and precipitation, create a unified system for monitoring climate changes on the territory of Belarus and Russia, as well as to develop methodologies for introducing these changes in the regulations of the applied climatology (Building Climatology, Agricultural Climatology, etc.).

Assessment of regional characteristics of climate change and its socio-economic consequences for the major sectors of the economy of Belarus and Russia as well as development of practical recommendations to adapt to changing climatic conditions are carried out in the frame of this program:

- Assessment of the observed trends of climate changes at regional level, and issue of a newsletter about its condition and changes at the territory of the Union State;
- Research and scenario evaluation of expected changes in regional climate at the territories of Belarus and Russia;
- Assessing the consequences of climate change and its impact on the basic aspects of social and economic activities and developing of recommendations on adaptation of the basic branches of economy of Belarus and Russia to possible climate changes;
- Improvement and development of single (unified) forms and technologies of representation of climatic manuals and other products for various sectors of economy (agriculture, water, housing, construction, transport, energy, etc.).

The requirements for climatic information are continuously increasing. Proper accounting of climatic factors is necessary for making optimal decisions and can provide significant financial and material resources savings. This is especially true for successful socio-economic development of Belarus; ensure energy and food security; rational environmental management and environmental protection in the present global climate change. Estimations of climate changes indicators give an idea about the quantitative parameters of climate change and their regional differences and differentiation across the country. As a result of this the research correction of existing projections of climate change will be carried out in Belarus.

The study of agricultural climate indicators in a changing climate has been finished. The basis of this work are tables of the most important agro-climatic indicators in the territory of Belarus, averaged for the twenty-year period (1986-2005), which will be included into the scientific-applied handbook «Agro-Climatic Resources of the

Republic of Belarus in a Changing Climate.» Assessment of climatic and agro-climatic indicators has been done, which gives an idea about the quantitative parameters of changes in agro-climatic resources and their regional differences and differentiation across the country. Researches are being conducted jointly with the Institute for Problems of Natural Resources and Environment of the National Academy of Sciences of Belarus.

Agriculture is one of the branches of material production, which is most sensitive to the influence of climatic factors. The Republic of Belarus is characterized by the developed agriculture, which is a basic sector of the economy and contributes significantly to the creation of its gross domestic product. Evaluation and integration of agro-climatic resources and current trends of its change identified on its basis should be widely used in long-term and current planning, development of agricultural production. The paper reflects the actual agro-climatic conditions, thereby enhancing customer service to a new level.

These scientific and applied data reflect agro-climatic realities of the modern era of global warming in which the formation and socio-economic development of the Republic of Belarus and its agriculture takes place. These results are eloquent of the magnitude of the changes in agroclimatic resources of Belarus, which accounts for their significant and multi-aspect impact on agricultural production.

Progress in research of climate changes and its prediction, climate impact assessment, application of climate knowledge when making economic decisions is entirely dependent on the availability and quality of climatic data. The CLICOM software for management of climate data (submitted by the World Meteorological Organization) allows calculating standard climate characteristics. However, now it is outdated, and it is important to have a modern system for climate data management using new technologies and introducing advanced software systems of climate data bank management (CLIWARE) for applied problems solving and dissemination of climate information among the customers. Therefore, in terms of activities of the Federal program for the period 2007 – 2011 it is planned to introduce in the National Hydro Meteorological Agency the CLIWARE system, developed in RIHMI WDC. In

2007 experts of RIHMI-WDC implemented the software system in the Climate Department and surrendered the documentation for conducting climatic, historical and operational hydro-meteorological information. In 2008 and 2009 the adaptation and development of the technology of climate production and databases submission by the means of application software was held. Implementation of these activities will allow supplying various sectors of economy with climatic information for current and future planning; scientific research; climate change assessment at a higher level.

Agro meteorological Department has developed and implemented the software complex to present the major crops of the Republic of Belarus.

Development of technology of indicators presentation in terms of mass occurrence of main phases of crop development in the Republic of Belarus is currently actual in the context of rapidly changing weather and climatic conditions, with a trend towards warming. In the future, the absolute agriculturel loss from adverse weather and climatic conditions may increase despite the growth of agriculture. Technology of indicators presentation of the major crops of the Republic of Belarus will identify positive and negative consequences of current and projected climate warming on the cultivation and crop production.

6.3 Systematic Observation of Climate Change

Atmospheric Climate Observing System

Hydrometeorological network for observations in the Republic of Belarus meets the requirements of the World Meteorological Organization to achieve the objective coverage of the country with hydro-meteorological and climatic characteristics. Saving the climate observation network efficiency and maintaining the high-quality observations are of major concern.

Serious attention should be given to databases on technical media. Currently, in Belarus climatic arrays in daily, monthly and urgent solution are written on technical media. Replenishment of arrays with current and historical information and tracking for its security is in progress. Large arrays of individual meteorological elements are stored in the form of tables and are being transferred to the technical media. Full bank of Belarusian climatic data will be created in future.

The CLICOM Software available for climatic data management allows to calculate standard climatic characteristics. For applied problems solving and climate information dissemination there has been laid the foundation for existing data management improvement.

A better system of hydro-meteorological information management - CLIWARE was installed in the National Hydro Meteorological Agency on February, 2008.

The CLIWARE system of hydro-meteorological information is designed to meet the challenges of integrated climatic, current and operational data for the purposes of customer service of various hydro meteorological products using modern means of communication on public networks. Several systems were tested in the WMO secretariat in 2002: IADAMA - Australia, CLIDATA - Czech Republic, JCDMS - Jordan, CLISYS - France, CLIWARE - Russian Federation, SDCLIM - Tunisia, CLIMSOFT - Zimbabwe. The CLIWARE system was admitted as the most technologically advanced and has been recommended for implementation and use in the countries, members of the WMO.

The CLIWARE system is a technological complex focused on management of hydro-meteorological information at different levels of processing and presentation. The complex is implemented in the form of a basic module on which you can build a variety of technologies for processing of hydro meteorological information, acquisition of different climatic characteristics and dissemination of information to the consumer. The complex is based solely on Web technology, which allows its use in local area networks and on the Internet. It solves the four main tasks: input of hydro meteorological information into system, acquisition of various climatic characteristics, maintaining of database of hydro meteorological information and metadata, as well as bring information to consumers.

The CLIWARE version installed in the National Hydro Meteorological Center is implemented in the DBMS ORACLE, and contains a database of both climate and operational information.

It allows handling incoming operational data, simultaneously dealing with main climatic goals: input of hydro meteorological information into system, reviewing and correcting of the data, obtaining of different climatic characteristics, maintaining of database of hydro meteorological information, displaying various forms of representation.

Creation of a climate database is still in progress now. The database contains urgent data and various kinds of generalizations from daily to monthly data for a multi-year period.

In addition to solving the climate problems, as noted above, the use of CLIWARE database allowed to begin the development of professional workstations using new technologies of acquisition and representation of hydro meteorological information in a relational database management systems.

Using the CLIWARE operational database system will allow to:

- Improve the technology of automated processing of incoming hydro meteorological information;
- Give the ability to user to view and adjust the data as it becomes available;
- Gather software applications into a single system, thereby facilitating maintenance of software packages;
- Being currently in the process of implementation the CLIWARE system will allow improving the technology of climatic and operational data processing.

7 EDUCATION, TRAINING OF SPECIALISTS AND PUBLIC AWARENESS

7.1 General Policy on Education, Training and Public Awareness

In accordance with Articles 4.1 i) and 6 of the United Nations Framework Convention on Climate Change Parties included in Annex I promote and cooperate in education, training and public awareness related to climate change and encourage the widest participation in this progress, including that of non-governmental organizations. Also in accordance to national circumstances they promote and facilitate activity concerning the public awareness on climate change and its impacts; public access to information on climate change and its impacts; public participation in addressing climate change and its impacts and developing adequate responses; perform training of scientific, technical and management personnel, and carry out the activities at the international level.

Achievements of the scientific and technological progress allowed creating favorable conditions for the human existence, although it caused global ecological problem, which affected the interests of all mankind. Therefore, improvement of environmental education is a priority for the development of the National education system in Belarus.

The state policy of the Republic of Belarus in the sphere of education is based on the principles, and one of them is the principle of the ecological education, which is set out in Article 1 of the Law of the Republic of Belarus «On Education».

Article 10 of the Law «On Environmental Protection» defines the competence of the Belarusian Ministry of Natural Resources and Environmental Protection (MNREP), under which the MNREP takes part in the development of the environmental education and the formation of the ecological culture, supplemented by dissemination of ecological knowledge among the population.

In order to create an environmental culture and train professionals in the field of environmental protection article 75 of the Law «On Environmental Protection» establishes the system of education in the field of environmental protection, including preschool, general primary, general secondary, vocational and technical education and secondary specialized education, higher and postgraduate education system, as well as staff training and retraining.

In preschool education institutions in our republic ecological education is provided for all age groups on the basis of an updated version of the National Program

of Education and Training «Praleska». One of the main parts of this Program is devoted to environmental education of children.

In accordance with Decree of the President of the Republic of Belarus of July 17, 2008 №.15 «On Some Issues of General Secondary Education» approaches to organization of ecological education in the general secondary education system have been changed. According to this decree school subjects are studied at a base level, which excludes the possibility of creation the general educational establishments and specialty classes of ecological orientation. Therefore, problems of the student ecological culture formation will be addressed through the integration of knowledge about nature, society and human beings into the list of the school subjects as well as the introduction of new topics and sections in the structure of the academic scientific subjects, which will deepen and extend certain aspects of environmental education.

Ecological education is a compulsory component of vocational, secondary specialized and higher education in our country.

Article 76 of the Law «On Environmental Protection» prescribes the requirements for employees whose work involves the use of natural resources and environmental impact. This article is realized through the incorporation of environmental issues into the system of advanced training. The level of environmental knowledge of specialists of enterprises and institutions is ensured by the inclusion of questions on nature protection during the evaluation of the employees. The government employees when first applying for the job should also verify their knowledge and pass the qualifying examination.

In order to create the environmental culture of population and develop their care about nature, in accordance with Article 77 of Law «On Environmental Protection» education in the field of environmental protection is provided through the dissemination of environmental information, including information on environmental safety, as well as the knowledge on the composition of environmental information, the procedure of its formation, distribution and presentation to the environment protection actors.

Obtaining complete, accurate and timely information about the state of the environment, the degree of pollution, measures for its protection and enhancement is the constitutional right of citizens of the Republic of Belarus.

In 2007 amendments and supplements on environmental information to the Law «On Environmental Protection» containing definitions: «environmental information», including «environmental information of a general-purpose» and «specialized environmental information», «winner of environmental information», «provision of

environmental information» and «dissemination of environmental information» were introduced to exercise this right.

The Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus Convention), adopted by the Decree of the President of the Republic of Belarus of December 14, 1999 No. 726, and the Law «On Environmental Protection» determines the composition, sources and types of environmental information, the forms of its submission and dissemination.

The law also defines the procedure of access to environmental information. Thus, general environmental information is available to citizens and legal persons that are not public authorities or other government organizations free of charge at the stated time. The content of applications for environmental information is also defined. It should contain description of the requested environmental information to determine its scope and composition, as well as an indication of the desired form of the provision of environmental information.

Access to specific environmental information is provided through public organizations, other entities that are not public authorities and citizens on the basis of a contract with the holder of the environmental information for a fee in terms and conditions specified by the contract. However, the amount of payment for the information provided can not exceed the economically justified costs associated with the collection, processing and analysis of specialized environmental information.

In Belarus, the environmental information of a general-purpose appears in newspapers and other media, on the official sites in the global computer network or is distributed in other publicly available ways.

Chapter 73 «State Fund of Data on the State of the Environment and the Impact on It» of the Law «On Environmental Protection is stated in the new version. Under the law, the fund is made up of environmental information collected in various government agencies: the Ministry of Natural Resources and Environmental Protection, Ministry of Forestry, Ministry of Agriculture and Food, Ministry of Emergency Situations, Ministry of Education, State Property Committee of Belarus, the State Flora and Fauna Inspectorate of the President of the Republic of Belarus, local executive and administrative bodies, as well as the National Academy of Science of Belarus and other state bodies and public organizations.

The main purpose of the Fund is collecting, processing, storage and organization of environmental information, information about its composition, content owners, as

well as an access to environmental information for public authorities, other government organizations, and other legal entities and citizens.

List of the information from the registers of environmental information of the State Fund of Data on the State of the Environment and the Environmental Impact posted on bulletin boards and placards are available to the general public on the official websites of public authorities and organizations on the Internet.

7.2 Primary, Secondary and Higher Education

The purpose of environmental education in the country is to form the social basis for the implementation of the ideas of sustainable development through creating the responsibility for nature, awareness of the need for its protection and management, raising the moral qualities of the person to a level corresponding to the scale of change in today's world. Environmental education and training are becoming the determinants of the humanization of modern education.

A system of continuous ecological education and upbringing was set up in Belarus. It includes the formation of ecological culture of pupils in child's preschool establishments; school and out-of-school ecological education; ecological education in establishments, which provide vocational and secondary specialized education; development of ecological culture of the students, environmental education and awareness in the staff training and retraining system.

The system of continuous ecological education encompasses not only children and young students, but parents, educators and all employees of educational institutions.

As mentioned above, in preschool establishments of the Republic of Belarus, environmental education is based on the National Program of Education and Training «Praleska». One of the major sections of the program is devoted to the ecological education of children. It is based on the main principle of environmental ethics - the recognition of the equal value of all forms of life that corresponds both to the essence of modern global ecological priorities and to child’s peculiarities of the world perception.

Some preschool establishments work according to the author programs of ecological education that is a bright confirmation of a creative, initiative approach of the teachers to their profession. The materials for ecological education of under-fives are regularly published under the heading «Environmental Path» of the national specialized pre-school magazine «Praleska».

In the system of general secondary education the ecological culture of the students is developed through the inclusion of knowledge about nature, society and

human beings into the school subjects, the introduction of new topics and sections into the structure of academic subjects (which will deepen and extend certain aspects of environmental education), creation of specialized ecological classes; creation of secondary ecological educational establishments.

A special role in the system of environmental education belongs to establishments of out-of-school education and training.

The Republican Environmental Centre for Children and Youth coordinates their activity. It cooperates with state bodies and departments, public associations, international organizations and funds, implements a long-term megaproject of developing the «My Land» center and organizes activity of numerous ecological groups and studios. Republican Environmental Center for Children and Youth publishes the «Ekovestnik» journal.

25 ecological centers provide methodological assistance to the Republican schools.

There are successful student scientific societies. In 2001/2002 38 students of these societies were monetary awarded by the Special Fund of President of The Republic of Belarus on Social Support of the Gifted Students.

The Belarusian Small Forestry Academy operates at a Republican Ecological Centre. Students have the opportunity to enhance their knowledge about the forest, its inhabitants, the regional wildlife. More than 80% of its graduates bound their lives to forestry, biology and became highly qualified specialists.

In general, we note that a unique educational community was created in out-of-school educational and training institutions of the Republic that substantially complements the pre-school and school education and promotes the creative achievement of personhood.

In order to develop civic consciousness and patriotism, create the feeling of love for the Motherland, respect to its history and culture, pride of the achievements of modern Belarus, develop a careful attitude towards the native land the first lesson held in all secondary educational establishments was entitled «Parents' Land Is My Land». Ministry of Education developed and sent methodical recommendations on conducting in the general educational establishments the Day of Knowledge on September, 1 to the departments of education of regional executive committees, the Minsk City Executive Committee and the Committee on Education. The Day of Knowledge was also held in the institutions providing vocational and technical, secondary and higher education.

In January 2009 began the second stage of the Republican students' campaign «I Live in Belarus and I'm Proud of It» (Decree №129 of the Ministry of Education of the Republic of Belarus of December 20, 2008). Its main feature was the participation of pupils and students from specialized secondary and higher education establishments.

Plan of the main activities within the Republican students' campaign «I Live in Belarus and I'm Proud of It» was developed and approved for 2009-2010.

Regional preschool establishments held competition of children's drawings, photography exhibitions.

The best works will be presented within the framework of the republican scientific-practical conference «Managing the Quality of Preschool Education: State, Problems and Prospects» September, 2009, and also on the board of the Ministry of Education on December 2009.

In the system of vocational and specialized secondary education environmental education and upbringing is a necessary component regardless of future career of the students. It is implemented through general subjects as well as through special ones: Environmental Protection and Energy Conservation, The Basics of Industrial Ecology, Ecology of Land Use and Radiation Safety.

Also environmental education and training take place in the process of technological and pre-diploma practice, course and diploma projects in the system of methodical, extracurricular work on developing the environmental culture and worldperception of the future specialist.

Video classes, thematic class hours, verbal magazines, conferences, round tables are conducted, the exhibitions of literature and artistic works are organized, ecological information sheets are produced, competitions of the reports and environmental posters are being held. Students are actively involved in improving the campus territories. Students of the Gomel State Machine-Building College, Lida State Pedagogical College, Brest State Polytechnic College, etc. are involved in forest planting.

A special place in the system of continuous environmental education is given to higher educational institutions. Their preparation is carried out by Belarusian National Technical University, Belarusian State Technological University, International Sakharov Environmental University and several other universities. All in all 9 higher educational establishments in the country provide training of the environmental specialists. In 2008 about 270 ecological specialists graduated from higher establishments. Environmental specialists are sent to work in various ministries and

departments, the National Academy of Sciences of Belarus, to the Ministry of Education for teaching and research activities.

At the universities of the country mandatory environmental training is provided both through the inclusion of the environment issues into the educational process and through the introduction of integrated courses. Obligatory environmental training at higher school is carried out, foremost, on the base of course «Basics of Ecology». Such additional courses as «Radiation Safety», «Environmental Security», «Ecology and environmental management», «Environmental Monitoring» are provided for the non-economic faculties. A number of special environmental disciplines are introduced in the curricula of agricultural and forestry specialists. The legal aspects of environmental use are studied at the legal and management universities.

However, the curricula and programs are mostly highly specialized and do not include the full range of environmental activities, as required by the Law of the Republic of Belarus «On Environmental Protection». In this regard, MNREP has initiated the training of specialists with qualifications of the environmental engineer-inspectors in the Belarusian National Technical University on the basis of the existing degree of the Environmental Management and Audit in the Industry.

Primary Education and Preschool Education professions include such disciplines as the Methodology of Teaching the Basic Understanding of the World and Environmental Education, the Methodology of Acquaintance with Nature, Environmental Education of Children and Practical Nature Studies.

An important activity of higher education institutions is the organization of environmental research and extracurricular work. Students actively participate in environmental activities, carry out various actions to protect the environment, organize eco-regional clubs and associations, and participate in the international environmental motion. The results of practical activity are reflected in course and diploma projects, in research works presented at national and international competitions and are reported at the scientific and practical student conferences.

7.3 Public Awareness Campaigns

An important tool of information for citizens is the mass media. For example, only in 2007 there were organized more than 1000 environmental publications in the media. 62 press conferences on the most important environmental problems and issues (including 14 press conferences in 2007) were held on the basis of the National Press

Center of the Republic of Belarus SE and International Center integration of information. Public Press Center Press House RUE.

In order to prepare and issue the up-to-date environmental information the MNREP signed contracts with such news agencies as BELTA RUE and Interfax IE. 200 pages of thematic environmental issue «EkoSreda» were published together with the Narodnaya Gazeta publishing house.

Furthermore on September 24, 2007 an agreement on cooperation between the MNREP and the National State TV and Radio Company of Belarus was signed.

With the support of MNREP the release of information and analytical publications and surveys on specific environmental issues, a collection of «National Environmental Monitoring System of the Republic of Belarus», the Belarusian Climate Data Sheet, the annual environmental newsletter «The State of the Environment in Belarus», as well as several other publications are published on a regular basis. Basic information about the environmental situation, including the status of the air is a separate section of the annual statistical compendium, published by the Ministry of Statistics and Analysis.

7.4 Training Programs

In the system of training and retraining attention is paid to environmental teachers education as well as to upbringing of children and young people. For all categories of educators there are relevant courses, seminars and meetings as well as methodical associations. Listeners of the retraining courses prepare essays, term papers, reports on topics of environmental education and training. Many of them are involved in the development of environmental education projects.

Ministry of Education of the Republic of Belarus issued special licenses (permissions) for conducting educational activities to retrain the specialists with secondary and tertiary education on specializations «Technology» («Environment Protection») and «Environmental Science». Licenses for the «Technology» specialization were issued for Belarusian National Technical University, Educational Establishment Belarusian State Technological University, Belarusian State University of Transport, Belarusian State Institute of Advanced Training and Retraining in standardization, metrology and quality management, and for the State Education Center for Training, Further Training and Retraining of Personnel in the Field of Environmental Protection. Licenses for the «Environmental Science» were issued fo- Belarusian State University, Educational Establishment International Sakharov

Environmental University, Republican Institute of Higher Education, State Vocational-Technical Baking College. Both permissions are issued for Polotsk State University and Institute of Training and Retraining of Managers and Industry Specialists «Personnel Industry».

The country developed special programs, courses and workshops, extracurricular activities and voluntary classes: «Ecology and Environmental Education», «The Pre-School Ecological Culture Formation System», «Environmental Protection», «Healthy Lifestyle», «Organizing Work with Children on Environmental Education and Training», «Modern Technology and Methodical System of Environmental Education», «Environmental Education of Parents».

Priority given to environmental education, compulsory introduction of environmental subjects in all educational institutions, the principle of integrating environmental knowledge to the appraisal of manufacturing managers are prescribed by the laws of the Republic of Belarus «On Education» and «On Environmental Protection». In 1991 the Government approved the National Program of Education for the environment, which defines the purpose and principles of environmental education. The goal is to introduce compulsory environmental courses in all forms of education. Under this program, the elements of nature knowledge are included in the existing «Educational and Awareness Programs in Kindergarten». Vocational and secondary schools introduced a special course «Environmental Protection and Rational Use of Natural Resources». A number of higher educational institutions opened new environmental departments (for example, Department of Geographical Ecology at the Faculty of Geography, Belarusian State University). During the last 20 years environmental specialists have been receiving higher education at the biological faculty of Belarusian State University. Ecology and Environment courses are given at Belarusian Technological University.

7.5 Research and Information Centers

Aarhus Center of the Republic of Belarus is a good example of such a center. It has been operating since December 2005 on the basis of RUE Bel SRC «Ecology». Its main aims and objectives are: ensuring public right to receive accurate and complete information on the state of the environment, planned and carried out activities which may have a significant impact on the environment, establishing the relationship between the public and the authorities, providing practical assistance to government employees

in fulfilling their obligations towards the provisions of the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, environmental education and raising public awareness of environmental issues, promoting public participation in decision-making and obtaining access to justice in environmental matters, learning from international experience and international cooperation the new approaches to the Aarhus Convention implementation.

Aarhus Center conducts joint activities with the republican state bodies, public environmental organizations. Thus in the frame of the national action plan for the 2008 Year of Health a workshop was held in conjunction with the Ministry of Health to inform the public about the state of the environment and its impact on human health.

Aarhus Center informs the public on topical issues of environmental management and protection through the publications in periodicals (regular columns in the journal «Rodnaya Priroda» «On-Line Hotline of the MNREP», the «Narodnaya Gazeta» and «Va-bank» newspapers) and speeches in the program «Aktualny Mikrofon» on the first channel of the Belarusian Radio.

Aarhus Center in cooperation with the MNREP professionals takes part in the preparation of draft regulations relating to the environment.

The head of the Aarhus Center regularly delivers trainings and lectures at the MNREP Republic Training Center for groups of listeners – MNREP specialists and its regional bodies, professional organizations, enterprises and industries on the topic «Implementing the Aarhus Convention in the Republic of Belarus». About 110 people attended these lectures during 2008.

For further implementation of the Aarhus Convention, on January 19, 2007 there has been developed and adopted Resolution № 2 «On the Public Environmental Coordination Council under the Ministry of Natural Resources and Environment of the Republic of Belarus».

7.6 Involving the Public and Non-Governmental Organizations

As mentioned above, in order to ensure maximum awareness and public involvement in decision-making process concerning the environment the Ministry of Natural Resources created a Social Focal Environmental Council (SFEC). In 2007 SFEC held 3 meetings, which addressed issues of preparation and holding of the Fifth

National Environmental Forum, the interaction with international NGOs, the formation of public opinion on nuclear plant construction, etc.

SFEC should also consider the draft Law of the Republic of Belarus «On introduction of Amendments and Additions to the Law of the Republic of Belarus «On Environmental Protection» Regarding the Environmental Information and the Redress of Environmental Harm».

Decree of the Ministry of Natural Resources and Environment of the Republic of Belarus of June 17, 2005 № 30 approved the Instruction on the procedure of assessing the environmental impact of planned economic and other activities in the Republic of Belarus, which regulates public participation in decisions on any kind of activity that could have a significant impact on the environment. In accordance with the instructions the public discussion of the planned activity is held as part of assessing the impact of the given activity on the environment.

In addition, citizens of the republic apply to the state environmental authorities via the MNREP's «hot» line to report of violations of environmental legislation.

For example, residents of Minsk have repeatedly appealed to the Minsk City Committee of Natural Resources and Environmental Protection with complaints about the emissions of Minsk Heating Equipment Plant. Having processed the complaint the Committee included special measures to address the problem of the plant into the Minsk Ecological Safety Plan for 2010.

In October 2008, a roundtable on reducing emissions of greenhouse gases representatives of ministries and departments, managers and employees of enterprises of all forms of property, non-governmental environmental organizations, bankers, and journalists from leading media was held.

In January 2008 Albert Gore's movie «An Inconvenient Truth' was presented followed by the discussion on global warming and the fourth report of the Intergovernmental Panel on Climate Change.

In the framework of international projects, public and governmental organizations working in the field of environmental protection organized and conducted a number of activities. For example, in May 2009 Minsk hosted a seminar «Energy Saving: the Practical Potential for Energy Conservation in Buildings». The seminar welcomed representatives of educational institutions, extracurricular organizations and NGOs from Minsk and Gomel regions.

A training seminar on climate change for ISEU students and members of the student environmental club MIEC named after I. Rau was held during the week of the Informal Education-2009 in Minsk.

October 24, 2009 the world hosted the International Day of Climate Shares. As part of this the Green Network ecological partnership conducted a set of events in different parts of Belarus: Minsk, Brest, Grodno and Vitebsk region.

In Minsk the international action began with the exhibition «Education and Career», which was held 21-23 October 2009 in the Minsk Palace of Children and Youth. As part of this exhibition, students of environmental gymnasium № 19 held a series of actions called «350» promoting the idea of preventing climate change. Each visitor of the exhibition had the opportunity to draw his/her own «350» poster right at the exhibition and get current information on climate change and the role that he/she can play in reducing his/her «carbon trace». Anyone who drew a poster received a gift. Alongside with the exhibition there was a theatrical show performed by the students of Minsk University of Culture and Arts on the causes of climate change and possible actions of humankind to overcome this problem. Coordinator of the Green Network's working group «Belarus and Climate Change» held a master-class on climate change issues for the school teachers. The master-class also included the Albert Gore's film «An Inconvenient Truth». Specifically for the International Day of Climate Shares students of Belarusian State University of Culture and Arts shot a spot about the 350 action and the problem of climate change on the planet. The spot was aired in the days preceding the action and on October 24 in the Minsk Metro and on the dashboards of main universities in Minsk. On October 24, Minsk held four flash-mobs «Let's Save the Planet Together!». The participants illustrated the consequences of climate change and the actions you can take to prevent CO2 emissions. On October 24 Brest streets also welcomed flash mobs «Let's Save the Planet Together!». A week earlier, members of this group prepared cards from natural material displaying the figure 350. On October 24 these cards with the enclosed information on climate change were handed out in the streets. On October 24 schools in Shumilino district (Vitebsk region) had a number of climatic lessons under the title «350». Brest secondary school № 10 had a «350» week ending on October 24. The week was devoted to informative talks with schoolchildren on global climate change.

Various street actions were held on this day in Vitebsk. A concrete wall near Grodno State University was splattered with graffiti under the slogan «We'll Save the Climate»: 350 slat emissions, climate change and actions to protect the planet from

global warming. On October 24 environmental activists from Grodno State University held mini-conferences on climate change in other educational institutions of their city. The peer-to-peer format meant that the young activists should conduct the conferences without the participation of the teachers. Two weeks prior to October 24 Brest State University and the Secondary School № 2 in Malorita organized a 350 Belarusian rubles voluntary donation collection for purchasing the seedlings of trees. Tree planting took place on October 24.

One of the main activities of public organization «Belaya Rus» is to assist in the formation of environmental awareness, education and awareness in the field of alternative energy. The most significant projects are: development of the Agenda XXI in Dzerzhinsk, publishing the «Green News» ecological bulletin, demonstration of an alternative energy a project in Volma jointly with ISEU.

International public association of ecologists (Minsk Branch), guided by the evolving situation in the energy sector and the climate issue, plans to create the Expert Council on the green (climatic) construction and the Center for Air Pollution (the Council).

The purpose of the Council is to assist in solving the problem of energy consumption through the development of recommendations and requirements for designers and builders, monitoring and issuing of green certificates of compliance guidelines for ready-made objects.

The Center for Air Pollution and Climate will be called to solve practical problems of climate and air pollution by changing the mentality/public awareness through media and direct actions.

The Russian website of eco-NGOs (with representatives from Greenpeace, WWF and others) hosts an expert blog of Eugene Shirokov – the Chairman of the Minsk city branch of the International Public Association of Ecologists, the Head of the Green Network's working group «Renewable Energy». Its main issues are - energy efficiency, alternative energy, «green» construction and others.

7.7 Participation in the International Activities

In May 2008 Agreement on Cooperation in Training, Further Training of Specialists in the Field of Meteorology was signed. In accordance with this agreement, employees of the State Hydrometeorological Service improve their skills in the Regional Meteorological Training Center of the World Meteorological Organization

located in the Russian Federation (GEE Institute of Further Training of Specialists and Executives of RusHydromet). During 2008-2009 20 employees of State Hydrometeorological Service upgraded their qualifications in this center.

10 employees of the Hydrometeorological Service are undergoing free extramural training at the Russian State Hydrometeorological University, based on the bilateral agreement between the MNREP and this university.

Future specialists of hydrometeorological organizations receive secondary vocational education in state educational institutions of secondary vocational education at Moscow Hydrometeorological College on the same terms.

Directive of the President of Belarus №3 assigns a task to create billboards for energy conservation campaigns, to publish energy saving training manuals, as well as to publish children's cognitive literature on saving energy and natural resources and to increase the amount of energy saving information on the Internet. This is a necessary condition in order to involve the general public in energy conservation and rational use of natural resources.

Norwegian Society for Nature is the initiator of the SPARE program – a school project for of energy and resources use in the CIS and Eastern Europe. Good practice, positive experience and effective partnership within the SPARE program are already established in Russia, where projects have been carried out for over 10 years, in Kazakhstan, Tajikistan, Armenia, Ukraine and other countries.

Since 2006 Norwegian partners have been carrying out SPARE program in Belarus receiving a positive result. Since 2007, the SPARE project has been carried out at a high national level with the support from the Ministry of Education, Ministry of Natural Resources and Environmental Protection, the Department of Energy. Energy and natural resources saving activities generated great interest of teachers, students, representatives of school administration, who took part in them.

At present it is important to ensure the expansion of the SPARE program in Belarus with the support and coordination of the Norwegian Society for Nature Conservation. The proposed long-term project will implement the SPARE program at the national level - with the involvement of teachers, students from schools, gymnasiums, high schools, non-formal environmental educational institutions, as well as parents of students in all regions of the country. One of the important conditions of the SPARE project in Belarus should be the active participation of voluntary associations and the media (both national, regional, and local) in this program.

The relevance of this project stems from the need to raise awareness of teachers, students and young people of opportunities and energy efficiency. So far such educational programs and projects for teachers, students and youth haven't been widely presented in Belarus. It is particularly important to disseminate in schools and among young people the information on practical measures for saving energy and using low-cost energy-saving technologies that can be used directly in classrooms, schools, at home. It is also important to organize a broad awareness and dissemination of knowledge about the prospects of renewable wind, solar, water and biomass energy.

7.8 Organization and Participation of Public in Ecological Events (Additional Information)

In addition, the republic is doing a great job in organizing the various activities that promote environmental issues.

Thus, in December 2007 young workers of Minsk enterprises and organizations under 31 years old took part in the 1st environmental quiz «ECOMIR». Its main task was the formation of environmental culture of the young citizens, their involvement in the environmental movement. The training and promotional film «ECOMIR – The Environmental Quiz for Young Workers» is intended for further use in environmental education of youth.

In 2007, the Fifth National Environmental Forum, which ended on September 15 in Braslav (Vitebsk region) ran a number of national environmental competitions, including the competition for the best haulage contractor to reduce air pollution.

One of the main events of the forum was the exhibition «Modern Technologies in Environmental Management and Environmental Protection» which presented new technologies and equipment for air protection, use and protection of water, land, flora and fauna, landscape and mineral resources.

In 2007 the work on providing the state bodies and the public with environmental information continued. For this purpose the MNREP's website on the Internet (www.minpriroda.by) was redesigned with the aim to provide weekly information statement. Daily updated information us also provided on the site of the National Hydrometeorological Centre www.pogoda.by.

As part of the Republican energy conservation program for 2006-2010, approved by Decree of the Presidium of the Council of Ministers of the Republic of Belarus of January 24, 2006, ISEU created an educational and scientific complex «International

Ecological Park «Volma». The Ecological Park provides the demonstration area for the renewable energy and serves as the information center on the use of cleaner alternative energy solutions.

The Republican environmental posters contest «Defending the Nature» took place in 2009. 894 works from various educational institutions were represented at the regional round and 246 works were selected at the Republican round by the decision of the jury.

There was organized the Republican Propaganda Contest «This Nature We Are Willed to Save». 162 teams took part in the regional contest, 73 scenarios of propaganda speeches from 71 educational institutions were presented at the republican tour on September, 2009. Best propaganda teams were invited on September 19, 2009 to present their speeches at the research and practice conference of young environmentalists.

A major role in schools and institutions of the republic is given to the educational work of museums. Zoological museum of the Belarusian State University (at the Zoology Department of the Biological Faculty) is the center of the storage and study of the faunal repository collections.

The environmental issue takes a specific place in different training and retraining programs. In the recent years national and international workshops, scientific and practical conferences on environmental topics are getting more attention. In Belarus participation and financial support of several international organizations allowed holding seminars and conferences on economic reforms and the environment, the strategy of the Republic of Belarus in the field of environmental protection, on the reduction of production and consumption of ozone-depleting substances, on practical matters of national development projects in the environmental, transport, ecological fields, etc. Detailed information on the status of natural resources and the environment is contained in the annual statistical reports, as well as in the book «State Forest Fund of the Republic of Belarus» and others.

The NGO «Protection of Birds in Motherland» based in the Berezinski Reserve held an international seminar within the project «Restoration of Peat Bogs of Belarus and the Application of the Concept of Sustainable Management - Reducing the Impact on the Climate with the Effect on the Economy and Biodiversity». Guests from Germany, Holland, Finland, Australia and Indonesia, together with their Belarusian colleagues discussed the problems of the formation of peat bogs and greenhouse gases.

The program of the seminar included field trips through the swamps of the reserve and a trip to the Tsna and Bartenikha swamps.

The same public organization held an action to restore the hydrological regime of the Elnya swamp in the Vitebsk region. The event was attended by more than 20 representatives of public organizations and volunteers.

«Protection of Birds in Motherland» during the 2007-2008 periodically conducted campaigns to restore the damaged upland bog Elnya. The Participants built special canal dams of earth to restore the level of the groundwater.

Elnya is one of Europe's largest upland bogs. Its recovery will reduce the possibility of large peat fires and thus reduce the damage to the environment.

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