REPUBLIC OF BULGARIA

THIRD NATIONAL COMMUNICATION ON CLIMATE CHANGE

UNITED NATIONS
FRAMEWORK CONVENTION
ON CLIMATE CHANGE

SOFIA , 2002

First printing: 2002
Total print: 600.

Printed in Bulgaria

ISBN 954-90820-6-7

TABLE OF CONTENTS

3 EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

S.1. INTRODUCTION

Bulgaria signed the United Nations Framework Convention on Climate Change (UNFCCC) in Rio de Janeiro in June 1992, and the Parliament ratified it in March 1995. The country adopted as a base year for the implementation of the Convention 1988 instead of 1990.

Demonstrating strong commitment to the international efforts to revert the Global Climate Change, and in harmony with the European Union environmental policy targets, Bulgarian Government signed Kyoto Protocol to the Convention on 18 September 1998 (ratified by the Bulgarian Parliament on 17 July 2002). According to Annex B of the Protocol, the quantified emissions reduction the country has to achieve during first commitment period (2008-2012) is 8% of the base year 1988 emissions.

S.2. NATIONAL CIRCUMSTANCES

Bulgaria (capital – Sofia) is a middle-size country with surface area of 110 993.6 km^2. The geographic profile of Bulgaria determines its climate as belonging to the mild continental zone with regular rotation of four seasons. In the eastern and southern parts of the country the climate demonstrates Mediterranean features influenced by the impact of large water basins. The diversity of terrain altitudes affects the temperature and precipitation patterns and provokes further weather variability.

The population of Bulgaria during the last several years is constantly decreasing. The social and economic hardships in the country during the transition period caused a negative development of the natural growth rate since 1988. The National Statistical Institute (NSI) and Eurostat predict a further decrease of the population. The census that took place in 2001 indicated that the decrease in population has reached 7.974 million people (8.981 million in 1988).

Bulgaria is a parliamentary republic and conforms to the Constitution of the Republic passed by the Grand National Assembly in July 1991. All international treaties, which are ratified pursuant to the constitutional procedure, are considered part of the domestic legislation.

The **economic reform** in Bulgaria began in 1991 with the signing of Bulgaria's first program with the International Monetary Fund (IMF). Within the first four years, the cornerstones of legal and institutional framework of the market economy were put in place. However, after a period of growth in 1994 and 1995, the GDP dropped in 1996 and 1997. In the first quarter of 1997, a new agreement with the IMF was reached, which marked the introduction of a currency board (July 1997), and a set of austere and radical new measures for reform. A few major events mark the **1998-2000** period. After the introduction of the currency board, macroeconomic stabilization was registered, growth was resumed, and inflation was curbed to single digit levels. The economy started to recover in 1998 as the year was marked by events with favorable impact on market reforms, e.g. the three-year IMF agreement and the accession to Central European Free Trade Agreement (CEFTA). In 1998 practically almost all prices were liberalized, as only the household electricity consumption, district heating, post and telephone services remained at their fixed levels. Bulgaria achieved financial stabilization, 3.5% real GDP growth and 1% end-year inflation.

A broad international acknowledgement of the political and economic changes in Bulgaria was the invitation to start EU accession negotiations in December 1999, and their initiation in March 2000. The Government has set up an ambitious agenda to complete them by the beginning of 2007.

A new governmental program **People Are the Wealth of Bulgaria** was adopted in 2001 by the new Government of the country with Prime Minister Simeon Saxe-Coburg Gotha. The overall priority of the program is the stable macroeconomic framework for sustainable development and actual growth of the economy. Planned annual growth rates for the 2002-2005 period are 5-7% as a ground for the sustainable development and higher living standard for the population. The main components of the reform program continue to be privatisation of the remaining state-owned enterprises, liberalisation of agricultural and energy sectors, development of the health insurance system, the pension system reform, and increasing the public sector capacity. According to preliminary review, the real GDP growth for 2001 is 4%, while the inflation for the same year is 4.8%.

Bulgaria has historically followed a very **energy intensive development policy**. At the same time its energy resources are very limited, consisting primarily of a single large deposit of low grade, high sulphur lignite. The country is extremely dependent on the energy imports that account for more than 70% of its primary energy resources. Its GDP is highly energy intensive, with energy use per unit of output estimated to be up to two times higher than comparable market economies. The sector is undergoing substantial restructuring.

The **industrial policy** of the country is focused towards the achievement of a stable economic growth, acceleration of the privatisation and the restructuring processes, industrial development, competitiveness of the enterprises and establishment of an environment that stimulates the development of small and medium size enterprises. In economic aspect, there is a steady shift from manufacturing production to services.

The country has a relatively well-developed **transportation network**, for both domestic and international passenger and cargo services. Total length of the road network is 37,288 km, and the railroad one is 4,300 km. Bulgaria has two major ports on Danube river, two major sea ports on the Black Sea coast, and 10 civil airports. Current efforts are focused on restructuring the network so it becomes able to meet the requirements of the European Union. Special emphasis is given to the privatization in the sector, and developing the infrastructure along the Trans-European transport corridors.

Bulgaria enjoys excellent natural conditions for the development of **agriculture**. Cultivated agricultural land occupies about 4.8 million hectares or 43% of the total territory of the country. The favorable climate, soil and national agricultural traditions have led to a relatively well developed plant growing and animal breeding. Among the main crops are tomatoes, pepper, tobacco, grapes, wheat, maize, beans, potato, sunflower, peaches, apricots, apples, melons, nuts, and others. The sheep, pig and cattle breeding, poultry farming, and bee-keeping are relatively well developed. In 1999 the Bulgarian economy employed 3,071,913 people in total, and the agriculture sector accounted for 25.88% of the above figure.

The **forest** resource area for 1996-2000 period has comparatively stable ranges of 3.88 to 3.91 mln ha. Forests cover from 86.6 to 86.8% of this area with a slight tendency for increase with 3.36-3.40 mln ha. This tendency is due to the reduced areas with cut-down and non-restored forests, and reduced actual uprooting. Coniferous forests decreased their tentative share over the 1996-2000 period from 34.8% to 32.8%. The trends in the forest type distribution are expected to be kept – this assumption has to do with the expected changes in the Bulgarian forests due to the climate change.

S.3. INVENTORY OF GHG EMISSIONS IN BULGARIA

The inventory included in the Third National Communication is based on the Revised 1996 IPCC Guidelines, and the IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories. Other estimation methods have been used whereas appropriate in order to achieve better estimates for particular cases, e.g. GHG emissions from transport sector.

The inventory starts with the year 1988, which is the base year for implementation of the UNFCCC in Bulgaria. It covers emissions of main GHG gases carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O); GHG precursors (NO_X, CO and NMVOCs); and sulphur dioxide (SO_2). The emissions of Hydrofluorocarbons (HFCs) and Perfluorocarbons (PFCs) were addressed in the studies that began with the base year in Bulgaria for these gases – 1995. This NC presents the emissions trends. These emissions were re-calculated in accordance with IPCC Revised Guidelines 1996 (Tables S.1 and S.2).

CO_2 emissions are estimated using both methods recommended in the IPCC Guidelines (the "top-down" (reference) approach and the "bottom-up" approach). The overall estimates of CO_2 emissions and sinks in Bulgaria in 1988 and in the period 1990-1999 divided by sectors are given in Table S.1.

The fossil fuels prevail in the structure of primary energy resources used in Bulgaria. As a consequence fossil fuel combustion is the major source of CO_2 in Bulgaria that accounts for about 90% of the total CO_2 emissions (Fig. S.1).

At the same time energy production and transformation activities are the most important sources among the energy-related CO_2 emitting activities with a share of about 65-70%.

Methane emissions: waste is the major anthropogenic source of methane emissions, and the major portion is emitted by landfills. The second important source is coal mining, and production and transportation of oil and natural gas. Livestock breeding in the agricultural sector is the third important methane source.

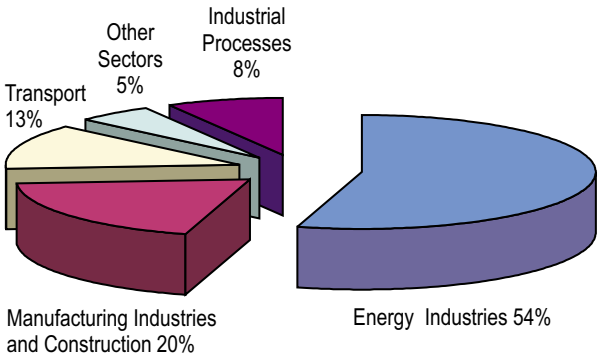

Fig. S.1. CO_2 emissions by sector in 1999

Three major sources of **N_2O emissions** are identified in Bulgaria: agricultural soil, fuel combustion, and Nitric acid production. Compared to the inventory included in the 1st and 2nd NCs, the share of the N_2O emissions has increased significantly. This is due to the adoption of the new methodology suggested in the revised 1996 IPCC Guidelines for estimation of N_2O emissions from agricultural soil. Fuel combustion and production of nitric acid are ranked next as sources of N_2O emissions.

New gases – in 2000, first attempt to estimate the emissions of the new gases was made. Consumption of new gases is generally estimated following the Tier 1a approach. Only for the year 1995 three approaches were implemented simultaneously: Tier 1a, Tier 1b and Tier 2. Bulgaria does not produce any of the new gases, thus the emissions sources constitute the secondary processing of raw aluminum and usage of other products that contain new gases.

The aggregated GHG emissions (Table S.2) are calculated with the GWP values from IPCC, 1996.

The trend in the overall GHG emissions is as follows: CO_2 is the main GHG in Bulgaria with a share of 57-67% of the total emissions. Methane that was the second main GHG at the beginning of the period gradually looses importance in comparison to the N_2O emissions, which keep comparatively stable level over the period. The increased share of N_2O in 1999 is due to the revision of the emission factor for N_2O from agricultural soils in compliance to the Good Practice Guidance. The contribution of the new gases in the overall emissions in Bulgaria is less than 1%.

S.4. POLICIES AND MEASURES

The underlying principles of the national climate change policy are predetermined by the strong will of Bulgaria to join the international efforts for addressing the climate change issue. The process should be carried out in such a manner that will not place insurmountable barrier to the national economy, and at the same time will assist with attracting foreign investments that should help with the implementation.

The nature of the GHG mitigation policies and measures in the country is set forth by the **National Climate Change Action Plan** (NCCAP) adopted by the Bulgarian Government (decision No. 393 / July 6, 2000). In addition to NCCAP objectives, there are other relevant policies that are consistent with the GHG mitigation targets. These include the National Strategy for the Environment, and the drafts of the National Energy Efficiency Program and the National Program on Renewables.

The institutional setup for implementation of the country's climate change policy is represented by the **Inter-ministerial Committee** established with NCCAP. It has to monitor the implementation of the plan; to assess the progress of the GHG emission reduction; to adjust the plan to the changing conditions in the country; to track violations; and to develop compensatory measures to accomplish the objectives. The overall implementation of the plan is controlled by the MOEW.

Approximation to the EU Acquis is perceived to be of help when addressing climate change issues too, since many measures would lead to reduction of GHG. The Environmental Acquis of EU contains both climate specific and other laws that are relevant to climate change. Bulgaria has to take many of these policies into consideration during the process of becoming a member of the EU. According to the

Table S.1. Total CO_2 emissions and sinks in Bulgaria by sector

Categories	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
National CO_2 emission (Gg)											
Energy	95,495	76,804	61,170	55,064	57,678	54,239	56,609	55,101	53,560	48,515	44,513
Stationary	82,856	65,940	54,646	48,629	50,234	47,692	49,764	48,795	48,245	42,040	38,301
Mobile	12,639	10,864	6,525	6,435	7,444	6,547	6,845	6,306	5,315	6,475	6,212
Industrial Processes	8,361	7,332	4,873	4,118	4,181	4,939	5,723	5,610	5,182	3,762	3,927
Net CO_2 sinks (Gg)											
LUCF	–4,657	–5,801	–7,880	–7,636	–7,022	–6,974	–7,520	–7,190	–5,852	–6,233	–6,608

Table S.2. Aggregated GHG emissions in CO_2 equivalent (LUCF excluded), [Gg]

Emissions	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
CO_2	103,856	84,136	66,043	59,183	61,859	59,178	62,332	60,710	58,742	52,277	48,440
CH_4	28,009	29,602	28,420	26,188	23,550	17,178	18,641	17,370	14,775	13,739	10,149
N_2O	25,225	23,964	21,217	18,339	16,675	16,230	17,110	16,640	16,295	14,698	18,961
HFC							1.76	NE	NE	577	103
PFC							46.92	NE	NE	69	44
Total	157,090	137,701	115,679	103,710	102,084	92,586	98,131	94,721	89,811	81,360	77,697
Rate (1988=100%)	0	–12.3	–26.4	–34.0	–35.0	–41.1	–37.5	–39.7	–42.8	–48.2	–50.5

Note: Actual emissions of PFC and potential emissions of HFC are included in the totals for 1995, 1998 and 1999. NE – not estimated.

National Program for introducing the European environmental law in Bulgaria (Regulation of Council of Ministers No. 657/October 9, 2000), a Clean Air Act –related regulation has to be completed until December 30, 2002. It has to define the competent institutions and procedures for gathering information on pollutants including GHG emission. Responsible institution is the MOEW. The approximation of EC Directives on energy will also have influence on GHG in the candidate countries like Bulgaria. New policies are being developed for liberalizing of the electricity and gas markets in accordance with the Directives on the liberalization of the electricity (96/92/EC) and gas (98/30/EC) markets.

The **National Strategy for the Environment** is closely related to a range of other program documents adopted by the government: the National Plan for Economic Development of Republic of Bulgaria 2000-2006, the drafts of the National Energy Efficiency Program and the National Program on Renewables, the National Plan for development of the Agriculture, the National Program for Adoption and Implementation of the Aquis (NPAA), and the Environment Sector of the National ISPA Strategy.

National Environmental Protection Fund and the **Municipal Environmental Protection Funds** (State Gazette No. 5/1993) continue to be the main funding sources for financing various environmental projects (including energy efficiency and climate change such).

The **National Waste Management Program** (NWMP) is developed on the base of the *Environmental Protection Act (EPA)* and Article 27 of the *Limitation of the Harmful Impact of the Waste upon Environment Act (LHIWEA)*. The Program aims at promoting an environmentally friendly waste management all over the country.

Energy

Since the main share of the GHG emissions in Bulgaria are the energy related CO_2 emissions, and this share is expected to increase further if the energy intensive production pattern is not replaced by energy-efficient options, energy is the main sector where mitigation measures are being attempted. These measures however could not be implemented unless crucial changes in the sector take place.

The ***Power Sector*** restructuring is the chief priority for the development of the sector. Two phases were envisaged in the 1999 National Energy Strategy for the transition period:

First Phase: Restructuring of the vertically integrated National Electrical Company (NEC). This stage is already implemented.

Second Phase is currently under way: the establishment of free power market, and privatization of the distribution and sale of electricity to the end users. The number of the end users that have the right to negotiate directly with a chosen producer will increase. Within the period of 2002-2005 there will be a process of establishing generation plants privatized through selling of shares to investors, including municipalities.

Certain policy and measures in the power sector are likely to lead to **increase of GHG emissions**. The policy for fuel diversification with optimal participation of the indigenous fuels is being implemented through increased mining and combustion of lignites from Maritza East minefields. In 1999 the mining amount was lower than 20 Mt, while in 1988 it was 28 Mt. The plans for the power sector including construction of two thermal units on lignites (2 x 335 MW) and rehabilitation of the other lignite units lead to demand for annual mining of over 38 Mt coal, which will lead to almost doubling of CO_2 emissions from lignite combustion in 2007 compared to 1999.

One of the requirements for accession of Bulgaria to EU is to phase out four nuclear units with total capacity of 1760 MW in NPP Kozloduy. In 2003 two of the units should be phased out (total 880 MW). This will lead to CO_2 emission increase

by 5.4 Mt in the years after 2002. EU requires that the other two nuclear units be phased out not later than 2007. This will bring about another 5.1 Mt CO_2 emission increase. The high emission increase with the phase out of nuclear units is due to the planned replacement of these units by TPP capacities burning low quality lignite.

The restructuring of the ***coal mining*** is part of the overall reform in the energy sector.

The structural reform in the ***gas supply system*** has to be in compliance with the requirements of the draft EU Directive for the general rules of the internal natural gas markets.

The ***district heating*** will continue to have significant share in the energy market. The introduction of new options for heating (gas supply to households, efficient individual heating installations, etc.) that require lower investments and are economically feasible will enhance the development of the district heating within the cities and in the regions where there is already some infrastructure in place.

In the district heating, the following measures have high GHG emission reduction potential:

- Modernization of the existing heating facilities with increased share of the combined heat and power generation that is planed for the period after 2005, but could be accelerated by the market development.
- Rehabilitation and modernization of the heat transmission networks and user stations that allow transmission losses reduction from about 20% to 10%. It is underway now and will be accelerated by funding from a special World Bank program.
- Installation of equipment and measurement devices for individual monitoring and control of the heat consumption is underway and has to be finalized by the end of 2002. It will influence the heat consumption starting with the 2001/2002 heating season.
- Structural and price reform that will allow for district-heating utilities to be competitive at the energy market. It was postponed due to the high natural gas prices during the 1999/2000.
- Reduction of the state subsidies.
- Adoption of the legislative framework for control and market-based development of the sector.

The price regulation for the energy sector (gas, heat, electricity) is a main function of the State Commission for Energy Regulation, established by the LEEE. In April 2000, the Council of Ministers adopted Ordinance for Setting and Applying Prices of Electricity, which will regulate the price setting for the trade companies in the power energy sector according to their activities – generation, transmission and distribution. These regulations are being experimentally applied for the period in which fixed prices hold (until December 31, 2001), after separating the independent power producers and power transmission companies from NEC. During this period, the State Commission for Energy Regulation is monitoring the application of the rules for the price setting and price implementation by NEC and the independent distribution and generation companies.

State Energy Efficiency Fund has not been established so far, which affected to a certain extent the possibility to reduce GHG emissions. Furthermore, the most energy intensive industrial enterprises had no funds for energy efficiency improvements, which made them non-competitive and eventually led to many shut-downs in the period 1998-2001. On the other hand, the privatization process has its influence on the energy intensity since the new owners tend to implement low cost energy efficient measures. As a result of these circumstances the GHG emissions were reduced by 14% in 2 years from the 1997 to 1999.

Transport

The key priority in the Governmental Program **People Are the Wealth of Bulgaria** in the field of transport is the development of the national transport infrastructure as an integral part of the Pan-European Transport Network. The existing transport infrastructure is to undergo restructuring and upgrading in order to fulfill the EU and NATO requirements. An essential precondition for building a modern infrastructure of the Bulgarian economy that meets international standards is to develop environment-friendly transportation systems and technologies, promote intermodal transportation and put into operation modern safety, telecommunications and information systems. Achieving these goals will influence the environmental and GHG emission related performance of the sector. The **National Plan for Economic Development for the years 2000-2006** emphasize on the priority to develop transport infrastructure along the route of Pan-European Transport Corridors Nos. IV, VIII and IX. The strategic objectives for the development of transport infrastructure in the medium term (2000-2006) include:

- Balanced and inter-related infrastructure development among individual modes of transport.

- Improving speeds and services along Corridor IV Sections.
- Completing track electrification of railway sections along the Pan-European Transport Corridors.
- Completing the reconstruction and modernization of major highway sections, included in the Pan-European Transport Corridors.
- Compliance of the transport strategy with environmental issues.

Industry

Industry uses about half of the total generated energy. A series of measures were developed as a part of the 1998 draft Energy Efficiency Program and the National Climate Change Action plan aiming at reduction of energy intensity of production, and mitigation of GHG emissions from industry. Those measures were developed for the following subsectors of the economy: ferrous metallurgy, nonferrous metallurgy, chemical production, light industry, food processing industry, machine building and metal works, electrical and electronic industry, construction, and building material industry.

Agriculture

Since the last National Communication, the Council of Ministers has accepted the **National Agriculture and Rural Development Plan for 2000-2006 (NARDP)**, and entrusted its implementation to the Minister of Agriculture and Forestry (MAF). The NARDP was prepared by the MAF in compliance with the main goal of the national economic development. The NARDP was prepared in close collaboration with representatives of regional and local authorities, farmers associations, regional development agencies and non-governmental organizations. The two main goals of the NARDP are:

- Improvement of the efficiency of agricultural production and promotion of a competitive food-processing sector by better market and technological infrastructure and strategic investment policies ultimately aimed at reaching EC standards.
- Sustainable rural development consistent with the best environmental practices by introducing alternative employment, diversification of economic activity and establishment of the necessary infrastructure. This in turn will improve the living conditions and standards of rural communities, generate fairer income and open up employment opportunities.

Forestry

The major groups of measures in the NCCAP related to the forestry are:

- Changed selection of the species for afforestation.
- Biodiversity conservation.
- Increasing of the forest biomass through felling.
- Lowland forest creation.
- Extension of afforested areas with introduced drought-resistant species.

The change in the selection of the species for afforestation is practically a tendency of more wide use of the deciduous species in the afforestation. Ordinance No. 17 on afforestation and inventory of forest crops (State Gazette 67/2000) defines the specific requirements for selection of species for afforestation. The complex assessment of natural circumstances, including climate, is among the main principles in planning and afforestation procedures.

Lowland forest creation: all kinds of affectations including lowland forest creation and afforestation in shelterbelts follow the regulations of the forest management projects. Afforestation of lands, inappropriate for agricultural activities is not well developed despite envisaged support for owners according to articles 58 and 61 (par. 4) of the Regulation for application of the Forestry Act.

The extension of afforested areas with introduced drought-resistant species such as *Cedrus atlantica* is under way. The annual afforestation with this species in the period 1996-2000 has covered about 230-400 ha or a total area of 1,222 ha afforested with *Cedrus atlantica* over the period.

Waste

The policies and measures in the waste management sector are defined in two main documents: the frame is given in the NCCAP, and the specific measures are provided in the National Waste Management Program (NWMP). The measures given there have a more general nature but most of them have a direct impact on GHG emission reduction too.

S.5. GHG EMISSIONS PROJECTIONS AND ASSESSMENT 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 2015). 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 2015 were developed, analyzed 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. In both household and services sectors there are no special measures envisaged to improve energy efficiency. This scenario was originally developed in 1994 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. In general, this scenario reflects on the assumption that the climate change would have been no concern for the country.

The "**with measures**" projection encompasses currently implemented and adopted policies and measures, and those measures that are related to the energy sector. It envisages a growth rate of electricity demand by 26% for the period 2000-2015. This scenario projects relevant measures in the energy sector, while the rest of the sectors rely on planned and adopted measures without implementation of in-depth programs. 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 early termination of the work of some units, and expansion of heat generation units in Sofia. This projection integrates the assumption for increase in annual electricity export from 4,200 up to 8,000 GWh for the period after 2005.

Table S.3. Total emissions from energy [Gg CO_2 eqv.]

Year	Without measures	With measures	With additional measures
1995	64,350	64,350	64,350
2000	76,653	49,753	49,753
2005	93,244	68,023	63,616
2010	105,649	79,944	73,437
2015	121,939	85,618	80,435
2020	137,601	91,278	84,089

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.

Energy

CO_2 EMISSIONS

The "**with measures**" scenario compared to the "**without measures**" scenarios indicates a tendency for emissions reduction for the period 1995-2015 that results in 22-30% lower emissions. The reduction is due to the restructuring of the industrial and power sectors. The scenario "**with additional measures**" covers the planned measures for development and commissioning of power units, increase of electricity export and use of renewables. Both the "**with additional measures**" and "**with measures**" scenarios use one and the same projection for final energy demand. As a result the final CO_2 emissions for the "**with additional measures**" scenario are 3.2-8% lower.

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 lignites and from transportation and distribution of natural gas. The emissions reduction in the period 1995-2015 is 30-41%. It is the greatest for the 1999-2008 period when a more intensive commissioning of lignite fired units was expected in the scenario "**without measures**". In the period 2009-2015 the reduction is stabilized to 33-34%.

N_2O EMISSIONS

The "**with measures**" scenario compared to the "**without measures**" scenario indicates a tendency for reduction in the range of 7-20%. Table S.3 pres-

ents the overall emissions from Energy expressed in Gg CO_2 equivalent. The aggregated changes between the "**with measures**" and "**without measures**" scenarios are within the range of 22-30%, with more explicit deviation after 2010. The comparison of the "**with measures**" and "**with additional measures**" scenarios also indicates a constant tendency for increased reduction in the second scenario from 3.9 to 8.2% for the period 2000-2015.

Industrial processes

The emission projections for CO_2, CH_4 and N_2O from industrial processes are provided. The emissions from industrial processes include mainly ferrous industry, chemistry, building materials, food and beverage industry.

CO_2 EMISSIONS

Non-energy emissions of CO_2 are mainly due to the mineral production, ferrous metallurgy and ammonia production. The comparison of the scenarios "**with measures**" and "**without measures**" indicates an emissions reduction by 12-20% if measures are implemented.

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 23-28% over the 2000-2008 period. In the period 2009-2015 the reduction is within the range of 25-32%, being the greatest in 2010 (–32%). 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 1995-1999. As a result, for the entire projected period 2000-2015 the reduction of the scenario "**without measures**" is comparatively stable in the range of 53-57%.

Agriculture

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. The comparison of the scenario "**with measures**" to the scenario "**without measures**" indicates a stable increased reduction of the emissions when measures are applied within the range of 25-43%. The projected emissions of N_2O have different characteristics compared to the CH_4 emissions. Expected reduction is twice lower (within the range of 6-15%)

Waste

Comparison of the scenario "**with measures**" against the "**without measures**" scenario shows a comparatively stable reduction of the projected CH_4 emissions from the sector within the range of 19-30%, which is mainly due to the applied measures and the policy for the solid waste management.

Total GHG Emissions Projection

The forecasted total emissions for the three scenarios reflect the described sectoral measures for abatement of emissions and GHG reduction. Comparison of the total emissions in the scenarios "**with measures**" and "**without measures**" indicates a steady reduction in the range of 22-29%. Combination of sectoral measures for mitigation of GHG emissions triggers relatively slight variations in the reduction during the period until 2010, i.e. 22-26%. At the end of the forecasted period this reduction raises up to 29%.

Aggregated GHG Emissions

Comparison of "**without measures**" and "**with measures**" scenarios shows an emissions reduction in the range of 19-25%, which takes place in the period 2005-2015. Comparison of "**with addition measures**" and "**with measures**" scenarios reveals certain tendency for emissions reduction in the period 2005-2015, but in the range 3-6% (see.Fig. S.2).

First Kyoto 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.

Analysis of the projected emissions in Bulgaria during the 1st commitment period 2008-2012 (Table S.4) shows that if there were no certain measures taken already for rapid restructuring and increase of the efficiency of the economy in Bulgaria, the country would not be able to fulfill its obligation. During the period, the emissions would have exceeded by 18% the Kyoto target. The measures already taken would 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 11 million tons of CO_2 equivalent on yearly basis. Should **additional measures** be implemented, the emission trading potential would reach about 20 million tons. However, the imple-

Table S.4. Overall GHG emissions over the First Kyoto Commitment Period, CO_2-eqv. [Gg]

Years	Scenarios		
	Without measures	With measures	With additional measures
2008	156,714	128,087	117,313
2009	162,431	130,697	120,552
2010	168,982	133,694	125,485
2011	178,168	135,982	128,030
2012	185,980	138,495	131,634
Audraf d (2008,2012)	170,455	133,391	124,603
Kyntn tarf dt (amnt al audraf d)		**144,523**	

mentation of these **additional measures** would depend on whether or not Bulgaria will comply with the requirement form the European Union for early termination of the operation of two units in the Kozloduy Nuclear Power Plant.

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. EXPECTED IMPACTS OF CLIMATE CHANGE, VULNERABILITY ASSESSMENT AND ADAPTATION MEASURES

Climate Change Scenarios

Long-term variations of air temperature in Bulgaria were investigated, and anomalies of mean annual air temperature in Bulgaria, relative to the current climatic conditions, were studied (Fig. S.3). Generally, there did not seem to be a significant change in mean annual air temperature in Bulgaria during the 20th century .

Annual precipitation in Bulgaria varied considerably from year to year during the study period. In some years, very low annual precipitation ushered in droughts of different intensities (Fig. S.4). Bulgaria experienced several drought episodes during the 20th century, most notably in the 1940s and 1980s, which were observed everywhere across the country. Generally, mean annual precipitation in Bulgaria showed an overall decrease for the period from 1901 to present.

The transient GCMs predicted that annual temperatures in Bulgaria are to rise between 0.7 (HadCM2) and 1.8°C (GFDL-R15) in the 2020s. However, the HadCM2 model simulated a slight decrease in air temperature for November in the 2020s. A warmer climate is also predicted for the 2050s and 2080s, with an annual temperature increase ranging from 1.6 (HadCM2) to 3.1°C (GFDL-R15) in the 2050s, and 2.9 (HadCM2 and CGCM1 models) to 4.1°C (ECHAM4) in the 2080s. Warming is projected to be higher during the summer in the 2080s.

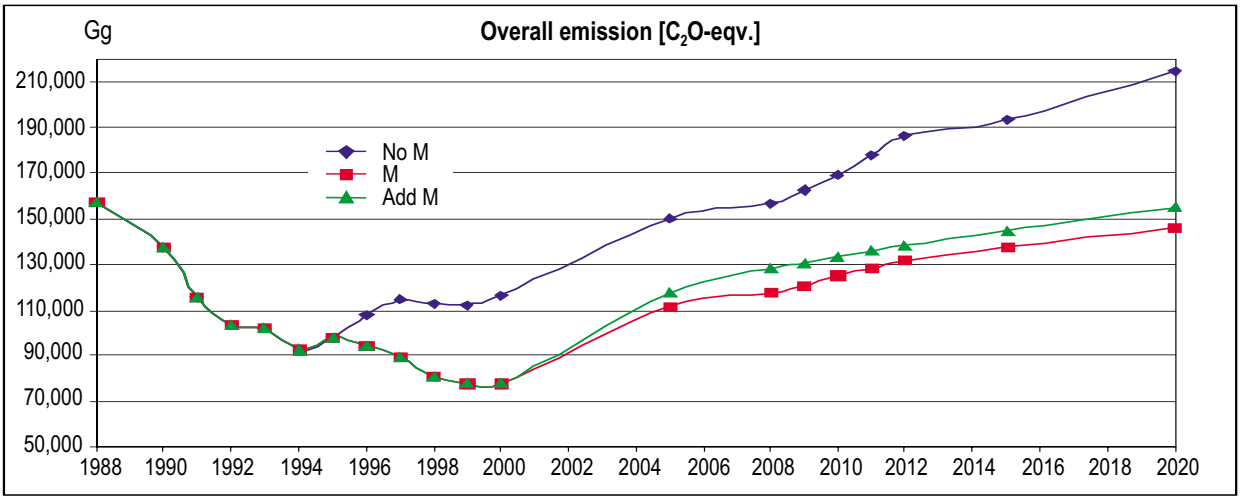

Fig. S.2. Aggregated GHG emissions, CO_2-eqv.

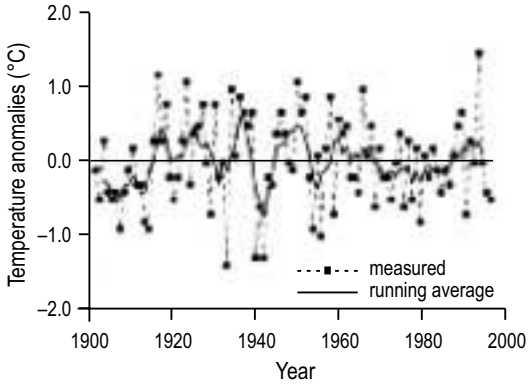

Fig. S.3. Anomalies of annual mean air temperature in Bulgaria, relative to the period 1961-90

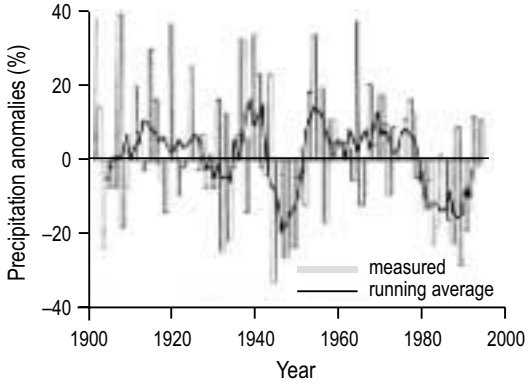

Fig. S.4. Anomalies of annual precipitation in Bulgaria, relative to the period 1961-90

The CGCM1 model predicted an increase in annual precipitation in the 2020s and 2050s. The GFDL-R15 model projected a decrease in precipitation in May, June and July in the 2020s and 2050s. The ECHAM4, HadCM2, and CSIRO-Mk2b models simulated a decrease in monthly, seasonal and annual precipitation in the 2080s. The changes in monthly solar radiation are expected to vary between −10 and +10% during the next century. An increase of solar radiation is expected during the cold-half of the year, based on the ECHAM4 model runs.

Vulnerability Assessment

Agriculture: The generic grain cereal model CERES v.3.5 (Ritchie et al., 1998), 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. All transient GCM climate change scenarios used in the CERES simulation model projected a shorter vegetative and reproductive growing season for maize and winter wheat during the 21st century. 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. Winter wheat showed a decrease in growing season duration for the 2020s, varying between 3 (HadCM2) and 14 days (GFDL-R15). 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. The decrease in simulated maize yield for the next century was primarily caused by shorter growing season duration and reductions in precipitation. 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. Projected yield reductions 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, all GCM climate change scenarios projected an increase in winter wheat yield.

Forestry: The 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 a hardly stable forest ecosystems due to the discrepancy between the ecological conditions (mainly rainfalls) and the requirements of the coniferous tree species. This resulted in forest disintegration in the last few years. In this sequence the vulnerability of the forest vegetation to the adverse dry climate increases. If the projections about the carbon dioxide doubling during the next century come true the ecological conditions in Bulgaria will drastically go worse. The forest vulnerability was evaluated following the GAP models that could evaluate the dynamics of a particular forest site in response to the climate change.

Adaptation

Agriculture: Warming will lead to an increased crop growing season and will move upper limits for agricultural production to 1000 m a.s.l. at suitable areas. This result will impose:

- New zoning of the agro-climatic resources and agricultural crops.
- New cultivars and hybrids to be adapted to climate change.
- Optimization of soil treatment.

- Measures for increase of the irrigation effectiveness.
- Adaptation phyto-sanitary measures.

Forestry: Due to previous study results, the first *National Strategy For Conservation Of The Forests And Development Of The Forestry* (1996), along with the basic priorities also addresses subjects such as:

- Helping the forests adaptation to the unfavorable climatic conditions.
- Preserving the biodiversity and genetic resources to ensure forest reproduction.
- The change in the selection of the species for afforestation is the most realistic method for adaptation of the forest ecosystems to future climate changes. At future warming and drought the participation of the deciduous tree species will grow.

Most of the measures related to forestry sector are in the application stage and results are forthcoming.

S.7. FINANCIAL RESOURCES AND TRANSFER OF TECHNOLOGY

Although Bulgaria is present in the UNFCCC Annex I list, being a country with economy in transition it does not have any obligations for provision of financial resources and transfer of technologies to developing countries. The country is rather a host for such financial and technical support mainly carried out within the frame of the Joint Implementation (J I) mechanism.

In Bulgaria, J I is an economically feasible way to reduce the GHG emissions and obtain economic, technical and expert support at the same time. Some steps were already undertaken to make the society aware of the J I mechanism's options and procedures to get financial support for GHG mitigation projects. In 1999 two studies investigating the potential for J I projects in Bulgaria were completed:

- Capacity for Climate Protection in Central and Eastern Europe – REC and WRI.
- Joint Iimplementation Capacity Building: Bulgaria – UNDP.

In addition, a pilot J I project took place in 2001 in the City of Pleven.

The Republic of Bulgaria and the Kingdom of the Netherlands have signed Memorandum of Understanding (MoU) on co-operation in reducing emissions of greenhouse gases under article 6 of the Kyoto Protocol. The co-operation under this memorandum aims at transfer of emission reduction units of an average of 3 Mt CO_2-equivalent per year during the commitment period 2008-2012. Decisions on the transfer are taken on a case-by-case basis by means of International Emission Reduction Unit Procurement Tender (ERUPT). According to the MoU a Joint Implementation Unit-Bulgaria was established on 1 July 2000. The Joint Implementation Unit (J I Unit) is an independent evaluating entity, initially hosted by the Energy Efficiency Agency (now hosted within the Ministry of Environment and Water), and under the direct supervision of the Ministry of Environment and Water. It is the "driving force" of the Join Implementation co-operation with the Netherlands and the contact point for Senter International – the Dutch agency that administers ERUPT. J I Unit is also the "knowledge" center on Joint Implementation in the country.

Memoranda of Understanding are expected to be signed with Austria and Switzerland in near future.

S.8. RESEARCH AND SYSTEMATIC OBSERVATION

There are numerous studies in Bulgaria directly or indirectly dealing with the climate change issue. The research work is focused in the Energy Institute and in the various institutes of the Bulgarian Academy of Sciences, such as Forestry Institute, Institute of Nuclear Research and Nuclear Energy, Institute of Economics, National Institute of Meteorology and Hydrology, as well as in some other research institutes as Agricultural Academy. The National Co-ordination Center on Global Change co-ordinates the activities of more than 20 institutions and organizations including BAS, the Environmental Executive Agency, the National Statistical Institute, the Energy Institute, Economic Analysis and Forecasts Agency, University of National and International Economy, Union of the Scientists, and Balkan Center for Architecture and Ecology, etc. Parts of the activities are within the frame of international projects.

As indicated in the National Climate Change Action Plan, research activities should continue and their results should be and supported for achieving better GHG mitigation results. BAS, and in particular NIMH, is initiator and one of the main organizations responsible for the research activities in the climate related field. The research work in place now refers to the following topics in the area:

Topic 1: Climate process and climate system studies, including paleo-climate studies.
Topic 2: Modeling and prediction, including general circulation models.
Topic 3: Research on the impacts of climate change.
Topic 4: Socio-economic analysis, including analysis of both the impacts of climate change and response options.
Topic 5: Research and development on mitigation and adaptation technologies.

Up to now, the activities under systematic observations 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.

S.9. EDUCATION AND PUBLIC AWARENESS

Climate change related activities in the country are generally coordinated by the MOEW. In the last year MOEW has undertaken a series of activities within a campaign on Climate Change, UNFCCC and Kyoto Protocol. The provision of information on Kyoto mechanism and the ways of companies to participate in the J I mechanism are among the priorities of the J I-unit.

Another institution closely involved in the educational activities related to climate change is the Ministry of Education and Science (MES). It deals with the climate change issue within the frame of environmental education and professional training. Regulation 2 on the school contents (from May 18, 2000, SG 48/2000) subdivided curriculum into 8 main fields, the fifth one being "Natural sciences and ecology". This field is covered in primary and secondary school. It is also addressed in the professional training and in the activities outside class and school area. In their everyday work teachers and students use various environmental materials approved by MES.

Important section in the public awareness activities is training and hands-on education. The LEEE (in force since July 1999) provides for activities on creation of regional energy efficiency centers. With the assistance of international programs such as PHARE, SAVE II and UNFCCC-UNECE, energy efficiency centers are created or are under construction in the municipalities of Haskovo, Lovetch, Plovdiv, Stara Zagora, Blagoevgrad, Pernik, Sofia, Rousse and Burgas. The Municipal Energy Efficiency Network operates within the frame of the project Strategy for GHG Mitigation through Energy Efficiency. The demonstration projects undertaken already have outputs and the results of energy efficiency improvements are communicated to the stakeholders.

Ministry of Economy also supports centers for promotion of energy efficiency in industry.

Besides the interest of the governmental and municipal authorities, climate change issue is also addressed by the NGOs. In 1998 the Academic Youth Ecological Club (AYEC) joined the Climate Action Network for Central and Eastern Europe (CANCEE) and started to monitor the official UNFCCC process. Nowadays, more NGOs are becoming interested in activities related to addressing the problem with the climate change on national level.

THIRD NATIONAL COMMUNICATION ON CLIMATE CHANGE

1. INTRODUCTION

The climate of our planet has been changing continuously but while in the past these changes had been natural, now the scientists believe that the industrial and agricultural emissions of carbon dioxide and other gases may cause irreversible change of global climate. The drastic increase of concentration of these gases known as "greenhouse gases" may lead not only to a substantial temperature rise but also to unfavorable climate pattern in the future.

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. The goal of the Convention could be achieved by implementing a global strategy to conserve the climate system for present and future generations.

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 National Communication 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 and the Research Institute Energoproekt (now Energy Institute). It was submitted to the UNFCCC Secretariat in February 1996.

The Second 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. This put new targets in front of the country and stressed on the need of a consistent policy to reduce the anthropogenic emissions of GHG. 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 Second Communication was developed along the Guidelines adopted by the Second Conference of the Parties of the Convention. It was based on the findings presented in the First Communication, supplemented and refined during the development of the National Action Plan on Climate Change within the frame of the US Country Study Program – Support for National Action Plans. The Second National Communication 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 and the Research Institute Energoproekt (now Energy Institute).

The underlying principles of the national climate change policy are predetermined by the strong will of Bulgaria to join the international efforts for addressing the climate change issue. The process should be carried out in such a manner that will not place insurmountable barriers to the national economy, and at the same time will assist with attracting foreign investments that should help with the implementation.

The nature of the GHG mitigation policies and measures in the country is set forth by the **National Climate Change Action Plan** (NCCAP) adopted by the Bulgarian Government (decision No. 393 / July 6, 2000). In addition to NCCAP objectives, there are other relevant policies that are consistent with the GHG mitigation targets. These include the National Strategy for the Environment,

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

and the drafts of the National Energy Efficiency Program and the National Program on Renewables.

The institutional setup for implementation of the country's climate change policy is represented by the Inter-ministerial Climate Committee established with the NCCAP. It has to monitor the implementation of the plan; to assess the progress of the GHG emission reduction; to adjust the plan to the changing conditions in the country; to track violations; and to develop compensatory measures to accomplish the objectives. The overall implementation of the plan is controlled by the MOEW.

The Third National Communication has been prepared by the Energy Institute under coordination from the Ministry of Environment and Water. The Communication presents the overall situation in the country for the period since the Second National Communication till mid-2001.

Dolores Arsenova
Minister of Environment and Waters
Republic of Bulgaria

2. NATIONAL CIRCUMSTANCES RELEVANT TO GREENHOUSE GAS EMISSIONS AND REMOVALS

2.1. 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, FYR 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. The lay of Bulgaria is highly varied. To the north there is the Danube plane, 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 km² and water volume of 211 mln cubic meters, and 23 dams with total area of 376 km² and water volume of 4,571 mln cubic meters. The biggest is Iskar with water volume of 673 mln m^3 and area of 30 km².

2.2. 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. The average monthly temperatures for the capital city of Sofia range from –3.7 °C in December to 28.2 °C in August.

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.

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 Lowdown, 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.

2.3. POPULATION PROFILE

The population of Bulgaria during the last several years is constantly decreasing (Fig. 2.1). The social and economic hardships in Bulgaria during the transition period caused this negative development of the natural growth rate since 1988. The National Statistical Institute (NSI) and Eurostat predict a further decrease of the population. The census that took place in 2001 indicated that the decrease in the population number has reached 7.974 million people (8.981 million in 1988).

The density index continues to drop as well, and in 2000 reached 73.4 persons per km^2. The population is getting older as a result mainly of the tendency of birth rate decrease. The average age increased with 0.2 years annually and reached 39.9 years in 2000 (Table 2.1). The decrease in birth rate became significant after 1988. However in the last 2-3 years the total crude birth rate reached indicates a slight increase and became 9 per thousand.

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 current structure of the population will lead to further development of the above listed tendencies.

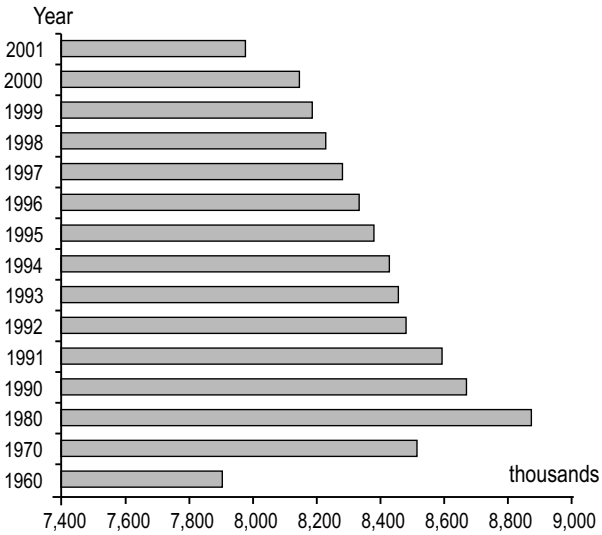

Fig. 2.1. Population growth rates in Bulgaria

2.4. GOVERMENT STRUCTURE AND ADMINISTRATIVE DIVISION

Bulgaria is a parliamentary republic and conforms to the Constitution of the Republic passed by the Grand National Assembly in July 1991. All international treaties, which are ratified pursuant to the constitutional procedure, are considered part of the domestic legislation. The National Assembly is a one-chamber parliament. It consists of 240 Members who are directly elected every four years. The National Assembly is a permanent acting body. The head of the state is the President, who embodies the unity of the nation and represents the Republic of Bulgaria at international level. Government is the executive state body and implements the domestic and foreign policy of the country.

The territory of the Republic of Bulgaria is divided into 278 municipalities and 28 regions. Municipalities are legal entities and have the right of ownership and independent municipal budgets. The municipal council is the local government authority, which determines the policies for development of the municipality. The 28 regions are administrative-territorial units, which implement the regional policy of the central government. The regions' management is carried out by regional governors and regional administration at the cost of the state budget. Regional governors are appointed by the Government.

2.5. ECONOMIC PROFILE

Since ***1991***, a radical economic reform is taking place in Bulgaria. It began with the signing of Bulgaria's first program with the International Monetary Fund (IMF). The major goals of this program were to curb inflation, slow down the decline of economy, achieve relative stability of the national currency and encourage private sector steady annual growth until 1995. Within the first four years, the cornerstones of legal and institutional framework of the market economy were put in place, which led to certain economic revival. However, after a period of growth, the GDP dropped in 1996 and 1997. The main reasons for the decline were structural reform blockages, slowdown of privatisation and the loss of international market position for Bulgarian companies following the disintegration of the Union for Economic Cooperation of the former socialistic bloc. The embargo on ex-Yugoslavia and unpaid debts of over USD 2.5 bil-

Table 2.1. General population data

	1960	1970	1980	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Birth rate %	17.8	16.3	14.5	12.1	11.1	10.4	10.0	9.4	8.6	8.6	7.7	7.9	8.8	9.0
Natural increase %	9.7	6.0	3.4	–0.4	–1.7	–2.2	–2.9	–3.8	–5.0	–5.4	–7.0	–6.4	–4.8	–5.1
Marriage rate %	8.8	8.6	7.9	6.9	5.6	5.2	4.7	4.5	4.4	4.3	4.2	4.3	4.3	4.1
Average age of population	32.4	34.4	35.8	37.5	37.8	38.1	38.4	38.5	38.9	38.8	39.2	39.4	39.6	39.9

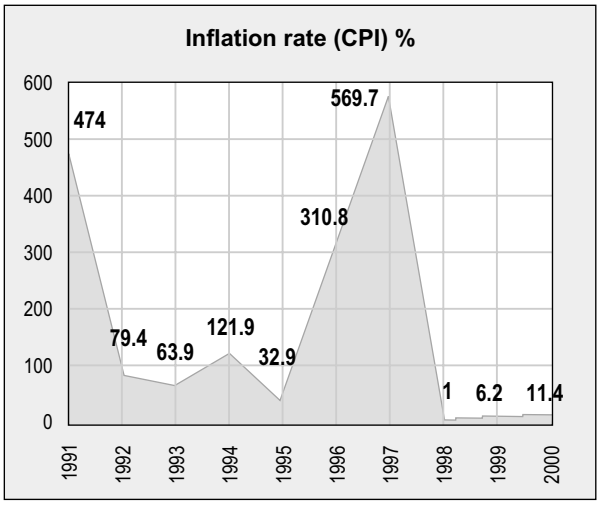

Fig. 2.2. Inflation rate [%]

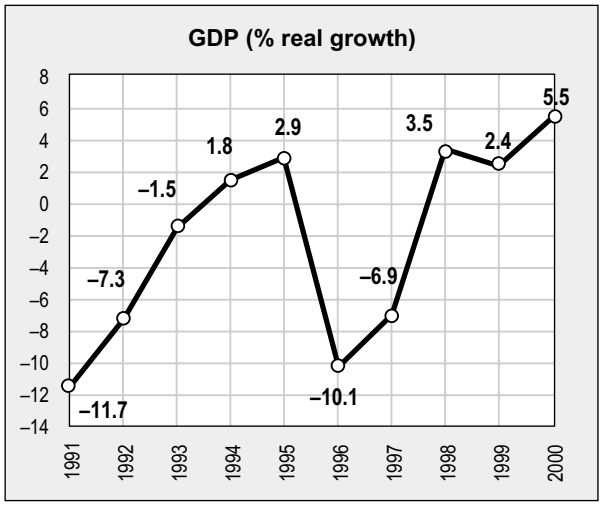

Fig. 2.3. GDP (% real growth)

lion owed to Bulgaria by third world countries further worsened the state of the Bulgarian economy. The government supported loss-making public sector enterprises at the expense of draining out the banking sector and causing severe macroeconomic dis-balances. In the first quarter of 1997, a new agreement with the IMF was reached, which marked the introduction of a currency board (July 1997) and a set of austere and radical new measures for reform.

A few major events marked the ***1998-2000*** period[1]. After the introduction of the currency board agreement, macroeconomic stabilisation was registered, growth was resumed and inflation was curbed to single digit levels (Fig. 2.2). The economy started to recover in 1998 as the year was marked by events with favourable impact on market reforms, e.g. the three-year IMF agreement and the accession to CEFTA. In 1998 practically all prices were liberalised, as only the household power consumption, district heating, post and telephone services remained at their fixed levels. The centrally regulated prices in 1998 comprised 2.78% of GDP. Bulgaria achieved indubitable financial stabilisation, 3.5% real GDP growth and 1% end-year inflation.

A broad international acknowledgement of the political and economic changes in Bulgaria was the invitation to start EU accession negotiations in December 1999 and their initiation in March 2000. The Government has set up an ambitious agenda to complete them by the beginning of 2007.

[1] The analysis in this chapter is based mainly on statistical data from year 1999. Whenever appropriate and available, preliminary data for year 2000 was used and displayed, too.

Privatisation reached its final stage as by the end of 2000 51% of the long-term assets of the state owned enterprises accounting to BGN 296 billion were privatized. This percentage rises to 77% if the assets, which are not subject to privatisation in the long run, are excluded from the balance. Banking sector privatisation is close to completion with only one more state bank operating on the market. About 99% of the agricultural land has been restored to its former owners. The cumulative value of all foreign direct investments in Bulgaria reached USD 3.929 billion in 2000. About 80.5% of them have been received during the period 1997-2000 (Table 2.2). The main components of the reform program continue to be privatisation of the remaining state-owned enterprises, liberalisation of agricultural and energy sectors, the development of the health insurance system, the pension system reform, and increasing the public sector capacity. The forecasted real GDP growth for 2001 was about 5.5% with inflation of about 5.3% (Fig. 2.3).

A **new governmental program** (People Are the Wealth of Bulgaria) was adopted in 2001 by the new Government of the country with Prime Minister Simeon Saxe-Coburg Gotha. The overall priority of the program is the stable macroeconomic framework for sustainable development and actual growth in the economy. Planned annual growth rates for the 2002-2005 period are 5-7% as a ground for the sustainable development and higher living standard for the population. These are combined with the creation of new jobs, increased incomes and reduced unemployment rates.

An aspect of the development model is the investment policy that envisages annual foreign in-

Table 2.2. Key economic indicators

Indicator	1997	1998	1999	2000
GDP (billion USD)	10.2	12.2	12.4	12.1
Growth of real GDP (%)	–6.9	3.5	2.4	5.0
(% change at the end of the period)	578.5	1.0	6.2	11.4
Interest rate	7.0	5.2	4.6	4.7
Current account balance (% of GDP)	4.4	–0.5	–5.5	–5.5
Gross currency reserves (million USD)	2,468	3,056	3,222	3,460
Gross debt (% of GDP)	95.9	81.8	79.7	83.4
Direct foreign investments (million USD)	506.5	537.2	765.5	974.6
Direct foreign investments (% of GDP)	4.9	4.4	6.6	8.1
Unemployment (end of year)	13.4	12.2	16.0	17.5

Source: Bulgarian National Bank and International Monetary Fund

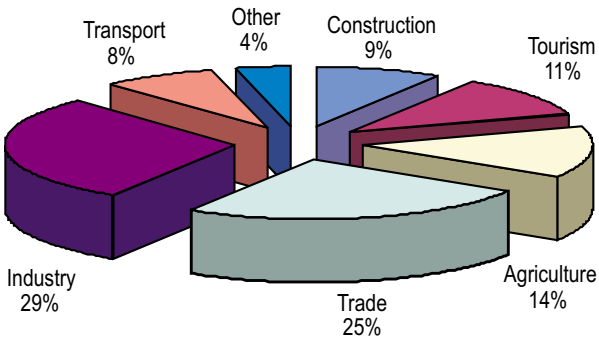

Fig. 2.4. Structure of privatisation deals by sectors

vestments of USD 1-1.2 billion and conditions for balanced development of large and small-size enterprises. The improvement of the trade balance and the current account are other priorities of the program. It projects an increase of the export volume and of its share in the GDP, strict fiscal policy, further reduction of inflation rates. Monetary policy will guarantee the macro-economic stability by sustaining the rates of BGL to the Euro until Bulgaria joins the European monitory union.

2.5.1. Privatisation

Privatisation in Bulgaria started in 1993 by various means, such as public offering of shares, public auctions, public competitive bidding by invited bidders, management buy-outs, negotiations with potential buyers and central public offering (Table 2.3). The privatisation process is carried out under two separate, but associated programmes:

- Market (cash) privatisation of state and municipal enterprises.
- Voucher privatisation.

Cash privatisation: The structure by sectors of privatisation deals, in the period 1993-2000, is presented in Fig. 2.4. Some 76% of the state assets for privatisation were sold in that period.

Voucher Privatisation: In 1996, the government adopted an ambitious voucher privatisation programme where more than 1,000 companies were offered for sale to the Bulgarian citizens. The first wave of voucher privatisation ended in July 1997. Approximately 21.1% of all state assets were privatised. The second wave is currently in progress. The deadlines for registration of vouchers expired at the end of 2001. So far 14 tenders have been held and shares from 547 companies have been offered for privatisation. In 2001, shares amounting to BGN 1.2 million were offered for privatisation. The objective of the government is to divest of its remaining shares in newly privatised companies.

Restitution aims at returning expropriated land, including agricultural land, forests, urban property, factories and workshops to former owners. According to government estimates, almost all of arable land and urban property subject to restitution have been returned to its former owners. The res-

Table 2.3. Relative share of private sector in GDP (%)

	1994	1995	1996	1997	1998	1999	2000
Private sector (total)	41.6	48.3	51.9	56,5	56.7	57.1	61.3
Agriculture and forestry	10.2	11.1	9.5	23.2	18.4	14.8	12.6
Industry	7.1	9.4	9.1	8.7	11.3	12.5	16.7
Services	24.3	27.8	33.2	24.6	27.0	29.8	32.0

titution of forests is under way (56% have been returned to their owners so far).

Restructuring: A Government Council for supervision of financial discipline and fiscal risks was established in late 1999 to oversee a group of 154 companies with a 50% or more state ownership. The list of these companies was prepared to meet the requirements of the World Bank with regards to the second loan for restructuring of the real and financial sector, FESAL 2, amounting to USD 100 million. The list included large state companies like Bulgarian Posts, the Water and Sewerage service companies, ports, airports and some mines.

The major trend in the foreign investments is given in Fig. 2.5.

Greenfield – Greenfield investment + additional foreign investment in companies with foreign participation + reinvested earnings + joint ventures + credits by direct investor

There is a significant increase in the foreign investments in Bulgaria for the last few years. They amount to 3,162 million USD for the last 4 years, which accounts for 80% of all foreign investments since 1992. The peak of investment activities is 2000 when the investments reached 1,100 million USD. There is a stable tendency of increase in the Greenfield investments.

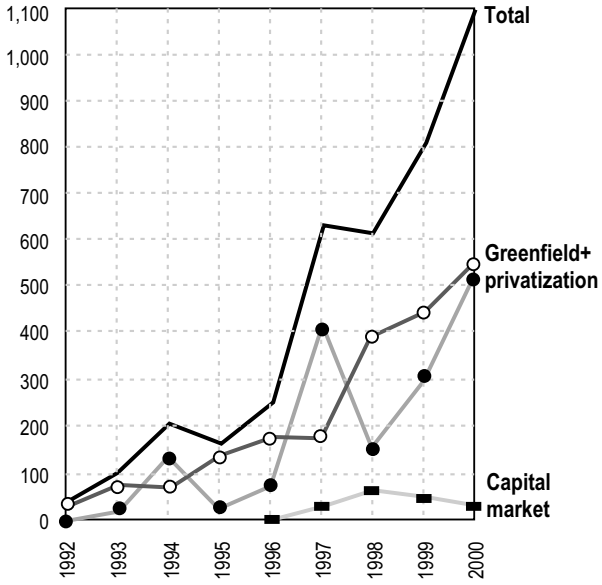

Fig. 2.5. Foreign direct investment inflows in Bulgaria by years [million USD]

2.5.2. Sectors

Major structural changes in economy occurred, and as consequence some changes in the GDP structure took place during the transition period (Fig. 2.6). Before the crisis the economic production structure was characterized by strong development of processing industry, mining and quarrying as a result of industrialization performed in the last decades. This position has been overtaken by the services sector in the last few years.

ENERGY

Bulgaria has historically followed a very energy intensive development policy. At the same time its energy resources are very limited, consisting primarily of a single large deposit of low grade, high sulphur lignite. The country is extremely dependent on the energy imports that account for more than 70% of its primary energy resources. Its GDP

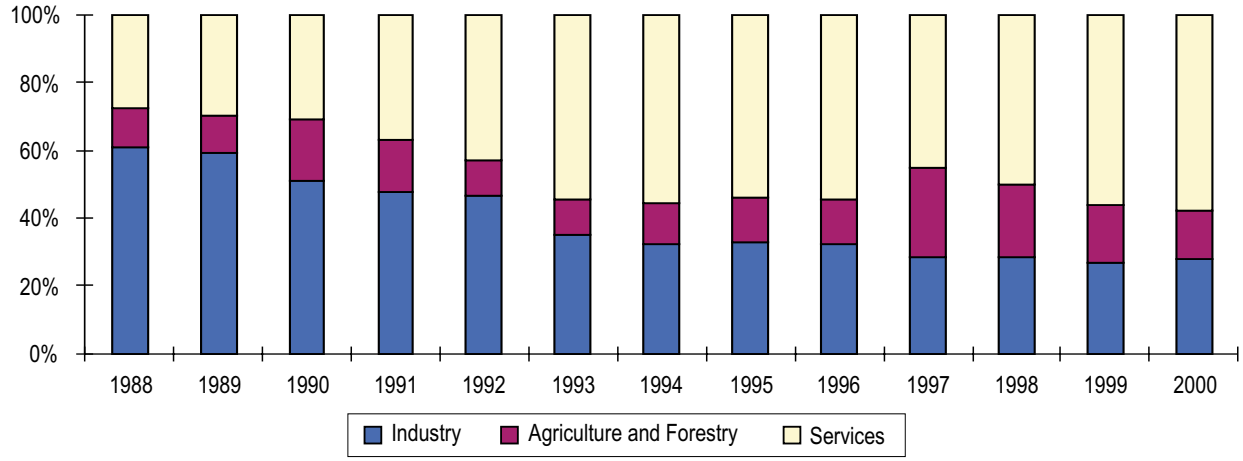

Fig. 2.6. GDP structure

Note: In 1997 the NSI adopted a new sectoral division for GDP reporting by sectors. The new sector classification is based on the statistical division of the economic sectors in the EU (NACE Rev.1). This is the reason that the shares in Fig. 2.6 for 1997 are hardly comparable to those for the previous years.

is highly energy intensive, with energy use per unit of output estimated to be up to two times higher than comparable market economies

In the Second National Communication the drafts for the Energy Law and draft National Energy Strategy were discussed. Meanwhile the Law on Energy and Energy Efficiency and the National Energy Strategy were adopted and amended. With the election of new Government of Bulgaria, some serious changes are further expected. In 2002 a new law on energy will be developed and adopted.

Currently, the sector is regulated by several laws such as the Law on Energy and Energy Efficiency, the Law on peaceful use of nuclear fuel, the Law on concessions, Environmental protection act, etc. The sector is also influenced by several international documents and treaties Bulgaria is a Party to.

Bulgaria's energy sector is in the early stage of liberalisation. National Electricity Company (NEC), the former electric monopoly, has undergone substantial unbundling with the spin-offs of key Independent Power Producers (NPP Kozloduy, TPP Maritza Iztok 1, TPP Maritza Iztok 2, TPP Varna, TPP Maritza-3 Dimitrovgrad, TPP Bobovdol, TPP Rousse East) and distribution companies (seven regional distribution companies were established). A similar unbundling of gas monopolist Bulgargas is in the preparatory stages. The district heating industry is undergoing a steady reduction of state subsidies. There have been very little privatisation and private greenfield investments in any of the three industries. The Law on Energy and Energy Efficiency (LEEE) of 1999 (State Gassette 64/ July 16, 1999) enabled the start of liberalisation, but it has many flaws. Most notably, the LEEE failed to inspire competition by abandoning the single-buyer model. A revision of the LEEE was made at the end of 2001 (State Gassette 108/ December 14, 2001). New priorities in the sector are also set in the Governmental program. It has been announced that a new law will be prepared for the sector at the first half of 2002.

The main priorities of the work in the 2001-2005 period according to the Governmental program are:

- Development of modern competitive energy market.
- Update of legislation in compliance to the EU laws.
- Attraction of investments and privatisation in energy sector.
- Energy supply with minimal cost.
- Energy efficiency.
- Encouraged use of renewables.
- Integration of Bulgarian energy system and market with the EU's.
- Nuclear safety and safe treatment of radioactive waste and waste fuel.

Governmental participation should be limited to establishment of transparent and straightforward rules for development of the trade activities and social security, while the investment will be defined by expected demand and the risk will be taken by the investors.

Primary Energy Resources

The structure of the primary energy resources for 1999 is presented in Fig. 2.7. Bulgaria has limited domestic energy resources. Proven oil and gas reserves for the country have declined for a number of years and are only about 3 million tonnes of oil equivalent, which is very small – less than three months normal consumption for Bulgaria. Hydropower potential is also limited since most of Bulgarian rivers are small and the only large river, the Danube, has a fairly small drop in altitude where it forms Bulgarian northern border with Romania.

Coal

Bulgaria is relatively rich in low-grade lignite and sub-bituminous coal, but poor in higher quality coal reserves (see Table 2.4).

The reserves of the major types of coal in active mining areas are briefly described below:

- Lignite reserves occur in two regions of the country: in central Bulgaria, near Stara Zagora, and in western Bulgaria, mainly west and south of Sofia. The large, open-pit deposits of Maritza East dominate the central Bulgaria reserves, which alone represent 2.2 billion tonnes or 95% of all Bulgarian lignite reserves. A significant

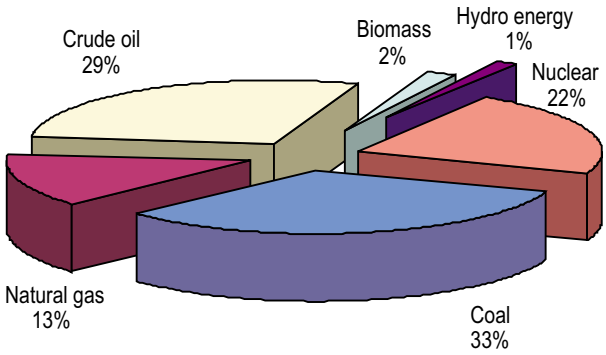

Fig. 2.7. Primary energy resources in 1999

Table 2.4. Coal resources in Bulgaria

Coal resources	Minable reserves	Present production (2000)	Lifetime
	mln tonnes	mln tonnes/year	years
Lignite	2,200	21	85
Sub-bituminous	210	4	40
Bituminous	10	< 1	40

amount of these reserves are located under villages and towns, and at this stage it is uncertain whether that portion will ever be exploited.

- Sub-bituminous coal reserves occur in western Bulgaria, at Bobov dol, Pernik and Pirin and in eastern Bulgaria, north of Bourgas. The Bobovdol reserves, at 160 million tonnes, are by far the largest, representing 75% of sub-bituminous coal reserves.
- Hard coal reserves are limited to about 10 million tonnes. None of these reserves can be mined economically.

Liquid Fuels

Bulgaria imports almost all of its petroleum since domestic production is negligible. This petroleum is imported either in the form of crude oil or directly as oil products. Typically about 90% of the petroleum is imported as crude and most of the rest is imported as heavy fuel oil. Petroleum products meet approximately 29% of Bulgarian primary energy demand.

Natural Gas

The state retains nearly full control over the gas sector through government-owned company Bulgargas, which enjoys a monopoly on the import and transmission of natural gas. Since the low-pressure distribution network is underdeveloped, large industrial consumers dominate the gas demand. Natural gas consumption has declined over the past several years. The government has launched a restructuring of the industry, with a focus on attracting private investment for development of local gas distribution network. The major consumers of gas in Bulgaria are companies from the following sectors: chemical fertilisers, district heating, oil refining, metallurgy, glass/ceramics/bricks production. At present some 74% of local gas demand is generated by only 9 industrial consumers. Furthermore, gas consumption in Bulgaria has been steadily shrinking since 1997. The decline is partly due to the lack of opportunities for consumers to negotiate and benefit from supply agreements other than that of Bulgargas with Russian Gazprom. The continuing crisis in the nitrogen fertilizer industry and the rising price of gas further suppressed the market in 2000 (3,417 billion m^3).

Renewables

Renewables that could be used in Bulgaria are hydro energy, wind, geothermal, solar energy, biomass, wood and some wastes. Currently only hydro energy and fire wood have a significant share in the energy balance. Depending on the climate cycles the annual output of the hydro power plans varies within the range of 2-3.5 TWh, that covers 7-9% of electricity generation, 2.7% of the final energy demand and 1.5% of the primary energy demand. There are 1975 MW of hydroelectric capacity in the country, making up approximately 18% of the total installed capacity. Altogether there are 87 operating hydro plants, however, the 11 larger plants have 77% of the capacity. The total installed capacity of micro-HPP (to 10 MW) is about 137 MW. They cover about 1.4% of electricity demand. The potential of hydro energy is well studied and there exists an increasing interest towards it in the last few years.

Nuclear Energy

The only nuclear plant in Bulgaria is situated at the town of Kozloduy, about 220 km north of Sofia on the Danube River. It comprises 4 x 440 MW and 2 x 1,000 MW units with a total installed capacity of 3,760 MW. All units are pressurized water reactors utilizing slightly enriched uranium as fuel and water as moderator and coolant. The nuclear energy share in the structure of the consumed primary fuel and energy resources in the last years amounts to about 22%.

Energy Demand

The final energy consumption in the country during the period 1987-1989 was almost constant-approximately 891 thousand TJ, but it is constantly declining since 1990. The structure of the energy demand by in 1999 is presented in Fig. 2.8.

The greatest consumer of energy is the industrial sector. It accounts for over 50 % of the fuel and energy consumption in the country. This high relative share was due to the years-lasting strategy

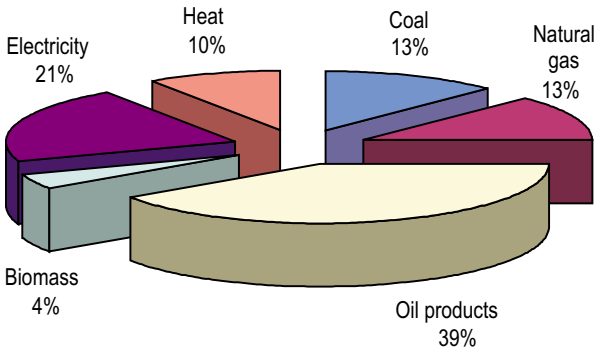

Fig. 2.8. Final energy demand – 1999

aimed at the accelerated industrialization of the country without taking into consideration the lack of qualitative indigenous energy resources. Now this share is gradually shrinking.

The second greatest energy consumer in the country is the residential sector. The households consume about 30% of the fuels and the energy. The energy consumption per capita in Bulgaria is approximately two times less compared to the economically developed countries, so it is expected to increase in the next years and this would lead to an increase in the relative share of the residential energy consumption.

The relative share of the service sector in the energy demand (now about 13%) is expected to increase, too.

POWER SECTOR

The state's electricity company NEC (National Electric Company) owned until recently all of the power production plants and the transmission and distribution networks of Bulgaria. NEC is currently subject to restructuring and privatisation. Domestic consumption of electricity has fallen behind government forecast of annual average increase of 2 million kWh. Nevertheless, Bulgaria remains a major exporter of electricity in the Balkan region.

NEC reported actual consumption of electricity in Bulgaria in 2000 roughly the same as in 1999, that is 36,226 million kWh. The results fell much behind the government's forecast of 46,660 for 2000. Last year the company registered also increased exports of electricity – total 4.4 billion kWh, 69% up from 1999. Of those, 3.2 billion kWh were exported to Turkey and the rest – to Kosovo, Macedonia, Greece and Yugoslavia.

NEC is a state-owned joint stock company with responsibilities for power generation, transmission and distribution. NEC has a statutory "single-buyer" position on the Bulgarian electric power market. The generating plants have no direct access to end-users. NEC has the authority to define the equilibrium of demand and supply while the former State Agency of Energy and Energy Resources (now Ministry of Energy) is in charge of defining the production mix. NEC buys and sells 89% of annual electricity output. The remaining 11% of the electricity are produced by 17 independent power producers (IPPs) and auto-producers, which sell directly to industrial consumers or produce for their own consumption.

NEC operates a nation wide transmission system consisting of a 400 kV high voltage grid (1,844 km) and a 220 kV network (2,283 km) with both systems forming a closed loop linking all major plants and substations. The major part of the 110 kV network is operated by NEC, too.

Installed power generation units in country have capacity 13,163 MW (actual 10,535 MW) distributed as followed:

Power Plants	Installed capacity		Available capacity	
	MW	%	MW	%
TPP	6,564	49.9	4,915	47.2
NPP	3,760	28.6	3,400	32
HPP and CHP	2,839	21.6	2,220	20.8

From TPP:

- on lignite – 50.2%
- on imported coal – 28.3%
- on natural gas and oil – 21.5%

Key generation facilities are:

TPP – Three plants comprising the Maritza Iztok TPP Complex: Maritza Iztok 1 (600 MW), Maritza Iztok 2 (1440 MW), Maritza Iztok 3 (840 MW). The plants are situated around Bulgaria's biggest coal deposit and most of their units burn low-grade domestic lignite. TPP Varna (1,260 MW) has 6 units of 210 MW each, and all of its equipment is made in the former USSR. In 1998 a tender was announced for the rehabilitation of the three old units installed in the period 1968-1969. TPP Devnja, with generation capacity 230 MW, was privatized in July 1999. Solvay Sodi (Belgium) won the tender for 77% stake in the TPP.

Other TPPs include TPP Bobovdol (540 MW), TPP Rousse Iztok (400 MW), TPP Maritza 3 – Dimitrovgrad (120 MW).

Kozloduy Nuclear Power Plant has a capacity of 3,760 MW, or 29.7% of Bulgaria's total capacity, and generates some 40% of the total electricity output in the country.

The electricity production of these key plants for 1999 and 2000 is given in Table 2.5.

Since the national demand has not increased, the rise in the generation by 14% is due to the increase in the electricity export and reduced import.

District heating sector

Bulgaria has 22 DHCs operating in 21 cities: Sofia (4), Varna, Plovdiv (2), Bourgas, Rousse, Pleven, Lovetch, Veliko Turnovo, Yambol, Gabrovo, Sliven, Vratsa, Shumen, Kazanlak, Samokov, Pravets, Pernik and others. The heat distribution network reaches over 1.650 million people in 570,000 households. The volume of public buildings within the network equals that of 243,000 households. However demand from industrial consumers has fallen drastically. In accordance with the IMF's agreements and in cooperation with the World Bank, a strategy for development of the heating companies is under completion.

Administrative arrangement

The new conditions require and define new functions of state in the energy sector – elaboration and realisation of long-term energy policy, fulfilment of the rights and obligations as asset-owner and price regulation in the sector. In conformity with the Law on Energy and Energy Efficiency, those three basic functions are carried out by the State Agency for Energy and Energy Resources (now Ministry of Energy and Energy Resources), Energy Efficiency Agency (EEA) and State Commission for Energy Regulation (SCER), which is a specialised administration with a statute of a ministry.

MEER (Ministry of Energy and Energy Resources) – responsible for the Energy sector's development, planning, administration and legislation.

SERC (State Energy Regulation Committee) – a body with 7 members appointed by Ministerial Decree for 5 years; and supporting personnel. It has the following responsibilities:

- Issuing licenses (and their withdrawal)
- Establishing energy prices
- Regulating access to the networks.

SERC has a sanction capacity. Income for the State Energy Regulatory Commission comes from a combination of State funding and self-financing (from licensing activities).

EEA (Energy Efficiency Agency) – carries out the development and the implementation of the state policy in the field of the energy efficiency. It is an executive agency. As stated in the amended LEEE "national policy for energy efficiency and use of renewables for electricity and heat generation is part of the energy policy of the sector and it is carried out by the minister of energy and energy resources". All state bodies are obliged to support these activities. AEE coordinates the activities in the field. Its main functions are related to the elaboration of energy efficiency programs, promotion of the utilisation of renewable energy sources, developing subordinate legislation and standards, control in the field of energy efficiency, etc.

For the purposes of elaborating a legislative framework in the area of labelling of household

Table 2.5. Gross electricity production by plants, GWh

Plant/ Year	1999	2000	Change (%)
TPP Maritza east 1	930	1,045	12
TPP Maritza east 2	6,103	6,350	4
TPP Maritza east 3	3,504	4,187	19
TPP Maritza 3	208	202	–3
TPP Bobov dol	2,177	2,041	–7
TPP Varna	1,852	1,529	–16
TPP Rousse East	342	410	20
NPP Kozloduy – units 1-4	7,486	7,560	1
NPP Kozloduy – units 5-6	8,328	10,550	27
HPP	2,962	2,918	–1
Autogeneration	2,522	2,306	–9
District heating cogeneration	1,806	1,661	–8
Import	1,670	168	–90
Export	3,426	4,400	28
Overall generation + import	39,890	40,927	14

appliances, an Inter-Departmental Working Group was set up. Its members are representatives of the Ministry of Economy, the Energy Efficiency Agency, the State Agency of Standardization and Metrology, and the Branch Chamber of Electrical Industry (at the Bulgarian Chamber of Economy).

The State control on the safe utilisation of atomic energy is carried out by the Committee for the Use of Atomic Energy for Peaceful Purposes (the Regulatory body), through its Inspectorate on the Safe Use of Atomic Energy (ISUAE).

TRANSPORTATION

A network of international motorways crosses the country, making vital connections to Western Europe; Russia; Asia Minor; to the Adriatic, the Aegean and the Black Sea. Both sea and river transport (the Black Sea and the Danube River) offer good communications and transportation to and from the region.

Basic data on transportation sector are given in Table 2.6. Classification of the vehicles by type is provided in Table 2.7.

Only for the road traffic the changes in the last 5 years are given in Table 2.8.

The total length of the national **road network** is 37,288 km and the average density is 0.33 km/km^2 (somewhat below the EU average). Approximately 90% of the roads are with asphalt surface.

Bulgaria has 324 km of motorways, 3,011 km of first class roads, 3,818 km second class roads, and 29,937 km third and fourth class roads. Most common are the two lane roads with overall width between 6.00 and 7.50 m. Road building in Bulgaria is generally difficult and costly as some 40% of the country's territory is mountainous.The social and economic difficulties in Bulgaria coupled with the lack of financing for road infrastructure have brought about a deterioration of the roads in general. More than 28% of main roads are in very poor condition and together with the lower grade roads,

Table 2.6. Basic data transport development

Year	1960	1970	1980	1990	1995	1996	1997	1998	1999	2000
Length of railway lines [km]	5,620	6,040	6,419	6,604	6,507	6,490	6,484	6,470	6,467	6,518
Roads [thous km]	33	36.1	36.4	36.9	37.3	37.3	37.3	37.3	37.3	37.3
Airlines [thous km]	5.4	28.1	77.5	153	211	149	152	152	142	–
Towns with trolleys lines	2	2	2	13	16	16	16	16	15	15

Table 2.7. Vehicles by type

Year	1990	1995	1996	1997	1998	1999	2000
Locomotives	1,111	872	813	773	715	714	683
Rail motor vehicle	94	88	87	86	84	82	82
Passenger carriages	1,932	1,753	1,740	1,737	1,709	1,675	1,672
Wagons	40,918	29,790	28,236	27,598	26,266	25,637	24,968
Trolleys	863	820	807	780	777	750	699
Trams	444	416	397	368	366	355	369
Passenger cars (thous)	1,317	1,648	1,707	1,750	1,809	1,908	N/A
Sea cargo ships	13	6	3	3	3	3	1
Passenger liners	59	46	45	44	42	40	N/A

Table 2.8. New and rehabilitated roads

Year	1996	1997	1998	1999	2000
Rehabilitated roads:					
km	117	340.2	224.5	357	672.4
million BGL	39	116	93	157	186
New roads:					
km	0	12	16	33	38
million BGL	0	13	21	47	167
Total – mln BGL	39	129	114	204	353
Daily traffic – km	16,500	14,500	16,500	19,000	22,500*

* Average on the base of data until June 30, 2000.

pose serious problems. The Implementing Agency "Roads", the national department responsible for the planning, design, construction and maintenance of the national road network, in co-operation with the Bulgarian Government, are working vigorously to improve this situation. The programme "Transit Roads" was started in 1992 with the financial help of the European Investment Bank, the European Bank for Reconstruction and Development and the PHARE programme.

At present the national road network is developing and modernising in line with current policy of the Bulgarian Government for the development of trade and economic relations with the neighbouring countries – Greece, former Yugoslavia, Romania and Turkey. The process of improving the road transport connections with neighbouring countries includes the following main activities:

- Opening new border crossings.
- Construction of new access roads or optimisation of the existing roads to the standards corresponding to current and expected traffic.
- Increasing category and capacity of existing border crossings.

The **railway network** of Bulgaria consists of about 4,300 km railway lines, 4,055 km of which is standard gauge (1,435 mm), the rest being narrow-gauge (960 mm). About 960km (22% of the whole network) is double track and 2,640 km, about 61.4% is electrified. The system includes around 400 full stations and 300 station halts. The major part of the railroad network is designed for speeds of 80-100 km/h, with only 150 km of the lines designed for speeds up to 130 km/h. The maximum speed allowed over the station switches is 100 km/h, which in turn limits traffic speed through the stations.

Weight of trains does not present any limiting condition. The overall weight of a train at a speed of 80 km/h is designated for each line between 560 and 1,900 tons. In practice, the speeds are reduced by 10-20% because of poor traction rolling stock.

The signalling system in general conforms to European standards. The signalling equipment used for the various lines is appropriate for the type of traffic, line capacity and speed. Trains are fitted with secure radio, and Automatic Train Protection is provided on the primary routes.

The country possesses the following railway terminals handling large tonnage containers: Sofia freight, Plovdiv – Philipovo, Dimitrovgrad, Stara Zagora, Tchestovo freight, Pleven West and Vratza. The other specialised container terminals are located at the sea and river ports (described in the next section). The upgrading and construction of new infrastructure for **combined transport** is included in the transport investment programme, where the development of environmentally friendly combined transport is one of the priorities of the transport policy of the country.

The river Danube is both a Bulgarian and an international waterway, regulated by a number of agreements and conventions. The two major ports on this water route are Ruse and Lom. The harbour of Ruse has an intermodal terminal, serving the traffic to Germany and Ukraine, while in the harbour of Lom there is a terminal of SOMAT (International Road Transport) for catamarans travelling to Western Europe.

The two major **sea ports** of Bulgaria – Varna and Bourgas handle more than 60% of the national foreign trade freight turnover. These ports have container terminals, Ro-Ro equipment and many berths for different types of bulk and liquid freight. They are spread over a substantial area and are connected with the railway and road networks.

Bulgaria has 10 civil **airports**, four of which have international status. The other six serve also agricultural aviation. Air transport activity at the moment is concentrated in Sofia, Bourgas and Varna which serve mostly international destinations.

In order to prepare the legislative basis for reforms in transport sector and to harmonise national laws in the field a lot of acts were developed and adopted in the period 1997-2001. They cover all the sub-sectors as marine, air, road, and railway transport. Lots of by-laws were also developed and adopted. The legislative frame is already enforced or it is in its latest stage of development. The major attention is paid to the safety of all transportation modes and the institutional development. For the successful restructuring in the sector some new administrative structures were created.

The policy in the sector has followed the principles in the Governmental programme Bulgaria 2001.

The communication with EC on Chapter 9 Transport policy has started at high level in June 2001. The 2000 Regular Report on Bulgaria indicated that "Progress in transport has accelerated compared to previous years. Steps have been taken in all sectors and work has started on maritime safety. The long-standing issue of a second bridge across the Danube to Romania has been resolved with an agreement between Bulgaria and Romania in February 2000".

The new laws allow for private ownership of ports, airports, and railway transport. Privatisation measures have been undertaken in the sector. The ownership of 56 transportation companies and 6 bus stations has been passed to the municipalities.

In July 2000 the **National Transport Strategy** was coordinated with ISPA. This strategy contains the main priorities of the sector until 2006.

- Harmonisation of national legislation and transport regulations with those of the European Union Member States.
- Development of transport infrastructure.
- Implementation of structural reform and privatisation in transport.

The Ministry of Transport and Communication has also developed a **Programme for transport infrastructure development for the period 2001-2005.**

INDUSTRY

The industrial policy of the country is focused towards the achievement of a stable economic growth, acceleration of the privatisation and the restructuring processes, industrial development, competitiveness of the enterprises and stimulation of the development of small and medium size enterprises. A special attention is being paid to the improvement of the investment climate and the attraction of foreign investments. Meanwhile, the realisation of the approved by IMF Programme for Macroeconomic Stability and Structuring Reform in the context of the assigned three-year agreement is continuing. The agreements for acceleration of the Structural Reform with the financial institutions (World Bank, European Bank for Reconstruction and Development) outline the schedule for realisation of the steps needed to achieve the priority targets.

Considerable changes in the legislation were made in 1999. They are meant to guarantee maximum transparency of the privatisation process, to improve and simplify the liquidation and insolvency procedures and to increase the effectiveness of the concession granting procedures via conformance with the privatisation process. The Law on Commerce of the Republic of Bulgaria ensures full equality between the local and foreign persons when registering commercial company; and the Law on Foreign Investments provides equal rights and common procedure for foreign investment activities. A legal protection of the competition and the intellectual property is secured.

Short-term priorities of the sector:

- Finalisation of the privatisation of large state-owned enterprises and restructuring of the industry.
- Improvement of the financial discipline in the real sector.
- Strengthening the competitiveness of the Bulgarian Industry through liberalisation of the economic activities.
- Actualisation of the Strategy for Industrial Development (part of National Development Plan for the period 2000-2006) in accordance with the comments from the part of the European Commission.

Medium and long-term priorities

- Strengthening the competitiveness of Bulgarian industry through pursuing a quality promotion policy.
- Encouraging investments.
- Creating viable industrial enterprises in a market economy environment.
- Developing high technologies.
- Enhancing Industrial co-operation and stimulating development of small and medium-size enterprises.

Leading branches in the Bulgarian Industry are:

- **Chemical Industry** is one of the well-developed sectors in Bulgaria (about 20% of the total industrial output). This branch has good positions on the main export markets of Bulgaria and supplies the domestic and foreign market with intermediate and finished products. The main manufactured products are organic and non-organic chemicals, fertilisers, soda ash, plastics, PVC, polyamide and polyester fibres, paints, varnishes, synthetic substances, pharmaceutical products, perfumery and cosmetics, oils and fuels, etc. Chemical products have significant share in Bulgarian exports.
- **Food-processing, beverages and tobacco industries** are priority branches in the Bulgarian economy. The favourable climate and long-term traditions in the production of quality wines, cheese, tobacco products, vegetable oil, etc. stimulate its development. Food production accounts for 19.7% of the total industrial produc-

Table 2.9. Quantities of municipal solid waste

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total (1000 t)	8,428	8,022	8,503	8,067	7,357	6,052	4,495	4,031	3,628	3,197	3,203
Population (1000)	8,994	8,669	8,595	8,485	8,460	8,427	8,400	8,341	8,283	8,230	8,190
Standard generation (kg/capita/year)	937	892	947	945	870	718	508	483	436	388	391

Source: Annual Statistical Bulletin

tion with an export share of 9%. The main sectors of food, beverages and tobacco industries include meat processing, dairy, canning, sugar and sugar products manufacturing, vegetable oil production, wine production, brewing, fish processing, tobacco production, and milling. The share of the food-processing industry in GDP has grown slightly to almost 4%[2] of GDP in 1999. Over-capacity remains a problem and it is estimated that the processing industry presently utilises only 40% of its capacity. About 75.8% of the fixed assets have been privatised. Investment in the food processing industry accounts for 30% of the total foreign investment in Bulgaria.

- **Metallurgical industry** – Ferrous and non-ferrous metallurgy are the basis of machine-building industry, construction and other branches of the Bulgarian economy. In 1999 the output of metallurgy accounted for 9% of the total industrial output. Their share in the total exports for the first 10 months of 2000 was about 18%.
- **Mechanical works** has an important position in the national economy with a share of 10.6% in the total industrial output. The machine-building sector comprises some 500 enterprises in branches like production of tools and machines, automated machines, fork-lift trucks, electric chain hoists, automobile completing units and parts, warehouse machinery, hydraulic units, fittings, agriculture machines and spare parts, shipbuilding and shipyards.
- **Electrical and electronics industry** has been designated as strategic sectors and have priority in long-term development programs. The production of these sectors in 1999 amounts to 3.4% of the total industrial production. Electrical engineering and electronics industry combine the potential of more than 200 enterprises, specialised in different branches like electrical engineering (electric motors, transformers, batteries, cables, etc.), computer and office facilities, electronics, radio-engineering and communication equipment, household appliances, military-industrial complex.
- **Textile Industry** is one of the oldest branches of Bulgarian industry and its modern development has begun in 1,834. Now the sector comprises some 3,000 enterprises in the textile, knitting and clothing branches with about 5.3% share in the total industrial output for 1999 and 17% in exports.

Some of the other industrial branches, which have a well-developed production base are: building materials industry; pulp and paper industry; leather, fur and footwear industry; glass and china industry; woodworking industry, etc.

WASTE

Landfills are among the main sources of CH_4 in the country. During the last few years in the residential areas have been generated on average 4 mln tones municipal solid waste annually, that is almost one half from the reported quantities until 1992. Since 1993 a trend for gradual decrease of the waste appeared which could be result of the reduced consumption, caused by the difficult state of the national economy in general, as well as of the increased control of the Municipal authorities on the information and reports on municipal solid waste and its management.

The information on waste generated during the previous years is presented in Table 2.9.

The assessment of the municipal solid waste generated in Bulgaria is not easy. A small number of landfills are equipped with weighting bridges to measure the waste. The quantities of the waste collected are reported by transportation documents only. As result of that practice, is considered that the quantities of reported municipal solid wastes are higher than the real ones. In the NSEM (National Ecological Monitoring System) data on morphological composition obtained from sample examination or expert estimation of waste is available. The recent data is from "Experiment on the

[2] Source Bulgarian National Agriculture and Rural Development Plan 2000-2006

Table 2.10. Morphological composition of the municipal solid waste for the country

Material	Average Morphologic Structure by Expert Assessment	ECMSW in Sofia 97-98
Paper and Carton	4%	8.5%
Plastics	1.6%	3.1%
Glass	1.8%	14.3%
Metals	4.6%	0.7%
Textile	1.8%	1.3%
Rubber and Leather	0.8%	0.24%
Others	65.4%	72%

Source: Strategy for Recycling, 1998

characteristics of municipal solid waste (ECMSW) in Sofia", conducted during the period November 1997 – June 1998.

The comparison between the average morphological composition of the municipal solid waste for the country, determined on expert assessment, and the results of the ECMSW in Sofia is given in Table 2.10.

In spite of the fact that experiment results obtained for one settlement can not be a base for assessment of the average country data, the information collected allows to draw certain conclusions:

- The relative share of the recyclable materials is app. 30% which is in accordance with the average quantities in the world practice.
- The waste remaining after removal of the recyclable components (paper, plastics, glass, metal, textile, leather and rubbers) has an organic content giving possibilities for composting to be applied. It also high caloric value suitable for combustion.

According to data from the Executive Environmental Agency for 1999, 3,203,739 tonnes of municipal solid waste has been reported, collected from 660 settlements with total population of 6,531,053, which is 80% of the country population. This quantity corresponds to 491 kg per habitant and is by 24 kg less than 1998. The collected waste is deposited in 236 municipality landfills with 525 ha total area. Most of the landfills are reported as municipal solid waste landfills, however, mixed municipal solid waste, construction, industrial and in some cases hazardous wastes are disposed of there. Disposing of hospital waste in municipality landfills is a common practice. Deposition of earth layers, on a weekly basis, over the stored waste is seldom practised. Usually such layers are deposited over the waste 1-2 times per year. Many landfill operators do not apply such technology.

The landfills servicing more than 20,000 inhabitants, occupy 303 ha. 2,268,117 tonnes of domestic waste from 256 settlements with 5,408,227 inhabitants, i.e. 66% of the country population is collected in these landfills. The total waste collected in the landfills is 419 kg per inhabitant of the serviced population. For comparison, in 1998, the quantity of municipal solid waste per inhabitant is 513 kg, for the big landfills. In the Western European countries the respective figure varies in the range 280-450 kg. The European Waste Management Strategy sets a target value of 350 kg per inhabitant.

The waste treatment for this period is landfilling. A project has started to investigate the potential for composting of municipal and animal wastes. Some attempts for landfill gas generation from MSW landfills are made, but still there is no a system for its utilisation.

For 1999, 524 enterprises in Bulgaria have reported total of 1,843,438 tonnes of **industrial waste** (excluding the waste resulting from exploration, mining, dressing and further treatment of minerals and quarry, group code 01, analysed above). The reported quantity of waste is by 19% less than in 1998. The analysis of available data shows that thirty enterprises have generated nearly 90% of the total reported quantity of industrial waste. About 94% of this quantity are deposited on specialised landfills or other storage facilities operated by the enterprises. Those are mainly inorganic wastes from thermal processes and wastes form inorganic chemical processes. The rest 6% of waste is landfilled together with municipal solid waste on municipal landfills.

53,305 tonnes of industrial wastes disposed by incineration have been reported. This method is

typical for waste generated in wood processing (about 36%) and some of the waste generated in food processing. The share of processed waste in the total waste generated in the period under review has been increased by 7%, compared to 1998.

According to the information received, 89,438 tonnes of industrial waste collected for processing have been utilised. This is mainly waste from food preparation and processing. About 61% of this quantity are utilised in agriculture – for fodder and fertilisers.

For the period under review, about 96 000 tonnes of ferrous and non-ferrous metal, paper, plastic and glass waste are reported. Traditionally, a large part of such waste is recycled. Depending on the particular organisation, the waste collected by the enterprises is processed on-site or delivered directly to other enterprises or companies licensed for trading of recyclable waste.

The **National Waste Management Program** (NWMP) is developed on the base of the *Environmental Protection Act (EPA)* and Article 27 of the *Limitation of the Harmful Impact of the Waste upon Environment Act (LHIWEA).* The Program takes into consideration that the waste is risk for the human health and the environment. It aims at environmentally friendly waste management all over the country.

Institutional framework

The Ministry of Environment and Water is the competent authority regarding the waste management – legislation, strategies, international programs and projects, monitoring and control, regulation of the activities in the public and private sector. These activities of the Ministry are executed in co-operation with the EEA and the network of 15 Regional Inspectorates of Environment and Waters (RIEW).

The Ministry of Regional Development and Public Works (MRDPW) is the competent authority in regard to development of legislation, regulating the provisions that shall be met by the sites for waste treatment facilities, requirements on the construction and operation of equipment and installation for disposal of municipal solid waste and the conditions and requirements for construction and operation of landfill sites. The MRDPR together with the MOEW determines on annual basis the funds from the state budget and other sources for construction of facilities and installations for treatment of municipal solid waste and remediation and re-cultivation of areas damaged by old contaminated sites.

The Municipal administrations set out the policy for construction and development of the municipalities in respect to the waste management activities:

- Amounts of the local taxes within the range envisaged in the *Local Taxes and Fees Act (LTCA).*
- The requirements towards the natural and legal persons acting on their territory; approve guidelines, regulations and instructions on these issues.
- Organise the developmental and communal activities.
- Approve measures aiming at improvement and restoration of the environment.

On the 18th of September 1997 the Parliament accepted the ***Limitation of the Harmful Impact of Waste upon Environment Act.*** It has been developed conforming to the European legislation and the requirements of the European Union in accordance with the Directive 75/442/EEC on waste; Directive 91/689/EEC on hazardous waste; and the *Basel's Convention on the control of trans-boundary movement of hazardous waste and their disposal* (it has been ratified on the 18 of January 1996 and the MOEW is the national competent body for implementation of this Convention).

During the course of implementation of the National Program on Approximation of the Legal Achievements of the EC, secondary legislative provisions in 1998 were prepared and adopted:

- Ordinance on the permits for import, export and transit transportation of waste on the territory of Bulgaria.
- Ordinance on the requirements which must be met by the waste treatment facilities.
- Ordinance on the conditions and requirements for construction and operation exploitation of municipal waste disposal facilities and installations.
- Ordinance on the filling out of the report and the waste management information documents.
- Ordinance on the conditions and requirements for construction and operation of waste landfill sites.
- Order on waste classification.
- Ordinance on the requirements for industrial and hazardous waste treatment and transportation (adopted in 1999).

Waste water

Bulgaria is among the countries with the poorest water resources in Europe. The average quantity per capita is around 2,300-2,400 m^3 and the usable part of it is from 800 to 1,000 m^3 per year. The use of the available waters is restricted by their quality as a result of their contamination with communal sewer and industrial waste waters, as well as from diffuse sources. There is a tendency for increasing of the water consumption, so the deficit of water would also raise and would become a very serious social, economic and ecological problem for the country, and that is why the waste water treatment becomes so extremely important. While the water supply infrastructure is relatively well developed and the centralised water supply services 98% of the population, the degree of establishment of the sewer networks and the urban treatment plants is considerably lower and can be assessed even as unsatisfactory. Besides the poor technical condition of the sewer networks and their insufficient coverage, there also often lacks synchronisation with the capacities of the already constructed treatments plants in both senses – insufficiently loaded or overloaded. To this concerning picture there could be added also the necessity for extension, reconstruction and modernisation of the already built stations, which operate below their designed capacity.

At present in process of construction are 16 urban WWTPs, and the construction of some of them continues already for over 10-15 years. The reasons for this are the lack of clear financial plan for their realisation, shortcomings during designing, as well as inadequate policy of some of the investors and construction companies as regards their completion and bringing into operation.

BUILDING STOCK AND URBAN STRUCTURE

In the last five years construction activities in the country gained speed. The dwellings that were completed increased from 6,815 in 1995 to 9,824 in 1999. The average area of the dwellings is about 85 m^2. Usually bigger houses are built in the urban areas. The main share of the new dwellings is also in the towns. The trend in this direction is very obvious. While in 1995 only 83% of the new dwellings were in towns, in 1999 the percentage is 97. The upward tendency is also vivid in case of private and public buildings. While in 1995 only about a half of the buildings were private, now 83.4% are classified as private.

The building envelope and structure defines to a large extent the thermal integrity of the buildings and the potential for heat losses. Four types of buildings can be distinguished in Bulgaria (industrial, residential, traditional and commercial/public buildings) with different building construction methods which are used (prefabricated construction; brick building (has the lowest cost and is mainly carried out at the moment); wooden masonry; etc.). Three main types of heating systems are used: district heating, central heating and individual heating.

At the end of 1999 about 530,000 flats were supplied by district heating, that is equivalent to 16% of the existing residential stock. The highest percentage of DH supplied flats is in Sofia (64%), while in Plovdiv region the figure is 13% and in the region of Bourgas – 12%. The heating installations in the buildings are of convective type, with induced circulation and heat carrier temperature 95/70 °C.

Central heating is used mainly for public and administrative buildings. The capacity of the installations is between 100 and 2,000 kW depending on the building volume. Light fuel oil, heavy fuel oil and more rarely coal and natural gas are used. There are also a few installations providing geothermal energy as a means for heating. Buildings normally use low temperature floor pipe heating.

For those buildings not connected to the district heating, the most common way of heating is individual heating by electric heaters. More than 80 % of the population use it. The low electricity prices in the past have stimulated its use for heating and 6-7 GWh (about 25% of the electricity consumption) are used for this purpose. The sharp increase in the electricity prices, however, is the main reason that the inhabitants of these buildings have to use less electricity for heating.

In general, energy consumption in the building sector in Bulgaria is rather big, due to the low energy efficiency of the heating installations and the low thermo physical parameters of the heated buildings. Thus, the potential for the energy saving in the area of space heating is quite large, but households will conserve energy in a slow rate because:

- Households using district heating have no incentive to conserve energy since they are not billed for heat usage.
- Households are not aware of energy saving options.
- Materials for undertaking conservation measures (insulations, window sealant, thermostatic radiator valves) are expensive and sometimes difficult to be found in the market.

Table 2.11. Heat conductivity standards

Type of construction	1987 Regulation	German regulation inside temperature		Regulation in force now W/m² °C
		19°C, W/m² °C	12-19°C W/m² °C	
Outside wall	1.11-0.89*	0.5-0.4**	0.75	0.5
Widows	–	1.8	–	2.65
Deck–roofs	0.60-0.51*	0.30	0.40	0.3
Floor	0.91-0.76*	0.50	–	0.5

* For ambient air temperature within the range –12ºC to –18ºC;
** under reconstruction.

On the other hand, Bulgaria does have the major advantage that at least 80% of its housing stock is private property and mostly owner occupied, so that the occupant of a dwelling who has to pay for an investment also benefits from it. Exploitation of energy conservation potential in communal buildings is not expected to be high due to lack of incentives.

The Ministry of Regional Development and Reconstruction participates in the process of legislative regulation of the energy consumption in the buildings. It has developed an ordinance on the energy consumption and attempts to stimulate energy conservation measures in the sector.

Since April 1999 Regulation No. 1 is enforced for the heat insulation of buildings that matches the German standards for heat insulation of the buildings without setting a maximum for annual energy consumption for heating of buildings.

Comparison of heat insulation standards from 1987, 1995 and current standards is given in Table 2.11.

Currently changes and amendments to Regulation No. 1 are under development. They will address:

- Technical requirements to the outside constructions of low temperature buildings (inside temperatures 12ºC-19ºC) and duration of heating period at least four months.
- Update of Annex 3 with coefficients for heat conductivity of the up-to-date equipment.
- New Annex "Methodology for estimates on the necessary heat and energy for space heating based on improved heat balance" that describes the heat balance of a building and the methods for estimation of the annual energy consumption for heating based on DIN 4,108 – part 6 in compliance to the EU standard 832 and accounting for the Bulgarian climate conditions. It integrates the requirements of 14 EU standards part of which are already adopted in Bulgaria and the rest have to be adopted soon.

ARGICULTURE

Bulgaria enjoys excellent natural conditions for the development of agriculture. Cultivated agricultural land occupies about 4.8 million hectares or 43% of the total territory of the country. The favourable climate, soil and long-term agricultural tradition have led to a relatively well developed plant growing and animal breeding. Among the main crops are tomatoes, pepper, tobacco, grapes, wheat, maize, beans, potato, sunflower, peaches, apricots, apples, melons, nuts, etc. There are good traditions in the sheep, pig and cattle breeding, poultry farming, and bee-keeping. In 1999 the Bulgarian economy employed 3,071,913 people in total, and agriculture accounted for 25.88% of the above figure. The current tendency toward increasing private sector contribution to employment in agriculture remained unchanged as the share of the private sector was estimated at 98.3 % in 1999.

The classification of the agricultural entities **by forms of ownership** over the period 1996-1999 is presented in Table 2.12.

The above data reflects the number of agricultural enterprises registered under the relevant provisions of Bulgarian law. In 1999 the total number of agricultural entities increased by 6.2 % compared to the 1998 figure. For yet another year in a row the share of agricultural enterprises privately owned by local individuals (registered as individual traders under the Commercial Code) prevailed over the sector, accounting for 63.8 % (7,862) of 12,317 agricultural entities in total, followed by the farm co-operatives with 29.7 % (3,666) share. For comparison, in 1998, the agricultural entities privately owned by local individuals accounted for 62.4 % (7,241) of the total and the farm co-operatives for 30.9 % (3,589).

The sectoral structure **by types of farming activities** over the period 1996-99 is shown in Table 2.13.

Despite the growing number of agricultural enterprises registered in 1999, there were no consid-

Table 2.12. Classification of agricultural entities by forms of ownership, 1996-1999

Form of Ownership	Number of Agricultural Entities			
	1996	1997	1998	1999
State-owned	488	475	308	311
Municipal	10	18	21	21
Private – local legal entities	292	263	321	327
Private – local individuals	5,245	6,021	7,241	7,862
Private – farm co-operatives	3,479	3,475	3,589	3,666
Private – foreign legal entities	12	8	12	12
Private – foreign individuals	22	50	68	82
Private – foreign individuals in co-operatives	2	2	2	2
Private – associations	10	12	13	16
Private – religious organisations	3	16	16	16
Private – other NGOs	1	1	2	2
Total	9,564	10,341	11,593	12,317

Source: NSI.

Table 2.13. Classification of agricultural entities by types of farming activities, 1996-1999

Type of Activities	Number of Agricultural Entities			
	1996	1997	1998	1999
Crop Production	6,216	6,627	7,404	7,779
Livestock Production	1,566	1,688	1,874	1,957
Mixed (crop and livestock)	660	666	709	745
Services (veterinary services excluded)	1,122	1,271	1,512	1,724
Cultivation and Exploitation of Grasslands	–	89	94	112
Total	**9,564**	**10,341**	**11,593**	**12,317**

Source: NSI.

erable changes in the relative share of the different types of farming activities compared to previous years. The predominant proportion of agricultural enterprises (nearly 64 %) was involved in crop production while livestock farms accounted for nearly 16 % of the total. The farms of mixed type (crop and livestock production) accounted for further 6 %. More important, 1999 witnessed an increase in the number of service providers in agriculture by 212, which in turn led to a 1 % increase in their relative share up to 14.

Data on land area and structure **by forms of use** is presented in Table 2.14.

The arable land accounted for 77.46 % of total agricultural land whereas its share in the private sector was estimated at 92 %. Compared to 1998, the private sector reported an increase in total area by 41,000 ha while the arable land increased by 13,000 ha. The relative share of arable land in total agricultural land within the private sector remained unchanged at 92 %.

Land Reform. Restitution of Agricultural Land. Until December 27, 2000, the rights of the legitimate owners to a total of 5,679,600 ha or 99.79 % of the agricultural land subject to restitution were restored within existing or recoverable physical boundaries, or on the basis of land division plans, including:

- Within existing or recoverable physical boundaries – 1,472,700 ha or 25.98 % of the total land subject to restitution.
- On the basis of land division plans – 4,122,800 ha or 72.72 %.

The second half of 1999 witnessed the launch of a procedure for the compensation of former landowners whose land could not be restituted through the regular procedures provided by law. The issuance of certificates to the holders of compensatory bonds is currently underway.

The existing legislation enables the full transferability of compensatory bonds and broadens the scope of their validity as a legal tender. Certain observations prove their increasing attractiveness to potential buyers. The legislative provisions allowing transactions with restituted land against compensatory bonds will free additional SLF resource needed for compensation of former owners

Table 2.14. Land area and structure by forms of use, 1998-1999

Form of Use	All Farm Categories x 1000 ha		Incl. Private Farms x 1000 ha	
	1998	1999	1998	1999
Total Agricultural land	6,203	6,203	5,021	5,062
Arable land	4,805	4,805	4,621	4,633
Crop fields	4,280	4,284	4,143	4,160
Planting area	3,205	3,004	3,142	2,944
Other land	1,074	1,280	1,001	1,216
Natural meadows	294	294	260	259
Cultivated pastures and other categories of land	13	13	6	6
Perennials (orchards, strawberries and other permanent crops)	218	214	212	208
Permanent grasslands and pastures	1,398	1,398	400	429

Source: NSI.

and land-settlement of landless and under-propertied members of society.

Since the beginning of the **privatisation process**, as at December 31, 2000, the Ministry of Agriculture and Forestry had launched 792 individual procedures for the privatisation of agricultural and agro-food entities, including 664 whole enterprises and 128 detached parts. The number of privatisation deals concluded over the same period totalled 508, including 391 deals on whole enterprises and 117 deals on detached parts. The payments contracted under the deals amounted to BGN 235,644,000 whereas only the investment commitments totalled BGN 239,569,000. These investments could have a crucial role for improvement of energy efficiency and GHG emission mitigation in the sector.

Crop Production

Crop production plays a strategic role in both the agricultural sector and the national economy as a whole. Its major purpose is to provide the country's population with sufficient quantities of food products and to ensure the inflow of raw materials to the livestock sub-sector.

Cereals and pulses dominate crop production with a relative share ranging from 46 % to 50 %, followed by industrial and oil-bearing crops (18 %), fruits (6 %) and vegetables (2.2 %).

According to NSI data, the area under cereals and pulses totalled 1,815 thousand ha in 1999, declining by 239 thousand ha compared to 1998. The 1999 output amounted to 5,207 thousand tons, stepping down by 180 thousand tons on a year earlier (Table 2.15).

In general, the area under cereals and pulses accounts for 39 % to 46 % of all arable land. Wheat, maize, barley, oats and beans are the major crops traditionally favoured by producers and consumers. Wheat accounts for about 60 % of the total output of cereals and pulses. The domestic demand ranges from 80 % to 85 % of total output or 2.4 to 2.7 million tons used mainly for production of flour, feed and seeds.

In 1999, the area under **industrial and oil-bearing crops** totalled 681 thousand ha, increasing by 31.6 thousand ha compared to 1998.

The tendencies in the outputs are not stable. Thus in 2000 the crops suffered from the severe drought and the outputs are lower compared to previous years.

In terms of essential oils perennials, the latest developments in production indicate a tendency toward introduction of new species of essential oils perennials, namely lavender, bee balm, mint and salvia.

The total area under sugar beet has been declining constantly over the past few years. The output is insignificant compared to the domestic demand for sugar. Low farm-gate prices and cheap imports of raw sugar cane make sugar beet unattractive to producers. The same is valid for cotton.

The last few years witnessed a continued decline in tobacco production. The producers failed to procure the quantities contracted under the output quotas (pursuant to the provisions of the Tobacco Act). This situation is due mainly to the inefficient mechanisms used to determine the quotas.

In 1999, the production of **vegetables, potatoes, melons and watermelons** amounted to 1,317,459 tons in total, stepping down by 6 % on a year earlier. Potatoes dominated production with a relative share of 43%, followed by toma-

Table 2.15. Areas under wheat, average yields and output volumes, 1998-1999 (Source: NSI)

Region	Areas (ha)		Average Yields (t/ha)		Output Volumes (tons)	
	1998	1999	1998	1999	1998	1999
Wheat	1,141,682	966,282	2,805	2,735	3,203,359	2,642,973
Barley	289,948	254,690	2,472	2,567	717,105	653,799
Maize	477,140	455,026	2,731	3,818	1,303,436	1,739,969

toes (32%) and peppers (16%). All other vegetables accounted for only 9% of the total output.

The analysis of available data clearly indicates the extensive characteristics of 1999 production. Small-sized plots, deviations from standard technology and unfavourable weather conditions during different stages of growth altogether resulted in lower yields and deteriorated output quality, making Bulgarian production less competitive on the international markets.

The 1999 **fruit** production totalled 289,059 tons, stepping down by 12 % on a year earlier. Apples dominated production with a share of 32%, followed by plums (23%), peaches (13%) and cherries (11%). At the same time productive orchards areas stepped down by 3 % on a year earlier. The insignificant decrease is partially due to the fact that aged orchards have not been totally eradicated but put into further use in some cases. On the other hand, the young orchards entering productive maturity have contributed very little to the total area.

The unfavourable age composition (about 60 % of all orchards are over or close to the age of eradication) and deviations from standard technologies result in deteriorated output quality, making Bulgarian production less competitive on the international markets. While producers are losing traditional export markets there has been a constant increase in fruit imports.

Grape production also declined by 4 % compared to 1998. The fall in production is directly related to diminishing total area of productive vineyards. Recent years witnessed insignificant changes in total area due to the fact that aged vineyards have not been totally eradicated but put into further use in some cases. On the other hand, recently grown vineyards entering productive maturity have contributed very little to total area.

Livestock Production

The changing economic conditions following the transfer of property rights to the private sector and the introduction of market mechanisms in agriculture as a result of trade and price liberalisation caused a substantial effect on the development of livestock production in Bulgaria.

At present, the first stage of structural reforms involving privatisation of state-owned companies is completed. As of January 1, 2000, the private sector accounted for 98.5 % of cattle numbers, 99 % of sheep numbers, 99.6 % of pig numbers, 98.1 % of poultry numbers, 99.8 % of beehives and 100 % of feed-processing facilities in the country.

The difficulties encountered in the course of reforms resulted in decreasing livestock numbers. 1999 witnessed a sharp fall in water buffalo, sheep, pig and poultry numbers, and to a lesser degree in goat numbers. Horse and cattle numbers increased insignificantly while the number of beehives registered a substantial rise (Table 2.16).

Cattle and Water-Buffalo Breeding The last few years witnessed a continued trend of stabilisation and partial recovery in cattle numbers. The 1999 reports indicate a 1.5 % rise on a year earlier. Despite the disruptions in the sector, the on-going process of herd rehabilitation is an important factor contributing to the increase in cattle numbers. During the first half of 2000, cow numbers continued to rise, although on a small scale, which resulted in increased output capacity in this segment of livestock production. However, over the same period, overall cattle numbers declined by 0.9 % due to a certain number of animals having been slaughtered.

In contrast, water-buffalo numbers continued to decline, despite the exceptional qualities of water buffalo's milk and the profit potential offered by production.

Sheep Breeding In 1999, sheep numbers continued to decline, registering a 9.1 % decrease compared to 1998. The major factors contributing to this adverse situation are:

- Low profitability in sheep breeding due to seasonal specificity of milk production and inconsistent market demand for wool.
- Low market prices of sheep products resulting in reduced incentives among producers.
- Depopulation of rural areas, especially in the mountainous regions featuring large expanses of

Table 2.16. Livestock numbers, 1998-1999

Indicators	1998	1999	99/98 %	2000 preliminary	2001 forecast	2000/1999 %	2001/1999 %
1. Cattle	671,376	681,661	101.5	681,000	700,000	99.9	102.7
O/w cows	423,949	433,820	102.3	440,000	450,000	101.4	103.7
2. Water-buffaloes	10,365	9,277	89.5	9,000	10,000	97.0	107.8
O/w water-buffalo cows	6,329	5,880	92.9	5,500	6,000	93.5	102.0
3. Sheep	2,773,702	2,548,884	91.9	2,600,000	2,700,000	102.0	105.9
O/w reproductive ewes	2,057,575	1,947,276	94.6	2,150,000	2,300,000	110.4	118.1
4. Goats	1,047,611	1,046,286	99.9	1,050,000	1,050,000	100.4	100.4
O/w reproductive nanny-goats	830,698	846,835	101.9	850,000	850,000	100.4	100.4
5. Pigs	1,721,497	1,512,344	87.9	1,356,000	1,163,000	89.7	76.9
O/w reproductive sows	201,491	171,389	85.1	150,000	150,000	87.5	87.5
6. Poultry	15,685,644	14,963,142	95.4	15,400,000	15,600,000	102.9	104.3
O/w laying hens	8,896,131	8,304,375	93.3	8,400,000	8,450,000	101.2	101.8
7. Horses	133,370	133,700	100.2	133,000	133,000	99.5	99.5
O/w reproductive mares	49,274	49,370	100.2	49,300	49,300	99.9	99.9
8. Beehives	311,064	334,865	107.7	350,000	370,000	104.5	110.5

Source: NSI

natural pastures, which constitute an important input reserve and enable environmental production.
- Spreading of contagious diseases among sheep.
- Small proportion of female lambs is allowed to reach reproductive maturity.

Goat Breeding In recent years, goat numbers have been constantly on increase, and the average milk yield per nanny-goat remained relatively stable.

Pig Breeding The pig number sustains the negative trend.

Poultry Breeding The structural reforms in poultry production are close to completion. The private sector accounts for over 98.2 % of poultry numbers and for all poultry-processing facilities in Bulgaria.

Horse Breeding According to NSI data, as at January 1, 2000, horse numbers amounted to 133,700, donkey numbers to 220,736 and mule numbers to 15,729. The private sector accounted for 98.65 % of overall horse numbers and for 100 % of donkey and mule numbers. However, large proportions of overall numbers do not meet the international requirements for reproductive breeding. Similar situation occurs in racing and mounting horse breeding.

Bee Keeping Comparatively quick return of investment and availability of dedicated finance in the *State Fund Agriculture*'s portfolio result in increasing interest in bee keeping among producers and therefore contributes to growing honey output.

According to the Regular Report of EU on Bulgaria for 2000, agriculture in Bulgaria accounted for 17.3% of GDP in 1999, as opposed to 21.1% in 1998. Employment in agriculture and forestry has slightly increased over the past year accounting for 26.6% of total employment in 1999, compared to 26.2% in 1998.

In 1999, EC imports of agricultural products originating in Bulgaria increased by 10% to 264 million. EC exports to Bulgaria decreased by 14% to 211 million. Bulgaria's trade surplus amounted to 53 million in 1999, compared to a deficit of 7 million in 1998. The most important product groups in terms of EC imports (76.8%) from Bulgaria are alcoholic beverages and oil seeds. As far as EC exports to Bulgaria are concerned, the most important products are meat and edible meat offal. Exports of Bulgarian wine represent approximately one third of the total agricultural exports of the country.

Negotiations for further liberalisation of bilateral trade with the EC were concluded in May 2000 and entered into force on 1 July 2000 through autonomous measures. As a consequence, two thirds of EC imports of agricultural products from Bulgaria are now exempt of duties.

Stimulating private enterprising in agriculture, releasing credits, rural development through use of EC SAPARD funds according to the adopted National Agriculture and Rural Development Plan for 2000-2006 (NARDP), and harmonisation of Bulgarian legislation with EC standards have been identified as main priorities of the Ministry of Agriculture and Forestry (MAF) in the updated 2001 government program.

FORESTRY

According to data provided by the Ministry of Agriculture and Forests (the National Forestry Board) the forest resource area for 1996-2000 period has comparatively stable ranges of 3.88 to 3.91 mln ha. Forests cover 86.6 to 86.8% of this area with a slight tendency for an increase from 3.36 to 3.40 mln ha. This tendency is due to the reduced areas with cuts and not recovered forests, and reduced actual uprooting. The share of forestry in the GDP is about 0.5%.

Since the adoption of the Forest Restitution Act in 1997, decisions for the restitution of 534,213 ha were taken, which means 85.35% of the total forest area addressed by the Act. The ownership of private owners is 51.95%, municipalities 43.07%, schools – 0.82, religious entities – 3.26, cooperative and trade organizations – 0.06%, other – 0.84%. The ratio of state to non-state forests is 85.2% to 14.8% (8.1% of these forests belong to private owners).

The trends in the types of forests are as follows: Coniferous forests – decrease of their tentative share over the 1996-2000 period from 34.8% to 32.8%. Their area is 2.26 mln ha or 66% of the total afforested area. Deciduous forests have increased their tentative share over the period from 65.2 to 67.2%. In 2000 the total area of protected and recreational forests or forests in protected areas according to article 5, para. 2 of the Forestry Act was 1.33 mln ha or 34.1% of the forest area, including: 1.04 mln ha of protected and recreational forests; 294 thous. ha of forest in protected areas; 119.2 thous. ha of National Parks. In 2000 two new National Parks were added "Rila Monastery" and "Persina". Thus the area of the national parks reached 237,610 ha, 159,185 ha of which belong to the forestry reserve. Protected areas are 103 with total area of 159,185.1 ha, 14,967 ha of which belong to the forestry reserve. Nature landmarks are 426 covering 23,153.3 ha, 9,080 ha of them being forest reserves. The effective protection of forests is among the key priorities in NDF operations. Forest guards secure an overall area of 3,877,557 ha including 3,351,366 ha of forests. The organisational responsibilities have been assigned to 16 RDFs and 171 forestry stations.

The trends in the forest type distribution are expected to be kept despite the change in the ownership. This assumption has to do with the expected changes in the Bulgarian forests due to climate change.

After restitution an increased interest for afforestation of low-productive agricultural, mountain and eroded lands is observed, as well as creation of species for intensive wood production. The state will support the initiative of private owners offering co-financing under the accession program of EU – SAPARD, and also using legislative instruments.

The key **priorities** in the forestry policy are conservation and expansion of forest; sustainable development and protection of their biodiversity; multifunctional utilization of forest with balance between environmental and economic interest in the free market and diverse ownership of forests; and introduction of environmental certification of forests.

They are set in the "National program (strategy) for sustainable development of forests and forest resources of the Republic of Bulgaria" that is under elaboration. It declares the national priorities in the sector, as well as the strategic goals and measures in the field of development of forest resources, protection of biodiversity and genetic resources of forest flora and fauna; and sustainable reproduction, multifunctional and adaptive forest management.

Stated priorities are incorporated in the new forest **law**. Following the adoption of the two main acts in the sector in 1997, namely the Forestry Act and the Forest Restitution Act, in the period 1998-2001 the enumerated laws were adopted: Hunting and Game Protection Act, guidance for the application of the act; 11 regulations; 6 instructions and other documents supporting the reform in the forestry sector.

The sectoral action plan of the Ministry should envisage specific economic mechanisms to stimulate and involve municipalities and private owners in the afforestation activities, forest preservation, as well as keeping of wood cover (according the Law on restitution of forests and areas from the forest stock and the priorities in the National Directorate on Forests).

The tendency for an increased wood reserve is kept. In 2000 it was 526.1 mln m^3, while in 1995 it had been 456.7 mln m^3. Annual increments changed from 12.81 mln m^3 in 1999 to 13.69 mln m^3 in 2000. Corresponding increment per ha are 3.8 m^3 and 4.03 m^3. Basic statistical data on the Bulgarian forests for the 1955-1995 period are given in Table 2.17.

The data for the 1955-1995 period were provided in the Second National Communication. Some of the tendencies discussed before are continued in the current period. For example, data indicates that the mean annual increment of wood in Bulgarian forest continues to increase and has

Table 2.17. Basic data on the Bulgarian forests for 1990-2000

Characteristics	1990	1995	1996	1997	1998	1999	2000
1. Total area, million ha	3.77	3.77	3.88	3.88	3.899	3.894	3.914
2. Afforested area, million ha	3.26	3.26	3.36	3.35	3.37	3.37	3.398
3. Percentage of conifers	37.00	32.70	36.8	34.5	33.4	33.7	32.8
4. Protected forests, %	30.90	39.80	n.a.	n.a.	n.a.	34	34.1
5. Mean increment, million m^3	10.97	12.35	n.a.	n.a.	n.a.	12.81	13.69
6. Total volume, million m^3	396	456.7	n.a.	n.a.	n.a.	472.2	572.2
7. Cut (planned), million m^3	6.37	6.24	6.54	6.16	6.65	6.80	6.81
8. Cut (actual), million m^3	4.68	4.76	5.87	5.35	5.49	5.18	4.63
9. Produced seedlings, million (n)	347	156	137	144	119	90	62
10. Afforestation , x 1 000 ha	28.04	9.165	10.5	10.22	7.51	7.74	6.31

reached to 13.69 million m^3/year, i.e. more than twice as high compared to 1955. The outputs of the long-term forestry policy in Bulgaria are positive. As shown in Table 2.18 the carbon sink in Bulgaria changed from -0.36 Mt in 1955 to 2.44 Mt in 2000 and the CO_2 sequestered grew from -1.33 Mt to 8.93 Mt in 2000. The tendency is well represented in Fig. 2.9 that provides information on the carbon balance of the forests in Bulgaria over the last 40 years.

Offences against the forestry act, and areas affected by fire

After 1996 there is a tendency for increased number and areas affected by fires. The summary information for the period is provided in Table 2.19.

In 2000, 13,924 ha of affected areas were with coniferous trees and 37,391 ha – with deciduous vegetation. Besides the natural coniferous areas, terrains created in the steep erosion prone regions were also affected.

The drastic increase of fires in 2000 and 2001 is explained by the extremely high temperature and droughts in summer combined with a complex of other factors. The fires had negative impacts on the wood production and on the entire forest ecosystems. Part of affected areas is covered in Annex I of EU Directive 92/43 or is included as priority areas in the national strategy on protection of biodiversity. The recovery of these areas in their natural characteristics poses many challenges related to the requirements in selection of species, measures and types of intervention.

Adaptation

The forest zones vulnerable to climate change are defined during the Country Study to Address Climate Change (1994-1996). The measures to adapt forests to climate change are priority in forest resource management of low part of the country – up to 800 m above sea level. The directions for adaptation are given in the National Climate Change Action Plan. The tentative selection of species for afforestation and priority to deciduous species that are more adaptive to climate change are the most realistic measure for adaptation of forest ecosystems.

Data on the participation of forest types in afforestation for the 1996-2000 period indicate a steady trend of domination of deciduous species. The average percentage of those species is 63.3%, while coniferous species account for 36.7%. Afforestation practices tolerate local tree species and change according to the specific regions in the country.

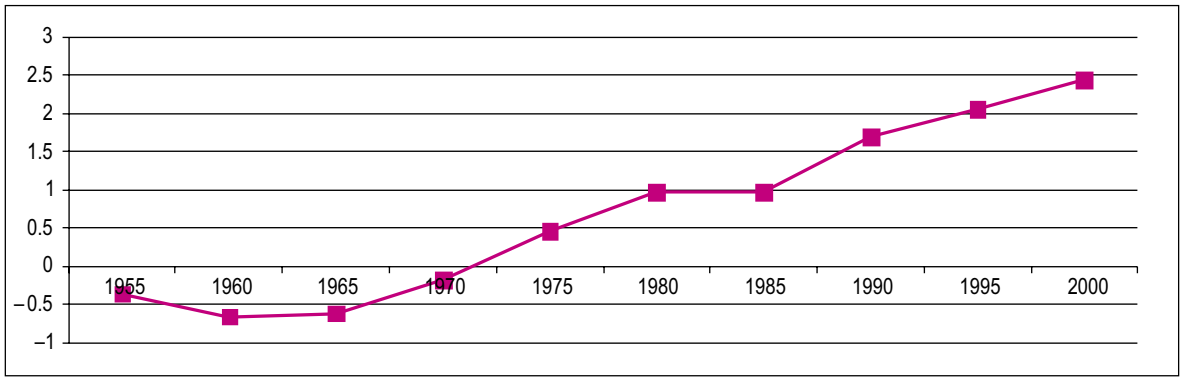

Fig. 2.9. Changes of the amounts of carbon accumulated in Bulgarian forests in the period 1955-2000 [Tg]

Table 2.18. Carbon balance of the epigeaus biomass of the Bulgaria forests for the 1955-2000 p eriod

Year	Increment	Yield	Balance	ODM K=0.6	Carbon accumulation	CO_2 offset
	million. m^3				million. T	
1955	6.10	7.45	–1.35	–0.81	–0.36	–1.33
1960	6.15	8.57	–2.42	–1.45	–0.65	–2.40
1965	5.90	8.16	–2.26	–1.36	–0.61	–2.23
1970	6.47	7.14	–0.67	–0.40	–0.18	–0.66
1975	6.83	6.32	0.51	0.31	0.14	0.50
1980	7.62	5.91	1.71	1.03	0.46	1.70
1985	9.11	5.53	3.58	2.15	0.97	3.54
1990	10.97	4.68	6.29	3.77	1.70	6.22
1995	12.35	4.76	7.59	4.55	2.05	7.50
1999	12.81	5.18	7.63	4.58	2.06	7.54
2000	13.69	4.63	9.06	5.44	2.44	8.93

OTHER

Policy priorities

The EU accession talks were initiated in the beginning of 2000, and the Government set up an ambitious agenda to complete them by 2006. Bulgaria undertook the commitment to fully harmonise its legislation and transform its institutions in compliance with EU standards. Major steps are made under the updated Government Programme 2001 aimed at mobilising the investment market. The Cabinet focuses its efforts on promoting the private business development and measures are taken for elimination of many licensing and permissive regimes, which are outdated or too complicated. The regulations connected with the EU legislation will be preserved. Programme 2001 envisages public investments through the major infrastructure projects, thus stimulating the creation of new jobs and expanding consumption.

Decisions of the European Council in Luxembourg (December, 1997) and Helsinki (December, 1999) put the beginning of a new period of the relations between Bulgaria and the European Union. With the beginning of the accession negotiations /February, 2000/ the preparation for accession was oriented towards assuming and implementing of the obligations of full membership. Bulgarian negotiation strategy is based on the assumption that Bulgaria will be a full member of the EU by the end of the year 2006. This date serves as a basic orientation for the national schedule in the preparation for assuming the obligations of the full membership.

The immediate foreign policy objectives of the Republic of Bulgaria, laid down in the National Strategy for Accession to the EU (March, 1998) are achieved: positive assessment for the progress of Bulgaria in the first (1998) and the second (1999) Regular Report from the European Commission on the implementation of membership criteria and the priorities of the "Accession Partnership". This paved the way for the decision taken in Helsinki for opening the accession negotiations.

With the present up-dated National Programme for the Adoption of the Acquis the Bulgarian government aims at consolidating the efforts for preparation and assuming the obligations of membership in the pre-accession period.

2.5.3. Environmental protection. Monitoring. Executive Environmental Agency

National Air Quality Monitoring System (NAQMS) exists in Bulgaria since 1975. The Institutions included in the NAQMS are:

- the Ministry of Environment and Water (MOEW),
- the Executive Environmental Agency (EEA),
- Regional Inspectorates of Environment (RIE), and
- the National Institute for Meteorology and Hydrology (NIMH).

Table 2.19. Summary information about areas affected by fires

Indicator	1996	1997	1998	1999	2000
Number of fires	246	200	578	320	1,710
Affected area (total)	2,150	776.7	6,967	8,290.8	57,406.2
Forest areas affected	1,933.2	685.3	5,913.2	7,635.7	51,320.2

NAQMS consists of 68 stations: 16 of them are on-line; 52 with manual sampling, and 6 mobile on-line stations. Monitoring stations are situated in 39 villages and cities. Air quality is monitored mainly in areas where there exists a health risk for the population due to air pollution (e.g. close to big industrial enterprises, etc.). The measurements cover dust, iron aerosols, SO_2, NO_2, hydrogen sulphide, ammonia, phenol, methane, NMVOC, chlorine, hydrogen chloride, CO, NO, O_3 and heavy metals: Cd, Mn, As. The system uses common methods. Samples for manual stations are taken at set intervals and hours 4 times per day and 5 times per week that are the same for the entire country. Unified methods are used also at the laboratories of the EEA and RIE. The national database of the air quality is archived in EEA. Since 1 January 2000 three new regulations regarding air quality are in force that requested changes in data format. The regulations are in compliance with the EU Directives. The institutions responsible for emission control are the MOEW and EEA, RIE, NSI. The emissions of 150 large point sources are controlled by the EEA and RIE. Other 2000 point sources are responsibility of NSI. All emissions are grouped in 11 major sources: Thermal power plants; Residential combustion; Industrial combustion; Nn-combustion industrial processes; Extraction and processing of fossil fuels; Solvent use; Road transportation; Other transportation; Municipal Solid Waste; Agriculture and Other sources.

Water quality is monitored separately for surface water and underground water. There are 253 points for monitoring of surface water in the country based on running water and used 4-12 times annually for the estimate of various indicators such as water composition, water flows, temperature, oxygen, etc. Underground water is monitored using a network of sampling points of MOEW and the Committee of Geology and Natural Resources. The number of the points is 225. Seasonal or half year monitoring is undertaken at these points with measurements of various characteristics such as water debit and level, temperature, oxidation, etc.

Forests systems are also monitored in Bulgaria. There is a monitoring network developed in the country with 280 sample areas. The indicators under control are:

Level 1:
- Assessment of three leaves.
- Taxology of plants.
- Leave analysis.
- Soil analysis.
- Phitocenetic characteristics.

Level 2 includes characteristics given in Level 1 and data on meteorological parameters, priority emissions, biotic impacts.

Soil monitoring is also part of the automated eco-monitoring in the country. The measuring stations are distributed through the country following a network that allows timely and precise recording of changes in soil characteristics.

2.5.4. Education

Environmental issues are part of the policy of the MES and as such it is reflected in the school programmes for primary and secondary schools and in the impetus to realisation of projects based on the research activities in the field.

Ecology and environmental protection are included in all grades of the school programs. There is no a particular subject "Ecology" in general schools in Bulgaria. Global environmental issues and climate change, in particular, are part of the State requirements for school contents in the new school programmes of subjects: Biology and Health Education; Geography and Economy; Chemistry and Environmental Protection, and Physics and Astronomy. These requirements enter in force since 2000/2001 school year.

In the professional schools environmental protection is addressed in several ways:

- Health education, skills and habits for environmental protection since early childhood.
- Professional training and education in school – professional schools, colleges.
- Better qualification of staff for environmental protection activities – centres for professional training and educators' education centres.

Professional education in Bulgaria covers 126 professional areas. In each of them, depending on its specificity, there is a section devoted to environmental protection. During the 39th National Conference "Chemical education at the brink of 21st century" (5-8/10/2000), organised by the Council of Chemists in Bulgaria and MES, there were presented projects developed by students regarding the opportunities of the theoretical chemistry and the perspectives the environmental problems to be solved. Some of the topics were: Ecology and Chemistry; Ozone – a friend and an enemy; Chemistry on trial of 21st century, etc. In 26 technical schools for chemical industry about 450 students annually obtain background in environmental protecting

technologies. The school programme is continuously updated.

Since 1999 Regulation for the uniform state requirements for University education in the field *Ecology and environmental protection* and for professional qualification as an "Ecologist" was adopted by a Governmental Decree from 26/09/1999 (State Gazette 84/1999). The higher education (Bachelor and Master degree) in the field can be obtained in the Universities meeting the requirements of the Act on Higher Education and of the Regulation. Currently 3,377 students study environmental protection in the Universities. For school year 2000/2001 according to Governmental Decision 401/99 another 660 students were accepted, including those in private universities.

Pursuant to the Regulation for the uniform state requirements for University education in the field of Biology, *Ecology and Environmental Protection* is a compulsory discipline in the University programme.

2.5.5. Tourism

Tourism is one of the key sectors in Bulgaria due to the specific nature and climate of the country. Bulgaria offers diverse forms of tourism as health tourism, hunting and fishing, nautical tourism and cruising, congress tourism, etc. The abundance of mineral water springs in the interior of the country and near the sea, and mountain resorts create excellent conditions for the development of balneological tourism. The unique cultural and historical monuments, including the ones from Thracian and Roman times, the original folklore, customs, and the specific national cuisine and beverages are a major attraction for the foreign tourists. The resorts along the Black sea coast – Golden Sands, Sunny Beach, Albena, Duni, Eleni, Sunny Day, Riviera are preferred for the summer vacation. For the fans of winter sports, the mountain resorts Pamporovo, Borovets and Bansko offer very good conditions and competitive prices. It is worth mentioning that the capital city Sofia is located very close to the Vitosha mountain, where the skiers can find good recreation facilities only 30 min away from the city centre. Bulgaria has the unique Rose Valley near the town of Kazanluk – a world famous place with the growing of roses and the extraction of highest quality rose oil, used in the perfume industry by the most prestigious companies. According to preliminary data, the number of foreign tourists visited Bulgaria in 2000 is about 2.4 million (13% increase in comparison to 1999).

2.5.6. Others

Ministry of Foreign Affairs follows its commitments under the NCCAP and UNFCCC during the negotiations regarding the accession of Bulgaria to the EU. The issue is addressed by all units participating in the coordination of the activities on the preparation of Bulgaria for the accession and in the negotiation process. Climate change is included as a priority in the Partnership for Accession, in the relevant chapters in the National Programme for the Adoption of the Acquis and of working groups 22 "Environment" and 14 "Energy" of the Coordination Council for Preparing the Republic of Bulgaria for EU Accession.

Within the meeting of Working group 6 "Transport, Trans-European Networks, Energy and Environment" (20-22 March 2001, Sofia), Bulgarian side presented its achievements in the capacity building and legislation in the field. There were separate items in the agenda of the meeting in sector "Energy" regarding "After Kyoto, energy efficiency" and "Harmonisation of regulations and standards in the field of environment". Under the first item the development of energy efficiency policy (goals, tasks, progress, time frame), the level of integration of EU Asquis into the field of energy efficiency (labelling, energy efficiency standards) was reported. Information was provided on Bulgarian participation in SAVE II, PHARE, TAIEX programs; and the cooperation and possibilities for participation in the 5th Framework Programme and in ALTERNER II:

- Four projects under SAVE II.
- Three projects under UNECE within the framework of *Development of Energy Efficiency Project for Mitigation of Climate Changes* under the *Energy Efficiency 2000* programme.
- Start-up of *Strategy for Implementation of Energy Saving Contracts with Proven Results in the Republic of Bulgaria*, NEEA together with the Energy agency of Berlin and MES.
- Start-up of a project *Sustainable Regional Energy Planning*, financed by the British Know How Fund.
- Establishment of Information Centre to the NEEA.
- Establishment of mobile laboratories on energy efficiency.

The priorities in the field of legislation on energy efficiency were also reported, including elaboration of the legislative base related to the rational utilisation of energy (standards, marking, labelling) and harmonization with the requirements of the EU.

1.1. Elaboration and adoption of sub-laws to the LEEE (responsible entity is EEA):

- A standard determining the system for reporting energy and fuel consumption indicators in the manufacture of goods or provision of services under Article 144 of LEEE.
- A standard determining the method of marking under Article 145 of LEEE of the operational energy consumption indicators for goods – both locally produced and imported, as well as for the buildings which, during regular operation consume electricity, heating energy, natural gas, fossil and liquid fuels.
- An ordinance specifying the terms and conditions for issuing certificates of conformity to the established EE standards of goods using, generating, converting or conserving energy under Art. 147 para. 3 of LEEE.
- An Ordinance specifying the terms and conditions for expertise and surveys for EE for objects which annual fuel or energy usage exceeds the limits determined under art. 149, para. 2 and para. 3 of LEEE.
- An Ordinance specifying the terms and conditions for issuing permits for expert assessments of EE objects with yearly fuel or energy usage exceeding the limits determined under art. 152, para. 3 of LEEE.
- Tariff for the taxes gathered at applications submission for issuing of permits for energy efficiency expert assessments and investigations (art. 152, para. 4 of LEEE).

1.2. Elaboration and adoption of legislation in compliance to the Framework Directive of EU on Labelling of Household Appliances.

The main goal is elaboration of a normative document to comply with the Framework Directive, as well as setting of legislation on the labelling of various household devises. Pursuant to art. 7 of the Law on the customer protection and to the trade rules there are documents elaborated following Framework Directive 92/75, and Directive 94/2 on Refrigerators, Freezers and Combinations Thereof and Directive 98/11 on household lamps. They had to be adopted until the end of 2001. The same is valid for Directive 96/57 on Refrigerators, Freezers and Combinations Thereof and Directive 92/42 on boilers on gas and liquid fuel, which have to be adopted until the end of this year.

Until the end of 2002 documents compliant to the following Directives should be elaborated and adopted: Directive 95/12 on Washing Machines; Directive 95/13 on Dryers; Directive 96/60 on Combined Washing / Drying Machines; Directive 97/17 on Dishwashers.

Administrative capacity: Currently there is a J I unit established to the NEEA that is institutionally independent. It helps with the initiation, support, projection and implementation of J I projects aiming at GHG emission reduction and therefore to climate change related policy.

There is unit "Ecoenergy" established in the SAEER with activities in the fields of: Energy efficiency in energy plants; Environmental protection in energy plants; Use of renewables for heat and electricity generation.

In the process of preparing and financing the above-mentioned programmes, the subject of environmental protection has become an integrated part of the economic reconstruction and privatisation. Environmental audits, including financial incentives for carrying out activities that meet environmental requirements, as well as plans for self-monitoring and recovery programmes for old environmental damage, are integrated into the privatisation process for national enterprises. These audit requirements are now a regular part of privatisation contracts and provide a real possibility for taking into account the environmental requirements in the process of the structural reform.

Climate change issue was included in the updated report of the review of the country application of EU legislation in the field of environment. In this report that is indispensable from the opening of the negotiations on Chapter "Environment", it is stated that Bulgaria ratified the UNFCCC in May 1995 and signed the Kyoto Protocol in 1998 setting reduction target of 8%. A special attention is paid to the adoption of the NCCAP and the establishment of an Interministerial commission to control and co-ordinate the activities under the Action plan. European Commission considers that the plan covers required information under Decision 99/296 and the GHG mitigation measures, giving also GHG emission projections till 2010. A special attention is given to the newly created mechanism for gathering necessary information and preparation of the reports on the emissions from the established working group to work under the supervision of the Interministerial commission. The reliability and transparency of the information based on NSI data is confirmed. The report states that the country is in position to present its Third National Communication.

3. GREENHOUSE GAS INVENTORY INFORMATION

3.1. INTRODUCTION

As a Party to the UN Framework Convention on Climate Change (UNFCCC), Bulgaria has the commitment to develop and periodically update its annual inventories of greenhouse gas (GHG) emissions by sources and removals by sinks using the GHG inventory methodology approved by the UNFCCC. Compliant to these commitments, Bulgaria submits annual GHG inventories. The time series starts with the base year which for Bulgaria is 1988.

First national inventory has covered the 1988-1994 time period and was developed as a part of the project Country Study to Address Climate Change. Further on, annual inventories were prepared annually, reported to the UNFCCC Secretariat and included in the National Communications and in the National Climate Change Action Plan.

Inventories cover emissions of main GHG gases carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O); GHG precursors (NO_X, CO and NMVOCs); and sulphur dioxide (SO_2). The emissions of Hydrofluorocarbons (HFCs) and Perfluorocarbons (PFCs) were addressed in the studies since the base year in Bulgaria for these gases – 1995.

3.2. METHODS OF ESTIMATION

All the inventories followed the IPCC Guidelines on National GHG Emissions by Sources and Removals by Sinks, starting with the 1994 Draft version, 1995 official versions of the guidelines and going to the Revised 1996 IPCC Guidelines and the IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories. The inventory included in the Third National Communication is based on the Revised 1996 IPCC Guidelines and the IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories. Other estimation methods have been used whereas appropriate in order to achieve better estimates for particular cases, e.g. GHG emissions from transport sector. GHG emissions are computed using data for each category and each economic sector multiplied by the specific emission factors. The major activity data are taken by the official publications of the Bulgarian National Statistical Institute (NSI).

The estimation of the GHG emissions from fuel combustion is based on the "bottom-up" approach and emission factors' values were determined by experimental measurement or expert judgements, or default emission factors recommended by the IPCC Guidelines. The emissions from mobile sources are calculated according to the IPCC structure for vehicle types but with additional split of the vehicles according to their weight and engine volume in compliance with the guidelines in CORINAIR94. Thus a list of emission factors is coined which corresponds to the Bulgarian conditions.

3.3. COMPARISON WITH THE SECOND NATIONAL COMMUNICATION

Two recalculations of the GHG emissions were made so far. The first one was for the emissions included in the First National Communication, when some adjustments to the previous estimates were made based on the experience and the new data available. In 2000, a second recalculation was made that covered all the years in the time series. The reason was the application of the Revised 1996 IPCC Guidelines that request for estimation of some new sources, as well as the change in the default methods for some sources (e.g. N_2O emissions from agricultural soil). Meanwhile some new activity data was made available that contributed to the precision of the estimates.

The inventory provided in the current National Communication starts with 1988 (the base year for Bulgaria). GHG emission estimates for this year were provided in the Ist and IInd National Communications, but the figures in this NC are those estimated after revising the methodology. This has brought to an increase in the emission estimates.

The main differences in comparison to the Ist and IInd National Communication are given in Table 3.1.

Generally the reasons for the changes in the recalculated emissions are the same for the entire series of recalculated emissions for the period 1988-1997. 1998 is the first year where the estimates are made following directly the Revised 1996 IPCC Guidelines. 1999 estimates follow the same methods with some amendments and revisions consistent with the Good Practices Guidance.

Table 3.1. Comparison of inventories included in the First and Second National Communic ation

Specify the sector and source/sink category[1] where changes in estimates have occurred:		GHG	RECALCULATION DUE TO CHANGES IN: Methods [2]	Emission factors [2]	Activity data [2]	Addition/removal/ replacement of source/sink categories
1.A.	Fuel Combustion Activities	CO_2, CH_4, N_2O	NO	Changes in EFs. EFs used over the entire period are the same.	Precision and rearrangement of activity data.	The emissions from autoproducers are removed to the subcategory of Manufacturing industries and construction
1.B.	Fugitive Emissions from Fuels – Solid fuels	CH_4	Global average method is applied to all years (slight change in the conversion factors used)	NO	Update of the activity data for some subcategories	
	Fugitive Emissions from Fuels – Oil and Natural Gas	CH_4	NO	Change in EF for transportation/distribution of natural gas; Application of different factors for leakage from industrial and commercial sector	Update of the AD for some subcategories	Emissions from venting and flaring are added
2.	Industrial Processes	CO_2	NO	EFs added for the new sources	Slight revision of AD	Emissions from Calcium Carbide added to emissions from Mineral Products, Emissions from Aluminium and ferro-alloys production added to the emissions from Metal Production;
		CH_4	NO	EFs added for the new sources	Slight revision of AD	Emissions from Plastics, synthetic resins and glues included under Others.
		N_2O	NO	Changed EF for nitric acid production	NO	NO
4.	Agriculture – Enteric Fermentation	CH_4	NO	NO	Slight revision of AD	NO
	Agriculture – Manure Management	CH_4	NO	Updated EFs for dairy anc non-dairy cattle and for swine	Slight revision of AD	NO
		N_2O	New	New	New	New
	Agriculture – Rice Cultivation	CH_4	Revised methodology	Revised EF	NO	NO
	Agriculture – Agricultural Soils	N_2O	New	New	New	New
	Agriculture – Field Burning of Residues	CH_4, N_2O	NO	Revised EF	Revised values	NO
6.	Waste – Solid Waste Disposal on Land	CO_2				Excluded from the overall emissions
		CH_4	NO	NO	Slight revision	NO
	Waste – Solid Waste Disposal on Land	CH_4	Revised methodology	Revised/added EF	Revisions and new AD	Emissions from sludge added
		N_2O	New	New	New	New

3.4. REPORTING

Since the year 2000, for reporting of the GHG emissions and removals Bulgaria uses the Common Reporting Format. In 2001 together with the submission of the Common Reporting Format, Bulgaria submitted a National Inventory Report meant to provide some additional data for the understanding of emission and removal estimates and to increase transparency of the estimation methods.

Table 3.2. CO_2 emissions from fuel combustion, Gg

Method	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Top-down	90,790	71,760	59,204	55,551	60,251	55,810	57,716	55,870	54,414	50,810	44,573
Bottom-up	94,432	76,484	60,626	55,416	57,650	54,322	56,255	54,442	53,527	48,515	44,513
Difference, %	–3.85	–6.2	–2.3	+0.2	+4.5	+2.7	+2.6	+2.6	+1.7	+4.7	–0.14

The report aims to reflect this national application of the methodology and to explain the peculiarities and the way the methods have been adapted to the Bulgarian conditions and data availability. The structure of the report follows the structure of the GHG inventory source categories that are covered in Bulgaria, as follows:

- Energy.
- Industrial processes.
- Solvent use.
- Agriculture.
- Land-use change and forestry.
- Waste.

The CRF Summary Tables for the 1999 Inventory, and the trend tables for the period 1988-1999 are provided as an Annex at the end of the Communication. The full set of CRF tables is informative for the emission/removal trends. Additional information on the GHG inventory is available in the GHG Inventory Report submitted to UNFCCC Secretariat.

3.5. EMISSIONS AND SINKS OF CO_2

Fossil fuel combustion and change in land use are the two primary reasons for the observed increase of the atmospheric CO_2. Production and consumption of cement, lime, glass, steel, pig iron, ammonia and soda ash are other important sources. The activities in the forestry and the changes in land use are two-sided, i.e. they are CO_2 emitters and sinks simultaneously.

The emissions of CO_2 are estimated using both methods recommended in the Revised 1996 IPCC Guidelines and the UNFCCC Guidelines. In contrast to the "bottom-up" approach – which estimates the emissions by sector and source-technology – the "top-down" (reference) approach starts from the total fuel quantities used up in the combustion and transformation processes. Table 3.2 gives information on the total CO_2 emission estimation using both the approaches (these values were being reported annually, which means that they are not re-calculated). The deviation of the results received by application of both methods is within the range of 0.14-6.2%.

The enumerated differences are due to:

- Different operation modes of the processing technologies (oil refineries, coke batteries, etc.).
- Different operation modes of the fuel stores.
- Different emission factors at the input and output of the transformation processes.
- Statistical difference in the energy balance sheets, due to problems related to the accurate accounting of the export and changes in the ownership, because of the privatisation process.
- More precise accounting of the emissions from international bunkering and the resources for non-energy use.

The overall estimates of CO_2 emissions and sinks in Bulgaria in 1988 and in the period 1990-1999 allocated by sectors are given in Table 3.3.

Fossil fuels prevail in the structure of primary energy resources used in Bulgaria. As a consequence of this fact and since the emissions from fossil fuel combustion are high, this source is the most important source of CO_2 in the country that accounts for more than 90% of the total CO_2 emissions (Fig. 3.1).

At the same time energy production and transformation activities are the most important sources among the energy-related CO_2 emitting activities with a share of about 65-70%. This exceeds the total contribution of all other energy-related emissions. The second important source among the fuel combustion processes is the transportation sector. Its share of 13% is smaller compared to the developed countries. Industrial processes are ranked third as a CO_2 emission source. The historical trends of CO_2 emissions and their allocation among stationary combustion (sub-sectors: Energy Industries, Manufacturing Industries and Construction, Other Sectors, Oth-

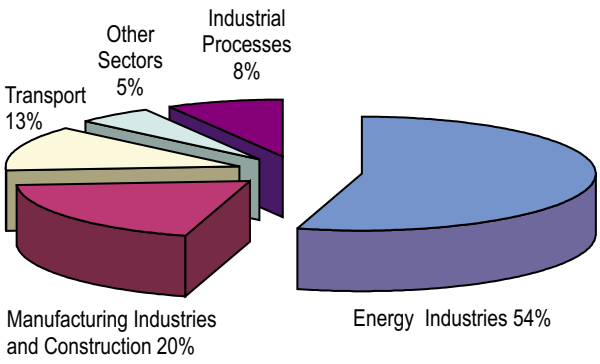

Fig. 3.1. CO_2 emissions by sectors in 1999

Table 3.3. Total CO_2 emissions and sinks in Bulgaria by sectors

CATEGORIES	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)										
National CO_2 emission (Gg)											
Energy	**95,495**	**76,804**	**61,170**	**55,064**	**57,678**	**54,239**	**56,609**	**55,101**	**53,560**	**48,515**	**44,513**
Stationary	82,856	65,940	54,646	48,629	50,234	47,692	49,764	48,795	48,245	42,040	38,301
Mobile	12,639	10,864	6,525	6,435	7,444	6,547	6,845	6,306	5,315	6,475	6,212
Ind. Processes	**8,361**	**7,332**	**4,873**	**4,118**	**4,181**	**4,939**	**5,723**	**5,610**	**5,182**	**3,762**	**3,927**
Net CO_2 sinks (Gg)											
LUCF	**–4,657**	**–5,801**	**–7,880**	**–7,636**	**–7,022**	**–6,974**	**–7,520**	**–7,190**	**–5,852**	**–6,233**	**–6,608**

ers), mobile combustion, and industrial processes in the period 1988-1999 are shown in Fig. 3.2.

As seen, the downward tendency is common within the range for each of the sources. The major drop is in the manufacturing industries and constructions, which are the most sensitive to the economic crisis in Bulgaria.

For the period there are different tendencies in the emissions from stationary and mobile combustion. Stationary combustion keeps its downward trend as a source of CO_2 emissions, while mobile combustion has uneven emission levels with changes in the sign. Transportation in Bulgaria is very dependent on the liquid fuel prices at international market, since 95% of the gasoline is imported. Stationary combustion is comparatively more independent from international prices. The downward trend in CO_2 emissions from stationary combustion is mainly due to the decrease in the electricity and heat demand in industry and households.

About 30% of the territory of Bulgaria is covered by forests. Forest clearing and land use changes are not estimated in Bulgaria and therefore only managed forests are considered as an emission/source category. Due to the intensive process of afforestation after 1950 and the normalisation of wood harvesting since 1985, the annual increment of Bulgarian forest exceeds substantially the annual cut. Therefore, managed forests act as a net sink. At the same time the forest cut for energy use keeps increasing during the last few years. Input data for calculation of a forest sink capacity are taken from the forests inventories carried out every five years, as well as on statistics for annual forest harvesting.

3.6. METHANE EMISSIONS

Methane emissions in Bulgaria by sectors in 1999, and the changes in the period 1988-1999 are displayed in Figs. 3.3 and 3.4, respectively. Wastes are the major source of methane and the major portion is emitted by landfills. There are serious changes when compared to the First National Communication in the emissions from this sector. It results from the changed methodology for waste estimates in the National Statistical Institute and

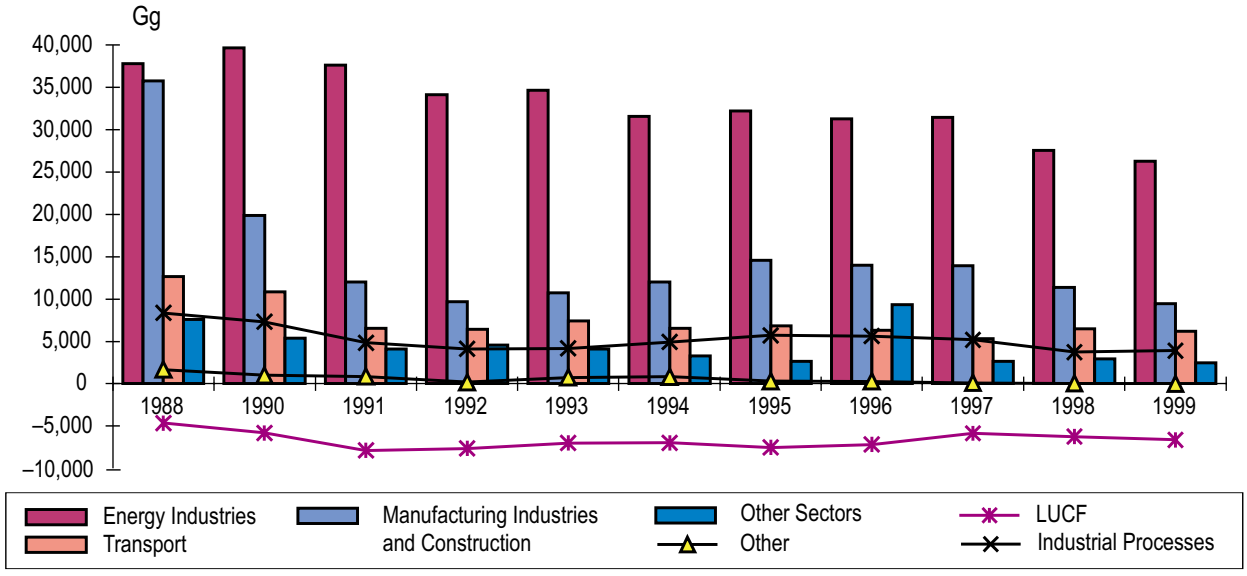

Fig. 3.2. Historical trends of CO_2 emissions by sectors in Bulgaria

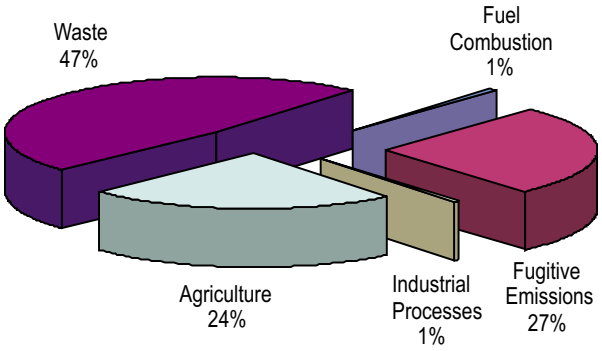

Fig. 3.3. CH_4 emissions in Bulgaria in 1999 by sectors

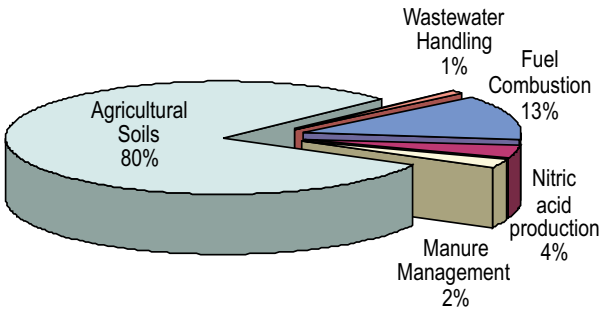

Fig. 3.5. N_2O emissions in Bulgaria in 1999

respectively to the drastic drop in the estimates for solid wastes per capita.

The second important source is the coal mining and the production of oil and natural gas. More than 77.7% of the coal in Bulgaria is extracted through open-pit mining. The fugitive methane emissions per unit production in open coal mines are 15 times less than in the underground mines. Therefore the overall emissions from coal production are comparatively small, i.e. 5-8% from the total emissions.

The emissions from natural gas and oil systems are also low (14.3-16.3%), due to the fact that the natural gas and oil systems are not quite developed yet.

The livestock breeding in the agricultural sector is the third important methane source.

In general, a stable decrease of the CH_4 emission is observed during the entire study period. The decrease in the emissions from solid waste disposal is very sharp at a point because of the change in the accounting method for the amounts of landfilled wastes used by the National Statistical Institute.

3.7. N_2O EMISSIONS

Fig. 3.5 shows the N_2O emissions by sources in 1999. Three major sources of N_2O emissions identified in Bulgaria are: agricultural soil, fuel combustion, and nitric acid production. Compared to the inventory included in the I^{st} and II^{-nd} NCs, the share of the N_2O emissions has increased significantly. This is due to the new methodology suggested in the Revised 1996 IPCC Guidelines for estimation of N_2O emissions from agricultural soil. Fuel combustion and production of nitric acid are ranked next as sources of N_2O emissions.

Fig. 3.6 shows the N_2O emissions trends over the period starting with the base year. The rise at the end of the period in the emissions from agricultural soil is artificial since it is due to a change in the emission factor as suggested in the Good Practice Guidance. In case the old emission factor is used, the value will be kept almost constant compared to the previous year. The overall tendency follows the trend in the GDP and overall economic development of the country.

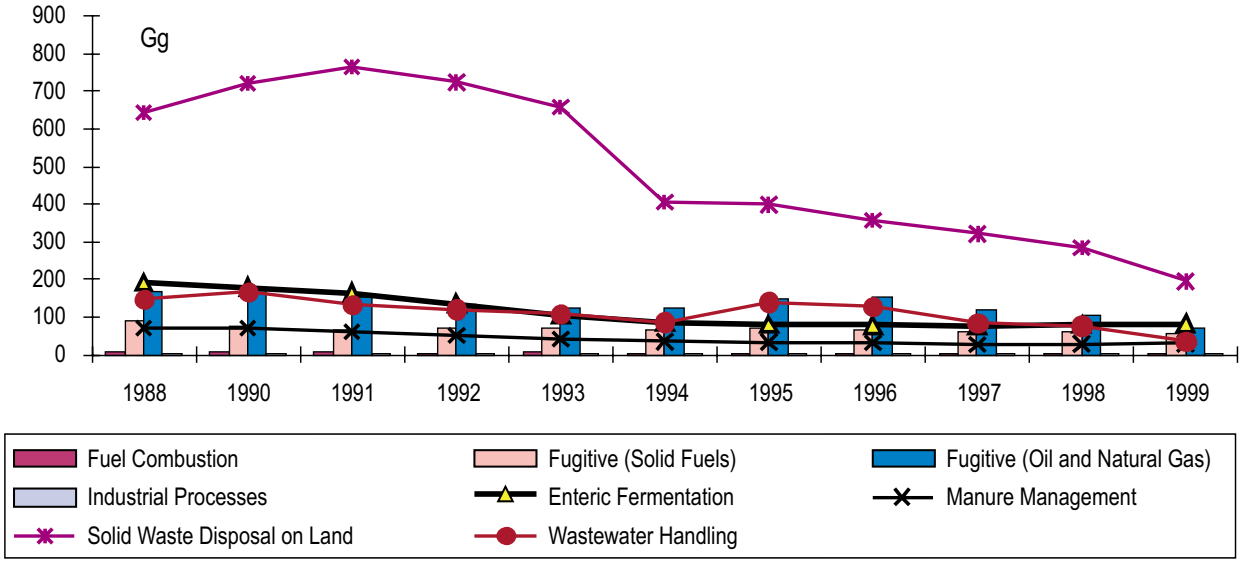

Fig. 3.4. CH_4 emission trends in Bulgaria by sectors

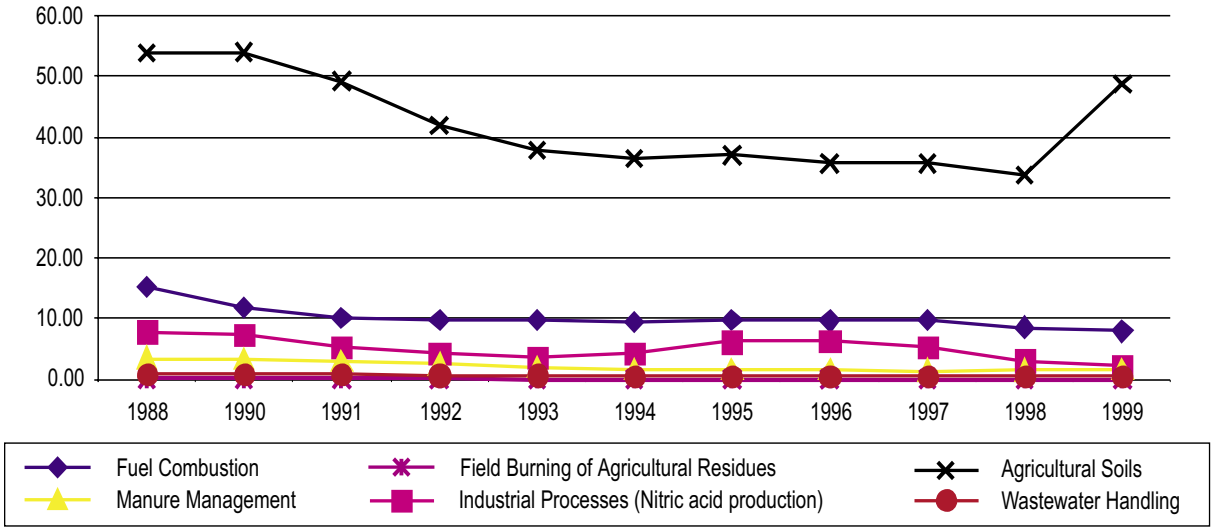

Fig. 3.6. N_2O emissions trend in Bulgaria

3.8. NEW GASES

In 2000, first attempt to estimate the emissions of the new gases was made. Questionnaires were prepared and data was collected in order to identify which of the recommended methods in the Revised 1996 IPCC Guidelines is applicable for Bulgaria. The results of the study indicated lack of detailed information on the new gases. These are not produced in Bulgaria, therefore only their import (no data on export) is taken into account. In terms of consumption the Tier 1a method is applied. The emissions for the years 1995, 1998 and 1999 are provided in Table 3.4.

The emissions for 1995 were estimated using all the methods recommended by the IPCC Guidelines. As seen the differences among the Tier 1a, 1b and Tier 2 methods are quite big. For the rest of the years only data for the potential emissions was available.

3.9. PRECURSORS EMISSIONS (NO_2, CO, NMVOC) AND SO_2 EMISSIONS

The greenhouse gases precursors and SO_2 are also addressed in the national GHG inventory. Since they are covered by other conventions, their emissions are included for informative purposes. The overall trend in these emissions is provided in Fig. 3.7. The main NO_X emission sources identified in Bulgaria are stationary and mobile combustion. The change between these two sources tends to decrease over the period.

There are four main CO emitters in Bulgaria – transport, stationary combustion, agricultural wastes and biomass burning. The values and change for the period 1988 and 1999 are given in Fig. 3.8. The overall decrease is obvious, while the emissions from transport sector tend to keep their share.

The anthropogenic emissions of NMVOCs are from two major sources – transportation and solvent use. Since there is no available data on solvents import, only the local production is considered. The emissions from combustion are steadily decreasing over the period. The second greatest NMVOC emitter, i.e. solvent use, had comparatively stable contribution after the sharp drop in 1991.

NMVOC emissions from solvent use are estimated using a simplified methodology based on the CORINAIR and country specific emission factors. Since 1999 some of the activity data on use of paints and lacquers have been revised and

Table 3.4. Emissions of HFCs and PFCs [t]

Year/GHG	HFC-23	HFC-32	HFC-125	HFC-134a	HFC-152a	HFC-143	HFC-143a	CF_4	C_2F_6
1995			0.0228 (1a) 0.0011 (2)	14.25 (1a) 47.69 (1b) 1.3485 (2)			0.027 (1a) 0.0014 (2)	6.3266	0.63
1998	29.88	0	16.39	54.08	0.42	0	29.16	9.36	0.94
1999	0.63	0,26	7.22	56.80	1.10	3.10	0	5.87	0.59

Note: The HFCs are potential emissions, while PFCs are actual emissions.

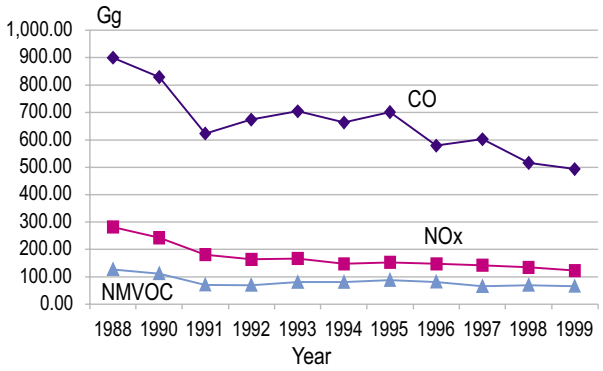

Fig. 3.7. Emissions of GHG precursors

for the first time emissions from medical output were included.

SO_2 emissions have the opposite functions compared to the GHG and are more regional as impacts. About 80% of the anthropogenic emissions of SO_2 are due to combustion processes and ¾ of them from coal burning. The emission factors used in Energy sector are mainly country specific. In general the emissions of SO_2 have dropped by 11% due to the overall reduction of fossil fuel consumption. Some changes in the emission levels could be expected after 2001 when the FDG installations in the TPP Maritza East 2 come in operation.

3.10. OVERALL ANTHROPOGENIC GHG EMISSIONS IN BULGARIA

The results of the GHG inventories of Bulgaria for the period 1988-1999 are given in Table 3.5. Only the emissions for 1998 and 1999 are calculated according to the revised IPCC 1996 Guidelines. Data for 1988-1997 is not recalculated.

The emissions and removals from the various sectors are integrated as CO_2 equivalent emissions. For the estimates the following Global Warming Potential (GWP) values have been used – see Table 3.6.

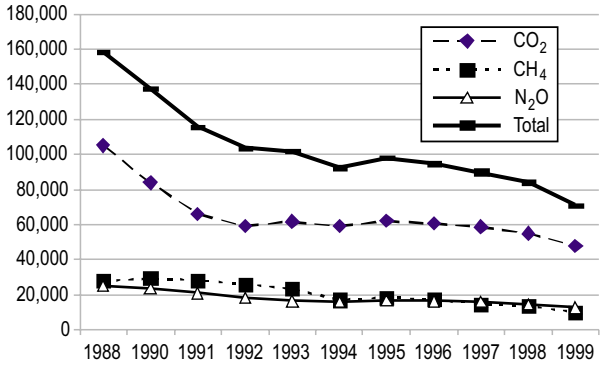

Fig. 3.9. GHG emission trends in Bulgaria, Gg

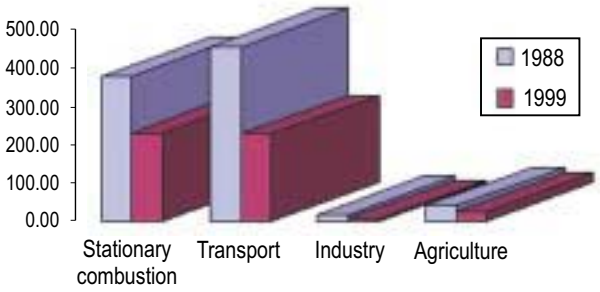

Fig. 3.8. CO emissions in 1988 and 1999

Using those values the CO_2 equivalent emissions over the study period are recalculated in accordance with Revised IPCC 1996 Guidelines – Table 3.7.

The overall downward trend for the GHG emissions reaches its bottom in 1999, when registered drop of the emissions is by 51% compared to the base year.

Fig. 3.9 gives information on the share of each GHG in the overall emissions. As shown, CO_2 is the main GHG in Bulgaria with a share of 57-67% of the total emissions. Methane that was the second main GHG at the beginning of the period gradually looses importance in comparison to the N_2O emissions, which keep comparatively stable level over the period. The increased share of N_2O in 1999 is due to the revision of the emission factor for N_2O from agricultural soils in compliance with the Good Practice Guidance. The time series is not recalculated for the entire period. The contribution of the new gases in the overall emissions in Bulgaria is less than 1%. The trends could be seen in Fig. 3.9 and in Table 3.8.

In terms of emission allocation among sectors, Energy is the main source category with contribution of 60-70% in the total GHG emissions (see Table 3.9). Agriculture is the second source of importance, while waste treatment is ranked third. Industrial processes are not a big source in Bulgaria given the decrease in the industrial output during the last decade. Solvents use is not included in the allocation since it emits only GHG precursors. LUCF is net sink for Bulgaria.

3.11. KEY SOURCES

The IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories includes the notion "key source". Thus the choice of method for estimate of emissions/removals is based on "decision tree" that allows the most appropriate method to be chosen. It takes into ac-

Table 3.5. Overall anthropogenic GHG emissions in Bulgaria (LUCF excluded), [Gg]

	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
CO_2	96,878	85,278	67,020	61,037	63,257	60,390	63,109	60,291	59,217	52,276	48,440
CH_4	1,413	1,420	1,358	1,250	1,117	826	901	852	892.4	654.3	483.3
N_2O	30.8	29.6	23.2	19.1	17.5	17.7	20.6	20.5	21.2	47.4	61.2
NO_x	486.4	250.8	191.4	179.4	183.7	162.8	161.3	133	142.7	133.9	122.7
CO	826.6	951.8	738	755	767.7	707.3	760.6	726.9	622.7	515.4	493.3
NMVOC	132.3	104.9	58.3	62.4	67.9	65.6	73.4	68	72	89.2	63.5
SO_2						–	–	–	1,304	1,197	1,062

Table 3.6. GWP for a 100 years time horizon

GAS	CO_2	CH_4	N_2O	HFC-23	HFC-32	HFC-125	HFC-134a	HFC-152a	HFC-152a	CF_4	C_2F_6
GWP	1	21	310	11,700	650	2,800	1,300	140	300	6,500	9,200

Table 3.7. Overall GHG emissions (LUCF excluded) – Gg CO_2 equivalent

Emissions	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
CO_2	103,856	84,136	66,043	59,183	61,859	59,178	62,332	60,710	58,742	52,277	48,440
CH_4	28,009	29,602	28,420	26,188	23,550	17,178	18,641	17,370	14,775	13,739	10,149
N_2O	25,225	23,964	21,217	18,339	16,675	16,230	17,110	16,640	16,295	14,698	18,961
HFC	0	0	0	0	0	0	1.76	0	0	577	103
PFC	0	0	0	0	0	0	46.92	0	0	69	44
Total [Gg CO_2 eqv]	157,090	137,701	115,679	103,710	102,084	92,586	98,131	94,721	89,811	81,360	77,697
Rate (1988=100%)	0	–12.3	–26.4	–34.0	–35.0	–41.1	–37.5	–39.7	–42.8	–48.2	–50.5

Note: Actual emissions of PFC and potential emissions of HFC are included in the totals for 1998 and 1999.

Table 3.8. Contribution of direct GHG in the overall emissions of Bulgaria, % (LUCF is not included)

GHG/year	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
CO_2	66.40	61.10	57.09	57.07	60.60	63.92	63.52	64.09	65.41	64.25	62.33
CH_4	17.68	21.50	24.57	25.25	23.07	18.55	19.00	18.34	16.45	16.89	13.07
N_2O	15.92	17.40	18.34	17.68	16.33	17.53	17.44	17.57	18.14	18.07	24.42
HFC/ PFCs	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.80	0.19

Table 3.9. Contribution of sectors in the overall emissions of Bulgaria, % (LUCF not included)

	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Energy	67.4	62.4	59.6	60.3	63.6	66.2	65.6	66.3	67.4	67.4	64.0
Ind. processes	6.9	7.0	5.7	5.3	5.3	6.9	7.9	8.1	7.7	6.7	6.3
Agriculture	15.0	16.8	18.2	17.1	15.1	15.5	14.7	14.6	15.3	16.3	23.2
LUCF	–3.0	–4.2	–6.8	–7.4	–6.9	–7.5	–7.7	–7.6	–6.5	–7.7	–8.5
Wastes	10.8	13.8	16.5	17.3	16.0	11.4	11.8	11.0	9.7	9.6	6.5

count the national circumstances, available data and the importance of the source in the overall emissions.

According to the Good Practice Guidance, when preparing their inventories Parties have to pay attention to the key sources defined using level assessment (contribution in the annual emissions) and trend assessment (contribution to the overall emissions trend) of the sources. The complexity of the estimation methods applied for each source should be dependent on the contribution of the source in the emission level and trend. This ranking indicates the key sources in the country and the sectors where further research should be made. These results were taken into account when choosing the methodology to use in the inventory of Bulgaria for 1999. Table 3.10 provides information on the key sources in Bulgaria.

Table 3.10. Assessment of GHG Sources in 1999

IPCC Source Categories	Direct GHG	*Key Source Category* Flag	If Column C is Yes, Criteria for Identification
ENERGY SECTOR			
CO_2 Emissions from Stationary Combustion – Coal	CO_2	Yes	Level, Trend
CO_2 Emissions from Stationary Combustion – Oil	CO_2	Yes	Level, Trend
CO_2 Emissions from Stationary Combustion – Gas	CO_2	Yes	Level
Non-CO_2 Emissions from Stationary Combustion	CH_4	No	
Non-CO_2 Emissions from Stationary Combustion	N_2O	Yes	Level, Trend
Mobile Combustion	CO_2	Yes	Level, Trend
Mobile Combustion	CH_4	No	
Mobile Combustion	N_2O	No	
Fugitive Emissions from Coal Mining and Handling	CH_4	Yes	Level, Trend
Fugitive Emissions from Oil and Gas Operations	CH_4	Yes	Level
INDUSTRIAL SECTOR			
CO_2 Emissions from Cement Production	CO_2	Yes	Level
CO_2 Emissions from Lime Production	CO_2	Yes	Level, Trend
CO_2 Emissions from Other Industrial Processes	CO_2	Yes	Level
CH_4 Emissions from Other Industrial Sources	CH_4	No	
N_2O Emissions from Nitric Acid Production	N_2O	Yes	Trend
New gases	PFC, HFC	No	
AGRICULTURAL SECTOR			
CH_4 Emissions from Enteric Fermentation in Domestic Livestock	CH_4	Yes	Level
CH_4 Emissions from Manure Management	CH_4	No	
N_2O Emissions from Manure Management	N_2O	No	
Direct N_2O Emissions from Agriculture Soils	N_2O	Yes	Level, Trend
Indirect N_2O Emissions from Agriculture Soils	N_2O	Yes	Level, Trend
CH_4 Emissions from Rice Production	CH_4	No	
CH_4 Emissions from Agricultural Residue Burning	CH_4	No	
N_2O Emissions from Agricultural Residue Burning	N_2O	No	
WASTE SECTOR			
CH_4 Emissions from Solid Waste Disposal Sites	CH_4	Yes	Level, Trend
Emissions from Wastewater Handling	CH_4	No	
Emissions from Wastewater Handling	N_2O	No	

3.12. NEW ELEMENT IN THE GHG INVENTORY

The IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories had been under elaboration since 1998. It aims at helping the countries to reduce the uncertainties in their inventories and to improve transparency, documentation, comparability and efficiency of inventory preparation.

The tasks for these aims to be achieved include:

- Choice of methods within the frame of the IPCC Guidelines.
- QA/QC in inventory compilation.
- Documentation, archiving and reporting of data in a way to facilitate inventory reviews.
- Quantitative assessment of uncertainties associated with source categories and of the total inventory.

The choice of method is based on "decision tree" that allows the most appropriate method to be chosen. It takes into account the national circumstances, available data and the importance of the source in the overall emissions. This approach has been followed when developing the inventory.

QA/QC includes quality assessment of measurements, estimates, completeness, documentation, reviews, etc. In 1999 inventory some im-

provements regarding the self-assessment were made.

Some attempts to use methods recommended by CORINAIR and Good Practice Guidance were made. A few differences were encountered and the reason for them is mainly due to the variation in the approaches applied to the sources and the difference in the emissions factors. Where applicable the emission factors used are compared. The difference between estimated emissions is also due to the differences in the coverage of the sources.

Another attempt to apply the Good Practice Guidance is the **uncertainty assessment** based on the uncertainty of the activity data and emissions factors. In accordance with the Overview table provided in IPCC Guidelines there is a self-assessment of the quality of the results obtained. The assessment provides just a tentative assessment of the inventory quality, since at this stage it is impossible to evaluate the accuracy of estimates using a single, uniform standard applied to the activity data and emission/removal factors that provide the basis of the inventory and have widely varying characteristics. Only initial steps in uncertainty estimates have been made with the current inventory year.

4. POLICIES AND MEASURES

4.1. BACKGROUND

The underlying principles of the national climate change policy are predetermined by the strong will of Bulgaria to join the international efforts for addressing the climate change issue. This process should be carried out in such manner that will not pose insurmountable burden to the national economy, and at the same time will assist with attracting foreign investments that shall help the implementation. The chapter starts with enumerating the legal and economic instruments already implemented that have positive impact on GHG mitigation.

4.2. CROSS-SECTORAL MEASURES

The nature of the GHG mitigation policies and measures in the country is set forth by the **National Climate Change Action Plan** (NCCAP) adopted by the Bulgarian Government (decision No. 393 / July 6, 2000). In addition to NCCAP objectives, there are other relevant policies that are consistent with the GHG mitigation targets. These include the National Strategy for the Environment; and the drafts of the National Energy Efficiency Program and the National Program on Renewables.

The institutional setup for implementation of the country's climate change policy is represented by the Inter-ministerial Committee established with NCCAP. The Committee has to monitor the implementation of the plan; to assess the progress of the GHG emission reduction; to adjust the plan to the changing conditions in the country; to track violations; and to develop compensatory measures to reach the objectives. The overall implementation of the plan is controlled by the MOEW.

The ministries should present annual reports for activities undertaken under NCCAP supplemented with appropriate additional documentation. The MOEW has to summarize the provided documents and publish information on the achieved results within a month. The NCCAP should be updated annually with revised measures, deadlines, and necessary funding. At present the first report on the actions taken so far under the NCCAP is prepared. First update of the NCCAP is expected at the end of 2002.

The Government Program **People Are the Wealth of Bulgaria** strives to bring environmental protection closer to the European Union standards. Crucial measures are foreseen to cope with the water-supply problem and speed up the completion of wastewater treatment plants. Measures are planned to tackle soil erosion (on farmland, woodland and elsewhere); to prevent landslides and sea abrasion; to find a lasting solution to the transboundary air pollution and to the smog in cities by switching over to unleaded petrol and putting restrictions on the import of worn-out vehicles; to work out programs to prevent the abuse of plant protection chemicals; to draft legislation that will not allow to use the country as a disposal site for imported nuclear and chemical waste; and to offer incentives for investing in power plants that utilize alternative energy sources.

Approximation to the EU Acquis is perceived to be of help when addressing climate change issues too, since many measures would lead to reduction of GHG. The Environmental Acquis of EU contains both climate specific and other laws that are relevant to climate change. The climate specific law (the Council Decision No. 99/296/EC) concerns the monitoring of CO_2 and other GHG. It requires Member States to determine, on an annual basis and in accordance with the methodologies adopted by the Conference of Parties to the UNFCCC, the anthropogenic emissions by sources and removal by sinks not controlled by the Montreal Protocol. Member States also have to establish and implement national programs for limiting and/or reducing anthropogenic emissions by sources and enhancing removals by sinks of all GHG.

Bulgaria has to take many of these policies into consideration during the process of becoming a member of the EU. According to the National Program for introducing the European environmental law in Bulgaria (Regulation of Council of Ministers No. 657/ October 9, 2000), a Clean Air Act – related regulation has to be completed until December 30, 2002. It has to define the competent institutions and procedures for gathering information on pollutants including GHG emission. Responsible institution is the MOEW.

The approximation of EC Directives on energy will also have influence on GHG in the candidate countries like Bulgaria. New policies are being developed for liberalizing of the electricity and gas

markets in accordance with the Directives on the liberalization of the electricity (96/92/EC) and gas (98/30/EC) markets.

The **National Strategy for the Environment** is closely related to a range of other program documents adopted by the government: the National Plan for Economic Development of Republic of Bulgaria 2000-2006, the National Strategy for Energy Efficiency, the National Plan for development of the Agriculture, the National Program for Adoption and Implementation of the Aquis (NPAA), and the Environment Sector of the National IPSA Strategy.

The National Strategy for the Environment is a strategic document. It defines the development of the national policy on the environment, and formulates the national long-term priorities. With respect to the climate change issue, under the component "**Air**", the National Strategy takes into account the following *successes and strengths*:

- The process of harmonization of the national environmental law with the EU such is completed.
- The country fulfils its obligations under the Convention on Trans-boundary long distance air pollution, United Nations Framework Convention on Climate Change, Vienna Convention on the Ozone Layer; and the protocols to these.
- Reduced emissions of the main monitored pollutants as a result of the close-down of some industries as well as the mitigation measures taken.

At the same time some *problems and weaknesses* under the same component include:

- Few companies carry out their own monitoring of emitting sources.
- Increased pollution from transport due to very outdated motor fleet.
- Very high level of sulphur oxide emissions.
- Fuel fees are not used for earmarked projects for improvement of air quality.

Under the component "**Energy**", the following *successes and strengths* are underlined:

- A considerable part of the electricity produced in Bulgaria comes from nuclear power generation that does not emit GHG.
- Governmental programs were adopted and implemented for ensuring safety exploitation and security in the nuclear power generation plant Kozloduy.

Some *problems and weaknesses* are pointed out too:

- The TPPs fuelled by local brown coal are a major source of pollution including sulphur oxide, carbon dioxide and relatively large source of nitrogen oxides, dioxins and furans.
- The National Strategy for development of the energy industry does not take into complete account the state's obligations in the field of environmental protection.
- There is a concern that Bulgaria may have problems fulfilling the obligation under the Oslo Protocol on the sulphur oxides and the Kyoto protocol on GHG emissions.
- The present governmental strategies, plans and programs do not collaborate well in regard to reducing the emissions from sulphur oxides and carbon dioxide from the energy sector.

National Environmental Protection Fund and the **Municipal Environmental Protection Funds** (State Gazette No. 5/1993) continue to be the main funding sources for financing various environmental projects (including energy efficiency and climate change such). By the **Law on Liquid Fuels Taxation for the Republic Road Network Fund and for the National Environmental Protection Fund** adopted on 14 February 1996, the level of taxes levied on the production and import of gasoline, diesel and residual with sulphur content over 1% was updated. The tax levels were set as follows:

- Car gasoline: 19% of the producer price or of the custom taxable value increased by import duties and taxes. 14% of the sum is accumulated in the Republic Road Network Fund and 5% in the National Environmental Protection Fund.
- Diesel fuel: 15% allocated as follows: 11% in the Republic Road Network Fund and 4% – in the National Environmental Protection Fund.

According to the latest amendment of the Law (1999) the liquid fuel excise and taxes are shown in Table 4.1.

Fines for pollution or damage of air, waters, soils, etc. above the admissible level are the economic instruments most commonly applied in Bulgaria. These have existed since 1978, but the related laws have been updated and amended several times since 1993 in accordance with the current economic conditions. The collected revenues are channelled as follows: 30% to Municipal Envi-

Table 4.1. Rates for liquid fuels [BGL/tons]

	Octane	Excise	National Environmental Protection Fund	Road tax
Leaded gasoline	Up to 98	300	37	180
	98 and above	550	48	180
Unleaded gasoline	Up to 98	300	24	180
	98 and above	500	24	180
Diesel		110	14	180
LPG		120*		

* Introduced since 2002.

ronmental Fund where the fine was levied, and 70% to the National Environmental Fund. During the last 3 years a trend for increase of the relative annual growth of revenues from fines is evident (in % compared to the previous year): 1994 – 7.1%; 1995 – 3.1%; 1996 – 31.5%, 1997 – over 50%. However, the growth of the revenues is many times lower than the rate of inflation. The collected total annual revenues from fines were:

Year	1994	1995	1996	1997	1998	1999
Revenues [mln BGL]	76.4	82	107.8	743.2	1,698.9	2,224.9

The **Law on Corporative Income Taxation** in force since 1 January 1998 provides for tax incentive to stimulate environmental friendly development of the economy, and to encourage environmental protection. The Law states that the financial result before tax adjustment shall be reduced with the amount for donations made to environmental organizations not to exceed 10% of the financial result and only in case the donations are from the capital reserves at the expense of the owner.

A positive step is the control of the import/export of the "new greenhouse gases" PFCs, HFCs, and HF6 that came into force and will help the completeness and accuracy of national inventory preparation in the part of industrial processes.

A cross-sectoral measure expected to have general positive impact on GHG emissions mitigation is the **climate change related studies**. Within the frame of the National Climate Change Action Plan, Ministry of Education and Science has provided financial support to Small and Medium Enterprises for scientific and practical research for modern environmentally friendly and energy conservation technologies. Until 2000, 16 tasks related to climate change have been completed, and 10 projects were implemented under the 5th frame program of the EU for Research and Technical Development.

4.3. POLICIES AND MEASURES BY SECTORS

4.3.1. Energy

Since the main share of the GHG emissions in Bulgaria are the energy related CO_2 emissions, and this share is expected to increase further if the energy intensive production pattern is not replaced by energy-efficient options, energy is the main sector where mitigation measures are being attempted. These measures however could not be implemented unless crucial changes in the sector take place.

The following measures are considered in the Government Program **People Are The Wealth Of Bulgaria** for the energy sector: creation of conditions for liberalization and competition that will give consumers the freedom of choice and access; fast-track transparent privatisation of power generation assets in the sector while the Government remains the owner of the transmission and of the National Dispatching Centre; implementation of regional investment projects to make maximum use of Bulgaria's unique geo-strategic location; offering incentives to raise efficiency in the energy sector; least-cost power generation and adjusted tariffs for the socially vulnerable; and liberalization of the natural gas market.

The GHG mitigation measures are consistent with the overall priorities for the future development of the sector. Those priorities were established by the **National Energy Strategy**, adopted by the National Assembly in the early 1999. The priorities set in the Strategy are:

- Further improvement of the national energy law in harmony with the EU law for establishment of conditions for competitive domestic energy market.
- Completion of structural reform in energy to enhance the competition between, and privatisation of main energy companies.
- Improved pricing policy with preservation of state and consumers' interest.

- Balanced economic regulations of energy companies that are natural monopolies.
- Research, development and technological innovations in the sector.
- Fuel diversification with optimal inclusion of indigenous fuels.
- Making use of the potential for improvement of energy efficiency in industry and households.
- Efficient environmental protection measures.
- Search for strategic partners and investors in the sector.

The **Law on Energy and Energy Efficiency** (LEEE) has been changed twice since the 2nd National Communication. It integrates the key items of the drafts for Energy Act and Energy Efficiency Act presented in the Second National Communication. LEEE has created the legislative frame for implementing the governmental policy in the energy sector leading to improvement of energy efficiency, competitiveness, removing monopolies, improving energy regulation, attracting strategic investors, and privatisation. For the successful implementation of the law a series of regulations were adopted (Regulation on the rules and conditions for connecting consumers and producers to the transmission and distribution network; Regulation on the technical exploitation of energy equipment; Regulation on the technical operation of power plants and networks; and Regulation on the rules and conditions for collection and maintenance of fuel reserves).

The **power sector restructuring** is the chief priority for the development of the sector. Two phases were envisaged in the transition period:

First Phase: Restructuring of the vertically integrated National Electrical Company (NEC). This stage is already implemented. Its components were:

- Separate accounting for the production, transmission, and distribution.
- Introduction of separate prices for power production, transmission and distribution that are used as a basis for establishing a system of contracts for production, transmission and distribution.
- Development and introduction, along with the Energy Act, of a series of normative, organizational, technological, financial, tariff and personnel principles and elements consistent with the Single Buyer Model (power producers, transmission system operator, single buyer, distribution system operators, etc.).
- NEC became the National Electricity Transmission company and a Single Buyer. Seven independent distribution companies were established and all generation plants are independent producers (except for the big HPP that are owned by NEC).

Second Phase is currently under way: Free power market and privatisation of the distribution and sales of electricity to the end users. The number of the end users that have the right to negotiate directly with a chosen producer will increase. Within the period of 2002-2005 there will be a process of establishing generation plants privatised through selling shares to investors, including municipalities.

The privatisation process in the sector started after the Governmental decision from January 1998 for pool privatisation of 22 Micro Hydro Power Plant (HPP). Other 40 micro HPP were chosen for sale in the next 2-3 years. The privatisation of TPP Maritza 3 and TPP Rousse is under consideration.

It is planed that NEC remains owner only of the transmission network, the main hydro power generation facilities, and pump storage plants. The Nuclear Power Plant (NPP) Kozloduy was transformed to PLC but it is not to be privatized.

Bulgarian Government has thus far supported the following projects of foreign investors:

- Decision 256/April 26, 1999 for establishment of inter-ministerial group to provide institutional support for two US companies:
  - New 670 MW lignite fired (2 x 335 MW) capacity in TPP Maritza East 1 – AES – Horizon; 800 million USD investments.
  - Rehabilitation and modernization of existing units in TPP Maritza East 3 and construction of FGD – Entergy; 400 million USD investments.

The details of the project implementation are still to be negotiated. Their application will play a significant role in environmental aspect in general and will impact significantly CO_2 emission level in the country.

- Decision 261/ May 11, 2000 for establishment of inter-ministerial group to provide institutional support to Jeilan Insaat (Turkish company) for construction of 3 dams and 3 HPP with capacity of 170 MW within the Gorna Arda cascade; 220 million USD investments.

- Decision 396/ June 15, 1999 for establishment of inter-ministerial group to provide institutional support to Solvay Sody JSC for investments in the energy supply and mining. After privatisation of TPP Devnja, Solvay Sody JSC intends to invest 400 million BGL in cogeneration project on natural gas for 300 MW with significant annual emission reduction.

There are applications for establishment of inter-ministerial groups for institutional support for:

- Bulkon Energy Ltd. for construction of energy complex of 21 gas turbines for electricity and heat generation with total capacity of 540 MW and 210 million USD investment. The operation of the power plants will meet the German environmental standards consistent with the EU Directives and the Gjoteborg protocol of 1999 to the Convention on trans-boundary pollution.
- Bulgarian Eco-energy Ltd. in collaboration with Balkanstar Energy Ltd. for 500 MW wind masters for power generation. The pilot project envisages construction of 25 wind towers type V52 with nominal capacity of 850 kW each in the region of Shabla.

Those projects are in process of discussion with the various ministries and agencies. New government considers that negotiations with potential investors should be carried out only in special cases. The major approach in the sector should be the open public tenders for construction of new capacities and rehabilitation of existing capacities. Companies from Germany, Japan, Turkey and Italy also demonstrate interest in penetration of renewable energy sources in Bulgaria. Some of these investments along with their impact on the national economy have significant potential for GHG emission mitigation.

Finalizing of the construction of 1,000 MW nuclear unit at Belene NPP is under discussion. The construction was suspended in 1991 due to the economic and political crisis that set in the country. Until the suspension, more than 1.2 billion USD were expended on this project, which allowed for 70 % of the equipment to be supplied, and 40 % of the construction works to be done. The site and the equipment have been kept in excellent conditions ever since. It is estimated that additional 1.1-1.25 billion dollars will be needed to commission the first unit. The operation of the unit can begin at earliest in 2008, and is meant to compensate the expected earlier termination of the operation of 4 units in Kozloduy NPP. Once the unit begins operation, the estimated GHG mitigation potential would amount to 9 million tons of CO_2-equivalent per year.

Certain policies and measures in the Power Sector are likely to lead to **increase of GHG emissions**. The policy for fuel diversification with optimal participation of the indigenous fuels is being implemented through increased mining and combustion of lignites from Maritza East minefields. In 1999 the mining amount was lower than 20 Mt, while in 1988 it was 28 Mt. The plans for power sector including construction of two thermal units on lignites (2 x 335 MW) and rehabilitation of the other lignite units lead to demand for annual mining of over 38 Mt coal, which will lead to almost doubling of CO_2 emissions from lignite combustion in 2007 compared to 1999.

One of the requirements for accession of Bulgaria to EU is to phase out four nuclear units with total capacity of 1,760 MW in NPP Kozloduy. In 2003 two of the units should be phased out (total 880 MW). This will lead to CO_2 emission increase by 5.4 Mt in the years after 2002. EU requires that the other two nuclear units be phased out not later than 2007. This will bring about another 5.1 Mt CO_2 emission increase. The high emission increase with the phase out of nuclear units is due to the planned replacement of these units by TPP capacities burning low quality lignite, as mentioned above.

The restructuring of the **coal mining** is part of the overall reform in the energy sector:

- First stage (under way): Stabilization and preparation for market development; close down of inefficient mining units; investments and privatisation in the sector.
- Second stage (after 2001): Stabilization and privatisation of energy facilities producing electricity, heat, briquettes, etc.

The structural reform in the **gas supply system** has to be in compliance with the requirements of the draft EU Directive for the general rules of the internal natural gas markets. The plan is to establish a national company for extraction, import, transmission, storage, and natural gas trade; and separate companies for gas distribution to be kept and further developed. This model allows gradual transition to free market for natural gas and is based on the experience in the Western countries. Since 2001 the privatisation of the National Gas

Company was expected to start through sales of shares at the stock exchange or to a partner.

The expansion of the natural gas market goes into two directions:

- Development of gas supply and new tariff methodology.
- Adoption and realization of the program for diversification of the natural gas sources.

The final goal of the structural reform is the integration of the national market with the natural gas markets in Europe and in the Middle East.

The **district heating** will continue to have significant share in the energy market. The introduction of new options for heating (gas supply to households, efficient individual heating installations, etc.) that require lower investments and are economically feasible will enhance the development of the district heating within the cities and in the regions where there is already infrastructure in place.

The following measures have high GHG emission reduction potential:

- Modernization of the existing heating facilities with increased share of the combined heat and power generation that is planed for the period after 2005, but could be accelerated by the market.
- Rehabilitation and modernization of the heat transmission networks and user stations that allow transmission losses reduction from about 20% to 10%. It is in process now and will be accelerated by the special World Bank program.
- Installation of equipment and measurement devices for individual monitoring and control of the heat consumption is in process and has to be finalized by the end of 2002. It will influence the heat consumption during the 2001/2002 heating season.
- Structural and price reform that will allow district-heating utilities to be competitive at the energy market. It was postponed due to the high natural gas prices during the 1999/2000.
- Reduction of the state subsidies.
- Adoption of the legislative framework for control and market-based development of the sector.

The analysis of the energy sector in comparison to the priority areas set in the Energy Strategy from 1999 indicates that the changes go on as planned and the development follows the long term priorities for development of the sector. The former State Agency for Energy and Energy Resources that was responsible for the national energy policy has been transformed into Ministry of Energy and Energy Resources effective January 1st 2002. This act has certain environmental aspect. The mining of energy resources, and the heat and electricity generation usually have negative impact on the environment. Therefore, during exploration and processing of energy resources, and in the heat and electricity generation process, an array of measures needs to be applied in order to mitigate the adverse effects and to restore disturbed environmental balance. Those include:

- *Restoration of disturbed environmental balance in coal mining.* The exploitation of underground resources, including open and underground mining will be carried out in compliance with the provisions in the Environmental Protection Act and the by-laws in the field.
- *Environmental considerations in the heat and electricity generation.* All construction in the energy sector until 1990 has followed obsolete requirements in terms of environmental protection. Since 1991 the new legislation is harmonized with international standards. Currently Bulgarian legislation transposes the requirements of EC Directive 96/61 for IPPC (Integrated Pollution Prevention Control). According to this directive, companies will have complex permissions for production activities with quantitative limitations for used resources, fuels, electricity and emissions by pollutants.

European Directives relevant to environmental protection and energy in Bulgaria were Directive 88/609/EEC and its amendments in Directive 94/66/EEC for limitation of emissions of SO_2, NO_x and dust from large stationary combustion; and Guidelines 1836/93/EEC for eco-management and audit. Directive 88/609/EEC is replaces with Directive 80/2001/EC (soon to be transposed into the Bulgarian environmental law).

As stated in the Second National Communication a draft **Energy Efficiency Act** was elaborated and finalized in 1998. The draft act, after its coordination with all ministries and authorities, was offered to the attention of the Legislation Board and to the Government. The Energy Efficiency Act had to regulate the actions related to energy efficiency improvement and to encourage the use of renewable energy sources. The goals of that law

are to reduce the energy intensity of the products and services, to mitigate the environmental impact of energy transformation processes, and to improve the quality of the energy services. It had to create impetus for the development of energy efficiency projects, and to increase the overall energy efficiency of industry through:

- Setting standards for energy efficiency of technologies and equipment, introduction of obligatory energy efficiency labelling of equipment.
- Mandatory energy audits that should be accomplished for each new large industrial project with high energy consumption, including commissioning of new energy units.
- Establishment of **State Energy Efficiency Fund** that should serve as a financial mechanism to promote national energy efficient policy, projects and activities. Main fund sources would be state budget subsidies, donations, local and foreign financial assistance, and restored sums.

This Act did not get approved and only became partially incorporated in the LEEE. Very little of what the EE law intended has been achieved so far. Most worrisome was the fact that the State Energy Efficiency Fund was not established, which affected to a certain extent the possibility to reduce GHG emissions. Furthermore, the most energy intensive industrial enterprises had no funds for energy efficiency improvements, which made them non-competitive and eventually led to many shut-downs in the period 1998-2000. On the other hand, the privatisation process has its influence on the energy intensity since the new owners tend to implement low cost energy efficient measures. As a result of these circumstances the GHG emissions were reduced by 14% in 2 years from the 1997 to 1999.

According to the LEEE, the Energy Efficiency Agency (EEA) is authorised to carry out the national policy in the field of energy efficiency and renewable energy sources. EEA carries out its duties through coordinating EE and RES activities with various ministries, local administration, NGOs, companies, and professional bodies aiming to decrease the energy intensity of GDP, and increase the share of RES in the energy balance of the country. Such a policy together with the other measures undertaken within the frame of the NCCAP will lead to lower GHG emissions.

ENERGY AND FUEL PRICES

Changes of structure and level of energy prices are fundamental to promote energy efficiency, to conserve energy, to reduce GHG emissions emitted at the end-use energy consumption, and to help the restructuring of Bulgarian energy sector. The process of the gradual liberalization of energy prices was discussed in the Second National Communication.

The price regulation for the energy sector is a main function of the State Commission for Energy Regulation, established by the LEEE. In April 2000, the Council of Ministers adopted Ordinance for Setting and Applying Prices of Electricity, which will regulate the price setting for the trade companies in the power energy sector according to their activities – generation, transmission and distribution. These regulations are being experimentally applied for the period in which fixed prices hold (until December 31, 2001), after separating the independent power producers and power transmission companies from NEC. During this period, the State Commission for Energy Regulation is monitoring the application of the rules for the price setting and price implementation by NEC and the independent distribution and generation companies.

In accordance with the economic policy of the Government formulated in the three-year agreement with the IMF, the State Budget Law for the year 2000 foresees subsidies for financial support for the district heating and the coal mining companies. It is to be done directly through allocation of funds from the state budget. The amount of funds was around 2.6 times less than the amount for the year 1999, and will be further reduced by the end of 2002. Since January 1, 2000 the registration regime for import and export for coal, crude oil, liquid oils, etc. has been terminated.

The energy price reform stipulates that:

- Prices of all types of coal and briquettes are liberalized.
- Prices of thermal energy for industrial consumers and budget-supported organizations are set on the basis of total costs in accordance with article 22 of the LEEE. The price of the thermal energy for domestic purposes is fixed and there is a proposal for the subsidy scheme to be extended until the year 2004. The gradual levelling off of the heat energy prices for domestic purposes, with the production costs, is scheduled. Since October 1, 2001 the price of heat

Table 4.2. Prices of electricity for industrial consumers (VAT excluded)

Type of measure	Time zone	Price (BGL/kWh) according to type of voltage		
		High	Medium	Low
Three scale	Peak	0.102	0.114	0.136
	Day	0.063	0.071	0.084
	Night	0.038	0.043	0.052
Two scale	Day	0.082	0.091	0.108
	Night	0.038	0.043	0.052
One scale		0.078	0.087	0.103

supplied by district heating companies to households was increased by 10% and set to 40.051 BGL/Gcal.

- Electricity prices are fixed for all categories of consumers, based on temporary rules for price setting until December 31, 2001, adopted by the Council of Ministers, when the Ordinance for electricity, heat and natural gas price setting and application for the domestic sector will comes in force. The price changes are in accordance with the adopted Action Plan, in which the price growth per period until the year 2001 is specified. The action plan foresees a faster rate of price increase for domestic needs, which aims at the gradual elimination of cross subsidizing between different consumer categories. The SCER analysis indicates that suspending of price increase for domestic consumers that will grant a possibility for preserving the amount of power consumed is needed, together with some delay of the increase of the prices for the low voltage consumers.

In all cases the price policy goes along with the process of gradual liberalization of energy market and the harmonization with the EU legislation. Such a policy will stimulate the development of local industry based on the new price tariffs integrating the interests of energy producers and energy consumers – Table 4.2.

Prices of electricity for household (VAT included) have been increased by 10% and since October 1, 2001 they are:

- Daytime rate – 0.098 BGL/kWh
- Night rate – 0.053 BGL/kWh

After 2001 a gradual liberalisation of the electricity prices will take place. The prices have to mirror the long-term marginal costs, including the cost for system maintenance and development, for storage of the nuclear wastes, for decommissioning of the nuclear equipment and for environmental recovery. The liberalisation of electricity market and establishment of market-based prices will replace state regulation in electricity generation.

Natural gas price is universal for all industrial consumers. In accordance with the Law on Energy and Energy Efficiency and the related ordinances, the introduction of differentiated prices and tariffs for the natural gas is scheduled for the beginning of 2002. Differentiated prices for industrial and residential consumers are planned for the future that will take into consideration the gas consumption mode, consumed volumes, safety requirements for the deliverer, requirements for continuous supply, and necessary investments.

The regulation of the prices for transit, transmission, connection, and distribution will be a responsibility of the State Commission for Energy Regulation using transparent procedure including proof of economic expenses and necessity for investments. The price policy in the period of 2002-2010 will be related to the possibility for various sources for gas supply, introduction of competition for end user supply and gradual liberalisation of market.

The prices will depend on international prices and state regulated taxes for transmission and distribution. Since 2010 prices will tend to become market determined taking into account the possibilities for use of alternative fuels and for free access to the national gas transmission network.

SPECIFIC MEASURES

The measures with practical importance to the GHG emissions in the sector are modernisation of NPP; construction of new nuclear units; introduction of FDG installations to 2 units of TPP Maritza East 2; rehabilitation program for all TPPs; introduction of cogeneration; development of Hydro Power; electricity transmission and distribution losses reduction; preparation of power system for integration with Union for Coordination of the Transmission of Electricity (UCTE); upgrading of heat transmission networks with up-do-date technologies; installation of appliances for individual measuring and control of heating (Table 4.3).

Table 4.3. Summary of mitigation policies and measures in energy sector

Policy name	Objective	GHG affected	Type of instrument	Status	Implementing entity(ies)	Mitigation impact by gas [t CO_2 eqv.]
						1995 2000 2005
Elaboration of Individual heat accounting program	The program sets conditions for carrying out of various services for implementation of EE measures, measuring equipment and accounting of consumed energy	CO_2 CH_4 N_2O	Economic	A	EEA	Significant but cannot be measured at this point.
Establishment of J I unit	Trading of 3 Mt CO_2 eq. with the Netherlands	CO_2, CH_4 N_2O	Economic	A	EEA and MOEW	3 Mt for the period 2008–2012
Coordination of a project under SAVE II: Research of the possible implementation of a large scale program for energy saving in Bulgaria	Assessment of the potential for improvement of energy efficiency in all sectors and brunches in Bulgaria.	CO_2 CH_4 N_2O	Research	A	EEA	Expected effect: mitigation of 2 Mt CO_2 eq.
SAVE II project: Indicators for energy efficiency in the CEE – pilot project for Hungary and Bulgaria	Integration of Bulgaria to the central database ODYSSEE for monitoring of national progress of each EU country member and achievements of the national goals in the EE sector.		Research	I	EEA	–
Projects for EE demonstration zones in Blagoevgrad, Pernik and Burgas within the frame of UNECE project "ECE-CIS-99-043 Development of Energy Efficiency Project for Mitigation of Climate Changes" under the *Energy Efficiency 2000 program* in 2 directions: street lighting; heating and hospitals	Reduced energy use in the 3 directions: street lighting; heating and hospitals in the 3 demonstration zones	CO_2. CH_4 N_2O	Economic	I – Ist part of the project i.e. training of representatives from municipalities and preparation of 25 project proposals	EEA and municipalities	Significant
Project proposal: Pilot project for EE improvement of street lighting in Sofia; PHARE 2001	Reduced power consumption by use of efficient lighting system	CO_2, CH_4 N_2O	Economic	–	EEA	1,700
Development of National Program of Renewable Energy Sources	Assessment of RES potential in Bulgaria and elaboration of regional and sectoral programs for their penetration	CO_2 CH_4 N_2O	Economic	A	EEA	Significant, but cannot be estimated at this point
Adoption of a patterns for contracts on energy savings with guaranteed outputs in Bulgaria (joint venture with Energy Agency of Berlin)	Elaboration of a specific model for energy saving contracts with guaranteed output and suitable for Bulgarian conditions	CO_2 CH_4 N_2O	Economic	A, 1st phase is implemented	EEA and Energy Agency of Berlin	Cannot be estimated at this point
Sustainable energy planning at local level (joint venture with UK company – ESD Ltd.)	Elaboration of regional energy plans for sustainable development and setting of priorities and measures for improvement of energy services at local level	CO_2 CH_4 N_2O	Economic	A	EEA and ESD Ltd.	Cannot be estimated at the moment
Replacement of heating installation in "Christo Botev" School in Velingrad	Shift to geothermal energy source	CO_2, CH_4 N_2O	Economic	I	EEA	150
Information campaign on energy efficiency and Renewable Energy Sources (RES) – PHARE 2000	Public awareness on EE and the benefits of RES		Education	A	EEA	–
Completion of new NPP units	To compensate for expected early termination of 4 units in Kozloduy NPP	CO_2	Investment	P	NPP Belene	9 Mt

Policy name	Objective	GHG affected	Type of instrument	Status	Implementing entity(ies)	Mitigation impact by gas [t CO_2 eqv.]
						1995 2000 2005
Safety improvement and NPP rehabilitation	Nuclear safety and loading factor improvement by 15%	CO_2	Investment	A	NPP Kozloduy	2.5 Mt
TPP rehabilitation	Efficiency, availability and environmental performance improvement, lifetime extension	CO_2	Investment	A	Ministry Of Energy	1–1.3 Mt
Electricity transmission losses reduction	Improved operation of HV transmission network	CO_2	Investment	A	NEC	0.3 Mt
HPP rehabilitation	Improved efficiency of the HPP	CO_2	Investment	A	NEC	50-120 kt
Cogeneration plant rehabilitation and upgrading	Installation of natural gas turbines at District heating plants, efficiency improvement	CO_2	Investment	P	Ministry of Energy	2 Mt
Heat transmission and distribution losses reduction	Improved isolation of heat transmission and distribution pipelines	CO_2	Investment	A	Ministry of Energy	0.5-2 Mt
Individual heat consumption measurements and control	Installation of individual measurement and control	CO_2	Investment	A	Households	0.5-4 Mt
Electricity distribution losses reduction	Improved operation of electricity distribution network	CO_2	Investment	A	7 DISCO	0.3-0.7 Mt
2 x 440 MW nuclear power units phase out	To meet EU requirements for EU membership	CO_2	Investment	P 2003	NPP Kozloduy	5.4 Mt increase
2 x 440 MW nuclear power units phase out	To meet EU requirements for EU membership	CO_2	Investment	P under discussion – 2007	NPP Kozloduy	5.1 Mt increase after 2006
Construction of 2 x 335 MW lignite fired thermal power units	To increase import fuel independence of the country, to fulfil the long term electricity export contracts	CO_2	Investment	P permit issuing	AES Horizon	2004 (3.3 Mt increase), 2005 (3.3 Mt increase)
Restructuring of power sector	Liberalization of electricity market	CO_2	Legislation	A	Ministry of energy	–
Energy efficiency program for municipalities	Reduced fuel consumption by municipalities, hospitals, schools, etc.	CO_2	Policy	A	Municipalities, NGOs, EEA	0.5-4.5 Mt
Natural gas market liberalization	Accelerated penetration of natural gas to the market	CO_2	Policy	P	Ministry of energy	–
Natural gas supply to households	Support for fuel switching in households and construction of distribution network	CO_2	Investment	A	Private companies and municipalities	0.3-3 Mt
National Program on Renewables	Institutional support for Renewable energy penetration	CO_2	Policy	P	EEA	
Energy Conservation in Buildings		CO_2				
Coal prices liberalization	Restructuring of inefficient coal mining	CH_4, CO_2	Policy	I	Ministry Of Energy	–
Utilization of nuclear units 3 and 4 in NPP Kozloduy till the end of their design lifetime	Improved safety of nuclear units	CO_2	Policy	P	Government	10 Mt (after 2007)
Accelerated penetration of renewables for electricity production (micro-hydro and HPP)	Utilization of hydro potential	CO_2	Investment	P	NEC, Private companies	0.2-3 Mt

I: implemented; A: adopted; P: planned

ENERGY EFFICIENCY

Energy efficiency is directly linked to the environmental protection. It concerns not only energy but also industry, construction, transportation, agriculture, trade, services and households. Energy efficiency improvements are crucial for the stabilisation of Bulgarian economy since the energy intensity of GDP is twice as high compared to the average energy intensity in the EU. Therefore energy efficiency was among the priorities of Program 2001 of the Government and important part in the Law on Energy and Energy Efficiency in force since July 1999. The activities of the Energy Efficiency Agency cover implementation of various measures (standards, labelling, energy audits, heat accounting, and permits) leading to improvement of energy efficiency and introduction of renewables. The common goal for Bulgaria is set in the Energy Charter that states that energy efficiency should become an additional energy source with positive impact on environment. The overall success of the policy towards meeting the commitments under the Kyoto Protocol is also dependant on the achievements of the energy efficiency improvement and the penetration of renewable energy sources.

Short-term priorities of EEA envisage the following documents and policies to be elaborated and pursued:

- National Energy Efficiency Program.
- National Program for Renewables.
- Sectoral and regional programs for energy efficiency and renewables.
- Annual Investment Programs.
- Regulation for certificates on energy efficiency – art. 147 (3) of LEEE.
- Regulation for energy efficiency audits – art. 149 (2, 3) of LEEE.
- Regulation for certificates on conducting of energy efficiency audits – art. 152 (3) of LEEE.
- Tariff for state tax from permits according art. 152 (4) of LEEE.
- Standards for energy and fuel use / savings in production activities / services – art. 144 of LEEE.
- Labelling for equipment locally produced or imported, as well as for buildings using electricity, heat energy, natural gas, solid and liquid fuels – art. 145 of LEEE.

One of the significant mitigation measures in the field of energy efficiency is the **National Action Plan for Energy Savings** elaborated in the framework of the project "Study on the possibilities for implementation of a widespread energy savings program in Bulgaria" under the SAVE II Program of the European Union. It has been worked out by EEA in consortium with the Austrian Energy Agency (E.V.A.) and the International Consulting on Energy (IEC), France. The Action Plan has two parts: a general section, containing guidelines about the method of designing energy conservation programs, and a specific section, in which the programs for the covered areas of action are prepared for introduction. The plan focuses on several fields, determined in compliance with the national priorities. The following methodology has been used:

- A **database** of energy conservation measures that are of interest to Bulgaria has been created. It contains more than 80 measures, structured in a unified format, sorted by sectors and evaluated by different criteria. The database remains open and may be expanded.
- The most promising measures for implementation by 2006 have been selected. They define the scope of the **National Energy Saving Program**. The selected measures are grouped by economic sectors.
- Upon further selection, the most important programs for the next 2-3 years have been elaborated in more detail and summarized in an **Action Plan**. The Plan contains concrete projects and the preparatory work for their implementation.

Although industry accounts for about one half of the total energy end-use, in short-term prospective energy efficiency in industry does not rank as first priority. More efforts need to be made in the demand-side, and in the public sector (state and public property), since the rate of return there is better guaranteed. It has been realized that the governmental policy to encourage energy conservation by end-users is less developed.

The multitude of all evaluated measures requires an investment in the amount of BGL 11.6 billion and would produce savings in monetary terms of BGL 2.2 billion annually. The implementation of these measures would produce 17% reduction of the total energy end-use. The measures selected for incorporation in the Action Plan are mainly those with a payback period of less than 3 years and partially the ones with a payback up to 6 years. The measures with a payback be-

low 3 years, included in the package, would require investments in the amount of BGL 1.8 billion and the estimated savings amount to BGL 0.85 billion.

The measures in the Action Plan are grouped by programs for three years with investment steps for each year. The evaluation of each measure in the programs is carried out on the basis of the following criteria: required investments, simple payback, Net Present Value, Internal Rate of Return, saved CO_2 emissions. The evaluations are made at 15% discount rate.

The programs are oriented towards sectors such as: housing construction (residential sector), centralized district heating, industry, households and communal services, transport, agriculture. Quantitative targets have been laid down for some of the sectors, while for others, like agriculture, no such targets were set.

One example from the Action Plan is the section on *building sector*. The building sector accounts for one third of the total energy consumption in Bulgaria. This share is approximately equal to the values of this index in the developed countries, and in the near future its weight will remain constant or increase. Buildings in Bulgaria have well defined ownership, which offers substantial technical opportunities for energy conservation. The measures to realize these energy savings are easy to implement, accessible, relatively cheap and have a positive environmental impact.

The Action Plan takes into consideration the existing building stock in the country and the conservation options. With respect to existing building stock, the average specific energy consumption (per unit heated area) is estimated to be more than 200 kWh/m^2. The objective is to reduce this amount by 50 kWh/m^2, i.e. by about 25%. It is intended that after a specialised rehabilitation program, including improvement of the space heating systems and promotion of the use of solar energy, the consumption rate should drop to 100 kWh/m^2, or a reduction of 50% shall be achieved.

In the case of new construction the energy consumption is expected to be less than or equal to 100 kWh/m^2.

The Action Plan groups the measures in the sector as technical measures:

- Program for energy conservation in large-panel buildings.
- Program for energy conservation in commercial and public buildings.
- Program for energy conservation in solid-frame (brickwork) buildings.
- and non-technical measures:
- Program for education and training on energy conservation.
- Energy labelling of buildings.

The **Municipal Energy Efficiency Network** – "EcoEnergy" – is informal non-profit voluntary association of Bulgarian municipalities, established in February 1997 on initiative of the mayors of 23 municipalities. The foundation of the Network and its first steps were supported by the US Agency for International Development (USAID) in the framework of the project *Municipal Energy Efficiency Initiative*. Several projects of the USAID continue to provide support to EcoEnergy. Currently, the activity of the Network is supported mainly through the project *Energy Efficiency Strategy to Mitigate GHG Emissions. Energy Efficiency Demonstration Zone in the City of Gabrovo, Republic of Bulgaria,* funded by the Global Environment Facility (GEF) through the United Nations Development Programme (UNDP). The Municipal Energy Efficiency Network has three strategic goals:

- To coordinate efforts by member municipalities to consider and improve energy efficiency as a means of addressing important national issues within the energy and environmental policy.
- To create conditions for diminishing the burden of energy costs on municipal budgets so that the savings can be used for other municipal priorities.
- To reduce the energy costs incurred by individual end-users within the municipalities and to increase public support for a municipal energy conservation policy.

To achieve these goals, the MEEN carries out the following activities:

- *Institution building:* the institutional building activities include first the organisational set up of the Network itself. A strategy for the development of the MEEN for the period up to the year 2006 has been elaborated. The annual conferences of the Network are the milestones in the consolidation of the Network and the

development of its activities. The tasks of the MEEN in the member-municipalities are carried out by the Municipal Energy Efficiency Offices. They are part of the municipal administration and are the agents for promoting energy efficiency and incorporating energy efficiency considerations into municipal programmes and strategies. Until now 31 such offices have been established and equipped. A computer network linking the Municipal Energy Efficiency Offices and the Secretariat has been established. Some municipalities from the network have established municipal energy agencies in partnership with other stakeholders in the municipality, such as utilities, companies, and industries.

- *Information database*: An information system about energy consumption in MEEN member-municipalities has been created. The system covers information about actual fuel and energy consumption by municipal sectors, groups and facilities. Special information database software for municipal energy management has been developed and is in use in all member-municipalities.
- *Municipal energy planning*: The priority actions of the MEEN in the period 1999-2002 aimed to create the basis for development of a municipal energy efficiency policy. Planning for energy efficiency is a new activity for the municipal authorities. A model for a municipal energy efficiency programme was developed and discussed. Draft pilot projects for municipal energy efficiency programmes were developed for two municipalities (Gabrovo and Stara Zagora). 20 municipal energy efficiency programmes were developed during the training courses for municipal experts. The programmes identified the priority actions for realizing the energy efficiency potential in the municipal sector of the respective municipalities. They envisaged a 25-30 percent reduction of energy consumption in the facilities included in the programmes. Priority target groups are schools, kindergartens, street lighting, administrative buildings.
- *Training and Education*: Seminars and workshops are conducted on different energy efficiency topics of interest to municipal experts and leaders. A specialized training program on energy planning and financial management for municipalities is under way. Training materials on municipal energy planning and management; energy audits, assessment of the energy efficiency potential and environmental benefits; planning, management and financing of energy efficiency projects were developed. All municipalities from the Network have the possibility of sending several representatives in this training programme. The approach of the training programme is "learning by doing". The participants in the training course develop draft municipal energy efficiency programmes and business plans for priority energy efficiency projects.
- *Information dissemination*: The Network publishes and distributes a newsletter, EcoEnergy. Information on different energy efficiency issues is disseminated among the member-municipalities. A Network website was created (www.ecoenergy-bg.net).

4.3.2. Transport

The key priority in the Governmental Program **People Are the Wealth of Bulgaria** in the field of transport is development of the national transport infrastructure as an integral part of the Pan-European Transport Network. The existing transport infrastructure is to undergo restructuring and upgrading in order to fulfil the EU and the NATO requirements. It is important to liberalise the transport market, complete the legal and institutional reform in the transport sector, and provide business-friendly environment to private competitive transportation companies. An essential precondition for building a modern infrastructure of the Bulgarian economy that meets international standards is to develop environment-friendly transportation systems and technologies, promote intermodal transportation and put into operation modern safety, telecommunications and information systems. Achieving these goals will influence the environmental and GHG emission related performance of the sector.

The **National Plan for Economic Development for the years 2000-2006** emphasize on the priority to develop transport infrastructure along the route of Pan-European Transport Corridors Nos. IV, VIII and IX. The same principles of development of transport infrastructure are grounded in the elaborated by the Ministry of Transport and Communications updated **National Strategy for Development of the Transport Sector** (approved by the ISPA Steering Committee of the European Commission – July 20, 2000) for the same period and **Program for**

Transport Infrastructure Development for the Period 2001-2005. The program is elaborated on the basis of the following documents:

- The Decisions of the Second (Crete – April 1994) and the Third (Helsinki – June 1997) Pan-European Conferences of the Ministers of Transport for development of the Pan-European Transport Corridors and the Trans-European Transport Network.
- Program "Bulgaria 2001" and "The Updated Program of the Government of the Republic of Bulgaria: January 2000 – April 2001".
- Mid-term Investment Program of the Government of the Republic of Bulgaria for public investments in the period 1998-2001.
- Republic of Bulgaria's National Economic Development Plan for the period 2000-2006.

The program includes main projects in the air, water, railway and combined transportation for the period 2001-2005. The priorities are based on the importance of the projects on national, regional and European level. The overall cost of the program is about 4 billion Euro that are expected to come from national budget (31%); international credits (30%); grants (PHARE; ISPA and other programs – 18%); capital of transport companies (10%); and private investments (11%).

STRATEGY FOR THE DEVELOPMENT OF TRANSPORT INFRASTRUCTURE IN THE MEDIUM TERM (2000-2006)

Bulgaria is a member of the European Conference of the Ministers of Transport (ECMT) and meets the requirements of the road transport regime. The participation of Bulgaria in the **TINA** project is an important component of the development of transport infrastructure. Five of the ten Pan-European Transport Corridors are passing through Bulgaria. This commits the Bulgarian Government to complete a number of projects, located along the routes of the Pan-European Transport Corridors Nos. VIII, IV, X, IX and VII.

The Program of Transport Sector Development also includes the construction and development of: Sofia National Airport; Restructuring, rehabilitation and modernization of rail transport; Rehabilitation, modernization and development of the national road network.

The four-year *Mid-term National Investment Program for the period 1998-2001* clearly determines the obligations of the State Budget for development of the country's overall infrastructure requirements, including the transport sector. There are 25 Ministry of Transport and Communications projects approved in the National Investment Program. These have been allocated a total State budget contribution of approximately Euro 480 million for the period 1998 to 2001 (this figure excludes other possible sources of financing).

In addition to the Mid-term Investment Program, the Ministry of Transport and Communications has elaborated an *Investment Program for Development of the Transport Infrastructure of the country*, with 36 national investment transport projects and the investments necessary for their construction until year 2015 (estimated total cost of approximately Euro 4,890 million).

The strategic objectives for the development of transport infrastructure in the Medium term (2000-2006) include:

- Balanced and inter-related infrastructure development among individual modes of transport.

The principles of equal competition between modes of transport, multimodal transport, combined transport, and particularly environmental awareness, must be adhered to in transport investment. This would guarantee harmonious development of infrastructure for all modes of transport, maintaining at the same time market principles and encouraging competition in meeting specific national transport needs. This is particularly relevant to items of structural significance, which are primarily the remits of the state such as railways and highways, or of major national and regional importance such as Sofia Airport.

- Improving speeds and service levels along important Corridor IV Sections.

The Corridor's importance has increased after works started on a Bosphorus rail tunnel to enable uninterrupted rail travel between the two continents. This is expected to boost annual rail freight crossing Bulgaria by 10 million tons (an increase of approximately one third of current traffic levels). To accommodate this significant rise, the Bulgarian Government plans to upgrade the Plovdiv – Svilengrad – Kapitan Andreevo railway to 160 km/h speeds along its entire length, and to provide for future track doubling.

- Completing track electrification of railway sections along the Pan-European Transport Corridors.

This objective includes track electrification, refurbishment and modernisation. To attain this objective electrification is proposed of the entire railway infrastructure along Transport Corridors Nos. VIII and IV. In practice this would mean general completion of electrification of all Bulgarian track forming part of the Pan European Transport Network under the TINA Project: the balance of track along Corridors Nos. VIII and IX are electrified except the Radomir to Gueshevo sector of Corridor No. VIII. Due for refurbishment and electrification, the latter will await completion of the Skopje to the Bulgarian/FYR of Macedonia border railway, most likely after 2004.

- Completing the reconstruction and modernization of major highway sections, included in the Pan-European Transport Corridors.

This objective is two-fold: first, completing the Republican Highway Network rehabilitation and upgrading by the end of the ISPA programming period (2006); and second, extending the motorway network by including new segments as part of the Pan European Transport Corridors Nos. VIII and IV.

- Compliance of the transport strategy with environmental issues.

In general, developments in the transport sector could have undesirable environmental effects. Finding acceptable environmental solutions in connection with traffic growth, undesirable modal split and sustainable infrastructure construction is one of the greatest challenges for countries during the transition period. As a country negotiating for accession to the European Union, Bulgaria is obliged to harmonise its policy with respect to transport and the environment with that of the European Union.

The **key objectives** for solving the environmental problems caused by the transport sector include:

Improving the environmental performance of transport infrastructure plans and projects – all transport infrastructure projects will have to carry out an environmental impact assessment similar to the procedures of Council Directive 85/337/EC as amended by Directive 97/11/EC. The Environmental Impact Assessment principles have to be applied to all levels of decision-making with respect to development of the transport infrastructure network.

Enhancing the use of cleaner fuels – fuel quality is a key transport-related environmental issue; the first step in fulfilling the objective in Bulgaria is the elimination of the use of leaded petrol by year 2003, envisaged in National program for ceasing the production and usage of leaded gasoline as adopted by the Council of Ministers.

Limiting the increase of transit inter-urban car traffic – the measures envisaged for attaining the objective are promoting public transport and efficient use of infrastructure – construction of bypass roads around the biggest towns in the country are planned.

Improving urban bus transport in respect to environmental aspects – some measures for attaining the objective are already underway in the biggest towns of the country. They include renewal of the bus fleet and use of new environmentally friendly motors.

Promoting the use of rail transport – the measures include improving rail infrastructure and services; the shifting of traffic from road to rail transport is a priority in the transport policy, both of the European Union and Bulgaria.

Extending rail electrification – the planned total electrification of the railway lines along Pan-European transport corridors on the territory of Bulgaria is another step in helping to address the environmental problems.

Promoting the use of combined transport – new legislation is under preparation and the reconstruction and construction of new combined transport terminals are envisaged.

Enhancing the use of maritime and inland waterway transport for shipping of goods.

Sustainable development of air transport – the development of Sofia airport complies with all European environmental requirements. The overall development of air transport follows the EU Directives (in respect to gaseous emissions, noise, etc.).

The program "Transit Roads" started in 1992 with the financial support from the European Investment Bank, the European Bank for Reconstruction and Development and the PHARE program. More than 600 Km of first class roads with intensive traffic were rehabilitated under the program "Transit Roads I". The reconstruction of approximately 800 Kms of the main road network was catered for under the program "Transit Roads II", carried out between 1997 and 1999. This program was directed to the most heavily loaded sections in worst operational condition on the route of the international roads and the Pan-European corridors.

The former General Road Directorate has already started the realisation of the program "Tran-

Table 4.4. Summary of mitigation policies and measures in transportation

Policy name	Objective	GHG affected	Type of instrument	Status	Implementing entity(ies)	Mitigation impact by gas [t CO_2 equivalent]		
						1995	2000	2005
1. Normative documents related to the Law on road traffic	Improved road traffic	N_2O	legislative	I	MRRB	n.a.		
2. Improvement of the infrastructure of the transport system	Improved infrastructure	N_2O	policy (chapter VI – Investment policy)	I	MRRB	gradual reduction of emissions: 2000 – 3,100 t; 2005 – 5,000 t		
3. Strategy for the development of transport infrastructure in the medium term	Environmental performance of transport sector	GHG	policy	A	MTC	–	–	625 kt

sit Roads III", which will cover the period 1999-2002 and provide for more than 600 Km of the main road network.

Bulgaria is not a producer of cars and trucks and therefore there are no programs for improved efficiency of the new vehicles. The average age of the road transportation vehicles is over 18 years and the related emissions per Km are high. The MOEW has included in its priorities the need for renovation of the automobile stock in the country by enforcing emission standards that could not be met by the old vehicles. It is assumed that the high fees for exceeding the standards will lead to changes in the vehicles stock and reduction of the emissions by 30-40%. Summary of mitigation policies and measures are shown in Table 4.4.

4.3.3. Industry

Industry uses about half of the total generated energy. A series of measures were developed as a part of the Energy Efficiency Program and the National Climate Change Action plan aiming at reduction of energy intensity of production, and mitigation of GHG emissions from industry. Those measures were developed for the following sub-sectors of the economy: ferrous metallurgy, non-ferrous metallurgy, chemical production, light industry, food processing industry, machine building and metal works, electrical and electronic industry, construction, building material industry.

- The measures were also grouped according to the required investment:
- Non-investment measures and low-cost projects (organisational/technical and managerial) – until 2000.
- Medium-cost measures with 1 to 3 years pay back period – till 2010.
- High-cost investment projects with 5 to 10 years play back period.

Another grouping according to their characteristics was made as follows: Financial; Investments; Regulatory; Legislative; Institutional.

The overall annual fuel and energy savings resulting from implementation of the measures were estimated to 1,855 thousand toe/year. Implementation of the individual measures or sets of measures involves significant investment and is directly related to the political and economic stability in the country, as well as to the market opportunities for sale of the product. Ownership restructuring in the industry after completion of the privatisation and finalisation of the privatisation transactions will determine the performance of investment projects during the period until 2005 and the actual technological and hardware renovation of the companies.

It should be noted that due to the privatisation of a significant part of the big enterprises in Bulgaria, some of the measures are already implemented. The efficiency of the production tends to improve and therefore the GHG emissions are decreasing. On the other hand, a significant part of the plants with energy-intensive production are already closed down and they do not contribute to GHG emissions in the country any more.

In terms of the short-term framework tasks for the sector set in the NCCAP, it should be noted that they are already implemented, namely:

- Establishment of a energy efficiency centre: with the support of the Japan International Cooperation Agency (J ICA) there was established (Governmental Decision 248/November 27, 2000) a Centre for Energy Efficiency in Industry (CEEI) that functions as a unit to the

Ministry of Industry. The main goal of the Centre is to reduce energy consumption and hence to mitigate GHG emissions.
- Development of a program for energy efficiency improvement in industry: a project is to be elaborated on the "Study on the possibilities for a large scale energy saving program in Bulgaria" within the frame of SAVE II program of EU.
- Establishment of a mechanism for compulsory priority energy audits of all plants with high energy-intensity and more than 100 employees: CEEI provides consultative services for the technologies with a GHG potential.
- Public awareness campaigns on climate change, Kyoto mechanisms, energy efficiency (energy management). Campaigns to promote energy efficiency at enterprises are among the obligations of the CEEI.

In 1999-2000 period, a joint venture with the Japanese Organisation for New Energy and Industrial Technologies (NEDO) on the "Main systems for installation of energy saving equipment in Kremikovci" had been carried out. An assessment of the outputs of the project is underway and decision should be made by Japanese site for financial support for the next stage of the project (implementation of the results and decisions from the first stage).

Some specific GHG mitigation measures reported by the Ministry of Economy are listed in Table 4.5.

4.3.4. Agriculture

Since the last National Communication, the Council of Ministers has accepted the **National Agriculture and Rural Development Plan for 2000-2006 (NARDP)**, and entrusted its implementation to the Minister of Agriculture and Forestry. The NARDP was prepared by the MAF in compliance with the main goal of the National Economic Development Plan which is to achieve low-inflation economic growth as a precondition for increasing incomes and improving living conditions in view of the further integration with the European economic and social area as well as in compliance with the National Program for the adoption of the acquis. The NARDP was prepared in close collaboration with representatives of regional and local authorities, farmers associations, regional development agencies and other non-governmental organizations.

The two main goals of the NARDP are:

- Improvement of the efficiency of agricultural production and promotion of a competitive food-processing sector by better market and technological infrastructure and strategic investment policies ultimately aimed at reaching EC standards.
- Sustainable rural development consistent with the best environmental practices by introducing alternative employment, diversification of economic activity and establishment of the necessary infrastructure. This in turn will improve the living conditions and standards of rural communities, generate fairer income and open up employment opportunities.

The NARDP was approved by the Council of Ministers by a Decision No. 726 dated 22 Nov 1999 and presented to the EC at the beginning of April 2000 to start the procedure for its approval and adoption.

On September 13th 2000 the STAR Management Committee of the EC discussed and highly appraised the national plans of six applicant countries under the SAPARD Program, among which is the NARDP of Bulgaria. In the same year, grant funds for projects in the following areas were expected:

- Investments in agricultural holdings.
- Improvement of the processing and marketing of agricultural and fish products.
- Development and diversification of economic activities, providing for multiple activities and alternative income.
- Setting up producer groups.
- Technical assistance.

Concerning *organic farming*, Bulgaria adopted framework legislation in August 1999.

The MAF is working on a strategy to prepare Bulgaria to implement the Common Agriculture Policy (CAP). Detailed feasibility studies on the mechanisms under some of the key common market regulations (milk and dairy, fruit and vegetables, and grain) are under preparation. These studies will use cost-benefit analysis to identify options and recommend plans for gradual introduction of the agricultural *acquis,* policy mechanisms and practices that will create favourable economic conditions.

A **Code of Good Agricultural Practices** has been prepared setting minimum obligations for farmers to be eligible for the SAPARD "development of environmentally friendly agricultural practices and activities" measure.

Table 4.5. Summary of mitigation policies and measures in industrial sector

Policy name	Objective	GHG affected	Type of instrument	Status	Implementing entity(ies)	Mitigation impact by gas [t CO_2 equivalent]		
						1995	2000	2005
1. Reduced operation time of steam boiler with 5000 Nm^3/h load	Change in the technological scheme of ammonia transportation	CO_2	Technical	I	"Neohim" – Dimitrovgrad	63,828	63,828	63,828
2. Shut-down of a compressor for natural gas pressure rise	Optimisation	CO_2	Technical	I	"Neohim" – Dimitrovgrad	–	32,328	32,328
3. Restructuring of a reforming furnace	Optimisation	CO_2	Technical	P	"Neohim" – Dimitrovgrad	–	–	17,784
4. Use of heat from cathode waste gas (H_2)	Reduction of fossil fuel use (10 000 t coal/ yr)	CO_2	Technical	P	"Polimeri" – Devnja	–	–	25,000
5. Reduce consumption of CO_2	Reduced production	CO_2	Technical	I	"Kotlostroene" – Sofia	5.5	9.4	9.4
6. Reduce fuel use	Reduced production	CO_2	Technical	I	"Kotlostroene" – Sofia	0.7	0.85	0.85
7. Installation for wood briquettes	Utilisation of waste wood	CO_2	Technical	I	Sviloza – Svishtov	–	12,480	12,480
8. Installation for production of pallets from waste wood bark	Utilisation of waste wood	CO_2	Technical	P	Sviloza – Svishtov	–	–	43,440
9. Use of chemical additive for liquid fuels "Helios"	Improved combustion process	CO_2	Technical	I	Balkanfarma – Trojan	–	5.4	6.3
10. Gas supply to steam boiler	Reduced emissions	CO_2	Technical		Balkanfarma – Trojan	–	6.8	6.2
11. New equipment of units; chance of burners	Automated dose meters and use of residual and natural gas	CO_2	Technical	I	Balkanfarma – Dupnica	227,355	227,614	227,614
12. Gas supply of steam plant	Reduction of emissions	CO_2	Technical	P	Balkanfarma – Dupnica	–	–	14,000
13. Technological upgrading	Optimisation	CO_2 N_2O	Technical	I	Serdika – Stara Zagora	1,700 1,225	1,860 388	–
14. Restructuring of steam boiler	Shift from residual to natural gas (900 t residual oil/yr)	CO_2 N_2O	Technical	A	Serdika – Stara Zagora	–	2,200 101	2,100 34
15. Restucturing and replacement of filers	Emission reduction	CO_2	Technical	A	KCM – Plovdiv	–	4,300	3,700
16. Restructuring of electric filter of lime furnace	Better dust catching	CO_2	Technical	A	Stomana – Pernik	–	20,100	18,500
17. Construction of dust precipitators	Emission reduction	CO_2	Technical	A	Stomana – Pernik	–	3,100	2,900
18. New filters to the dust precipitators	Emission reduction	CO_2	Technical	A	Bentonit – Kardjali	–	560	440
19. Restructuring of industrial sector; privatisation and energy efficiency improvement	Improved efficiency, organizational and low cost measurements for energy efficiency improvement	CO_2	Policy	A	Privatisation Agency / Private companies	2.1-4 Mt		
20. Closure of non-competitive industrial enterprises	Reduced state subsidy	CO_2, N_2O	Policy	I	Government	4.3 Mt		
21. Energy efficiency program for industry	To facilitate energy efficiency improvement in industrial enterprises	CO_2	Program/ Policy	A	Ministry of Industry	2.5-6 Mt		

Approximation of legislation in the veterinary sector is progressing well, with the adoption of secondary legislation necessary to implement the **Law on Veterinary Activity** (published in May 1999), and the adoption of relevant Ordinances. Further legislative work is ongoing and will be focused on animal-waste treatment, residues and zoonosis control.

An **Animal Breeding Act**, setting up conditions for the sustainable development of animal breeding, efficient production of livestock, and preservation and support for the national gene bank, and providing the legislative framework for the introduction of EC standards, came into force in September 2000. The Act introduces EC requirements concerning the recognition of breeding associations, which establish or maintain herd books for pure-bred animals.

A **Feed Act**, adopted in September 1999, aims to preserve and improve animal productivity, to ensure the use of quality and suitable food, and to provide the legal framework for the introduction of other standards. It sets the conditions for production, circulation, import, export and use of products and substances intended for animal consumption, and establishes the Directorate on Food Control within the National Grain Service. The Service includes 7 regional offices and laboratories, 3 of which are accredited. An Ordinance on registration of producers of animal food was adopted in October 1999, but the relevant administrative structures have not been established yet.

The **National Service for Plant Protection, Quarantine and Agro-chemistry (NSPPQA)** covers all the administrative needs for Bulgaria to meet EC requirements in the area of plant health. However, further improvement of the human resource capacity as well as provision of equipment to laboratories and Border Inspection Points is still needed. In the last year the capacity of the NSPPQA has been improved through provision of necessary equipment, in particular for laboratories.

An **Executive Agency on variety testing, field inspection and seed control** has been established. The Agency co-ordinates the Variety Testing Directorate (testing of new plant varieties and their recording on the National Variety List), and the Field Inspection and Seed Control Directorate (certification of seeds and planting material and checks on the implementation of the marketing rules).

Preparation of agricultural statistics according to EC requirements is progressing well through the implementation of the Plan for the Development of Agricultural Statistics for the period 1997-2002, in line with EC standards.

The **Water Users Association Act** will facilitate the development of the WUA through enabling the direct and unconditionally granted tenure to state-owned and municipal irrigation infrastructure (natural water sources, dams), and even further on the transfer of ownership aimed at decentralizing the management of irrigation.

Plant Variety Testing, Approbation and Seed Grading. On the basis of Ordinance No. 203, dated January 1, 1999, the Council of Ministers established the Executive Agency of Plant Variety Testing, Approbation and Seed Grading under MAF. Further on, the National Plant Variety Council and the Head Inspectorate of Approbation and Seed Grading were transformed into directorates, respectively Directorate of Plant Variety Testing (DPT) and Directorate of Approbation and Seed Grading (DASG).

Plant Protection. The National Service for Plant Protection, Quarantine and Agro-Chemistry (NSPPQAC) monitors, through its network of divisions and branches, the level of pest and plant disease threat, and, based on the findings, issues bulletins informing the producers on the recommendable measures and chemicals to be used in consideration of possible economic implications.

Phyto-Sanitary Control. One of the major tasks assigned to the National Service for Plant Protection, Quarantine and Agro-Chemistry (NSPPQAC) is the implementation of the International Convention on Plant Protection (FAO) aimed at preventing trans-border transmission of pests and plant diseases. The phyto-sanitary control is assigned to the NSPPQAC offices at the border-crossings authorized for import, export and transit of plant products by the Council of Ministers, and to further 15 Regional Plant Protection, Quarantine and Agro-Chemical Treatment Services inland.

Agro-Chemical Treatment and Fertilizer Use. As regards fertilizer use, 1999 recorded a slight increase compared to 1998 (Table 4.6).

The overall growth in fertilizer use comes as a result of increased nitrogen use. While the optimum proportion N/P/K is 1/0.8/0.4, in 1999, N/P/K recorded 1/0.07/0.04, indicating an average use of phosphates and potassium fertilizers over 10 times lower than the recommended. In relative terms, phosphate use stepped down one year before. The unbalanced fertilizer use favouring nitrogen pre-

Table 4.6. Fertilizer use 1997-June 2000

Year	Total NPK		Nitrogen		Phosphates		Potassium	
	tons	kg/ha	tons	kg/ha	tons	kg/ha	tons	kg/ha
1997	163,922	36.47	145,773	32.49	16,275	3.58	1,864	0.40
1998	113,146	24.11	97,497	20.77	8,900	1.89	6,749	1.44
1999	156,344	33.31	140,269	29.88	10,376	2.21	5,699	1.21
First half 2000	115,120	–	107,959	–	5,545	–	1,616	–

Source: NSPPQAC

vailed over production in the last 7-8 years. In 1999, nitrogen use accounted for 29.5 % of all arable land, followed by phosphates (2.3 %) and potassium (0.67 %). The total area treated with fertilizers declined compared to 1998. The issue of low humus and phosphorous content of soils comes first among the major issues related to fertilizer use. Using extensive methods of production will most likely result in further decrease in average yields.

Selective Breeding. During 1999-2000, the process of structural reforms and privatisation in the area of selective livestock breeding made a significant progress. Initiated by experts from the former National Service for Selective Livestock Breeding (NSSLB), later transformed into Department of Livestock Breeding Control (DLBC) under NVS, the reported period saw the establishment of associations dedicated to different breeds of domestic animals. Besides the technical measures, climate change issue will benefit from the activities in the field of **education and public awareness** undertaken in the sector. Over the years, the Ministry of Agriculture and Forestry has provided finance for a network of 100 vocational schools. The MAF has elaborated a public information campaign for the SAPARD program, including organization of a number of seminars for branch organizations, commercial banks, private producers and processors, regional and municipal authorities, insurance company and other interested parties.

In 1999, the **National Agriculture Advisory (NAAS)** continued its operations with the financial assistance of MAF. The NAAS administration made a motivated proposal for the establishment of a **National Agricultural Advisory Service (NAAS)** with the statute of a legal entity funded by government budget allocations. Therefore, the NAAS has been transformed into NCAS pursuant to the Act on the establishment of a National Centre for Agricultural Studies (*State Gazette No.115*, December 1999).

The National Agricultural Advisory Service under MAF has been assigned to implement the government policies related to sustainable development of agriculture in the rural areas. The long-term objectives of NAAS include:

- Improving the quality of agricultural products.
- Protecting and upgrading the environment and natural resources in rural areas.
- Improving the social and financial status of rural communities.

In view of above objectives, the NAAS operations should focus on the following specific goals:

- Facilitating the consolidation of agricultural holdings.
- Providing adequate information on levels of risk and profitability in agriculture and agro-food industry in rural areas.
- Providing expertise and information regarding the adoption of leading international practices in the main segments of agriculture.
- Providing extension services to agricultural producers aimed at improving their knowledge and skills.

A major priority in **institution building** in agriculture is the establishment of institutions and administrative structures designed to effectively apply and monitor the implementation of the newly adopted law. The following priority measures were implemented over the last year:

- Structural Policies (A SAPARD unit was set up within the Ministry of Agriculture).
- Agro statistics (an agro-statistics unit was created together with its regional structures).

The great deal of measures within the priority areas like the internal market, the SAPARD program and agro-statistics are directly related with creation of conditions for implementing the **Common Agricultural Policy** (CAP). The institutions built up in the context of integration with the internal market, which carry out the animal identification and the information systems management will gradually

Table 4.7. Summary of mitigation policies and measures in agriculture

Policy name	Objective	GHG affected	Type of instrument	Status	Implementing entity(ies)	Mitigation impact by gas [t CO_2 equivalent]		
						1995	2000	2005
1.Introducing EC standards	Harmonisation with EU legislation		Regulatory	I	MAF	–	–	–
2.Balanced agro–chemical treatment and fertiliser use	Reduced emissions	N_2O	Technical	P	MAF	–	1,500 kt	2,100 kt
3. Improved animal productivity and feeding conditions	Reduced emissions	CH_4, N_2O	Technical	A	MAF	–	230 kt 32 kt	270 kt 41 kt

form the administrative basis needed for the functioning and implementing of the CAP intervention and premium schemes after Bulgaria has been acceded to the EU. The institutions which will be established to implement SAPARD will further take on the functions of the CAP financial system, whereas the information obtained by the agro-statistical administration will form the basis for planning and implementing the CAP policies.

Regarding the creation of institutional environment meant to facilitate the implementation of newly adopted legislation in accordance with the EU requirements and practices, in the beginning of 1999, MAF formed an **Agro-Statistical Unit** assigned to establish a new system for collecting and processing agricultural data. The main objective lies in the development and the progressive adoption of new statistical methods based on either representative or territorial principle.

Main surveys:

- Land Use – BANCIK (Bulgarian Survey on Agricultural and Economic Situation).
- Estimating average yields of major crops.
- Survey on farm structure.
- Survey on livestock numbers.
- Survey on grape production; survey on meat-processing enterprises and survey on dairy enterprises; survey on orchard perennial composition.

Following the initial period of testing and adopting new surveys included in the system of agricultural statistics, their further timing will be determined in consideration of country's needs and the EU requirements (Table 4.7).

4.3.5. Forestry

Efficient forest management and conservation will be the pivots of the forestry policy as stated in the Government Program **People Are the Wealth of Bulgaria**.

The major groups of measures in the NCCAP addressing forestry are:

- Changed selection of the species for afforestation.
- Biodiversity conservation.
- Increasing of the forest biomass through felling.
- Lowland Forest Creation.
- Extension of afforested areas with introduced drought-resistant species.

The change in the selection of the species for afforestation is practically a tendency of more wide use of the deciduous species in the afforestation. In Ordinance No. 17 on afforestation and inventory of forest crops (State Gazette 67/2000) the specific requirements for selection of species for afforestation. The complex assessment of natural circumstances, including climate, is among the main principles in planning and afforestation procedures.

In regard to the two methods for conserving the biodiversity, the 'in situ' method has greater practical importance and it includes protection of national parks and seed producing stands. In 2000, these stands are 5,439 at area of 51,128 ha, including 14 coniferous and 43 deciduous species.

The 'ex situ' method relies on establishment of seed banks that have area of 523 ha (eight coniferous and one deciduous species).

The planned felling according to the forest management projects was to be increased, but actually there is a decreasing tendency. In 1997 the area with new planted felling is 81,933ha, and in 2000 – 46,920 ha. The main reason is the redirection of efforts towards sanitary cuts for waste crops and crops affected by disasters (33,306 ha in 1996 those increased to 41,58 ha).

Lowland forest creation. All kinds of affectations including lowland forest creation and afforestation in shelterbelts follow the regulations of the forest management projects. Afforestation of

lands, inappropriate for agricultural activities is not well developed despite envisaged support for owners according to articles 58 and 61 (par. 4) of the Regulation for application of the Forestry Act.

The extension of afforested areas with introduced drought-resistant species such as Cedrus atlantica is under way. The annual afforestation with this species in the period 1996-2000 has covered about 230-400 ha or a total area of 1,222 ha afforested with Cedrus atlantica over the period.

Its worth mentioning that all specific task in terms of mitigation and adaptation measures addressed in the NCCAP are reported as "under implementation", namely:

- Directing the research work of the research units under the authority of the Ministry of Agriculture and Forestry towards adaptation of the agriculture to the changing climate conditions;
- Gradual changing the species for newly planted forests by using heat and draught resistant species.
- Enlarging the planted areas by establishment of shelter belts and forestation of abandoned agricultural land.
- Preparing and implementation of a campaign on climate change problems and vulnerability of agriculture and forestry, as well as informing the owners about possible measures for mitigating GHG emissions: It is addressed in the media strategy of the ministry. The information strategy of the MAF on forests and especially forest fires covers the priority areas in the annual media plans that also include the climate change issue.
- Development and proposal of tools (financial and other incentives) to engage private land owners with implementation of the developed measures: Thanks to a Bulgarian-German project on forest the work with the private forest owners was initiated in terms of consultancy and establishment of awareness and involvement in application of planned measures on the areas they own.

Based on the experience acquired in the land restitution process and the implementation of nine pilot projects dedicated to forest restitution, MAF drafted a Regulation No. 1 (*State Gazette,* No. 10/2000) on the technical activities under the restitution of forests and forest land. In addition, MAF determined a pricing methodology with respect to the technical activities in question and developed digital models of Bulgarian forests.

In 2000, the restitution of forests and forest land along with the structural reforms pursuant to Article 5 of the Forestry Act continued to be among the major priorities in the sector. The process of structural reforms in forestry is already completed. Pursuant to Article 5 of the Forestry Act, the control functions of the former State Forestry Holdings have been taken over by the Regional Directorates of Forestry (RDF) and the forestry stations, while the economic functions have been assigned to 63 public limited companies (PLC) currently undergoing privatisation procedures. This sets the administrative structures that could be involved in the measures related to GHG mitigation measures and awareness campaigns.

The 1999 and 2000 projections regarding afforestation, seed-collection and sapling growing have been based on the *National Afforestation Program 1999-2000* setting forth as priority the afforestation of forests affected by fire and other natural disasters as well as areas cleared due to sanitary logging of forests affected by diseases. The afforestation activities have been financed by the National Fund *Bulgarian Forest*. Summary of mitigation policies and measures are shown in Table 4.8.

4.3.6. Waste

MUNICIPAL SOLID WASTE MANAGEMENT

The P&M in the waste management sector are contained in two main documents: the frame is given in the NCCAP, and the specific measures are provided in the National Waste Management Plan (NWMP). The measures given there have a more general nature but most of them have a direct impact on GHG emission reduction too. The information on these measures was provided in the Second National Communication.

The NWMP is a tool for improvement of the waste management in Bulgaria. It creates the needed prerequisites the waste generators – industry, commerce and consumers, society – to decrease the quantities of the waste generated. An essential element of the program is the waste treatment hierarchy:

- Waste reduction or prevention.
- Re-use and recycling.
- Improvements of the waste collection and transportation system.
- Environmentally sound disposal.
- Remediation of old contaminated sites.

The national program aims at environmentally sound waste management with regard to **the**

Table 4.8. Summary of mitigation policies and measures in forestry (CO_2 sinks)

Policy name	Objective	GHG affected	Type of instrument	Status	Implementing entity(ies)	Mitigation impact by gas [t CO_2 equivalent]		
						1995	2000	2005
1. Afforestation of lands, inappropriate for agricultural activities	Afforestation of 250 000 ha. Potential carbon sink – 12,15 Gg.	CO_2	Economic (Investment) but needs legislative support	A	Ministry of Agriculture and Forestry (MAF)– National Forestry Directorate (NFD). Assistance by the municipal and regional bodies (administrative organisations and NGOs)			
2. Establishment of new shelter belts	50 000 ha. Potential carbon sink – 2 ,43 Gg	CO_2	Economic	P	MAF – NFD, MOEW, MF, regions, municipalities			
3. Linear afforestation		CO_2	Economic	P	MAF – NFD, MOEW, MF, regions, municipalities			
4. Afforestation with Cedrus	8000 ha. Potential carbon sink – 486 Gg. Increase of areas with introduced drought-resistant species	CO_2	Economic	I	MAF – NFD, MOEW, MF, regions, municipalities			486,000
5. Pilot project "Rakovitza"	Afforestation of 300 ha aiming to check the adaptive potential of the species to climate change. Bio and technical adaptation. Potential carbon sink – 28 Gg	CO_2	Research and Economic	I	Institute of Forests, Forestry Technical University, NFD			28,000
6. Pilot project "Maritza East"	Recultivation of 50 ha through afforestation. Potential carbon sink – 4 Gg	CO_2	Research and Economic	I	Institute of Forests, Forestry Technical University, NFD			4,000

waste prevention, reduction or limitation of the harmful impact upon human health and environment, incl.:

- Legislative base ensuring effective waste management and harmonization with the EC standards in the field of waste management.
- Introduction of high technological standards and legal regulation of the waste related activities and transposition of the EU directives into the Bulgarian legislation and their further implementation.
- The costs of waste management activities to be covered by the generator to the highest possible extend.
- Reduction of waste for disposal due to prevention, recycling and recovery.
- Ensuring the necessarily measures, steps and means for implementation of integrated system of equipment and installation for disposal of municipal, industrial and hazardous waste.
- Application of the market principles in the field of waste management, while maintaining strong cooperation between the public institutions, local authorities, private sector and society.

The prevention of waste generation is the major goal in the waste management policy. It is expected to increase the interest of the different companies with implementation of high technical and operational measures for the waste disposal facilities and respectively increasing the disposal expenses. Another expectation is related to the municipalities in order to envisage proper measures for waste generation prevention.

The specific priorities included in meeting this goal include some measures that will have direct impact on GHG emission reduction, such as:

- Decreasing of the average waste standard generation to 350 kg/capita/year until the year 2002 and its stabilization, in spite of the fact that the consumers demand is expected to increase. Binding of waste fee with the amount of the waste generated and the real costs for environmental protection.
- Waste prevention, including:

  – Regulation and encouragement of the requirements for environmental control as:
  – Introduction of permit regime on waste quantities generated by the biggest industrial facilities, in respect to the *Directive 96/61/EC on Integrated prevention and control (IPPC)*;
  – Encouragement of clean technologies introduction;
  – Introduction of systems for environmental management and auditing schemes according to Regulation 93/1836/EC on systems environmental management and auditing (EMAS) and ISO 14001.
  – Regulation of the *Producers' responsibility* principle:
  – Encouragement of carrying out 'Life cycle analysis' during the product design stage, according to ISO 14040.
  – Introduction of Regulation 92/880/EEC in regard to the introduction of scheme for 'eco-labelling'.

All these measures will have contribution for the reduction of the CH_4 emissions from waste.

The authorities will continue to encourage activities in the field of **recycling and re-use** and shall undertake:

- Formulation of targets in the field of recycling and re-use for different waste streams from the industrial sectors.
- Formulation of objectives for reduction and recycling of waste in the public institutions and organizations.
- Ensuring access to information for the best available technologies and operational practices for the various sector of industry.
- Encouragement of new technologies' introduction in the field of reuse and recycling.
- Encouragement of waste exchange within the industry.
- Encouragement of marketing of goods produced from waste materials.
- Introduction of legislation, relevant to the responsibility of the producers and importers of waste, generated as a result of the supply of goods (implementation of the Directive on Packaging.

Specific steps in that direction will be:

- Increase of the quantities of recyclable waste in the country with 40% until 2005 and with 30% until 2010.
- Increase of the quality of waste collected for recycling purposes.
- Introduction of schemes for separate waste collection.
- Increase of the type of waste collected in order to be recycled or re-used.
- Construction of new facilities for wastes recycling (including centres for dismantling of end-of-life vehicles).
- Enlargement of the scope of the system for deposit of packaging materials for multipurpose use and introduction of labelling of the products and packaging that can be recycled.

Methane emissions are mainly related to the MSW disposal. The NWMP envisaged specific measures during the construction of new sanitary landfills – special isolation liners and other steps aiming at protection of human health and environment.

Together with the introduction of the European standards, the investment costs for new landfill sites shall increase considerably. These expenses will not be affordable for any municipality, therefore cooperation between several municipalities will decrease the waste disposal cost. Priorities measures in the area include:

- Construction of small number of high efficiency waste disposal facilities, allowing effective monitoring and control.
- Implementation of the requirements of the draft Directive on landfills (COM 97/108):
- Non-allowance of disposal of waste without treatment.
- Achieving of the following levels of recovery of the biodegradable components of the waste stream, which will lead to reduction of methane gas production from the landfill:
- Not later than year 2002 biodegradable municipal waste going to landfills must be reduced to 75% of the total amount (by weight) of biodegradable municipal waste produced in 1993.

- Not later than year 2005 biodegradable municipal waste going to landfills must be reduced to 50% and 25% till 2010 of the total amount (by weight) of biodegradable municipal waste produced in 1993.
- The landfill gas must be recovered or flared.

The measures in the sector also include the observation of the legislative regulation of waste management. The LHIWEA and its by-laws are the basis for transposing of the EU legislation into Bulgarian one in the field of waste management. The developed legislative provisions in 1998 ensure setting out of framework legislation on waste of the EU (75/442/EEC, 91/689/EEC, 259/93/EEC) and introduction of the requirements towards the facilities and installation for waste disposal (89/429/EEC, 89/369/EEC, 94/67/EEC, COM (97)105).

Aiming at **public awareness and participation**, it is recommend establishing of public working groups, and partnership of national, regional and municipal levels between the public institutions, local authorities, business actors, NGOs, scientific bodies and mass media.

The National Program aims at **improvements in the system for monitoring, information collection and control**. This measure including the survey, introduction and application of the methodologies for sampling and analytical control of waste, ensuring the technical support needed for the monitoring system would prove useful for the proper monitoring of CH_4 emissions under the UNFCCC too. The launching of National Information Centre on Waste Management after the year 2002 will further help the process.

Besides the results expected after the execution of the Program such as (prevention and reduction of the human health risk; improvements in the public hygiene at the territory of the settlements and the country side areas; improvements of the quality and the scope of the services offered in the field under consideration; improvements of the conditions for tourism development; achievement of the European standards in the waste management; reduction of the raw materials consumption through increase of utilization of secondary materials; new jobs creation), the program will bring to reduction of CH_4 emissions from anthropogenic activities and will contribute to the overall mitigation of GHG emissions in the country. It is difficult to assess the mitigation potential of the program in general, as it contains many specific measures the synergetic effect of which is not clear.

The first outputs of the implementation of this program are already at place. They include:

- Waste reduction or prevention – development of national schemes for collection and treatment of batteries, used oils, and lamps.
- Reuse and recycling – A prohibition for discharge of the acid from accumulators is introduced. Better system for their collection, storage, transportation and processing is established supported by funds of 500 thous. BGL; The amount of wood wastes utilization under various projects increases; A significant part of the facilities for recycling of plastics has been exposed to modernization and the investments in the field amounted to 1,310 BGL.
- Better collection and transportation – Modernization and optimization of MSW collection and transportation systems in 9 municipalities through purchasing of new equipment for 4,710 BGL, credit from the National Environmental Fund.
- Environmentally friendly waste treatment – In the period 1999-2002. 35 landfills are planned for construction. These landfills will be in compliance with the requirements for environmental performance, including construction of a system for collection, transmission and utilization or flaring of landifill gas. Construction of 14 regional landfills has already started with the financial support of the Environmental fund (16,046,960 BGL) and the state budget (10,501,000 BGL). Instalation of weighting machines to 6 municipal landfills for better accountability and input monitoring of the wastes. Development and approval by EC of a project for construction of 6 waste treatment plants for 60 million Euro and with 75% support of ISPA program. The construction of these landfills will be accomplished by the end of 2003. For the rest of the planned landfills the negotiations and cetrificate issuing procedures are in progress.
- Reduction of the contamination risk from operating landfills – audits of 57 municipal MSW landfills under operation. They are assessed in term of environmental risk. Proposals for closure or plans for rehabilitation and cost for these measures are made. Continuous projects for cleaning up areas contamminated by MSW. As a result in the period 1999-2000 over 30,000 dka were cleaned.
- Legislation – The law on limitation of harmful impacts of wastes on the environment and 11 by-laws for its implementation were adopted. A

document with direct address CH_4 emissions from landfils is Regulation No. 13 on provisions for construction and exploitation of landfills. This regulation bans free discharge of biogas generated in the landfills. These emissions should be caught by special systems and utilised or flared.

- Public awareness – a serie of information materials (over 20) on waste management – partly addressing the society, and partly the experts in the field .
- Improvements in the system for monitoring, information collection and control – uniform requirement for issuing permits for waste treatment at regional and national level and a National registry for issuing these permits were established; Significant improvement was made in the monitoring system, including collection of data for wastes and treatment equipment; Landfill exploitation monitoring is improved.

WASTE WATER MANAGEMENT

In compliance to this a National program for priority construction of urban waste water treatment plants for populated areas with over 10,000 equivalent inhabitants in the republic of Bulgaria (1999) was developed and adopted. The objective of the program is to establish according to river basins, the priorities for construction of urban WWTPs for all populated areas in the country with over 10,000 equivalent inhabitants, as well as the national short-term priorities until year 2002. It includes the completion of the constructed at present urban WWTPs, the reconstruction, the extension and modernisation of the existing ones, as well as the design and construction of new urban WWTPs. The program was prepared and coordinated with the main principles of the European legislation as regards the water quality management. The program creates the prerequisites for practical implementation of the European Directives and achieving of the requirements, which they envisage. It is also the practical tool for fulfilling of these requirements when the regulative basis is developed.

The necessary for construction, completion or reconstruction WWTPs according to the program are:

- New – 71
- For completion of construction – 10
- For extension, reconstruction and modernisation – 23
- Total – 104

The implementation of the program presented herein will be a significant step towards the solution of problems related to waste management in Bulgaria, as well as overcoming of the unsatisfactorily state of the existing facilities and construction of new ones designed for waste treatment. It application would have positive impact on the GHG emission mitigation. Summary of policies and measures is given in Table 4.9.

4.4. CONCLUSION

In the period after the IInd National Communication a National Climate Change Action Plan was approved and put under implementation. This plan is a crucial step for reduction of the CHG emissions in the country. The approximation of the Bulgarian laws to the EU environmental acquis is believed to guarantee for implementing climate-related policies and measures.

At the same time, the requirement from EU for early termination of the operation of 4 units in the NPP Kozloduy with total capacity of 1,780 MW would likely lead to significant increase of GHG emissions in the near future.

Bulgaria will continue to carry out mitigation policies and measures to the extent corresponding to the possibilities of the national policy and the amount of the earmarked foreign investments.

Table 4.9. Summary of mitigation policies and measures in waste management

Policy name	Objective	GHG affected	Type of instrument	Status	Implementing entity(ies)	Mitigation impact by gas [t CO_2 equivalent]		
						1995	2000	2005
1. Prevention and reduction of waste production	Pilot projects for different type of cities for assessing of the waste charge in relation to the quantity waste generated Elaboration and introducing restrictions for disposal of waste suitable for recycling	CH_4	Technical	I	MOEW		210 kt	450 kt
2. Reuse and recycling	system for separate collection of waste; wood waste utilisation branch strategies for waste management	CH_4	Technical	I	MOEW	21 kt	79.8 kt	117.6 kt
3. Environmentally-sound waste disposal	Building up and reconstruction of MSW landfills in accordance to the contemporary technical norms and standards; MSW incineration and composting sludge treatment	CH_4	Technical	A	MOEW			260 kt
4. Minimisation of the risk from old contaminated sites	Liquidation of old polluted sites							
5.Legal regulation of waste management	municipal regulations, defining the management of municipal and construction waste, generated on the territory of the municipality; Elaboration of regulation on the sludge treatment and implementation of the requirements of Directive 86/278/EEC;	CH_4	Regulatory	P	MOEW			
6. Public awareness and participation in waste management issues	To couple the issue with the climate change problem	CH_4	Policy	I	MOEW			
7. Improving of the system for monitoring, data collection and control	Will improve the quality of GHG inventory and will clearly indicate the areas for further improvement (e.g. cadastre and registers about waste sector)	CH_4	Policy	I	MOEW			

5. PROJECTIONS AND THE TOTAL EFFECT 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 2015). 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 and Second 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 decade (1988 – base-year, 1990-1999). 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 First and Second National Communications.
- Accounting for the actual GHG emissions / removals for the period 1988-1999 and the underlying reasons for the trends (national and external factors).
- Accounting for the main assumptions for the energy sector development set in the draft of the updated national strategy for development of the energy sector of Bulgaria until 2015.
- 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 2015 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. In both household and services sectors there are no special measures envisaged to improve energy efficiency. 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. Present IPCC guidelines cover bigger number of emission sources, so the "**with measures**" and "**with additional measures**" scenarios include them. Furthermore, after 1994 the Global Warming Potential (GWP) factors have been changed. To assure comparability between the three scenarios, based on the forecasted in 1994 macroeconomic indicators, production volumes, activity data and the new GWP factors, the emissions forecast in "**without measures**" scenario have been revised. The procedure for this revision is similar to the procedure for recalculation of GHG inventories used during preparation of 1999 GHG inventories.

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 26% for the period 2000-2015. This scenario projects relevant measures in the energy sector, while the rest of the sectors rely on separate measures without implementation of in-depth programs.

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

- The worn-out 4 lignite fired units in TPP Maritsa East 1 are used until the end of 2004.

- Units 1 and 2 of NPP Kozloduy (totalling 880 MW) are to be decommissioned in 2003.
- Units 3 and 4 of NPP Kozloduy are to be decommissioned in 2006 and 2007 respectively.
- 80 MW of new renewable energy capacity to be commissioned in 2002-2014.
- New lignite fired units 335 MW each are to be commissioned in TPP Maritsa East 1 as follows: 2004 – 1x335 MW; 2005 – 2x335 MW.
- Furnishing of the heat facilities in Sofia with gas turbines as follows: 2005 – 1x120 MW; 2009 – 1x120 MW; 2012 – 1x90 MW; 2013 – 1x90 MW and 2015 – 1x120 MW.
- Commissioning of new 300 MW unit fuelled by imported coal in 2005.
- Commissioning of new HPP Gorna Arda – 2006.

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 8,000 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:

- One less lignite fired unit in TPP Maritza East 1.
- New 100 MW HPP Tzenov Kamak.
- Doubling of the renewable capacity, so it reaches up to 160 MW.
- Electricity export is kept at annual level of 4,200 GWh.
- Units 3 and 4 of NPP are to be decommissioned according to their technological lifetime – in 2010 and 2012, respectively.
- There are no new units on imported coal that are planned for commissioning.

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:

Projected GHG emissions from energy sector

1. CO_2 emissions
2. CH_4 emissions
   - combustion
   - fugitive emissions
3. N_2O emissions

Projected GHG emissions from industrial processes

1. CO_2 emissions
2. CH_4 emissions
3. N_2O emissions

Projected GHG emissions from agriculture

1. CH_4 emissions
2. N_2O emissions

Projected CO_2 emissions from LUCF
Projected GHG emissions from wastes

1. CH_4 emissions
2. N_2O emissions

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. In order to compare all the three scenarios for the 2015-2020 period, the curves "**with measures**" and "**with additional measures**" for that period in the figures are an extrapolation of forecast using the same growth rate as for the 2010-2015 period.

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. Those measures are implemented by the relevant ministries and organisations focusing on specific plants and industrial units. The scenario "**without measures**" used the baseline scenario from the First National Communication. This scenario is revised with the results obtained by the GHG inven-

tories until 1995. The new GHG emissions sources added in accordance to the revised IPCC inventory guidelines were accounted for.

The emission analysis doesn't address the period 2015-2020, as for the "**with measures**" and "**with additional measures**" scenarios the emissions reported are estimated as extrapolation of the trends for the 2010-2015 period.

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 aggregated way 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.

Table 5.1. CO_2 emission projection from Energy [Gg]

Year	Without measures	With measures	With additional measures
1995	56,609	56,609	56,609
2000	69,455	44,513	44,513
2005	83,933	61,125	56,996
2010	95,184	71,852	66,048
2015	110,047	76,953	72,282
2020	123,157	82,005	75,453

Table 5.2. CH_4 emission projection from Energy [Gg]

Year	Without measures	With measures	With additional measures
1995	225	225.0	225.0
2000	199.6	132.9	132.9
2005	250.0	148.4	151.4
2010	278.4	183.1	170.3
2015	305.0	204.5	199.3
2020	410.3	223.1	216.4

Table 5.3. N_2O emission projection from Energy [Gg]

Year	Without measures	With measures	With additional measures
1995	9.73	9.73	9.73
2000	9.70	7.90	7.90
2005	13.10	12.20	11.10
2010	14.90	13.70	12.30
2015	17.70	14.10	12.80
2020	18.80	14.80	13.20

CO_2 EMISSIONS

The "**with measures**" scenario compared to the "**without measures**" scenarios indicates a tendency for decrease of the emissions for the period 1995-2015 that results in 22-30% lower emissions. The decrease is due to the restructuring of the industrial and power sectors. A significant delay in the rehabilitation of old capacities and introduction of new units in electricity sector is observed. On the other hand the energy demand for the "**with measures**" scenario is lower by 23-43% in the period 2000-2015 compared to the "**without measures**" scenario.

The scenario "**with additional measures**" covers the planned measures for development and commissioning of power units, decrease of electricity export and increased use of renewables. Both the "**with additional measures**" and "**with measures**" scenarios use one and the same projection for final energy demand. As a result the final CO_2 emissions for the "**with additional measures**" scenario are 6-8% lower. The deviation between the two scenarios is the greatest in the period 2005-2010 because of the less lignite-fired units and higher electricity export in this period.

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 lignites and from transportation and distribution of natural gas. The decrease of the emissions in the period 1995-2015 is 30-41%. It is the greatest for the 1999-2008 period when a more intensive commissioning of lignite fired units is expected in the scenario "**without measures**". In the period 2009-2015 the decrease is stabilised to 33-34%.

The comparison of the "**with measures**" and "**with additional measures**" scenarios indicates very low differences of 2.5-7% and mainly for the period after 2007. The peculiarity is that about 2005 the emissions in the "**with additional measures**" scenario increase by 1.7% due to the decommissioning of units on imported coal replaced by units on local lignites.

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.

The "**with measures**" scenario compared to the "**without measures**" scenarios indicates a tendency for decrease in the range of 7-20%. The dif-

ference till 2008-2009 is stabilised to 7-9% and then gradually increases to reach 20% in 2015.

The comparison of the "**with additional measures**" and "**with measures**" scenarios indicates gradual increase of the differences from 1-2% after 2001 to 10% in 2010. After that the difference stays constant in the range 8-9%.

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	Without measures	With measures	With additional measures
1995	64,350	64,350	64,350
2000	76,653	49,753	49,753
2005	93,244	68,023	63,616
2010	105,649	79,944	73,437
2015	121,939	85,618	80,435
2020	137,601	91,278	84,089

The aggregated changes between the "**with measures**" and "**without measures**" scenarios are within the range of 22-30% with more explicit deviation after 2010. The comparison of the "**with measures**" and "**with additional measures**" scenarios also indicates a constant tendency for decrease in the second scenario from 6 to 8.2% for the period 2000-2015.

If a comparison is made for the three scenarios over the 2000-2015 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 2000-2015 period, %

Scenario/ GHG	CO_2	CH_4	N_2O	CO_2 eqv.
Without measures	158	153	182	159
With measures	173	154	178	172
With additional measures	162	150	162	162

For example the rates of increase of the GDP for some sectors as industry, transport and services are 185%, 266% and 189% respectively. Those sectors are the most energy intensive part of the Energy sector and this indicates the efficiency of the mitigation measures included in the scenarios with measures. Even the emissions in the "**without measures**" scenario have lower rates of increase compared to the GDP rates because of the secondary environmental impact of the restructuring of the economy, change in the ownership and the implementation of energy efficiency measures.

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. When the scenarios were under development it turned out that there are no data for a scenario "**with additional measures**". 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

Non-energy emissions of CO_2 are mainly due to the mineral production, ferrous metallurgy and ammonia production.

The comparison of the scenarios "**with measures**" and "**without measures**" indicates a decrease of the emissions by 12-28% if measures are included. After the inventories for the period 1995-1999 were made, it turned out that the emissions of CO_2 are significantly lower compared to the projections in the "**without measures**" scenario due to the actual drop in the iron and cement production.

In the period 2000-2005 a recovery in these productions is expected and the decrease stays at 15-18%.

The increase in the scenario "**with measures**" continues after this period and the difference with the "without measures" scenario becomes 12-14%. After 2010 the emissions are expected to increase steeply for the "**without measures**" scenario and the difference between the scenarios becomes 12-18%.

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 23-30% over the 2000-2008 period. In the period 2009-2015 the decrease is within the range of 25-32%, being the greatest in 2010 (-32%).

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 fertilisers in the period 1995-1999 that provides lower base for projections in the scenario "**with measures**". As a result, for the entire projected period 2000-2015 the decrease to the scenario "**without measures**" is comparatively stable in the range 51-57%.

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

Year	Without measures	With measures	With additional measures
1995	5,723	5,723	5,723
2000	5,456	3,927	3,927
2005	5,810	4,987	4,987
2010	6,430	5,643	5,643
2015	7,457	6,125	6,125
2020	9,419	6,578	6,578

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

Year	Without measures	With measures	With additional measures
1995	3.72	3.72	3.72
2000	3.6	2.50	2.50
2005	4	3.10	3.10
2010	4.4	3.00	3.00
2015	4.8	3.60	3.60
2020	5.5	4.10	4.10

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

Year	Without measures	With measures	With additional measures
1995	6.20	6.20	6.20
2000	6.80	2.36	2.36
2005	8.30	4.10	4.10
2010	9.90	4.80	4.80
2015	12.00	5.20	5.20
2020	13.50	6.10	6.10

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

Year	Without measures	With measures	With additional measures
1995	7,723	7,723	7,723
2000	7,640	4,711	4,711
2005	8,467	6,323	6,323
2010	9,591	7,194	7,194
2015	11,278	7,813	7,813
2020	13,720	8,555	8,555

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. 5.7 and 5.8 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	Without measures	With measures	With additional measures
1995	119	119	119
2000	158	115	115
2005	225	150	150
2010	255	156	156
2015	266	151	151
2020	271	155	155

Table 5.11. N_2O emission projection from Agriculture [Gg]

Year	Without measures	With measures	With additional measures
1995	38.62	38.62	38.62
2000	57	50.35	50.35
2005	63	59.40	59.40
2010	67	61.40	61.40
2015	78	66.50	66.50
2020	82	71.40	71.40

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

Year	Without measures	With measures	With additional measures
1995	14,465	14,465	14,465
2000	20,988	18,030	18,030
2005	24,255	21,564	21,564
2010	26,125	22,310	22,310
2015	29,766	23,786	23,786
2020	31,111	25,389	25,389

The restitution in the sector is lately finalised and the projection on the future of agriculture is very difficult. This was the obstacle for the development of a scenario "**with additional measures**". One of the reasons is the very initial stage of development of the organisations in the agricultural sector (co-operations, farmers, state owned land, etc.), which interests and behaviour is difficult to project.

The comparison of the scenario "**with measures**" to the scenario "**without measures**" indicates a stable downward tendency of the emissions when measures are applied within the range of 27-43%.

The projected emissions of N_2O have different characteristics compared to the CH_4 emissions. Expected reduction is twice lower (within the range of 6-15%) and the trend over the 2000-2015 period is unstable. The difference in the trend of CH_4 and N_2O emissions is due to the difference in the emission sources for these gases. While the CH_4 emissions come from stock breeding, the N_2O emissions are result of soils and are related to the different ownership of land. The overall trend of the emissions from the sector is closer to the trend of CH_4 emissions. It is stable over the entire period of 2000-2015 and keeps range of 11-22%.

5.2.4. Waste

Projected emissions of CH_4, N_2O and total emissions from Waste sector are given in Tables 5.13, 5.14 and 5.15. Figs. 5.9 and 5.10 show the N_2O and CH_4 emissions for all years of the period.

Table 5.13. CH_4 emission projection from Waste [Gg]

Year	Without measures	With measures	With additional measures
1995	540	540	540
2000	300	233	233
2005	350	245	187
2010	444	335	256
2015	505	409	327
2020	555	478	401

Table 5.14. N_2O emission projection from Waste [Gg]

Year	Without measures	With measures	With additional measures
1995	0.65	0.65	0.65
2000	0.73	0.54	0.54
2005	0.80	0.61	0.5
2010	0.86	0.66	0.52
2015	0.92	0.73	0.58
2020	0.97	0.81	0.61

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

Year	Without measures	With measures	With additional measures
1995	11,548	11,547.8	11,547.8
2000	6,526	5,052	5,052
2005	7,598	5,334.1	4,082
2010	9,591	7,239.6	5,537.2
2015	10,890	8,815.3	7,046.8
2020	11,956	10,289.1	8,610.1

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 19-30%. 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**" doesn't exhaust the mitigation potential for the sector. This is evident in the scenario "**with additional measures**" that allows an additional reduction of 20-24% of the CH_4 emissions over the projection period. After 2005 the emissions are constantly by 20-24% lower compared to the „**with measures**" scenario. N_2O emissions are comparatively low in absolute terms and their trend doesn't affect the aggregated emissions from 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 22-29% in the forecasted period after year 2000. Combination of sectoral measures for mitigation of emissions and GHG triggers relatively slight variations in the reduction during the period until 2010, i.e. 22-26%. At the end of the forecasted period this reduction raises up to 29%.

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 4-8%, with the peak expected in the period 2005-2010. At the end of this period, the reduction reaches the level of the period 2000-2005.

Analysis of the change of the forecasted CH_4 emissions shows lower variations in the emission reduction in the "**with measures**" scenario compared to "**without measures**" one. The expected reduction during the forecasted period is 20-23%.

Comparison of "**with additional measures**" scenario with "**with measures**" one shows reduc-

Table 5.16. Total CO_2 emissions [Gg]

Year	Without measures	With measures	With additional measures
1995	62,332	62,332	62,332
2000	75,762	48,440	48,440
2005	90,706	67,071	62,942
2010	102,682	78,563	72,759
2015	118,781	84,352	79,681
2020	134,005	90,007	83,455

Table 5.17. Total CH_4 emissions [Gg]

Year	Without measures	With measures	With additional measures
1995	888	888	888
2000	827	483	483
2005	1,289	993	938
2010	1,450	1,125	1,033
2015	1,551	1,217	1,129
2020	1,712	1,310	1,226

Table 5.18. Total N_2O emissions [Gg]

Year	Without measures	With measures	With additional measures
1995	55	55	55
2000	91	61	61
2005	105	95	94
2010	116	102	100
2015	135	112	110
2020	144	121	119

Table 5.19. Aggregated GHG Emissions, CO_2-eqv.

Year	Without measures	With measures	With additional measures
1995	98,086	98,086	98,086
2000	121,415	77,546	77,546
2005	150,232	117,448	111,788
2010	168,982	133,694	125,485
2015	193,080	144,506	137,554
2020	214677	155082	146214

tion of CH_4 emissions in the range 4-8%. This reduction is basically similar to the reduction of CO_2 emissions when comparing these two scenarios.

It has to be mentioned that in the total emissions of CH_4 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 447-449 Gg will be valid for the period after year 2000. This amount leads to significant 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 10-17%. The decrease value is higher at the end of the period – after 2010. 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. Volume of these emissions is the same for the three scenarios and changes by years as follow:

- 2005: 18.9 Gg
- 2010: 21.1 Gg
- 2015: 25.1 Gg

Comparison of forecasted N_2O emissions for "**with additional measures**" scenario to "**with measures**" scenario shows a relatively small decrease in the range of 1-2%. This is due to the fact that in the sectors "agriculture" and "industrial processes" there is no "**with additional measures**" scenario developed, thus changes in the other sectors ("energy" and "waste") related to the "**additional measures scenario**" are less influential.

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. 5.11. Comparison of "**without measures**" and "**with measures**" scenarios shows an emission decrease in the range of 19-25%, which takes place in the period 2005-2015.

Comparison of "**with addition measures**" and "**with measures**" scenarios reveals too certain tendency for decrease of emissions in the period 2005-2015, but in smaller range: 3-6%.

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).

GHG PROJECTIONS

Energy sector

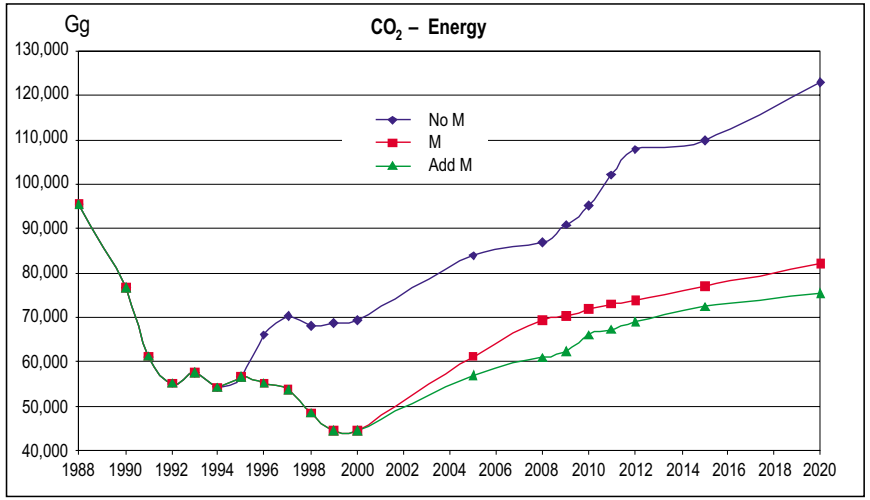

Fig. 5.1. CO_2 emission projection from Energy [Gg]

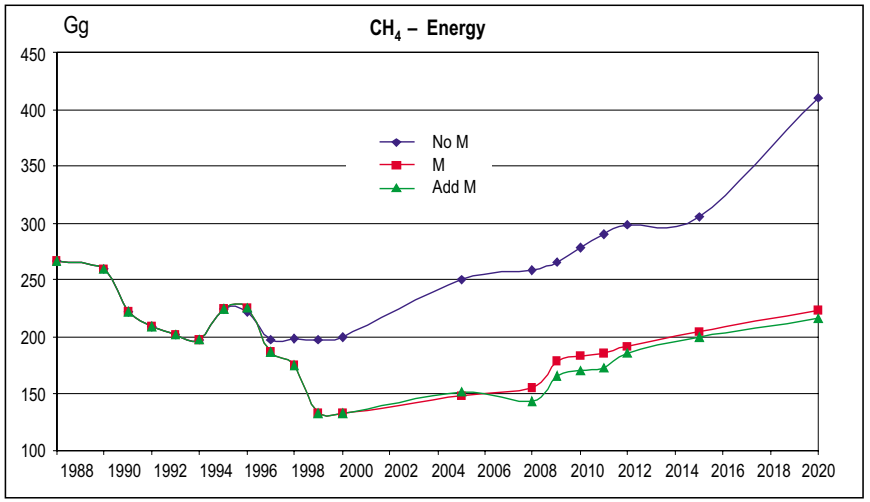

Fig. 5.2. CH_4 emission projection from Energy [Gg]

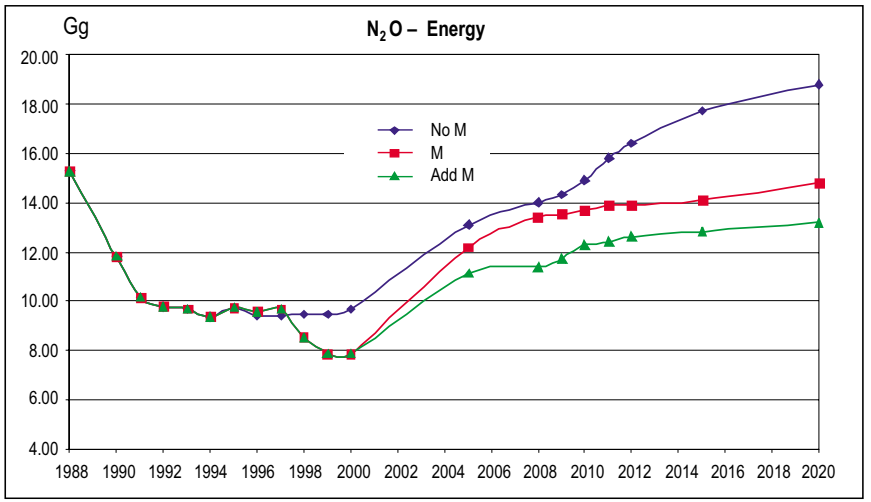

Fig. 5.3. N_2O emission projection from Energy [Gg]

Industrial sector

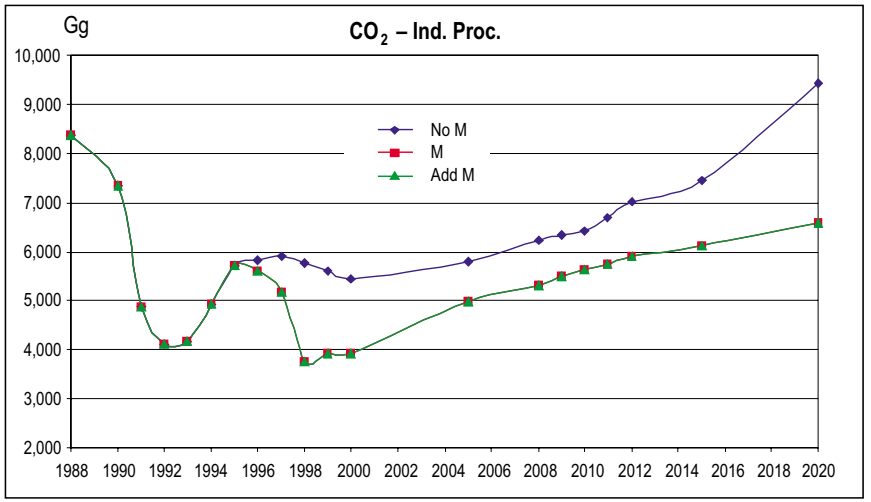

Fig. 5.4. CO_2 emission projection from Industrial Processes [Gg]

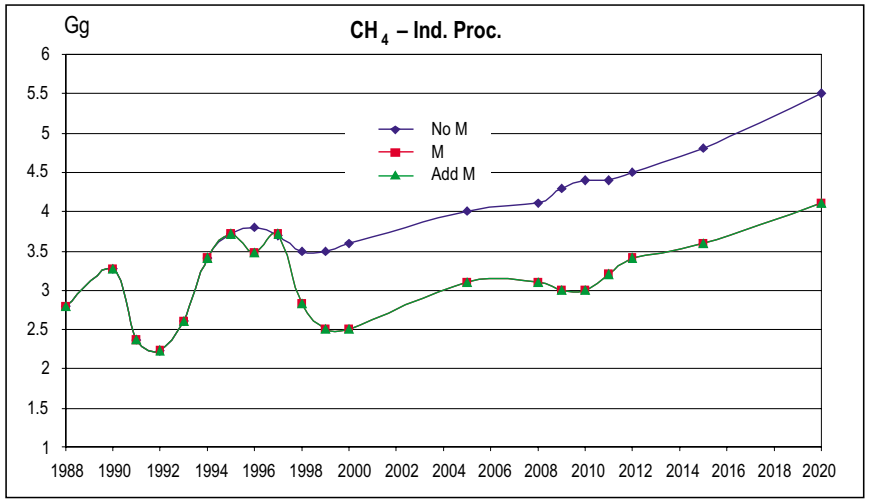

Fig. 5.5. CH_4 emission projection from Industrial Processes [Gg]

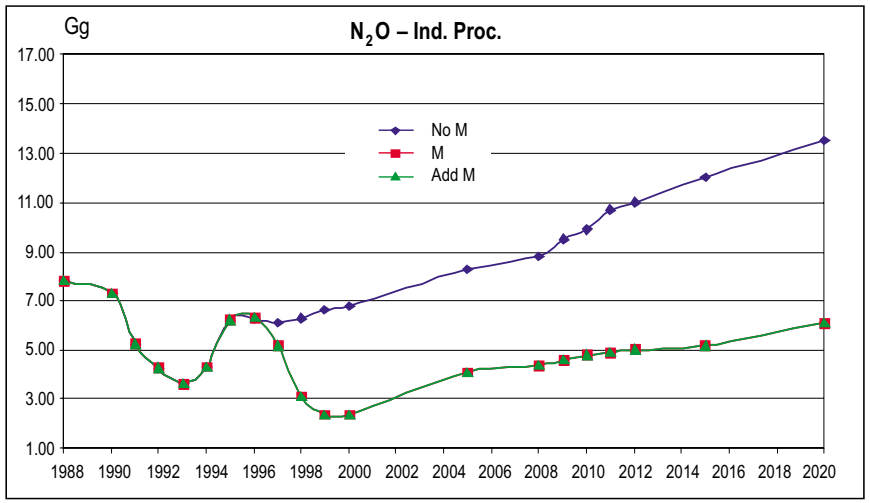

Fig. 5.6. N_2O emission projection from Industrial Processes [Gg]

Agriculture

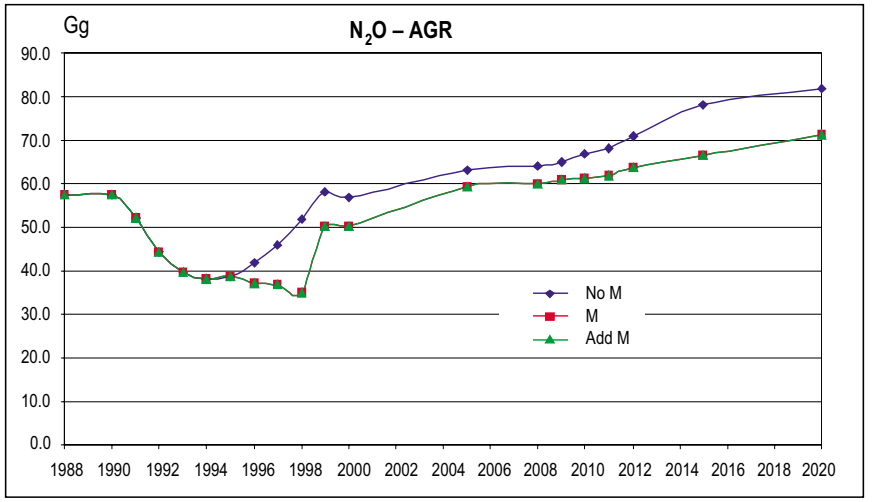

Fig. 5.7. N_2O emission projection from Agriculture [Gg]

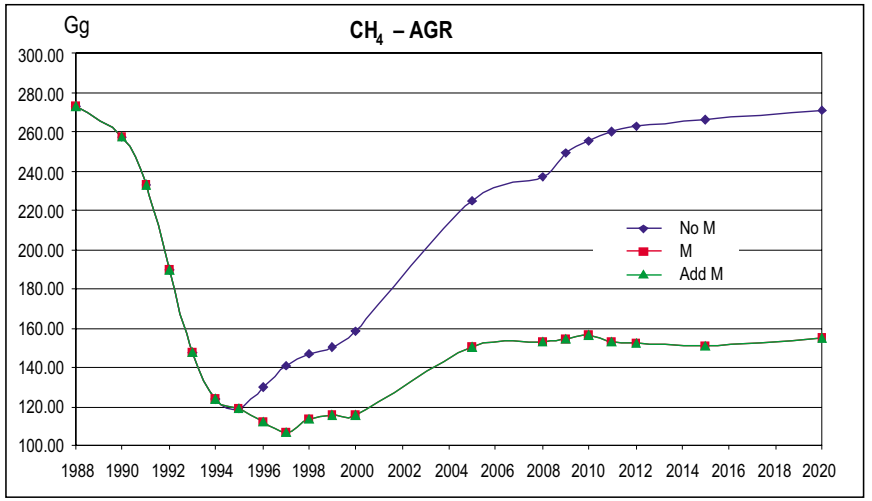

Fig. 5.8. CH_4 emission projection from Agriculture [Gg]

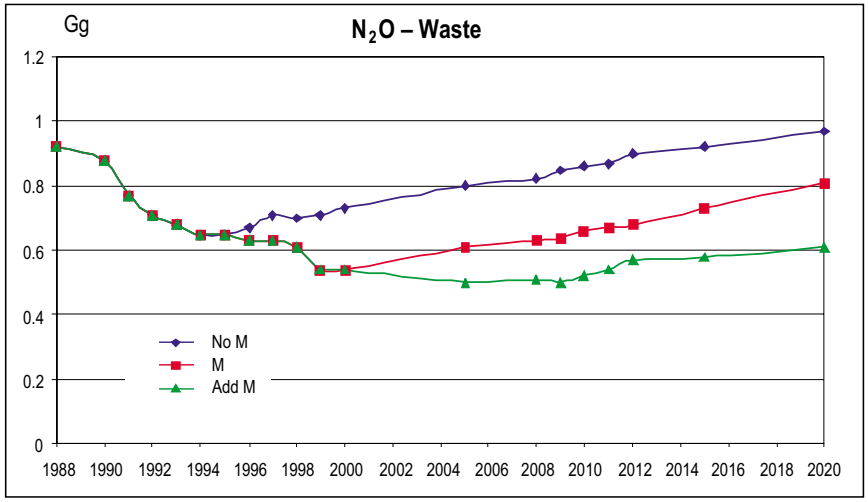

Fig. 5.9. N_2O emission projection from Waste [Gg]

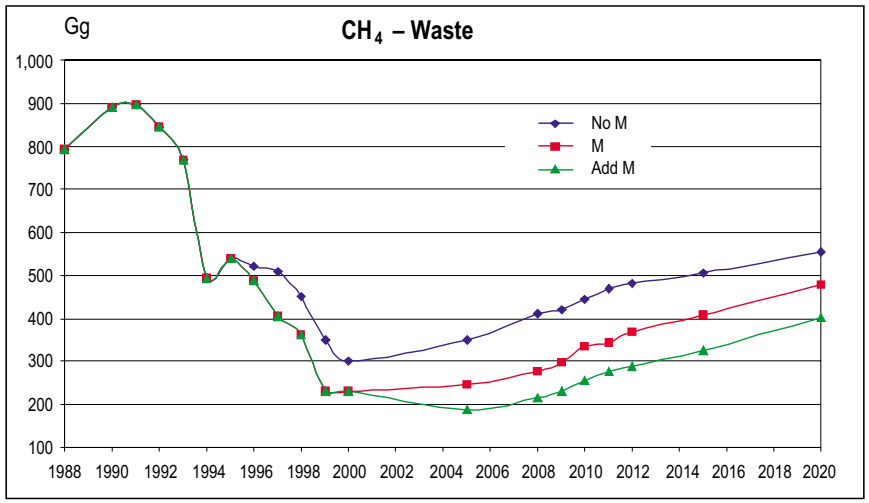

Fig. 5.10. CH_4 emission projection from Waste [Gg]

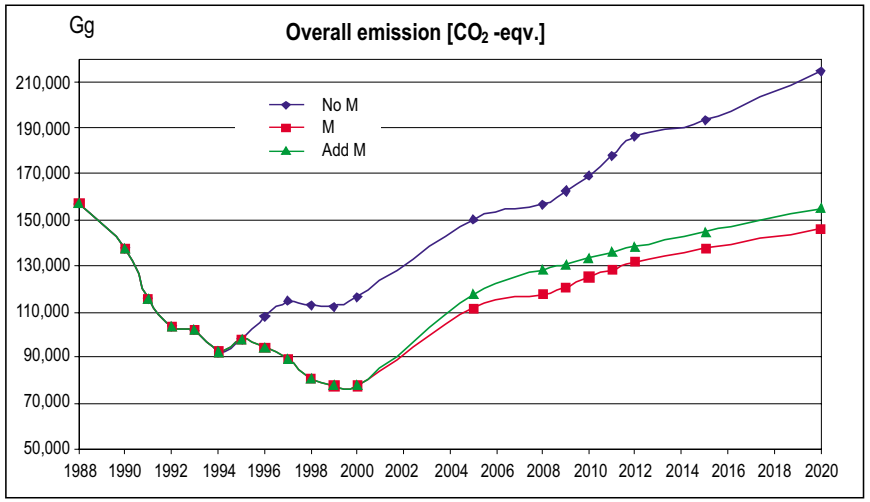

Fig. 5.11. Aggregated GHG Emissions, CO_2-eqv.

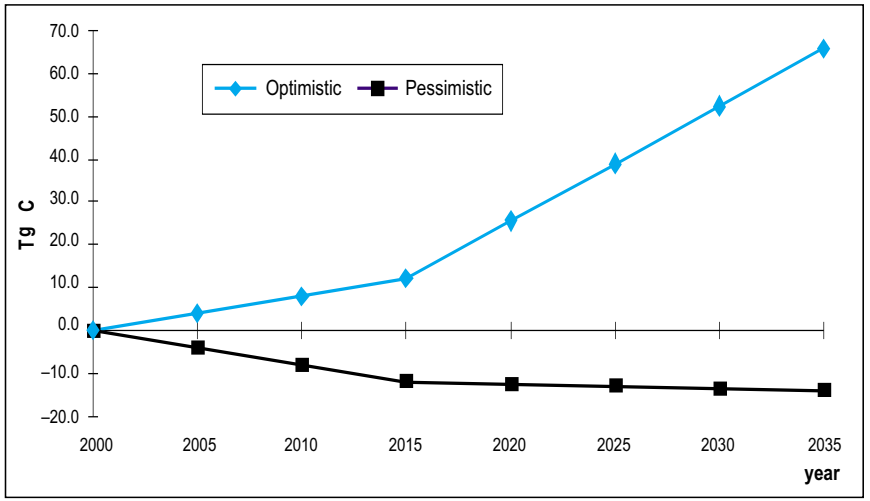

Fig. 5.12. Projected carbon accumulation in wood biomass: optimistic and pessimistic scenarios

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 18% the Kyoto target. The measures already taken would 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 11 million tons of CO_2 equivalent on yearly basis. Should **additional measures** be implemented, the emission trading potential would reach about 20 million tons. However, the implementation of these **additional measures** would depend on whether or not Bulgaria will comply with the requirement form the European Union for early termination of the operation of two units in the Kozloduy Nuclear Power Plant.

There is even a bigger potential for emissions reduction in Bulgaria, however it cannot be realised 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.

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 scenarios:

Optimistic scenario	Pessimistic scenario
For the period until 2035 the afforested area remains unchanged.	The area with forests will be reduced by 5% in 25 years (until 2020), and at the same time the percent of the afforested area will remain 30%. (Article 16(1); 17(1); and 18)
The harvest would be done outside the protected areas (Article 7 (2)) over 75% of the mature forests, subject to normal rotations, i.e. above 81 years for the high-stem forests and above 21 years for the low-stem and coppice forests.	100% of the mature forests will be harvested Rotations: above 60 years for high-stem forests and above 15 years for low-stem and coppice forests (Article 50(5); and 52(2)) .
After harvesting the areas will be 100% afforested and naturally regenerated (Article 43(1); 44 (1); and 52(1))	
The wood utilisation of all forests, in spite of their ownership, should be completed according to the Forest Land-use Projects (Article 57(1) and 60).	

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 million m^3 of wood biomass from the coppice and from low-stem forests above 41 years old are to be harvested.

Pessimistic scenario realisation (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) sup-

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

Years	Scenarios		
	No measures	With measures	With additional measures
2008	156,714	128,087	117,313
2009	162,431	130,697	120,552
2010	168,982	133,694	125,485
2011	178,168	135,982	128,030
2012	185,980	138,495	131,634
Average (2008-2012)	170,455	133,391	124,603
Kyoto target (average)	**144,523**		

plement of enormous quantities of renewable energy sources.

Having in mind these assumptions, projections on the aggregated carbon stored in the wood biomass are made as given in the Fig. 5.12 (p. 96).

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 scrutinising the interrelationships between macroeconomic development, sectoral development (including the energy sector), and GHG emissions is used. The main software used is the DOS version of the ENPEP package that has been used in the 1st and 2nd 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 GDP forecasts had been developed in collaboration with the International Monetary Fund (IMF). Such macroeconomic data presents key inputs to the MACRO module, along with the structure of the sub-sectors of the economy. MACRO provides an interface with DEMAND, to which it transfers the macroeconomic projections for further analysis. 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. It uses a market-based simulation approach to determine how various segments of the energy system will respond to changes in energy prices and quantities needed. BALANCE relies on a decentralised decision making process in the energy sector and can be calibrated to the different preferences of energy users and suppliers. 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 aggregated 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 model uses probabilistic simulation to calculate the production costs and reliability parameters for a large number of possible future system configurations, and a dynamic programming technique to determine an economically optimal expansion path for the electric power system under consideration.

The IMPACTS module of ENPEP calculates the residuals (air pollutants, water pollutants, solid waste, 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. IMPACTS also allows the user to prescribe a variety of different environmental control regulations that can vary with the age of the facility. Some of the projections for the emissions are made using the new version of the BALANCE module that incorporates IMPACT's functions in it and is able to run under Microsoft Windows operating system.

5.3.1. Specific assumptions related to the scenario with measures for GHG emissions

Given the aforementioned assumptions the scenario with measures is generated in a way to ac-

count for the draft *Updated Strategy for Development of Energy Sector in Bulgaria*, issued in 2001.

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:

- Economic stabilization and growth.
- 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.

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 2000) and the Bulgarian Agency for Economic Analysis and Forecasts (Ministry of Finance). Projections of the rate of growth for GDP by subsectors were also developed by the Agency, in collaboration with the International Monetary Fund (IMF), Table 5.21.

Expected overall GDP growth rates are as follows:

- 2001-2003 – 5%
- 2004-2008 – 4%
- 2009-2011 – 3.5%
- 2012-2015 – 3%

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.

Table 5.21. Forecast of GDP, 1999-2015 (10^6 Levs, 1999 prices)

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Total GDP	22,776	23,801	24,991	26,241	27,553	28,655	29,801	30,993	32,233	33,361	34,528	35,737	36,809	37,913	39,051	40,222	41,429
Annual Growth Rate, %		4.5	5	5	5	4	4	4	4	3.5	3.5	3.5	3	3	3	3	3
Industry	5,326	5,445	5,588	5,762	5,939	6,111	6,296	6,548	6,844	7,190	7,553	7,935	8,333	8,751	9,190	9,651	10,085
Of which:																	
Metallurgy	436	443	452	464	475	487	507	527	551	578	607	637	669	703	738	775	810
Chemical Industry	910	950	996	1,050	1,107	1,155	1,206	1,254	1,311	1,376	1,445	1,518	1,593	1,673	1,757	1,845	1,928
Building Materials	21	22	23	24	26	27	29	30	32	33	34	36	37	39	41	43	45
Other	3,959	4,031	4,116	4,224	4,331	4,441	4,555	4,736	4,951	5,202	5,467	5,745	6,033	6,336	6,655	6,989	7,302
Agriculture	3,440	3,465	3,503	3,554	3,611	3,602	3,615	3,613	3,623	3,804	3,994	4,194	4,404	4,624	4,855	5,098	5,328
Transport	959	1,021	1,094	1,173	1,257	1,347	1,444	1,548	1,659	1,777	1,905	2,041	2,161	2,288	2,423	2,565	2,716
Services	10,166	10,750	11,419	12,184	12,998	13,730	14,500	15,186	15,979	16,778	17,472	17,772	16,823	17,664	18,547	19,475	20,351
Correction factor	2,885	3,120	3,387	3,568	3,749	3,864	3,946	4,099	4,128	3,811	3,604	3,794	5,088	4,585	4,036	3,433	2,949
Relative Shares, % (Correction Factor included with Industry):																	
Industry	36	36	36	36	35	35	34	34	34	33	32	33	36	35	34	33	31
Agriculture	15	15	14	14	13	12	12	12	11	12	12	12	12	12	12	13	13
Transport	4	4	4	4	5	5	5	5	5	5	6	6	6	6	6	6	7
Services	45	45	46	46	47	48	49	49	50	50	50	50	46	47	47	48	49
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Source: Agency for Economic Analysis and Forecasts

Table 5.22. Final energy consumption – PJ

Sector	2000	2005	2010	2015
Industry	281	242	263	290
Transportation	89	99	118	136
Agriculture	14	14	15	17
Residential	80	98	112	120
Service	11	31	33	35
Total	476	464	519	575

Table 5.23. Forecast of structure energy demand by sectors, %

Year	Industry	Transport	Agriculture	Households	Services
2000	59.10	18.62	2.99	16.87	2.32
2005	50.13	20.40	2.89	20.24	6.33
2010	48.63	21.76	2.84	20.66	6.11
2015	48.49	22.79	2.78	20.08	5.85

b) The second set of key inputs was the **population in 1998** (8.2 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 1.8% over the period 1998-2000, 3.1% between 2000 and 2010 and 3% between 2010 and 2015. Consequently, total population drops to about 7.4 million by 2015. 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 in the *Draft Energy Strategy* from 2000/2001 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 minimal scenario (that has become the basis for "**with measures**" scenario in the present National Communication) is 476.2 PJ in 2000, 463.2 PJ in 2005, 519.2 PJ in 2010 and 576.6 PJ in 2015.

The forecasted final energy demand and its structure are shown in Tables 5.22 and 5.23, respectively.

The energy intensity of the GDP in Bulgaria is considerably 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:

- 2005 – 27.4 TJ/million BGL
- 2010 – 24.6 TJ/million BGL
- 2015 – 22.4 TJ/million BGL

5.3.2. Electricity and heat forecast

Projected gross electricity demand is elaborated for the Min scenario of the *Updated Strategy*. Max scenario expects about 6.6% higher gross electricity demand.

In the industrial sector the expectations are not for a big increase in electricity demand. As a result of the structural reform and the accomplished privatisation, the specific industrial electricity demand will decline faster compared to the increase of the demand of the technologically innovated production.

Household demand depends on the incomes, inflation and electricity prices. The analysis indicates that in case of stable ratio between incomes and prices, the electricity demand for households increases. The growth rates are higher when the income and lifestyle exceed the electricity prices.

For the period until 2015 the expected export of electricity is 4.2 billion kWh annually. This

Table 5.24. Average annual increase of the gross electricity demand [%]

Stage/ Scenario	2001-2005	2006-2010	2011-2015	2001-2015
Min scenario	2.9	1.3	0.9	1.5

Table 5.25. District heat generation and demand

Indicator	Unit	2000	2005	2010	2015
Population	1,000	1,560	1,639	1,723	1,811
Apartments	1,000	577	606	637	669
Public buildings (apartments)	1,000	236	236	240	240
Total apartments	1,000	813	842	877	909
Heat generation	GWh	10,705	10,823	11,110	11,210
Net heat demand, incl.	GWh	8,753	9,154	9,682	10,054
• industry	GWh	1,259	1,346	1,346	1,481
• public buildings	GWh	2,176	2,187	2,263	2,263
• population	GWh	5,318	5,620	6,008	6,310

projection is based on the long-term contract with Turkey and the state of the power systems and the demand expectations in the other neighbouring countries.

The sum of the expected demand in economy, households and exports gives the overall projections for gross power generations. The average annual growth rate in power sector for the period 2001-2015 is 1.5% in the Min scenario. In the particular stages of the period the growth rates are as given in Table 5.24.

In terms of district heating, heat demand, heat generation and the main indicators that are used in the projections are given in Table 5.25.

These assumptions are integrated in the projections made for each sector. In additions the plans for each sector are taken into account for defining the scenarios with measures and with additional measures.

Primary energy demand for the scenarios is provided in Tables 5.26 and 5.27.

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 5.26. Primary energy consumption – "**with measures**" scenario [PJ]

Source	2000	2005	2010	2015
Imported coal	99	92	118	144
Domestic coal	206	292	310	311
Natural gas	123	130	146	167
Liquid oil	285	288	350	387
Nuclear	211	184	177	177
Hydro	8	8	9	9
Elimport	0	0	0	0
Renewables	13	14	16	17
Total	946	1,009	1,128	1,213

Table 5.27. Primary energy consumption – "**with additional measures**" scenario [PJ]

Source	2000	2005	2010	2015
Imported coal	99	73	124	142
Domestic coal	206	277	287	288
Natural gas	123	125	141	178
Liquid oil	285	287	350	387
Nuclear	211	184	157	131
Hydro	8	8	10	10
Elimport	0	0	0	0
Renewables	13	14	17	17
Total	946	969	1,087	1,154

6. VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

6.1. INTRODUCTION

This chapter's content is based on the studies and findings that were made during the preparation of the National Climate Change Action Plan. Most of these were included in the Second National Communication prepared in 1998. The lack of financial support hindered further in-depth investigation in the field at national level. Any new findings reflected in this chapter come from related research in the field of agriculture, forestry and water management. Data observations on climate change and impacts on agricultural crops are taken from the paper "Impact of climate variability and change on crop yield in Bulgaria" (V.A. Alexandrov, G. Hoogenboom)[3].

6.2. BACKGROUND

Bulgaria is located on the Balkan Peninsula in southeastern 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 southeastern Bulgaria.

[3] Alexandrov, V. and G. Hoogenboom, 2000. The Impact of Climate Variability and Change on Crop Yield in Bulgaria. Agricultural and Forest Meteorology, Vol 104(4), pp. 315-327.

The Data Distribution Center (DDC) of the Intergovernmental Panel on Climate Change (IPCC) provided the 30-year averaged transient Global Circulation Models monthly meteorological outputs for the periods: 1961–1990, 2010–2039, 2040–2069, and 2070–2099 (the latter three periods are referred to as 2020s, 2050s, and 2080s). The GCMs used in this study include the models from the Max-Planck Institute for Meteorology (ECHAM4), UK Hadley Center for Climate Prediction and Research (HadCM2), Canadian Center for Climate Modeling and Analysis (CGCM1), Australian Commonwealth Scientific and Industrial Research Organization (CSIRO-Mk2b), and Geophysical Fluid Dynamics Laboratory (GFDL-R15) (IPCC DDC, 1999). The simulated results from the 'business as usual' scenario (IS92a), greenhouse gas and sulfate aerosol forced GCM experiments were used. The outputs for air temperature, precipitation, and solar radiation of the GFDL-R15 model for the 2080s, were not available.

Studies for Bulgaria used GCM data from the four nearest grid points to interpolate observed data, simulated climatic data, or transient data for the 2020s, 2050s, and 2080s to a specific point, e.g. weather station. The actual value was calculated using linear average or inverse distance techniques between the specific point and the GCM grid points (ANL, 1994). Meteorological data that used was provided by the weather network of the NIMH.

In the initial analysis, long-term variations of air temperature in Bulgaria were investigated. In Fig. 6.1, anomalies of mean annual air temperature in Bulgaria, relative to the current climatic conditions are presented. Generally, there did not seem to be a significant change in mean annual air temperature in Bulgaria during the 20th century. The period from the 1920s to 1950s was characterised as a warmer period during the warm-half of the year, i.e. April–September. There has been an obvious increase in air temperature during April–September since the end of the 1970s, despite lower air temperatures in 1991 and 1997. A slight increase in air temperature during the cold-half of the year, i.e. October–March was observed. This

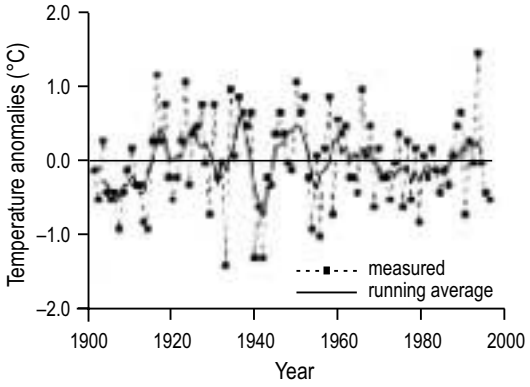

Fig. 6.1. Anomalies of annual mean air temperature in Bulgaria, relative to the period 1961-90

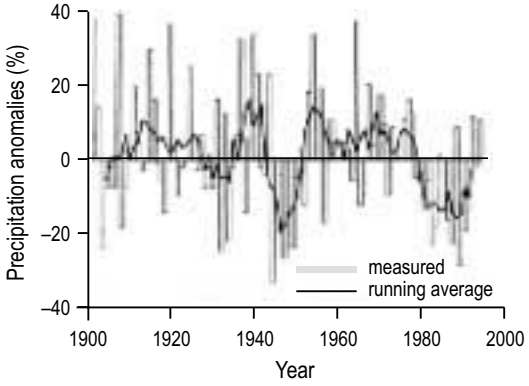

Fig. 6.2. Anomalies of annual precipitation in Bulgaria, relative to the period 1961-90

trend is most obvious during the winter, i.e. January–March, due to a significant warming in January and February. Spring, i.e. April–June, also tends to be warmer at the end of the 20th century. However, summer air temperatures, i.e. July–August, tended to be a little bit lower. The average air temperature for June showed a slight increase, while air temperatures in July and August showed an overall decrease, mainly due to a significant cool spell during the 1970s. Air temperature in autumn, i.e. October–December, varied around the current climatic values without any definite changes.

Annual precipitation in Bulgaria varied considerably from year to year during the study period. In some years, very low annual precipitation ushered in droughts of different intensities. Bulgaria experienced several drought episodes during the 20th century, most notably in the 1940s and 1980s (Fig. 6.2), which were observed everywhere across the country. Generally, mean annual precipitation in Bulgaria showed an overall decrease for the period from 1901 to present. There was a decrease in precipitation for the period from April to September, starting at the end of 1970s. Precipitation has been below normal or the 1961–1990 average for the 13 of the last 17 years in this study. The years 1985, 1988, and 1993 were among the driest years. There was no significant overall trend in precipitation during the cold-half of the year, despite the decreasing trend that has been observed since the end of 1960s. A deficit in winter precipitation was observed during the last decade. Both spring and summer, as well as autumn precipitation have shown a tendency to decrease during the 20th century. However, February, April, August, and December have shown an increasing trend in precipitation, while all other months have had precipitation reductions during the study period.

As part of the climate variability study, long-term variations of agroclimatic indexes were also determined. Starting, ending, as well as the duration periods that have a temperature above a base of 5 and 10 C were used; and temperatures during these periods as agroclimatic indexes were accumulated. The beginning of the periods above 5 and 10 C usually occurred in March and April, while the end of these periods can be observed in No-

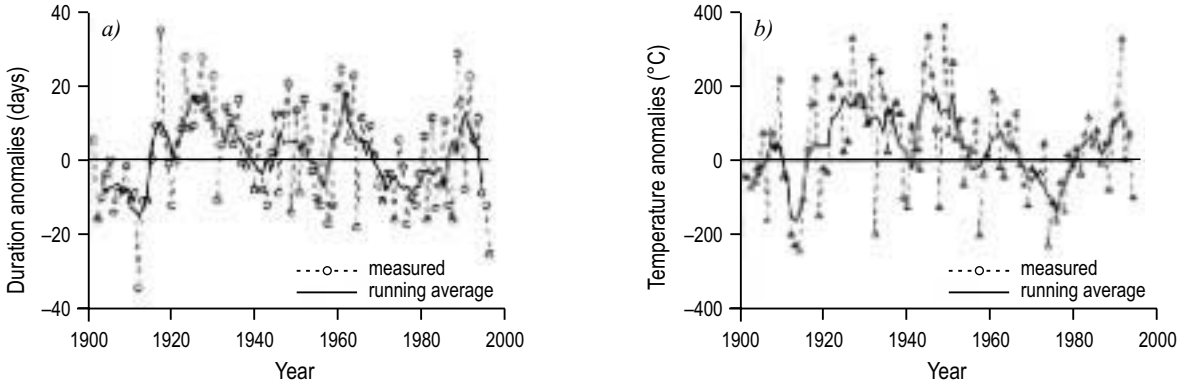

Fig. 6.3. Anomalies of duration of the period (a) and accumulated air temperatures (b) above a base of 10°C, relative to the period 1961-1990

vember and October, respectively. Potential crop growing seasons above the two thresholds started earlier in the 1910s, and 1920s, 1940s, and during the last decade, except for 1996 and 1997. The beginning of these periods occurred later in the 1900s, 1950s, and 1970s. As a result of these variations, a slight delay of the beginning for the growing conditions above a base of 5 C was found. Variations for the end of the period above bases of 5 and 10 C occurred 2–3 days earlier. Overall, this caused a decrease in the duration of potential crop growing season above 5 or 10 C (Fig. 6.3a). From the middle of the 1920s until the end of 1970s, there is a significant decrease in total accumulated degree days for growing season above either 5 or 10 C. Since the early 1980s, an increase in total accumulated degree days has been observed (Fig. 6.3b).

6.3. CLIMATE CHANGE SCENARIOS

The current (1961–1990) climatic outputs from the General Circulation Models (GCMs) should first be compared with averaged observed climatic data for a region, not with site-specific climate data. The HadCM2 model was considered to be the most appropriate transient GCM to simulate monthly air temperature in Bulgaria. The difference between simulated and observed monthly air temperature exceeded 2 C for only 3 months, i.e. April, May, and June.

Most of the transient GCMs used in the study, except the CGCM1 model, overestimated average precipitation for Bulgaria during the cold-half of the year. However, precipitation during the summer months, e.g. July–September, was underestimated by most GCMs, especially by the CGCM1 and GFDL-R15 models.

The CSIRO-Mk2b model simulated the observed precipitation well from April to September, as well as in November, with deviations < 15%. The other GCMs either considerably overestimated or underestimated precipitation for most months.

The transient GCMs predicted that annual temperatures in Bulgaria are to rise between 0.7 (HadCM2) and 1.8 C (GFDL-R15) in the 2020s. However, the HadCM2 model simulated a slight decrease in air temperature for November in the 2020s. A warmer climate is also predicted for the 2050s and 2080s, with an annual temperature increase ranging from 1.6 (HadCM2) to 3.1 C (GFDL-R15) in the 2050s, and 2.9 (HadCM2 and CGCM1 models) to 4.1 C (ECHAM4) in the 2080s. Warming is projected to be higher during the summer in the 2080s.

The CGCM1 model predicted an increase in annual precipitation in the 2020s and 2050s. The GFDL-R15 model projected a decrease in precipitation in May, June and July in the 2020s and 2050s. The ECHAM4, HadCM2, and CSIRO-Mk2b models simulated a decrease in monthly, seasonal and annual precipitation in the 2080s. The changes in monthly solar radiation are expected to vary between –10 and 10% during the next century. An increase of solar radiation is expected during the cold-half of the year, based on the ECHAM4 model runs.

6.4. VULNERABILITY ASSESSMENT

6.4.1. Agriculture

The generic grain cereal model CERES v.3.5 (Ritchie et al., 1998), included in the computerized Decision Support System for Agrotechnology Transfer DSSAT v.3.5 (Tsuji et al., 1994) 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 (Tsuji et al., 1998). The DSSAT seasonal analysis program (Thornton and Hoogenboom, 1994) 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.

All transient GCM climate change scenarios used in the CERES simulation model projected a shorter vegetative and reproductive growing season for maize and winter wheat 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.

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 increase 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. 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, all GCM climate change scenarios projected an increase in winter wheat yield. 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 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, projected increases in wheat yield varied between 12 and 49% due to the fertilization impact of the increased CO_2 level.

6.4.2. 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 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 borderside into the South-Bulgarian forest vegetation area, respectively. That means that it could be expected that the South-Bulgarian borderside area will be settled by typical Mediterranean vegetation, a part of which is to be seen there even at present. Some important representatives of this vegetation are *Cercis siliquastrum L., Cupressus sempervirens L., Olea europaea L., Pinus brutia Ten., P. halepensis Mill., P. pinaster Ait., P. pinea L., Quercus aegilops L., Q. ilex L., Q. suber L., Q. trojana Webb.*

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 par-

ticular 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 realised 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.

6.4.3. Soil

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.

6.4.4. Water reserves

The variability of Bulgarian climate requires irrigation activity during the growing period (June – September) to compensate water deficit. Projected temperature rise will impact water reserves:

- precipitation will increase by 5% over next 30 years;
- winter precipitation will increase particularly in the southern part of the country;
- summer precipitation will decrease in the southern part and increase in the northern part;
- evaporation losses will increase;
- river flows will increase in autumn and winter and decrease in summer months
- it is possible the underground water to decrease.

6.5. ADAPTATION

6.5.1. Agriculture

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

New zoning of the agroclimatic resources and agricultural crops

- Expanding areas of the most important agricultural crops over new regions characterised by improved thermal and moisture conditions.
- Utilisation 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.

Optimisation 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.
- Melioration of soils with low fertility.
- Effective use of mineral fertilisers relevant to the soils diversity.
- Overcoming of the misbalance of the main nutrients and normalisation of the mineral /organic fertilisers ratio.

Measures for increase of the irrigation effectiveness

- Introduction of irrigation technologies with decreased water charges and without losses during water transportation and distribution.
- Restoring and reconstruction of the already constructed hydro-meliorative fund.
- Reconstruction and building of new test-pits for utilisation of groundwater.
- Utilisation of river water and precipitation for moisture storing irrigation during the winter season.
- Utilisation of waste water and drainage system water.

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 utilisation 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.

6.5.2. Forestry

The Second 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 part of the country (up to 800 m a.s.l.), where most significant climate changes can be expected, as a strategic task in the management of the forest resources in the country, the aim for a fight for adaptation of the forests to the aridisation of the climate and for prevention of the forest resources from worsened climatic conditions is discussed.

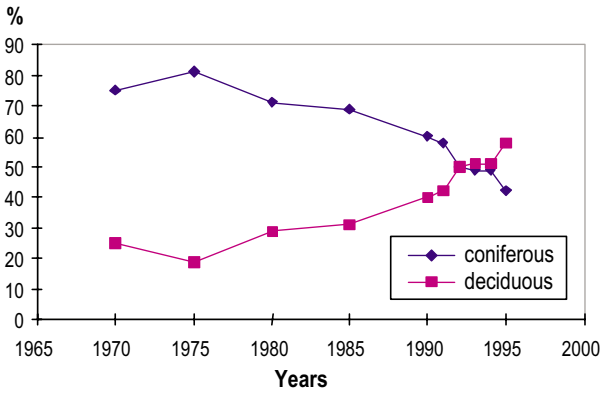

Fig. 6.4. Afforestation with coniferous and deciduous species in during the period 1970-95

For the forests in the higher parts of the country, i.e. over 800 m a.s.l. where the expected changes probably will not be drastic, the aims are:

- preserving the biodiversity;
- resistance of the ecosystems;
- multifunctional utilisation;
- system of protected natural territories.

The first *National strategy for conservation of the forests and development of the forestry in the Republic of Bulgaria* (1996) along with the basic priorities addresses also issues closely related to climate change, such as:

- Helping the forests adaptation to the unfavourable climatic conditions;
- Preserving the biodiversity and genetic resources of the flora and fauna to guarantee forest reproduction.

The change in the selection of the species for afforestation is the most realistic method for adaptation of the forest ecosystems to future climate changes.

Fig. 6.4 shows that the tendency of more wide use of the deciduous species in the afforestation is the right one. At future warming and drought, expected as a consequence from the greenhouse effect in the atmosphere, the participation of the deciduous tree species will grow. In 1955 the conifers in Bulgaria were only 11% of the forest area and after 40 years of increased afforestation activity with conifers this percent increases to 38.

If the climate changes are in a direction of warming and drought, a considerable xerophytisation of the vegetation can be expected. The hygrophytes and some mesophytes will be strongly reduced. A strong reduction can be expected among the representatives of 32 local vegetation genera and 57 species. This concerns also the introduced forest tree and shrub species. About 17 genera and 22 species are assumed to be too sensitive to the expected climatic changes.

The coming changes in the biodiversity will appear in reduction and fall off of the boreal forest species and increased participation of the species more resistant to drought and warming. Main role for conservation of the vegetation cover most probably will play these natural species which have the necessary morphological and physiological features to survive under the new forest vegetation conditions. Such a resistance can be expected mainly from 18 families with forest tree and shrub species, 46 genera and 70 species. At an eventual xerophytisation of the growth conditions, representatives of 21 families, 33 genera and 48 species could suitable. This data show that the natural and introduced forest tree and shrub species in Bulgaria have great capacity for good adaptation to the eventual climate change in the next century.

The Cedar ssp. trees are representatives of the few conifer species which would be recommended as appropriate in the future afforestation in the conditions of climate changes. There are favourable conditions for cedar trees growth in the lowland belt – from 0 to 700 m a.s.l., and appropriate terrain for these species are localised in the southern half of the country. The annual areas for afforestation might reach from 180 to 400 ha. Through thinning out of the young stands, the living space of the rest of the specimen is increased, and the light and water regime is improved. In that manner the adaptation possibilities of the tree stands are increased and as a result the biomass increases too. The forestry management plans project about 120,000 ha to be cultivated annually with average timber output of 2,801,800 m^3.

7. FINANCIAL RESOURCES AND TRANSFER OF TECHNOLOGY

Although Bulgaria is present in the UNFCCC Annex I, being a country with economy in transition it does not have any obligations for provision of financial resources and transfer of technologies to developing countries. The country is rather a host for such financial and technical support mainly carried out within the frame of the Joint Implementation mechanism.

Currently, the 11 economies in transition in Central and Eastern Europe (CG 11) included in Annex I of the UNFCCC are hosting a total of 68 Activities Implemented Jointly projects as well as a number of others not formally registered with the Convention Secretariat (Table 7.1).

Table 7.1. UNFCCC list of AIJ Projects

EIT country	Number of projects	Project area
Bulgaria	1	Energy
Croatia	1	Energy
Czech Republic	3	Energy
Estonia	20	Energy
Hungary	3	Energy
Latvia	23	Energy
Lithuania	8	Energy
Poland	3	Energy
Romania	4	Energy
Slovakia	2	Energy
Slovenia	0	No project
Total projects	68	

Source: World Resource Institute

Through its flexible mechanisms, the Kyoto Protocol on climate change creates incentives for industrialised countries to invest in clean, climate-friendly technologies in countries with economies in transition, as well as in developing countries. Joint Implementation is a project-based instrument, designed to foster the transfer of technology for cost-effective greenhouse gases (GHG) emissions reductions in Annex I Parties.

For Bulgaria J I is a useful and feasible way to obtain economic, technical and expert support with the efforts geared towards GCC mitigation. In 1999 two studies investigating the potential for J I projects in Bulgaria were conducted. In 2001, a pilot J I project took place in the City of Pleven. Details about these are provided below:

1. Capacity for Climate Protection in Central and Eastern Europe – REC and WRI, 1999.

This project revealed that the advantages of eventual J I in Bulgaria projects would be:

- GHG mitigation with least costs.
- Opportunity for technology transfer.
- Support with the restructuring of economy.
- Successful means for attracting foreign investments.
- Assistance in solving local environmental problems and realization of economic development.
- Help to national environmental policy and its integration with the European Union policy.

At the same time, the following barriers to the successful implementation of J I projects need to be overcome:

- Necessity to develop infrastructure
- Unclear items in the procedures for J I projects implementation.
- Lack of methodology for development of baselines consistent with the national circumstances.
- Clear criteria for development of projects and for the role of the various participants.
- Insufficient participation of private companies in initiation and implementation of projects
- Lack of wider public awareness.

2. J I Capacity Buildidng: Bulgaria, UNDP, 1999.

The project findings were similar to the ones from the first project: J I would provide for long-term GHG mitigation via application of energy efficient measures in selected sectors; good potential for attracting investors.

On the other hand, the low public awareness, lack of feasibility studies with appropriate assessment of GHG emission reduction and specific costs and insuffient work for distribution of information to potential investors were identified as the main barriers for successful application of J I mechanism in Bulgaria.

3. Implementation of a system for information and control in District Heating Company Pleven, Tebodin Consultants Netherlands, 2001.

This pilot project aimed at increasing energy efficiency and environmental management, and thus reducing GHG emissions. 65% of the ERUs in 2008-2012 will be transferred to the Netherlands. The expected annual CO_2 reduction is 3.1 Gg. Besides, the positive effect of modernization of equipment, increased energy efficiency, improved insulation, and training of experts is already achieved.

Republic of Bulgaria and the Kingdom of the Netherlands have signed Memorandum of Understanding (MoU) on co-operation in reducing emissions of greenhouse gases under article 6 of the Kyoto Protocol. The co-operation under this memorandum aims at transfer of emission reduction units of an average of 3 Mt CO_2-equivalent per year during the commitment period 2008-2012. Decisions on the transfer are taken on a case-by-case basis by means of international Emission Reduction Unit Procurement Tender (ERUPT).

The Netherlands Party contributes to the development and implementation of projects by the procurement of claims on emission reduction units, which claims are to be sold by companies that develop and realise emission reduction projects in the Republic of Bulgaria. The procurement contract includes the formal Netherlands approval of the project in accordance with Article 6.1 (a) of the Kyoto Protocol.

The Bulgarian Party contributes to the development and implementation of projects by supporting interested companies (information, consultation, licensing etc.) and by the formal approval of the project in accordance with Article 6.1 (a) of the Kyoto Protocol. The approval is a necessary condition for the Netherlands Party to enter a definite procurement contract. Therefore the approval needs to contain the binding affirmation of the Bulgarian Party that it will transfer the resulting emission reduction units, which can be claimed under the procurement contracts, to the Netherlands, in accordance with article 6 of the Kyoto Protocol and with the guidelines elaborated by the Parties to the Protocol. The letter of approval will also have to affirm that the transfer will be free of any charge and under the responsibility of the Republic of Bulgaria for the fulfilment of the obligations referred to in Article 8 of the Kyoto Protocol. Changes in national policy (energy, environment, etc.) of the host country that result in the impossibility to deliver of the Emission Reduction Units by the project executor oblige the Republic of Bulgaria to deliver the emission reduction units agreed upon with the company in the Letter of Approval at no cost to the Netherlands.

According to the MoU, a Joint Implementation Unit-Bulgaria was established on 1 July 2000. The Joint Implementation Unit (J I Unit) is an independent evaluating unit, hosted by the State Energy Efficiency Agency (now moved to MOEW), and under the direct supervision of the Ministry of Environment and Waters. It is the "driving force" of the Join Implementation co-operation with the Netherlands and the contact point for Senter International – the Dutch agency responsible for administering the ERUPT. J I Unit is also the "knowledge" centre on Joint Implementation in the country.

The main task of the Unit is to evaluate the project proposals submitted to Senter International, and prepare an advice for decisions to the Ministry of Environment and Waters of Bulgaria. The staff of the J I-Unit assists in the development of project selection criteria, co-ordinates the Joint Implementation activities with the Ministry of Environment and Waters, performs negotiations on credit sharing, and maintains close communications with the project developers.

A significant part of J I-Unit's responsibility is the promotion of ERUPT scheme and creation of awareness on Joint Implementation in general. The purpose is to increase the quality and the quantity of future Bulgarian projects submitted to ERUPT. The promotional activities include provision of detailed information on ERUPT to local business communities, foreign companies active in Bulgaria, and other stakeholders such as municipalities, Ministries, agencies, and NGOs. The communication role of the Unit provides for organisation of meetings and workshops, participation in seminars and relevant events.

The first Tender was closed for expressions of interest on 17 July 2000. There were only three project proposals from Bulgaria and none of them was contracted. The reason for this failure was mostly the lack of sufficient information on J I and in particular the requirements of the ERUPT.

Lately, the activities of the J I Unit were focused at the preparation of Bulgarian participation in the second ERUPT tender, which was opened on Dec. 3 and closed on March 5. There were six project proposals submitted this time. The results of the tender are expected in the end of May 2002.

Memoranda of Understanding are expected to be signed with Austria and Switzerland in the near future.

8. RESEARCH AND SYSTEMATIC OBSERVATION

8.1. INTRODUCTION

Research activities in the field of climate change in Bulgaria are limited and mainly carried out with the help of international financial support. Systematic observations in the country are not officially linked with the climate change activities.

There are numerous studies in Bulgaria directly or indirectly dealing with the climate change issue. The research work is focused in the Energy Institute and in the various institutes to Bulgarian Academy of Sciences, such as Forestry Institute, Institute of Nuclear Research and Nuclear Energy, Institute of Economics, National Institute of Meteorology and Hydrology, as well as in some other research institutes as Agricultural Academy. The National Coordination Center on Global Change co-ordinates the activities of more than 20 institutions and organizations including Bulgarian Academy of Science (BAS), the Environmental Executive Agency, the National Statistical Institute, the Energy Institute, Economic Analysis and Forecasts Agency, University of National and International Economy, Union of the Scientists, and Balkan Center for Architecture and Ecology. Parts of the activities are within the frame of international projects. When it comes to systematic observation, it is carried out as a part of the commitments of Bulgaria under various agreements, without being linked to the climate change related activities so far.

8.2. RESEARCH

Research activities in the field of climate change are being carried out by some research institutes like the National Institute of Meteorology and Hydrology (NIMH) and Energy Institute. Furthermore, the climate change issues are included in the activities of other institutions, ministries, and NGOs. Hereafter the activities held by the NIMH, SEEA and Ministry of Economy are presented. They illustrate only part of the activities in the field.

BAS, and in particular NIMH, is initiator and one of the main organizations responsible for the research activities in the climate related field. The output of the research work is available in the resume of the annual report of the BAS.

NIMH has started research in the field since the middle of 19th century. These activities continued during 20th century with higher intensity in the last decade. There are series of research in the field of climate change conducted at national and regional level and its impact on particular sectors, e.g. agriculture. There are few PhD thesis on the topic completed by research fellows: 1995 – climate change and its impact on ecosystems; 1996 – emission estimates in Bulgaria (including GHG emissions). Scientists from NIMH have taken participation in various international seminars and workshops. The libraries of NIMH and BAS keep publications and reports on the issue. Summarized information could be also found in the National Coordination Center on Global change within BAS.

NIMH uses data form the international exchange and the programs of the World Meteorological Organization (WMO). At national level there are certain problems coming from the lack of internal telecommunication data exchange and inter-institutional exchange of meteorological data. The insufficient funding also hinders the construction of a modern archive for meteorological data.

For the successful overcoming of these problems a special funding at national level for improvement of equipment to match European Union standards, and for a serious research projects on climate change and all its impacts is needed. Bulgaria has to participate in more international projects in the field too.

Scientists and the management have submitted various local and international projects regarding climate change some of which have received funding from international institutions. Generally BAS covers its research activities through limited state subsidies that do not provide for investments in equipment for system observations. Some other sources are also sought for (mainly international).

The projects in NIMH are financed as follows:

- Budget subsidies – 10 projects, but not enough funds for equipment for system observations.
- Other national sources – for support of observations, other expenses and computers for data processing and testing of climate models.
- National fund "Scientific Research" – partial support to 3 projects for the last 3 years. Currently only 2 projects related to the issue are being carried out.

- MOSW – 2 projects.
- International projects – 2 EC projects.

The policy of NIMH in the field has two aspects:

- Training of experts in the field of climate change.
- Encouraging of research works in the field by means of setting competitions, PhD programs, specialization; participation in conferences and workshops; support in scientific projects.

The research work underway now refers to the following topics in the area:

Topic 1: Climate process and climate system studies, including paleo-climate studies

A study revealed the upward trend in the average temperatures (average for the period 1961-1990) for the period 1901-2000 from increase of 0.07°C at the beginning to 0.18 °C at the end of the century. The tendency in the annual temperatures in the last century is for warming of Northern Bulgaria and slight cooling of Southern Bulgaria. In term of rainfalls compared to the average values (for the period 1961-1990), the trend for the period 1901-2000 is downward and more obvious in the southern part of the country. The driest decade is 1941-1950 for northern part and 1981-1990 for the Southern part. For the entire century there is not a year with monthly rainfalls only below or only higher than the standards (Koleva et al., 2001).

There are also studies on climate change (air temperatures) and precipitation in different years, seasons, months and period of time in the last century (1901-2000) (Alexandrov, 2000; Alexandrov and Hoogenboom, 2000; Sharov et al., 2001). Regarding the annual air temperatures, despite the temperature rise in the last two decades there is no statistically significant tendency of increase in the 20th century (Alexandrov, 2000; Alexandrov and Hogenboom, 2000; Alexandrov et al., 1999; 2000). The highest temperatures are registered in 1994, temperatures in 1999 and 2000 are also high (Alexandrov, 2000; Alexandrov, 2001). The fluctuations of the annual sums of rainfalls indicate a drought tendency over the last two decades. The most serious droughts are registered in 1945 and 2000. Since the end of 1970 there is a tendency for decrease of rains in the warmer part of the year (April – September). Rains were below the standards for 14 out of the 20 years within the period.

Data from rocket probes in the middle atmosphere (in station Ahtopol, 1982-1992) for the region of South—East of Europe indicate cooling of the high stratosphere for the period after 1985 (Simeonov and Kolev, 2001, Simeonov et al., 1997) that is confirmed by data from neighboring regions (data from station Volgograd) and by other scientists after 1992. This proves the opposite interconnection with the warming of the lower troposphere.

Hydrological studies of scientific team from NIMH and other Institutes of BAS discovered the tendency of decrease of river flow in the country over the last century.

Current studies on oscillations of atmospheric circulation with draft results indicate lower frequency of cyclones from Mediterranean region (that bring rainfalls) over Bulgaria, especially after 1980.

Topic 2: Modelling and prediction, including general circulation models

Within the frame of the agreement between the German Foundation for Scientific Research DFG (Germany) and BAS a model for the 24-hours rainfalls sums in the Southern part of Bulgaria was developed that could be used for assessment of the daily, monthly and annual sums of the rainfalls over south-east part of Bulgaria (Zuccini, Neykov and Neychev, 2001). A significant application of the model is its ability to assess the risk of droughts and floods that is of interest to a wide circle of scientists and research fellows in the field of ecology, hydrology, meteorology, energy, agriculture, forestry and water management.

Scenarios for the air temperature and precipitation in 21 century based on global circulation models were prepared in 1997 (Alexandrov, 1997). They were used in the Second National Communication of Bulgaria. According to these scenarios air temperatures in Bulgaria are expected to increase within the range of 3.4° (OSU model) and 5.8° (UK89 model) in case of doubling of CO_2 concentration.

The Data Distribution Center (DDC) of the IPCC was created to assist dissemination of modern climatic scenarios, simulated by new versions of the global circulation models. In this relation, using simulation of the models (ECHAM4, HadCM2, CGCM1, CSIRO-Mk2b, GFDL-R15),

recommended by IPCC, some climatic scenarios for 2020, 2050 and 2080 were created in NIMH within BAS. Air temperature are expected to rise by 0.7°-1.8°C until 2020, by 1.6°-3.1°C until 2050, and by 2.9°- 4.1°C until 2080 (Alexandrov and Hoogenboom, 2000; Alexandrov et al., 1999; 2000). In general, precipitation is expected to increase in the winter time and to drop in the warmer part of the year at the end of the century. It has to be indicated that these are **climatic scenarios** for assessment of vulnerability of a given sector (e.g. water resources, agriculture). The reliability of the outputs decreases with the limitation of the model when spanning the whole territory of one country.

Topic 3: Research on the impacts of climate change

During the recent decade there were intensive research activities related to the impact of climate change on the agricultural crops carried out at NIMH. Main instruments in this research were the climatic scenarios of the global circulation models and dynamic model of the system "soil-plant-atmosphere". In the last years most often the American Decision Support System for Agro-technology Transfer (DSSAT) was used for assessment of vulnerability of main crops such as wheat and maize under possible climate change in Bulgaria (Alexandrov, 1998; Alexandrov, 1997; 1999; Alexandrov and Hoogenboom, 2000). If current concentration of CO_2 in the atmosphere is sustained, the yield of winter wheat, and especially of maize, will drop because of the shorter crop growing season and the precipitation deficit during the warmer part of the year. When the direct fertilization impact of increase concentration of CO_2 on the agricultural plants is taken into account, most of the simulations indicate increase of the yield of winter wheat compared to the average yield for the contemporary climate.

Under contract 177 between NIMH and EU on the "Adaptation of efficient criteria in limited regions in Europe and Middle East with scarce water resources subject to environmental control, climate changes and socio-economic development", currently some assessment is being made on the changes of elements of the water balance in soil and plants (e.g. evaporation, flows, humidity of soil) under simulated new climatic conditions (Alexandrov, 2001).

Particular impacts of the changes of rainfall patterns over many years on some of the main crops in 20th century are reported (Slavov and Rousseva, 2000).

Topic 4: Socio-economic analysis, including analysis of both the impacts of climate change and response options

Within the frame of a contract between NIMH and IAEA "Analysis of the environmental aspects of various power generation options in Bulgaria" as part of the international project DECADES "Databases and methodologies for comparative assessment of different power generation options", the following activities have been undertaken within the period 1994-2000:

- Data collection and archiving (in specialized database for Bulgaria under DECADES project) on economic, technical and environmental characteristics of the technologies for electricity generation in Bulgaria.
- Study and adaptation to Bulgarian circumstances of models RAINS (developed by the International Institute of Applied System Analysis – Luxembourg, Austria), Energy Service Model, ESM (developed by the Technical University of Denmark, Copenhagen) and some other models of this type (e.g. Sustainable Energy System Analysis Model, SESAM).
- Construction and comparison of different scenarios for development of electricity generation in Bulgaria, searching for a sustainable development option for the sector.

The task "Analysis of energy aspects of climatic resources" out of the research plan of NIMH (1997-1999) provides for research of theoretical grounds for analysis of interrelation between climate and energy systems, and options for application of models for integrated assessment of this interrelation with a view to formulation of proposals for environmentally friendly strategies for development of energy sector in Bulgaria.

Since the beginning of 2001 research has been initiated in collaboration with the University of Wageningen, Netherlands, addressing economic aspects of climate change, and in particular approaches for modelling and quantitative assessment of risks of crucial climatic phenomenon when developing a response policy to climate change. Initial results of the joint work were presented as a poster

presentation at the international conference "Challenges of a Changing Earth: Global Change Open Science Conference" (Amsterdam, July 2001).

Topic 5: Research and development on mitigation and adaptation technologies

As a result of the studies on the vulnerability of crops to climate change, some dynamic models are used to simulate and analyze various adaptation measures in agriculture. Using the DSSAT computer model various adaptation options are tested, such as change in roto-technological policies – change in dates for sowing, changes in irrigation and fertilization, changes in species and hybrids etc. (Alexandrov, 1999; Alexandrov and Eitzinger, 2000; Alexandrov and Hoogenboom, 2000).

Under the frame of the project "Installation and demonstration of European solar technologies for water heating for utilization in Central and Eastern Europe – "DEMO SOLAR EAST-WEST" two solar installations were delivered at NIMH. The installations are connected to the cold and hot water systems in the main building of NIMH and supply each floor of the building with hot water from the transformed solar energy. The installations have all necessary measuring and control devices in order to operate in automated mode and to allow for scientific research on the transformation of solar radiation to heat. There is a special Demonstration room to show the advantages of renewable sources. An international workshop on "Utilization of solar energy for water heating" was organized and held in the period 29-30 June 2001 with 57 participants, 13 of them foreign experts from Austria, Greece, Ukraine and Romania and 28 reports (i.e. Ivanov et al., Schwaerzler et al.).

Research activities in the field of energy efficiency are closely linked to the climate change issues since energy generation and transformation is the main GHG emission source in Bulgaria. Thus the policy of Energy Efficiency Agency towards energy efficiency improvement and wider introduction of renewables is meant to bring about GHG emission reduction. Main supporting institutions are SAVE II; PHARE; British Know-How fund; and Ministry of Environment of Germany. EEA participates in the development of a National Strategy for energy sector and energy efficiency development in the country, and coordinates the national policy in the field. It creates and supports information system on the state of energy efficiency at national and regional level.

The Energy Efficiency Center in Industry is active in the field of energy audits of industrial enterprises. Consultancy services on the technologies with GHG mitigation effect are provided to the companies. At company level there are also campaigns aiming to stimulate energy efficiency.

8.3. 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 (pages 101-108). 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.

The National Institute on Meteorology and Hydrology (NIMH) is a participant in the Global Climate Observing System (GCOS). As such NIMH provides meteorological data for the GCOS as follows:

Meteorological data: monthly data from 4 stations: Vidin, Varna, Sofia, Kardjali. In 1998 Vidin was replaced by Lom, and Kardjali – by Bourgas.

Atmospheric data: one station (Sofia) for ozone measurements and 5 stations for air pollution from sub-programs to the Global Atmosphere Watch (GAW) program.

Oceanology: 5 shore stations (Shabla, Kaliakra, Varna, Bourgas, Ahtopol) for Black Sea under Global Ocean Observing System (GOOS).

As a representative of Bulgaria in WMO, NIMH submits information vie Telecommunication center (that is regional for Region VI of WMO) to the following programs:

- World Weather Watch (WWW) – 14 stations; another 19 stations in the international exchange for regional needs of the countries in the South-East of Europe of Region VI.
- Global Climate Observing System (GCOS) – 1 station at the peak of Musala in Rila Mountain.
- Global Atmosphere Watch (GAW) – one station (Sofia) for ozone measurements and 5 stations for air pollution.

Table 8.1. Participation in the global atmospheric observing systems

	GSN	GUAN	GAW	Solar radiation	WWW
How many stations are under supervision of the Party?	1			7	13 (NIMH) + 1 (APPD)
How many of those are operating now?	1			2	13 + 1
How many of those are operating to GCOS standards now?	1			2	13 + 1
How many are expected to be operating in 2005?	1			5*	
How many are providing data to international data centers now?	1			2	13 + 1

- World Hydrological Cycle Observing System (WHYCOS) to sub-program MEDHICOS – 6 hydrological stations.
- Global Ocean Observing System (GOOS) – 5 seashore stations to its sub-programs.

There is not a special institute to observe only the global climate changes in Bulgaria. Through GCOS NIMH participates in the Integrated Global Observing Strategy (IGOS). It sends data on:

- Solar radiation from 2 stations – to St. Petersburg.
- Precipitation from 27 stations – to WRCP and GCOS.
- Meteorological data from 33 stations – to international data exchange.
- Ozone – to the Regional ozone center in Thessalonica, Greece.

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.

8.3.1. Meteorological and atmospheric observation

These observations (Table 8.1) are consistent with the best available practices provided in the WMO Manual on the Global Observing System, to the extent possible given the available technologies and devises in Bulgaria. Data quality control and archiving follows internal rules and procedures that are in process of update. They are in compliance to the WMO instructions.

In 2000 the following training was accomplished:

- 3 months training of an expert in the field of statistics in agro-meteorological climatology (July-September 2000, the UK), sponsored by WMO.
- Participation of 1 junior expert in "Harmonization and Quality Control in Climatic Data Base" (September 2000, Hungary), sponsored by WMO.

GSN – only the station at the peak of Musala is included in the official GCOS list. The other 4 stations are used for observations of regional climate. (*) – those stations will operate if financial support allows for repair of the solar radiation equipment. There is a great need of new equipment to measure UV radiation.

8.3.2. Oceanographic observations

Oceanographic observations (Table 8.2) include:

- Temperature of sea water – 5 seashore stations and climatic stations.
- Sea level – 4 stations; data from 2 of them go to international centers for archiving.
- Salinity of sea water – 5 seashore stations.

Data is consistent with the requirement of IOC. Quality control and archiving of data on temperature and salinity is made under Medax Medatlas II Project.

8.3.3. Terrestrial observations

There are observations for the snow cover in the meteorological stations and 4 hydrological stations, as well as 2 automated stations to MEDHICOS to WHYCOS. Data is in compliance to existing requirements and the country participates in data quality control and archiving.

8.4. EU INFORMATION EXCHANGE

On December 8, 2000 the National Assembly ratified *Agreement on the Participation of Bulgaria in the European Environment Agency(EEA),* signed

Table 8.2. Participation in the global oceanographic observing systems

	VOS	SOOP	TIDE GAUGES
How many platforms are under the Party supervision?			4
How many are providing data to international data centers?			2
How many are expected to be operating in 2005?	5	2	3

in Brussels on October 9, 2000 (Law on Ratification, State Gazette No. 105/19.12 2000). Therefore Bulgaria participates in the systematic observations and exchange of information made by the EU countries. Bulgaria already participates in the EIONET network and has been actively cooperating with the EEA for the last 4 years. National coordinators, reference centers and primary contact points to cooperate with the five European Topic Centers (namely ETCs: Air and Climate Change, Water, Waste and Material Flows, Terrestrial Environment, Nature Protection and Biodiversity) are designated as required by the EEA.

National Focal Point for the EEA is the Ministry of Environment and Water (European Integration Department). National Reference Center for the EEA is the Executive Environment Agency (ExEA), which is under the supervision of the Minister of Environment and Water. It is established to carry out and coordinate the information and monitoring services regarding the protection and preservation of the environment in Bulgaria. The Agency is the governing body of the National System for Environmental Monitoring (NSEM). The National System for Environmental Monitoring, administrated by the ExEA, covers the territory of the whole country and maintains the data base on both national and regional levels. The System provides timely and reliable information on environmental components and factors. On this basis analyses, assessments and prognoses for activities relating to preservation and conservation of the environment are prepared.

The ExEA has created a **National Information System** on environmental components. It has a hierarchical structure and includes the creation of local databases in the regional inspectorates and a national database in the ExEA. The system's aim is to create an overall information network for observation. Several projects have been started to implement the National Information System. For instance one such project involves the transmission and processing of data by automatic stations for ambient air quality control. This project is a part of Twinning-98 and is due for completion in 2001. At that stage the system will include 20 automatic stations measuring air quality, covering the whole territory of Bulgaria.

8.4.1. Air

The Executive Environment Agency takes part in:

- Supporting the Bulgarian link of EIONET – the telematics network of the EEA.
- Developing the Catalogue of Data Sources for environmental information, and its publication on Internet. This task is at its earliest state of implementation, namely gathering of the data needed.
- Overseeing the State of Environment Reporting System including the preparation and publication of the Report on the State of Environment in Bulgaria in electronic format. Annual Reports of the Ministry of Environment and Water for 1997, 1998 and 1999 have been published so far.
- Collecting, processing and representing (in summarized and final versions) the information on emissions of harmful substances in the air (so far in partnership with the PHARE Topic Link on Air Emissions).
- Collecting, processing and representing (in summarized and full versions) the information on emissions of harmful substances in water and soil.

In 1997 Bulgaria was included in the EUROAIRNET Telematics network with 42 air monitoring sites. After actualization of the inland and groundwater monitoring sites carried out in 1998, Bulgaria was also included in the European water-monitoring network EUROWATERNET, established in 1999.

EUROAIRNET incorporated Bulgaria into the Monitoring and Information Environmental Network of the EU (concerning air pollution) in 1997. Forty-two measuring points from MOEW's National System of Environmental Monitoring are included in the European network. This information is collected, processed and reported by the national Executive Environment Agency in terms defined by the European Environment Agency.

8.4.2. Water

The designation of measurement points for surface water in Bulgaria according to general rules of the EEA gave the possibility for the country to be included in the European water-monitoring network EUROWATERNET. According to the EEA criteria, there are 11 background points (1 item) for the major water streams: Ogosta, Iskar, Vit, Yantra, and Rusenski Lom. The Bulgarian part of EUROWATERNET includes 3 automatic stations situated on the rivers Struma, Mesta and Maritza.

The European Environmental Agency was provided with information about the location of surface

water points from EUROWATERNET, and also for geographical data, water area and water quantity of the rivers, etc. There are 74 water bodies falling within this scope and information will be collected about their hydrogeology, including minimum, annual and maximum rainfalls and geological characteristics. An indispensable part of the groundwater information of EUROWATERNET are the processed cards showing the change in the amount of ammonia, nitrates and phosphates from 1989 to1998 in 23 water bodies in Bulgaria. A hydro-geological map of the Republic of Bulgaria was developed in January 2000.

8.4.3. Land cover

The Corrine Land Cover (CLC) project for the EU-associated countries started in 1992 and was fully funded by the PHARE Program. Bulgaria was included in the project in 1994 and CLC was completed for the country in 1996. The satellite images, which were bought for the project implementation, are from the period 1989-1990 and the database is in 1:100,000 scale. The character, type and content of the database are geared for development, presentation and popularization of various activities, each of which are related to the policy and management of different governmental, public, and scientific sectors.

Bulgaria is committed to participate in the CLC database update (CLC 2000), which has already started for the EU Member States and is financed at a level of 50% from the Commission with each individual country covering the rest.

8.4.4. Nature protection

The preparation of a short summary on the work with the EEA has resulted in 2000 in the completion of two EIONET questionnaires on nature conservation data in the Phare countries and transmission of this data back to the Phare Topic Link (PTL) and the EEA European Topic Center (ETC) Nature Conservation. Both questionnaires were to contribute to the Catalogue of Data Sources as part of the European Information System on Nature (EUNIS).

A Twinning Project is now under implementation in cooperation with the Austrian Environmental Protection Agency. One of the outputs of this project will be the elaboration of a Cadaster of the protected territories in Bulgaria.

Since 1998 a joint project "Forest ecosystems monitoring" is undergoing between Bulgaria and Switzerland. It aims to help Bulgaria with meetings its commitments under the UN/ECE Convention on Long-range Trans-boundary Air Pollution.

8.5. PUBLICATIONS

Topic 1:

1. E. Koleva, N. Slavov, V Alexandrov, 2001. Dry Periods in 20th Century. B – Dry Period 1982-1994 in Bulgaria. Edited by D. Mishev et al. BAS Publishing.
2. P. Simeonov, 2001. Some characteristics of the global climate change and specifics of the weather in 2000 in Bulgaria. Science Magazine, year 9, volume 2, page 72-78.
3. P. Simeonov, S. Kolev, L. Milenkova, V. Zahariev. Climate of the mid-atmosphere over South-East Europe. Scientific report, library of the National Institute for Hydrology and Meteorology, reg. number 84000151, 1997, page 30.
4. Project report "General schemes for basin water management in Bulgaria. Team of several institutes, edited by O. Santurdjan, 2000 (in the library of MOEW).
5. Alexandrov, V., 2001. Water and meteorology. Workshop on adaptation of efficient water use criteria in marginal regions of Europe and middle Asia with scare sources subject to environmental control, climate changes and socio-economic development. University of Algarve, Portugal.
6. Alexandrov, V., 2000. Climate Variability in Bulgaria during the 20th Century. Proceedings of the Conference "Images and Reconstructions of Weather and Climate over the Last Millennium", Cracow, Poland.
7. Alexandrov, V. and G. Hoogenboom, 2000. The Impact of Climate Variability and Change on Crop Yield in Bulgaria. Agricultural and Forest Meteorology, Vol 104(4), pp. 315-327.
8. Alexandrov, V. M. Genev and L. Krastev, 1999. Adaptation of efficient water use criteria in marginal regions of Europe and middle Asia with scare sources subject to environmental control, climate changes and socio-economic development. 1st annual report.
9. Alexandrov, V. M. Genev and L. Krastev, 2000. Adaptation of efficient water use criteria in marginal regions of Europe and middle Asia with scare sources subject to environmental control, climate changes and socio-economic development. 1st annual report.
10. Sharov, V., E. Koleva and V. Alexandrov, 2001. Climate Variability and Change. In:

Hristov, T., G. Knight and M. Staneva (eds.). Global Change in Bulgaria, Pennsylvania, USA (in Press)
11. Simeonov P.T., S.I. Kolev, 2001. On temperature variabilities in middle atmosphere over Southeastern Europe. Bulgarian Journal of Physics (in Press).

Topic 2:

1. Alexandrov, V. and G. Hoogenboom, 2000. The Impact of Climate Variability and Change on Crop Yield in Bulgaria. Agricultural and Forest Meteorology, Vol 104(4), pp. 315-327.
2. Alexandrov, V., 1997. GCM Climate Change Scenarios for Bulgaria. Bulgarian Journal of Meteorology and Hydrology, Vol.4, No.4, pp. 205-211.
3. Alexandrov, V. M. Genev and L. Krastev, 1999. Adaptation of efficient water use criteria in marginal regions of Europe and middle Asia with scare sources subject to environmental control, climate changes and socio-economic development. 1st annual report.
4. Alexandrov, V. M. Genev and L. Krastev, 2000. Adaptation of efficient water use criteria in marginal regions of Europe and middle Asia with scare sources subject to environmental control, climate changes and socio-economic development. 1st annual report.
5. Zuccini, W., N. Neykov and P. Neytchev, 2001. Development of a daily precipitation model for South-West Bulgaria, Technical Report, Univ. of Göttingen, Germany, 69 pages.

Topic 3:

1. V. Alexandrov, 1998. Influence of the variations and the change of the climate on agroclimatic resources and the crop productivity in Bulgaria. Magazine of BAS, number 3-4, page 34-43.
2. Alexandrov, V., 2001. Water and meteorology. Workshop on adaptation of efficient water use criteria in marginal regions of Europe and middle Asia with scare sources subject to environmental control, climate changes and socio-economic development. University of Algarve, Portugal.
3. Alexandrov, V., 1999. Vulnerability and Adaptation of Agronomic Systems in Bulgaria. Climate Research, Vol 12 (2-3), pp. 161-173.
4. Slavov N. and M. Rousseva. 2000. Agroclimatic assessment of crop growing seasonal precipitation during the XX century in Bulgaria.ECAC 2000 ''3-rd European Conference Applied Climatology '' Piza, Italy CD Version, 6 pp.

Topic 4:

1. Iotova, A., Todorov, T., Atanassov, D. (1998): Comparison of the capability of the DECPAC and RAINS models as tools for integrated assessment in the energy planning process – In "Air Pollution Modelling and its Application XIII" Volume of the NATO Challenges of Modern Society Series (Proceedings of the 23rd NATO/CCMS International Technical Meeting on Air Pollution Modelling and its Application held on 28 September – 2 October 1998 in Riviera near Varna, Bulgaria), Kluwer Academic/Plenum Publishers, New York, 2000, pp. 723-724
2. Iotova, A. (1998): Energy Related Climate Change and Impacts of Climate Change on Energy: A Conceptual Analysis with Regard to Policy Development – presentation during the 2nd European Conference on Applied Climatology held in Vienna, Austria, October 1998 (issued on CD)
3. Todorov, T. (1999): Prediction and Comparison of Air Pollution Emissions from Electrical Power Plants in Bulgaria – Journal of Balkan Ecology, Vol. 2, 1999
4. Todorov, T. (1999): Model Assessment of Bulgarian Power Plants Emissions in Air and Deposition Fields Trends – Journal of Balkan Ecology, Vol. 3, 1999.
5. Todorov, T. (2000): Strategy for Sustainable Development of Bulgarian Electricity Sector - Journal of Balkan Ecology (accepted for publication).
6. Yotova, A. (2000): Climate Change, Human Systems and Policy – Theme level contribution to Encyclopedia of Life Support Systems published by UNESCO and EOLSS Publishers (will appear on CD in 2001).

Topic 5:

1. Alexandrov, V. and J. Eitzinger, 2000. An Approach for Irrigation Planning and Management of Maize Crop in North Bulgaria. Proceedings of the XXth Conference of the Danube Countries on Hydrological Forecasting and Hydrological Bases of Water Management, Bratislava, The Slovak Republic (CD version), 6 pp.
2. Alexandrov, V. and G. Hoogenboom, 2000. The Impact of Climate Variability and Change on Crop Yield in Bulgaria. Agricultural and Forest Meteorology, Vol 104(4), pp. 315-327.

3. Alexandrov, V., 1999. Vulnerability and Adaptation of Agronomic Systems in Bulgaria. Climate Research, Vol 12 (2-3), pp. 161-173.
4. Ivanov P., St.Lingova, L.Trifonova. Solar Energy Resources for Solar Thermal Proceedings of the International Seminar :"Solar Energy for Hot Water Production. Solar Market &Technology", 29-30 June, 2000, Sofia.
5. Schwaerzler G., P. Ivanov,L.Trifonova, S.Nikolov, N.Stankov, St.Raikov. Statistical Evaluation and Analyses of Large-Scale Bulgarian Solar Installations. Proceedings of the International Seminar: "Solar Energy for Hot Water Production.Solar Market &Technology", 29-30 June, 2000, Sofia.

9. EDUCATION, TRAINING AND PUBLIC AWARENESS

9.1. GENERAL POLICY TOWARD EDUCATION, TRAINING AND PUBLIC AWARENESS

Climate change related activities in Bulgaria are generally coordinated by the Ministry of Environment and Water (MOEW). In the last year MOEW has undertaken series of activities within a frame of campaign on Climate Change, UNFCCC and Kyoto Protocol. The activities included in the campaign include:

- Publishing of the National Climate Change Action Plan on the web site of the Ministry in Bulgarian and English language.
- Establishment of a link in the MOEW's site regarding the national information and public awareness campaign on climate change (in progress).
- A special poster "What are we doing with our planet?" and T-shirts with the same slogan regarding the climate change issue prepared and distributed for the Earth Day (22 April 2001) by MOEW together with the foundation "The Century of Love".
- Distribution of 200 T-shirts with climate change related slogans in 2 schools.
- Muppet show for 5-10 years old children to be presented in open air – in parks (in progress).
- A series of workshops on climate change with various stakeholders with the financial support of GEF (The fist one with participation of ministries and state agencies has already taken place: *Climate change and implementation of National Climate Change Action Plan*. 28-29 May 2001).
- Publishing of a Guide for beginners in the field of the climate change, UNFCCC and Kyoto Protocol for various social groups (in progress).
- Use of mass media for raising public awareness on the climate change issue.

The public awareness in terms of provision of information on Kyoto mechanism and the ways of companies to participate in the J I mechanism is among the priorities of the J I unit. Amongst its first steps in this direction was the organization of workshop: *From Kyoto to ERUPT* on 19 December 2000. Representatives of Ministries, energy companies, and other stakeholders attended the workshop.

EnEffect is perhaps the most active NGO working on promotion of energy efficiency in Bulgaria. Its work focuses on collection and dissemination of useful information, as well as on publishing of a variety of publications aimed at encouraging energy conservation. The Centre's activities in this respect are organized in three major groups of actions which result in the following major products:

- Database (e.g. EnEffect develops and maintains various databases on the issues of energy efficiency and in particular they cover the following three major fields: Publications on Energy Efficiency, Individuals and Institutions Active in Energy Efficiency, and Municipal Energy Efficiency Network).
- Periodical editions (e.g. "EcoEnergy").
- Information materials and Guides ("Sources of Funding for Energy Efficiency Projects in Bulgaria"; "How to Save Energy at Home"; Guide for beginners: Climate Change, UNFCCC and Kyoto Protocol.

9.2. PRIMARY, SECONDARY AND HIGHER EDUCATION

Another institution closely involved in the educational activities related to climate change is the Ministry of Education and Science. It deals with the climate change issue within the frame of environmental education and professional training. Regulation 2 on the school contents (from May May 18, 2000, SG 48/2000) subdivided curriculum into 8 main fields:

- Bulgarian language and literature
- Foreign languages;
- Mathematics, informatics and information technologies
- Social science and civil education
- **Natural sciences and ecology**
- Arts
- Lifestyle and technologies
- Sports

Natural sciences and ecology includes the following subjects:

- Environment, man and nature (grades II-VI);
- Biology and health education (grades VII-XII);
- Physics and astronomy (grades VII-XII);

- Chemistry and environmental protection (grades VII-XII).

Primary level of education makes pupils aware of the anthropogenic activities that pollute environment and impact natural equilibrium. They also make children aware of air temperature and how to measure it.

Secondary school supplements the knowledge of pupils with explanation on the state of environment, main natural lows, impacts of human activities and their consequences, projection on future impacts, explanation of existing environmental problems, environmentally-friendly measures.

The system for professional training in Bulgaria aims at managing and education of children and adults in the following directions:

- How to accept nature as a valuable asset and invaluable source of material and intellectual existence.
- How to utilize technologies without contaminating air, soils and water.
- How to foresee the outputs of anthropogenic activities and to limit the adverse effect on nature.

An interesting aspect in the professional training and education in Bulgaria is the development of new elements in the theory and practice of the training for specialist in *Ecology and environmental protection.* This activity is undertaken with the support and co-operation of various experts in and outside the MES.

"Ecology" is also a part of the activities outside class and school area. Various subordinate units to the ministry at national and regional level carry out initiatives in the above-mentioned field. Part of those activities is held in cooperation with the NGOs and municipalities; and is of practical nature.

There are awareness campaigns carried out together with NGOs aiming to raise the awareness of the society of environmental issues. Such an example is the national campaign "Let's Save Ozone" of the NGO "Borrowed Nature". Educational materials have been prepared and disseminated for the purposes of the campaign.

9.3. TRAINING PROGRAMS AND INFORMATION CENTERS

The Bulgarian Energy Efficiency Agency (EEA) works on creation of regional energy efficiency centres and units, and trains experts. With the assistance of international programs such as PHARE, SAVE II and UNFCCC-UNECE, energy efficiency centers are created and are under construction in the municipalities of Haskovo, Lovetch, Plovdiv, Stara Zagora, Blagoevgrad, Pernik, Burgas.

The currently elaborated by the EEA National Program on Energy Conservation and National Programme on Renewables are expected to stimulate the creation of regional energy efficiency structures and experts in the remaining regions of the country.

The Energy Efficiency in Industry Center trains experts in the field of energy efficiency with the financial support of J ICA.

Within the governmental structure, there is a National Agency for Professional Training and Qualification. Experts from the Ministry of Economy participate in the commissions of experts for different economic sectors. These commissions issue licenses for the candidates for setting of centers for professional training in trade companies. Educational programs include topics related to production organization, energy efficiency improvement in compliance to the environmental and heath legislation.

The Energy Efficiency Center EnEffect continues conducting training of the managers and experts. The municipal energy efficiency centers disseminate information, knowledge, consulting services to the industry and households. The Municipal Initiative for Energy Efficiency operates within the frame of the project Strategy for GHG Mitigation through Energy Efficiency. The demonstration projects undertaken already have outputs and the results of energy efficiency improvements are communicated to the stakeholders.

9.4. INVOLVEMENT OF THE PUBLIC AND NON-GOVERNMENTAL ORGANIZATIONS

Climate change is not a separate area of interest for any NGO in Bulgaria, but it exists in the scope of activities of a few NGOs. In 1998 the Academic Youth Ecological Club (AYEC) joined the Climate Action Network for Central and Eastern Europe (CANCEE) and started to monitor the official UNFCCC process. Among the projects, which AYEC has implemented related to climate change are the initiative to celebrate May 15 as Climate Action Day in Bulgaria

(1992), participation in an international project called *The Climate Is Right for a Change* organized by the European environmental youth network A SEED and funded by the Local Office of REC-Budapest (1995), support for the ratification of the UN Framework Convention on Climate Change (UNFCCC) (1995).

At the traditional National conference of NGOs (18-20 December 2000, Sofia) there was a separate meeting discussing the climate change issue. The representatives of NGOs attending the meeting have discussed their activities and concerns with the representatives of the MOEW. During the meeting those NGOs were invited to participate in the preparation and review of the Third National Communication under the UNFCCC.

To support the development of the sustainable energy efficiency financing in Bulgaria, US Agency for International Development strives to expand the role of the private sector in the delivery of energy efficiency services, equipment and financing; educate energy consumers about the benefits of energy efficiency and develop innovative financing mechanisms applicable to Bulgaria that will stimulate implementation of additional projects.

Among the projects supported by USAID with direct and indirect contribution to GHG emission reduction are:

- Regional Climate Change Training Program for Eastern Europe (June 2000- February 2001). Implementing organization is Institute of International Education and its partners are the Center for Energy Efficiency, MOEW, private sector, NGOs. Under the regional initiative including Macedonia and Romania, the following workshop took place: Climate change and development forum; Economics of climate change; Macroeconomic Modeling of climate change options, and the Role of local governments in climate change.
- Reducing Greenhouse Gases by Introducing Renewable Energy Sources (Leader: Municipality of Kyustendil; partner: Holzer Energy Management Co.).
- Greenhouse Emissions Reduction and Energy Saving Program (Leader: Polimery PLC; partner: Translectro, Hungary).
- Using Renewable Hydro Energy Resources in Bulgaria (Leader: Interconsult Association; partner: BET Consultants, USA).
- Energy Efficiency Action Plan for Sofia Building Stock (Leader: Municipality of Sofia; partner: Good Consulting, USA).
- Landfill Biogas Extraction and Energy Utilization at the Bratoveo Landfill in Bourgas (Leader: Municipality of Bourgas; partner: Brown, Vence and Associateds, Inc.).
- Development of a Program for Energy Efficiency in Hotels and Restaurants in Relation to the Environmental Protection (Leader: Bulgarian Hotel and Restaurant Association; partner: Artemel International, USA; Euroinform Ltd., Bulgaria).
- Reducing Emissions from Schools by Implementing Demand Side Efficiency Measures and Utilizing Existing Geothermal Sources (Leader: Municipality of Varna; partner: Centeh Energy Marketing and Consulting Ltd.).

9.5. PARTICIPATION IN INTERNATIONAL ACTIVITIES

In the last few years Bulgarian participation in international activities in the fields could be presented by the following events:

- Participation of Bulgarian experts in international workshops and in the SBSTA/SBI sessions, COP 5, COP 6 and COP 6-bis.
- Participation of Bulgarian experts in regional training on Kyoto mechanisms (in Romania) and GHG emission projections using ENPEP (the Ukraine).
- Participation of Bulgarian experts in in-depth reviews of National communications and centralized inventory reviews.

An important project was the Capacity Building Program for the Balkan countries is an initiative of the Greek Ministry for the Environment, Physical Planning and Public Works. It involved experts form Albania, Bosnia-Herzegovina, Bulgaria, FYROM, Romania and Yugoslavia.

The main goals of the program are:

- Assistance to Balkan countries for the elaboration and implementation of reliable national inventories of anthropogenic emissions by sources and removals by sinks of GHG, coupled with the necessary supportive systems for data collection and management that is the elements which allow for an assessment of the current situation and observed trends.

- Assistance to Balkan countries in identifying, evaluating, and selecting appropriate measures for the reduction of GHG emissions, taking into account national priorities, constraints faced and infrastructure needs, as well as potential supportive policies and measures to overcome these difficulties.
- Identification of priority areas for action in Balkan countries within the framework of the KP Flexible Mechanisms.
- Assessment of the vulnerability of these countries to climate change.
- Improvement of the general environmental conditions in the Balkan peninsular.

List of Terms and Abbreviations

ASAP	Automated Shipboard Aerological Program
BAS	Bulgarian Academy of Sciences
CANCEE	Climate Action Network for Central and Eastern Europe
CEC	Commission of the European Community
CEE	Central and Eastern Europe
CEFTA	Central European Free Trade Agreement
cif	cost, insurance and freight
CoE	Committee of Energy (formerly Ministry for Energy and Energy Resources)
CoG	Committee of Geology
CoM	Council of Ministers
DGXII	Directorate General for Research and Development (European Commission)
DGXVII	Directorate General for Energy (European Commission)
EBRD	European Bank for Reconstruction and Development
EC	Commission for European Communities ("European Commission"/CEC)
EIB	European Investment Bank
EU	European Union
FLUXNET	Global Terrestrial Network – Carbon
fob	free on board
GAW	Global Atmosphere Watch of WMO
GCC	Global Climate Change
GCM	Global Circulation Models
GCOS	Global Climate Observing System
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gases
GOOS	Global Ocean Observing System
GSN	GCOS Surface Network
GTN-G	Global Terrestrial Network – Glaciers
GTN-P	Global Terrestrial Network – Permafrost
GTOS	Global Terrestrial Observation System
GUAN	GCOS Upper Air Network
ICSU	International Council for Science
IGBP	International Geosphere-Biosphere Program
IGOS	Integrated Global Observing Strategy
IOC	Intergovernmental Oceanographic Commission of UNESCO
IBRD	International Bank for Reconstruction and Development (the World Bank)
IFC	International Finance Corporation (part of the World Bank Group)
IMF	International Monetary Fund
IPP	Independent Power Producer
IPCC	Intergovernmental Panel on Climate Change
J I	Joint Implementation
KP	Kyoto Protocol
LEEE	Law on Energy and Energy Efficiency
MEER	Ministry of Energy and Energy Resources
MoA	Ministry of Agriculture
MoEW	Ministry of Environment and Water
MoF	Ministry of Finance
MoH	Ministry of Health
MoI	Ministry of Industry
MoLSA	Ministry of Labor and Social Affairs
NARDP	National Agricultural and Rural Development Plant
NCCAP	National Climate Change Action Plan
NWMP	National Waste Management Program
NEK	National Electricity Company
NMVOC	Non-methane Volatile Organic Compound
NPP	Nuclear Power Plant
NSEM	National Ecological Monitoring System
NSI	National Statistics Institution
ODA	Overseas Development Administration (UK)
PIU	Project Implementation Unit (for PHARE)
PPA	Power Purchase Agreement
REC	Regional Environmental Center (Budapest)
RES	Renewable Energy Sources
RET	Renewable Energy Technologies
SAFIRE	Strategic Assessment Framework for the Implementation of Rational Energy

SEC	Specific Energy Consumption
SPEAR	Strategic Penetration and Adoption of Renewables Project (for DGXVII)
SFC	Drifters Surface Drifters
SOOP	Ship of Opportunity Program
Sub-SFC	Sub-surface
TOR	Terms of Reference
TPA	Third Party Access
USAID	United States Agency for International Development
NIMH	National Institute for Meteorology and Hydrology
ERUPT	Emission Reduction Units Procurement Trade
HPP	Hydro Power Plant
IPCC	Intergovernmental Panel on Climate Change
RTD	Research and Technological development
PLC	Public Limited Company
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
VOS	Volunteer Observing Ship
WCRP	World Climate Research Program
WHYCOS	World Hydrological Cycle Observing System
WMO	World Meteorological Organization
WRI	World Resources Institute
WWW	World Weather Watch of WMO

UNITS OF MEASURE

gms	Grams
GJ	Giga joule (1,000 million joules = 10^9 joules)
GW	Gigawatt (1,000 million watts = 10^9 watts)
GWh	Gigawatt hour (= 10^9 watt hours)
Joule	Amount of energy to move 9.81 kg one metre
kcal	kilocalorie (1,000 calories)
kg	kilogram (1,000 grams)
kW	kilowatt (1,000 watts)
kWh	kilowatt hour (1,000 watt hours)
m^3	cubic metre (1m x 1m x 1m)
MJ	Mega joule (1 million joules = 10^6 joules)
MT	Metric tonne (1,000 kg)
MW	Megawatt (1 million watts = 10^6 watts)
MWh	Megawatt hour (= 10^6 watt hours)
toe	tonne of oil equivalent **(mtoe = millions of tonnes of oil equivalent)**
TW	Terawatt (=10^{12} watts)
TWh	Terawatt hour (=10^{12} watt hours)

REFERENCES

The main sources of the National Communication are the submissions from the ministries and agencies. The structure of the submissions follows a questionnaire with separate sections for each organization. The reaction of the institution in support to the activities set as responsibilities in the National Climate Change Action Plan adopted by the Government.

Submissions of the following Ministries and Agencies are taken into account for the development of this National Communication:

- State Energy Efficiency Agency (letter No. 04-00-38/February 16, 2001)
- Ministry of Education and Science (letter No. 10547/April 6, 2001)
- Executive Environmental Agency (letter No. 934/April 10, 2001)
- Ministry of Foreign Affairs (letter No. 04-24-67/April 6, 2001)
- National Institute on Meteorology and Hydrology (letter No. 506/March 19, 2001)
- Ministry of Economy (letter No. 04-20-176/February 16, 2001)
- State Agency of Energy and Energy Resources (letter No. 04-21-27/July 7, 2001)
- Ministry of Regional Development and Welfare (letter No. 90-05-427/July 20, 2001)
- Ministry of Agriculture and Forests (letter No. 0403-507/February 2, 2001)
- Agency for Foreign Investments (letter No. 0410-4/April 4, 2001)

Other sources and materials:

- First National Communication under UNFCCC. 1996
- Second National Communication under UNFCCC. 1998
- National Climate Change Action Plan. Adopted July 2000.
- Bulgaria'99: Social-economic development. NSI. Sofia, 2000.
- Statistical Yearbook 2000. NSI. Sofia 2000
- Statistical Yearbook 2001. NSI. Sofia 2001
- Annual bulletin 1999. EEA. Sofia, 2001
- Annual report for the state of environment in Bulgaria (Green Book) 1999. Sofia 2001
- IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, 2000.
- UNFCCC Guidelines on reporting and review. FCCC/CP/1999/7.
- Methodology for calculation by the Mass Balance Methods of the emissions of harmful substances (polluters) released into the atmosphere, Sofia 2000.
- Revised 1996 IPCC Guidelines for National GHG Inventories. Volumes 1-3. IPCC/OECD Joint Programme, 1997.
- Updated Strategy for Development of Energy Sector in Bulgaria. Sofia, 2001.
- Completion of GHG inventory and development of the 3rd National Communication on Climate Change of the Republic of Bulgaria: Part 1 – Inventory for 1995 of the additional GHG included in the Kyoto Protocol; Part 2 – Update of the inventory of GHG in Bulgaria for the period 1988-1995; Part 3 – Inventory of GHG in Bulgaria for 1998. Sofia, MOEW, 2000, Page 67.
- Technical report No. 30, Second edition. EMEP Co-operative Programme for Monitoring and Evaluation of the Long Range Transmission of Air Pollutants in Europe. CORINAIR. The Core Inventory of Air Emissions in Europe. Atmospheric emission inventory guidebook (First edition). 1999.
- IEA book "Climate Change Policy Initiatives, 1995/96 Update, Vol. II Non-OECD Countries"
- Bulgaria 2000. 2000 Regular report from the Commissions on Bulgaria's Progress Towards Accession. 8 Nov. 2000.
- Governmental Programme 1997-2001.
- Memorandum on Economic Policies of the Government of the Republic of Bulgaria.
- Intergovernmental Conference on the Accession of the Republic of Bulgaria to the European Union. Negotiating Position on Chapter 22 Environment

ANNEX 3

1999 GHG Inventory
Common Reporting Format
Summary and Trends Tables

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

(Sheet 1 of 3)

Bulgaria
1999 Submission

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	**48,440.36**	**-6,607.60**	**483.30**	**61.16**	**102.68**	**0.00**	**0.00**	**43.55**	**0.00**	**0.00**	**122.77**	**493.31**	**63.51**	**1,061.65**
1. Energy	**44,513.04**		**132.89**	**7.90**							**115.57**	**461.24**	**43.71**	**1,052.99**
A. Fuel Combustion — Reference Approach [2]	44,573.25													
Sectoral Approach [2]	44,513.04		4.08	7.90							115.57	461.24	43.71	1,052.99
1. Energy Industries	26,321.91		1.39	7.00							48.61	13.94	6.72	857.56
2. Manufacturing Industries and Construction	9,488.15		0.39	0.54							16.63	4.33	0.21	110.16
3. Transport	6,211.56		1.46	0.12							42.56	229.33	36.48	8.00
4. Other Sectors	2,491.43		0.30	0.24							6.30	79.27	0.17	77.26
5. Other	0.00		0.55	0.00							1.46	134.38	0.12	0.00
B. Fugitive Emissions from Fuels	0.00		128.81	0.00							0.00	0.00	0.00	0.00
1. Solid Fuels	0.00		56.01	0.00							0.00	0.00	0.00	0.00
2. Oil and Natural Gas	0.00		72.80	0.00							0.00	0.00	0.00	0.00
2. Industrial Processes	**3,927.32**		**2.50**	**2.36**	**102.68**	**0.00**	**0.00**	**43.55**	**0.00**	**0.00**	**6.30**	**6.66**	**12.40**	**8.66**
A. Mineral Products	1,878.14		0.00	0.00							0.00	0.00	0.89	0.62
B. Chemical Industry	338.39		0.27	2.36	0.00	0.00	0.00	0.00	0.00	0.00	5.91	2.99	4.17	5.31
C. Metal Production	1,710.79		2.23	0.00				43.55		0.00	0.09	2.53	0.18	1.30
D. Other Production [3]	0.00										0.31	1.14	7.16	1.43
E. Production of Halocarbons and SF_6						0.00		0.00		0.00				
F. Consumption of Halocarbons and SF_6					102.68	0.00	0.00	0.00	0.00	0.00				
G. 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

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

[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)

)Si f f u2 og4)

Bvlgasia

2999 Svcn itt ioo

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**									**7.41**	
4. Agriculture	**0.00**	**0.00**	**115.34**	**50.35**							0.89	25.40	0.00	0.00
A. Enteric Fermentation			82.95											
B. Manure Management			30.29	1.51									0.00	
C. Rice Cultivation			0.90										0.00	
D. Agricultural Soils	(4)	(4)	0.00	48.82									0.00	
E. Prescribed Burning of Savannas			0.00	0.00							NO	NO	NO	
F. Field Burning of Agricultural Residues			1.20	0.03							0.89	25.40	0.00	
G. Other			0.00	0.00							0.00	0.00	0.00	
5. Land-Use Change and Forestry	(5) **0.00**	(5) **-6,607.60**	**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) -6,607.60												
B. Forest and Grassland Conversion	0.00		0.00	0.00							0.00	0.00		
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		
6. Waste	**0.00**		**232.56**	**0.54**							**0.00**	**0.00**	**0.00**	**0.00**
A. Solid Waste Disposal on Land	(6) 0.00		195.71									0.00	0.00	
B. Wastewater Handling			36.85	0.54							0.00	0.00	0.00	
C. Waste Incineration	(6) 0.00		0.00	0.00							NE	NE	NE	NE
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)

)Si ffu4 og4)

Bvlgasia
2999 Svcn ittioo

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	**344.80**		**0.03**	**0.03**							**1.84**	**0.69**	**0.11**	**0.20**
Aviation	319.27		0.01	0.00							1.28	0.54	0.08	0.10
Marine	25.53		0.01	0.03							0.56	0.15	0.03	0.10
Multilateral Operations	**NO**		**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	**2,412.84**													

[7] Memo Items are not included in the national totals.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS

(Sheet 1 of 1)

Bulgaria
1999 Submission

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]	**41,832.76**	**10,149.30**	**18,960.99**	**0.00**	**43.55**	**0.00**	**70,986.60**
1. Energy	**44,513.04**	**2,790.77**	**2,450.47**				**49,754.27**
A. Fuel Combustion (Sectoral Approach)	44,513.04	85.77	2,450.47				47,049.28
1. Energy Industries	26,321.91	29.19	2,169.31				28,520.41
2. Manufacturing Industries and Construction	9,488.15	8.25	167.01				9,663.41
3. Transport	6,211.56	30.58	38.26				6,280.40
4. Other Sectors	2,491.43	6.25	75.89				2,573.56
5. Other	0.00	11.50	0.00				11.50
B. Fugitive Emissions from Fuels	0.00	2,704.99	0.00				2,704.99
1. Solid Fuels	0.00	1,176.24	0.00				1,176.24
2. Oil and Natural Gas	0.00	1,528.76	0.00				1,528.76
2. Industrial Processes	**3,927.32**	**52.58**	**732.46**	**0.00**	**43.55**	**0.00**	**4,755.91**
A. Mineral Products	1,878.14	0.00	0.00				1,878.14
B. Chemical Industry	338.39	5.67	732.46	0.00	0.00	0.00	1,076.51
C. Metal Production	1,710.79	46.92	0.00		43.55	0.00	1,801.25
D. Other Production	0.00						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	0.00	0.00
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**	**2,422.21**	**15,609.82**				**18,032.04**
A. Enteric Fermentation		1,742.05					1,742.05
B. Manure Management		636.01	466.59				1,102.59
C. Rice Cultivation		18.88					18.88
D. Agricultural Soils [2]		0.00	15,133.78				15,133.78
E. Prescribed Burning of Savannas		0.00	0.00				0.00
F. Field Burning of Agricultural Residues		25.27	9.46				34.73
G. Other		0.00	0.00				0.00
5. Land-Use Change and Forestry [1]	**-6,607.60**	**0.00**	**0.00**				**-6,607.60**
6. Waste	**0.00**	**4,883.74**	**168.24**				5,051.98
A. Solid Waste Disposal on Land	0.00	4,109.82					4,109.82
B. Wastewater Handling		773.93	168.24				942.17
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**
							0.00
Memo Items:							
International Bunkers	**344.80**	**0.53**	**8.45**				**353.79**
Aviation	319.27	0.22	0.01				319.49
Marine	25.53	0.31	8.45				34.29
Multilateral Operations	**NO**	**0.00**	**0.00**				**0.00**
CO_2 Emissions from Biomass	**2,412.84**						**2,412.84**

[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	5,716.06	-12,323.67	-6,607.60			-6,607.60
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	5,716.06	-12,323.67	-6,607.60	0.00	0.00	-6,607.60

Total CO_2 Equivalent Emissions without Land-Use Change and Forestry [a]	77,594.20
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry [a]	70,986.60

[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.

TABLE 10 EMISSIONS TRENDS (CO_2)

(Sheet 1 of 5)

Bulgaria
1999 Submission

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)										
1. Energy	95,494.68	76,803.82	61,170.20	55,064.19	57,678.20	54,239.27	56,608.77	55,100.74	53,560.47	48,514.91	44,513.04
A- Et dkBnl at rshnm(RdbsnqkAooqnabg(	84,383-57	65,702-71	50,060-10	44,053-08	46,567-10	43,128-16	45,507-66	44,000-63	42,450-36	37,403-80	33,402-03
0- Dnukfx khet rsqhr	26,711-57	28,552-61	26,515-24	23,016-20	23,521-34	20,462-43	21,135-18	20,174-85	20,376-05	16,500-33	15,210-80
1- Lant@bst qnf khet rsqhr anr Bnnrsqf bshnm	24,644-78	08,778-75	01,040-02	8,582-77	00,640-58	00,873-31	03,470-66	03,000-23	02,856-62	00,300-17	8,377-04
2- Sqmronqs	01,527-58	00,752-60	5,413-46	5,324-27	6,332-82	5,435-84	5,733-52	5,204-50	4,204-10	5,364-12	5,100-45
3- NsgdqRdbsnqr	6,500-81	4,270-48	3,075-14	3,500-65	3,006-01	2,213-64	1,510-05	2,126-57	1,567-18	1,877-73	1,380-32
4- Nsgdq	0,554-40	0,004-82	770-78	084-75	622-00	708-50	204-01	150-03	001-07	38-01	0-00
A- Et f khd Dl hrrhnr qpl Et dkr	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00
0- Rnkr Et dkr	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00
1- Nkhanr Mst qkFar	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00
2. Industrial Processes	8,360.97	7,331.93	4,872.63	4,118.33	4,181.06	4,938.90	5,723.05	5,609.73	5,181.79	3,761.64	3,927.32
A- LhudqkOqpct bsr	3,518-24	3,152-52	1,361-22	0,868-00	0,634-77	0,805-44	1,217-30	1,334-41	1,033-00	0,300-07	0,767-03
A- Bgdl hkkhet rsqc	0,135-34	0,113-40	0,002-70	712-01	682-00	777-25	0,060-47	0,051-82	767-16	363-28	227-28
B- LdsakOqpct bshnm	1,374-07	0,732-67	0,285-40	0,205-10	0,531-07	1,022-88	1,212-05	1,000-18	1,148-40	0,766-07	0,600-68
C- NsgdqOqpct bshnm	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00
D- Oqpct bshnmne Gkhbaqnmr anr RE_6											
E- Bnmrt l oshnmne Gkhbaqnmr anr RE_6											
F- Nsgdq	0-00	0-00	0-00	0-00	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	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00
4. Agriculture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A- Dnsdqlo Edcj dnsehnm	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00
A- Lant ql Lanat fdl dns	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00
B- Rlbd Bt khehnm	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00
C- Af qhpt kt qkkRnkr [2]	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00
D- Oqhrbqhcdc At qhnf ne Rauannar	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00
E- Ehdkc At qhnf ne Af qhpt kt qkkRdrhet dr	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00
F- Nsgdq	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00
5. Land-Use Change and Forestry [3]	-4,656.67	-5,800.67	-7,879.67	-7,635.83	-7,021.67	-6,974.00	-7,520.33	-7,190.33	-5,852.00	-6,232.71	-6,607.60
A- Bganf dr hmEnqhrs anr NsgdqWnncx Ahnl arr Rsnbkr	,3,545-56	,4,700-56	,6,768-56	,6,524-72	,6,010-56	,5,863-00	,6,410-22	,6,080-22	,4,741-00	,5,121-60	,5,506-50
A- Enqhrs anr Fqrrkanr Bnmudqhnm	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00
B- Aaannmk dns ne Lanat fdc Kánar	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00
C- BN_2 Dl hrrhnr anr Rdl nu kc qpl Rnkc	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00
D- Nsgdq	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00
6. Waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A- Rnkr Warsd Chonrakmmkánr	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00
A- Warsd Lvasdq Gánerlhnf	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00
B- Warsd khbhndqjshnm	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00	0-00
C- Nsgdq	0-00	0-00	0-00	0-00	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
Total Emissions/Removals with LUCF [4]	99,198.98	78,335.08	58,163.16	51,546.68	54,837.60	52,204.17	54,811.49	53,520.14	52,890.26	46,043.84	41,832.76
Total Emissions without LUCF [4]	103,855.65	84,135.74	66,042.83	59,182.52	61,859.26	59,178.17	62,331.82	60,710.47	58,742.26	52,276.55	48,440.36
Memo Items:											
International Bunkers	1,766.14	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	344.80
Aulahnm	781-15	781-15	210-11	454-06	627-64	521-32	438-30	361-01	316-44	168-75	208-16
Laqhnl	762-77	762-77	767-01	762-08	732-86	740-33	771-26	620-47	0,080-84	0,121-44	14-42
Multilateral Operations	MN	MN	MN	MN	MN	MN	MN	MN	MN	MN	NO
CO_2 Emissions from Biomass											

[1] Ehkhnsgd aard xdaqacnosdc ax sgd Otqsx t nedqsgd Bnmudnshnm) lechudqhnsqpl 0880-

[2] Rdd annsnnsd 3 sn Rt l l aqc 0-A nesglr bnl l nmqlonqhnf cnd as-

[3] Sakd sgd nals dl hrrhnr ar qlonqdc hnRt l l aqc 0-A nesglr bnl l nmqlonqhnf cnd as- Ckdard nnsd sgas enqsgd ot qnrndr ne qlonqhnf, sgd rlf nr enqt osakd aql alv axr (,(anr enqdl hrrhnr (+(-

[4] Sgd hnnd ashnmnsgdrd qnv r hr qlpt drsdc sn esbkkasd bnl oadrnnnecasa, rhnbd Otqhlr chudqlnsgd v ax sgdx qlonqs BN_2 dl hrrhnr anr qll nu kc qpl Kánar, Trd Bganf d anr Enqhrsqc-

UBCMF 21 FN ITTIP OT USFOET)DI $_5$)

)Si ffu2 og6)

Bvlgasia

2999 Svcn ittioo

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)										
Total Emissions	1,333.77	1,409.60	1,353.32	1,247.04	1,121.43	817.99	887.69	827.15	703.55	654.25	483.30
1. Energy	266.85	259.65	221.84	209.39	201.83	197.28	224.98	225.24	187.08	175.44	132.89
A. Fuel Combustion (Sectoral Approach)	8.26	7.18	5.63	4.66	5.41	4.97	5.32	4.66	5.03	3.96	4.08
1. Energy Industries	3.14	1.54	2.55	1.42	1.93	1.51	1.39	1.28	1.50	1.29	1.39
2. Manufacturing Industries and Construction	0.93	1.61	0.56	0.45	0.49	0.52	0.56	0.61	0.66	0.43	0.39
3. Transport	3.00	2.91	1.41	1.70	1.93	1.87	2.02	1.75	1.27	1.40	1.46
4. Other Sectors	0.25	0.21	0.11	0.11	0.07	0.09	0.10	0.12	0.12	0.25	0.30
5. Other	0.93	0.91	0.99	0.98	0.99	0.98	1.24	0.90	1.49	0.59	0.55
B. Fugitive Emissions from Fuels	258.59	252.46	216.21	204.73	196.41	192.31	219.66	220.59	182.04	171.49	128.81
1. Solid Fuels	91.86	75.80	65.12	71.53	71.42	66.74	69.21	67.33	60.69	63.73	56.01
2. Oil and Natural Gas	166.73	176.66	151.09	133.20	124.99	125.56	150.45	153.25	121.35	107.76	72.80
2. Industrial Processes	2.79	3.27	2.36	2.23	2.61	3.40	3.72	3.47	3.71	2.83	2.50
A. Mineral Products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Chemical Industry	0.04	0.02	0.01	0.01	0.03	0.03	0.04	0.02	0.02	0.21	0.27
C. Metal Production	2.02	2.76	2.05	1.94	2.25	3.00	3.29	3.04	3.29	2.62	2.23
D. Other Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Production of Halocarbons and SF_6											
F. Consumption of Halocarbons and SF_6											
G. Other	0.73	0.50	0.29	0.28	0.33	0.37	0.39	0.41	0.40	0.00	0.00
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
4. Agriculture	272.88	257.38	232.79	189.50	147.45	123.44	118.68	112.43	106.51	113.72	115.34
A. Enteric Fermentation	192.79	179.75	164.70	135.23	104.18	87.22	82.41	79.15	75.93	81.79	82.95
B. Manure Management	72.53	71.47	62.80	51.09	40.88	34.71	34.51	31.59	27.92	29.63	30.29
C. Rice Cultivation	5.64	4.24	3.28	1.81	1.25	0.33	0.55	1.04	1.52	1.31	0.90
D. Agricultural Soils	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Prescribed Burning of Savannas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F. Field Burning of Agricultural Residues	1.92	1.92	2.02	1.37	1.13	1.18	1.21	0.65	1.14	1.00	1.20
G. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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
A. Changes in Forest and Other Woody Biomass Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Forest and Grassland Conversion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Abandonment of Managed Lands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. CO_2 Emissions and Removals from Soil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Waste	791.25	889.30	896.33	845.92	769.55	493.88	540.31	486.01	406.26	362.26	232.56
A. Solid Waste Disposal on Land	642.76	720.65	763.87	724.66	658.77	405.79	399.70	356.06	321.18	284.28	195.71
B. Waste-water Handling	148.50	168.66	132.46	121.26	110.78	88.09	140.62	129.95	85.07	77.98	36.85
C. Waste Incineration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Other	0.00	0.00	0.00	0.00	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
Memo Items:											
International Bunkers	0.06	0.06	0.03	0.03	0.04	0.03	0.03	0.03	0.03	0.03	0.03
Aviation	0.04	0.04	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01
Marine	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.01
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass											

UBCMF 21 FN ITTIP OT USFOET)O_3P)

)Si ffu4 og6)

Bvlgasia

2999 Svcn itt ioo

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)										
Total Emissions	81.37	77.30	68.44	59.16	53.79	52.35	55.19	53.68	52.56	47.41	61.16
1. Energy	15.27	11.79	10.19	9.78	9.68	9.38	9.73	9.60	9.71	8.53	7.90
A. Fuel Combustion (Sectoral Approach)	15.27	11.79	10.19	9.78	9.68	9.38	9.73	9.60	9.71	8.53	7.90
1. Energy Industries	9.28	9.56	8.86	8.77	8.62	8.28	8.56	8.42	8.47	7.72	7.00
2. Manufacturing Industries and Construction	4.99	1.69	0.92	0.70	0.72	0.74	0.88	0.93	1.06	0.51	0.54
3. Transport	0.23	0.25	0.15	0.14	0.16	0.14	0.14	0.13	0.12	0.13	0.12
4. Other Sectors	0.58	0.22	0.18	0.11	0.09	0.18	0.09	0.06	0.04	0.17	0.24
5. Other	0.18	0.06	0.08	0.06	0.09	0.03	0.05	0.06	0.02	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
1. Solid Fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Oil and Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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
A. Mineral Products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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
C. Metal Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Other Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Production of Halocarbons and SF_6											
F. Consumption of Halocarbons and SF_6											
G. Other	0.00	0.00	0.00	0.00	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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4. Agriculture	57.37	57.36	52.24	44.40	39.78	38.01	38.62	37.12	37.01	35.15	50.35
A. Enteric Fermentation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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
C. Rice Cultivation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Agricultural Soils	53.91	53.99	49.21	41.92	37.79	36.34	36.99	35.62	35.62	33.67	48.82
E. Prescribed Burning of Savannas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F. Field Burning of Agricultural Residues	0.05	0.05	0.05	0.04	0.03	0.03	0.03	0.02	0.03	0.02	0.03
G. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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
A. Changes in Forest and Other Woody Biomass Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Forest and Grassland Conversion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Abandonment of Managed Lands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. CO_2 Emissions and Removals from Soil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Waste	0.92	0.88	0.77	0.71	0.68	0.65	0.65	0.63	0.63	0.61	0.54
A. Solid Waste Disposal on Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Waste-water Handling	0.92	0.88	0.77	0.71	0.68	0.65	0.65	0.63	0.63	0.61	0.54
C. Waste Incineration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Other	0.00	0.00	0.00	0.00	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
Memo Items:											
International Bunkers	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
Aviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Marine	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
Multilateral Operations	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)

)Si f f u5 og6)

Bvlgasia

2999 Svcn ittioo

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)										
Emissions of HFCs[5] - CO_2 equivalent (Gg)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.76**	**0.00**	**0.00**	**576.65**	**102.68**
HFC-23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00
HFC-32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-43-10mee	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-125	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01
HFC-134	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-134a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.06
HFC-152a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-143	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-143a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00
HFC-227ea	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-236fa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-245ca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Emissions of PFCs[5] - CO_2 equivalent (Gg)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**46.92**	**0.00**	**0.00**	**69.44**	**43.55**
CF_4	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01
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
C_3F_8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C_4F_{10}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
c-C_4F_8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C_5F_{12}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C_6F_{14}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Emissions of SF_6[5] - CO_2 equivalent (Gg)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
SF_6											

Chemical	GWP
HFCs	
HFC-23	11700
HFC-32	650
HFC-41	150
HFC-43-10m	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-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.

HFCs data are on potential emissions.

TABLE 10 EMISSION TRENDS (SUMMARY)

(Sheet 5 of 5)

Bulgaria
1999 Submission

GREENHOUSE GAS EMISSIONS	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)										
Net CO_2 emissions/removals	99,198.98	78,335.08	58,163.16	51,546.68	54,837.60	52,204.17	54,811.49	53,520.14	52,890.26	46,043.84	41,832.76
CO_2 emissions (without LUCF) [6]	103,855.65	84,135.74	66,042.83	59,182.52	61,859.26	59,178.17	62,331.82	60,710.47	58,742.26	52,276.55	48,440.36
CH_4	28,009.22	29,601.62	28,419.68	26,187.84	23,550.06	17,177.82	18,641.39	17,370.20	14,774.52	13,739.31	10,149.30
N_2O	25,224.99	23,963.97	21,216.86	18,339.20	16,674.88	16,229.86	17,109.60	16,640.54	16,294.64	14,698.09	18,960.99
HFCs	0.00	0.00	0.00	0.00	0.00	0.00	1.76	0.00	0.00	576.65	102.68
PFCs	0.00	0.00	0.00	0.00	0.00	0.00	46.92	0.00	0.00	69.44	43.55
SF_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total (with net CO_2 emissions/removals)	**152,433.19**	**131,900.67**	**107,799.70**	**96,073.73**	**95,062.54**	**85,611.85**	**90,611.16**	**87,530.87**	**83,959.43**	**75,127.34**	**71,089.28**
Total (without CO_2 from LUCF) [6]	**157,089.86**	**137,701.33**	**115,679.37**	**103,709.56**	**102,084.20**	**92,585.85**	**98,131.49**	**94,721.21**	**89,811.43**	**81,360.05**	**77,696.88**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)										
1. Energy	105,831.61	85,910.99	68,986.79	62,492.48	64,918.36	61,290.92	64,348.70	62,805.61	60,499.37	54,842.71	49,754.27
2. Industrial Processes	10,841.23	9,656.10	6,548.18	5,488.91	5,368.57	6,348.24	7,770.85	7,644.92	6,874.14	5,435.74	4,858.59
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
4. Agriculture	23,514.33	23,186.09	21,082.75	17,743.77	15,427.13	14,375.08	14,463.13	13,868.68	13,710.79	13,285.47	18,032.04
5. Land-Use Change and Forestry [7]	-4,656.67	-5,800.67	-7,879.67	-7,635.83	-7,021.67	-6,974.00	-7,520.33	-7,190.33	-5,852.00	-6,232.71	-6,607.60
6. Waste	16,902.68	18,948.16	19,061.65	17,984.40	16,370.15	10,571.61	11,548.81	10,402.00	8,727.14	7,797.72	5,051.98
7. Other	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.

HFCs data is taken from the estimated potential emissions.

PREPARED BY:

MINISTRY OF ENVIRONMENT AND WATER

Strategy, European Integration and
International Cooperation Division
64 Gladstone St.
1000 Sofia
Bulgaria
Phone: 359 2 9406244
Fax: 359 2 9816610
E-mail: dstoytcheva@moew.government.bg
ecoins@moew.government.bg

ENERGY INSTITUTE JSCo

Climate Change Unit
20 F. Joliot-Courie Blvd.
1113 Sofia
Bulgaria
Phone: 359 2 688034
Fax: 359 2 9634038
E-mail: christov@eninbg.com
nra@enpro.bg

This publication was printed with the financial assistance from the United Nations Development Program and the Global Environmental Facility in Bulgaria.