REPUBLIC OF BULGARIA

FOURTH
NATIONAL COMMUNICATION
ON CLIMATE CHANGE

UNITED NATIONS
FRAMEWORK CONVENTION ON CLIMATE CHANGE

SOFIA - 2006

LIST OF ABBREVIATIONS

a.s.l.	above see level
BAS	Bulgarian Academy of Sciences
DSSAT	Decision Support System for Agrotechnology Transfer
EC	European Commission
EE	Energy Efficiency
EEA	Energy Efficiency Agency
EPER	European Pollutant Emission Register
EU	European Union
EU ETS	European Union Emission Trading Scheme
ExEA	Executive Environmental Agency
FCCC	Framework Convention on Climate Change
FEC	Final Energy Consumption
FEC	Final Energy Consumption
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	Green House Gases
GVA	Gross Value Added
HPP	Hydro Power Plant
IMCCC	Inter-Ministerial Committee on Climate Change
IPPC	Integrated Pollution Prevention and Control
ISPA, PHARE, SAPHARD	European Union funds and programmes
IWG	Interministerial Working Group
JI	Joint Implementation
JISC	Joint Implementation Steering Committee
KP	Kyoto Protocol
LUCF	Land use Change and Forestry
MAF	Ministry of Agriculture and Forestry.
MEE	Ministry of Economy and Energy
MES	Ministry of Education and Science
MF	Ministry of Finance
MFA	The Ministry of Foreign Affairs
MOEW	Ministry of Environment and Water
MRDPW	Ministry of Regional Development and Public Works
NCCAP (NAPCC)	National Climate Change Action Plan
NFD	National Forestry Directorate
NGO	Nongovernmental Organization
NIMH	National Institute of Meteorology and Hydrology
NPP	Nuclear Power Plant
NSI	National Statistical Institute
PEC	Primary Energy Consumption
PRTR	Pollutant Release and Transfer Register
R&D	Research and Development

RES	Renewable Energy Sources
SAF	State Agricultural Fund
SC	Steering Committee
SME	small and medium-sized enterprises
TPP	Thermal Power Plant
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change

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EXECUTIVE SUMMARY

S.1. Introduction

The United Nations Framework Convention on Climate Change (UNFCCC), thereon referred to as the Convention, is the first and major international legal instrument to address climate change issues at a global scale. Acknowledging the importance of the climate change issue and the need for international cooperation to address this problem, Bulgaria signed the UNFCCC in Rio de Janeiro in June 1992 and the Parliament ratified it in March 1995. In compliance with Article 4.6 and 4.2(b) of the FCCC, Bulgaria as a country in transition has adopted 1988 as a base year for the implementation of the Convention instead of 1990. The First and Second National Communications of Bulgaria were elaborated by the Interministerial Committee supported by independent organizations and experts. The work was coordinated by the Ministry of Environment and Water. The Third National Communication was a further step in elaborating and implementing the national climate change policy. It was delivered after the Kyoto Conference of the Parties and after the new commitments agreed by the Parties to the Convention. According to Annex B of the Kyoto Protocol[†] the quantified emission reduction commitment of Bulgaria for the first commitment period (2008-2012) is 8 % of the base year (1988) emissions.

The Fourth National Communication has been prepared by the Ministry of Environment and Water by assignment to the Energy Institute in cooperation with the, Ministry of Agriculture and Forestry, Ministry of Economy and Energy, Ministry of Economy and Energy, National Institute of Meteorology and Hydrology and Energy Efficiency Agency. It presents the main principles of the national policy on climate change. The structure and organization of this report follow the UNFCCC Guidelines (FCCC/CP/1999/7).

S.2. National Circumstances

Bulgaria is situated in the Southeast part of the Balkan Peninsula. The country has a territory of 110,993.6 sq. km., bordering Greece and Turkey to the South, FY Republic of Macedonia and Yugoslavia to the West. The River Danube separates it from Romania to the North. Its natural eastern border is the Black Sea. Bulgaria ranks fifteenth in size among the European countries. Bulgaria is dominated by rugged mountains, except for the Danube lowland in the north that it shares with Romania. The lay of Bulgaria is highly varied

The climate in Bulgaria is temperate Continental-Mediterranean. Due to the geographical situation and the varied landscape, the contrasts in the climate are distinct among regions. The climate is with four distinctive seasons and varies with altitude and location. The Black Sea coast features a milder winter as opposed to the harsher winter conditions in the central north plains. The air humidity is between 66 and 85% in the different regions of the country. There is a stable snow cover during the winter of about 20-200 cm. The average wind speed is 1.2 m/s (1.3 m/s in winter time), while prevailing winds are west or northeast.

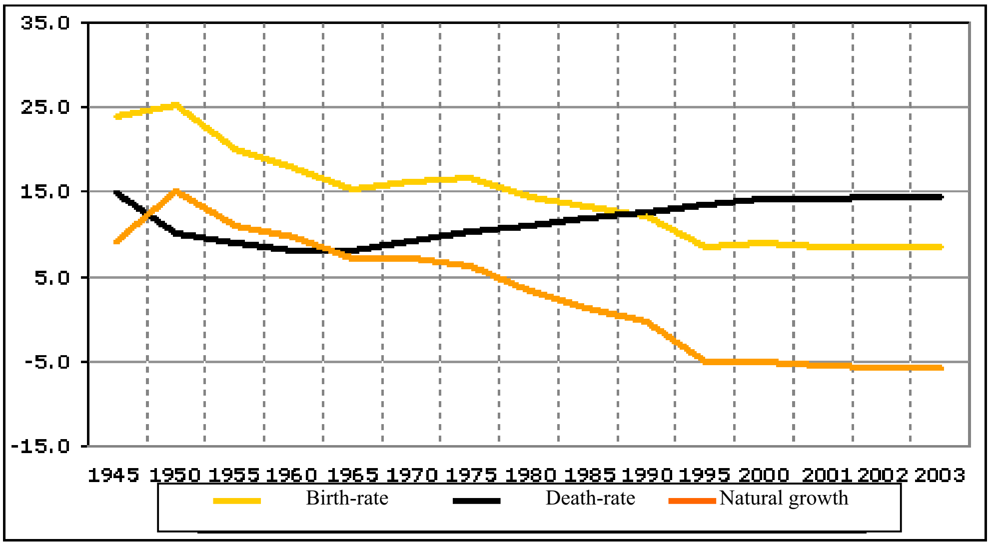
In the last few years the tendency is towards warmer and drier climate. 1998 had warm and dry winter, hot dry summer, cool dry spring, and cold and very rainy fall. Average precipitation in Bulgaria is about 630 millimetres per year.

The demographic picture in Bulgaria is unfavourable at the beginning of the XXI century. It ranks the country amongst those in Europe with negative rate of natural increase, low birth rate, high adult mortality and child death rate, decreasing average age of population. Most of the

[†] The Kyoto Protocol was ratified by the Bulgarian Parliament on July 17, 2002.

population is concentrated in the urban areas. Sofia – the largest city and the capital of the country – has a population of over a million inhabitants.
The relative share of the population in working age decreases. Currently every forth person in Bulgaria is a pensioner. The trends for the main demographic parameters – birth rate, death rate and natural increase are given in Figure S.1.

Figure S.1 Demographic parameters, ‰



Population density is 70.3 per sq km at the end of 2003. Bulgaria's population was 7 801.3 thousand people at the end of 2003. Due to more deaths than births, the population has decreased with 40 224 (or with 0.5%) for one year. The average age of the population for the country is 41.0 for 2003. The aging process is observed not only in the villages but also in the cities, while the average age for the villages is higher than in the cities. For the cities the index is 39.3 and for the villages it is 41.0 years. 5 431.8 thousand people live in cities in 2003, that is 70.0% of the population of the country, while 2 329.2 thousand (or 30.0%) live in villages.

Economic profile: The country has successfully achieved and continues to deliver macroeconomic stability after 1998. The introduced Currency Board, sound fiscal policy, limited pay raise, etc. have been rules, administrative in their nature, which are in the basis of the macroeconomic and financial stability. After the introduction of the currency board and the denomination of the lev in 1999, a slow increase in GDP is witnessed in the country. GDP growth is at moderate, balanced pace with no sudden fluctuations, typical for past periods. During the last few years of the analysis, the pace of GDP growth is bigger due to favourable economic climate in the country. The registered average annual real rate of growth (4.4%) is far beyond the rate of the European economies, which facilitates Bulgaria becoming closer to the EU.

The agriculture is one of the most important sectors of the Bulgarian economy. Much of the Bulgarian population is occupied in it. The sector forms a relatively small share of the GDP. Cultivated agricultural land covers 48% of the total territory of the country. The favourable climate for various cultures, the fertile soil and long standing traditions in the sector, low labour cost, the presence of colleges and high schools on modern farming training can support a promising development of this sector. Agriculture is in a crisis at present. Most of the farms are small and do not have at their disposal significant financial means. Various European funds are not enough efficiently used. The state must intervene to get out quickly of the crisis in this important structural sector of the Bulgarian economy.

Forestry is a traditional important economic sector for Bulgaria, where significant state investments for the last 40 years have created a potential for significant and sustainable logging in the future, when young plantations will grow and become suitable for felling.

The forests cover some 34% of the total area of the country, support valuable ecosystems and control erosion. A big share of these forests (39.8%) has special function – protective and rehabilitation. A potential problem in the sector is the slow pace of reforms and restructuring.

The objective of the **tax policy** is to reach macroeconomic stability, a sustainable economic growth, preparation of the country for EC membership and increase of social responsibility.

The objectives above cause reduction of the social security burden increase of indirect taxes, raising the threshold of the personal income amount not subject to taxation, profit tax reduction and raising the property tax assessment values. The Bulgarian government has declared its intention for lowering the corporate tax rates with several percentage points and also its intentions for new legislation on corporate tax and Value Added Tax.

Energy - Bulgaria imports 100% of the needed nuclear fuel, 99% of the oil, 99% of the natural gas and 44% of the coal. The structure of the Final Energy Consumption (FEC) for the Bulgarian economy predetermines a big share of secondary energies and necessity of transformation of a significant quantity of energy resources, i.e. about 40% of the energy resources included in the Primary Energy Consumption (PEC) are lost in the transformation processes. The primary energy intensity of the GDP drops down continuously for the period 1997-2003 but the pace of reduction has decreased after 2003.

Industry - The Bulgarian industry has gone its difficult way from centralized planned economy to the open gates of EU. As an ex member country of Comecon, in a short period of time, Bulgaria was industrialized with low efficiency heavy industry, which was also great resource consumer. The private sector and the main manufacturing sectors in the Bulgarian industry have a significant share in the growth during the last few years.

Transport - The transport network is characterized by a poorly developed infrastructure in all transport sectors. Bulgaria is drafting a concept for the development of transport infrastructure during the period 2005-2015. The vehicle park in Bulgaria is changing its structure not only in quantity but also in quality for the last few years. The increased number of passenger cars comes from the big import of second hand cars mainly from Germany, Austria and the Netherlands. This determines their relative high average age. The vehicles are 2 652 556 on 31.12.2003 and the unfavourable proportion in regard to their age related to the year of their initial registration is being kept. More than 1/3rd of the total number of vehicles is older than 20 years, which causes increased emissions in the atmosphere on one hand and increased number of car incidents on the other.

Waste - Landfilled solid waste is one of the key contributors for GHG emissions in Bulgaria.

S.3. Inventories of Greenhouse Gas Emissions by Sources and Removals by Sinks

The GHG Inventory for the year 2003 revealed that the overall GHG emissions expressed in CO_2–eqv. are 69 167 Gg not taking into account the sequestration in sector Land use Change and Forestry. The net emissions (including the sequestration from LUCF) are 62 111 Gg. In 2003 the CO_2 emissions form the largest share of 75 % from the overall GHG emissions expressed in CO_2-eqv.; the CH_4 emissions are second with 15 % and the N_2O emissions with a 10 % share stand in the third place.

There can be seen that in the year 2003 the overall of the GHG emissions expressed in CO_2-eqv. registered an increase. The emissions for the year 2003 are 50 % in comparison to the base year 1988 and they registered an increase with 9.2 % in comparison to the previous year 2002.

The "Energy sector" headed the list of emission sources in 2003 with the biggest share – 77 %. Sector "Waste" ranked the second place, and sector "Industrial processes" ranked the third place.

CO_2 emissions from **road transport** were key source of GHG emissions. These emissions were 9 % of the overall country emissions in 2003

S.4. Policies and Measures

The main framework of the environmental policy in the country is the National Environmental Strategy, which serves as a base for the activities in the environmental policy areas, including climate change.

Due to the forthcoming accession of Bulgaria to the European Union the country is harmonizing all the aspects of the environmental legislation with the EU legislation. Based on the legal acts the Government has approved set of secondary laws, regulations and methodologies of the MOEW and its subsidiaries, which are already operational. The harmonization of the legislation is ongoing and all the already approved and the future EU legislative initiatives in the field of climate change will find place within the Bulgarian legislation.

Institutional Organization

The Ministry of Environment and Water (MOEW) is the governmental institution authorized to develop and carry out the state policy related to protection of the environment. MOEW is responsible for the preparation and reporting of the annual inventories of GHG emissions, as well as for the formulation and implementation of the policies and measures to mitigate climate change.

The Inter-Ministerial Committee on Climate Change IMCCC was set up under the Governmental decision to coordinate the implementation of the First Action Plan on Climate Change in July 2000. The Committee consists of representatives from a majority of the ministries, the Energy Efficiency Agency and an observer from Sofia Municipality, and is chaired by Deputy Minister of MOEW.

The Steering Committee (SC) for Joint Implementation Projects is an evaluation body for Joint Implementation projects under the Kyoto Protocol. It consists of representatives from MOEW, the Ministry of Economy and Energy, the Ministry of Finance, the Ministry of Regional Development and Public Works, the Ministry of Agriculture and Forestry, the Executive Energy Efficiency Agency and the Bulgarian Investments Agency. The Committee is chaired by the Minister of MOEW. The SC evaluates proposed JI projects and advises the Minister of the Environment and Water in issuing / not issuing a Letter of Approval for each particular proposal.

The Interministerial Working Group for Development of the National Allocation Plan is composed of representatives of the MOEW, the MEE, the MRDPW, the MF, the NSI and representatives of NGOs: Bulgarian Chamber of Commerce and branch organizations of the industrial branches that are covered by the Scheme – Bulgarian Association of the Cement Industry, Bulgarian Branch Chamber of the Energetic, Branch Chamber of the Pulp and Paper Industry, Branch Chamber of the Glass Industry, Branch Chamber of the Iron and Steel Industry, Branch Chamber of the Chemical Industry, Bulgarian Union of the Ceramics.

The Executive Environmental Agency within MOEW performs monitoring of the implementation of climate change-related measures. The agency deals with water and air quality control and receives data from the monitoring stations nationwide. It also carries out the procedures on issuing the permits under the IPPC Directive. The Agency is responsible for the preparation of the GHG inventories, projections and registers. It carries out the procedures on issuing the GHG emission permits – considers the operators' application forms and drafts the permits. The National Administrator of the National Registry for issuing, possession, transfer and cancellation of the GHG emission allowances.

The Energy Efficiency Agency within MEER – organizes the implementation of projects and measures in accordance with the national long- and short-term energy efficiency programs; approves projects for energy efficiency and controls their implementation; participates in the preparation of legal regulations in the field of energy efficiency: proposes development and improvement of energy efficiency standards in order to achieve approximation to the EU norms and to encourage energy efficiency at the demand side; cooperates with central and regional governmental institutions, employers' associations, branch organizations, consumer associations and NGOs on implementation of energy efficiency policies and measures; develops programs for implementation and control of EE measures and programs for EE awareness rising; develops programs for implementation of EE on local (municipal) level; cooperates in implementing EE training.

Policy instruments

This section presents set of political instruments which could be applied in the Climate Change Policy. In functional plan, these instruments have an intersectoral impact and influence the economy and household in general.

● **Legal instruments and regulations** comprise of multilateral and bilateral international agreements, the EU legislation in the field of climate change and the national legislation, which relate to the climate change:

● **Fiscal policy** contains instruments to stimulate measures that reduce emissions of greenhouse gases and/or save energy.

● **Financing emission reduction projects** was hindered by a lack of financial resources, mainly caused by the economic situation of the country during the 1990s. Both private and public sector lack adequate financial resources to finance climate measures. It is expected that this situation will not significantly change in the period 2005-2008. Below some of the options are listed:

- Energy efficiency funds
- State Agricultural Fund (SAF)
- Kyoto Protocol Mechanisms - Joint Implementation, International Emissions Trading (Green Investment Scheme)
- EU structural funds

● **Education, research and development and awareness raising and public information**

● **National strategy for the Environment and Second National Action Plan 2005-2014**

The Strategy was developed for the period 2005-2014 together with an Action Plan 2005-2009. The National Strategy for the Environment is consistent with the principles of the prevention and reduction of the human health risk, integration of the environmental protection policy in the sectoral policies on the development of the economy and awareness of the citizens on the state of the environment.

● **Second National Climate Change Action Plan (2005-2008)**

The following four categories of actions are included in the updated Plan:

- Actions to implement mitigation policies and measures that result in GHG emission reductions in the different economic sectors in Bulgaria;
- Actions to create the necessary conditions for implementation of the mitigation measures, for instance institutional arrangements and awareness raising;

- Actions related to the monitoring and registration of GHG gases and the systematic evaluation of emission trends and projections, including the evaluation of policies and measures;
- Actions for the implementation of the Joint Implementation and Emissions Trading schemes.

The NAPCC comprises mainly measures that do not require budget financing, since the economic situation in Bulgaria does not allow for the allocation of significant funding and other public resources for implementing climate change-related policies and measures. Nevertheless, the plan includes a set of "backup" measures which can be implemented in case when the GHG emissions grow faster than expected one or when the economic situation in Bulgaria allows the Government to participate more actively in this field.

Sectoral policies and measures for reducing GHG emissions in Bulgaria

The need for Bulgaria to undertake mitigation measures is limited given the current GHG emission level and the expected emission trend. Implementing climate change measures are, however, also driven by other factors. Firstly, the commitments under the Climate Convention, the Kyoto Protocol and the EU accession require an active attitude of the country to mitigate greenhouse gas emissions.

Secondly, national and EU regulation require specific actions such as the implementation of standards, the development of a Green Certificates Scheme under the Renewable Energy Directive and Emissions Trading Scheme. And last but not least various climate change measures will lead to an energy efficiency improvement and contribute to long-term cost savings. Measures are envisaged for the following sectors:

- Energy sector
- Industry
- Residential and Commercial/Institutional Buildings
- Transport
- Agriculture
- Waste Management

S.5. Projections and Effects of Policies and Measures

Decision making for GHG emission mitigation is closely related to the actual GHG emissions in the country as assessed by the inventories and the projections for their mid-term trends (i.e. until 2020). GHG projections are elaborated taking in consideration the trends of key macro-economic, technological, demographic and other indicators that determine the economic development of the country.

Three scenarios for GHG emission projections until 2020 were developed, analysed and compared:

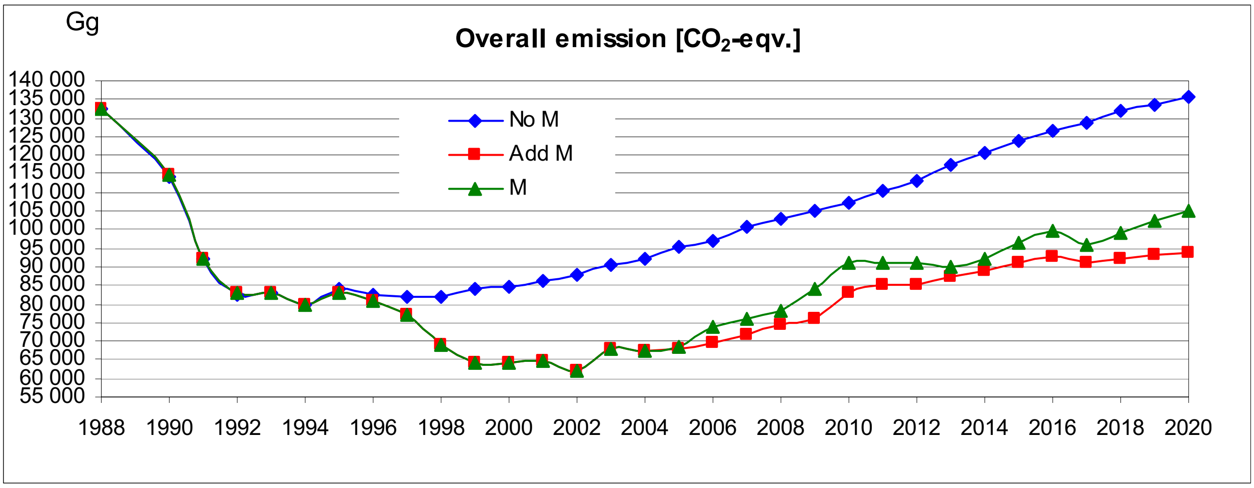
- "**without measures**" scenario
- "**with measures"** scenario
- "**with additional measures"** scenario

The "**without measures**" scenario is based on the assumption for intensive economic development with emphasis on energy intensive technologies and limited application of energy efficiency improvement measures in industry and agriculture. This scenario was originally developed in 1994 (before Bulgaria ratified the UNFCCC).

The "**with measures"** projection encompasses currently implemented and adopted policies and measures, and those measures that are given in the energy sector. This scenario projects relevant measures in the energy sector, while the rest of the sectors rely on already applied measures.

The “**with additional measures”** scenario comprises planned policies and measures for GHG mitigation. While in the “**with measures**” scenario the measures are more generally referring to environmentally friendly development, this scenario is more concentrated on the specific GHG mitigation measures and policies in the power sector. It is based on the same key macroeconomic characteristics.

Fig.S.2. Aggregated GHG Emissions, CO_2-eqv



First Commitment Period - Analysis of the projected emissions in Bulgaria during the 1st commitment period 2008-2012 shows that if there were no certain measures taken already for rapid increase of the efficiency of the economy in Bulgaria, the country would not be able to fulfil its obligation. During the period, the emissions would have exceeded by 12% the Kyoto target. The measures already taken are guarantee that the country meets the commitment. In addition, a significant potential for emission trading appears. For the “with measures” scenario, this potential is estimated at over 34 million tons of CO_2 equivalent on yearly basis. Should additional measures be implemented, the emission trading potential would reach about 41 million tons.

There is even a bigger potential for emissions reduction in Bulgaria, however it cannot be realized due to lack of investments. Yet the carrying out of Joint Implementation projects in the field of energy efficiency in the industry and building sectors, or projects for developing the natural gas household network would eventually lead to additional emission reduction in the amount of 10-15 million tons CO_2-equivalent.

S.6. Vulnerability Assessment, Climate Change Influence and Adaptation Measures

The observed warming in Bulgaria continued at the beginning of the 21st century. So far 2002 is the third warmest year for the last 15 years while 2004 was the seventh in a row after 1997 with temperatures higher than the annual average air temperatures (Figure S.3). Despite the fact that the annual average air temperatures in Bulgaria in 2005 were about ($\pm$ 0.2°C) the climatic values, the observed slight warming since the beginning of the 1980-ies continued in some areas of the country in 2005.

Climate change scenarios are developed for 2015, for the 2020s, 2050s and 2080s and climate scenario for the end of the 21st century

Some of the climate models simulate an increase of the air temperature in Bulgaria from 2 to 5°C having a two-fold increase of the carbon dioxide concentration in the atmosphere. For most climatic scenarios, winter precipitation are projected to increase until the end of the present century but precipitations will drop significantly for the warm half-year and mostly during the summer.

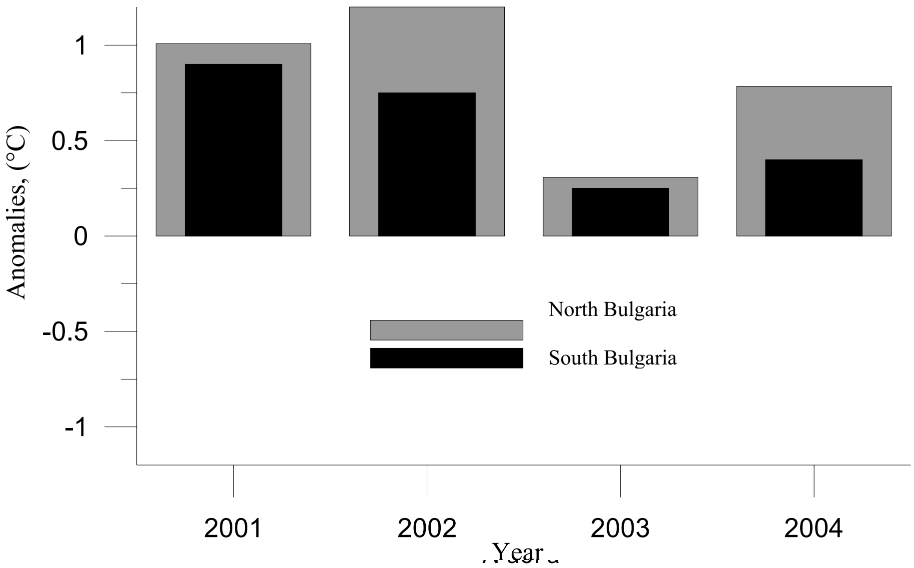


Figure.S.3. Anomalies (2001-2004) of annual average air temperatures in north Bulgaria and south Bulgaria relative to the climatic norms (1961-1990) (source: NIMH-BAS)

Climatic scenarios reveal that an increased risk and vulnerability to soil droughts are expected – an increase in the occurrence, intensity and level of impact of the soil droughts in Bulgaria for the 21st century. The soils with low capacity of moisture preservation and the regions in south-east Bulgaria are most vulnerable to those changes, in which areas precipitations during the warm half-year are low, even at present climatic conditions.

During the climate change in Bulgaria in the 21st century, most vulnerable will be: a) spring agricultural crops, due to the expected precipitation deficit during the warm half-year; b) crops cultivated on infertile soils; c) crops on non-irrigated areas; d) arable lands in south-east Bulgaria where even during the present climate, precipitation quantities are insufficient for normal growth, vegetation and productivity of agricultural crops.

The climate change scenarios derived for Bulgaria were used to evaluate potential changes in forest vegetation. The altered temperature and precipitation databases corresponding to each of the climate change scenarios were used to run the Holdridge life zone classification model. The GAP model results show that in case of climate warming over the next 90 years, the following consequences could be expected:

A. In the lowlands – Tree species diversity reduction. In spite of that, the biodiversity would be greater compared with the biodiversity in the mountain regions. The selected tree species guarantee increased bio-productivity. It could be considered that if proper selection is made, optimal bio-production could be released under changed climate conditions.

B. In mountains – Increased tree biodiversity could be expected. It could be realized by means of the natural shifting of tree vegetation from lower to higher sites in the mountains. This process would be combined with biomass production increase.

C. Both in lowlands and mountains – Increased biomass productivity would be accompanied by increased CO_2 absorption.

Soil diversity in Bulgaria is enormous. Soils have different characteristics, fertility and vulnerability to climate change. The temperature rise will increase the water deficit in soils with low precipitation rates that are prone to droughts. The most serious impacts will be observed for soils with light mechanical content and bad water characteristics and partly for heavy clay soils. About 30% of the soils in Bulgaria are prone to wind erosion.

The objectives of adaptation measures in agriculture are to support and sustain the agricultural production and to bring to minimum the impact of climate change by reducing the vulnerability of the agricultural crops. The adaptation to climate change will be carried out in various forms, including technological innovations, changes in arable land, changes in irrigation, etc. Technological innovations include the creation of new cultivars and hybrids, which have higher productivity during changes in the climate. Farmers can start growing other cultures or cultures, prone to drought and diseases. The sowing dates of spring crops in Bulgaria could shift under the GCM climate change scenarios in order to reduce the yield loss caused by temperature increase. Another option for adaptation is to use different hybrids and cultivars. There is an opportunity for cultivation of more productive, later or earlier-maturing, disease and pest tolerant hybrids and cultivars. Switching from maize hybrids with a long to a short or very short growing season projected an additional decrease of final yield under a potential warming in Bulgaria. However, using hybrids with a medium growing season would be beneficial for maize productivity. Technological innovations, including the development of new crop hybrids and cultivars that may be bred to better match the changing climate, are considered as a promising adaptation strategy. However, the cost of these innovations is still unclear.

For the forests in the low parts of the country (under 800 m a.s.l.), where the most significant impact from climate change is expected, the strategic objective of the management must be adaptation towards drought and improving forest sustainability.

For the forests in the higher parts of the country, i.e. those above 800 m a.s.l., where expected changes are not likely to be drastic, the objectives are preservation of biodiversity, eco system sustainability, multifunctional management, system of protected nature territories.

The natural and introduced forest wood and shrub species in Bulgaria have great potential for a good adaptation towards possible climate change in the present century.

S.7. Financial Resources and Technologies Transfer

Despite the fact that Bulgaria is an Annex I Party of the UN FCCC, as a country with economy in transition, it has no commitments to provide financial resources and technology transfer to developing countries. The country rather accepts financial and technological help, mainly within the framework of the Joint Implementation (JI) mechanism.

Through is flexible mechanisms, the Kyoto Protocol encourages the industrialized states to invest with clean, climate supporting technologies the countries with economies in transition as well as the developing countries. The Joint Implementation mechanism is an instrument, based on projects, aimed to encourage technology transfer for profitable greenhouse gases (GHG) emission reduction for Annex I countries.

The JI mechanism is a convenient and profitable way for Bulgaria to receive economic, technical and expert help with GHG mitigation efforts.

The basic principles of the national policy on climate change were developed on the basis of Bulgaria's good will to join the efforts of the international community to solve the climate change problems according to the potential of the national economy and looking at the opportunity to attract foreign investments, which will facilitate their implementation.

As an implementation of the signed bilateral agreements, 12 projects have been approved and some of them have already started. The execution of those projects will lead to greenhouse gases emission reduction at more than 8 mln. tons carbon dioxide equivalent for the period 2008-2012.

S.8. Education, Training and Public Awareness

Public interest in climate changes has been significant. Various governmental, non-governmental and social non-economic organizations have raised the issue on various occasions. However, the more serious problem is that a vast amount of people do not realize the increasing by the hour environmental threat for our planet. In this respect, each one of us, being direct or indirect component of the environment, can and must contribute to the protection of the environmental balance.

Bulgaria carried out a project for self assessment of the capacity of the country in the field of sustainable development in 2004. The results from the project in the section Environmental education and public awareness in climate change problems allow to define the priority topic, the explanation of which will improve not only the level of the educational system but also public awareness.

Three complexes and a number of specific reasons have been formulated as a reason for the unsatisfactory level of capacity. Specific objectives and tasks have been elaborated to improve the situation and direct and indirect assets have been recognized that allow the tasks to be solved in a short period of time.

The topics of environmental protection and climate change are included in school syllabuses in the educational and cultural field “Natural science and environment”. They are studied in most details in the “Geography” subject but also, even in lesser scale in “Environmental chemistry” and “Biology. In this context, one should add the necessity of introduction of compulsory environmental lessons in primary schools and outdoor activities.

A “Specialized course on vocational training of chemistry teachers on environmental protection” was carried out in 2005. It was on 3 stages during the school year. All 50 participants – chemistry teachers have obtained a certificate. The participants in the course have been selected from all over the country. The successful completion of the education can be used as a model for future training and elaboration of similar courses for training of teachers.

S.9. Research and Projects

The Bulgarian Academy of Sciences (BAS) carries out research and other activities on climate change. The information for this research is so big that can not be summarized and analyzed within this document. Work is going on not only on planned tasks with national financing but also in cooperation with research organizations from EU member countries within the Sixth Framework Programme.

Comprehending the significance of this problem, BAS established a National Coordination Centre for Global Change. The Centre for Global Change carries out work in the following directions:

– Organizational activity for strengthening of the Centre;
– Publication of books, papers, and other materials on global change problems;
– Participation in scientific conferences and discussions dedicated to global changes; Supporting the contacts of our scientists with foreign scientists, who work on the topics of global change;
– Public awareness on those changes.

On national level the centre puts efforts to strengthen the cooperation amongst Bulgarian institutions and organizations. In regard to this, it organizes discussions about the Second National Action Plan on Climate Change and the policy of MOEW on climate change; on climate change and global change project implementation, etc.

1 INTRODUCTION

The United Nations Framework Convention on Climate Change (UNFCCC), thereon referred to as the Convention, is the first and major international legal instrument to address climate change issues at a global scale. It was signed in June 1992 at the Rio de Janeiro Earth Summit by more than 150 countries; and entered into force on 21st March 1994. The ultimate goal of the Convention is to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level has to be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change; to ensure sufficient food production and to enable sustainable economic development.

Acknowledging the importance of the climate change issue and the need for international cooperation to address this problem, Bulgaria signed the UNFCCC in Rio de Janeiro in June 1992 and the Parliament ratified it in March 1995. In compliance with Article 4.6 and 4.2(b) of the FCCC, Bulgaria as a country in transition has adopted 1988 as a base year for the implementation of the Convention instead of 1990. As an Annex I Party of the UN FCCC the Republic of Bulgaria adopted the target to stabilize emissions of greenhouse gases by 2000 at a level not exceeded that in 1988. The same year was used when comparing, evaluating and projecting greenhouse gas emissions.

The First and Second National Communications of Bulgaria was elaborated by the Interministerial Committee supported by independent organizations and experts. The work was coordinated by the Ministry of Environment and Water.

The Third National Communication was a further step in elaborating and implementing the national climate change policy. It was delivered after the Kyoto Conference of the Parties and after the new commitments agreed by the Parties to the Convention. According to Annex B of the Kyoto Protocol[†] the quantified emission reduction commitment of Bulgaria for the first commitment period (2008-2012) is 8 % of the base year (1988) emissions.

The Kyoto Protocol (KP) was approved on the Third session of the Conference of the Parties in December 1997 in Kyoto, Japan. Until August 2004 KP was ratified by 159 countries, including Bulgaria which ratified it on August 15th, 2002. After its ratification by the Russian Federation in November 2004, the Kyoto Protocol entered into force on February 16th 2005.

The Third Communication was developed along the Guidelines adopted by the Second Conference of the Parties of the Convention. The Third National Communication of Bulgaria was elaborated by the Ministry of Environment and Water by assignment to the Energy Institute and under coordination of Interministerial Committee on Climate Change supported by independent organizations and experts.

The main principles of the national policy on climate change are presented in the Fourth Communication. The structure and organization of this report follow the UNFCCC Guidelines (FCCC/CP/1999/7). As the Kyoto Protocol entered into force since the beginning of 2005, the Communication reports also contain information in compliance with article 7.2 of the Protocol.

The nature of the GHG mitigation policies and measures in the country is set forth by the Second National Climate Change Action Plan 2005 – 2008 (NCCAP) adopted by the Bulgarian Government (decision No. 1012 / December 21, 2004).

[†] The Kyoto Protocol was ratified by the Bulgarian Parliament on July 17, 2002.

The three scenario presented in the Fourth Communication for GHG emission projections take into account the implemented and planned policies and measures from the Third Communication and the real GHG emission changes as in the annual inventories. The developed projections differ significantly from those in the Third Communication due to the dynamics of the characteristics of the problems on climate change in Bulgaria.

The institutional setup for implementation of the country’s climate change policy is represented by the Ministry of Environment and Water (MOEW) under the coordination of Inter-ministerial Climate Committee on Climate Change (IMCCC) established with the NCCAP. It monitors the overall implementation of the Action Plan; assesses the progress of the GHG emission reduction; adjusts the plan to the changing conditions in the country; tracks violations; and to develops compensatory measures to accomplish the objectives. The overall implementation of the plan is controlled by the MOEW.

The present report was prepared in parallel with the Report on demonstrable progress. The information in the Fourth National Communication is much more comprehensive than the one in the Third National Communication, allowing to be adopted for a basis of the draft of the Report on demonstrable progress.

The Fourth National Communication has been prepared by the Ministry of Environment and Water by assignment to the Energy Institute in cooperation with the, Ministry of Agriculture and Forestry, Ministry of Industry and Energy, Ministry of Economy and Energy, National Institute of Meteorology and Hydrology and Energy Efficiency Agency.

The Communication presents the overall situation in the country for the period since the Third National Communication till the end of 2005.

2 NATIONAL CIRCUMSTANCES

2.1. Background and Institutional Setting

The Ministry of Environment and Water is responsible for the overall national environmental policy in Bulgaria including the climate change problems.

It is responsible for the applying the adopted legislation on national scale and conceiving new legislation in the future. The problem for environmental protection is a global one and for this reason MOEW works together with almost all other ministries. The MOEW has the following subsidiary bodies: The Executive Environmental Agency, fifteen Regional Inspectorates for Environment and Water, three National Parks and four Basin Directorates.

The following organizations support the activities of MOEW: The Ministry of Economy and Energy (MEE), The Energy Efficiency Agency (EEA), The Ministry of Agriculture and Forestry (MAF), The Ministry of Finance (MF), The Ministry of Regional Development and Public Works (MRDPW), The Ministry of Education and Science (MES), The Ministry of Foreign Affairs, as well as The National Statistical Institute, The Bulgarian Academy of Sciences etc, which participate in the process of application, development and perfection of GHG mitigation measures, procedures and mechanisms. The coordination of climate change activities within interministerial working groups was accepted as a Good Practice and now the following are functioning: Interministerial Committee on Climate Change (IMCCC), Joint Implementation Steering Committee (JISC) and Interministerial Working Group for Development of the National Allocation Plan (IWGNAP). In this way the efforts of all concerned Governmental Agencies, business and NGOs are united.

Bulgaria has already started work on the application of the Directive establishing a scheme for greenhouse gas emission allowance trading (Directive 2003/87/EC). The emission trading scheme is the main EU instrument to fulfil the commitments under Kyoto Protocol. The Emissions Trading in the EU started on 01.01.2005, and Bulgaria is to start on 01.01.2007 along with the EU membership of the country.

2.2. Government Structure

The government type in Bulgaria is parliamentary democracy. Chief of state is President Georgi Parvanov and Vice President Angel Marin since 22 January 2002. They are elected on the same ticket by popular vote for five-year period.

The chairman of the Council of Ministers is the head of government – Mr. Sergey Stanishev since September 2005. The chairman of the Council of Ministers (the Prime minister) is nominated by the president and elected by the National Assembly.

The Bulgarian National Assembly (the Parliament) has 240 seats; members are elected by the popular vote for four-year terms.

The government activities are divided among 15 ministries. The Ministry of Environment and Water carries out all activities and responsibilities on the environmental protection and climate change problems.

2.3. Geographic Profile

Bulgaria is situated in the Southeast part of the Balkan Peninsula. The country has a territory of 110,993.6 sq. km., bordering Greece and Turkey to the South, FY Republic of Macedonia and

Yugoslavia to the West. The River Danube separates it from Romania to the North. Its natural eastern border is the Black Sea. Bulgaria ranks fifteenth in size among the European countries. Bulgaria is dominated by rugged mountains, except for the Danube lowland in the north that it shares with Romania. The lay of Bulgaria is highly varied. To the north there is rich farmland the Danube plane, 130 kilometres of sandy beaches on the Black Sea, and mountainous terrain characterizing some of the least densely populated parts of the country. To the south is the Balkan Mountain which slopes gently to the north and drop more abruptly to the south. Further to the south are the Rhodopes and to the west lies the highest mountain on the Balkan Peninsula – the Rila Mountain with the highest Bulgarian peak Mousala – 2,925 m. Bulgaria is scarce in water resources, despite that over 60 rivers flow trough the country. The Danube is the biggest one with total length of 470 km on Bulgarian territory. There are also 6 lakes with total area of 87 km^2 and water volume of 211 mln cubic meters, and 23 dams with total area of 376 km^2 and water volume of 4,571 mln cubic meters. Bulgaria has three National Parks – Pirin, Rila and Central Balkan. They have a total area of 193,049 hectares and comprise more than one-third of all protected areas in Bulgaria. The National Parks belong to the state. They are managed and administered by Directorates, operating under the Ministry of Environment and Waters. The Bulgarian National Parks offer excellent opportunities for tourism, scientific research and education.

2.4. Climate Profile

The climate in Bulgaria is temperate Continental-Mediterranean. Due to the geographical situation and the varied landscape, the contrasts in the climate are distinct among regions. The climate is with four distinctive seasons and varies with altitude and location. The Black Sea coast features a milder winter as opposed to the harsher winter conditions in the central north plains.

Bulgaria has five climatic zones - Moderate Continental, Intermediate, Continental-Mediterranean, Maritime and Mountainous. The main factor distinguishing the first three zones is the latitude, the terrain for the mountainous and the Black Sea for the maritime.

The heating season varies between 160 and 220 days for different locations. An important indicator describing the duration of the heating season and roughly the energy requirements for heating is the number of degree days. The heating degree days for indoor temperatures of 20°C vary between 2,100 and 3,500 for different regions in Bulgaria. For Sofia these are 2,500 on average annual basis.

The air humidity is between 66 and 85% in the different regions of the country. There is a stable snow cover during the winter of about 20-200 cm. The Thracian Plain and the north-eastern coastal area suffer from low rainfalls. The total annual quantity of precipitation measured at the 40 monitoring meteorological stations vary from 455 to 93 mm, which is 60% to 137% of the norm. The mean values in 1999 was 619 mm, which is 98.84% of the annual norm, by about 4.3% lower than the value for 1998, and by 6.4% lower than the value for 1997. The tendencies over the last years are: almost ubiquitous reduction of precipitation, especially in the mountain areas of the country; total annual quantities of precipitation in northeast Bulgaria, Black Sea coast, Upper Thrace Low-down, southwest Bulgaria, Vratza-Pleven and Sofia regions are lower; no change in the established annual rate of non-precipitation days.

The average wind speed is 1.2 m/s (1.3 m/s in winter time), while prevailing winds are west or northeast.

In the last few years the tendency is towards warmer and drier climate. 1998 had warm and dry winter, hot dry summer, cool dry spring, and cold and very rainy fall. These abrupt deviations from the normal climatic conditions reflect increased climate instability. Thus, the temperature amplitude recorded a maximum for the last decade. Significant are the amplitudes of the other climatic characteristics as well. 2000 was the warmest year in 30-year period, while the rainfalls were 60% less compared to standard values.

Considering its small area, Bulgaria has an unusually variable and complex climate. The country lies between the strongly contrasting continental and Mediterranean climatic zones. Bulgarian mountains and valleys act as barriers or channels for air masses, causing sharp contrasts in weather over relatively short distances. The continental zone is slightly larger, because continental air masses flow easily into the unobstructed Danubian Plain. The continental influence, stronger during the winter, produces abundant snowfall; the Mediterranean influence increases during the summer and produces hot, dry weather. The barrier effect of the Balkan Mountains is felt throughout the country: on the average, northern Bulgaria is about one degree cooler and receives about 192 more millimetres of rain than southern Bulgaria. Because the Black Sea is too small to be a primary influence over much of the country's weather, it only affects the immediate area along its coastline.

The Balkan Mountains are the southern boundary of the area in which continental air masses circulate freely. The Rhodope Mountains mark the northern limits of domination by Mediterranean weather systems. The area between, which includes the Thracian Plain, is influenced by a combination of the two systems, with the continental predominating.

Average precipitation in Bulgaria is about 630 millimetres per year. Dobrudja in the northeast, the Black Sea coastal area, and parts of the Thracian Plain usually receive less than 500 millimetres. The remainder of the Thracian Plain and the Danubian Plateau get less than the country average; the Thracian Plain is often subject to summer droughts. Higher elevations, which receive the most rainfall in the country, may average over 2,540 millimetres per year.

The many valley basins scattered through the uplands have temperature inversions resulting in stagnant air. Sofia is located in such a basin, but its elevation (about 530 meters) tends to moderate summer temperature and relieve oppressive high humidity. Sofia also is sheltered from the northern European winds by the mountains that surround its trough like basin. Temperatures in Sofia average -2°C in January and about 21°C in August. The city's rainfall is near the country average, and the overall climate is pleasant. The coastal climate is moderated by the Black Sea, but strong winds and violent local storms are frequent during the winter. Winters along the Danube River are bitterly cold, while sheltered valleys opening to the south along the Greek and Turkish borders may be as mild as areas along the Mediterranean or Aegean coasts.

2.5. Population Profile

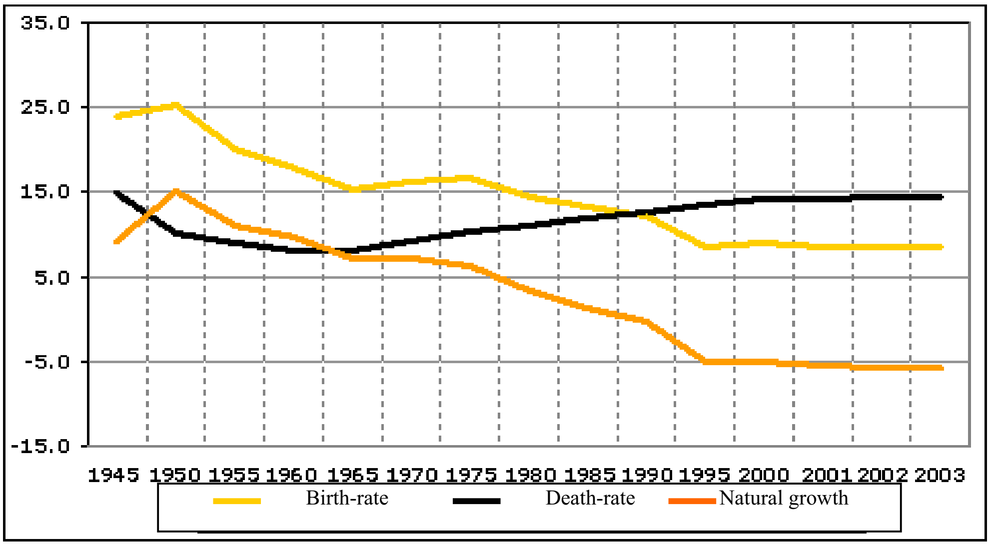
The demographic picture in Bulgaria is unfavourable at the beginning of the XXI century. It ranks the country amongst those in Europe with negative rate of natural increase, low birth rate, high adult mortality and child death rate, decreasing average age of population.

Table 2.1 Demographic data for the country

	1960	1970	1980	1990	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Birth rate ‰	17.8	16.3	14.5	12.1	9.4	8.6	8.6	7.7	7.9	8.8	9.0	9.0	8.5	8.6
Natural increase ‰	9.7	6.0	3.4	–0.4	–3.8	–5.0	–5.4	–7.0	–6.4	-4.8	-5.1	-5.6	-5.8	-5.7
Marriage rate‰	8.8	8.6	7.9	6.9	4.5	4.4	4.3	4.2	4.3	4.3	4.3	4.0	3.7	3.9
Average age of population	32.4	34.4	35.8	37.5	38.5	38.9	38.8	39.2	39.4	39.6	39.9	40.4	40.6	40.8

Most of the population is concentrated in the urban areas. Sofia – the largest city and the capital of the country – has a population of over a million inhabitants. The next largest cities – Plovdiv and Varna – have population of about 300,000 people. Despite the positive natural rate for the urban population the emigration process led to its decrease. The relative share of the population in working age decreases. Currently every forth person in Bulgaria is a pensioner. The trends for the main demographic parameters – birth rate, death rate and natural increase are given in Figure 2.1.

Figure 2.1 Demographic parameters, ‰



Population density is 70.3 per sq km at the end of 2003. According to preliminary data, Bulgaria's population is 7801.3 thousand people at the end of 2003. Due to more deaths than births, the population has decreased with 40 224 (or with 0.5%) for one year.

The average age of the population for the country is 41.0 for 2003. The aging process is observed not only in the villages but also in the cities, while the average age for the villages is higher than in the cities. For the cities the index is 39.3 and for the villages it is 41.0 years.

Average life expectancy in Bulgaria is 68.68 for male and 75.59 for female for the period 2001-2003. In comparison, the average life expectancy for 1935-1939 was respectively 50.98 and 52.56, and for the period 1984-1986 it was 68.17 for male and 74.44 for female.

The change in the trend of population change in Bulgaria is given in Figure 2.2.

In total, women continue to be more (51.5%)

5 431.8 thousand people live in cities in 2003, that is 70.0% of the population of the country, while 2 329.2 thousand (or 30.0%) live in villages.

2.6. Economic Profile

The country has successfully achieved and continues to deliver macroeconomic stability after 1998. The introduced Currency Board, sound fiscal policy, limited pay raise, etc. have been rules, administrative in their nature, which are in the basis of the macroeconomic and financial stability. The functioning of the companies of the real economy, despite some positive trends, mainly in the sales growth, is still not leading to overcome the crisis in the real economy. The Gross Domestic Product, 2003 has reach 93% of the one in 1990. The level of pay rise in the country is 40% bellow the one in 1990.

As a result the average economic growth for the last five years was 4.1% and the inflation was decreasing.

After the introduction of the currency board and the denomination of the lev in 1999, a slow increase in GDP is witnessed in the country. The economic growth is stable and within a moderate range. Still, GDP levels are far bellow the desired levels. The trends of GDP change in mil. leva is given in Figure 2.3.

Figure 2.2. Bulgaria's population

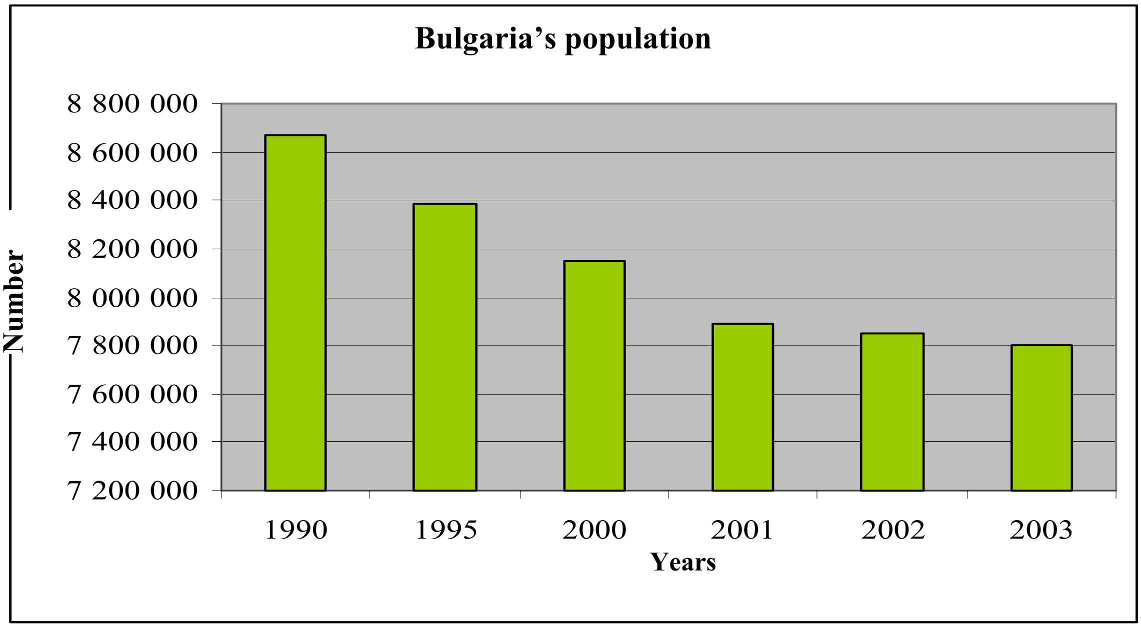
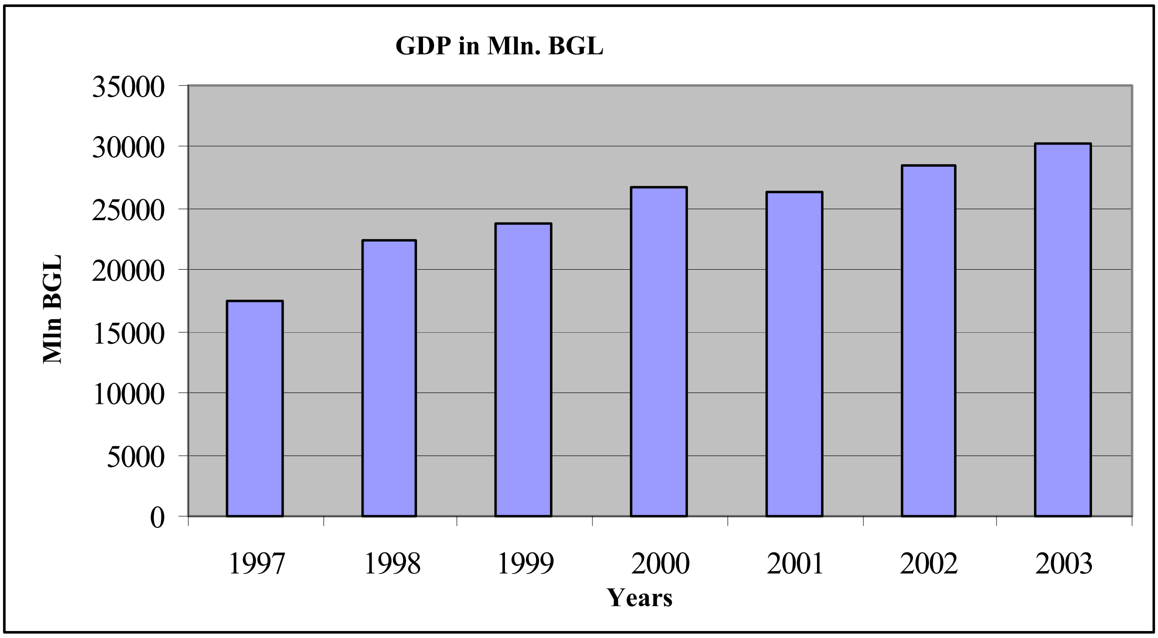


Table 2.2 GDP, current prices

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003
Gross Domestic Product (mil. Lv)	45390	880332	1761	17433	22421	23790	26753	26356	28526	30227
GDP (annual real growth rate, %)	-9.1	2.9	-10.1	-7.0	3.5	2.4	5.8	4.1	4.9	4.5
GDP per capita USD)	1163	1564	1190	1251	1548	1582	1546	1723	1984	2082

Source: NSI

Figure 2.3 GDP in mil. lv, present, denominated



GDP growth is at moderate, balanced pace with no sudden fluctuations, typical for past periods. During the last few years of the analysis, the pace of GDP growth is bigger due to favourable economic climate in the country. The main economic indicators are given in Table 2.3.

Table 2.3 Main economic indicators

	1997	1998	1999	2000	2001	2002	2003
Interest rate	7.0	5.2	4.6	4.7	4.8	3.8	5.6
Current account balance (% of GDP)	4.4	–0.5	–5.5	–5.5	-7.3	-5.6	-9.2
Gross currency reserves (million USD)	2.468	3.056	3.222	3.46	5.2	5.6	5.7
Gross debt (% of GDP)	95.9	81.8	79.7	83.4	78.6	65.1	60.2
Direct foreign investments (% of GDP)	4.9	4.4	10.5	6.6	8.1	5.9	10.5

Source: NSI

The registered average annual real rate of growth (4.4%) is far beyond the rate of the European economies, which facilitates Bulgaria becoming closer to the EU.

The introduction of the Currency Board lowered the inflation and became an important prerequisite for the revival of the economic activities. The accumulated GDP growth is more than 30% for the period 1988-2003. The inflation was reduced significantly and has come nearer the level of the industrial states.

The start position to reach the standards of the EU member states looks already good: low budget deficit and low inflation, adequately capitalized currency board and lower debt/GDP ratio.

The main problems for the country come from the relatively high unemployment, high current account deficit, uneven level of economical development and living standard in different regions.

Foreign investments rise significantly due to the increased confidence in the Bulgarian institutions and stable business situation.

The external trade of the country shows the level of economic development, currency stability, technological development, etc. Data on external trade and trade balance is given in Table 2.4. Import significantly surpasses export and this negative trend increases.

Table 2.4 Trade balance

	1998	1999	2000	2001	2002	2003
Export mil. lv	7575.8	7302.6	10274.1	11176.1	11857.9	13041.9
Import mil. lv	8 827.5	10052.8	13856.8	15896.6	16450.9	18796.6
Trade balance	-474.7	-2 058.2	-2 503.3	-3478.1	-3 309.0	-4 302.0

Source: NSI

2.7. Privatization

The denationalization became a priority only at the beginning of 1993 and was put into practice only at the beginning of 1996 with the appropriate privatization forms and mechanisms, etc. It was not embedded in a clear enough vision on the structural reforms in the national economy and for the development of the real economy in the new market environment. Contradictory views and because of this – programs for denationalization of ruling governments lead to failure to achieve the necessary swift and favourable effects on the market situation.

The prevailing fragmented private property in industry, agriculture and tourism and at the same time significant share of the state in areas like gas supply, railway transport, road infrastructure, partial power supply and power transportation lead to worsening business environment and reducing the possibilities for fast economic growth.

2.8. Sectors

The importance of the private sector in Bulgaria's GDP increases in the last few years. In relative structural terms, in regard to the private sector, the sector Services has the biggest importance. Just after it ranks the Industry sector.

Table 2.5 Relative share of the private sector in GDP (%)

	1996	1997	2000	2001	2002	2003
Private sector (total)	52.8	56.7	61.6	63.4	64.3	64.5
Agriculture and forestry	15.1	26.2	13.9	13.7	12.1	11.4
Industry	30.7	27.9	29.1	28.5	29.1	29.7
Services	54.2	45.9	57.0	57.9	58.8	58.6

Source: NSI

The indicator "GVA, private sector" is the Gross Value Added from producers, classified according to the type of property in the private sector: private, non-finance finance enterprises, households, non-trade organizations, service households.

It is necessary to take into account the increased importance of the private sector in the Bulgarian economy for the analyzed period. The Services sector remains the biggest with largest relative share in the travelled way toward market economy.

One disturbing fact is the drop in the agricultural sector. This is an important sector for the Bulgarian economy together with Tourism, taking into consideration the geographic location of the country and its climate profile. This negative trend is since the year 2000. To overcome this trend, the country must adequately use the EC agricultural structural funds, to introduce preferential state policy in the sector and initiate entrepreneur training of the Bulgarian farmers regarding their entrepreneurial spirit.

2.8.1. Land Use and National Resources

Bulgaria territory is endowed with a variety of both metallic and non-metallic minerals. Geologic exploration has identified about 40 coal basins, which together contain an estimated 4.1 billion tons of proven recoverable reserves. Of the reserves, virtually all is lignite. The main mining areas are in the Pernik basin south-west of Sofia, the Maritsa basin south of Stara Zagora, the Maritsa basin at Dimitrovgrad in the south, and Lom on the Danube. Lignite and brown coal fuel the country's thermal power stations and are used as fuel and as raw material for many of its industries. Although deposits of bituminous and anthracite coal have been almost exhausted in Bulgaria, other promising deposits of black coking coal have been found in the northeast, in the Dobruja region Deposits of iron ore are estimated at 317 million tons; one of the largest reserves is at Kremikovtsi near Sofia, the site of the country's largest metallurgical plant. Smaller quantities of iron ore are mined in the northwest (Montana [formerly Mikhaylovgrad]), in the central region (Troyan), and in the southeast (Yambol). There are significant deposits of nonferrous ores (copper, lead, and zinc) in the Rhodope Mountains, the Balkan Mountains, and the Sredna Gora Mountains. Bulgaria is also rich in less valuable minerals, including rock salt, gypsum, limestone, dolomite, kaolin (china clay), asbestos, perlite, feldspar, fluorite, and barite. Bulgaria has only small deposits of oil and natural gas; mineralogists have begun offshore exploration of the Black Sea, which is believed to be rich in coal, oil, natural gas, and other minerals.

Table 2.6 Land use in Bulgaria – general information

Arable land	43%
Permanent crops	2%
Permanent pastures	14%
Forests and woodland	38%
Other	3%
Irrigated land	12,370 sq.km

Source: MAF

2.8.2. Agriculture

Agriculture is one of the most important sectors of the Bulgarian economy. Much of the Bulgarian population is occupied in it. The sector forms a relatively small share of the GDP.

Bulgaria has excellent natural conditions for the development of **agriculture**. Cultivated agricultural land covers 48% of the total territory of the country. The favourable climate for various cultures, the fertile soil and long standing traditions in the sector, low labour cost, the presence of colleges and high schools on modern farming training can support a promising development of this sector.

Agriculture is in a crisis at present. Most of the farms are small and do not have at their disposal significant financial means. Various European funds are not enough efficiently used. The state must intervene to get out quickly of the crisis in this important structural sector of the Bulgarian economy.

2.8.3. Forestry

Forestry is a traditional important economic sector for Bulgaria, where significant state investments for the last 40 years have created a potential for significant and sustainable logging in the future, when young plantations will grow and become suitable for felling.

The forests cover some 34% of the total area of the country, support valuable ecosystems and control erosion. A big share of these forests (39.8%) has special function – protective and rehabilitation. A potential problem in the sector is the slow pace of reforms and restructuring.

In the following two tables – Table 2.7 and Table 2.8, data for the forest areas in Bulgaria is given and also – activities for afforestation.

Table 2.7 Total and wooded forest area

Type of forest	1993	1995	1999	2000	2001	2002	2003
Total	**3877**	**3876**	**3894**	**3914**	**3980**	**4003**	**4015**
Coniferous	1318	1304	1214	1282	1295	1291	1289
Non-coniferous							
High-stemmed	1586	1579	1561	1535	1541	1525	1501
Low-stemmed	973	993	1059	1097	1144	1187	1225
of which: Wooded forest area	3329	3334	3347	3375	3443	3489	3526
Coniferous	1176	1154	1113	1115	1123	1122	1126
Non-coniferous							
High-stemmed	1246	1251	1244	1237	1253	1256	1252
Low-stemmed	907	929	990	1023	1067	1111	1148

Source: Forest Research Institute, Bulgarian Academy of Sciences

Table 2.8 Activities for afforestation

Year	1993	1995	1999	2000	2001	2002	2003
Afforestation (ha)							
Preparation of area	10620	10911	7598	6056	5475	8295	8105
Afforestation	16473	14367	7740	6313	5031	7134	8377
Establishing of intensive plantation	1476	959	1287	952	643	881	967
Reforestation of artificial forest	4623	4892	2697	2086	2344	2733	2352

Source: Forest Research Institute, Bulgarian Academy of Sciences

Data from Table 2.8 presents some disturbing facts for the last few years. The preparation of areas for afforestation has decreased with 30% for the last decade.

The Bulgarian Government Program 2001 – 2005, has identified the following main priorities in the areas of agriculture and forestry:

1. Efficient management of agriculture and forestry resources and development of market structures.
2. Increasing the competitiveness of primary and secondary agricultural sector and creating conditions for development of export oriented agriculture.
3. Preparation for the implementation of the requirements of EU common market and cap mechanisms, as well as adherence to international agreements.
4. Sustainable rural development.
5. Eco-friendly and sustainable management of forestry resources, game and protected natural areas.

2.9. Biodiversity

The big variety of habitats and biogeographic conditions has lead to a diversity of the flora and fauna in the country, ranking Bulgaria amongst the first in Europe.

Table 2.9 Biodiversity

Groups of organisms	Europe	Bulgaria	Endemic taxons/ Rare taxons/ Protected species		
Protozoa	n.a.	1 800	n.a.	422	0
Fungal/mushrooms	n.a.	3 500	n.a.	n.a.	0
Seaweeds and pubescence	n.a.	3 666	n.a.	41	0
Mosses	n.a.	709	14	25	0
Higher plants	12 500*	3 750	170	728	389
Invertebrates	200 000*	23 180*	1 131	2 125	All cave habitats and 11 insect species
Fresh water fish	227	122	10	17	0
Amphibians	71	16	1**	0	14
Reptiles	199	36	4**	2	21
Birds	520	383	0	78	327
Mammals	250	94	6**	10	45
* - approximately ** - subspecies n.a. – not available					

One of the main ways for the protection of this biodiversity and landscape diversity is the protection of territories. According to the Forest Act, the National Forestry Directorate (NFD) at MAF creates a special purpose system of forests, the objective of which is the protection and increase of the non-wood producing functions of the forest eco systems. These areas, reaching 34% of the total area of the state forest fund, have a management regime categories I to VIII as in the protected area territories classification of IUCN.

A system of recreational forests has been established around the national tourist and balneo centres, vacation villages and big cities. Its objective is to create optimal conditions for relaxation, tourism and treatment of the citizens. Their area is 237 903 ha.

The protection of the genetic fund of forest wood species is carried out with the creation of seed-funds, plantations, dendrary botanical gardens and botanical gardens with an total are of 44 622 at present.

The hunting grounds encompass 140 127 ha area and are located in territories, where the genetic fund of the game and its population is being preserved and increased.

Having 3 567 higher plants on its territory, Bulgaria ranks 5th in Europe on number of species. Bulgaria also has 750 medical plants.

2.10. Taxes and Charges. Tax Policy

The objective of the tax policy is to reach macroeconomic stability, a sustainable economic growth, preparation of the country for EU membership and increase of social responsibility.

The objectives above cause reduction of the social security burden, increase of indirect taxes, raising the threshold of the personal income amount not subject to taxation, profit tax reduction and raising the property tax assessment values.

Changes in tax legislation that shift the tax burden from direct to indirect taxes are in the right direction, but without a reduction of the total burden itself they will be only of redistributive nature.

The Bulgarian government has declared its intention for lowering the corporate tax rates with several percentage points and also its intentions for new legislation on corporate tax and Value added tax.

2.11. Energy and Industrial Profile

2.11.1. Energy Profile

The big and swift industrialization of Bulgaria during the 60-ies of the last century determined the energy profile of the country. Industry is the biggest energy consumer with the energy intensity of the consumption of the sector decreasing during the last few years. The development of the Services sector and its bigger share in GDP are the logical reason for an increase of the energy consumption in the transport sector. Data on the structure of energy consumption in Bulgaria are given in Table 2.10.

Table 2.10 Structure of final energy consumption (Per cent)

	1995	1999	2000	2001	2002	2003
Industry	52.7	39.9	40.9	40.3	38.2	38.4
Transport	5.9	23.2	21.8	23.2	24.1	25.3
Households	30.5	25.7	26.0	24.2	25.7	25.1
Others	10.9	11.2	11.3	12.4	11.9	11.3
Total	100	100	100	100	100	100

Source: NSI

Industry is the biggest energy consumer in Bulgaria's economy.

Table 2.11 Final energy consumption (PJ)

	1995	1999	2000	2001	2002	2003
Industry	250.3	146.02	144.5	142.0	136.3	147.5
Transport	27.9	85.0	77.0	81.6	86.1	97.1
Households	145.0	94.2	91.7	85.1	91.8	96.5
Others	51.5	41.1	40.0	43.6	42.6	43.4
Total	**474.7**	**366.2**	**353.2**	**352.3**	**356.8**	**384.5**

Source: NSI

Public administration, in control and responsible for energy and industry includes:
● Ministry of Economy and Energy
● Energy Efficiency Agency (EEA)
● State Energy and Water Regulatory Commission
● Agency for Nuclear Regulation
● Ministry of Environment and Water

Bellow is given organizations, part of which non-governmental, engaged with the problems of the economy and the energy sector.
● Local and Regional Energy Agencies and Energy Bodies
● Sofia Energy Agency SOFENA;
● Foundation Regional Energy Centre
● The Foundation Regional Energy Centre located in Lovech acquires and transfers information, technology and know-how to the region and Bulgaria.
● Energy Agency of Plovdiv
● Union of Bulgarian Black Sea Local Authorities
● Black Sea Regional Energy Centre

Energy related funds and programmes:

● Bulgarian Energy Efficiency Fund
● Bulgarian National Programme on Renewable Energy Sources, draft
● Bulgaria Municipal Energy Efficiency Program.

Bulgaria imports 100% of the needed nuclear fuel, 99% of the oil, 99% of the natural gas and 44% of the coal. The structure of the Final Energy Consumption (FEC) for the Bulgarian economy predetermines a big share of secondary energies and necessity of transformation of a significant quantity of energy resources, i.e. about 40% of the energy resources included in the Primary Energy Consumption (PEC) are lost in the transformation processes.

Solid and liquid fuels, which are on market prices and also secondary energies (electricity and heat energy), whose prices are being regulated, decrease their share in FEC. The share of natural gas started to grow fast after 2002, following a long period of decrease. The biggest consumer of electricity and heat energy, as well as biomass (wood burning) is the household.

After a long period of decrease FEC started to increase extensively faster than GDP in 2003. The Industry sector is the decisive one for the high value of FEC.

The primary energy intensity of the GDP drops down continuously for the period 1997-2003 but the pace of reduction has decreased after 2003.

2.11.2. Industrial Profile

The Bulgarian industry has gone its difficult way from centralized planned economy to the open gates of EU. As an ex member country of Comecon, in a short period of time, Bulgaria was industrialized with low efficiency heavy industry, which was also great resource consumer.

The private sector and the main manufacturing sectors in the Bulgarian industry have a significant share in the growth during the last few years, which can be seen in data in Tables 2.12 and 2.13 bellow.

Table 2.12 Output of the industrial enterprises by kind of ownership (Per cent)

	1990	1995	1999	2000	2001	2002	2003
Total	100	100	100	100	100	100	100
Public sector	99.2	88.8	49.6	25.4	22.3	21.4	16.6
Private sector	0.8	11.2	50.4	74.6	77.7	78.6	81.4

Table 2.13 Output of the industrial enterprises (Per cent)

Sector	1990	1995	1999	2000	2001	2002	2003
Mining and quarrying	3.2	5.7	5.5	5.1	4.7	4.3	4.2
Manufacturing	92.3	86.8	79.3	80	79.8	78.6	80
Electricity, gas and water supply	4.5	7.5	15.2	14.9	15.5	17.1	15.8

Source: NSI

2.12. Transport

Bulgaria had 19265 roads on 31.12.2003. 18684 of them are asphalt paved. In structural terms the majority are category 3 roads with a 62.1% share, followed by category 2 – 20.8%. Highways are 345 km with the lowest relative share – 1.7%.

The transport network is characterized by a poorly developed infrastructure in all transport sectors.

Bulgaria is drafting a concept for the development of transport infrastructure during the period 2005-2015.

Data on carried passengers and transport of goods is given in Tables 2.14 and 2.15, respectively.

Table 2.14 Passengers carried – thousands

Year	1993	1995	1997	2000	2001	2002	2003
Total	1451820	1301152	1091126	1506645	1478151	1123950	1161266
Land transport	1096158	967343	709439	1158551	1130505	810872	830272
Waterway transport	81	28	31	76	67	60	79
Air transport	1848	1297	1209	1261	861	856	1471
Urban electrical transport	277648	273544	297791	346757	346718	312162	329444

Table 2.15 Transport of goods - thousand tons

Year	1993	1995	1997	2000	2001	2002	2003
Total	130427	109978	77053	96001	95000	110745	107011
Land transport	74101	48393	19717	75514	76959	93560	92826
Waterway transport	16575	19210	20542	20465	18037	17178	14174
Air transport	18	14	13	22	4	7	13

Source: NSI

The Bulgarian vehicle motor park is changing dynamically for the last few years. There is a steady increase for all kind of vehicles, which reflects in the increased traffic on the streets. Data on the number of motor vehicles is given in Table 2.16.

Table 2.16 Number of motor vehicles

Year	1993	1995	1997	2000	2001	2002	2003
Passenger cars	1505451	1647571	1730506	1992748	2085730	2174081	2309343
Lorries	185824	203257	210960	237655	245962	255412	268098
Special vehicles	40282	40605	40051	41798	42464	43241	44408
Busses	39280	41019	40422	42306	42870	41172	43687
Motorcycles and mopeds	514598	519266	524950	522374	526046	530262	535669

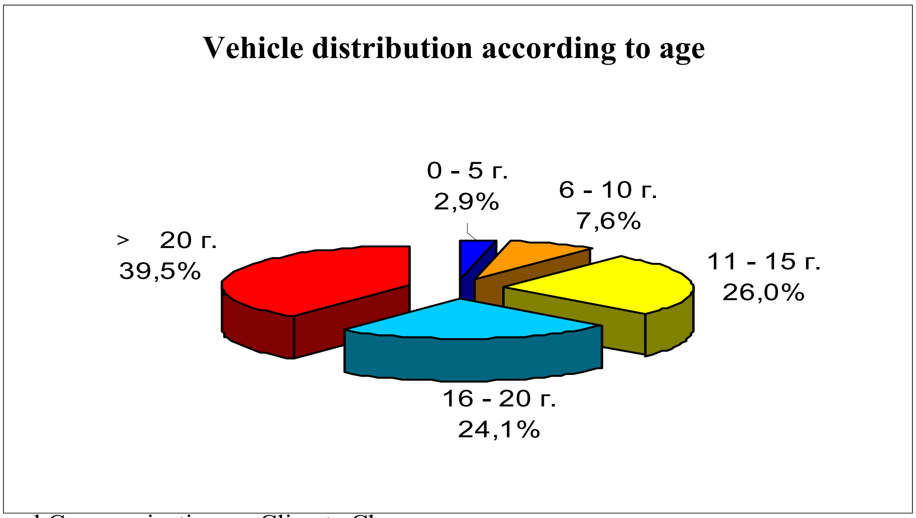
Source: NSI

The most stable growth is for passenger cars and lorries, while there is almost no change for motorcycles and mopeds.

The vehicle park in Bulgaria is changing its structure not only in quantity but also in quality for the last few years. The increased number of passenger cars comes from the big import of second hand cars mainly from Germany, Austria and the Netherlands. This determines their relative high average age.

The vehicles are 2 652 556 on 31.12.2003 and the unfavourable proportion in regard to their age related to the year of their initial registration is being kept as seen in Figure 2.4.

Figure 2.4. Vehicle distribution according to age, %



Data from Figure 2.4 show the unsatisfactory age level of the vehicles in Bulgaria. More than 1/3rd of the total number of vehicles is older than 20 years, which causes increased emissions in the atmosphere on one hand and increased number of car incidents on the other.

Current transport project with necessity for accelerated implementation:

- Danube bridge II – in the "Vidin-Kalafat" area;
- Rail road "Plovid-Svilengrad";
- Rail road "Karnobat-Sindel";
- Motorway "Lyulin";
- Dock complex "Lom";
- Construction of a terminal for combined transport in the area of the city of Sofia (Kazichane);
- Construction of the south arc of the Sofia ring road motorway
- Motorway "Trakia";
- Motorway "Maritca"

Those entire projects are at a different stage of realization. The common feature is the delay as to the planned schedule in the official investment programs of several governments. A trend of a constant increase of the planned resources is observed.

2.13. Waste

Landfilled solid waste is one of the key contributors for GHG emissions in Bulgaria. Some typical parameters for the collected waste are given in Table 2.17.

Table 2.17 Waste, thousand tons

Year	**1993**	**1995**	**1999**	**2000**	**2001**	**2002**	**2003**
Industrial non-hazardous waste	267819	254625	174709	92335	86397	79632	84313
of which: Landfilled	264010	251247	174067	91306	85142	78812	83375
Collected municipal waste	.	.	3213	3318	3211	3199	3209
Final landfilled municipal waste	.	.	3197	3271	3198	3188	3194

Source: IE and NSI

A number of attempts for capturing of methane at landfills have been made and using it as an energy source. So far the practice in Bulgaria is to only burn small quantities hazardous waste from the pharmaceutical industry.

Industrial and household waste water treatment is also a methane emission source. A planned discharge at several tailing ponds has been carried out. This lead to a significant increase of methane emissions from waste water, which has not been typical for the transitional period 1988-2002.

3 INVENTORIES OF GREENHOUSE GAS EMISSIONS BY SOURCES AND REMOVALS BY SINKS

3.1. Introduction

This chapter report represents information for the annual GHG Inventory in Bulgaria for 2003. This Inventory is prepared according to the UNFCCC Guideline approved by the Subsidiary Body for Scientific and Technological Appliance on The 21st session on 06-14.12.2004 in Buenos Aires. The rules and the structure of the National GHG Inventory Report are formed by this Guideline. The report is elaborated in compliance with the Revised IPCC Guidelines, 1996 and Good Practice Guidance for National GHG Inventories, 2000

According to the UNFCCC Guidance, the Inventory should be prepared in a way that ensures Transparency, Consistency, Comparativeness, Completeness and Accuracy.

These qualities of the Inventory are elements of the "Good Practices" were pointed out in the IPCC Good Practice Guidance, 2000.

That is the reason why the current report also presents the GHG emissions trends for the period 1988-2003. There are described as well:

- Methods and data for assessment of the uncertainty of the annual GHG emissions and trends;
- Key sources of the GHG emissions according to the methods from type Tier 1 and Tier 2 described in the Good Practice Guidance;
- Assessment of the system of Appliance and Control of the Quality.

Key sources

In defining the key sources of GHG emissions, the IPCC methodology, proposed in the Good Practice Guidance for GHG Inventories, is used.

The list of the key sources for 2003 is changed compared with the one in 2002. There are added two new key sources: CO_2 emissions from non-energy usage of natural gas and CH_4 emission from waste water treatment. The source for fugitive CH_4 emissions from the systems for extraction and transportation of oil and gas is dropped out.

The determination of the key sources according to the method type Tier 1 treats the national total annual emissions as well as the total trend for annual emissions.

The results from applying Tier 1 method in its two varieties (quantitative assessment of the participation in the total emissions and assessment of the trend of each source toward the total emission trend) are presented in details in Annex 1 of this report. From the total 39 emission sources, the key emission sources are 19 based on the quantitative assessment and 18 sources according to the trend assessment and the two types of assessment they give 95 % of the total quantity of the GHG emissions expressed in CO_2-eqv.

3.2. Trends of Bulgaria's Greenhouse Gas Emission

The GHG Inventory for the year 2003 revealed that the overall GHG emissions expressed in CO_2–eqv. are 69 167 Gg not taking into account the sequestration in sector Land use Change and Forestry. The net emissions (including the sequestration from LUCF) are 62 111 Gg.

The main greenhouse gases to be reported pursuant to UNFCCC are as follows:

● Carbon dioxide - CO_2

● Methane - CH_4
● Nitrous oxide - N_2O
● Hydrofluorocarbons – HFCs
● Perfluorocarbons - PFCs
● Sulphur hexafluoride - SF_6.

Each of these gases has a warming effect which can be distinguished by its amount. As an example, the gases HFCs, PFCs and SF_6 (so called F-gases) have much greater warming effect compared to methane, nitrous oxide and carbon dioxide.

Table 3.1 represents the emission trends of the basic GHG, the overall emissions (not taking into account the LUCF) and the relative share of the overall emissions to the emissions from the base year 1988 referred to as 100 %.

The analysis of the **Table 3.1** reveals that in 2003 the CO_2 emissions form the largest share of 75 % from the overall GHG emissions expressed in CO_2-eqv.; the CH_4 emissions are second with 15 % and the N_2O emissions with a 10 % share stand in the third place.

There can be seen that in the year 2003 the overall of the GHG emissions expressed in CO_2-eqv. registered an increase. The emissions for the year 2003 are 50 % in comparison to the base year 1988 and they registered an increase with 9.2 % in comparison to the previous year 2002.

The summary emissions from GHG-precursors and SOx are shown in **Table 3.2.**

3.3. Summary of Methodology and Data Sources

Carbon dioxide emissions

The CO_2 emissions are derived by combustion of fuels in the energy sector, transport and households. Data from the energy balance of the country is used for emission calculation.

Parameters, specified in the Revised IPCC Guidelines, are used for estimation of the carbon stocks in the products, which is not CO_2 emission source. The reason for that is the lack of concrete measured values of the non-oxidized carbon portion in the petrol products and in the natural gas, utilized in Bulgaria.

The present inventory reports for a first time on CO_2 emissions from the non-energy fuel utilization, taking into account the quantities of the carbon stored in the products.

Due to the fact that combustion of solid household waste is not widely spread in the country (for power production or for the purpose of liquidation), the corresponding CO_2 emissions are not reported.

Carbon dioxide sequestration

For the time being, Bulgaria reports on CO_2 sequestration from forestry only (category 5.A from sector " Land-Use Change and Forestry"). Data for C sequestration from forestry is on the basis of:
● Area of forestry used;
●Average annual forest growth by species (in m^3/ha/year);
●Annual felling (in m^3/year).

Estimation of the average annual forest biomass growth is made on the basis of data from forestry inventory, which is made each five years according to a methodology, approved by the forestry authorities. For estimation of the biomass dry content, a common conversion factor of 0.6 for both forestry types, coniferous and deciduous, is used.

Table 3.1. Summary of emission trend per source category and gas, Gg CO_2-eqv.

Source category	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1. All energy (combustion and fugitive)	**98 282**	**84 641**	**68 530**	**62 305**	**64 769**	**61 608**	**64 584**	**63 074**	**61 673**	**55 409**	**50 899**	**50 131**	**51 943**	**49 241**	**53 466**
1A. Energy: fuel combustion	95 011	82 432	66 583	60 298	62 755	59 638	62 478	60 999	59 816	53 539	49 274	48 332	50 179	47 511	51 741
CO_2:1. Energy industries	43 217	39 601	37 106	33 862	34 092	30 945	31 572	30 652	30 936	27 078	25 760	26 216	29 036	26 466	28 330
CO_2:2. Industry	24 755	21 821	14 758	12 093	13 296	15 032	18 023	17 499	17 691	14 221	12 283	11 868	10 788	10 198	11 402
CO_2:3. Transport	13 814	10 864	6 525	6 435	7 444	6 547	6 845	6 306	5 315	6 475	6 212	5 881	6 014	6 317	7 098
CO_2:4. Other sectors	8 940	5 381	4 086	4 610	4 117	3 325	2 621	3 238	2 678	2 989	2 491	1 896	1 638	2 074	2 206
CO_2:5. Other	0	1 006	882	196	733	810	315	261	112	49	0	0	0	0	0
CH_4	111	105	68	69	72	71	76	69	59	62	63	60	55	59	59
N_2O	4 174	3 655	3 158	3 031	3 002	2 909	3 027	2 975	3 024	2 664	2 465	2 411	2 648	2 398	2 647
B. Fugitive fuel emissions	**3 271**	**2 209**	**1 947**	**2 007**	**2 013**	**1 970**	**2 106**	**2 074**	**1 857**	**1 870**	**1 625**	**1 799**	**1 764**	**1 730**	**1 725**
CH_4	3 271	2 209	1 947	2 007	2 013	1 970	2 106	2 074	1 857	1 870	1 625	1 799	1 764	1 730	1 725
N_2O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Industrial Processes (ISIC)	**10 425**	**9 232**	**6 293**	**5 303**	**5 139**	**6 071**	**7 401**	**7 280**	**6 570**	**4 593**	**4 620**	**5 465**	**5 362**	**4 863**	**5 527**
CO_2	7 846	6 866	4 599	3 908	3 936	4 620	5 355	5 202	4 843	3 490	3 784	4 041	3 997	3 704	4 286
CH_4	82	63	46	44	51	68	74	69	74	63	58	74	51	46	59
N_2O	2 422	2 255	1 626	1 324	1 133	1 338	1 921	1 962	1 614	968	732	1 314	1 295	1 089	1 159
HFCs	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
PFCs	76	47	21	28	19	46	47	46	37	69	44	33	16	21	21
SF_6	0	0	0	0	0	0	1	1	2	2	2	2	2	3	3
3. Solvent and Other Product Use	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
4. Agriculture	**13 632**	**12 225**	**10 108**	**8 171**	**6 803**	**6 236**	**5 678**	**5 382**	**5 319**	**5 081**	**5 401**	**5 125**	**4 306**	**4 640**	**4 579**
CH_4 Enteric fermentation	4 049	3 784	3 486	2 887	2 251	1 893	1 791	1 730	1 669	1 717	1 742	1 665	1 306	1 448	1 502
CH_4 Manure management	1 524	1 501	1 319	1 073	859	729	725	664	586	622	636	569	405	471	512
CH_4 Rice cultivation	119	90	69	38	26	7	12	22	32	28	12	30	33	44	48
CH_4 Field Burning of Agricultural Residues	42	42	44	31	25	26	28	15	25	22	25	22	25	28	17
N_2O Manure Management	1 056	1 030	921	760	606	510	496	461	422	452	467	429	321	368	395
N_2O Agricultural soils	6 829	5 766	4 254	3 372	3 028	3 064	2 619	2 485	2 577	2 234	2 511	2 404	2 210	2 273	2 100
N_2O Field Burning of Agricultural Residues	14	13	15	10	7	7	8	5	7	6	8	6	6	7	5

Table 3.2 Summary emissions from GHG-precursors and SOx

Year	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
NOx	285.6	243.0	180.2	162.7	166.0	146.8	152.1	145.6	141.2	133.9	120.9	121.3	129.0	124.5	135.4
CO	863.8	778.7	571.3	596.6	621.5	592.0	612.6	565.4	486.7	513.6	489.5	431.8	376.1	429.6	387.2
NMVOCs	120.4	110.1	69.6	71.4	79.8	79.4	86.3	78.0	63.1	77.7	62.4	57.0	59.2	60.7	58.4
SOx	1781.4	1517.1	1313.2	1290.3	1278.4	1261.4	1298.9	1310.5	1310.4	1191.9	1056.4	1044.6	1095.8	982.9	1042.7

Methane

CH_4 emissions from fuel combustion were estimated by data from the energy balance and the emission factors, determined by methods of the type Tier 2. CH_4 emissions from road transport are estimated with emission factors, specific for the country, specified for the various motor vehicle categories. The main restrictions in this case are the quantities of used fuels, indicated in the general energy balance of the country.

Fugitive CH_4 emissions from coal mining and the systems for extraction and distribution of oil and natural gas are estimated, as a rule, by standard emission factors, specified in IPCC Guidance.

Methane emissions from agriculture are estimated by method of the type Tier 1, excluding the manure handling emissions of cattle’s and swine, where method of the type Tier 2 is used.

Methane emissions from solid waste disposal sites are estimated by the standard method, specified in IPCC Guidance. Using of methods with higher accuracy is not possible at present due to the lack of historically long time series for disposed household solid waste.

Nitrous oxide

N_2O emissions from fuel combustion are estimated by data from the general energy balance of the country and emission factors, specific for the country. The emissions from road transport are estimated on the basis of the fuels used from the various motor vehicle categories, and specific emission factors, defined for each category. Those emission factors have been defined by experimental-analytic method for the period until 1995, and have not been changed since then. The recent UNFCCC review teams reports on the national inventory review for Bulgaria state clearly and unequivocally that these emission factors should be revised

N_2O emissions from chemicals output include the nitric acid production only. For the time being there is no data available on emissions from utilization of solvents and for anaesthesia

N_2O emissions from agriculture soils are estimated in full accordance with the IPCC methodology. These emissions include all sources, provided for in the methodology as synthetic and natural fertilizers, crop residues, animal waste from pastures and indirect emissions from release of ammonia and NOx in the atmosphere, as well as due to drainage (leaching) of underground water.

Consumed proteins are calculated on the basis of the statistical data for the foodstuffs, consumed by humans. N_2O emissions are estimated on the proteins from the human waste, structured in sector “Waste”.

F- gases

There is no production of F- gases from the HFC and SF_6 groups in Bulgaria. However, in the aluminium production gases from the PFC group are emitted, subject of the inventory. Data on F- gases consumption is limited and allows just general assessments of the potential emissions of HFC and SF_6.

During the last years, large-scale inquiries were initiated for data collection regarding the available SF_6 quantities in the electrical equipment of the electric power system of the country. It resulted in reliable data for the fugitive SF_6 emissions during equipment operation for the period 1995 -2003.

As a whole, the data on the current F-gases emissions is too limited and does not correspond to the actual consumption level at the moment.

3.4. Summary of the Key Sources of GHG Emissions

GHG emission inventory for 2003 showed that the overall GHG emissions in CO_2–eqv. amounted to 69 167 Gg, without reporting of sequestration from sector Land-Use Change and Forestry (LUCF). The net emissions (without reporting of sequestration from LUCF) were 62 111 Gg.

In Table 3.3 are given emission trends of the main GHG, the summary emissions (without reporting of LUCF) and the overall emissions share of the emissions from the base year, 1988, assumed as 100 %.

Analysis of **Table 3.3** shows, that in 2003, CO_2 emissions headed the list with the biggest share – 75 % of the overall GHG emissions, expressed in CO_2-eqv., CH_4 emissions ranked the second place with 15 %, and N_2O emissions ranked the third place with 10 %. This distribution has undergone some changes compared to the base 1988, as it is shown in F**igure 3.1.** The distribution for 2003 is shown in **Figure 3.2.**

Figure 3.1

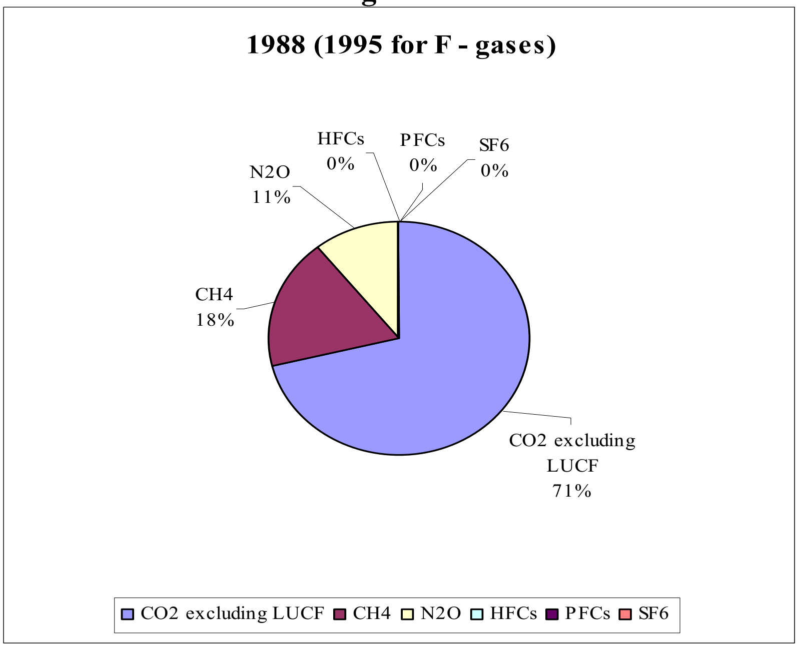
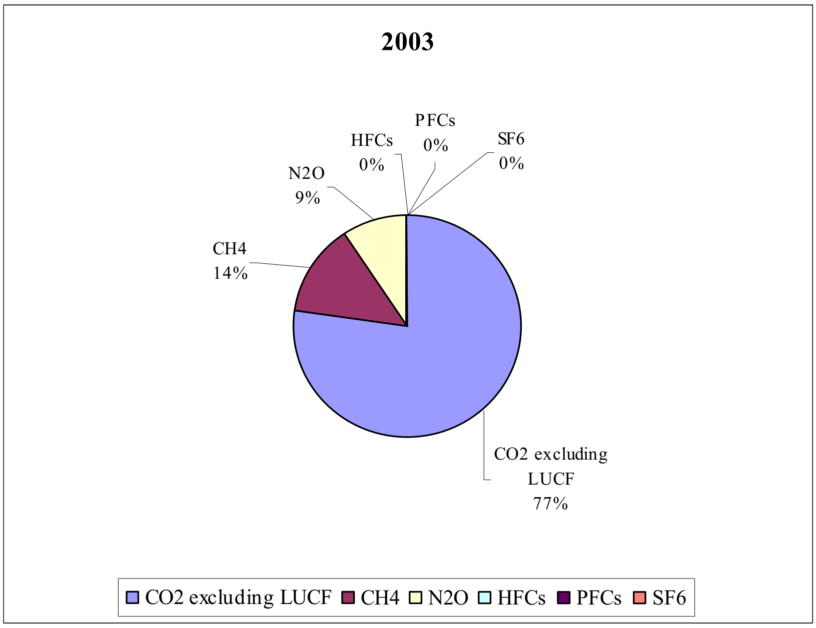


Table 3.3 The summary emission trends of main GHG (without reporting LUCF)

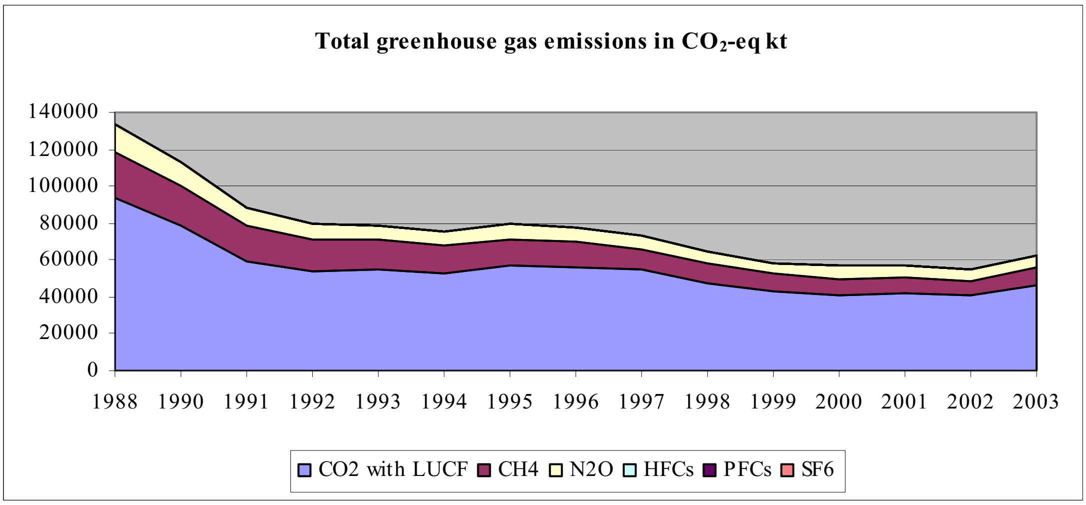
Source category	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CO_2 with LUCF	93 439	78 376	59 438	53 497	55 409	53 167	56 891	56 378	54 592	47 393	43 330	40 927	42 005	40 440	46 265
CO_2 excluding LUCF	98 572	84 533	67 074	60 910	62 884	60 469	64 416	62 895	61 463	54 253	50 530	49 903	51 472	48 758	53 321
CH_4	24 925	21 393	18 777	17 459	15 712	14 592	14 240	13 165	11 303	10 441	8 903	9 038	8 320	8 482	9 366
N_2O	14 805	12 943	10 176	8 698	7 968	8 010	8 248	8 056	7 789	6 489	6 352	6 723	6 626	6 275	6 456
HFCs	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
PFCs	76	47	21	28	19	46	47	46	37	69	44	33	16	21	21
SF_6	0	0	0	0	0	0	1	1	2	2	2	2	2	3	3
Total	**138 377**	**118 916**	**96 047**	**87 095**	**86 584**	**83 117**	**86 954**	**84 164**	**80 595**	**71 255**	**65 830**	**65 699**	**66 437**	**63 539**	**69 167**
Index (1988 = 100)															
Index CO_2 excluding LUCF	100	85.8	68.0	61.8	63.8	61.3	65.3	63.8	62.4	55.0	51.3	50.6	52.2	49.5	54.1
Index CH_4	100	85.8	75.3	70.0	63.0	58.5	57.1	52.8	45.3	41.9	35.7	36.3	33.4	34.0	37.6
Index N_2O	100	87.4	68.7	58.8	53.8	54.1	55.7	54.4	52.6	43.8	42.9	45.4	44.8	42.4	43.6
Index [group of six]	**100**	**85.9**	**69.4**	**62.9**	**62.6**	**60.1**	**62.8**	**60.8**	**58.2**	**51.5**	**47.6**	**47.5**	**48.0**	**45.9**	**50.0**
Index (1995 = 100)															
Index HFCs	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0
Index PFCs	160.9	100.8	45.4	59.5	40.5	97.6	100.0	97.7	79.4	147.9	92.8	70.6	34.7	45.6	44.1
Index SF_6	0.0	0.0	0.0	0.0	0.0	0.0	100.0	103.7	138.9	145.1	149.0	176.7	181.4	198.9	199.7
Index [group of new gases]	147.7	92.5	41.7	54.6	37.2	89.6	100.0	92.3	76.3	139.3	88.8	69.1	36.3	46.8	45.4

Figure 3.2



The change in the overall emissions for the period 1988–2003 is shown in F**igure 3.3.**

Figure 3.3 Total greenhouse gas emissions in CO_2-eqv. kt



The aggregated GHG emissions by sectors in Bulgaria are shown in **Table 3.4.**

Data in Table 3.4 shows the leading position of the aggregated emission of the energy sector. The sectors Waste and Industrial processes have almost the same contribution.

In Table 3.5 is given the sector contribution in aggregated emissions.

Table 3.4 Aggregated GHG emissions by sector, Gg, CO_2 eq

Sector/ year	1988	1990	1991	1992	1993	1994	1995
Energy	98 282	84 641	68 530	62 305	64 769	61 608	64 584
Industrial processes	10 425	9 232	6 293	5 303	5 139	6 071	7 401
Agriculture	13 632	12 225	10 108	8 171	6 803	6 236	5 678
Forestry	-5 133	-6 157	-7 636	-7 412	-7 476	-7 302	-7 524
Waste	16 038	13 823	11 999	11 511	10 607	10 011	9 607
Total (without LUCF)	**138 377**	**119 921**	**96 929**	**87 291**	**87 317**	**83 927**	**87 269**

Sector/ year	1996	1997	1998	1999	2000	2001	2002	2003
Energy	63 074	61 673	55 409	50 899	50 131	51 943	49 241	53 466
Industrial processes	7 280	6 570	4 593	4 620	5 465	5 362	4 863	5 527
Agriculture	5 382	5 319	5 081	5 401	5 125	4 306	4 640	4 579
Forestry	-6 517	-6 872	-6 860	-7 200	-8 976	-9 467	-8 318	-7 056
Waste	8 689	7 146	6 221	4 911	4 978	4 827	4 794	5 595
Total (without LUCF)	**84 425**	**80 707**	**71 304**	**65 830**	**65 699**	**66 437**	**63 539**	**69 167**

Table 3.5 Sector contribution in aggregated emissions, %

Sector/ year	1988	1990	1991	1992	1993	1994	1995
Energy	71.02	70.58	70.7	71.38	74.18	73.41	74.01
Industrial processes	7.53	7.7	6.49	6.08	5.89	7.23	8.48
Agriculture	9.85	10.19	10.43	9.36	7.79	7.43	6.51
Forestry	-3.71	-5.13	-7.88	-8.49	-8.56	-8.7	-8.62
Waste	11.59	11.53	12.38	13.19	12.15	11.93	11.01

Sector/ year	1996	1997	1998	1999	2000	2001	2002	2003
Energy	74.71	76.42	77.71	77.32	76.3	78.18	77.5	77.3
Industrial processes	8.62	8.14	6.44	7.02	8.32	8.07	7.65	7.99
Agriculture	6.37	6.59	7.13	8.2	7.8	6.48	7.3	6.62
Forestry	-7.72	-8.51	-9.62	-10.94	-13.66	-14.25	-13.09	-10.2
Waste	10.29	8.85	8.72	7.46	7.58	7.27	7.55	8.09

Analysis of **Table 3.5** shows that sector "Energy", where GHG emissions come from fuel combustion, headed the list in 2003 with the biggest share – 77 %. Sector "Waste" ranked the second place, and sector "Industrial processes" ranked the third place.

3.5. Sub-sector "Transport"

Sub-sector "Transport" includes air, sea, road, inland waterway transport and other kinds of transport. The group "Other transport" included emission sources form off-road vehicles from agriculture and construction, such as: agriculture machinery for land cultivation, wood processing machinery, construction machinery, etc.

The aggregation level was by fuel type, vehicle type and dimensions (the engine volume for automobiles and the loading capacity for trucks).

CO_2 emissions from **road transport** were key source of GHG emissions. This source ranked second place in key source list (estimated by method Tier 1 – with emission level assessment). These emissions were 9 % of the overall country emissions in 2003. Another key source was the CO_2 emissions from **"other transport"**, with 1 % share in the overall emissions.

The road transport was the largest emission source of main GHG in sub-sector "Transport" - 88% of the CO_2 emissions, 92 % of methane emissions, and 83 % of N_2O emissions.

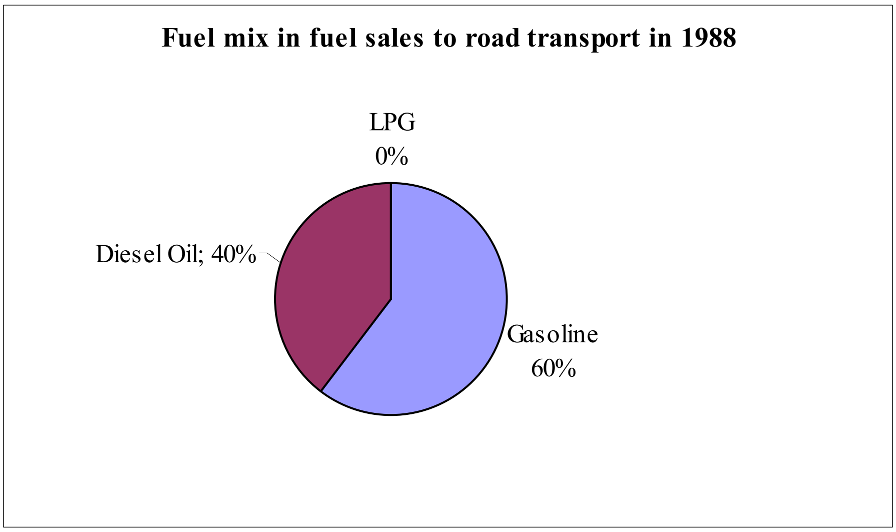
CO_2 emissions from the other kinds of transport were significantly less (about two orders of magnitude less), compared to the road transport. Off-road emissions were about one order of magnitude less than the road transport.

The avian transport emissions were spitted between domestic and international transport on the basis of expert assessment. The overall quantities of kerosene used were indicated in the energy balance of the country. It was assumed that 90 % of kerosene was used for international transport and the relevant emissions were reported in bunkering.

After 2000, there was no navigation on the Danube and the Black sea for the purposes of domestic passenger transport and because of that no fuels were reported. Only fuels for international transport were indicated and reported in bunkering.

The change in the fuel sales to road transport in 2003, compared to the base 1988 is shown in Figure 3.4. The fuel mix in fuel sales to road transport in 2003 is shown in Figure 3.5**.** A clear trend towards increase of fuel sales can be seen, concerning the fuels that emit less air pollutants, including GHG

Figure 3.4 Fuel mix in fuel sales to road transport in 1988



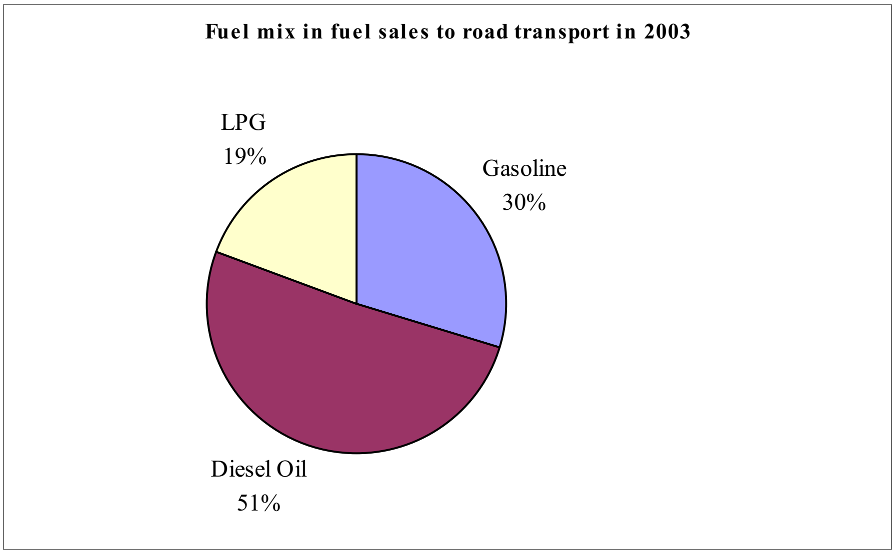
3.6. CH_4 Emissions

3.6.1. Energy

The Energy sector in Bulgaria holds a key position in the national economy. It was the source of over 77 % of the aggregated GHG emissions for the last inventory 2003.

Energy industries kept the largest share - over 45 % of the overall emissions in this sector. It was the only sector, where an increase of the relative share compared to the base 1988, can be observed – from 44 % up to 53 % in 2003. For all other sectors this share decreased: manufacturing industries from 25 down to 21 %, transport from 14 down to 13 %, and especially in the public sector and households – from 9 down to 4 %. The last figure can be assumed as a positive result from the reduced direct fuel combustion in the households, which led to an overall GHG emission and air pollutants' reduction.

Figure 3.5 Fuel mix in fuel sales to road transport in 2003



The emissions growth in the energy industries, compared to the preceding year, was due to the decommissioning of units 1 and 2 (880 MW) in NPP Kozloduy, and the increased power consumption in the country, despite the decreased export of electrical power by 19%.

The trend of Transport sub-sector shows slight fluctuations, as in 2003 the emissions increased and were 14 % of the overall CO_2 emissions in the sector. The fluctuations resulted from variations of liquid fuel prices, and from restructuring and renovation of the vehicles as well.

The overall trend in sub-sector "Other sectors" (Services, Households, Agriculture and Forestry) displayed fluctuations as well. The 1998 reduction was surmounted and emissions growth was observed in the last two years.

CO_2 emissions from non-energy use of fuels were reported in this sector, and not in sector Process emissions due to the fact that they belong exactly to this sector

3.6.2. Agriculture

GHG emissions from sector "Agriculture", result from production activities during processing of agricultural products, soil fertilization and animal manure management.

All emissions from combustion processes for energy production are reported in the "Agricultural and Forestry" sub sector of the Energy sector while the emissions from agricultural machines are reported in the category "Other Transportation" of the "Transport" sub sector of the Energy sector.

GHG process emissions in sector "Agriculture" are grouped in the following sub sectors;

- Enteric fermentation from domestic livestock;
- Manure management;
- Rice cultivation;
- Agricultural soils;
- Field burning of agricultural residues.

The biggest CH_4 emission source in the sector is the enteric fermentation from domestic livestock.

The biggest N_2O emission source is the Agricultural Soils sub sector.

The following GHG emission sources emerge as key sources for the year 2003:

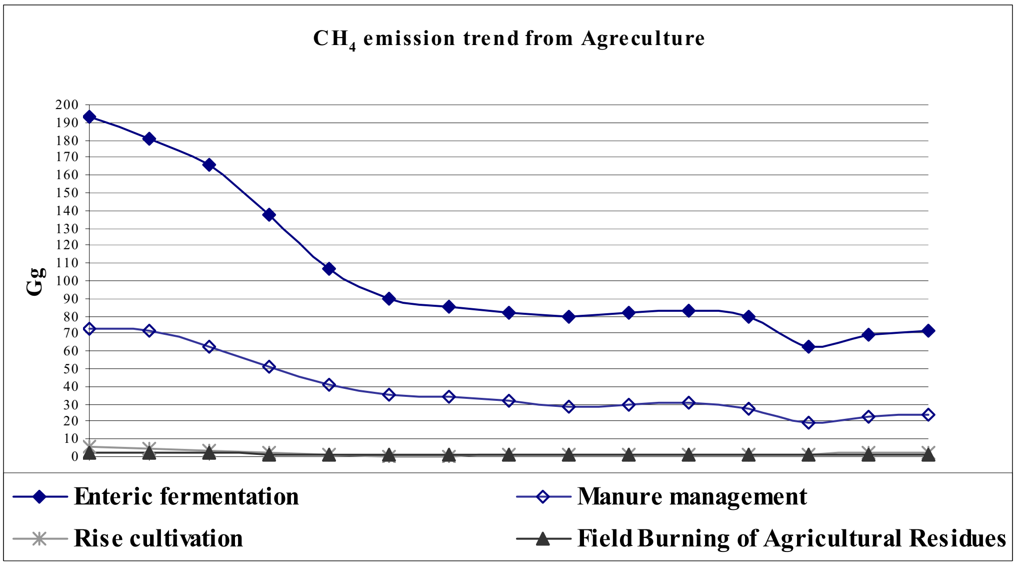
- CH_4 from Enteric fermentation
- Direct N_2O emissions from agricultural soils
- N_2O emissions from grazing animals

The ranking above comes from the list of key sources, drafted according to the Tier 1 method with an estimation of emissions level. Non key sources from this list are:

- Indirect N_2O emissions from agricultural soils;
- Methane emissions from manure treatment;
- N_2O emissions from manure treatment;
- CH_4 emissions from rice cultivation;
- CH_4 emissions from field burning of agricultural residues;
- N_2O emissions from field burning of agricultural residues.

Methane emission trends are given in Figure 3.8. They form 46 % of the total emissions in the sector in CO_2-eqv. A steady trend of emissions increase is observed since 2001. Despite that, the drop compared to the base 1988 year remains rather big – more than 63 %.

Figure 3.8 CH_4 emissions from Agriculture



N_2O emissions from the sector are also significant. The biggest share belongs to the agricultural soils emissions. It is about 84 % in the year 2003 and for the entire period 1988-2003, the share is in the range 83-88 %. N_2O emissions from manure management and field burning of agricultural residues are of an order of magnitude smaller and in total are about 13-15 % from the aggregated N_2O emissions of the sector.

In total, the N_2O emissions, expressed in CO_2-eqv. for 2003, are 17 % bigger than the CH_4 emissions in CO_2-eqv.

3.6.3. Waste Management

GHG emissions in the "Waste" sector result from the processes of collection, storage and management of solid waste from household and the public sector and waste water treatment from household and industry.

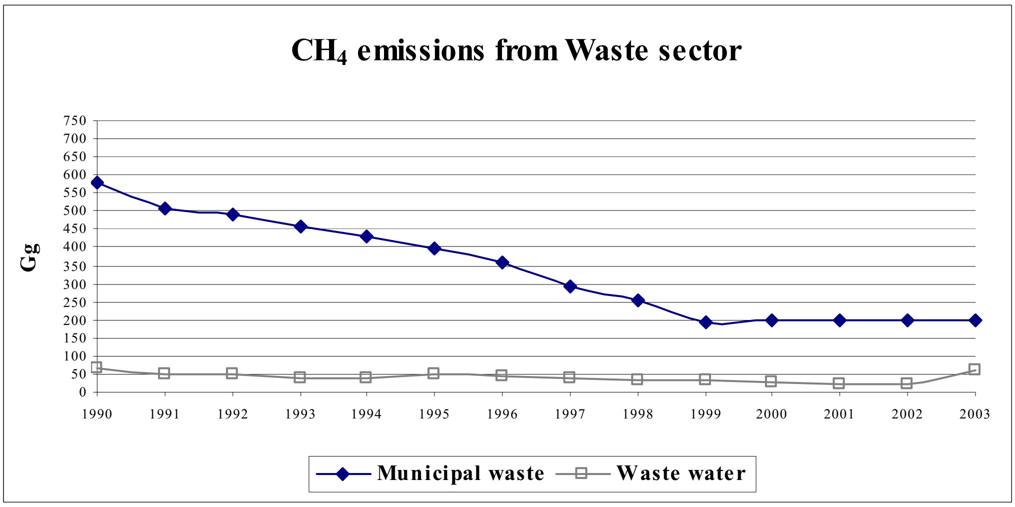
According to the IPCC nomenclature, the following categories in this sector are considered:

- solid waste disposal;
- Wastewater handling;
- Waste incineration;
- Other.

Only the first two categories from those mentioned above are included in the 2003 inventory for Bulgaria.

The change of the methane emission trend for the period 1988-2003 is given in Figure 3.7.

Figure 3.7 CH_4 emissions from Waste sector



Unlike the time series given in the 2002 inventory, this series is consistent and does not show sudden changes in some years. This is due to the recalculation, carried out to eliminate methodological peculiarities, leading to inconsistency.

The trend analysis shows that CH_4 emissions from ***solid waste disposal*** decrease from 300 to 200 Gg annually for the period 1997-1999 and keep a relatively steady level for the last three years.

CH_4 emissions from ***waste water*** are significantly smaller and have a trend, which does not change to the same degree as for solid waste. Significant increase of the methane emissions is observed in 2003 due to the governmental decision for a single discharge for several big tailing ponds.

3.7. HFCs, PFCs and SF_6 Emissions

The trends of F-gases are given in Table 3.6, presenting also data for the year 1995, which is not a base year for them.

The 2003 reduction of the overall F-gas emissions, compared to the base 1995, was 54.6 %. This reduction described best the aluminium output reduction, which led to reduction of PFCs emissions by 56 %. However, the actual SF_6 emissions increased by 99 % because of the large-scale investigation of the power equipment, using SF_6 as agent for electric arc extinguishing. Compared to the preceding 2002, a slight reduction of the overall emissions by 3 % can be seen. This was due to fluctuations in aluminium output.

Table 3.6 Actual emissions of HFCs, PFCs, SF_6- Gg CO_2-eq

F- gases, Gg	1 988	1 990	1 991	1 992	1 993	1 994	1 995
HFCs- total							2.95
PFCs-total	75.55	47.31	21.32	27.92	19.03	45.83	46.94
SF_6-use							1.26
Total F- gases	75.55	47.31	21.32	27.92	19.03	45.83	51.16

F- gases, Gg	1997	1998	1999	2000	2001	2002	2003
HFCs- total							
PFCs-total	37.26	69.44	43.55	33.14	16.29	21.42	20.69
SF_6-use	1.75	1.83	1.88	2.23	2.29	2.51	2.52
Total F- gases	39.01	71.27	45.43	35.37	18.58	23.93	23.21

In Table 3.7 is shown the differences between National Inventory Report (NIR) 2004 (the inventory for 2002 was presented in 2004) and NIR 2005 (the inventory for 2003 was presented in 2005) for 1988-2002 due to recalculation.

Table 3.7 Differences between NIR 2004 and NIR 2005 for 1988-2002 due to recalculation, %

Gas/sector	Source	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Energy	***NIR-2005 as to***														
CO_2	***NIR- 2004***	-4.17	3.60	4.42	4.30	4.39	5.59	6.05	6.26	6.91	5.61	5.99	7.53	5.69	4.65
CH_4		-30.34	-49.81	-49.12	-45.08	-43.18	-43.69	-46.72	-47.56	-43.99	-40.53	-39.10	-37.90	-36.61	-33.31
N_2O		-11.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.04	-0.04	0.00	0.00	0.00
Industrial processes															
CO_2		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CH_4		88.61	8.95	7.02	7.20	7.24	6.05	5.91	6.66	6.04	6.39	2.67	0.00	0.00	0.00
N_2O		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Solvent use															
NMVOCs		-71.73	-65.05	-46.43	-46.07	-39.05	-40.16	-45.48	-50.69	-51.40	-26.08	46.08	0.00	197.80	186.10
Agriculture															
CH_4		0.04	0.04	0.04	0.05	0.05	0.07	0.09	0.07	0.07	0.33	-0.32	0.34	0.00	0.00
N_2O		5.73	-9.79	-18.16	-10.76	-2.08	8.07	-4.82	-3.95	1.61	-4.21	4.57	0.04	0.07	-0.01
Forestry															
Sinks of CO_2		10.21	6.16	-3.11	-2.93	6.46	4.68	0.07	-9.35	17.43	10.07	8.96	0.00	0.00	0.00
Waste															
CH_4		13.87	-12.27	-26.57	-28.31	-27.48	8.56	0.00	0.72	0.00	0.01	-2.06	0.00	0.00	0.00
N_2O		31.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total without forests															
CO_2-eqv.-without F-gases		-2.48	-1.80	-4.61	-4.70	-3.42	3.03	1.54	1.71	2.82	1.82	2.46	3.28	2.33	1.77
CO_2-eqv.- total		-2.43	-1.76	-4.58	-4.67	-3.40	3.08	1.54	1.71	2.82	1.83	2.47	3.28	2.33	1.78
CO_2		-3.85	3.30	4.11	4.02	4.11	5.15	5.53	5.71	6.33	5.23	5.52	6.88	5.23	4.28
CH_4		1.98	-16.38	-24.85	-26.10	-26.02	-5.21	-11.80	-12.48	-11.71	-11.10	-11.79	-11.09	-11.21	-9.53
N_2O		-0.38	-5.40	-10.16	-5.43	-0.96	3.46	-1.88	-1.49	0.61	-1.81	2.08	0.01	0.03	0.00

4 POLICIES AND MEASURES

4.1. Introduction

This chapter provides an overview of general climate change policy in Bulgaria.

The main framework of the environmental policy in the country is the National Environmental Strategy, which serves as a base for the activities in the environmental policy areas, including climate change. The Second National Action Plan on Climate Change 2005 -2008 fulfils the role of elaborating the goals set out in this strategy, by identifying concrete policies and measures, including actions to implement these policies and measures.

Due to the forthcoming accession of Bulgaria to the European Union the country is harmonizing all the aspects of the environmental legislation with the EU legislation. Based on the legal acts the Government has approved set of secondary laws, regulations and methodologies of the MOEW and its subsidiaries, which are already operational. The laws in the MOEW competence are listed in p.1.2. Legislation.

The harmonization of the legislation is ongoing and all the already approved and the future EU legislative initiatives in the field of climate change will find place within the Bulgarian legislation.

4.2. Institutional Organization

● **Responsibility of the Ministry of Environment and Water**

The Ministry of Environment and Water (MOEW) is the governmental institution authorized to develop and carry out the state policy related to protection of the environment. MOEW is responsible for the preparation and reporting of the annual inventories of GHG emissions, as well as for the formulation and implementation of the policies and measures to mitigate climate change.

● **Role of the Inter-Ministerial Committee on Climate Change (IMCCC)**

The IMCCC was set up under the Governmental decision to coordinate the implementation of the First Action Plan on Climate Change in July 2000. It was intended to facilitate the communications among institutions and to ensure the control and coordination of their activities in relation to the climate change process in the country. The Committee consists of representatives from a majority of the ministries, the Energy Efficiency Agency and an observer from Sofia Municipality, and is chaired by Deputy Minister of MOEW.

● **The Steering Committee (SC) for Joint Implementation Projects**

Steering Committee is an evaluation body for and Joint Implementation projects under the Kyoto Protocol. It consists of representatives from MOEW, the Ministry of Economy, the Ministry of Finance, the Ministry of Regional Development and Public Works, the Ministry of Agriculture and Forestry, the Executive Energy Efficiency Agency and the Bulgarian Investments Agency. The Committee is chaired by the Minister of MOEW. The SC evaluates proposed JI projects according to the existing national criteria for JI projects on the basis of the Project Design Documents (a PDD). If necessary, additional expert opinions and statements from the relevant ministries and organizations are requested. The SC advises the Minister of the Environment and Water in issuing / not issuing a Letter of Approval for each particular proposal.

● **The Intrministerial Working Group for Development of the National Allocation Plan (IWGNAP)**

The introduction of the EU Emissions Trading Scheme requires the country to possess National Plan for allocation of emission allowances. The Plan development is coordinated by an interministerial working group set by the ordinance of the Minister of MOEW No. RD-186/06.04.2005. Representatives of the MOEW, the MEE, the MRDPW, the MF, the NSI and representatives of NGOs: Bulgarian Chamber of Commerce and branch organizations of the industrial branches that are covered by the Scheme – Bulgarian Association of the Cement Industry, Bulgarian Branch Chamber of the Energetic, Branch Chamber of the Pulp and Paper Industry, Branch Chamber of the Glass Industry, Branch Chamber of the Iron and Steel Industry, Branch Chamber of the Chemical Industry, Bulgarian Union of the Ceramics. The Plan development is supported by the Bulgarian and Dutch consultants under a project funded by the PSO program of the Government of The Netherlands.

● **Role of implementing agencies and other institutions**

The Executive Environmental Agency within MOEW performs monitoring of the implementation of climate change-related measures. The agency deals with water and air quality control and receives data from the monitoring stations nationwide. It also carries out the procedures on issuing the permits under the IPPC Directive. The Agency is responsible for the preparation of the GHG inventories, projections and registers. It carries out the procedures on issuing the GHG emission permits – considers the operators' application forms and drafts the permits. The National Administrator of the National Registry for issuing, possession, transfer and cancellation of the GHG emission allowances.

Energy Efficiency Agency within MEER – organizes the implementation of projects and measures in accordance with the national long- and short-term energy efficiency programs; approves projects for energy efficiency and controls their implementation; participates in the preparation of legal regulations in the field of energy efficiency: proposes development and improvement of energy efficiency standards in order to achieve approximation to the EU norms and to encourage energy efficiency at the demand side; cooperates with central and regional governmental institutions, employers' associations, branch organizations, consumer associations and NGOs on implementation of energy efficiency policies and measures; maintains the national information system on energy efficiency, develops guidelines for establishments and maintenance of EE information systems for central and regional governmental institutions; develops programs for implementation and control of EE measures and programs for EE awareness rising; develops programs for implementation of EE on local (municipal) level; cooperates in implementing EE training.

● **Municipalities**

The major responsibility of municipal energy management is imposed upon local authorities. The rational use of energy as well as its production and supply at local level, became responsibility of municipal authorities. The basic instrument for energy management in municipalities is the local (municipal) energy planning.

Municipal energy efficiency planning is obligatory according to the new Energy Efficiency Law. Therefore, the municipal administration has to adopt the following programmes:

- Refurbishment of the housings, administrative and utility buildings throughout the municipal territory aiming to carry out measures for energy efficiency;
- Introduction of energy-saving appliances for street lighting in settlements and in public buildings;
- Other measures for improvement of energy efficiency.

4.3. Policy Instruments

This section presents set of political instruments which could be applied in the Climate Change Policy. In functional plan, these instruments have an intersectoral impact and influence the economy and household in general.

● Legal instruments and regulation

In most countries laws and regulations are important instruments in climate change policy. The Bulgaria obligations in the climate change policy follow from multilateral and bilateral international agreements, from the EU legislation in the field of climate change as well as from the national legislation. The most important are:

Multilateral international agreements:

1. United Nations Framework Convention on Climate Change (UNFCCC), enforced in 1995.
2. Kyoto Protocol annexed to UNFCCC, enforced in 2005

European legislation:

1. Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC
2. Directive 2004/101/EC of the European Parliament and of the Council of 27 October 2004 amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, in respect of the Kyoto Protocol's project.
3. 2004/156/EC: Commission Decision of 29 January 2004 establishing guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council
4. Commission Regulation (EC) No 2216/2004 of 21 December 2004 for a standardised and secured system of registries pursuant to Directive 2003/87/EC of the European Parliament and of the Council and Decision No 280/2004/EC of the European Parliament and of the Council
5. Decision No 280/2004/EC of the European Parliament and of the Council of 11 February 2004 concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol

Bilateral international agreements

Seven Intergovernmental Memoranda of Understanding in the field of Joint Implementation Projects under the Kyoto Protocol, respectively with Netherlands (2000), Austria (2002), Switzerland (2003), Denmark (2003), World Bank's Prototype Carbon Fund (2002), Sweden and Japan (2006).

National legislation:

1. Ratification act of the United Nations Framework Convention on Climate Change (UNFCCC), published in State Gazette, No 28/28.03.1995.
2. Ratification act of the Kyoto Protocol to the United Nations Framework Convention on Climate Change, published in State Gazette, No 72/25.07.2002
3. Act amending the Environmental Protection Act concerning the transposition of Directive 2003/87/EC of the European Parliament and of the Council establishing a

scheme for greenhouse gas emission allowance trading within the Community (published in State Gazette, No.77/27.09.2005)

4. Decision № 1012/21.12.2004 of the Council of Ministers adopting the National Action Plan on Climate changes

5. Five Ratification acts of Bilateral Cooperation Agreements in the field of Joint Implementation Projects under the Kyoto Protocol, respectively with Netherlands, Austria, Switzerland, Denmark, World Bank's Prototype Carbon Fund, Sweden.

The other important laws that are directly or indirectly related to climate change are:

- The Environmental Protection Act (State Gazette, 25.09.2002) **and Clean Air Act** (State Gazette, 28.05.1996) and related secondary legislation, including a permit system for meeting minimum standards in accordance with EU regulation on Large Combustion Plants, the introduction of the EU ETS and technical inspection (e.g. for cars) etc;

- The Energy Law (State Gazette 107/9.12.2003) in its part on renewable energy and combined heat and power generation introduces the requirements of the two related EU directives and the use of instruments such as green certificates; defines indicative target for energy production from RES and mandates the state regulations to the licensed activities in the power sector and purchase obligations for district heating companies to buy utilized waste thermal energy (State Gazette 107, 18.12.2003);

- The Energy Efficiency Law and related secondary legislation (State Gazette, 5.03.2004), including obligation to adopt municipal energy efficiency programs, requirements for energy efficiency labelling, the use of minimum standards resulting from the EU directive on energy efficient appliances, regulations for energy efficiency labelling of various types of products (appliances, cars), obligatory audits and amendments of the Energy Performance Standards for existing buildings;

- **The Law on Waste Management** (State Gazette, 30.09.2004) and the related secondary legislation including the obligation for collecting, management and usage (or combustion) of the omitted gases from the new waste deposits;

- **The Law on Statistics** (State Gazette, 25.06.1999) including national and international monitoring and reporting obligations of GHG emissions.

● **Fiscal policy**

In many EU countries fiscal policies are important instruments to stimulate measures that reduce emissions of greenhouse gases and/or save energy. The advantage of the fiscal incentives is that they are equally available to all investors and make better use of the market mechanisms. When introducing such policies in Bulgaria it is necessary to remember that they have to be in harmony with EU legislation (especially in relation to competitiveness) and to be implemented in such a way that minimizes or eliminates the “free riders”.

A number of stimulating measures for the subjects of taxation were introduced in the Law on amendment and supplement of the Law on the Corporate Income Tax Act and also in the Law on amendment and supplement of the Personal Income Tax Law, regarding the activities of the newly established fund “Energy efficiency”.

● **Financing Emission Reduction Projects**

The evaluation of the First Action Plan pointed out that the implementation of several mitigation measures was hindered by a lack of financial resources, mainly caused by the economic situation of the country during the 1990s. Both private and public sector lack adequate financial resources to finance climate measures. It is expected that this situation will not significantly change in the period 2005-2008.

The implementation of measures can be funded by other financing schemes. Below some of the options are listed.

- Energy efficiency funds

The fund, which will become operational by January 2005, is supported by the World Bank and GEF. US$ 17 million will be available for energy efficiency projects.

At the same time the European Bank for Reconstruction and Development (EBRD) established an energy efficiency credit line of € 60 million, which will be used to improve energy efficiency at small and medium-sized enterprises (SMEs). Both funds will provide loans for energy efficiency activities.

- State Agricultural Fund (SAF)

The State Agricultural Fund has been established with support of the EU (SAPARD). Subsidies from this fund are granted only for agricultural activities. The fund gives priority to projects that lead to reduction of emissions from agricultural activities, such as manure treatment and storage, soil fertilizing and agricultural residue burning.

- Kyoto Protocol Mechanisms - Joint Implementation, International Emissions Trading (Green Investment Scheme)

The Kyoto Protocol defines the flexible instruments that can contribute to the reduction of GHG emissions and result is economical, social, technological and environmental benefits for the country.

- **EU structural funds**

ISPA and SAPARD are the main sources of EU financing the agricultural and infrastructure development of Bulgaria.

● Education, Research and Development (R&D)

Education and R&D are important for the future development of climate change activities and environmentally-friendly behaviour of future generations. Due to a lack of finance only limited actions have been undertaken:

- Introduction of climate change problems into the curriculum of schools and universities;
- Implementation of local R&D programs;
- Participation in EU Research programs (6th Framework program).

● Awareness Raising and Public Information

Different stakeholders such as the national Government, the business community, environmental NGOs and the media play an important role in the raising the public awareness about the climate change, international and national actions to mitigate climate change. Activities, which are undertaken in Bulgaria, are:

- Designation of National Focal Point under Art. 6 o the UN FCCC;
- Regular actualization of the information about the current climate change policy at the MOEW web site;
- Issuing and distribution of brochures and other materials;
- Inclusion of climate change days in the national environmental campaigns;

- Publications in the media presenting information on various aspects of the climate change;

- Information support and organization of workshops for business stakeholders on the opportunities to participate in Joint Implementation mechanism according to the requirements of the Kyoto Protocol and participation in the EU ETS;

- Dissemination of adapted scientific findings and information on climate change; popularized through integrating them in various specialized information flows.

● National strategy for the Environment and Second National Action Plan 2005-2014

The Strategy was developed for the period 2005-2014 together with an Action Plan 2005-2009. It is a continuation of the National Strategy for the Environment 2000-2006 and in this aspect keeps the long-term environmental policy objective. The National Strategy for the Environment is consistent with the principles of the prevention and reduction of the human health risk, integration of the environmental protection policy in the sectoral policies on the development of the economy and awareness of the citizens on the state of the environment.

The objectives and actions of this National strategy have been developed, taking into account the opinion of a wide variety of representatives – state institutions, business, municipalities, NGO, the general public.

For the first time, during the development of a strategic national document in the area of environmental protection, a national survey was carried out in order to take into consideration the opinion of the population in determining the priorities and measures in the National Strategy for the Environment and also the public awareness on the environmental protection issues.

The project of the National Strategy for the Environment 2005-2014 was approved by the Council of Ministers on April 7th, 2005 and was passed to the National Assembly for discussion and adoption.

● Second National Climate Change Action Plan (2005-2008)

During the analysis of the results of the actions undertaken to fulfil the First National Action Plan in 2002 a decision was undertaken to develop a Second National Action Plan for the period 2005 – 2008. The plan is approved by the Government and published in Bulgarian and English languages.

The First National Action Plan on Climate Change (NAPCC) for Bulgaria was developed in the period 1996 – 1997, and approved by the Government in 2000. It contained a coherent set of actions for the period in line with Bulgaria's international obligations in the context of UNFCCC as well as the Climate Change Program of the European Union.

The economic growth of Bulgaria after the year 2000 along with changes in the international and domestic policy and regulatory framework required an update of the Plan. The updated action plan will be implemented in the period 2005 – 2008, although the effects of the measures in terms of greenhouse gas (GHG) emission reduction are assessed up to year 2012, when the First Commitment Period under the Kyoto Protocol ends.

The following four categories of actions are included in the updated Plan:

- Actions to implement mitigation policies and measures that result in GHG emission reductions in the different economic sectors in Bulgaria;
- Actions to create the necessary conditions for implementation of the mitigation measures, for instance institutional arrangements and awareness raising;
- Actions related to the monitoring and registration of GHG gases and the systematic evaluation of emission trends and projections, including the evaluation of policies and measures;

- Actions for the implementation of the Joint Implementation and Emissions Trading schemes.

The NAPCC comprises mainly measures that do not require budget financing, since the economic situation in Bulgaria does not allow for the allocation of significant funding and other public resources for implementing climate change-related policies and measures. Nevertheless, the plan includes a set of "backup" measures which can be implemented in case when the GHG emissions grow faster than expected one or when the economic situation in Bulgaria allows the Government to participate more actively in this field.

4.4. Sectoral Policies and Measures for Reducing GHG Emissions in Bulgaria

Introduction

This chapter presents sector policies and measures, which contribute to a reduction of greenhouse gas emissions in Bulgaria. As discussed in Chapter 3, the need for Bulgaria to undertake mitigation measures is limited given the current GHG emission level and the expected emission trend. Implementing climate change measures are, however, also driven by other factors. Firstly, the commitments under the Climate Convention, the Kyoto Protocol and the EU accession require an active attitude of the country to mitigate greenhouse gas emissions.

Secondly, national and EU regulation require specific actions such as the implementation of standards, the development of a Green Certificates Scheme under the Renewable Energy Directive and Emissions Trading Scheme. And last but not least various climate change measures will lead to an energy efficiency improvement and contribute to long-term cost savings.

4.4.1. Energy Sector

The Energy strategy for Bulgaria is elaborated for the accelerated reformation of the Energy sector. The Bulgarian Energy Strategy was adopted by the Council of Ministers on May, 11th, 2002 and the National Assembly adopted it with Decision №39/2002. The strategy represents the national energy policy and the main reforms envisaged for this sector. The Bulgarian energy sector will continue to be based on two major pillars in the future: nuclear energy and local extraction of lignite coal as a leading priority for the development of a competitive energy market. All other priorities are directly related to:

- Security of supply;

- Competition at the energy market;

- Environmental protection.

These priorities fully match the priorities of the EU energy policy.

The preparations for liberalization of the Bulgarian energy market have reached an advanced stage and the new Energy Law incorporated the EU requirements of the Electricity and Natural Gas Directives regarding the establishment of an electricity market and a natural gas market. Implementation programs for the Directives on Large Combustion Plants and Waste Disposal Sites respectively have been adopted. The electricity and thermal energy prices for the population will be adjusted to the production costs. The state subsidies for the power sector will gradually be abolished and will be redirected to the low-income population groups.

Practically Bulgaria is the energy centre of South-East Europe due to its geographic location on one hand, and on the other – the country covers 45 % of the permanent deficit in the common energy balance of South-East Europe. From major electricity importer (up to 4.5 TWh per annum) now Bulgaria is a major electricity exporter (5-7 TWh per annum).

● **Improvement of the operation of nuclear power plant Kozloduy (NPP-K) – E1**

Kozloduy units 1-4 will gradually be put out of operation (units 1 and 2 in 2002, and units 3 and 4 in 2006). To preserve the share of nuclear energy in the overall production of electricity in the country measures have been implemented to further improve the operation of units 5 and 6 and modernize them.

● **E2 Accelerated development of hydro energy – E2**

The existing hydropower plants (HPPs) have been rehabilitated as a considerable part of them had outdated equipment. New automation and control systems were introduced. 70 % of the hydro potential is already utilized. New capacities of 400 MW could be built for an annual operation of 2 000 to 3 000 hours.

● **Upgrading of cogeneration plants and district heating boilers – E4**

The overall efficiency could be increased to 80-90 %, which is much higher than that of existing cogeneration units or heat boilers. The introduction of new natural-gas combined cycle for replacing capacities at some of the existing thermal power plants and district heating plants forms part of the Implementation Programme for the Directive on Large Combustion Plants for the period after 2007.

● **Electricity transmission and distribution losses – E5**

A reduction of the electricity losses will lead to fewer GHG emissions as a result of lower electricity production in coal-fired plants.

● **Heat transmission and distribution losses – E6**

Losses of heat can be reduced through rehabilitation, modernization and improving the exploitation of the transmission and distribution networks. A reduction of the heat losses will lead to fewer GHG emissions as a result of lower heat production in heat boilers.

● **E7 Biomass for electricity and heat production – E7**

The assessment of the theoretical potential resulted in the following figures: firewood – 7.7 PJ per year; waste paper - 0.3 PJ per year; agricultural solid waste - 77.1 PJ per year; waste from live-stock breeding -11.3 PJ per year; municipal solid waste - 12.5 PJ per year and industrial waste wood - 0.4 PJ per year.

The potential for reduction of carbon dioxide emissions in the list of measures in the energy sector is very big. The Second National Plan on Climate change envisages an annual potential for CO_2 emission reduction of 3.3 mil. tons per year from the overall modernization of the heating companies in the country, 2 mil. tons – from heating loss reduction, 6.8 mil. tons from natural gas supply to household.

The annual GHG emission reduction following concrete policies and measures in the Energy sector is given in Table 4.1.

Table 4.1 Policies and measures in the Energy sector for GHG emission reduction

Measure	Subsector	Activity	Instrument	Annual reduction of GHG in 2010 (Mt)	Year of introduction
E1	Nuclear energy	Improvement of the existing plants	Financial	0.9	2007
E2	Hydro energy	Construction of new blocks	Legislative Financial	0.4 (after 2012)	Subject to the introduction of Green certificates and additional financing
E3	Small and micro HPP	Construction of new blocks	Legislative Financial	0.2	Subject to the introduction of Green certificates and additional financing
E4	Electricity production from cogeneration and district heating	Upgrade	Legislative Financial	0.9	Subject to the introduction of Green certificates, the application of the IPPC Directive, the Directive on Large Combustion Plants and additional financing
E5	Transmission and distribution networks	Reduction of losses	Legislative	1.1	2005
E6	Heating power transmission networks	Reduction of losses	Legislative Financial	0.9	Gradually (subject to the regulations of SEWRC and additional financing
E7	Biomass	Burning	Legislative Financial	0.05	Subject to the introduction of Green certificates, the application of the IPPC Directive and additional financing.

4.4.2. Industry

The industry policy aims towards transition to a market economy, abolishment of subsidies and liberalization of the energy market has led to sharp reduction of the share of industry in GDP – from 61 % in 1987 to 29 % in 2002. The policy towards fast privatization resulted in almost complete privatization of the industrial plants. As a consequence, the most inefficient industries were closed.

The growth of industrial production that tended lately is quite unsteady. At some enterprises the years of production growth are followed by years of reduction. Under these conditions the baseline development scenario for industry include maintenance of liberalization and market principles without subsides and preferences. Energy efficiency measures with pay-back period less than 2 years are also included in the baseline scenario. The implementation of these measures is possible at own expenses and limited loans from bank institutions at the conditions of unstable production programme. These measures will result in an average annual growth of energy consumption in industry of 1.7 % at 3.9 % GDP growth. This corresponds to a comparatively good rate of increase of efficiency at the absence of designated state subsidies in this field.

● Reduction of thermal losses in industry – I1

The use of heat in the form of steam and hot water is an important part of the industrial energy consumption. Reduction of heat losses can be realized through thermal insulation, redesign and replacement or updating of heat exchangers leading to reduction of fuel consumption for its production

● **Natural gas supply to the industry by development of gas infrastructure – I2**

Industry is a large consumer of energy. Substituting liquid fuels with natural gas will lead to the reduction of the GHG emissions and higher efficiency.

● **Introduction of monitoring systems for energy consumption – I3**

One way to achieve improvement of the efficiency of production processes is the establishment of systems for monitoring and control of energy consumption at different technological stages. This enables companies to have more insight in their energy consumption in various parts of the process, showing where measures could be taken for increase of efficiency.

● **Upgrading of steam and heat generation and compressed-air plants – I4**

In the light industry, food processing industry, machine building and metalworking, electrical and electronic industry can all reduce about 20 % of the energy consumption. This can be done through modernization of steam and compressed-air installations, regulation of the heat energy systems, energy management and control and introduction of small-scale co-generation at the relevant enterprises.

● **Reduction of fuel consumption in production of building materials – I6**

Cement industry is a key GHG emissions source. Production of structural ceramics and quicklime consume large amounts of fuels (both liquid and solid) as well. The energy use in this sector can be reduced by replacing part of the fuel by combustible waste such as car tires

The annual GHG emission reduction following concrete policies and measures in the Industry sector is given in Table 4.2.

Table 4.2 Review of the policies and measures in the Industry sector

Measure	Subsector	Activity	Instrument	Annual reduction of GHG in 2010 (Mt)	Year of implementation
I1	All subsectors	Reduction of thermal losses in industry	Legislative Financial Voluntary Agreements (VA)	0.12	Subject to the source of financing
I2	All subsectors	Increased use of natural gas in industry	Financial	0.05	Subject to financing of the natural gas supply network
I3	Non-ferrous metallurgy Light industry Machine building, electrical and electronic industry	Control of energy consuming system in industry.	VA	0.11	Gradual introduction from 2006.
I4	Light industry, Food and beverage industry Machine building, electrical and electronic industry	Modernization of steam and compressed-air installations	Legislative Financial VA	0.02	Gradual introduction from 2007.
I5	Building	Introduction of highly effective machines in building, using diesel fuel.	Legislative	0.07	Gradual introduction from 2006.
I6	Production of building materials	replacing part of the fuel by combustible waste and car tires	Legislative VA	0.34	Gradual introduction from 2005.

4.4.3. Policies and Measures for Residential and Commercial/Institutional Buildings

Considerable progress in energy saving was achieved by national programmes on the improvement of thermal insulation of the existing buildings, on the replacement of incandescent lamps with compact luminescent lamps, and on the introduction of automated control of street lighting.

The analysis of options for RES utilization in households and services revealed a practicable potential for GHG emissions reduction through implementation of measures in the following directions (reported by the Energy Efficiency Agency and municipalities):

- Solar collectors at public buildings;

- Introduction of hybrid installations for hot water at nurseries, schools and hospitals.

● Gas supply to households - H1

The Gas Supply Program for Residential and Servicing sector of MEE plans for 720000 additional households to be connected towards 2020, which should lead to a reduction of 6.9 Mton CO_2 eqv. Assuming annual new connections varying between 20,000 households in 2004 till 60,000 in 2010, about 290 thousand additional households will be supplied towards 2010, leading to an emission reduction of 2.3 Mton.

● **Solar collectors – H2**

The geographical situation of the country provides for a substantial solar energy potential. The solar collectors transform solar energy in useful thermal energy. Due to the relatively low single capacities these panels are suitable for installation at institutional buildings and private homes.

● **Hybrid and other hot water installations – H3**

RES *potential* studies have shown a potential for hot water installations using renewable energy. This can be hybrid systems combining solar collectors and biomass boilers, as well as hot water installations using only biomass.

The annual GHG emission reduction following concrete policies and measures in the Residential and Servicing sector is given in Table 4.3.

Table 4.3 Policies and measures in the Residential and Services sector

Measure	Subsector	Activity	Instrument	Annual reduction of GHG in 2010 (Mt)	Year of implementation
H1	Household	Household gas supply	Financial Public awareness	2.3	Gradually but strongly dependent on the available financing
H2	Municipal and public	Solar panels	Financial	0.02	2006, Dependent on the available financing
H3	Municipal and public	Hybrid and other hot water installations	Financial	0.04	Dependent on the available financing

4.4.4. Transport

The governmental investment policy in transportation is based on development of the country's transport infrastructure as an integrated part of the overall European transport network. The transport infrastructure will be reconstructed and updated in accordance with the international requirements and standards. The most important objectives of the National Government are the liberalization of the transport market, finalization of the legislative and institutional restructuring of the transportation sector and the provision of beneficial conditions for development of private transport companies and renewing of the mobile park.

● **Transports dispatching system – T1**

A considerable part of the return trips of freight vehicles is done without cargo. Both from an economic and environmental point of view, this is not very efficient. The implementation of central information dispatching system for the loads will lead to a decrease of empty or semi-loaded return trips of Lorries and trains.

● **Railway transport power dispatching system – T2**

Supply of electricity to the electrified sections of the railway network and reduction of electricity losses require introduction of an automated system for collecting information and dispatching control. It will lead to an increase of the security of the electricity supply and, as a consequence, to a decrease of the emissions.

● **Modernization of Railways – T3**

The consumption of residual oil and electricity for transportation of one cargo unit or passenger at a given distance is much lowers that in the road transportation. There are technical solutions that can lead, if applied, to additional reduction of the consumption of oil and electricity. The proposed measures have direct and indirect effects on the increase of the passengers and load flows in the railway transport as well as on GHG emissions reduction.

● **Improving the public transportation, reducing transportation flows in cities and renewing the transport park – T4**

The improvement of public transportation and the reduction of private transportation in cities might contribute to lower GHG emissions from transportation. An increasing share of public transport in total transportation activities can however only is reached when policies are accompanied with instruments which make the use of cars less attractive (e.g. increased fuel or road taxes, introduction of parking taxes, introduction of car-free zones in city centres). The strengthening of the control and quality in the accomplishment of the periodical technical examinations will lead to the renewing of the transport park.

● **Introduction of biofuels – T5**

The implementation of this measure will lead to reduction of GHG emissions. Bulgaria has the possibility to produce a substantial amount of biomass. Production of biofuels has a positive effect on employment in the agricultural sector.

The annual GHG emission reduction following concrete policies and measures in the Transport sector is given in Table 4.4.

4.4.5. Agriculture

The Government will carry out a uniform national strategy focusing on sustainable development of the agricultural sector in compliance with the general agricultural EU policy, taking the specific natural circumstances in Bulgaria into account.

● **Manure management – A1**

Manure is one of the most considerable methane sources in agriculture. The modern manure management practices are not applied in Bulgaria.

In liquid manure management are used transportation tanks, underground disposal at cattle-breeding farms and poultry-farming sites, separation of manure into liquid and solid fraction at pig-breeding farms, etc.

● **Fertilization and irrigation – A2**

During the last years fertilization was conducted in an uncontrolled manner. The amounts of nitrous fertilizers applied to soils often exceeded the recommended ones. The requirements for quality of production and lower prime costs grew strict due to expanded import of agricultural goods from the neighbouring countries.

The annual GHG emission reduction following concrete policies and measures in the Agriculture sector is given in Table 4.5.

Table 4.4 Policies and measures in the Transport sector

Measure	Subsector	Activity	Instrument	Annual reduction of GHG in 2010 (Mt)	Year of introduction
T1	road/railway	Introduction of transport dispatching system for cargo	Fiscal Public awareness and campaigns	0.03	Dependent on the private sector initiatives
T2	railway	Introduction of railway transport power dispatching system	Legislative Financial Public awareness and campaigns	0.09	2005
T3	railway	Modernization	Legislative	0.04	Dependent on the ongoing improvements in the railway sector
T4	Public transport	Improvement of public transport and reduction of transportation flows in cities	Legislative Fiscal Financial Public awareness and campaigns stronger control	Not valued	Dependent on the presence of subsidies and regulations
T5	Car transport	Increased use of biofuels	Legislative Fiscal Financial Public awareness and campaigns	Not valued	Dependent on the biofuel production

4.4.6. Waste Management

The measures for reduction of GHG emissions to be implemented in this sector are related to management of municipal solid waste.

Landfill sites are widely used in the country. The typical amount of waste to be disposed at regional landfill sites varies between 50,000 and 100,000 ton per year. The governmental policy in this field is directed towards building up a system of 54 regional landfill sites and closing down these landfills which do not meet the legal requirements. With the setting up of these regional landfill sites the environmental friendly waste treatment of all waste generated in the country will be secured.

- **Utilization of the captured methane for production of electricity - W1**

At this moment the energy generated during the flaring of the captured methane is not utilized. The captured methane can be utilized in piston gas motors where electricity is generated. Because of the presence of mixtures in methane, a comparatively low efficiency is accepted for this type of machines (30 %). The received electrical energy from the burning of one ton captured methane will be about 4.2 MWh under the assumption that the diesel-generators operate 6 000 hours per year. This utilization of equipment for electricity production means an installed capacity of 19,517 kW.

The annual GHG emission reduction following concrete policies and measures in the Waste sector is given in Table 4.6.

Table 4.5 Policies and measures in the Agriculture sector

Measure	Subsector	Activity	Instrument	Annual reduction of GHG in 2010 (Mt)	Year of introduction
A1	Livestock breeding	Manure management	Financial Research, development and consultancy	0.07	Gradually from 2005
A2	Fertilization and irrigation	Improving fertilization practices Elaboration of irrigation technologies aiming at water use reduction	Legislative Financial Research, development and consultancy SAPARD programme and State fund "Agriculture"	0.17	Gradually from 2005

Table 4.6 Policies and measures in the Waste sector

Measure	Subsector	Activity	Instrument	Annual reduction of GHG in 2010 (Mt)	Year of introduction
W1	Landfills	Utilization of captured methane for production of electricity	Legislative Financial	0.09	Subject to the introduction of Green certificates and additional financing

5 PROJECTIONS AND EFFECTS OF POLICIES AND MEASURES

5.1. Introduction

Decision making for GHG emission mitigation is closely related to the actual GHG emissions in the country as assessed by the inventories and the projections for their mid-term trends (i.e. until 2020). GHG projections are elaborated taking in consideration the trends of key macro-economic, technological, demographic and other indicators that determine the economic development of the country.

When developing the First, Second and Third National Communications under UNFCCC, the link between the historical data and the projections was vague, thus the coverage of the inventories was limited to a few years. Currently, there is a significant change in this regard since the inventories cover a fifteen year period (1988 – base-year, 1990-2003). Furthermore, the inventory data has been recalculated and updated according to the latest IPCC methodological guidelines.

5.2. Projections

Current projections are based on the following procedures and assumptions:
- Analysis of the emissions projections reported in the Second National Communications.
- Accounting for the actual GHG emissions / removals for the period 1988-2003 and the underlying reasons for the trends (national and external factors).
- Taking into consideration the sectoral plans for agriculture, forestry, industry and waste as reported by the relevant state institutions and NGOs.

As a result, three scenarios for GHG emission projections until 2020 were developed, analysed and compared:
- "**without measures**" scenario
- "**with measures"** scenario
- "**with additional measures"** scenario

The "**without measures**" scenario is based on the assumption for intensive economic development with emphasis on energy intensive technologies and limited application of energy efficiency improvement measures in industry and agriculture. This scenario was originally developed in 1994 (before Bulgaria ratified the UNFCCC) for the preparation of the First National Communication. It was considered "business-as-usual" scenario, nonetheless it is not a "frozen efficiency" such. It incorporates all of the governmental policies and measures that have been adopted before 1994, thus making it more "likely-to-be" scenario. GHG projections for the scenario have been based on a limited number of emission sources, reflecting the actual IPCC Inventory Guidelines for that period. To assure comparability between the three scenarios, based on the forecasted in 1994 macroeconomic indicators, production volumes, activity data and emission factors the emissions forecast in "**without measures**" scenario have been revised.

The "**with measures"** projection encompasses currently implemented and adopted policies and measures, and those measures that are given in the energy sector. It envisages a growth rate of electricity demand by 62.8% for the period 2000-2020. This scenario projects relevant measures in the energy sector, while the rest of the sectors rely on already applied measures.

The key macroeconomic and energy characteristics of this scenario are provided in section 5.3 Methodology. Herein only the schedule for decommissioning of old and commissioning of new power units is given as follows:

- Units 3 and 4 of NPP Kozloduy are to be decommissioned in 2006.
- New lignite fired units 335 MW each are to be commissioned in TPP Maritsa East 1 as follows: 2009 – 1x335 MW; 2012 – 2x335 MW.
- Furnishing of the heat facilities in Sofia with gas turbines as follows: 2010 – 1x130 MW.
- Commissioning of renovated 100 MW unit fuelled by imported coal in 2009 in TPP Ruse.
- Commissioning of new HPP Tzenkov kamuk 80 MW – 2009.
- New NPP in Belene – 1000 MW in 2013 and 1000 MW in 2016.
- New HPP cascade Gorna Arda – 160 MW in 2015.
- New TPP on combined cycle – 1200 MW in period 2018-2020.

This scenario encompasses measures for entire rehabilitation of old units and improved environmental performance. GHG emissions mitigation could be expected due to the introduction of renewable energy sources (including Hydro Power), safe operation of NPP units after rehabilitation, and expansion of heat generation units in Sofia.

This projection integrates the assumption for increase in annual electricity export from 4,200 up to 7,000 GWh for the period after 2005.

The "**with additional measures**" scenario comprises planned policies and measures for GHG mitigation. While in the "**with measures**" scenario the measures are more generally referring to environmentally friendly development, this scenario is more concentrated on the specific GHG mitigation measures and policies in the power sector. It is based on the same key macroeconomic characteristics.

The main differences between the "with measures" and "with additional measures" scenarios are:

- Electricity demand increases by 37.4% for the period 2000 - 2020
- Electricity export is kept at annual level of 4,200 GWh.
- New NPP Belene – 1050 MW in 2017 and 1000 MW in 2022.
- New HPP cascade Gorna Arda – 160 MW in 2016.

The measures and influence of the EC Directives on biofuels, HPP and GHG Emission trading are considered for the other sectors as planned in the Second Action Plan (2005-2008). These directives will be applied after 2007.

Reported GHG inventory results reveal that the following sources are the major contributors for GHG emissions in Bulgaria:

- Energy, including stationary and mobile combustion – for CO_2, CH_4 and N_2O.
- Industrial processes – for CO_2, CH_4 and N_2O.
- Agriculture – for CH_4 and N_2O.
- Land use change and forestry – for CO_2.
- Landfills – for CH_4 and N_2O.

The categories represented below account for more than 99% of the total country emissions, thus they are the ones considered in the projection.

The GHG emission projections, by sector and by GHG; and the overall emission projection are given in the figures provided at the end of this chapter. The analysis of the sectoral projections and the overall GHG emission projections indicates the effect of the implementation of the measures described in Chapter 4.

The “**without measures**” scenario used the baseline scenario from the First National Communication. This scenario is revised with the results obtained by the GHG inventories until 2000.

The emission analysis address the period 2005-2020, for the “**with measures**” and “**with additional measures**” scenarios.

5.2.1. Energy

The sectoral emission projections for CO_2, CH_4 and N_2O are provided in Tables 5.1, 5.2 and 5.3. The trends in emissions from the base year 1988 until 2020 are given in Figs. 5.1, 5.2 and 5.3. The combined effect of the measures in power sector, industry, transport, agriculture, residential sector and services is given in the GHG emission projections. In terms of CO_2 and N_2O these measures account only for the emissions from fuel combustion in all those sectors. CH_4 account for those emissions; as well as for the fugitive emissions from production, transportation and distribution of coal, natural gas, and crude oil.

CO_2 emissions

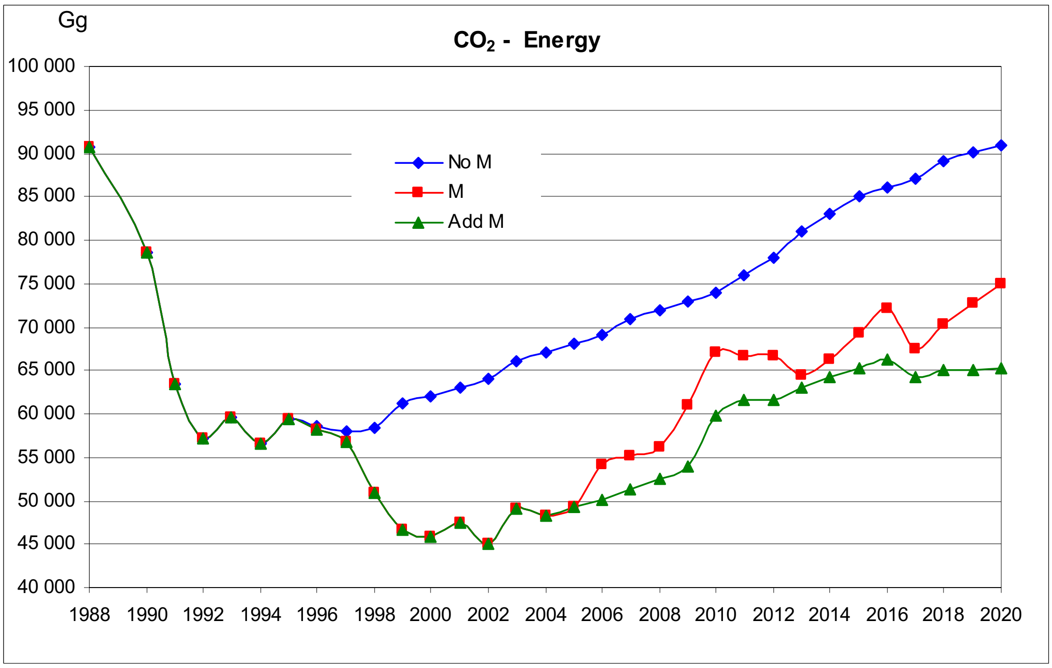
The "**with measures**" scenario compared to the "**without measures**" scenarios indicates a tendency for decrease of the emissions for the period 2000-2020 that results in 15-20% lower emissions. The decrease is due to the restructuring of the industrial and power sectors. On the other hand the energy demand for the "**with measures**" scenario is lower by 30-50% in the period 2000-2020 compared to the "**without measures**" scenario.

The scenario "**with additional measures**" covers the planned measures, decrease of electricity export and increased use of renewables. Both the "**with additional measures**" and "**with measures**" scenarios use different projection for final energy demand. As a result the final CO_2 emissions for the "**with additional measures**" scenario are 12-15% lower. The deviation between the two scenarios is the greatest in the period 2008-2012 and 2017-2020 because of the less lignite-fired units and new NPP in this period.

Table 5.1. CO_2 emission projection from Energy [Gg]

Year	No Measures	Measures	Add Measures
2000	62000	45862	45861
2005	68000	49362	49245
2010	74000	67172	59836
2015	85000	69274	65340
2020	91000	74943	65311

Fig.5.1. CO_2 emission projection from Energy [Gg]



CH_4 emissions

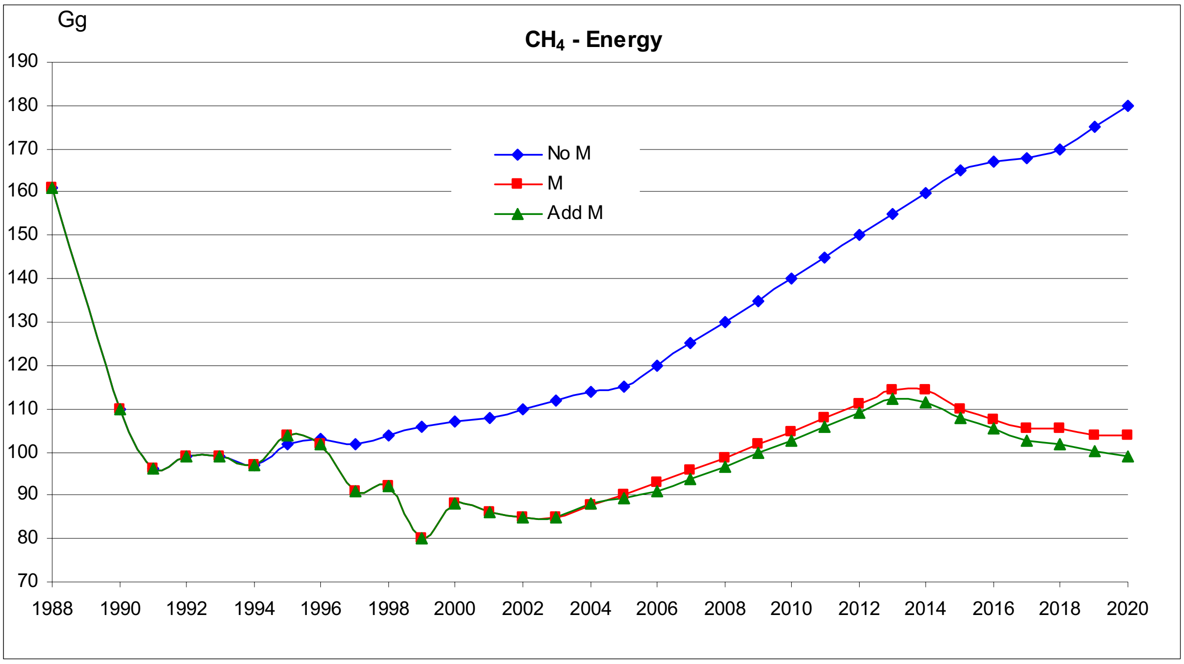
The comparison of "**with measures**" and "**without measures**" scenarios takes into account the role of the fugitive emissions. Most of these emissions are from mining of lignite and from transportation and distribution of natural gas. The decrease of the emissions in the period 2002-2013 is 23-26%. In the period 2009-2015 the decrease is variable and change from 26% in 2013 to 43% in 2020.

The comparison of the "**with measures**" and "**with additional measures**" scenarios indicates very low differences of 2-5% and mainly for the period after 2017.

Table 5.2. CH_4 emission projection from Energy [Gg]

Year	No Measures	Measures	Add Measures
2000	107	88	88
2005	115	90	89
2010	140	105	103
2015	165	110	108
2020	180	104	99

Fig.5.2. CH_4 emission projection from Energy [Gg]



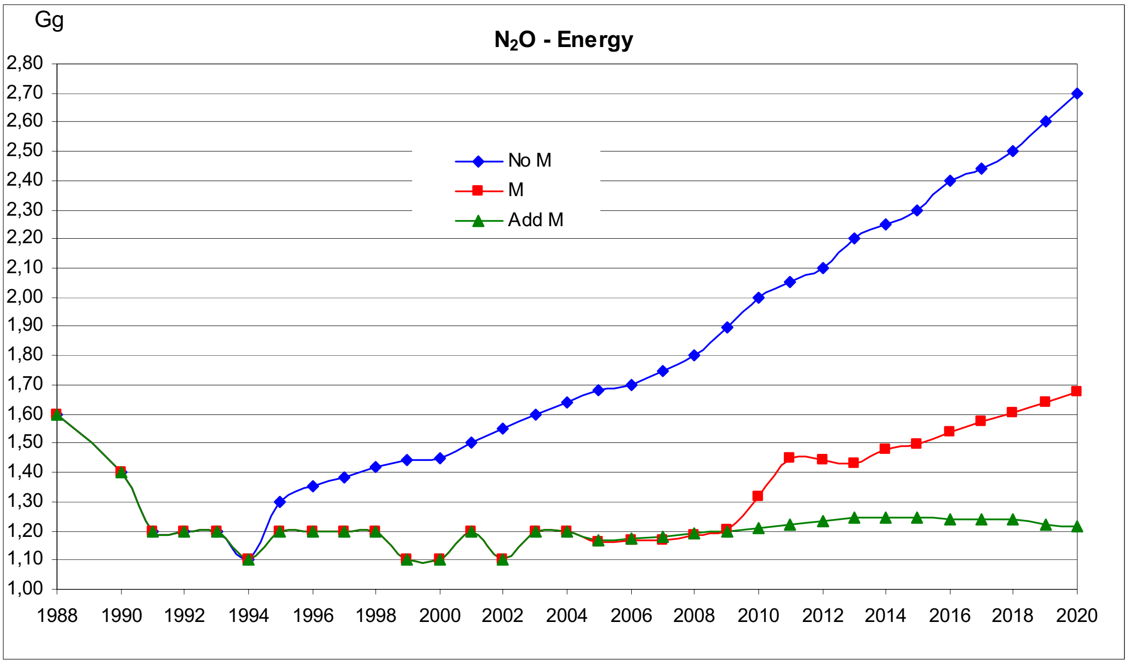
N_2O emissions

The emissions of N_2O from energy sector are several times lower compared to the emissions of CH_4 and occur in the energy transformation processes

Table 5.3. N_2O emission projection from Energy [Gg]

Year	No Measures	Measures	Add Measures
2000	1.45	1.10	1.10
2005	1.68	1.16	1.17
2010	2	1.31	1.21
2015	2.3	1.49	1.24
2020	2.7	1.67	1.21

Fig.5.3. N_2O emission projection from Energy [Gg]



The "**with measures**" scenario compared to the "**without measures**" scenarios indicates a tendency for increase in the range of 33-59%. The difference till 2008-2009 is stabilized to 42% and then gradually increases to reach 58.8% in 2020.

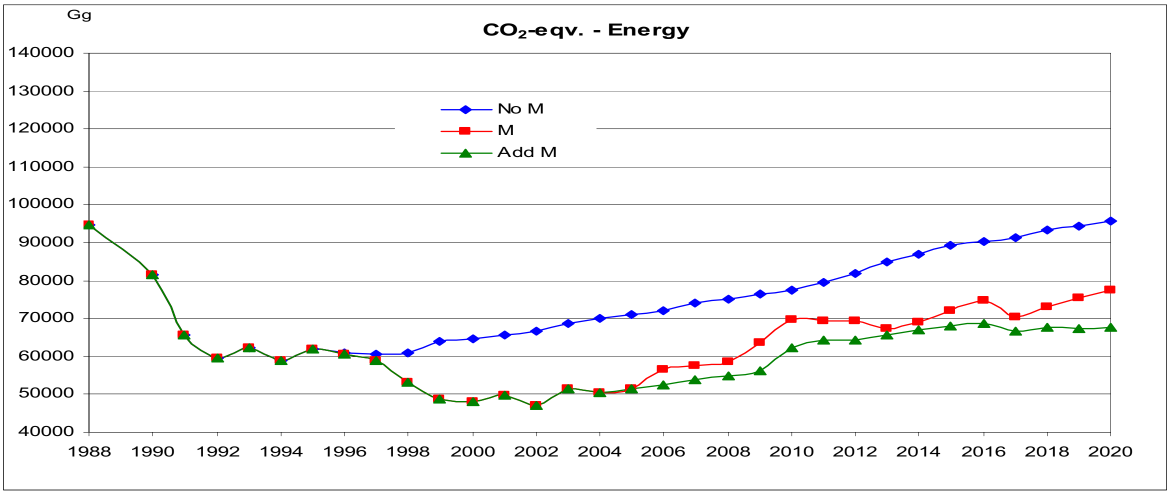
The comparison of the "**with additional measures**" and "**with measures**" scenarios indicates gradual increase of the differences from 8-9% in 2010 to 42% in 2020.

Table 5.4 presents the overall emissions from Energy expressed in Gg CO_2 equivalent. The tendencies described above are slightly affected by the aggregation due to the fact that the importance of the CO_2 emissions directs the overall trend.

Table 5.4. Total emissions from Energy [Gg CO_2 eqv.]

Year	No Measures	Measures	Add Measures
2000	64697	48051	48050
2005	70936	51617	51483
2010	77560	69778	62366
2015	89178	72044	67991
2020	95617	77640	67769

Fig.5.4. Total emissions from Energy [Gg CO_2 eqv.]



The aggregated changes between the "**with measures**" and "**without measures**" scenarios are within the range of 11-19% with more explicit deviation after 2010. The comparison of the "**with measures**" and "**with additional measures**" scenarios also indicates a tendency for decrease in the second scenario which followed the commissioning of the new NPP.

If a comparison is made for the three scenarios over the 2000-2020 period, it indicates that the rates of emission increase (Table 5.5) are lower compared to the rates of increase of GDP from the relevant sectors.

Table 5.5. GHG emission increase for the energy sector in the 2000-2020 period, %

Scenario/ GHG	**CO_2**	**CH_4**	**N_2O**	**CO_2 eqv.**
With measures	63	18	52	62
With additional measures	42	13	10	41

For example the increase of the GDP of the country (including industry, energy industries, transport and services) is 2.76 times. Even the emissions in the "**with measures**" scenario have considerably lower increase (62%).

5.2.2. Industrial Processes

The emission projections for CO_2, CH_4, N_2O and totals from industrial processes are provided in Tables 5.6, 5.7, 5.8 and 5.9. These do not include the emissions from fuel combustion.

The emissions from industrial processes include mainly ferrous industry, chemistry, building materials, food and beverage industry. Figs. 5.4, 5.5 and 5.6 provide emission trends for the period from the base year 1988 until 2020, including both inventory emissions and emission projections.

CO_2 emissions

The comparison of the scenarios "**with measures**" and "**without measures**" indicates a decrease of the emissions by 11-23% if measures are included.

The increase in the scenario "**with measures**" continues in period 2008-2012 and the difference with the " **with additional measures**" scenario becomes 0.9-2%. After 2014 the emissions are expected to increase steeply for the both scenarios

CH_4 and N_2O emissions

Non-energy emissions of CH_4 and N_2O are much lower compared to CO_2 emissions. The reduction of the CH_4 emissions according to the scenario "**with measures**" compared to the "**without measures**" scenario is about 11-52% over the 2000-2008 period. In the period 2009-2020 the decrease is within the range of 45-52%.

Projected N_2O emissions in the scenario "**with measures**" are considerably lower compared to the scenario "**without measures**". This is due to the drop in the production of fertilizers in the period 1995-2000 that provides lower base for projections in the scenario "**with measures**". As a result, for the entire projected period 2000-2020 the decrease to the scenario "**without measures**" is comparatively stable in the range 88-129%.

Table 5.6. CO_2 emission projection from Industrial Processes [Gg]

Year	No Measures	Measures	Add Measures
2000	4900	4315	4315
2005	5800	5093	5093
2010	7200	6465	6278
2015	8100	7530	7530
2020	8800	7969	7969

Fig.5.5. CO_2 emission projection from Industrial Processes [Gg]

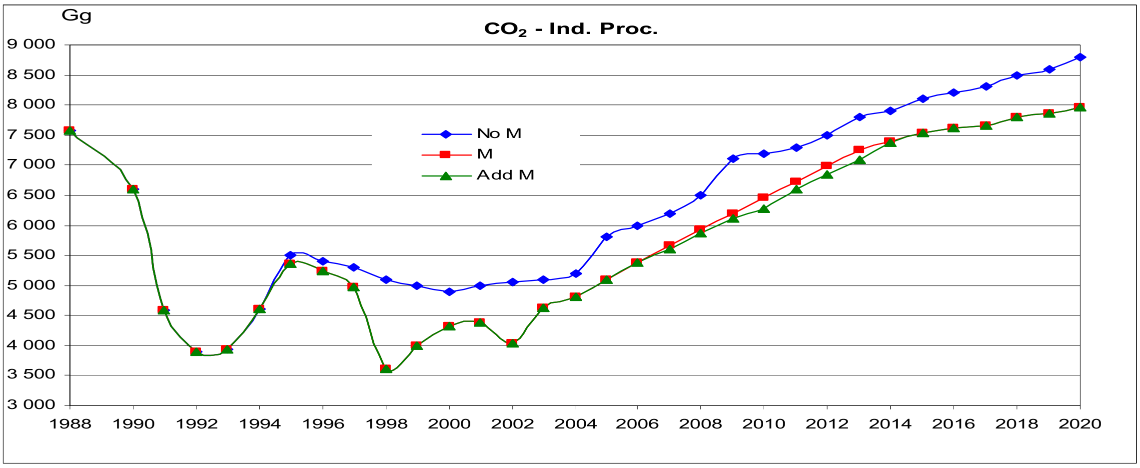


Table 5.7. CH_4 emission projection form Industrial Processes [Gg]

Year	No Measures	Measures	Add Measures
2000	3.9	3.50	3.5
2005	4.0	2.40	2.4
2010	4.3	3.05	3.0
2015	4.7	3.55	3.5
2020	5.3	3.75	3.8

Fig.5.6. CH_4 emission projection form Industrial Processes [Gg]

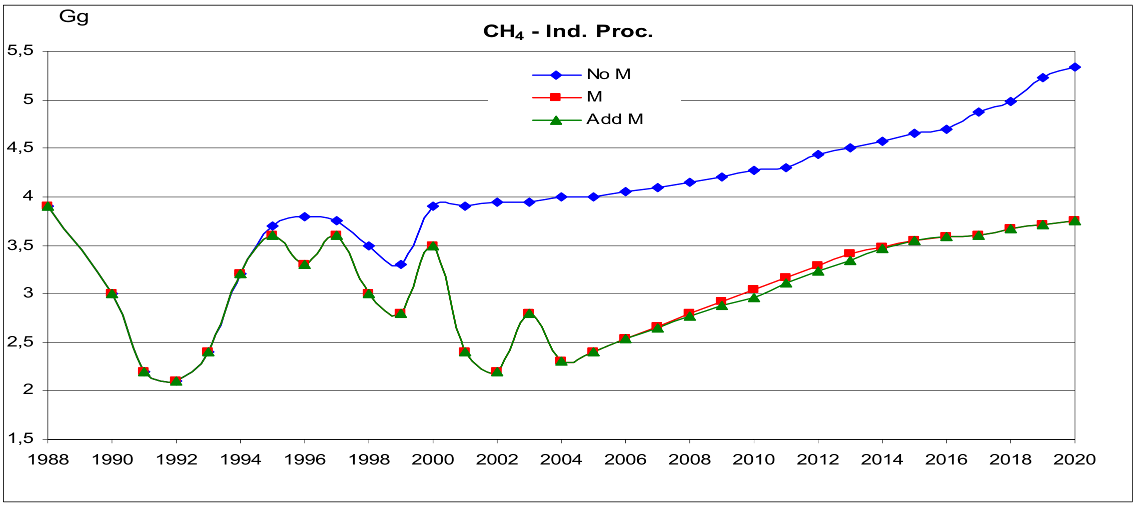


Table 5.8. N_2O emission projection from Industrial Processes [Gg]

Year	No Measures	Measures	Add Measures
2000	7.2	4.20	4.20
2005	8.3	2.93	2.93
2010	9.3	3.72	3.61
2015	10.5	4.33	4.33
2020	11.10	4.58	4.58

Fig.5.7. N_2O emission projection from Industrial Processes [Gg]

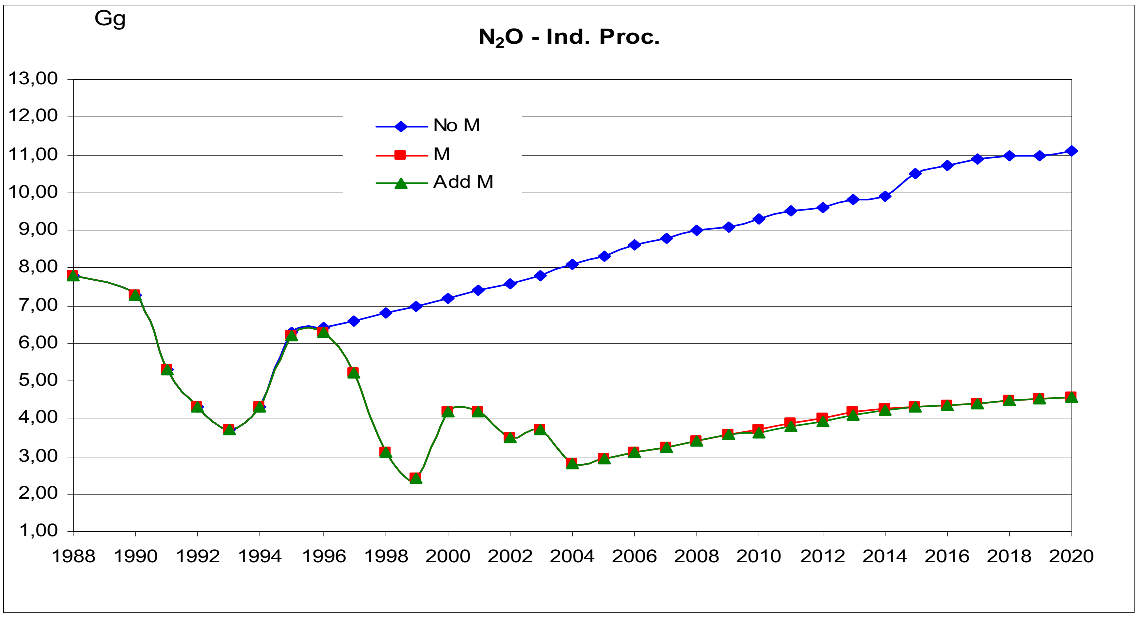
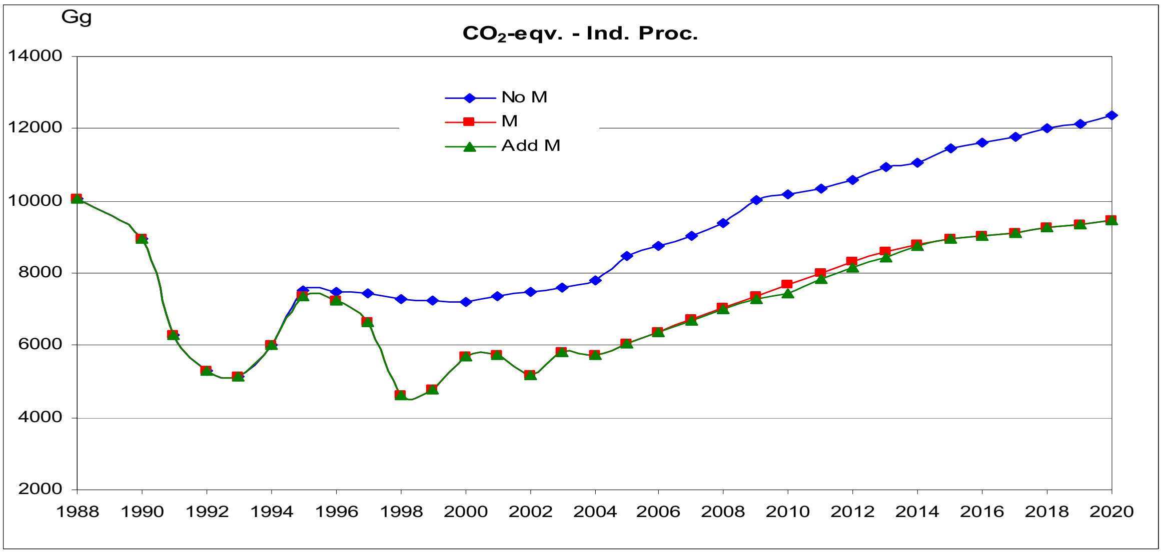


Table 5.9. Total emissions from Industrial Processes [Gg CO_2 eqv.]

Year	No Measures	Measures	Add Measures
2000	7214	5691	5691
2005	8457	6051	6051
2010	10173	7681	7459
2015	11453	8946	8946
2020	12353	9468	9468

Fig.5.8. Total emissions from Industrial Processes [Gg CO_2 eqv.]



5.2.3. Agriculture

Tables 5.10, 5.11, and 5.12 provide the non-energy emissions of CH_4, N_2O and the totals. Figs. 5.9 and 5.10 and 5.11 show the forecasts for N_2O and CH_4 emissions for all years of the period. The main sources of CH_4 are Enteric Fermentation and Manure Management that account for more than 95% of the CH_4 emissions from Agriculture.

Table 5.10. CH_4 emission projection from Agriculture [Gg]

Year	No Measures	Measures	Add Measures
2000	124	109.0	109.0
2005	131	108.0	102.6
2010	210	196.3	186.5
2015	256	225.0	200.0
2020	299	242.0	220.0

Fig.5.9. CH_4 emission projection from Agriculture [Gg]

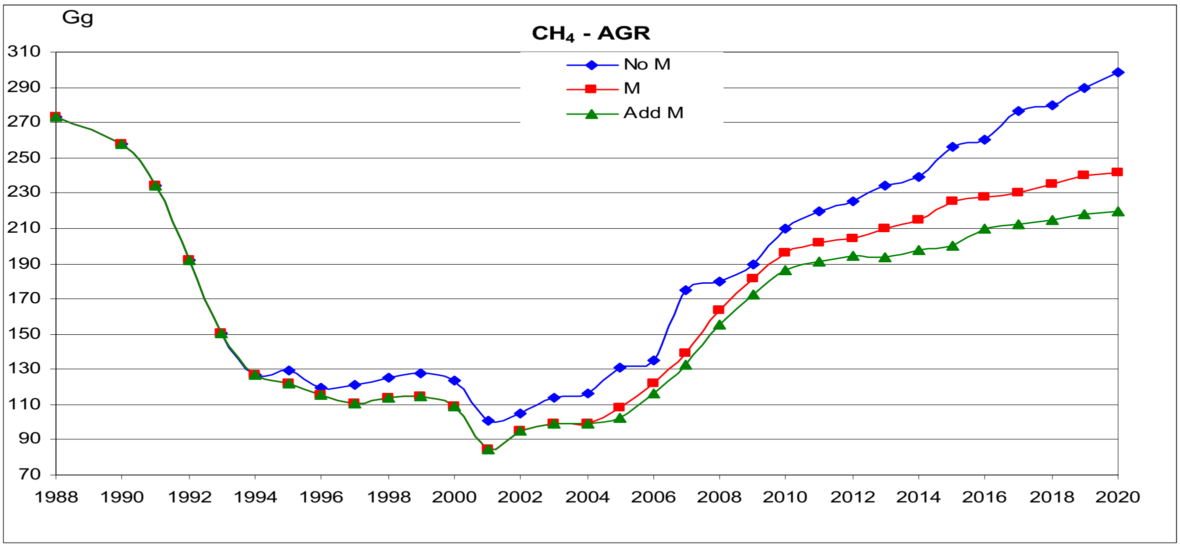


Table 5.11. N_2O emission projection from Agriculture [Gg]

Year	No Measures	Measures	Add Measures
2000	12.0	10.0	10.0
2005	13.0	9.4	8.9
2010	16.0	14.7	14.0
2015	22.0	20.6	18.5
2020	29.0	26.7	24.0

Fig.5.10. N_2O emission projection from Agriculture [Gg]

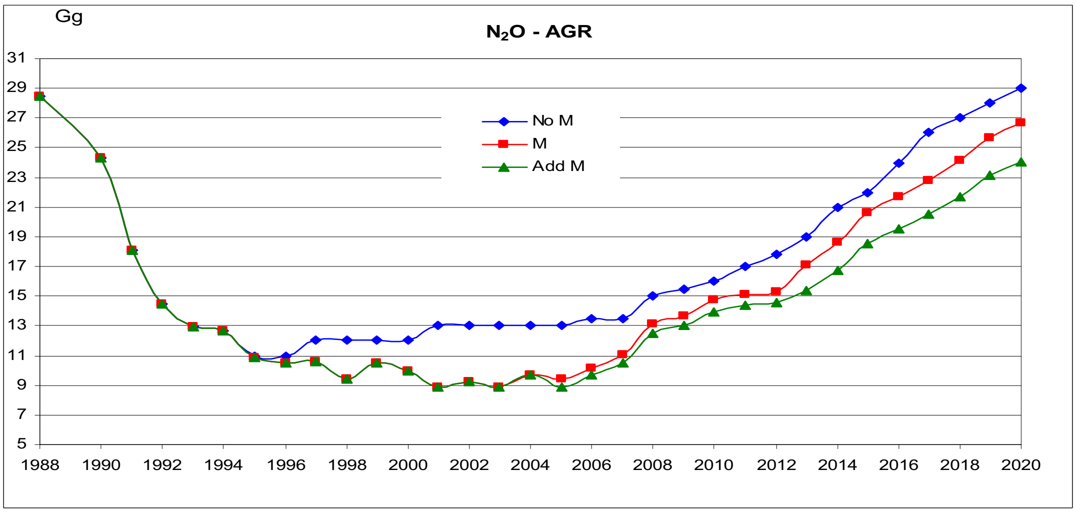
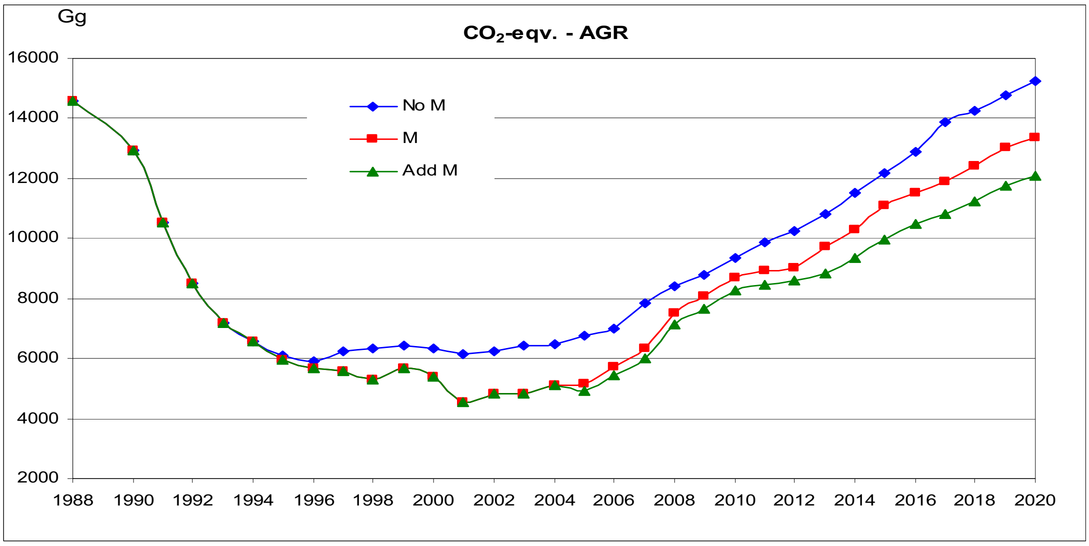


Table 5.12. Total emissions from Agriculture [Gg CO_2 eqv.]

Year	No Measures	Measures	Add Measures
2000	6324	5389	5389
2005	6781	5177	4919
2010	9370	8682	8248
2015	12196	11111	9947
2020	15269	13359	12069

Fig.5.11. Total emissions from Agriculture [Gg CO_2 eqv.]



The projections of the two scenarios “with measures” and “with additional measures” were prepared with the participation of the National Centre for Agricultural Sciences (NCAS) at MAF. They take into account the views for the development of livestock breeding and plant growing, recognizing all development programs, drafted and applied until the end of 2005.

The comparison of the scenario “**with measures**” to the scenario “**without measures**” indicates a stable downward tendency of the emission reduction when measures are applied within the range of 9-22%.

The projected emissions of N_2O have not different characteristics compared to the CH_4 emissions. Expected reduction is lower (within the range of 13-15%). The overall trend of the emissions from the sector is closer to the trend of N_2O emissions. It is stable over the entire period of 2000-2020 and keeps range of 6-16%.

Table 5.13. CH_4 emission projection from Waste [Gg]

Year	No Measures	Measures	Add Measures
2000	300	229.5	229.5
2005	420	239.7	239.7
2010	470	208.4	206.4
2015	520	178.9	176.1
2020	580	192.6	181.6

Fig.5.12. CH_4 emission projection from Waste [Gg]

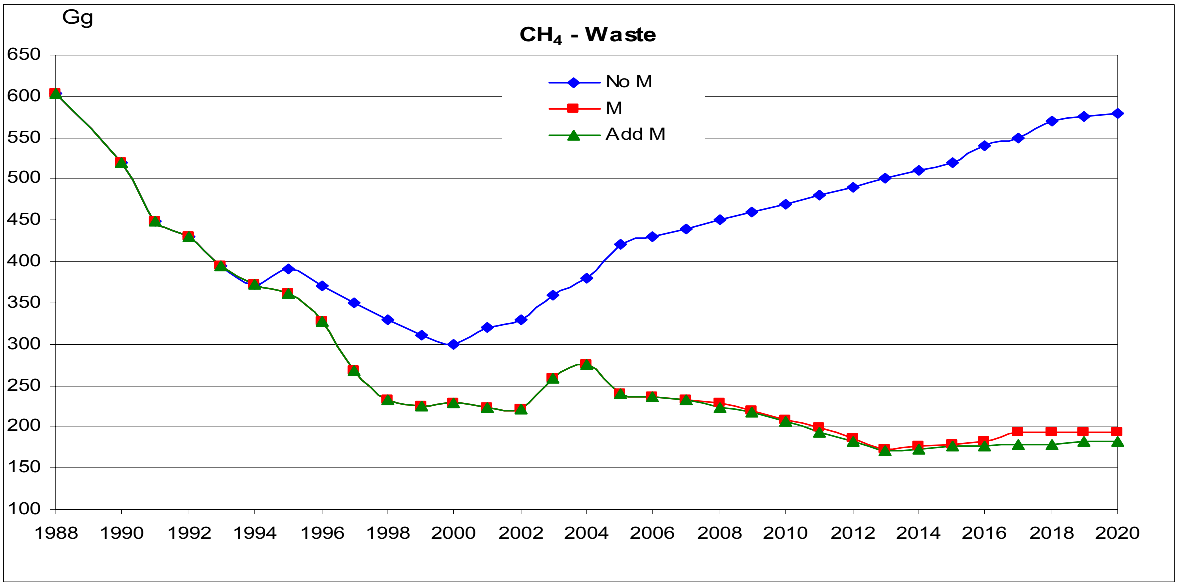


Table 5.14. N_2O emission projection from Waste [Gg]

Year	No Measures	Measures	Add Measures
2000	0.52	0.50	0.50
2005	0.58	0.42	0.42
2010	0.60	0.37	0.36
2015	0.65	0.31	0.31
2020	0.70	0.34	0.32

Fig.5.13. N_2O emission projection from Waste [Gg]

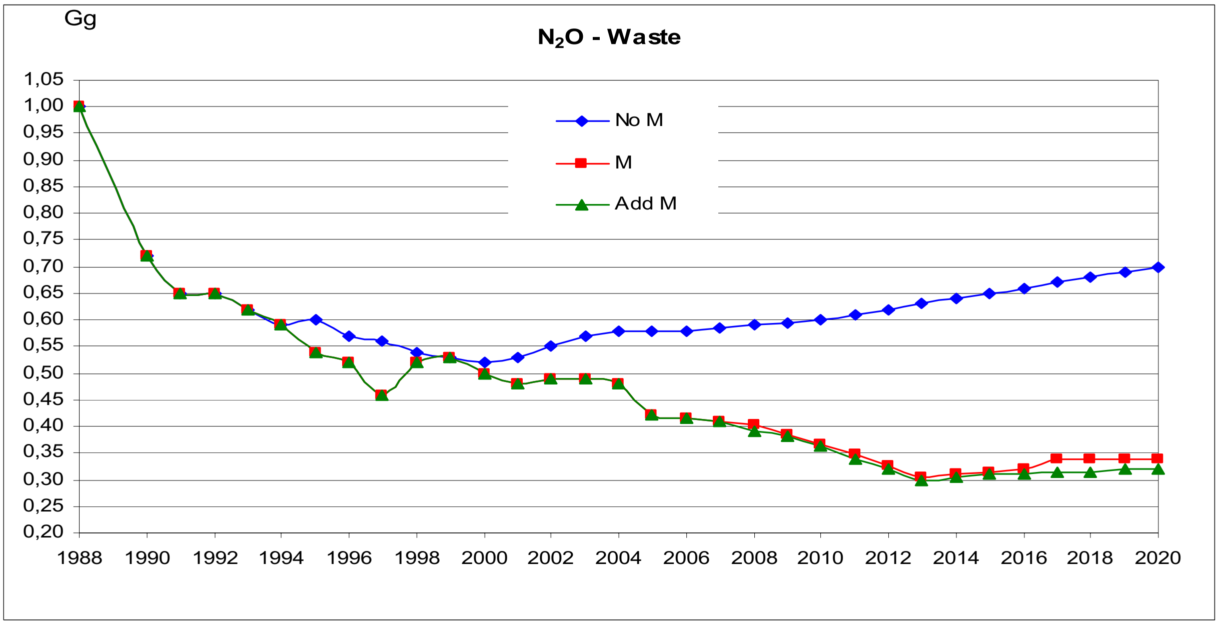
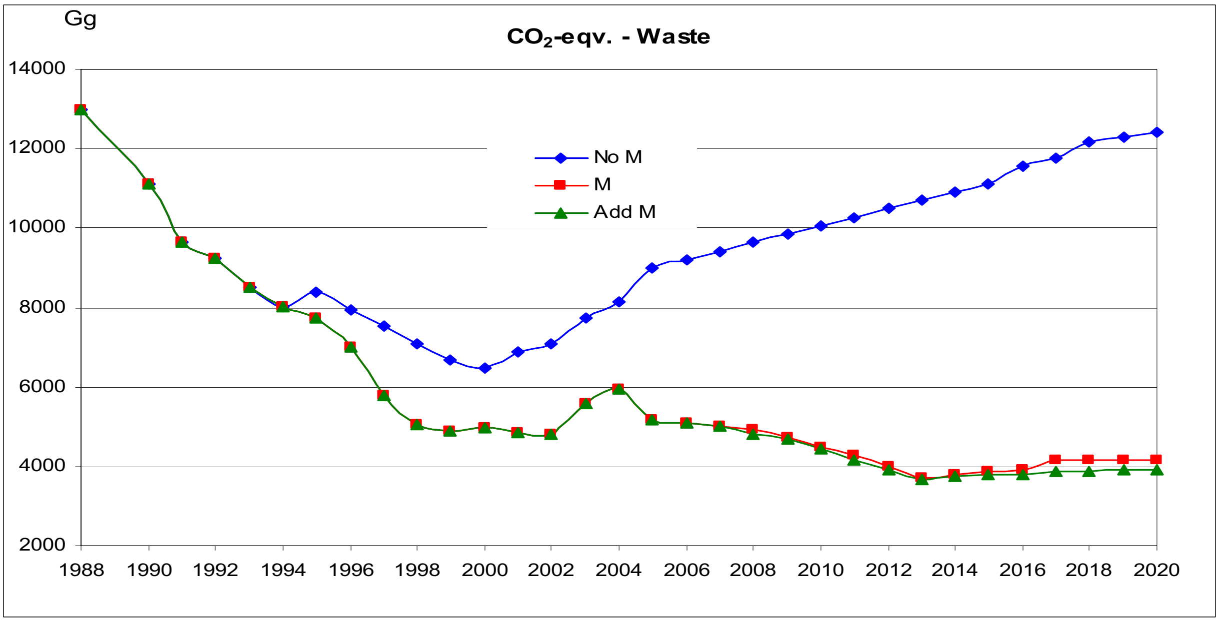


Table 5.15. Total emissions from Waste [Gg CO_2 eqv]

Year	No Measures	Measures	Add Measures
2000	6461	4974.5	4974.5
2005	9000	5164	5164
2010	10056	4491	4446
2015	11122	3853	3794
2020	12397	4150	3913

Fig.5.14. Total emissions from Waste [Gg CO_2 eqv]



5.2.4. Waste

Projected emissions of CH_4, N_2O and the total from Waste sector are given in Tables 5.13, 5.14 and 5.15. Figs. 5.12 and 5.13 and 5.14 shows the N_2O and CH_4 emissions for all years of the period.

Comparison of the scenario "**with measures**" against the "**without measures**" scenario shows a comparatively stable decrease of the projected CH_4 emissions from the sector due to the applied measures within the range of 72-185%. The main reason for the reduction is the policy for the solid waste management. The emissions from the solid wastes treatment are 85% of the total CH_4 emissions from the sector. Other sources are the treatment of the industrial and residential wastewater.

The scenario "**with measures**" does not exhaust the mitigation potential for the sector. This is evident in the scenario "**with additional measures**" that allows an additional reduction of 2-8% of the CH_4 emissions over the projection period.

N_2O emissions are comparatively low in absolute terms and their trend does not affect the aggregated emissions the sector (Table 5.15).

5.2.5. Projections of Total GHG Emissions

Tables 5.16, 5.17 and 5.18 show the forecasted emissions of CO_2, CN_4 and N_2O.

Comparison of the ***total CO_2 emissions*** in the scenarios "**with measures**" and "**without measures**" indicates a steady decrease in the range of 9-26% in the forecast period after year 2005.

Comparison of the "**with additional measures**" scenario with the "**with measures**" one reflects the measures in the energy sector described above. As a result, CO_2 emission reduction is in the range 8-12%, with the peak expected in the period 2006-2010.

Analysis of the change of the forecast ***CH_4 emissions*** shows high trend in the emission reduction in the "**with measures**" scenario compared to "**without measures**" one. The expected reduction during the forecast period is 49-98%.

Comparison of "**with additional measures**" scenario with "**with measures**" one shows reduction of CH_4 emissions in the range 5-10%. It has to be mentioned that in the total CH_4 emissions are included the emissions resulting from leakage in the systems for transportation of oil and natural gas. The forecast for that type of emissions is the same in all three scenarios – it is accepted that the amount 30-40 Gg will be valid for the period after year 2005. This amount leads to some differences between the percentage decrease in CH_4 emissions from the various sectors and the total CH_4 emissions.

Comparison of the forecasted ***emissions of N_2O*** in "**with measures**" scenario compared to the "**without measures**" one reveals a decrease in emissions during the forecasted period in the range 40-42%. The decrease value is higher at the start of the period – after 2005. The reason for this is the stronger decrease in the agriculture sector, which has the major share in these emissions.

In the total amount of N_2O emissions is included the emissions forecast from leakage of oil and natural gas during transit transportation.

Comparison of forecast N_2O emissions for "**with additional measures**" scenario to "**with measures**" scenario shows a relatively small decrease in the range of 9-10%.

5.2.6. Aggregated GHG Emissions

The forecasted aggregated emissions for the three scenarios reflect the described sectoral measures for abatement of emissions and GHG reduction. They are shown in terms of CO_2 equivalent given in Table 5.19 and Fig. 5.18. Comparison of "**without measures**" and "**with measures**" scenarios shows an emission decrease in the range of 22-32%, which takes place in the period 2005-2020.

Comparison of "**with addition measures**" and "**with measures**" scenarios reveals too certain tendency for decrease of emissions in the period 2005-2020, but in smaller range: 5-13%.

Table 5.16. Total CO_2 emissions [Gg]

Year	No Measures	Measures	Add Measures
2000	66900	50177	50176
2005	73800	54455	54338
2010	81200	73636	66114
2015	93100	76804	72869
2020	99800	82913	73280

Fig.5.15. Total CO_2 emissions [Gg]

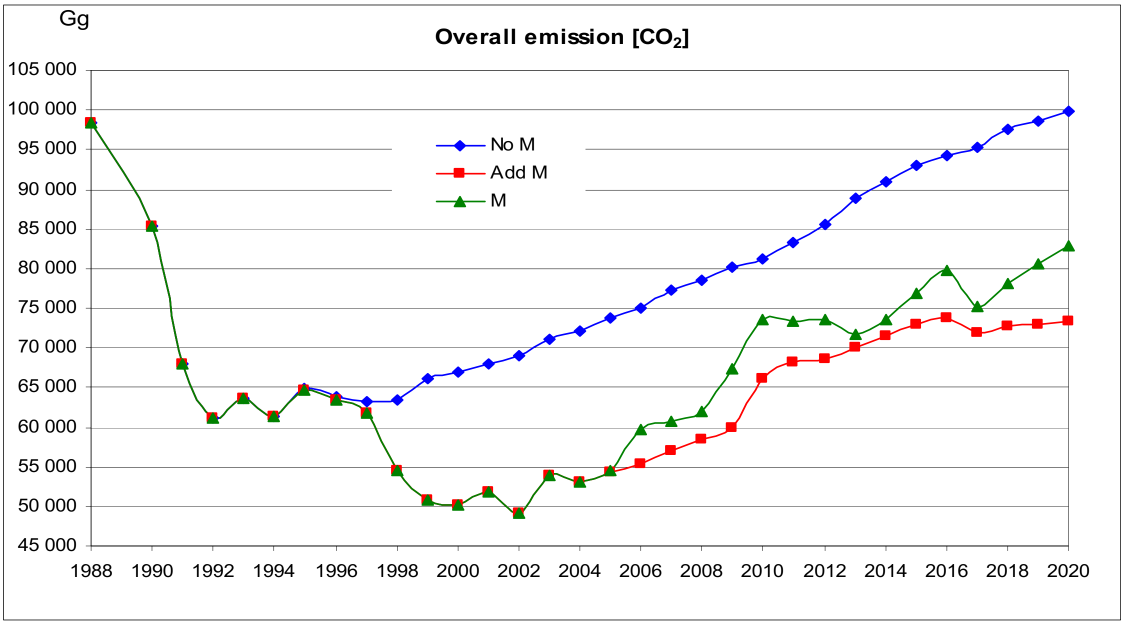


Table 5.17. Total CH_4 emissions [Gg]

Year	No Measures	Measures	Add Measures
2000	535	430	430
2005	670	440	434
2010	824	512	498
2015	946	517	488
2020	1064	542	505

Fig 5.16. Total CH_4 emissions [Gg]

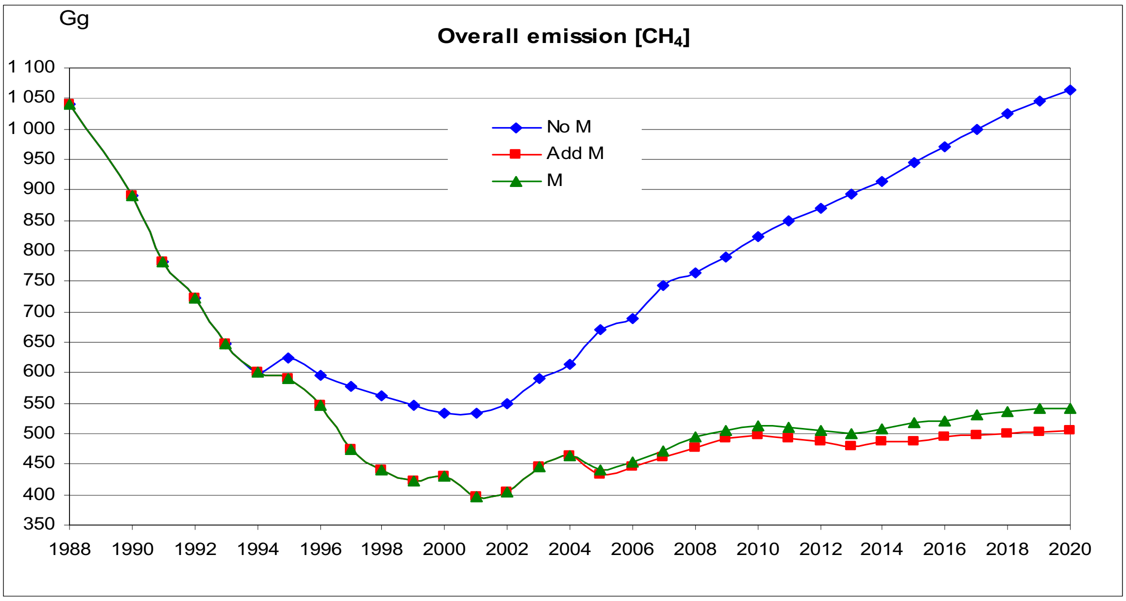


Table 5.18. Total N_2O emissions [Gg]

Year	No Measures	Measures	Add Measures
2000	21	16	16
2005	24	14	13
2010	28	20	19
2015	35	27	24
2020	44	33	30

Fig.5.17. Total N_2O emissions [Gg]

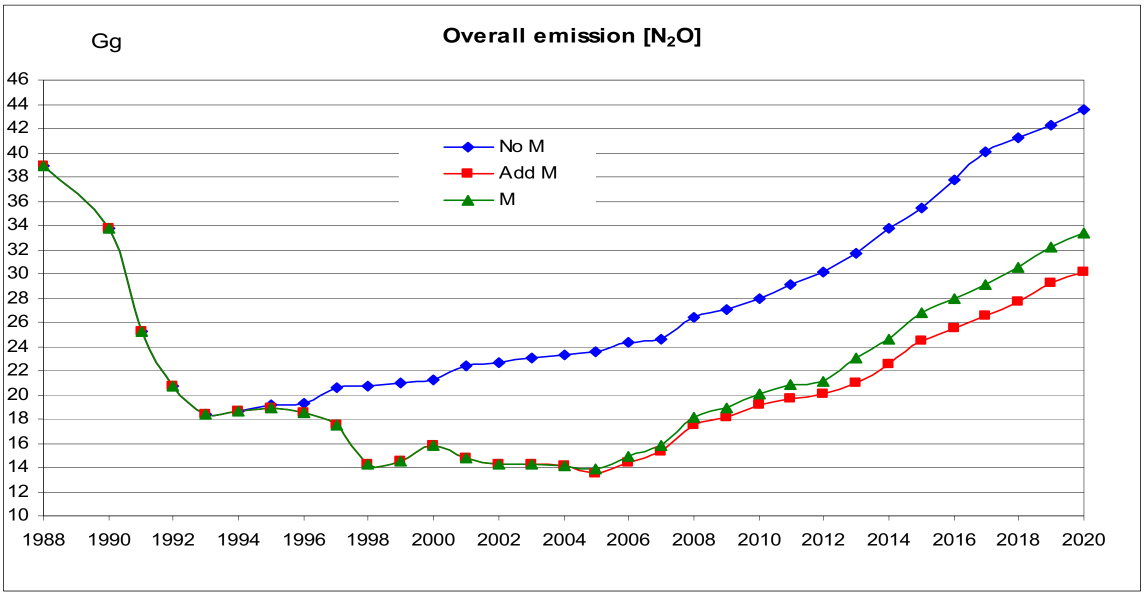


Table 5.19. Aggregated GHG Emissions, CO_2-eqv]

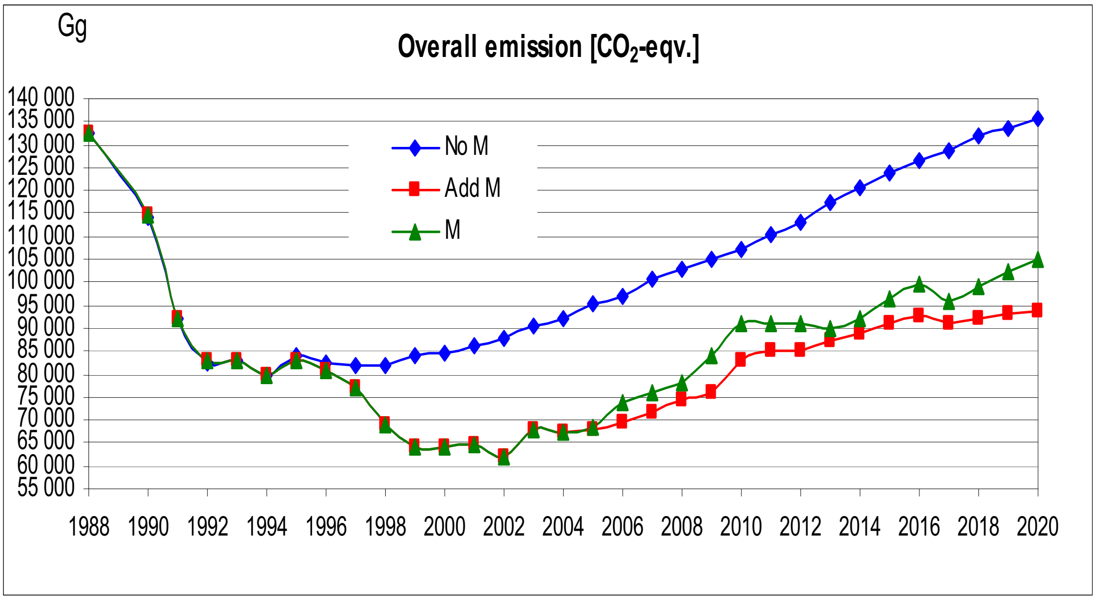
Year	No Measures	Measures	Add Measures
2000	84696	64236	64235
2005	95174	68268	67875
2010	107159	90981	82809
2015	123948	96344	91034
2020	135636	105048	93635
Av. 2008-12	**107646**	**87089**	**80702**

First Commitment Period

During the First Commitment Period 2008-2012, the expected yearly average amount of the total aggregated emissions is believed to be under the foreseen 8% reduction of the base year 1988 total amount of emissions (see Table 5.20).

Analysis of the projected emissions in Bulgaria during the 1st commitment period 2008-2012 shows that even if the without measures scenario would have happen (if there were no certain measures taken already for rapid increase of the efficiency of the economy in Bulgaria) the country would be able to fulfil its obligation as during the period, the emissions would have been by 12% below the Kyoto target. This is due to the already undertaken transition from centrally planed to the market economy and the restructuring that are guarantee that the country meets the commitment even without specific measures.. In addition, due to the implemented climate change policies and measures a significant potential for emission trading appears. For the "with measures" scenario, this potential is estimated at over 34 million tons of CO_2 equivalent on yearly basis. Should **additional measures** be implemented, the emission trading potential would reach about 41 million tons.

Fig.5.18. Aggregated GHG Emissions, CO_2-eqv



There is even a bigger potential for emissions reduction in Bulgaria, however it cannot be realized due to lack of investments. Yet the carrying out of Joint Implementation projects in the field of energy efficiency in the industry and building sectors, or projects for developing the natural gas household network would eventually lead to additional emission reduction in the amount of 10-15 million tons CO_2-equivalent.

Table 5.20. Overall GHG emissions over the First Kyoto commitment period [Gg]

Years	Scenarios		
	No measures	**With measures**	**With additional measures**
2008	102728	78372	71705
2009	105073	84072	76217
2010	107159	90981	82809
2011	110175	90878	85022
2012	113095	91140	85281
Average (2008-2012)	107646	87089	80207
Kyoto target (average)	**121 716**		

5.2.7. Projections of the Forest Sink Capacity until 2035

Forest ecosystems absorb CO_2 and thus influence the carbon budget. Inventory results for Bulgarian forests indicate that the forest off-set potential amounted to 5-7% from the total CO_2 emissions. Pursuant to the Forestry Act articles (1997), two scenarios for the forest sink capacity have been developed. The following assumptions are laid down in the two scenarios: optimistic and pessimistic.

Optimistic scenario: According to this scenario, a significant biomass accumulation is projected which means that carbon stored will increase up to 16 million t in 2035. Actually, the carbon stored could be expected to be more, if the planned/actual cut ratio remains the same.

Pessimistic scenario: According to this scenario the balance is negative, reaching the highest rate of decrease in 2015, but during the next 5 years the trend reaches almost zero values. The decrease of carbon accumulation could be projected to be small. In 2015, approximately 70 mil lion m^3 of wood biomass from the coppice and from low-stem forests above 41 years old are to be harvested.

Pessimistic scenario realization (in the part for 70 million m^3 coppice harvest) two positive results should be achieved: 1) improvement of the status (common) of the wood stands and 2) supplement of enormous quantities of renewable energy sources.

5.3. Methodology

As the inventory results indicate, the most significant contributors to GHG emissions in Bulgaria are the energy production sector and the energy-intensive sectors of the national economy. Therefore, the main efforts in the GHG emission forecasting are directed towards these sectors, while the studies that address non-energy sectors are more limited.

The GHG projections have two main targets:

- To identify whether Bulgaria will be able to meet its obligations to the UN FCCC and the Kyoto Protocol.
- To identify the most efficient policies and measures at macroeconomic, sectoral, utility, enterprise and household level that may lead to GHG emission reduction.

In order to meet these targets, a methodology that allows scrutinizing the interrelationships between macroeconomic development, sectoral development (including the energy sector), and GHG emissions is used. The main software used is the ENPEP package that has been used in the 2nd and 3rd National Communications of Bulgaria for the purposes of projecting GHG emissions. The following program modules of ENPEP were used: MACRO, DEMAND, BALANCE, WASP and IMPACTS.

The macroeconomic forecasts, including GDP and population growth, were provided by the Bulgarian Agency for Economic Analysis and Forecasts within the Ministry of Finance. The macroeconomic data are key inputs to the MACRO module. The DEMAND module estimates the useful and final energy demand by sector, including households, industry, services and transport.

The BALANCE module is a non-linear equilibrium model that matches the demand for energy with available resources and technologies. The purpose of the BALANCE module is to determine the equilibrium of the supply/demand balance for the study period. Its basic part is the energy network.

The general assumptions used are that the energy network is presented as a combination of sectoral and level presentation of data. The network is simplified as to represent only some of the sectors and some of the levels in a detailed way. Other information is generalized in a way to keep the total energy flows in the energy system and related emissions.

The WASP model (Vienna Automatic System Planning Package) is used to determine the least-cost generating system expansion, which adequately meets the demand for electrical power, subject to a number of user-defined constraints. The present value of total system costs, including the capital cost of new generating units, fixed and variable operation and maintenance (O&M) costs, fuel costs, and costs of undelivered energy, is used to measure the economic performance of alternative expansion plans.

The IMPACTS module of ENPEP calculates the residuals (air pollutants, water pollutants, solid waste, and land use) of the energy system. It takes the energy system design from BALANCE and WASP, and calculates the residuals based on fuel consumption and any environmental control technologies in use.

5.3.1. Specific Assumptions Related to the with Measures Scenario for GHG Emissions

Generally macroeconomic indicators determine the share of energy demand, which serves as driving force of economy development. For the current study a moderate projections are applied. The major economic factors influencing the development of the energy sector are:

- Restructuring of economy and increased share of private sector.
- Access to the markets of EU and Balkan countries.
- Closure of non-effective plants with high energy intensity, bad economic indicators or lack of markets.
- Decreasing share of heavy industry in the national economy.
- Increased share of production and services with low energy intensity.
- Technological progress and high technological development.
- Improved management and liberalization of energy prices.
- Energy efficiency policy at supply and demand side.

Table 5.21. Final energy consumption – PJ

Sectors	2000	2005	2010	2015	2020
Industry	144.5	147.4	147.2	151.9	157.3
Transportation	77.0	98.9	139.5	159.6	169.5
Residential	91.7	94.1	95.0	102.3	127.5
Others	40.0	45.2	55.7	64.1	72.2
Total	**353.2**	**385.6**	**437.4**	**477.8**	**526.5**

Table 5.22. Forecast of structure energy demand by sectors, %

Sector	2000	2005	2010	2015	2020
Industry	40.9	38.2	33.7	31.8	29.9
Transport	21.8	25.6	31.9	33.4	32.2
Residential	26	24.4	21.7	21.4	24.2
Others	11.3	11.7	12.7	13.4	13.7
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

The ENPEP modelling suite uses three sets of key inputs to produce the energy demand forecasts: the level and structure of GDP; total population; and the level and structure of final energy consumption.

a)For **GDP in the base year**, the information was provided by the Bulgarian National Statistical Institute (National Statistical Reference 2004) and the Bulgarian Agency for Economic Analyse and Forecasts.

Expected average annual GDP growth rates are as follows:

- 2001-2005 – 4.9%
- 2006-2010 – 5.6%
- 2011-2015 – 5.3%
- 2016-2020 – 5.0%

The sectoral structure of GDP assumes the restructuring tendencies to match the development of the sectors in the western countries, which means a slight decrease of the shares of industry, agriculture and forestry and increased share of services and transportation.

b)The second set of key inputs was the population in 2005 (7.67 million) and its growth rate. In line with the official projections of the Bulgarian Academy of Sciences, the population growth rate was assumed to decline by 3.9% between 2005 and 2010 and 6.8% between 2010 and 2020. Consequently, total population drops to about 6.9 million by 2020. By implication, *per capita* GDP more than doubles over the entire planning horizon.

c) The third set of key inputs describes **the level and structure of energy demand**.

The final energy demand forecast envisages two models of development: max and min, matching optimistic and pessimistic expectations for the energy intensity in the country. The expected energy demand according to the max scenario (that has become the basis for "**with measures**" scenario in the present National Communication) is 353.2 PJ in 2000, 385.5 PJ in 2005, 437.4 PJ in 2010 and 526.5 PJ in 2020.

The forecast final energy demand and its structure are shown in Tables 5.21 and 5.22, respectively.

The energy intensity of the GDP in Bulgaria is higher compared to the developed countries. Increasing energy efficiency is one of the basic objectives for the future development of the energy sector; expected to be achieved mainly by implementing the following structural changes in the national economy:

- Decrease in the share of the heavy industry in the GDP.
- Faster development of the service sector (including transport).
- Moderate development of the agricultural sector.

Decrease of the energy intensity of the GDP is also expected as follows:

Table 5.23 Energy intensity of GDP

Year	Toe/1000Euro	TJ/1000BGN
2000	180.0	3.8
2005	160.0	3.4
2010	132.0	2.8
2015	111.0	2.4
2020	93.0	2.0

5.4. Sectoral Analysis of the GHG Emission Projections

The GHG projections on sectoral level are based on the data that is used in emission calculations for each sector of the economy.

To project CO_2 and other GHG emissions for all scenarios, the emission factors from the GHG inventory have been used and the following activities have been considered:

- For GHG from energy combustion – projections on the quantities of fuels consumed in different sectors of economy and fuels for energy transformation.

- For GHG from coal mining, oil and gas systems – projections on the quantities of coal mined in underground and open cast mines as well as quantities of oil and gas production, transportation, distribution and refining.

- For GHG from industrial processes – projections on the quantities of produced cement, lime, ammonia, soda ash, glass, steel and others.

- Due to the change in ownership in agricultural lands as well as to the expected change in agricultural practice and structure, it is very difficult to project emissions originating from agriculture. Thus GHG emissions from agriculture are projected under 2 scenarios: without measures for energy savings and in case of limited penetration of such measures, particularly in livestock breeding.

- The projections on the CO_2 sequestration potential of forests is based on the new Forestry Act (as given in the previous section) where there is rule set the increments to exceed the wood quantities used for construction and combustion.
- There is a projection for the emissions from diesel and gasoline combusted by the transit road transport.
- The fugitive emissions in gas transportation are projected in accordance with the plans for development of the gas transmission network and expected transit of natural gas. The projected figures for natural gas transits are: 6.3 billion Nm^3 after 2000, and 18 billion Nm^3 in each year of the 2005-2020 period.

The total GHG emissions are calculated as a sum of all emissions. LUCF is not included in the totals.

Table 5.24. Primary energy consumption – "with measures" scenario [PJ]

Source	2000	2005	2010	2015	2020
Coal	282.2	364.74	354.27	333.33	352.18
Natural gas	176.72	99.25	98.41	134.00	165.83
Liquid oil	122.70	162.90	194.3	197.65	201.42
Nuclear	206.03	207.70	159.55	274.71	298.16
RES	33.04	48.99	45.23	55.28	68.68
Total	821.2	883.6	851.8	995.0	1086.3

Table 5.25. Primary energy consumption – "with additional measures" scenario [PJ]

Source	2000	2005	2010	2015	2020
Coal	282.75	364.74	332.08	342.13	299.41
Natural gas	176.72	99.25	84.17	120.60	134.00
Liquid oil	122.70	162.90	175.46	175.04	179.65
Nuclear	206.03	207.70	149.50	153.27	223.20
RES	33.04	71.19	79.56	54.86	67.00
Total	821.2	905.8	820.8	845.9	903.3

6 VULNERABILITY ASSESSMENT, CLIMATE CHANGE INFLUENCE AND ADAPTATION MEASURES

6.1. Background

Bulgaria is located on the Balkan Peninsula in south-eastern Europe. The country includes 31% low-lands (0–200 m), 41% hills (200–600 m), 25% high-lands (600–1,600 m), and 3% mountains (>1,600 m). The annual mean air temperatures in Bulgaria vary from -3.0 to 14.0 C, depending on the location and elevation. Air temperature normally reaches minimum in January and maximum in July. The monthly mean temperature varies from -10.9 to 3.2 C in January and from 5.0 to 25.0 C in July. Total precipitation depends on the circulation patterns, site elevation, and the specificity of local orographic features. Annual mean total precipitation is approximately 500–650 mm, with variation ranging from 440 to 1,020 mm. The highest monthly values are measured in June, and at some places in May, with the mean total varying between 55 and 85 mm. February, and sometimes March and September, are the driest months, with mean totals varying between 30 and 45 mm. Mean precipitation during the warm months, e.g. April through September, is 333 mm, with a standard deviation of 72 mm. Mean precipitation varies from a maximum of 573 mm in the Balkan Mountain to a minimum of 211 mm in south-eastern Bulgaria

Warming is observed from the middle of 1980s. The years 1994 and 2000 were among the warmest years on record in Bulgaria. In general there was not a significant warming trend during the last century in Bulgaria despite of the slight increase of average air temperature during the last two decades (Fig.6.1b). The linear trend for the 20th century varies within the interval from 0.2° to 0.5°C, which is lower than the diagnostic established by IPCC for the whole planet: 0.6±0.2°C. It confirms that the regional variations and trends can be different from the global ones. [1]

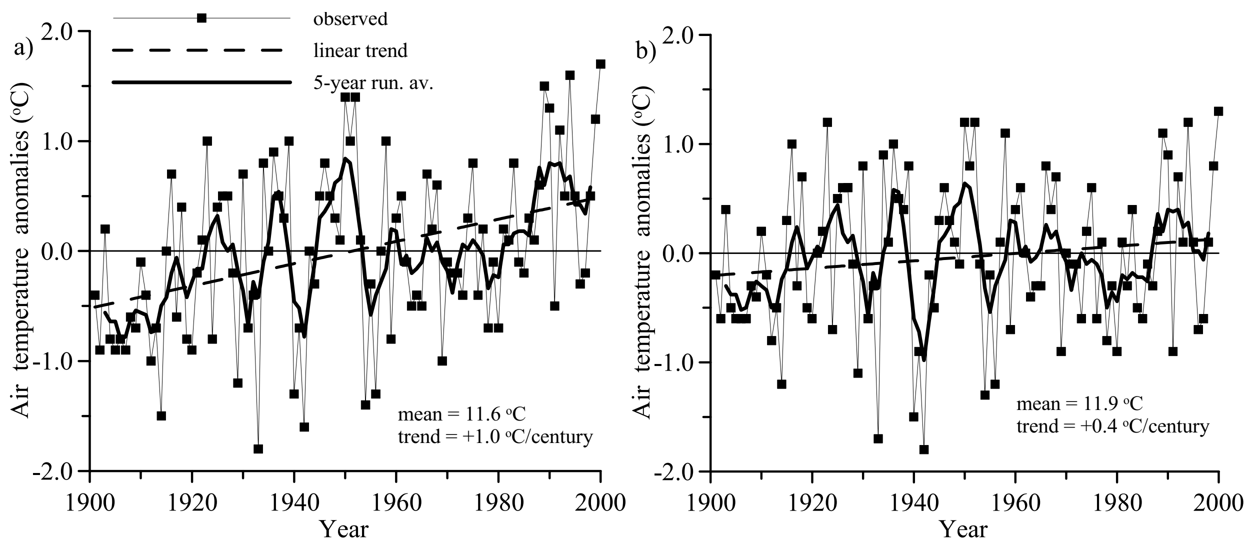


Figure. 6.1. Anomalies of annual average air temperature before (a) and after (b) homogenization in Pleven (north Bulgaria), relative to 1901-2000

[1] Alexandrov, V., M. Schneider, E. Koleva and J-M. Moisselin, 2004. Climate Variability and Change in Bulgaria during the 20th Century. *Theoretical and Applied Climatology* 79(3-4): 133-149.

Spring average air temperature did not show any significant changes during the 20th century. The temperature anomalies varied above and below the norms for the period 1901-2000 (Fig. 6.2). All weather stations have a slight positive trend during the both periods 1901-2000 and 1931-2000. Summer in Bulgaria is tending to be warmer from the beginning of the 1980s (Fig. 4.8b). Mainly positive anomalies were observed in the country during the last decade of the 20th century. The spatial distribution of the summer trend estimated by the Spearman coefficient indicated that the Danube plain was affected for the period 1901-2000 by slight cooling in the stations located in the this area. For the period 1931-2000 this insignificant cooling in summer was observed also in central and south Bulgaria. Regarding air temperature during the autumn season – there has been a significant decreasing trend in average air temperature since the 1930s. Average air temperature in winter shows a positive trend – winters during the second half of the century are definitely milder than before (Fig. 6.2d). There is a significant trend of an air temperature increase during the winter season in the northern Danubian weather stations during the two considered periods 1901-2000 and 1931-2000.

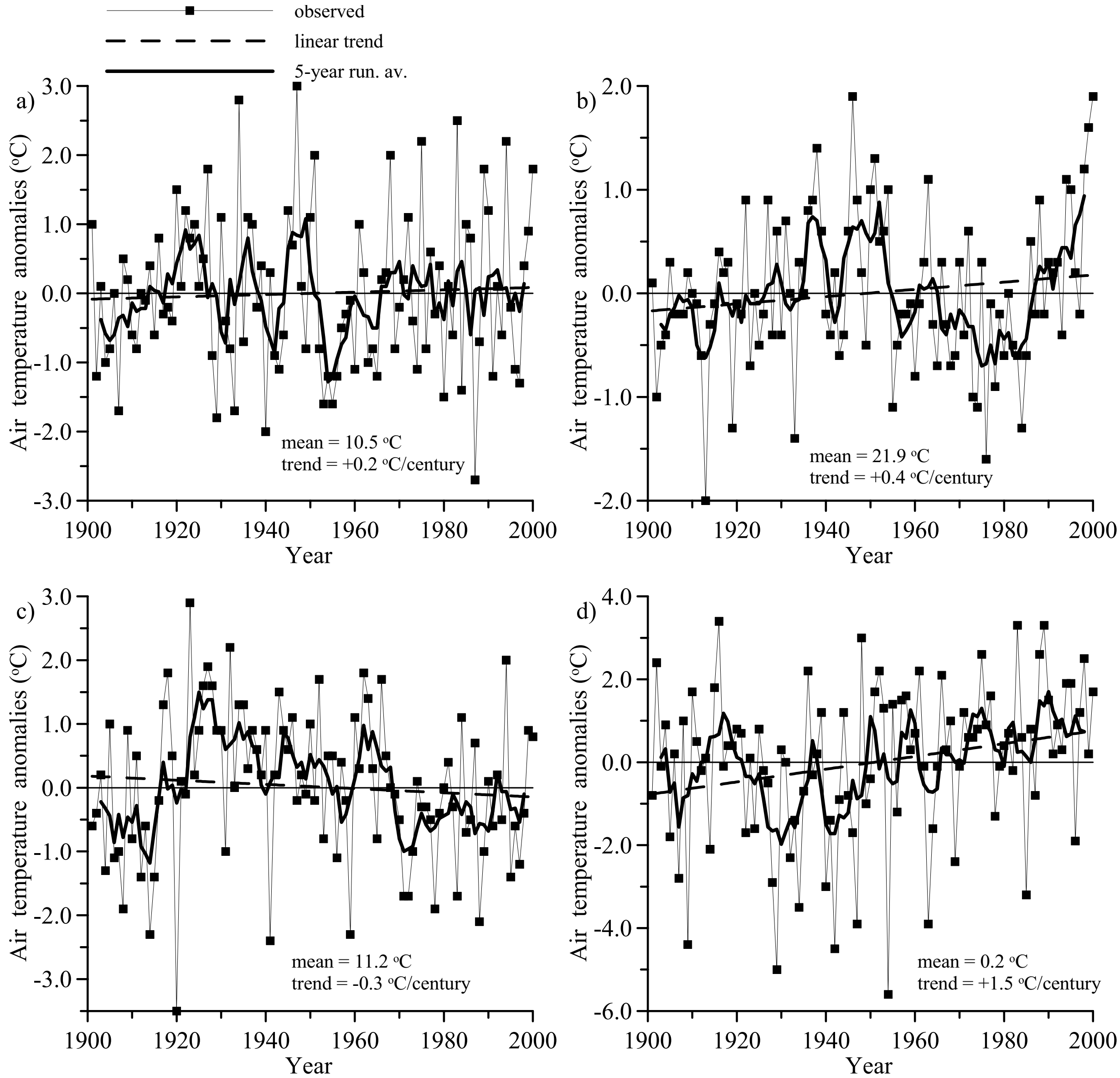


Figure. 6.2. Anomalies of spring (a), summer (b), autumn (c) and winter (d) average air temperature in Gabrovo (a: north Bulgaria), Burgas (b: east Bulgaria), Kazanlak (c: central Bulgaria) and Lom (d: northwest Bulgaria), relative to 1901-2000 [2]

Similarly to average air temperature, a significant cooling period appeared for annual minimum air temperature in the country from 1901 till the beginning of the second decade of the previous century. The next cold period occurred in the 1940s. An increase in minimum air temperature was observed in the 1950s, 1960 and the 1970s. There were insignificant anomalies above and below the average in the 1980s. The 1990s were characterised by significant positive anomalies, which in some years and stations range from 1.0° to 1.5°C. The last years of the 20th century were among the years with the highest minimum air temperature. The linear trend for the 20th century varies within the interval from 0.6° to 0.8°C. There was a significant increase in annual minimum air temperature across Bulgaria during the last century (Fig. 6.3). Warming is lower in south Bulgaria and higher in north Bulgaria[3].

a) b)

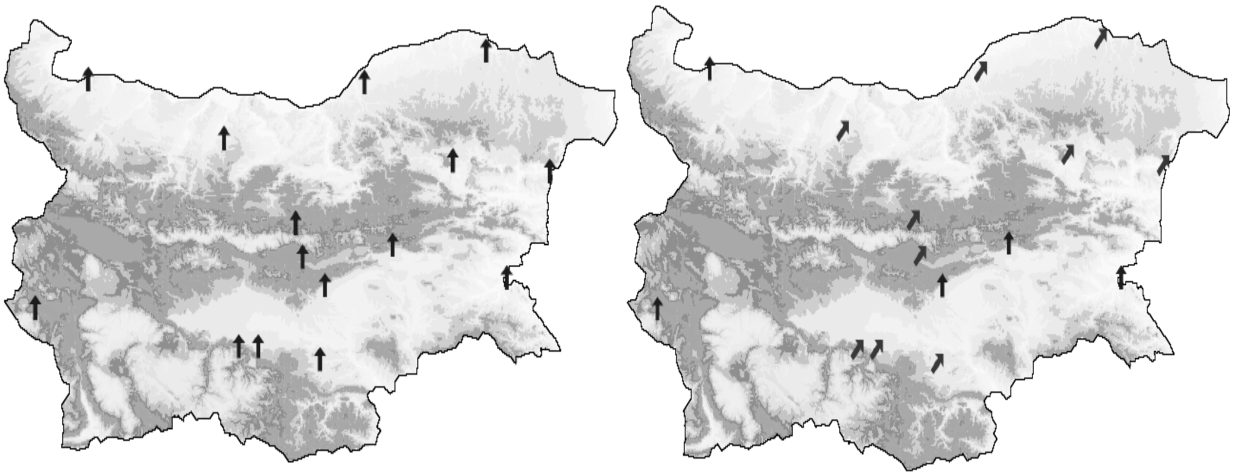


Figure 6.3. Spatial distribution of the trend in annual minimum (a) and maximum (b) air temperature (1901-2000) in Bulgaria by applying the coefficient of Spearman at probability level of 95%; 🡡 - significant increasing trend; 🡥 - increasing trend

Spring minimum air temperature also shows significant changes during the 20th century in the weather stations located in north Bulgaria, central Bulgaria and south Bulgaria. Positive but not significant trends are observed mainly in east Bulgaria. The highest warming in the terms of seasonal minimum air temperature is observed in summer. All weather stations covering temperature records the 20th century show a significant increasing trend during the summer season in Bulgaria. For example, the linear trend for the summer season in station Sadovo (south Bulgaria) is 1.4 ^{o}C/century. Most of the temperature anomalies in this station were positive during the second half of the 20th century. The minimum temperature anomalies during the autumn season varied above and below the average for the period 1901-2000 without showing any significant climate signal. Nevertheless, the insignificant positive trend is observed in most of the weather stations. Winter in Bulgaria is tending to be warmer at the end of the last century,

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[2] See 1.

[3] Alexandrov, V., 2003. Homogenization of Climate Long-term Series in Bulgaria. Report to Meteo-France, 41 pp

the spatial distribution of the winter trend in minimum air temperature indicated that only two weather stations are characterized by a significant increasing trend.

Homogenized annual maximum air temperature shows a lower increasing trend during the previous century in the country. In fact, there were not significant variations of annual maximum air temperature beyond the last decade, where mainly positive anomalies are observed. That is why, the linear trend of annual maximum air temperature for the 20th century varies within the interval from 0.4° to 0.6°C. The increase of annual maximum air temperature is higher in northwest Bulgaria and southeast Bulgaria than in south Bulgaria and northeast Bulgaria. Since the cooling spell in the 1950s a steady increase in spring maximum air temperature has been observed. Almost all weather stations considered in the study present an insignificant increasing trend in spring maximum air temperature in Bulgaria during the 20th century. There was a significant period of summer cooling in north Bulgaria during the 1960s, 1970s and the beginning of the 1980s in respect to maximum air temperature. However, since then a significant increasing trend in summer maximum air temperature has been observed. Regarding the autumn maximum air temperature – mainly insignificant increasing trends are spread across the country. Insignificant decreasing trends can be also identified in weather stations from east Bulgaria in respect of maximum air temperature during the autumn season. Finally, an increase to winter maximum air temperature is observed during the last century in the country.

The observed warming in Bulgaria continued at the beginning of the 21st century. So far 2002 is the third warmest year for the last 15 years while 2004 was the seventh in a row after 1997 with temperatures higher than the annual average air temperatures (Figure 6.4). Despite the fact that the annual average air temperatures in Bulgaria in 2005 were about (± 0.2°C) the climatic values, the observed slight warming since the beginning of the 1980-ies continued in some areas of the country in 2005. For example, in Dobrudja, annual average air temperatures were at average with 0.3°C higher than the climatic (1961-1990) norms (NIMH-BAS).

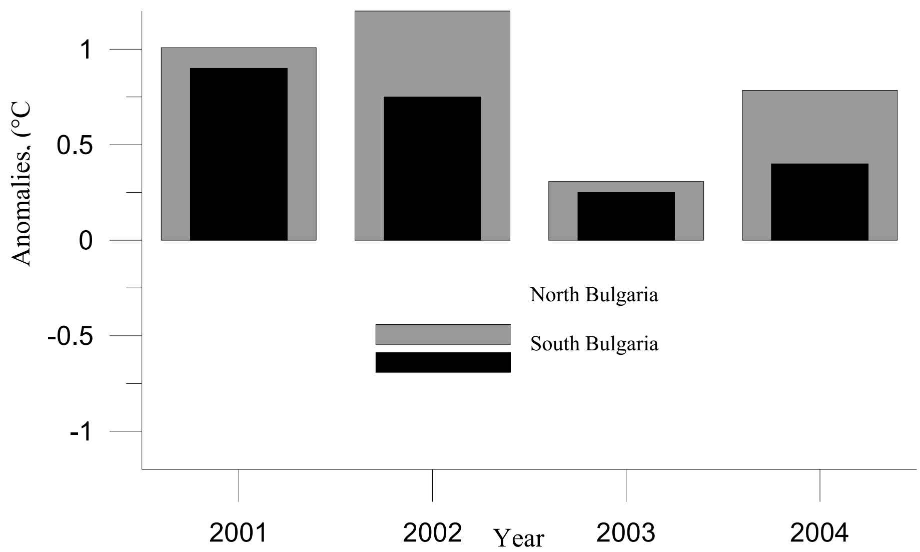


Figure.6.4. Anomalies (2001-2004) of annual average air temperatures in north Bulgaria and south Bulgaria relative to the climatic norms (1961-1990) (source: NIMH-BAS)

Annual precipitation in Bulgaria varied considerably from year to year during the 20th century. In some years, very low annual precipitation caused droughts of different intensities. The country has experienced several drought episodes during the 20th century, most notably in the 1940s and 1980s (Fig. 6.5). The drought spells in the 1940s and 1980s were observed everywhere across the country. Drought in Bulgaria was most severe in 1945 and especially year 2000 with precipitation 30% less than the current climatic values. In some weather stations a significant wet spell occurred in the 1950s. It was followed also by relatively high precipitation values in the 1960s and 1970s. Generally, the variations of annual precipitation in Bulgaria showed an overall decrease (Fig. 6.5b).

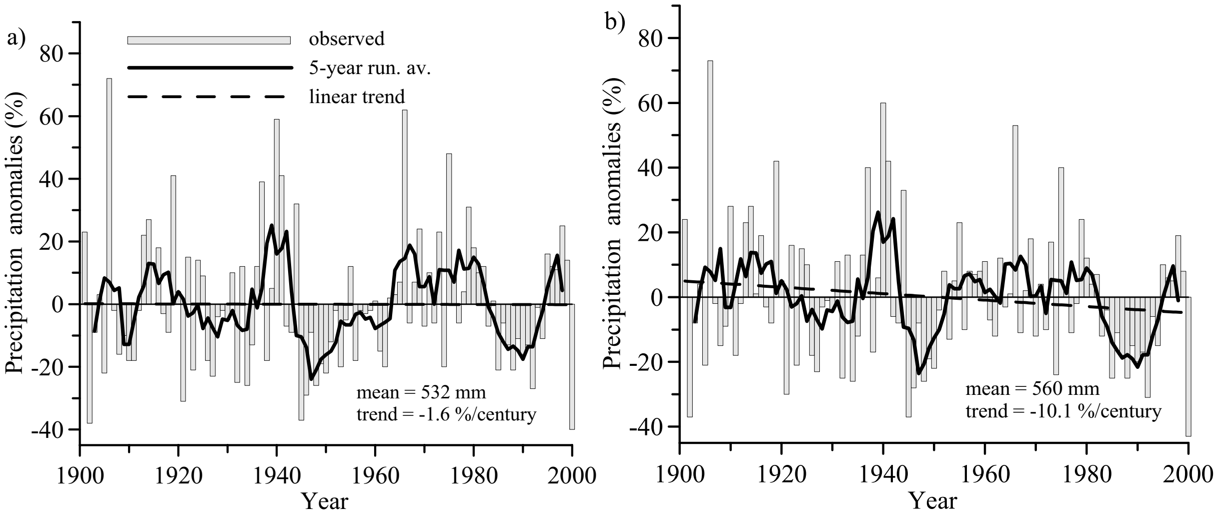


Figure 6.5. Anomalies of annual precipitation before (a) and after (b) homogenization in station Yambol (south Bulgaria), relative to the period 1901-2000[4]

Negative precipitation trends are observed mainly in the eastern and western parts of the country, while positive trend occurs in some central and northwest areas. However, it should be pointed out that the obtained trends in annual precipitation in Bulgaria for the period 1901-2000 are insignificant at the 95% probability level.

Sunshine duration - all weather stations covering the period 1931-2000 indicate a decreasing trend. Negative trends are also observed for spring and especially summer sunshine duration, where even some of the weather stations are characterized by a significant decreasing trend. Only positive trends are located for the winter season. No significant changes are seen in variability and trend of autumn sunshine duration.

6.2. Climate Change Scenarios

6.2.1. Climate Scenarios for 2015

HadCM3 A2 climate scenarios for four regions in Bulgaria (north Bulgaria, east Bulgaria, Thrace Low-down and south-west Bulgaria) for 2015 are presented in Table 6.1. The rise of the annual average air temperature for 2015, relative to the climatic norms of present climate (1961-1990) is expected to be from 0.7° (in east Bulgaria) and 1.1°C (in the other Bulgarian regions). The warming within a year is, however, different for different seasons and months. Warming is most likely to be bigger during summer months (July, August and September), while for the cold

[4] See 1.

half-year it will be less. Even the HadCM3 model simulates lower monthly temperatures (relative to the climatic norms) for November: -2°C in southwest Bulgaria and north Bulgaria and -0.6°C in east Bulgaria. Temperatures may not rise in February in east Bulgaria until 2015 and summer months are most likely not to be that hot as in the other regions in the country.

Despite the complexity of the simulation of future precipitation and the specifics of this hydrometeorological element, bellow follows the possible HadCM3 A2 scenario : Precipitation during some months (for example May, July and September) during the warm half-year are expected to be reduced by 30% relative to the present (1961-1990) climatic norms. This will increase the risk of drought – increased frequency, intensity and degree of impact. This might sound frivolously for the period 2005/2006 when Bulgaria experienced several floods due to big and intensive rainfalls. However, it is considered that after such relatively wet period, a relatively drought one follows. This statement is proved by the analysis of the available hydrometeorological information since the end of the 19^{th} century until 2004. Drought was and will be part of the climatic cycle of the Balkan Peninsula, Bulgaria included. During the colder half-year, the decreased precipitation in the country is lower (Table 6.1) as calculated by HadCM3 A2. Even in south-west Bulgaria an insignificant increase in the monthly precipitation quantities for December, March and in particular – November (by 20%) is projected. Low but positive are the percentages of change for the precipitation for March and November for the Thrace Low-down.

Table 6.1. Change in the average monthly air temperature (°C) and monthly precipitation (in %) for 2015 in certain regions of Bulgaria relative to the climatic norms for the period of the present climate (1961-1990); HadCM3 A2 climatic scenarios.

Month	North Bulgaria		East Bulgaria		Thrace Low-down		Southwest Bulgaria	
	Rate (°C)	precipitation (%)	Rate (°C)	precipitation (%)	Rate (°C)	precipitation (%)	Rate (°C)	precipitation (%)
I	1.4	-9	1.2	-22	1.2	-8	0.8	-11
II	0.2	-6	-0.1	-17	0.3	-9	0.0	-8
III	1.0	2	0.3	-12	1.1	5	1.2	2
IV	0.7	-5	0.2	-11	1.1	-11	1.2	-4
V	1.0	-31	0.4	-32	0.8	-35	1.0	-39
VI	1.1	-13	0.9	-10	1.2	-14	0.9	-10
VII	1.9	-28	1.5	-31	1.9	-35	2.2	-30
VIII	1.9	-19	1.3	-39	1.8	-12	2.2	-6
IX	1.8	-30	1.3	-22	1.9	-29	1.9	-29
X	0.9	-9	0.5	2	0.8	-18	0.9	-16
XI	-0.2	-5	-0.6	-4	0.0	4	-0.2	20
XII	1.3	-2	1.0	-2	1.1	-3	0.7	2

6.2.2. Climate Scenarios for the 2020s, 2050s and 2080s

The GCMs simulation results used, show an increase of the annual air temperatures in Bulgaria between (HadCM2 model) and 1.8°C (GFDL-R15 model) in the 2020s. The HadCM2 model simulates even slight decrease of the temperatures in November. A warmer climate is expected in the in the 2050s and 2080s with a rise in air temperatures between 1.6° (HadCM2) to 3.1°C (GFDL-R15) in the 2050s, and between 2.9° (HadCM2 and CGCM) and 4.1°C (ECHAM4) in the 2080s. The warming is expected to be bigger in the summer of 2080s (Figure 6.6).

The model CGCM1 projects an increase in the annual precipitation in the 2020s and 2050s. However, the GFDL-R15 model projects a decrease in the monthly precipitation in May, June and July. The models ECHAM4, HadCM2 and CSIRO-Mk2b simulate decrease of monthly, seasonal and annual precipitation in the 2080s. The change in solar radiation is expected to vary between -10 and 10% during the 21st century. The ECHAM4 model results show increase of the solar radiation for the cold half year.

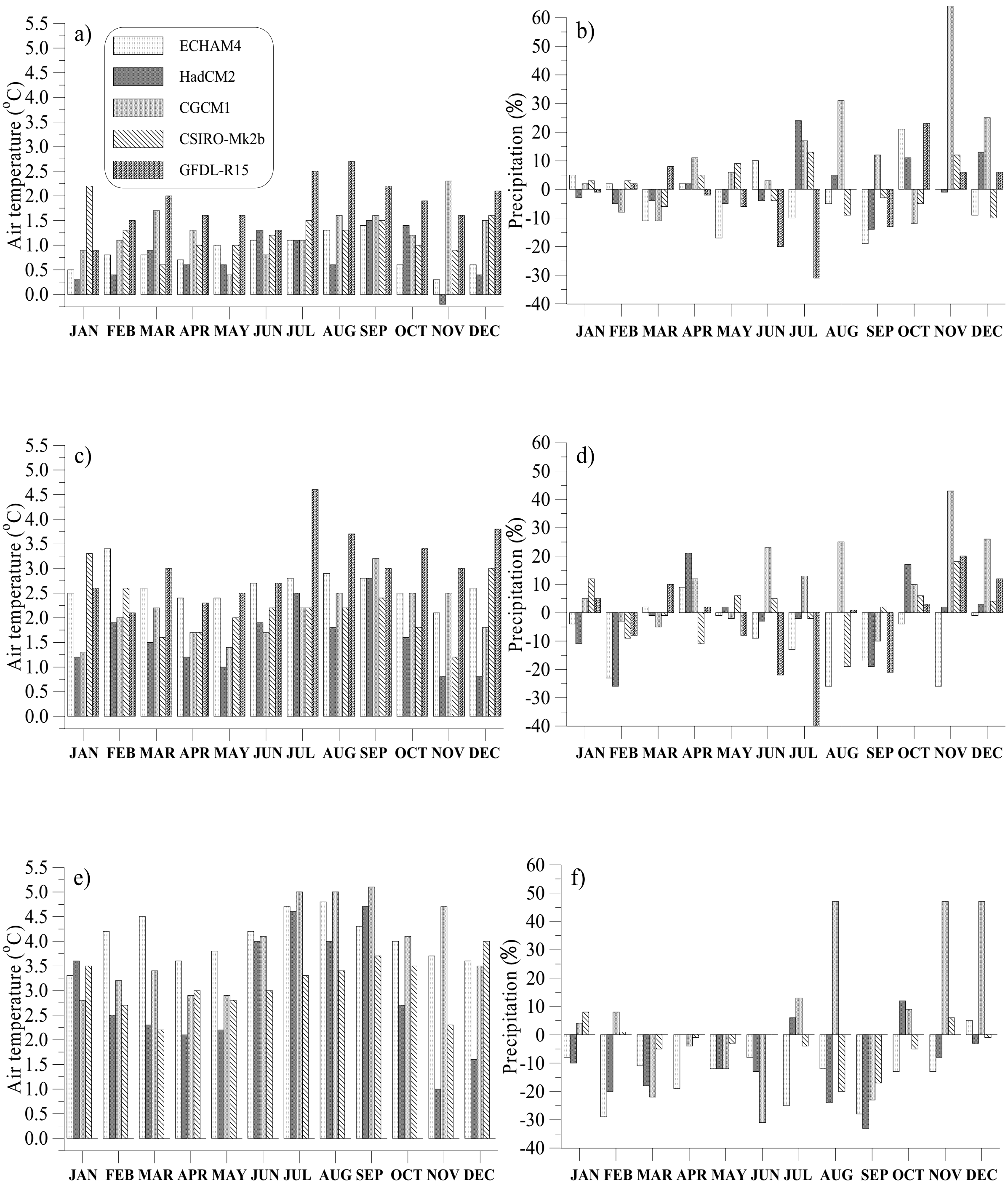
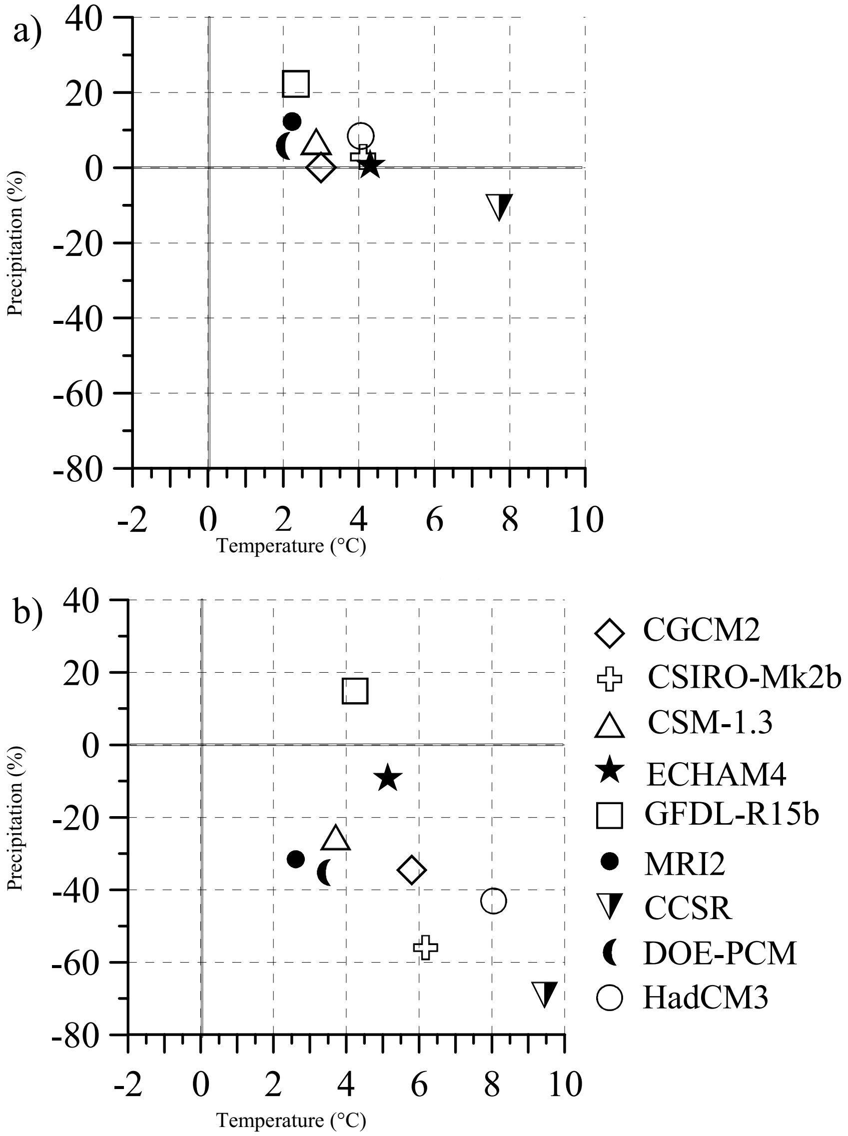


Figure 6.6. GCM climate scenarios for monthly temperature (a, c, e) and precipitation in Bulgaria in the 2020s (a, b), 2050s (c, d) and 2080s (e, f) [5]

6.2.3. Climate Scenario for the end of the 21st Century

Some of the climate models simulate an increase of the air temperature in Bulgaria from 2 to 5°C having a two-fold increase of the carbon dioxide concentration in the atmosphere. For most climatic scenarios, winter precipitation are projected to increase until the end of the present century but precipitations will drop significantly for the warm half-year and mostly during the summer (Figure 6.7).



[5] Alexandrov, V., 2001. Climate Change Impact on Water use of Maize in Bulgaria. *Proceedings of the international conference on 150 Years of Meteorological Service in Central Europe*, Stara Lesna, Slovakia, (CD) 13 pp.

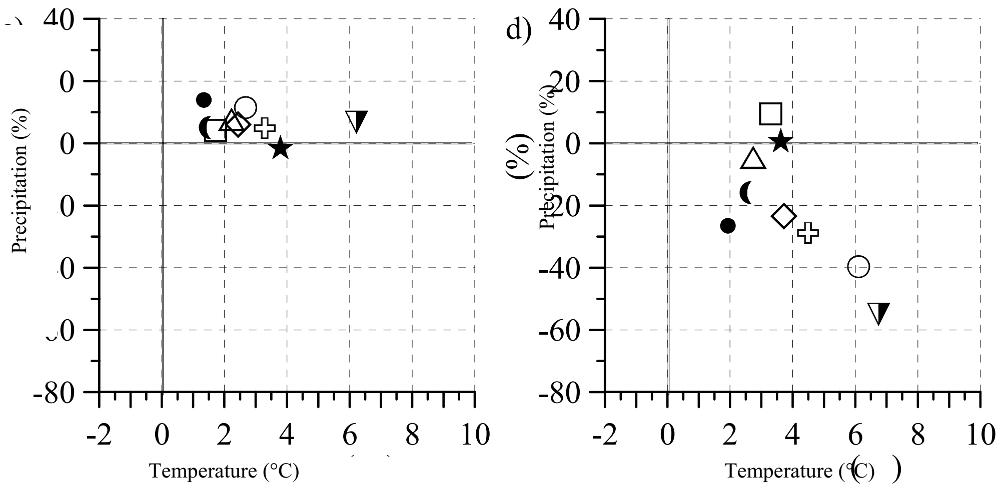


Figure 6.7. Climate model scenarios of average air temperatures and precipitation during winter (a, c) and summer (b, d) in Bulgaria at the end of the 21st century (for A2 (a, b) and B2 (c, d) SRES emission scenarios), relative to the present climate (1951-1990) (Alexandrow, 2002)

6.3. Vulnerability Assessment

6.3.1. Agriculture

Climatic scenarios reveal that an increased risk and vulnerability to soil droughts are expected – an increase in the occurrence, intensity and level of impact of the soil droughts in Bulgaria for the 21st century. The soils with low capacity of moisture preservation and the regions in south-east Bulgaria are most vulnerable to those changes, in which areas precipitations during the warm half-year are low, even at present climatic conditions.

The generic grain cereal model CERES v.3.5, included in the computerized Decision Support System for Agrotechnology Transfer DSSAT v.3.5 was used to determine the vulnerability of current agricultural management scenarios in Bulgaria. The DSSAT crop models are designed to use a minimum set of soil, weather, genetic, and management information. The models integrate at daily time steps, and therefore, require daily weather data, consisting of maximum and minimum temperature, solar radiation and precipitation, as input. The models calculate crop phase and morphological development as a function of temperature, day length, and genetic characteristics. Leaf development, growth, and expansion determine the amount of light intercepted, which is assumed to be proportional to biomass production. The biomass is partitioned to various growing organs in the plant, using a priority system. Water and nitrogen submodels provide feedback that influences the development and growth processes. All crop models are sensitive to carbon dioxide concentrations. The DSSAT seasonal analysis program was used to simulate possible adaptation measures, and to determine those management scenarios that can decrease the potential agricultural crop vulnerability under expected climate change conditions. The climate change impacts on agricultural crops are taken from the paper "Impact of climate variability and change on crop yield in Bulgaria".

The ROIMPEL crop model was also used for the vulnerability assessment. It is a modular simulation model of crop yields limited by soil -water and -nitrogen availability, using limited easy-to-map soil and weather data. Various practices for nitrogen and water management could be very easy considered specifying some easy to derive parameters through external files. ROIMPEL derives workability day statistics (optimum, soil too wet, or too dry) to be used for the optimization of machinery and labour at the farm level. The nitrate concentrations which are potential hazardous for groundwater contamination are optionally derived. The minimum requirements for soil data are the soil texture and organic matter classes. The minimum weather data needed by the model are monthly values of the average daily air temperature and the monthly-cumulated rainfall. Hence, ROIMPEL is very helpful for climate change research projects where the perturbations of the climate parameters are scaled down from GCMs on a monthly base.

All transient GCM climate change scenarios used in the CERES and ROIMPEL (Fig. 6.8) simulation models projected a shorter vegetative and reproductive crop growing season during the 21st century. These changes were caused by the predicted temperature increase of the GCM scenarios. The duration of the regular crop-growing season for maize was between 5 (HadCM2) and 20 (GFDL-R15) days shorter in the 2020 s. Maturity dates for maize were expected to occur between 11 and 30 days earlier in the 2050s. The predicted changes in the crop-growing duration for maize in the 2050s were less for the HadCM2, CGCM1, and CSIRO-Mk2b climate change scenarios than the changes predicted by the ECHAM4 and GFDL-R15 models. These last two models simulated a higher increase of air temperature in Bulgaria, especially the GFDL-R15 model, during the summer months July and August. The GCM climate change scenarios for the 2080s projected a decrease in maize growing season by 17 (CSIRO-MK2b) to 39 (ECHAM4 and CGCM1) days. This will cause a shift in harvest maturity dates for maize from September to August at the end of the next century.

Winter wheat showed a decrease in growing season duration for the 2020s, varying between 3 (HadCM2) and 14 days (GFDL-R15). The projected decreases in growing season for the 2020s, 2050s, and 2080s were less for the HadCM2 model, which predicted a smaller air temperature increase during November and December. Even a slight decrease in monthly air temperature in November was projected for the 2020s under the HadCM2 climate change scenario. The transient GCM climate change scenarios predicted that harvest maturity for winter wheat would be approximately 1–2 weeks earlier in the 2050s, and between 2–3 weeks earlier in the 2080s.

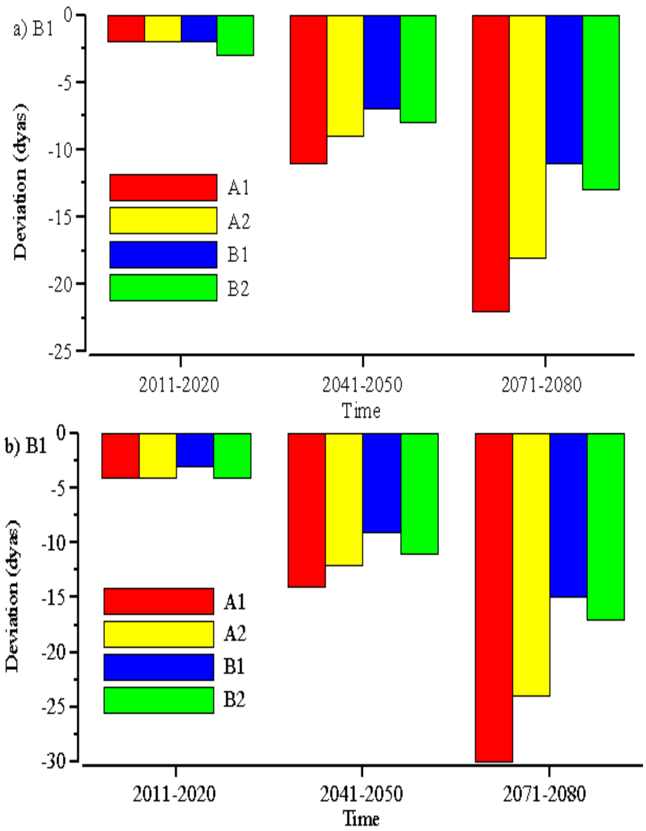


Figure 6.8 Departures of the ROIMPEL simulated maturity of maize at the North-western Bulgarian NUTS2 region, relative to 1991-2000; A1, A2, A3, A4 – various options regarding the model input data

The decrease in simulated maize yield for the next century was primarily caused by a shorter growing season duration and reductions in precipitation. All GCMs simulated a decrease in precipitation from March to June for the 2080s, which affected soil moisture recharge during the spring and the early developmental stages of maize. The simulated increase in maize grain yield for the HadCM2 climate change scenario for the 2020s was due to a relatively low projected increase in air temperature, as well as a predicted increase in precipitation in July. Because maize is a C_4 crop, an increased level of CO_2 alone had no significant impact on either maize crop growth, and development or final yield. Maize yield decreased by 3–8% in the 2020s for the ECHAM4, CGCM1, and CSIRO-Mk2b model scenarios. The projected decrease was highest for the GFDL-R15 model, e.g. between 8 and 14%, while the HadCM2 scenario projected an increase from 4 to 12% for the next decades. A slight decrease at the most experimental stations in northeast and south Bulgaria is even projected under the HadCM2 climate change scenario for the 2050s. The decrease in simulated maize yield for the 2050s ranged for most stations from 10 to 20% for the ECHAM4, CGCM1, CSIRO-Mk2b, and GFDL-R15 GCM scenarios. The largest decrease in maize yield is expected to occur at the end of the century.

All transient GCM climate change scenarios for the 21st century, including the adjustment for only air temperature, precipitation and solar radiation, projected a reduction in winter wheat yield across Bulgaria. The CERES projected yield reductions at the experimental station Radnevo (south Bulgaria) varied between 0 and 7% during the 2020s and 2050s, and between 4 and 20% in the 2080s. When the direct effect of higher CO_2 levels was assumed, most GCM climate change scenarios projected an increase in winter wheat yield (Fig. 6.9).

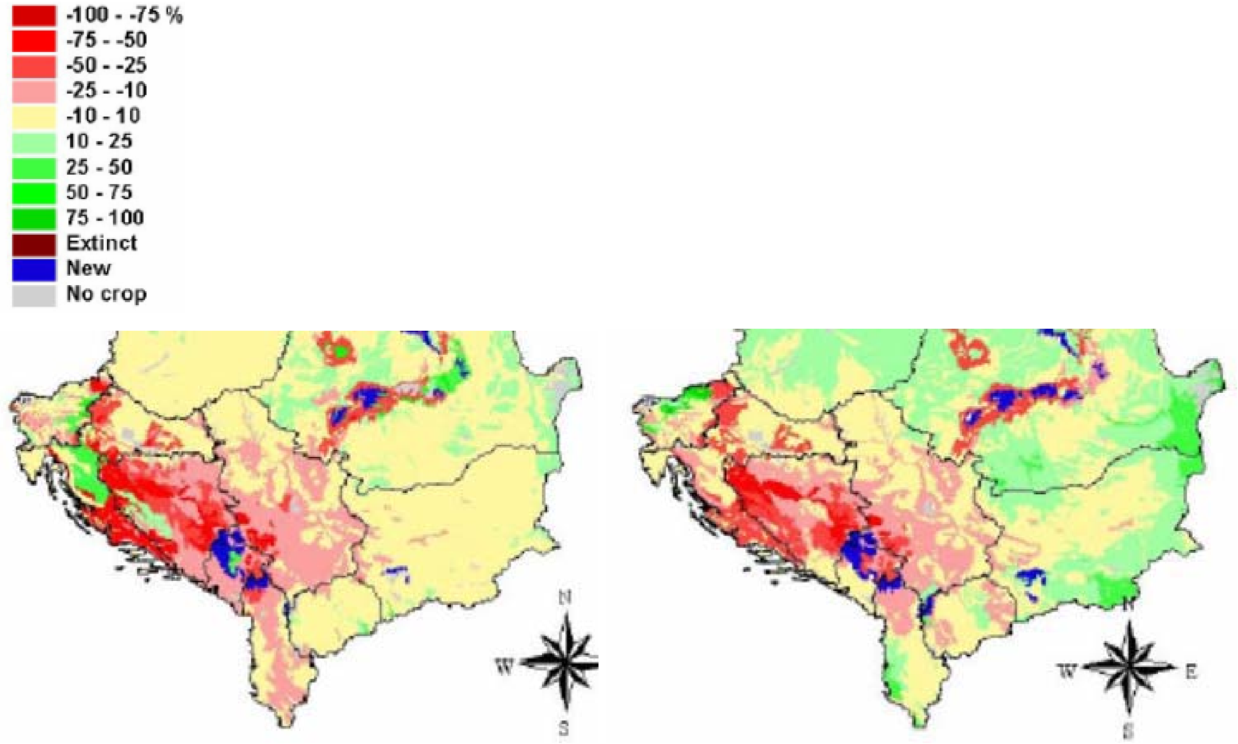


Figure. 6.9. Change in potential rain fed wheat (%) on the Balkan Peninsula for the HadCM3 A2 scenario in 2011-2020 (left) and 2071-2080 (right), relative to 1961-1990. ROIMPEL model[6]

The major cause for this change in impact is that many crops, such as wheat and soybean, belong to the group of C3 crops, which are more sensitive to changes in CO_2 concentration than the group of C4 crop, such as maize. The CO_2 effect alone caused an increase in CERES wheat yield 10–20% above the baseline (1961–1990) for the 2020s. The simulated deviations of wheat yield increased in the 2050 by more than 20–25% for the ECHAM4, HadCM2, CGCM1, and CSIRO-Mk2b climate change scenarios. The increase in wheat yield varied from 14 to 37% for the GFDL-R15 scenario, depending on the location. Despite expected high air temperatures and precipitation reductions during the spring in the 2080s, increases in wheat yield due to the fertilization impact of the increased CO_2 level were also projected.

During the climate change in Bulgaria in the 21st century, most vulnerable will be: a) spring agricultural crops, due to the expected precipitation deficit during the warm half-year; b) crops cultivated on infertile soils; c) crops on non-irrigated areas; d) arable lands in south-east Bulgaria where even during the present climate, precipitation quantities are insufficient for normal growth, vegetation and productivity of agricultural crops.

6.3.2. Forestry

In order to define the forest ecosystem vulnerability under the possible climate changes, as well as to find measures for their adaptation to the new conditions, an information is necessary for the Bulgarian forests calibrated to a basic period. 1990 has been chosen as a base year in the study. The meaning “status of Bulgarian forests” includes information about the areas, tree species, growth rates, volumes, etc. The status of the Bulgarian forest was thoroughly described in the First National Communication. In general, the total area of the forests in the country, the

[6] Audsley, E., K.R. Pearn, C. Simota, G. Cojocaru, E. Koutsidou, M.D.A. Rounsevell, M. Trnka and V. Alexandrov, 2006. What can scenario modelling tell us about future European scale land use, and what not? *Environmental Science and Policy* 9(2): 148-162.

percentage of woodiness, the protected territories and the total area of the coniferous forests has increased within the last few decades.

The areas of annual afforestation have varied from 28,040 ha up to 89,660 ha, and this allowed over 1 million ha of new forests be established in the past 35 years, hence, over 1/3 of the country's forests were re-established. The creative policy in the field of forestry resulted in a quick increase of the total volume of above-ground mass of wood in the forests of Bulgaria. The total volume of wood in the Bulgarian forests has increased from 244.68 mil. m^3 (in 1955) up to 396.02 mil. m^3 (in 1990), i.e. the amount of standing wood has increased by 61.8% in 35 years.

The consequences of this favourable effect on the forests in Bulgaria are obvious: the erosion in all the large water-catchment basins in the country was liquidated; the living conditions in many territories in the country improved, as well as the forests' microclimatic, hydrological, ameliorative, etc., i.e. all the peerless favourable functions of the forests in Bulgaria have been improved.

Analysis on the condition of the forest vegetation from the last decade in Bulgaria shows that the coniferous forest vegetation which was widely introduced during the last decades under 800 m a.s.l., i.e. out of its natural habitats, forms very unstable forest ecosystems. The main reason is the discrepancy between the ecological conditions (mainly rainfalls) and the requirements of the coniferous tree species. Due to this reason these forests are physiologically in a chronic water deficit and in drought periods like this one in 1983-1994 they begin to disintegrate. The above tendency subsequently encompasses the high fields of West Bulgaria, North Bulgaria, South Bulgaria, Black Sea Coast, and Southern parts of the country. In this sequence the vulnerability of the forest vegetation to the adverse dry climate increases.

The problem with the discrepancy of the ecological conditions of the forest vegetation is not a new one in Bulgaria forestry. Decay of the conifer plantations (*Pinus sylvestris, P. nigra*, more rarely *Picea abies* and *Pseudotsuga menziesii*) has been observed recently due to the improper introduction of these species in the low part of the country. The main reason for this dangerous phenomenon was the discrepancy between the climatic conditions in this part of the country and the ecological requirements of newly afforested coniferous species. If the projections about the carbon dioxide doubling during the next century come true the ecological conditions in Bulgaria will drastically deteriorate.

The climate change scenarios derived for Bulgaria were used to evaluate potential changes in forest vegetation. The altered temperature and precipitation databases corresponding to each of the climate change scenarios were used to run the Holdridge life zone (1967) classification model.

The changes are from "cool temperate moist forest" to "warm temperate dry forest" for North Bulgaria, and for South Bulgaria the "warm temperate dry forest" will remain typical. In the warmest country regions (station Sandansky) "subtropical dry forest" could be expected, which means drastic warming and droughts. Since 60.6% of forests are in the zone below 800 m, it is clear, that most of the Bulgarian forests would be vulnerable to the drastic climate change under the eventual doubling of carbon dioxide in the near future. The changes in the mountain regions of the country (station Smoljan, 1180 m a.s.l.) would pass from "cool temperate wet forest" to "warm temperate moist forest". At an eventual climate warming a moving of the species composition from South to North could be expected, which means shifting of tree and shrub vegetation from the South-Bulgarian into the North-Bulgarian and from the South-Bulgarian border region into the South-Bulgarian forest vegetation area, respectively. That means that it could be expected that the South-Bulgarian border region area will be settled by typical Mediterranean vegetation, a part of which is to be seen there even at present.

In addition to the First National Communication, hereafter the forest vulnerability was evaluated following the GAP models. The prediction of the forest ecosystem responses to long-term climate changes requires hierarchical constructed dynamic models, capable to cover and describe in a mechanistic manner the combination of the basic ecosystem processes and their interrelationships in space and time. The forest gap models are individually based programs which simulate the vegetation response functions to the environmental conditions. The model could evaluate the possible changes in the species composition, forest structure and productivity of specific forest sites. The model requires detailed information on specific forest species and environmental factors. The model could evaluate the dynamics of particular forest site in response to the climate change.

The GAP model results show that in case of climate warming over the next 90 years, the following consequences could be expected:

A. In the lowlands – Tree species diversity reduction. In spite of that, the biodiversity would be greater compared with the biodiversity in the mountain regions. The selected tree species guarantee increased bio-productivity. It could be considered that if proper selection is made, optimal bio-production could be released under changed climate conditions.

B. In mountains – Increased tree biodiversity could be expected. It could be realized by means of the natural shifting of tree vegetation from lower to higher sites in the mountains. This process would be combined with biomass production increase.

C. Both in lowlands and mountains – Increased biomass productivity would be accompanied by increased CO_2 absorption.

Either using Holdridge Life Zones Classification Model or JABOWA-II GAP Model, two climate zones of climate change influence have been established: from 0 to 600-800 m a.s.l. and over 800 (1,000) m a.s.l. Working with Holdridge model, critical situation for the future of the forests in the lowlands and low-hill regions on the whole was outlined, while developing GAP models it could be seen that the status of the forests (in all altitudes) wouldn't be critical at all. As Holdridge model provides a regional mapping system for interpreting spatial changes throughout the country or regions, while the forest GAP model evaluates the temporal dynamics of a given site in response to climate change, it could be considered that the GAP model results are more objective.

6.3.3. Soils

Soil diversity in Bulgaria is enormous. Soils have different characteristics, fertility and vulnerability to climate change. The temperature rise will increase the water deficit in soils with low precipitation rates that are prone to droughts. The most serious impacts will be observed for soils with light mechanical content and bad water characteristics and partly for heavy clay soils. About 30% of the soils in Bulgaria are prone to wind erosion.

Optimization of soil treatment includes:

- Choice of optimal dates and terms for the collection of major crops
- Soil monitoring;
- Measures for improvement water content in soils;
- Measures to improve soil structure and characteristics;
- Actions against erosion and for better nutrition mode;
- Up-to-date technologies for soil treatment, preserving the moisture and soil texture;
- Melioration of poor soils; ;
- Effective use of mineral fertilizers, relevant to various soils.

6.4. Adaptation

6.4.1. Agriculture

The objectives of adaptation measures in agriculture are to support and sustain the agricultural production and to bring to minimum the impact of climate change by reducing the vulnerability of the agricultural crops. The adaptation to climate change will be carried out in various forms, including technological innovations, changes in arable land, changes in irrigation, etc. Technological innovations include the creation of new cultivars and hybrids, which have higher productivity during changes in the climate. Farmers can start growing other cultures or cultures, prone to drought and diseases. The changes in arable lands, due not only to the needs of agricultural production following a population increase but also to climate change, are expected to be another form of adaptation. It is reasonable to expect that because of climate changes, there will be significant changes in arable lands. As the global climate has a tendency towards warming, a significant change in the irrigation of agricultural crops is expected. Introducing irrigation systems in areas and regions with high air temperatures and evapotranspiration values leading to a reduction of the present soil moisture will be a supportive measure in the stabilization of the agricultural production in those areas. The changes in meliorative activities can alter some negative impacts of climate changes. The times for various activities (for example dates for sowing, fertilization, pesticides and insectize) can be critical during the battle for plant vulnerability to the new climate conditions. The changes in the sowing density and fertilization standards can also be of use. Other actions like ploughing, change of predecessors and crops themselves can influence soil composition and structure and improve the flexibility of agricultural crops in relation to climate conditions. The adaptation options discussed above are only few examples of the many possible adaptation measures in the agricultural sector, being investigated and applied around the world.

The sowing dates of spring crops in Bulgaria could shift under the GCM climate change scenarios in order to reduce the yield loss caused by temperature increase. The selection of an earlier sowing date for maize will probably be the appropriate response to offset the negative effect of a potential increase in temperature. This change in planting date will allow for the crop to develop during a period of the year with lower temperatures, thereby decreasing developmental rates and increasing the growth duration, especially the grain filling period. The results show that the sowing date of maize for the experimental station Carev Brod (northeast Bulgaria) should occur at least 2 weeks earlier in the 2080s under the ECHAM4 scenario, relative to the current climate conditions. It should be noted, however, that although changes in sowing date are a no-cost decision that can be taken at the farm-level, a large shift in sowing dates probably would interfere with the agro-technological management of other crops, grown during the remainder of the year.

Another option for adaptation is to use different hybrids and cultivars. There is an opportunity for cultivation of more productive, later or earlier-maturing, disease and pest tolerant hybrids and cultivars. Switching from maize hybrids with a long to a short or very short growing season projected an additional decrease of final yield under a potential warming in Bulgaria. However, using hybrids with a medium growing season would be beneficial for maize productivity. Technological innovations, including the development of new crop hybrids and cultivars that may be bred to better match the changing climate, are considered as a promising adaptation strategy. However, the cost of these innovations is still unclear.

Results from the adaptation assessments suggest that possible changes in sowing date and hybrid selection can reduce the negative impact of potential warming on maize yield during the next century. Changes in cropping mixtures, irrigation, and agricultural land use can be additional alternative options for adaptation in agriculture.

The adaptation measures presented bellow in relation to irrigation in the conditions of the present and future climate in Bulgaria are based on various expert assessment (for example, *Vurlev, etc. 2004, Alexandrow and Slavov, 2003*), documents, action plans (for example, *Slavov and Ivanova 1998A, 1998b, 1999*) and programs (for example, *Republic of Bulgaria, 2001*)

Measures for increasing irrigation and irrigated agriculture adaptation of the country towards climate changes

The urgent necessity to undertake appropriate measures for increasing adaptation towards climate changes with warming and drought tendency is evident – not only in regard to agricultural production but also in to irrigation, which is the main factor in the fight with those tendencies, and also an element of the agricultural sector as a whole.

The objectives of the adaptation measures should be to decrease or avoid the damages from drought and from climatic changes in general, and be directed to support and maintain agricultural production at relatively high and sustainable productivity level, and also for effective and sparingly use of water resources, having full use of the built irrigation facilities. It is necessary to include activities on information dissemination about the nature of droughts, as knowing the phenomenon will diminish the sensitiveness and vulnerability o the population from their impact.

The main adaptation measures cover organizational and managerial, financial and economic, and legislative aspects of irrigation and irrigated agriculture and should aim at:

- improvement of management, use and protection of water resources in irrigated agriculture;
- improving the efficiency of the management and use of the existing irrigation facilities and elaboration of the technological and technical facilities for irrigation;
- use of rational and economically sound irrigation regimes for the irrigated crops and elaboration of the technologies for cultivation of crops in the conditions of droughts and water deficit.

Adaptation measures to improve management, use and protection of water resources in irrigated agriculture during climate change:

- establishing the impact of climate changes and drought on the quantity and quality of water resources used in irrigated agriculture;
- assessing the needs of water for irrigation of agricultural crops under climate changes and preparing long term projections for the required water resources to be used in agriculture.

Work is going on in various institutions like the Institute of melioration and mechanization, Institute of Water Problems, University of Architecture, Civil Engineering and Geodesy (UACEG), Institute of Soil Science and Agroecology "N. Pushkarov", Higher Institute of Agriculture, National Institute of Meteorology and Hydrology (NIMH), etc. Numerical experiments to determine the optimal dates and water quantity for irrigation of the maize for various climate scenarios are carried out in NIMH, using computer system for agrotechnological decision taking DSSAT (*Alexandrov, 1998, 1999*). The calculations are taken in regard to biophysical and economic analysis of the final yield and the received profit from the maize

During limited precipitation in summer, irrigation facilities must be used, oriented towards design and operation of irrigation facilities, which use water resources in an economical way and have very low water transportation losses during irrigation.

Gravitee feed irrigation and flooding of beds and rice fields should be used as a last resort, only when proven to be effective.

Main and distribution canals of old irrigation systems must be coated to bring to minimum losses from filtration. Permanent canals in irrigation systems must be afforested on sufferance strips to utilize filtered water and to cover them aiming at the reduction of the physical evaporation from water surface in the canals.

Adaptation measures to improve management efficiency and use of existing irrigation systems and elaboration of technological and technical means for irrigation under climate changes:

- To prepare up-to-date strategy and new program for the rehabilitation and restructuring of irrigation management and improving the efficiency of use of the existing irrigation infrastructure;
- To change legislation and regulation in the irrigation sector taking into consideration the altered agricultural conditions, the experience from the reforms carried out so far and to ask for free use of the technologically established hydromeliorative infrastructure and service facilities on the territory of the associations;
- To implement proper educational and training programs with emphasis on major issues on the involvement of users of water and the general public on drought problems;
- Preparation of information materials for water users on the benefits and good practices of agricultural crop irrigation.

Adaptation measures for use of rational and economically viable irrigation regimes for irrigated crops and elaboration of the technologies for cultivation under climate change:

- Determining the vulnerability of agricultural crops under climate changes, long term droughts and water deficit in the major agroclimatic regions in the country, respectively their impact on the quantity and quality of the yield from them;
- Reassessment of the water and irrigation norms and legislative provisions of irrigation, new zoning for the irrigated crops in the country;
- Development and application of optimized irrigation regimes for the major agricultural crops for various agroclimatic regions in the country;
- Research on the effect from irrigation and sustainability of yields under various water saving methods and irrigation technologies;
- Creation and application of mineral fertilization systems and integrated weed fight during cultivation of agricultural crops under irrigation conditions;
- Application of proper moisture preserving technologies and techniques for soil treatment in irrigated lands;
- Adaptation and introduction in practice of information and advisory system for irrigation necessity forecast and defining the parameters of the irrigation regime for the irrigated crops;
- Technology changes for irrigated crop cultivation in various agroclimatic regions under water shortage conditions;
- Use of new cultivars and hybrids that adapt better to water deficit.

The presented above allows the following ***conclusions*** to be drawn:

- Irrigation will be the main factor for the sustainable development of Bulgarian agriculture, giving guarantee for stable and quality plant production in years, varying in terms of the climate and accepting the challenges due to the expected periods of drought and water deficit in the years to come;
- To use effectively the irrigation opportunities in the country, it is necessary to undertake timely measures from the present moment, encompassing all its organizational and management, financial and economic and legislation aspects, which will provide the necessary preconditions for the recovery and reorganization of irrigation facilities and increase the effectiveness of their use and further development, in line with the features of the constantly changing climate and the requirement for modern policy of integrated and sustainable water protection and use;
- Fast restoration and development of the irrigation sector and irrigation agriculture should become a main priority of the state policy in the agricultural sector supported by real, active

and sound investment program, based on the use of national and international financial resources;

- Completion of the institutional reforms in this direction, aimed at the improvement of irrigation organization and management and use of irrigation systems;
- Completion of the economic efficiency assessment of the existing irrigation facilities and taking a decision for the restoration and reconstruction of economically effective, suitable and unsuitable facilities at the present moment;
- Discarding obsolete areas and equipment, the use of which is economically non-viable in the near future;
- Development and application of proper irrigation investment program for the next few years, with state subsidies aimed at the most efficient regions and such with active or to be established soon irrigation associations;
- Implementing the measure on irrigation from the SAPHARD programme;
- Reconstruction and reorganization of the existing irrigation systems, aimed at their use in the condition of water deficit, implementing proper models in representative regions in the country;
- Elaboration of the present irrigation technologies and equipment, aimed at compliance with the new needs of the irrigated cultivars and increasing their efficiency, development and use of new water saving and energy saving technologies and equipment;
- Assessment of the energy demand of the irrigation systems and developing measures to increase their energy efficiency;
- Development and application of technologies and systems for regulation and control of technological processes for distribution and use of water for irrigation;
- Development and application of economic viability policy in regard to price formation in the irrigation sector;
- Development and application of state support program for irrigation associations and other water users, aimed at encouraging and stimulation of their activities and transforming them in active participant of the joint management and development of the irrigation sector.

Some economic adaptation measures, such as substitution possibilities for other crops, availability, and costs of alternative production techniques, are recommended for evaluation in the future. As in the Second National Communication the other major adaptation measures under consideration in Bulgaria are:

New zoning of the agroclimatic resources and agricultural crops

- Expanding areas of the most important agricultural crops over new regions characterized by improved thermal and moisture conditions.
- Utilization of a variety of cultivars and hybrids, especially long-maturing, high-productive cultivars and hybrids with better industrial qualities.
- Cultivation of new agricultural crops grown with Mediterranean origin.

New cultivars and hybrids to be adapted to climate change

- The new cultivars of winter agricultural crops to pass through the winter season organogenesis under higher temperatures without deviations from the normal crop growth and development.
- The new cultivars and hybrids to be with higher dry-resistance, especially at the end of the vegetative period and at the beginning of the reproductive period.
- Higher maximal air temperatures not to provoke thermal stress effects, especially during crop flowering and formation of the reproductive organs.
- The new cultivars and hybrids to grow and photosynthesis under an increased concentration of carbon dioxide.

Optimization of soil treatment

- Optimal dates and terms of sowing of main crops.
- Soil monitoring.
- Measures for improvement of the water content in soils.
- Measures to improve the soil structure and performance.
- Actions against erosion and for better nutrition mode.
- Up-to-date technologies in soil treatment that keep soil water and structure.
- Effective use of mineral fertilizers relevant to the soils diversity.
- Overcoming of the misbalance of the main nutrients and normalization of the mineral /organic fertilizers ratio.

Adaptation phytosanitary measures

- Development of special sub-models incorporated into models of agro-ecosystems which simulate plant-protection situations, related to climate change.
- Assessment of already used pesticides and the way of their utilization and potential effectiveness of the chemical method against crop diseases and pests.
- Improving technologies for plant protection and priority development of non-chemical methods against crop diseases and pests.
- Improving the monitoring for the phytosanitary situation in the country.

6.4.2. Forestry

The Third National Communication thoroughly deals with the forestry sector and the available adaptation and mitigation measures. Current Communication only adds the latest research in the field.

For the forests in the low parts of the country (under 800 m a.s.l.), where the most significant impact from climate change is expected, the strategic objective of the management must be adaptation towards drought and improving forest sustainability.

For the forests in the higher parts of the country, i.e. those above 800 m a.s.l., where expected changes are not likely to be drastic, the objectives are preservation of biodiversity, eco system sustainability, multifunctional management, system of protected nature territories.

The natural and introduced forest wood and shrub species in Bulgaria have great potential for a good adaptation towards possible climate change in the present century.

Through planned felling of young plantations, the vital space of the remaining woods is improved and so is their light and water regime. This is also an approach to improve the possibilities for adaptation of wood plantations, resulting in increased biomass. Forest management projects forecast an annual growth of 120 000 ha with an average use of 2 801 800 m^3.

7 FINANCIAL RESOURCES AND TECHNOLOGIES TRANSFER

7.1. Introduction

Despite the fact that Bulgaria is an Annex I Party of the UN FCCC, as a country with economy in transition, it has no commitments to provide financial resources and technology transfer to developing countries. The country rather accepts financial and technological help, mainly within the framework of the Joint Implementation (JI) mechanism.

Through is flexible mechanisms, the Kyoto Protocol encourages the industrialized states to invest with clean, climate supporting technologies the countries with economies in transition as well as the developing countries. The Joint Implementation mechanism is an instrument, based on projects, aimed to encourage technology transfer for profitable GHG emission reduction for Annex I countries.

The JI mechanism is a convenient and profitable way for Bulgaria to receive economic, technical and expert help with GHG mitigation efforts.

The basic principles of the national policy on climate change were developed on the basis of Bulgaria's good will to join the efforts of the international community to solve the climate change problems according to the potential of the national economy and looking at the opportunity to attract foreign investments, which will facilitate their implementation.

7.2. The Joint Implementation Mechanism in Bulgaria

The Joint Implementation (JI) mechanism, recommended by UNFCCC and endorsed by the Kyoto Protocol is regarded as a useful mean, which will allow the country to fulfil its commitments. The position of the Republic of Bulgaria on JI, as expressed in National Communications is as follows:

- JI is economically effective because it allows global GHG emission reduction under minimal expenses;
- JI mechanism could facilitate for the introduction of the latest technologies in the country;
- JI is a voluntary activity with two or more participants and the activity must be undertaken and/or approved by the governments of the two participants.

Bulgaria is amongst the first countries in the world, which host JI projects, according to Article 6 of the Kyoto Protocol at UNFCCC. As a result, the country has already gained some experience in various aspects of the JI mechanism, amongst which: conclude a Memorandum of understanding/Cooperation Agreements with other Annex I countries, consultancy on the possibilities on the realization of JI projects, procedures for support and approval of particular projects.

The Sector Joint Implementation Projects at the department "Climate change policy" within the "Strategy, European integration and international cooperation" directorate in MOEW is responsible for the application of the flexible mechanisms of the Kyoto Protocol and for the execution of the procedures for assessment and approval of JI projects in Bulgaria. The department is also responsible for the EC Directive, introducing the Emission Allowance Trading Scheme.

The use of the JI mechanism in Bulgaria started in 2000 with the establishment of a JI mechanism unit as an independent structure in the State Agency for Energy Efficiency under the direct supervision of the Ministry of Environment and Waters.

The legislation on JI projects in Bulgaria includes the Laws on ratification of the UNFCCC and the Kyoto Protocol, signed bilateral Memorandums of Understanding with governments of other countries, that are Annex I parties and the Environmental protection act.

A procedure of approval of JI projects has been set and is in place, and it requires the assessment of each project by a Steering Committee for JI projects (SC JI), which committee is formed by the order of the Minister of Environment and Waters and consists of 8 members, experts from different institutions concerned – the Ministry of Environment and Waters, Ministry of Finance, Ministry of Industry and Energy, Ministry of Regional Development and Public Works, National Forestry Directorate, Executive Energy Efficiency Agency. The chairman is the Minister of Environment and Waters. SC JI carries out an assessment of compliance with criteria, elaborated in advance.

Seven Memorandums of Understanding/Cooperation Agreements have been signed aimed at JI cooperation – with The Netherlands, The Swiss Confederation, The Kingdom of Denmark, Republic of Austria, Prototype carbon Fund at World Bank, Japan and the Kingdom of Sweden. Memorandums with Finland, France, Spain and Italy are expected to be signed until the end of 2006.

The Joint Implementation project must be approved by both participating countries and should lead to emission reduction in addition to those, which would have been emitted in the absence of the project. The projects that satisfy the terms above and are accomplished before 2008 can be registered as Joint Implementation projects but the emission reduction units will be "issued" and transferred only after 2008. This will be done through a national register, which is to be established.

As an implementation of the signed bilateral agreements, 12 projects have been approved and some of them have already started. The execution of those projects will lead to greenhouse gases emission reduction more than 8 mln. tons carbon dioxide equivalent for the period 2008-2012.

7.3. List of the Approved Joint Implementation Projects

Bulgaria is ranked as the most attractive country for investment in Joint Implementation project, according to the Top 3 rating of the Agency for independent analysis – Point Carbon.

The country has already taken advantage numerous times from this very favourable situation in the following projects:

1. Cogeneration gas plant "Biovet JSC", Pestera, investor – "Biovet" SC
2. Reduction of greenhouse gases through gasification of the cities Veliko Tarnovo, Gorna Oryahovica and Lyaskovec, investor – "Overgas Inc" SC;
3. Rehabilitation of the heating system in TPP Sofia, City of Sofia, investor "Toplofikacia" Sofia JSC;
4. Rehabilitation of the heating system in TPP Pernik, City of Pernik, investor "Toplofikacia" Pernik JSC;
5. Reduction of nitrous oxides in "Agropolichim SC, city of Devnia, investor "Agropolichim" SC;
6. Paper factory Stambolijski SC, city of Stambolijski, Investor – "Stambolijski" SC;
7. Vacha Cascade, investor "National electrical Company" JSC;

8. Greenhouse gas reduction through gasification of Sofia municipality, city of Sofia, Investor "Overgas Inc." SC;
9. Greenhouse gas reduction through gasification of Varna municipality, city of Varna, Investor "Overgas Inc." SC ;
10. Cogeneration in TPP Plovdiv JSC, city of Plovdiv, investor "Toplofikaciya Plovdiv" JSC;
11. Common project for installation of cogeneration gas plants, put together as several sub projects – Polimeri SC; Kostenec HHI SC; Toplofikaciya Kazanlak SC; Toplofikaciya Yambol SC;
12. Utilization of biomass in Sviloza SC, city of Svistov, investor "Sviloza" SC;

A significant number of projects are supported at Project Idea Note stage. Now follows the process of a further development and possible approval.

7.4. List of Supported Project ideas for the Joint Implementation Mechanism

1. Capture of biogas and production of electricity from Waste water treatment station Kubratovo, city of Kubrat, Investor "Sofia water" SC;
2. TPP Eco energy 2004 – plant for joint heat and electricity production in Sofia, Republic of Bulgaria, city of Sofia, district Ovcha Kupel, Investor – "Risc Engineering" SC;
3. Construction of own autonomous source for electrical and heat energy in BF "Panajot Volov" SC based on gas turbine, City of Shoumen, Investor – Financial industrial concern "AKB FORES", JSC;
4. Factory for biodisel production, city of Slivovo pole, region of Russe, Investor "Astra Bio Plant" Ltd. ;
5. Construction and operation of HPP Potochnica, lower part of Arda river, Investor "Finauto" Ltd. ;
6. Wind energy park "Universum Energy" City of Kavarna, Dobrich region, Inverstor "Universum Energy" Ltd.;
7. Wind power station Kaliakra, Kavarna municipality, Investor "Mitsubishi Heavy Industries", Japan
8. Portfolio: "Energy efficiency and renewable energy in Bulgaria", incl. "Trakia gas", region of Plovdiv, "Sugar plants", city of Gorna Oryahovica, "Delektra Hydro", city of Lesichevo, "Viva Agrotex", city of Alfatar, "Astra V" Ltd., city of Devin, "Mount L", "Trestena", "Zebra" SC, city of Novi Iskar, "Pirinplast", city of Goce Delchev, United Bulgarian Bank, Investor – United Bulgarian Bank;
9. Opportunities for construction of small hydropower plants (SHPP) along Sofia water supply system, city of Sofia, Investor Sofia municipality;
10. Utilization of methane gas at the solid household landfill Suhodol, city of Sofia, Investor Sofia municipality;
11. Expansion, modernization and reconstruction of thermal power plant "Yambolen" SC on its conversion in independent power producer, TPP "Yambolen" SC, city of Yambol, Investor "Yambolen" SC;
12. Energy efficiency investment program in the Cellulose factory Sviloza SC, city of Svistov, Investor "Sviloza" SC;

13. Rehabilitation project for hydroenergy cascade “Lower Arda”, including HPP “Kurdjali”, HPP “Studen kladenec” and HPP “Ivajlovgrad, Investor “National electrical company” SCS;
14. Portfolio: Cascade Sreden Iskar, including 8 HPP on Iskar river, Investor “HPP Svoge” Ltd.;
15. Wind power plant “Murgash”, the region of the mount Murgash, ridge of Stara planina, Investor “Ecosource Energy” Ltd. ;
16. A set of projects for small HPP in Bulgaria, including HPP “Lozyata” close to HPP “Krichim”, HPP “Byala Mesta” – mountain part of the basin of Mesta river, HPP “Cherna Mesta” – mountain part of Mesta river basin;
17. Construction of FAME /biodiesel/ production installation, city of Silistra, Investor “Green oil” Ltd.;
18. Pilot project – Forestry sector: change of fuels, city of Ardino, Ardino municipality;
19. A set of small hydro power plants and wind parks, including SHPP “Banite”, village Banite, SHPP “Hulubovo”, village Gulubovo; SHPP “Oryahovec”, village Oryahovo, SHPP “Prespa”, village Prespa, SHPP “Slivka”, village Slivka; SHPP “Churekovska”, river Churekovska, SHPP “Yugovo”, village Yugovo; SHPP “Zverino”, village Zverino; SHPP “Lyutinbrod”, village Lutinbrod; SHPP “Energy Govedarci”, village Govedarci; SHPP “Stankova reka”, Stankova river; SHPP “Pchelina”, village Lobosh, “Retije cascade”, village Kremen; Wind Energy Park (WEP) “Irichek”, village Irichek; WEP “Vidno”, village Vidno; WEP “Rakovski”, village Rakovski; WEP “Hadji Dimitar”, village Hadji Dimitar; WEP “Selce”, village Selce; WEP “Kavarna-LM”, city of Kavarna; Reconstruction of steam plant Runo-Kazanlak, investor “Runo Kazanlak” SC, city of Kazanlak.
20. New plant for joint production of heat and electrical energy in Toplofikaciya Burgas SC, city of Burgas, Investor “Toplofikaciya Burgas”;
21. Greenhouse gas reduction through gasification of Burgas municipality, Burgas municipality, Investor “Overgas Inc.” SC;
22. N_2O emission reduction for Neochim SC, city of Dimitrovgrad, investor “Carbon Ventures”.

8 EDUCATION, TRAINING AND PUBLIC AWARENESS

8.1. Introduction

Public interest in climate changes has been significant. Various governmental, non-governmental and social non-economic organizations have raised the issue on various occasions. However, the more serious problem is that a vast amount of people do not realize the increasing by the hour environmental threat for our planet. In this respect, each one of us, being direct or indirect component of the environment, can and must contribute to the protection of the environmental balance.

8.2. Education

Bulgaria carried out a project for self assessment of the capacity of the country in the field of sustainable development in 2004. The results from the project in the section Environmental education and public awareness in climate change problems allow to define the priority topic, the explanation of which will improve not only the level of the educational system but also public awareness.

Three complex and a number of specific reasons have been formulated as a reason for the unsatisfactory level of capacity. Specific objectives and tasks have been elaborated to improve the situation and direct and indirect assets have been recognized that allow the tasks to be solved in a short period of time.

The main results from the work in the area of climate change are given in Table 8.1

Table 8.1 Reasons, specific objectives and assets

<table>
<tr><td><u>PRIORITY PROBLEM:</u>

Insufficient participation of the interested parties and general public in the national and international climate change activities</td><td colspan="2"><u>STRATEGIC OBJECTIVE:</u>

Active participation of the interested parties and general public in the formulation, development, execution and assessment of the climate change policies and measures</td></tr>
<tr><td></td><td colspan="2"></td></tr>
<tr><td><u>Complex reason:</u>
Lack of sufficient information on the subject or the information is hard to obtain</td><td colspan="2"><u>Specific objective</u> :
To create conditions the information on climate change, the international and national policy on this problem to be available and with easy accessed for everybody interested</td></tr>
<tr><td><u>Main reasons:</u>
• Lack of national program or plan for education, training and information on public awareness on climate change
• Lack of journalists competent in this area
• Media information are of sensational or campaign character, there are no fundamental and in-depth analysis</td><td><u>Tasks:</u>
• Development and adoption of national program or plan for education, training and information on public
• Creation of informal group of journalists and experts to prepare and present information on climate change</td><td><u>Direct assets:</u>
• A huge amount of information exists in Internet on climate change
• A company on environmental protection management activities exists
• There are environmental NGOs with experience in education and public</td></tr>
</table>

• Lack of coordination amongst the administration in regard to presenting information to various customers • Lack of effective information system for the ongoing work, results and achievements in various climate change areas • Lack of purpose financing for the activities defined in the New Delhi Program on Article 6 of the UNFCCC • Media do not contact experts on the topic	• Journalists trained on the subject • Create mechanism for Information Exchange (CHM) on climate change causes, its effect and prevention activities in various areas and sectors • Improved inter administration coordination for detailed and in-time presentation of information • Adapted scientific publications and information on climate change and popularizing through integration in various special information flows	awareness • MOEW has an information centre and Internet site on climate change • Ministries and Agencies have public awareness units **Indirect assets:** • There is a mechanism for Information Exchange (CHM) on biodiversity • Specialized radio and TV broadcasts exist (for ex. "Brazdi", "Ecocambana", etc.)
Complex reason: : There is no general education on the subject	**Specific objective:** Climate change subject integrated at all educational levels	
Main reasons: • Lack of enough teaching materials and books in Bulgarian • Lack of specialized information materials for teachers on climate change • Training aids on natural science and humanitarian subjects do not include climate change and its impact in the respective area	**Tasks:** • Development of educational and information materials in Bulgarian • Development of specialized educational programs on climate change for teachers and lecturers • Purpose financing is ensured on activities on the national program and for science and research in High schools • Training aids on natural science and humanitarian subjects that include climate change and its impact on the respective area	**Direct assets:** • MOEW have an expert on Education and Environment • The Ministry of Education carries out reforms in the system for improvement of teachers' training **Indirect assets:** • There are some educational materials in small circulation • State educational requirements are under way
Complex reason: : Lack of sufficient expert potential for business, local authorities, NGOs and academics	**Specific objective: :** Established expert potential in regard to climate change for business, local authorities, NGOs and academics	
Main reasons: • Insufficient targeting of scientific and research activities toward compliance and meeting the requirement of UNFCCC	**Tasks:** • To ensure financing on this subject from the National Science Fund • Special educational	**Direct assets:** • There are highly qualified experts and scientists with interest on climate change subject

• Lack of sufficient financing for research on this subject • Ignoring the gravity of the problem by the parties concerned • Lack of good opportunities for employment and professional growth	practices (seminars, courses, information campaigns) • Improved interconnection of business and science for popularizing and financing the research on the subject	• There are experienced teams in climate change projects • There is a limited number of experts with good knowledge on climate change **Indirect assets:** • There are chamber organizations that support information dissemination and protection of member interests • EPA requires the development and application of national and municipal environmental protection programs • There is experience in the development of municipal programs on EE • There are regional centres and local units on energy efficiency

There is already planning of the tasks from Table 8.1 and some positive results are in place.

8.2.1. Environmental Education in Schools

The effective use of human potential, especially in hard time as the present transitional period, is one of the greatest challenges, undertaken by people in the last decade. Environmental protection – soil, air, water, plants and animals, natural heritage must develop into personal conviction. One of the fundaments of the present education is to familiarize the pupils with the natural environment and form a positive attitude towards everything, surrounding them.

The topics of environmental protection and climate change are included in school syllabuses in the educational and cultural field "Natural science and environment". They are studied in most details in the "Geography" subject but also, even in lesser scale in "Environmental chemistry" and "Biology".

The children have contacts with nature even in primary school, they get used to watch it, get acquainted with various natural sites and objects, and follow different natural phenomenon. To enhance their knowledge on the environment it is of great benefit to have various games – didactic, of cognitive nature. When introducing Bulgarian mountains to them, a special attention should be drawn to the variety of mountains in the country.

For an efficient environmental education and training, trips and games at the open are very beneficial. The game "**How old is the tree**" will help the children understand how long does it take for a tree to grow.

Through a series of research, experiments are made on the state of the river, running through settlements. The water in the mountain is investigated and so is the water in the city. Even only primitive tools are used – magnifying glass, what is seen is enough for drawing some valuable conclusions. Visits of the Black Sea, numerous water dams, parks and reserves can also positively contribute on children's knowledge on environmental problems.

Pupils can see for themselves how much cleaner the water in the mountains is, where human presence is limited.

In this context, one should add the necessity of introduction of compulsory environmental lessons in primary schools and outdoor activities.

8.2.2. Development of Specific Syllabuses for Training of Teachers and Lecturers

A "Specialized course on vocational training of chemistry teachers on environmental protection" was carried out in 2005. It was on 3 stages during the school year. All 50 participants – chemistry teachers have obtained a certificate. The participants in the course have been selected from all over the country. The successful completion of the education can be used as a model for future training and elaboration of similar courses for training of teachers.

8.3. Ecotourism

The consolidation of the movement for environmental protection and development of ecotourism is typical for the period of transition to market economy. Both tendencies are expression of the concern for environmental protection and protection of the natural and cultural heritage. The protection of the environment, heritage and ecotourism are closely linked amongst them and need each other to achieve successfully their goals.

During the first national forum "Ecotourism, mountains and protected territories – partners for prosperity", the Ministry of Economy, Ministry of Environment and Waters and Ministry of Agriculture and Forestry signed a Protocol for cooperation in the ecotourism.

The strong orientation of ecotourism to the principles, guiding directions and certification, based on the standards of sustainability, assigns it a special part in the sector Tourism. During the years, since the term was defined for the first time, Bulgaria reached consensus on the main elements of ecotourism, which characterize it as follows:

- contributes for the biodiversity protection;
- supports the prosperity of the local population;
- includes a responsible behaviour from tourists and the tourist sector;
- requires the lowest possible use of non-renewable resource;
- services for small tourist groups are provided mainly by small business
- the emphasis is on local participation, private property and business opportunities, specially for people from rural areas;
- includes imperative/cognitive element.

8.4. Contribution of MES in Sector "Household and services" in the Second National Climate Change Action Plan

8.4.1. Improving Thermal Isolation (kindergartens, schools, universities and orphanages)

The Ministry of Education and Science has successfully fulfilled energy efficiency sanitation program for schools. The building and construction work have been distributed on types of activities, according to the presented technical specification. The activities from 2005 are the biggest so far and the financial means have used in the most effective way. The effect is in the decrease of energy costs for schools and budget relief through investments with a short period of buy out.

8.4.2. Gasification – Abolishing Liquid Fuels for Heating (kindergartens, schools, universities and orphanages)

The harmful emissions in the atmosphere and the air pollution are reduced by replacing liquid fuels with natural gas. The learning conditions are improved. Gasification is most often accompanied by major rehabilitation of heating facilities, thus significantly improving their efficiency.

8.4.3. Introducing Solar, Hybrid and Other Hot Water Installations (kindergartens, schools, universities and orphanages)

Similar installations can be discussed and built after presenting detailed economic reasoning and proposal for managerial decision.

The completion of those projects is accompanied by education of pupils for the necessity of efficient use of energy, reduction of the emissions in the environment, improvement of the living space and in particular – the microclimate in school rooms.

9 RESEARCH PROJECTS AND SYSTEMATIC OBSERVATION

The Bulgarian Academy of Sciences (BAS) carries out research and other activities on climate change. The information for this research is so big that can not be summarized and analyzed within this document. Work is going on not only on planned tasks with national financing but also in cooperation with research organizations from EU member countries within the Sixth Framework Programme.

Comprehending the significance of this problem, BAS established a National Coordination Centre for Global Change. The Centre for Global Change carries out work in the following directions:

– Organizational activity for strengthening of the Centre;
– Publication of books, papers, and other materials on global change problems;
– Participation in scientific conferences and discussions dedicated to global changes; Supporting the contacts of our scientists with foreign scientists, who work on the topics of global change;
– Public awareness on those changes.

On national level the centre puts efforts to strengthen the cooperation amongst Bulgarian institutions and organizations. In regard to this, it organizes discussions about the Second National Action Plan on Climate Change and the policy of MOEW on climate change; on climate change and global change project implementation, etc.

On international level, the centre supports participation in projects, publications and reports on climate change and global change.

A scientific monograph was published in the UK «Drought in Bulgaria. A Contemporary Analog for Climate Change» Ashgate, UK, pp. 336, edited by C. Gregory Knight, Ivan Raev, Marieta Staneva

Major planned projects:

– Applying European experience on using the results from climate change research in Bulgaria, Introduction of decision taking mechanisms in agriculture under the conditions of global changes by establishing contacts between users and experts, climate change impact assessment on the elements of the water balance.

- Forest-climatic research on the coniferous forests in Bulgaria.

Major publications:

- Alexandrov, V. and J. Eitzinger, 2005. The Potential Effect of Climate Change and Elevated Air Carbon Dioxide on Agricultural Crop Production in Central and South-eastern Europe. In: Tuba, Z. (ed.), 205. Ecological responses and adaptations of crops to rising atmospheric carbon dioxide. The Haworth Press Inc., USA, pp.291-332 and Journal of Crop Improvement 13(1-2): 291-331.

- Alexandrov, V., M.Genev and H.Aksoy, 2005. Climate variability and change effects on water resources in the western Black Sea coastal zone. Proceedings of the European Water Resources Association (EWRA'2005) Conference: "Sharing a common vision for our water resources", 7-10 September 2005, Menton, France, (CD version) 12 pp.

- Alexandrov, V., 2005. Role and involvement of Bulgarian meteorologists in the implementation of the UN Convention to Combat Desertification at national level. Proceedings of the Technical Workshop on Drought Preparedness in the Balkans within the context of UNCCD. UNCCD Secretariat, Bon, Germany, 22 pp.

- Alexandrov, V., M.Genev and H.Aksoy, 2005. The impact of climate variability and change on water resources in the western coastal zone of Black Sea. Regional Hydrological Impacts of Climatic Change - Impact Assessment and Decision Making (Proceedings of symposium S6 held during the Seventh IAHS Scientific Assembly at Foz do Iguaçu, Brazil, April 2005). IAHS Publ. 295, pp.62-71.
- Eitzinger, J. and V.Alexandrov, 2005. Results (and Problems) of Climate Change Impact Research in Agricultural Crop Production in Middle Europe. Proceedings of the CAgM OPAG 3.2 WMO Expert Team Meeting on Impact of Climate Change/Variability on Medium-to Long Range Predictions for Agriculture, 15-18 February 2005, Brisbane, Australia, WMO & Queensland Government, pp.17-20.
- Petkova N., R. Brown, E. Koleva and V. Alexandrov, 2005. Snow Cover Changes in Bulgarian Mountainous Regions, 1931-2000, Croatian Meteorological Journal 40: 662-665.
- Alexandrov, V., 2004. Climate variability and change and related drought on Balkan Peninsula. Proceedings of the Conference on Water Observation and Information System for Decision Support (BALWOIS) Ohrid, Macedonia, 25-29 May 2004, (CD) 14 pp.
- Alexandrov, V., 2004. Comparison of the CEECs scale crop modelling approaches. ACCELERATES Report, 81 pp.
- Alexandrov, V., 2003. Homogenization of Climate Long-term Series in Bulgaria. Report to Meteo-France, 41 pp.
- Alexandrov, V., 2001. Climate Change Impact on Water use of Maize in Bulgaria. Proceedings of the international conference on 150 Years of Meteorological Service in Central Europe, Stara Lesna, Slovakia, (CD) 13 pp.
- Audsley, E., K.R. Pearn, C. Simota, G. Cojocaru, E. Koutsidou, M.D.A. Rounsevell, M. Trnka and V. Alexandrov, 2006. What can scenario modelling tell us about future European scale land use, and what not? Environmental Science and Policy 9(2): 148-162.
- Alexandrov, V., M. Schneider, E. Koleva and J-M. Moisselin, 2004. Climate Variability and Change in Bulgaria during the 20th Century. Theoretical and Applied Climatology 79(3-4): 133-149.

9.1. Strategic Projects

- National self assessment of Bulgaria for a global environmental protection management.

This project is joint initiative of the Ministry of Environment and Waters and the United Nations Development Program and started at the end of 2002. The project was developed during the period February – June 2003. Its objective is to provide an in-depth assessment of Bulgaria's capacity to carry out its commitments on the three UN conventions and to lead to the development of a strategic action plan on the improvement of the global management of the environment in the areas, related to the conventions on national level.

9.2. Current Projects with International Financing

National Information System for Air control in real time PHARE 9916

The objective of the project is to connect 17 automatic stations and 4 OPSIS stations in a way to allow data transfer to the Regional Environment and Water Inspectorates and the Executive Environment Agency in real time. The main result from the project is the improvement of the available data in regard to the Bulgarian commitment for reporting.

Main objectives of the project - Further and full implementation of EU Air Quality Legislation by improving the administrative capacity of EEA and REIs with regard to QA/QC in the National Ambient Air *Monitoring* System (NAAMS).

Expected result

- Determination of present situation with regard to QA/QC within NAAMS i.e. to analyze the measurement methods, equipment and methodologies used; data handling, validation and verification procedures etc.;
- Established Calibration Lab operated on sustainable basis; ensured with adequate and well trained staff, as well as with the required methodologies
- Established National QA/QC System for AAQ measurements within NAAMS (in compliance with EU QA/QC requirements [ISO 17025] according to art.3 of The Framework Directive 96/62/EC on AAQ assessment and management); ensured with adequate and well trained staff (station operators and REI laboratory experts), as well as with the required guidebooks, instructions and methodologies
- Trained staff in 15 REIs and EEA (total 20 experts) on QA/QC in PAH and PCDD/PCDF emission measurements or other components
- Elaborated Action Plan for further development of QA/QC System (and The Calibration Lab) in order to gradually to increase it's scope by covering the new AAQ parameters established by 2000/69/EC, 2002/3/EC and the forthcoming daughter directives (PAH, benzene, arsenic, heavy metals).

Development and implementation of a soil monitoring and assessment framework for the republic of Bulgaria

Main objectives of the project

The *project* is deemed to be a pro-active step towards complying with the upcoming soil *monitoring* legislation of the EU

Expected results

- Review of the existing system for soil monitoring;
- Proposed structure and methodological approach for the new monitoring and assessment framework;
- Functional design of a GIS system.

Expected effect

Improved soil monitoring

Development of national system for monitoring of the biological diversity and protected areas in Bulgaria in compliance with Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora and Council Directive 79/409/EEC on the conservation of wild birds

Main objectives of the project - Strengthening the Bulgarian infrastructure for *monitoring* of the biodiversity and protected areas to ensure that the monitoring is in conformity with the EU-directives 92/43/EEC (habitat directive) and 79/409/EEC (bird directive).

Expected results

- A national *programme* for *monitoring* of the biodiversity and protected areas has been elaborated, including an action plan for its implementation;
- Strengthened capacity at the Executive Environment Agency (EEA) regarding the monitoring of the bio-diversity;
- Improved capacity of the Regional Inspectorates for Environment and Water staff for implementing the action plan activities in the field of the bio-diversity monitoring.

Expected effect
Improved monitoring of the biodiversity

Strengthening of the capacity and development of a Bulgarian national system for information management and reporting according to the IPPC directive

Main objectives of the project - Strengthening the capacity of the Executive Environment Agency with regard to issuing permits and reporting in accordance to the IPPC-directive (96/61/EC).

Expected results
- The Executive Environment Agency is able to issue permits in accordance with IPPC-requirements;
- Reporting by the Executive Environment Agency is in conformity with the IPPC-directive and other international agreements (EPER and PRTR);
- Increased awareness among Bulgarian industry regarding IPPC.

Expected effect
Effective reporting under IPPC-directive, EPER and PRTR

9.3. Financial Sources for Environmental Projects in Bulgaria

The main sources for financing of environmental projects in Bulgaria are:
● State budget;
● An enterprise for managing activities on environmental protection;
● National trust ecofund;
● European Union pre-accession funds for candidate member countries – ISPA, PHARE, SAPHARD;
● "Joint Implementation" mechanism within the framework of the Kyoto Protocol to the United Nations Framework Convention on Climate Change;
● Agreements for bilateral cooperation with:
- The Kingdom of the Netherlands;
- The Federal Republic of Germany;
- Denmark;
- Austria;
- The Kingdom of Belgium;
- The United Kingdom;
- The Principality of Monaco.

● International organizations and financial institutions:
- United Nations Development Program; ;
- Nordic-funds;
- CIM-projects;
- Central European Initiative;
- United States Agency for International Development;
- European Bank for Reconstruction and Development;
- The World Bank.

9.4. Systematic Observation

The section on systematic observations activities in the country follows the detailed guidance for required information as provided in the UNFCCC reporting guidelines on global climate observing systems. It includes summary information on the current status of national plans, programs and support for ground and space-based climate observing systems.

It should be pointed out that up to now activities in this field have been undertaken separately from the climate change policies and measures. They were more closely linked to the general commitments of the country in the field of meteorology.

There are no GSN (Global Surface Network) and GUAN (Global Upper Air Network) stations located in Bulgaria. There is only one GAW (Global Atmosphere Watch) station in the country (Rojen).

The National Institute of Meteorology and Hydrology in Sofia, Bulgaria has several weather stations included within the Regional Basic Synoptic Network (RBSN) and Regional Basic Climatological Network (RBCN) in RA VI (Europe):

Table 9.1. RBSN stations in Bulgaria

INDEX	LATITUDE	LONGITUDE	ALTITUDE OF BAROMETER (m)	NAME	OBSER-VATIONS
15502	43° 59’	22° 51’	595	VIDIN	S
15525	43° 09’	24° 42’	220	LOVETCH	S
15549	43° 34’	26° 30’	346	RAZGRAD	S
15552	43° 12’	27° 57’	40	VARNA	S
15614	42° 39’	23° 23’	595	SOFIA OBS	S
15614	42° 39’	23° 23’	588	SOFIA OBS	WR UTC 1200
15640	42° 40’	26° 20’	257	SLIVEN	S
15655	42° 30’	27° 29’	27	BURGAS	S
15712	41° 33’	23° 16’	203	SANDANSKI	S
15730	41° 39’	25° 23’	330	KURDJALI	S

Table 9.2. RBCN stations in Bulgaria

INDEX	NAME	CLIMAT	CLIMAT TEMP
15502	VIDIN	X	
15552	VARNA	X	
15614	SOFIA OBS	X	
15614	SOFIA OBS		X
15730	KURDJALI	X	

The UNFCCC Guidelines table 1 can be presented as follows:

Table 9.3. Participation in the global atmospheric observing systems

	GSN	GUAN	GAW	Other*
How many stations are the responsibility of the Party?	0	0	1	9+4
How many of those are operating now?	0	0	1	9+4
How many of those are operating to GCOS standards now?	0	0	1	9+4
How many are expected to be operating in 2005?	0	0	1	9+4
How many are providing data to international data centres now?	0	0	1	9+4

*- the weather stations included within the Regional Basic Synoptic Network (RBSN) “plus” Regional Basic Climatological Network (RBCN) in RA VI

In addition to the above information, the National Institute of Meteorology and Hydrology in Sofia, Bulgaria has about 40 synoptic and more than 90 climatic stations across the country.

The main problems in the field are related to the lack of financial support for modern telecommunication system. The same problem hinders the training of experts in the fields.

Oceanographic observations

National Institute of Meteorology and Hydrology, Sofia, Bulgaria: it has Black Sea coastal stations – 10 stations measure sea temperature; 10 stations measure sea level; 3 stations measure sea water salinity.

Institute of Oceanology, (PO Box 152, BG-9000 Varna, Bulgaria): Every year it carries out complex seasonal expeditions studying physical, chemical and biological parameters of sea water and bed at the western part of Black Sea. The research ship "Academic" executes up to 4 seasonal expeditions applying a constant scheme for monitoring (at about 50 points at the western part of Black Sea). The profiles of sea temperature and salinity, oxygen, phosphates, nitrates, nitrites, zooplanktons and fauna are measured. Weather observations are done at every location of interest: air temperature, sea level pressure, wind speed and direction. The institute is currently trying to recover and improve some oceanographic systems for observations such as VOS (Volunteer Observing Ship) and TIDE GAUGES as well as to include them within international programmers.

The Table 2 from the UNFCCC Guidelines can be presented as follows:

Table 9.4. UNFCCC table 2. Participation in the global oceanographic observing systems

Platforms	VOS	SOOP	TIDE GAU-GES	SFC DRIF-TERS	SUB-SFC FLOAT S	MOO-RED BUOY S	ASAP
For how many platforms is the Party responsible?	0	0	4	0	0	0	0
How many are providing data to international data centres?	0	0	0	0	0	0	0
How many are expected to be operating in 2005?	0	0	4	0	0	0	0

Legend to the table:

VOS - Volunteer Observing Ship
SOOP - Ship of Opportunity Programme
SFC DRIFTERS - Surface Drifters
SUB-SFC FLOATS- Sub-surface floats
ASAP - Automated Shipboard Aerological Programme

Institute of Oceanology, Varna, Bulgaria: the 4 stations measuring the Black Sea level are equipped with seagraphes and data are stored on paper. It does not allow operative data exchange.

Terrestrial observations

The National Institute of Meteorology and Hydrology in Sofia, Bulgaria has a network of 205 hydrological and 431 hydrogeological stations.

There are no carbon networks in the country.

The National Institute of Meteorology and Hydrology in Sofia, Bulgaria has a network of agrometeorogical stations observing the phenological development and stages of major crops as well as orchards and forest trees.

The other networks monitoring land-use, land cover, land-use change and forestry are managed at the Ministry of Agriculture and Forestry.

Space-based observations

National Institute of Meteorology and Hydrology, Sofia, Bulgaria:

In 1995 Bulgaria was involved in the European space-based observing programmes on meteorology after signing an Agreement on Use of Images from the EUMETSAT Meteosat Satellites between the National Institute of Meteorology and Hydrology (NIMH) and EUMETSAT, the European Organisation for the Exploitation of Meteorological Satellites.

High Resolution Image (HRI) data from Meteosat-7 in three channels (0,5-0,9 µm, 5,7-7,1 µm и 10,5-12,5 µm) are processed and utilized for operational and research purposes. Daily imagery analysis is made subjectively for the purposes of short-range weather forecasting.

The observations from the three channels of Meteosat-7 are received every 30 minutes at NIMH by operating a Primary Data User Station (PDUS).

A Cooperating State Agreement between the Government of the Republic of Bulgaria and EUMETSAT was signed in 2004. Bulgaria will benefit from faster and more comprehensive data made available by EUMETSAT’s Meteosat-8 satellite, the first of EUMETSAT’s second generation satellite, providing 12 channels of data and images every 15 minutes. The receiving of Meteosat-8 data at NIMH and pre-operational use of the imagery for short-range forecasting purposes has been initiated in April 2005.

Institute for Space Research:

Bulgaria is participating in space-based observing programmes by development and execution of national and international space programmes as well as development of complex research tools for:

- international crews of orbital space stations including those with the first and second Bulgarian astronauts
- space satellites
- geophysical rockets
- sub-space experiments

An important way related to participation in space-based observing programmes is development, analyses and interpretation of space satellite images.

The basic research directions in the field of space meteorology were established in 1967 by the space programme “INTERCOSMOS”. The first satellite pictures of the Earth were delivered at the Geophysical Institute in Sofia applying Bulgarian installations. At that time the space meteorology was established in the country. In the framework of this activity meteorologists developed and improve the methods for interpretation of cloud images obtained by meteorological satellites. Bulgarian scientists created the first morphological systematics of cloud vortexes over the Mediterranean. The book “Mediterranean cyclones in the field of cloudiness” was written by Bulgarian, Hungarian, Romanian and Russian researchers.

By a model, developed by Bulgarian scientists, important results related to the impact of inhomogeneous Earth surface on the cloud distribution were obtained. The theory and results were published in a book written by Bulgarian, Hungarian, German, Romanian and Russian researchers.

Studies on the statistical structure of meteorological fields in the stratosphere and mesosphere were carried out by applying rocket data. The obtained results were involved within the methods for analyses of meteorological fields, hydrodynamic and statistical forecasts.

In Bulgaria a method was developed for measurement of the wind velocity vector in the upper layers of the atmosphere by applying dipole reflectors cluttered from a container located in meteorological rockets. The obtained data for the wind profile at a level of 75-100 km together with the data of temperature, pressure and density allow to investigate the global atmosphere circulation in the stratosphere and mesosphere.

Bulgaria utilizes observations from satellites: satellite images with very high (IKONOS, QuickBird, EROS) high (IRS, SPOT) and moderate (Landsat, ASTER) space resolution are used. The satellite images are used for research and scientific experiments as well as an basic source of information under development of geoinformation systems.

Bulgaria is an active participant at the investigation of the Earth surface by aero-space tools. The country has its own contribution (project teams from the Institute for Space Research and some other space laboratories in the country) to utilization of spectral-reflector characteristics of various natural forms. Bulgarian specialists created a catalogue of the major soil types in the country. Since 1989 Bulgarian scientists have participated during two stages of an international project "Earth cover" by using satellite data.

The satellite images are received by: participation of various national and international projects and programmes (e.g. CD, DVD); Internet (e.g. FTP servers); purchase (e.g. CD, DVD).

The space studies are expensive activities and are possible only under the framework of a wide international collaboration. So far, Bulgaria participated in different space projects together with Russia, USA, EU countries, etc. At the institute project experience exists in the following fields: space physics, remote sensing methods for investigation of the Earth and planets; space biotechnology; etc.

Other ways for participation in space-based programmes are:

to organize and participate at national and international workshops, symposia and conferences;

to develop a project related to a micro-satellite BALKANSAT for ecological monitoring and education of students.

10 ANNEX

GHG INVENTORY
2003

Common Reporting Format
Summary Tables and Trends

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)

(Sheet 1 of 3)

Bulgaria
2003
2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)				(Gg)					
Total National Emissions and Removals	**53 321.38**	**-7 055.98**	**445.99**	**20.83**	**120.60**	**0.00**	**0.00**	**20.69**	**6.36**	**2.52**	**135.29**	**385.28**	**58.38**	**1 042.71**
1. Energy	**49 035.44**		**84.93**	**8.54**							**124.77**	**362.05**	**30.61**	**1 025.07**
A. Fuel Combustion — Reference Approach[2]	49 824.54													
Sectoral Approach[2]	49 035.44		2.79	8.54							124.77	362.05	30.61	1 025.07
1. Energy Industries	28 329.87		0.45	7.87							57.73	6.04	0.42	866.04
2. Manufacturing Industries and Construction	11 402.14		0.24	0.33							15.85	6.34	0.05	89.89
3. Transport	7 097.83		1.24	0.13							45.41	182.50	30.15	8.78
4. Other Sectors	2 205.59		0.41	0.21							4.58	55.74	0.00	60.36
5. Other	0.00		0.44	0.00							1.20	111.43	0.00	0.00
B. Fugitive Emissions from Fuels	0.00		82.14	0.00							0.00	0.00	0.00	0.00
1. Solid Fuels	0.00		57.54	0.00							0.00	0.00	0.00	0.00
2. Oil and Natural Gas	0.00		24.60	0.00							0.00	0.00	0.00	0.00
2. Industrial Processes	**4 285.94**		**2.79**	**3.74**	**120.60**	**0.00**	**0.00**	**20.69**	**6.36**	**2.52**	**9.89**	**6.12**	**13.23**	**17.64**
A. Mineral Products	2 279.10		0.00	0.00							0.00	0.00	1.02	0.76
B. Chemical Industry	345.10		0.27	3.74	0.00	0.00	0.00	0.00	0.00	0.00	9.62	3.15	4.13	14.53
C. Metal Production	1 661.74		2.51	0.00				20.69		0.00	0.08	2.27	0.19	1.47
D. Other Production[3]	NO										0.19	0.70	5.90	0.88
E. Production of Halocarbons and SF_6						0.00		0.00		0.00				
F. Consumption of Halocarbons and SF_6					120.60	0.00	0.00	0.00	6.36	2.52				
G. Other	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.99	0.00

P = Potential emissions based on Tier 1 approach of the IPCC Guidelines.

A = Actual emissions based on Tier 2 approach of the IPCC Guidelines.

(1) The emissions of HFCs and PFCs are to be expressed as CO_2 equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are to be provided in Table 2(II) of this common reporting format.

(2) For verification purposes, countries are asked to report the results of their calculations using the Reference approach and to explain any differences with the Sectoral approach. Where possible, the calculations using the Sectoral approach should be used for estimating national totals. Do not include the results of both the Reference approach and the Sectoral approach in national totals.

(3) Other Production includes Pulp and Paper and Food and Drink Production.

Note: The numbering of footnotes to all tables containing more than one sheet continue to the next sheet. Common footnotes are given only once at the first point of reference.

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)

(Sheet 2 of 3)

Bulgaria
2003
2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs [1]		PFCs [1]		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
3. Solvent and Other Product Use	**0.00**			**0.00**							NO	NO	**14.54**	NO
4. Agriculture	**0.00**	**0.00**	**99.01**	**8.06**							0.62	17.11	0.00	0.00
A. Enteric Fermentation			71.54											
B. Manure Management			24.38	1.27									0.00	
C. Rice Cultivation			2.27										0.00	
D. Agricultural Soils	[4] NO	[4] NO	0.00	6.77									0.00	
E. Prescribed Burning of Savannas			0.00	0.00							NO	NO	NO	
F. Field Burning of Agricultural Residues			0.81	0.0172							0.62	17.11	0.00	
G. Other			0.00	0.00							0.00	0.00	0.00	NO
5. Land-Use Change and Forestry	[5] **0.00**	[5] **-7 055.98**	**0.00**	**0.00**							**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	[5] 0.00	[5] -7 055.98												
B. Forest and Grassland Conversion	0.00		0.00	0.00							0.00	0.00	NO	
C. Abandonment of Managed Lands	[5] 0.00	[5] 0.00												
D. CO_2 Emissions and Removals from Soil	[5] 0.00	[5] 0.00												
E. Other	[5] 0.00	[5] 0.00	0.00	0.00							0.00	0.00	NO	NO
6. Waste	**0.00**		**259.27**	**0.48**							**0.00**	**0.00**	**0.00**	**0.00**
A. Solid Waste Disposal on Land	[4] 0.00		200.79									0.00	0.00	
B. Wastewater Handling			58.48	0.48							0.00	0.00	0.00	
C. Waste Incineration	[4] 0.00		0.00	0.00							NO	NO	NO	NO
D. Other	0.00		0.00	0.00							0.00	0.00	0.00	0.00
7. Other *(please specify)*	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

[4] According to the IPCC Guidelines (Volume 3. Reference Manual, pp. 4.2, 4.87), CO_2 emissions from agricultural soils are to be included under Land-Use Change and Forestry (LUCF). At the same time, the Summary Report 7A (Volume 1. Reporting Instructions, Tables.27) allows for reporting CO_2 emissions or removals from agricultural soils, either in the Agriculture sector, under D. Agricultural Soils or in the Land-Use Change and Forestry sector under D. Emissions and Removals from Soil. Parties may choose either way to report emissions or removals from this source in the common reporting format, but the way they have chosen to report should be clearly indicated, by inserting explanatory comments to the corresponding cells of Summary 1.A and Summary 1.B. Double-counting of these emissions or removals should be avoided. Parties should include these emissions or removals consistently in Table8(a) (Recalculation - Recalculated data) and Table10 (Emission trends).

[5] Please do not provide an estimate of both CO_2 emissions and CO_2 removals. "Net" emissions (emissions - removals) of CO_2 should be estimated and a single number placed in either the CO_2 emissions or CO_2 removals column, as appropriate. Please note that for the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

[6] Note that CO_2 from Waste Disposal and Incineration source categories should only be included if it stems from non-biogenic or inorganic waste streams.

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)

(Sheet 3 of 3)

Bulgaria
2003
2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs		PFCs		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)				(Gg)					
Memo Items: [7]														
International Bunkers	**920.82**		**0.05**	**0.01**							**11.17**	**3.71**	**0.79**	**0.96**
Aviation	485.03		0.01	0.00							1.94	0.80	0.12	0.16
Marine	435.78		0.03	0.01							9.23	2.91	0.67	0.80
Multilateral Operations	**NO**		**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	**3 410.54**													

[7] Memo Items are not included in the national totals.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS							Bulgaria
(Sheet 1 of 1)							2003
							2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**46 265.40**	**9 365.83**	**6 456.39**	**0.00**	**20.69**	**2.52**	**62 110.829**
1. Energy	**49 035.44**	**1 783.56**	**2 647.32**				**53 466.309**
A. Fuel Combustion (Sectoral Approach)	49 035.44	58.53	2 647.32				51 741.28
1. Energy Industries	28 329.87	9.45	2 439.59				30 778.9122
2. Manufacturing Industries and Construction	11 402.14	5.02	102.51				11 509.6755
3. Transport	7 097.83	26.07	41.16				7 165.0656
4. Other Sectors	2 205.59	8.64	64.06				2 278.285
5. Other	0.00	9.34	0.00				9.3436
B. Fugitive Emissions from Fuels	0.00	1 725.03	0.00				1 725.0267
1. Solid Fuels	0.00	1 208.32	0.00				1 208.3243
2. Oil and Natural Gas	0.00	516.70	0.00				516.7024
2. Industrial Processes	**4 285.94**	**58.54**	**1 159.38**	**0.00**	**20.69**	**2.52**	**5 527.071**
A. Mineral Products	2 279.10	0.00	0.00				2 279.1009
B. Chemical Industry	345.10	5.73	1 159.38	0.00	0.00	0.00	1 510.2163
C. Metal Production	1 661.74	52.81	0.00		20.69	0.00	1 735.2372
D. Other Production	NO						0.00
E. Production of Halocarbons and SF_6				0.00	0.00	0.00	0.00
F. Consumption of Halocarbons and SF_6				0.00	0.00	2.52	2.52
G. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Solvent and Other Product Use	**0.00**		**0.00**				**0.00**
4. Agriculture	**0.00**	**2 079.11**	**2 499.45**				**4 578.560**
A. Enteric Fermentation		1 502.33					1 502.331
B. Manure Management		511.93	394.56				906.495
C. Rice Cultivation		47.73					47.733
D. Agricultural Soils [2]	NO	0.00	2 099.54				2 099.544
E. Prescribed Burning of Savannas		0.00	0.00				0.000
F. Field Burning of Agricultural Residues		17.11	5.34				22.4574
G. Other		0.00	0.00				0.000
5. Land-Use Change and Forestry [1]	**-7 055.98**	**0.00**	**0.00**				**-7 055.98**
6. Waste	**0.00**	**5 444.63**	**150.24**				**5 594.869**
A. Solid Waste Disposal on Land	0.00	4 216.55					4 216.548
B. Wastewater Handling		1 228.08	150.24				1 378.321
C. Waste Incineration	0.00	0.00	0.00				0.00
D. Other	0.00	0.00	0.00				0.00
7. Other *(please specify)*	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
	NO	NO	NO	NO	NO	NO	0.00
Memo Items:							
International Bunkers	**920.82**	**0.95**	**3.39**				**925.15**
Aviation	485.03	0.29	0.00				485.32
Marine	435.78	0.66	3.39				439.83
Multilateral Operations	**NO**	**0.00**	**0.00**				**0.00**
CO_2 Emissions from Biomass	**3 410.54**						**3 410.54**

[1] For CO_2 emissions from Land-Use Change and Forestry the net emissions are to be reported. Please note that for the purposes of reporting, the signs
for uptake are always (-) and for emissions (+).
[2] See footnote 4 to Summary 1.A of this common reporting format.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	Net CO_2 emissions / removals	CH_4	N_2O	Total emissions
Land-Use Change and Forestry	CO_2 equivalent (Gg)					
A. Changes in Forest and Other Woody Biomass Stocks	6 502.07	-13 558.05	-7 055.98			-7 055.98
B. Forest and Grassland Conversion	0.00		0.00	0.00	0.00	0.00
C. Abandonment of Managed Lands	0.00	0.00	0.00			0.00
D. CO_2 Emissions and Removals from Soil	0.00	0.00	0.00			0.00
E. Other	0.00	0.00	0.00	0.00	0.00	0.00
Total CO_2 Equivalent Emissions from Land-Use Change and Forestry	6 502.07	-13 558.05	-7 055.98	0.00	0.00	-7 055.98

Total CO_2 Equivalent Emissions without Land-Use Change and Forestry [a]	69 166.809
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry [a]	62 110.83

[a] The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report emissions and removals from Land-Use Change and Forestry. Note that these totals will differ from the totals reported in Table 10s5 if Parties report non-CO2 emissions from LUCF.

TABLE 10 EMISSIONS TRENDS (CO_2)
(Sheet 1 of 5)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	(Gg)														
1. Energy	**90 725.67**	**78 672.85**	**63 356.62**	**57 197.49**	**59 681.67**	**56 658.23**	**59 375.81**	**57 954.77**	**56 733.02**	**50 812.88**	**46 746.32**	**45 861.46**	**47 475.34**	**45 054.34**	**49 035.44**
A. Fuel Combustion (Sectoral Approach)	90 725.67	78 672.85	63 356.62	57 197.49	59 681.67	56 658.23	59 375.81	57 954.77	56 733.02	50 812.88	46 746.32	45 861.46	47 475.34	45 054.34	49 035.44
1. Energy Industries	43216.90	39601.23	37106.22	33862.39	34091.59	30944.73	31571.95	30651.62	30936.08	27078.25	25760.34	26215.75	29035.91	26465.57	28329.87
2. Manufacturing Industries and Construction	24754.56	21821.39	14757.67	12093.40	13296.03	15032.19	18023.19	17498.72	17691.26	14221.44	12283.00	11868.18	10788.11	10198.06	11402.14
3. Transport	13813.97	10863.71	6524.57	6435.38	7443.93	6546.95	6844.63	6305.61	5315.21	6475.23	6211.56	5881.45	6013.52	6316.61	7097.83
4. Other Sectors	8940.25	5380.59	4086.25	4610.45	4117.02	3324.75	2621.01	3237.68	2678.29	2988.84	2491.43	1896.08	1637.81	2074.11	2205.59
5. Other	0.00	1005.93	881.89	195.86	733.11	809.61	315.02	261.14	112.18	49.12	0.00	0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1. Solid Fuels	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2. Oil and Natural Gas	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2. Industrial Processes	**7 845.94**	**6 865.67**	**4 598.92**	**3 907.88**	**3 935.89**	**4 619.97**	**5 354.78**	**5 201.65**	**4 842.62**	**3 489.67**	**3 783.61**	**4 041.33**	**3 996.97**	**3 703.71**	**4 285.94**
A. Mineral Products	4 114.32	3 797.38	2 198.62	1 768.55	1 500.71	1 597.62	1 960.14	2 037.44	1 704.85	1 138.20	1 734.43	1 988.09	2 068.30	2 051.84	2 279.10
B. Chemical Industry	1 246.45	1 224.51	1 003.80	823.12	793.00	888.36	1 071.58	1 062.93	878.27	474.39	338.39	569.90	506.70	325.40	345.10
C. Metal Production	2 485.18	1 843.78	1 396.50	1 316.21	1 642.18	2 133.99	2 323.06	2 101.29	2 259.51	1 877.08	1 710.79	1 483.34	1 421.97	1 326.47	1 661.74
D. Other Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Production of Halocarbons and SF_6															
F. Consumption of Halocarbons and SF_6															
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
4. Agriculture	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
A. Enteric Fermentation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Manure Management	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C. Rice Cultivation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Agricultural Soils [2]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F. Field Burning of Agricultural Residues	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry [3]	**-5 132.63**	**-6 156.99**	**-7 635.70**	**-7 412.03**	**-7 475.77**	**-7 301.67**	**-7 524.48**	**-6 517.45**	**-6 871.54**	**-6 860.50**	**-7 199.77**	**-8 976.23**	**-9 467.15**	**-8 318.06**	**-7 055.98**
A. Changes in Forest and Other Woody Biomass Stocks	-5 132.63	-6 156.99	-7 635.70	-7 412.03	-7 475.77	-7 301.67	-7 524.48	-6 517.45	-6 871.54	-6 860.50	-7 199.77	-8 976.23	-9 467.15	-8 318.06	-7 055.98
B. Forest and Grassland Conversion	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
C. Abandonment of Managed Lands	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
D. CO_2 Emissions and Removals from Soil	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Waste	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
A. Solid Waste Disposal on Land	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
B. Waste-water Handling	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C. Waste Incineration	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
7. Other *(please specify)*	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total Emissions/Removals with LUCF [4]	**93 438.98**	**79 381.53**	**60 319.84**	**53 693.34**	**56 141.80**	**53 976.53**	**57 206.11**	**56 638.97**	**54 704.11**	**47 442.06**	**43 330.16**	**40 926.56**	**42 005.17**	**40 439.99**	**46 265.40**
Total Emissions without LUCF [4]	**98 571.61**	**85 538.52**	**67 955.54**	**61 105.37**	**63 617.56**	**61 278.21**	**64 730.59**	**63 156.43**	**61 575.65**	**54 302.55**	**50 529.93**	**49 902.79**	**51 472.32**	**48 758.05**	**53 321.38**
Memo Items:															
International Bunkers	**1 718.36**	**1 766.14**	**1 198.34**	**1 438.15**	**1 582.72**	**1 482.87**	**1 431.78**	**1 203.60**	**1 519.50**	**1 512.41**	**344.76**	**475.16**	**699.16**	**735.38**	**920.82**
Aviation	749.41	892.27	320.22	565.07	738.75	632.43	549.40	472.02	427.55	490.42	319.22	269.84	393.30	399.14	485.03
Marine	968.95	873.88	878.12	873.09	843.97	850.44	882.37	731.58	1 091.95	1 021.99	25.53	205.31	305.85	336.24	435.78
Multilateral Operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	**1 468.56**	**1 311.71**	**1 306.93**	**1 288.44**	**1 168.19**	**1 287.58**	**1 560.14**	**1 609.51**	**1 680.95**	**2 402.19**	**2 412.84**	**2 955.11**	**2 876.11**	**3 389.72**	**3 410.54**

(1) Fill in the base year adopted by the Party under the Convention, if different from 1990.
(2) See footnote 4 to Summary 1.A of this common reporting format.
(3) Take the net emissions as reported in Summary 1.A of this common reporting format. Please note that for the purposes of reporting, the signs for uptake are always (-) and for emissions (+).
(4) The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report CO_2 emissions and removals from Land-Use Change and Forestry.

TABLE 10 EMISSIONS TRENDS (CH_4)

(Sheet 2 of 5)

Bulgaria 2003 2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	(Gg)														
Total Emissions	**1 186.88**	**1 018.70**	**894.13**	**831.40**	**748.21**	**694.87**	**678.09**	**626.92**	**538.24**	**497.50**	**423.94**	**430.38**	**396.18**	**403.89**	**445.99**
1. Energy	**161.04**	**110.19**	**95.96**	**98.89**	**99.30**	**97.17**	**103.87**	**102.07**	**91.23**	**91.98**	**80.37**	**88.51**	**86.61**	**85.20**	**84.93**
A. Fuel Combustion (Sectoral Approach)	5.30	4.99	3.25	3.30	3.42	3.37	3.60	3.29	2.82	2.93	3.00	2.83	2.62	2.80	2.79
1. Energy Industries	0.84	0.91	0.74	0.66	0.59	0.53	0.56	0.52	0.52	0.44	0.43	0.43	0.47	0.43	0.45
2. Manufacturing Industries and Construction	0.57	0.35	0.31	0.25	0.27	0.28	0.34	0.32	0.30	0.30	0.28	0.23	0.22	0.21	0.24
3. Transport	2.98	2.91	1.41	1.70	1.93	1.88	2.02	1.75	1.27	1.40	1.46	1.30	1.12	1.21	1.24
4. Other Sectors	0.32	0.21	0.11	0.11	0.07	0.09	0.10	0.12	0.12	0.25	0.29	0.38	0.33	0.39	0.41
5. Other	0.59	0.60	0.67	0.57	0.56	0.59	0.57	0.58	0.61	0.54	0.55	0.50	0.48	0.55	0.44
B. Fugitive Emissions from Fuels	155.74	105.20	92.71	95.59	95.88	93.80	100.27	98.78	88.41	89.04	77.36	85.68	83.99	82.40	82.14
1. Solid Fuels	94.84	75.80	65.12	71.53	71.42	66.74	69.21	67.33	60.69	63.73	56.01	57.09	57.70	58.50	57.54
2. Oil and Natural Gas	60.90	29.40	27.58	24.07	24.46	27.06	31.05	31.45	27.72	25.32	21.35	28.58	26.29	23.91	24.60
2. Industrial Processes	**3.89**	**3.02**	**2.21**	**2.09**	**2.45**	**3.21**	**3.52**	**3.27**	**3.51**	**3.01**	**2.77**	**3.51**	**2.42**	**2.19**	**2.79**
A. Mineral Products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Chemical Industry	0.04	0.02	0.01	0.01	0.03	0.03	0.04	0.02	0.02	0.21	0.46	0.15	0.14	0.13	0.27
C. Metal Production	3.49	2.76	2.05	1.94	2.25	3.00	3.29	3.04	3.29	2.62	2.23	3.37	2.28	2.06	2.51
D. Other Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E. Production of Halocarbons and SF_6															
F. Consumption of Halocarbons and SF_6															
G. Other	0.36	0.25	0.14	0.14	0.17	0.18	0.20	0.20	0.20	0.18	0.07	NO	NO	NO	0.00
3. Solvent and Other Product Use	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
4. Agriculture	**273.01**	**257.91**	**234.20**	**191.86**	**150.54**	**126.44**	**121.66**	**115.75**	**110.14**	**114.09**	**115.00**	**108.83**	**84.24**	**94.85**	**99.01**
A. Enteric Fermentation	192.79	180.17	165.99	137.48	107.19	90.13	85.27	82.38	79.48	81.77	82.95	79.28	62.20	68.97	71.54
B. Manure Management	72.55	71.49	62.81	51.10	40.90	34.72	34.52	31.60	27.93	29.64	30.30	27.08	19.30	22.42	24.38
C. Rice Cultivation	5.68	4.26	3.30	1.82	1.26	0.33	0.56	1.05	1.53	1.61	0.57	1.44	1.57	2.11	2.27
D. Agricultural Soils	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	1.99	1.98	2.09	1.46	1.19	1.26	1.32	0.73	1.21	1.07	1.17	1.03	1.17	1.35	0.81
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Forest and Grassland Conversion	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
C. Abandonment of Managed Lands	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. CO_2 Emissions and Removals from Soil	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Waste	**748.95**	**647.58**	**561.76**	**538.55**	**495.93**	**468.04**	**449.04**	**405.83**	**333.37**	**288.42**	**225.81**	**229.52**	**222.91**	**221.65**	**259.27**
A. Solid Waste Disposal on Land	661.09	581.07	510.09	491.30	455.81	430.76	399.69	358.97	293.58	254.09	195.71	201.25	199.98	199.86	200.79
B. Waste-water Handling	87.85	66.52	51.67	47.25	40.12	37.28	49.34	46.86	39.79	34.33	30.11	28.27	22.93	21.79	58.48
C. Waste Incineration	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
7. Other *(please specify)*	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items:															
International Bunkers	**0.06**	**0.06**	**0.03**	**0.03**	**0.04**	**0.03**	**0.03**	**0.03**	**0.03**	**0.03**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**
Aviation	0.02	0.04	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01
Marine	0.04	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.00	0.01	0.02	0.02	0.03
Multilateral Operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass															

TABLE 10 EMISSIONS TRENDS (N_2O)
(Sheet 3 of 5)

Bulgaria
2003
2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	(Gg)														
Total Emissions	**47.76**	**41.75**	**32.82**	**28.06**	**25.70**	**25.84**	**26.61**	**25.99**	**25.13**	**20.93**	**20.49**	**21.69**	**21.38**	**20.241**	**20.83**
1. Energy	**13.46**	**11.79**	**10.19**	**9.78**	**9.68**	**9.38**	**9.76**	**9.60**	**9.75**	**8.59**	**7.95**	**7.78**	**8.54**	**7.73**	**8.54**
A. Fuel Combustion (Sectoral Approach)	13.46	11.79	10.19	9.78	9.68	9.38	9.76	9.60	9.75	8.59	7.95	7.78	8.54	7.73	8.54
1. Energy Industries	11.40	9.56	8.86	8.77	8.62	8.28	8.56	8.42	8.47	7.72	6.99	7.25	8.00	7.19	7.87
2. Manufacturing Industries and Construction	0.92	1.69	0.92	0.70	0.72	0.74	0.92	0.93	1.11	0.58	0.58	0.20	0.18	0.21	0.33
3. Transport	0.33	0.25	0.15	0.14	0.17	0.14	0.14	0.13	0.12	0.13	0.12	0.11	0.11	0.11	0.13
4. Other Sectors	0.81	0.22	0.18	0.11	0.09	0.18	0.09	0.06	0.04	0.17	0.26	0.21	0.25	0.22	0.21
5. Other	0.00	0.06	0.08	0.06	0.09	0.03	0.05	0.05	0.02	0.00	0.00	0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1. Solid Fuels	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2. Oil and Natural Gas	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2. Industrial Processes	**7.81**	**7.28**	**5.25**	**4.27**	**3.65**	**4.32**	**6.20**	**6.33**	**5.21**	**3.12**	**2.36**	**4.24**	**4.18**	**3.51**	**3.74**
A. Mineral Products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Chemical Industry	7.81	7.28	5.25	4.27	3.65	4.32	6.20	6.33	5.21	3.12	2.36	4.24	4.18	3.51	3.74
C. Metal Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Other Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E. Production of Halocarbons and SF_6	0.00														0.00
F. Consumption of Halocarbons and SF_6	0.00														0.00
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
4. Agriculture	**25.48**	**21.97**	**16.74**	**13.36**	**11.75**	**11.55**	**10.07**	**9.52**	**9.70**	**8.68**	**9.63**	**9.16**	**8.18**	**8.54**	**8.06**
A. Enteric Fermentation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Manure Management	3.41	3.32	2.97	2.45	1.96	1.64	1.60	1.49	1.36	1.46	1.51	1.38	1.03	1.19	1.27
C. Rice Cultivation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Agricultural Soils	22.03	18.60	13.72	10.88	9.77	9.88	8.45	8.02	8.31	7.21	8.10	7.76	7.13	7.33	6.77
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	0.04	0.04	0.05	0.03	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Forest and Grassland Conversion	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
C. Abandonment of Managed Lands	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. CO_2 Emissions and Removals from Soil	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Waste	**1.00**	**0.72**	**0.65**	**0.65**	**0.62**	**0.59**	**0.57**	**0.54**	**0.47**	**0.53**	**0.54**	**0.51**	**0.47**	**0.45**	**0.48**
A. Solid Waste Disposal on Land	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Waste-water Handling	1.00	0.72	0.65	0.65	0.62	0.59	0.57	0.54	0.47	0.53	0.54	0.51	0.47	0.45	0.48
C. Waste Incineration	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
7. Other *(please specify)*	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items:															
International Bunkers	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.03**	**0.03**	**0.00**	**0.01**	**0.01**	**0.01**	**0.01**
Aviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.00	NO	NO	NO	0.00
Marine	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.00	0.01	0.01	0.01	0.01
Multilateral Operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass															

TABLE 10 EMISSION TRENDS (HFCs, PFCs and SF_6) | Bulgaria
(Sheet 4 of 5) | 2003
2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
								(Gg)							
Emissions of HFCs[5] - CO_2 equivalent (Gg)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.95**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
HFC-23	NE	NE	NE	NE	NE	NE		NE	NE	NE	NE	NE	NE	NE	NE
HFC-32	NE	NE	NE	NE	NE	NE		NE	NE	NE	NE	NE	NE	NE	NE
HFC-41	NE	NE	NE	NE	NE	NE		NE	NE	NE	NE	NE	NE	NE	NE
HFC-43-10mee	NE	NE	NE	NE	NE	NE		NE	NE	NE	NE	NE	NE	NE	NE
HFC-125	NE	NE	NE	NE	NE	NE	0.000	NE	NE	NE	NE	NE	NE	NE	NE
HFC-134	NE	NE	NE	NE	NE	NE		NE	NE	NE	NE	NE	NE	NE	NE
HFC-134a	NE	NE	NE	NE	NE	NE	0.002	NE	NE	NE	NE	NE	NE	NE	NE
HFC-152a	NE	NE	NE	NE	NE	NE		NE	NE	NE	NE	NE	NE	NE	NE
HFC-143	NE	NE	NE	NE	NE	NE		NE	NE	NE	NE	NE	NE	NE	NE
HFC-143a	NE	NE	NE	NE	NE	NE	0.000	NE	NE	NE	NE	NE	NE	NE	NE
HFC-227ea	NE	NE	NE	NE	NE	NE		NE	NE	NE	NE	NE	NE	NE	NE
HFC-236fa	NE	NE	NE	NE	NE	NE		NE	NE	NE	NE	NE	NE	NE	NE
HFC-245ca	NE	NE	NE	NE	NE	NE		NE	NE	NE	NE	NE	NE	NE	NE
Emissions of PFCs[5] - CO_2 equivalent (Gg)	**75.55**	**47.31**	**21.32**	**27.92**	**19.03**	**45.83**	**46.94**	**45.88**	**37.26**	**69.44**	**43.55**	**33.14**	**16.29**	**21.42**	**20.69**
CF_4	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
C_2F_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C_3F_8															
C_4F_{10}															
$c\text{-}C_4F_8$															
C_5F_{12}															
C_6F_{14}															
Emissions of SF_6[5] - CO_2 equivalent (Gg)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.26**	**1.31**	**1.75**	**1.83**	**1.88**	**2.23**	**2.29**	**2.51**	**2.52**
SF_6							0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Chemical	GWP
HFCs	
HFC-23	11700
HFC-32	650
HFC-41	150
HFC-43-10mee	1300
HFC-125	2800
HFC-134	1000
HFC-134a	1300
HFC-152a	140
HFC-143	300
HFC-143a	3800
HFC-227ea	2900
HFC-236fa	6300
HFC-245ca	560
PFCs	
CF_4	6500
C_2F_6	9200
C_3F_8	7000
C_4F_{10}	7000
$c\text{-}C_4F_8$	8700
C_5F_{12}	7500
C_6F_{14}	7400
SF_6	23900

[5] Enter information on the actual emissions. Where estimates are only available for the potential emissions, specify this in a comment to the corresponding cell. Only in this row the emissions are expressed as CO_2 equivalent emissions in order to facilitate data flow among spreadsheets.

TABLE 10 EMISSION TRENDS (SUMMARY)

(Sheet 5 of 5)

Bulgaria
2003
2005

GREENHOUSE GAS EMISSIONS	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	CO₂ equivalent (Gg)														
Net CO_2 emissions/removals	93 438.98	79 381.53	60 319.84	53 693.34	56 141.80	53 976.53	57 206.11	56 898.24	54 673.62	47 442.06	43 330.16	40 926.56	42 005.17	40 439.99	46 265.40
CO_2 emissions (without LUCF) [6]	98 571.61	85 538.52	67 955.54	61 105.37	63 617.56	61 278.21	64 730.59	63 415.69	61 545.16	54 302.55	50 529.93	49 902.79	51 472.32	48 758.05	53 321.38
CH_4	24 924.58	21 392.68	18 776.69	17 459.30	15 712.44	14 592.28	14 239.87	13 164.37	11 302.87	10 447.51	8 902.83	9 037.99	8 319.86	8 481.79	9 365.83
N_2O	14 805.01	12 942.96	10 175.61	8 697.98	7 968.44	8 010.36	8 247.63	8 058.23	7 789.52	6 488.61	6 352.06	6 722.67	6 626.36	6 274.80	6 456.39
HFCs	0.00	0.00	0.00	0.00	0.00	0.00	2.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PFCs	75.55	47.31	21.32	27.92	19.03	45.83	46.94	45.88	37.26	69.44	43.55	33.14	16.29	21.42	20.69
SF_6	0.00	0.00	0.00	0.00	0.00	0.00	1.26	1.31	1.75	1.83	1.88	2.23	2.29	2.51	2.52
Total (with net CO_2 emissions/removals)	**133 244.13**	**113 764.48**	**89 293.45**	**79 878.53**	**79 841.71**	**76 625.01**	**79 744.76**	**78 168.03**	**73 805.03**	**64 449.46**	**58 630.48**	**56 722.59**	**56 969.97**	**55 220.51**	**62 110.83**
Total (without CO_2 from LUCF) [6][8]	**138 376.76**	**119 921.47**	**96 929.15**	**87 290.56**	**87 317.47**	**83 926.68**	**87 269.24**	**84 685.48**	**80 676.57**	**71 309.95**	**65 830.25**	**65 698.82**	**66 437.12**	**63 538.57**	**69 166.810**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	CO₂ equivalent (Gg)														
1. Energy	98 281.50	84 641.35	68 529.78	62 305.38	64 768.89	61 607.83	64 583.63	63 334.55	61 641.98	55 408.84	50 899.09	50 131.17	51 942.66	49 241.31	53 466.31
2. Industrial Processes	10 424.87	9 231.93	6 292.75	5 303.43	5 138.96	6 071.30	7 400.94	7 279.75	6 569.78	4 592.75	4 619.67	5 464.93	5 361.62	4 862.54	5 527.071
3. Solvent and Other Product Use	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4. Agriculture	13 631.97	12 225.29	10 107.98	8 170.92	6 802.89	6 236.11	5 678.09	5 382.05	5 319.01	5 087.65	5 400.50	5 124.61	4 305.50	4 640.26	4 578.561
5. Land-Use Change and Forestry [7]	-5 132.63	-6 156.99	-7 635.70	-7 412.03	-7 475.77	-7 301.67	-7 524.48	-6 517.45	-6 871.54	-6 860.50	-7 199.77	-8 976.23	-9 467.15	-8 318.06	-7 055.98
6. Waste	16 038.41	13 822.90	11 998.64	11 510.83	10 606.74	10 011.44	9 606.59	8 689.14	7 145.80	6 220.72	4 910.98	4 978.11	4 827.34	4 794.46	5 594.87
7. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[6] The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report CO_2 emissions and removals from Land-Use Change and Forestry.

[7] Net emissions.

[8] The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report emissions and removals from Land-Use Change and Forestry. Note that these totals will differ from the totals reported in Table Summary2 if Parties report non-CO2 emissions from LUCF.

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REPUBLIC OF BULGARIA

FOURTH NATIONAL COMMUNICATION ON CLIMATE CHANGE

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