REPUBLIC OF BULGARIA

SIXTH
NATIONAL COMMUNICATION
ON CLIMATE CHANGE

UNITED NATIONS
FRAMEWORK CONVENTION ON CLIMATE CHANGE

SOFIA, 2013

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

a.s.l.	above see level
BAS	Bulgarian Academy of Sciences
DSSAT	Decision Support System for Agrotechnology Transfer
EC	European Commission
EE	Energy Efficiency
SEDA	Sustainable Energy Development Agency
EPER	European Pollutant Emission Register
EU	European Union
EU ETS	European Union Emission Trading Scheme
ExEA	Executive Environmental Agency
FCCC	Framework Convention on Climate Change
FEC	Final Energy Consumption
FEC	Final Energy Consumption
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	Green House Gases
GVA	Gross Value Added
HPP	Hydro Power Plant
IMCCC	Inter-Ministerial Committee on Climate Change
IPPC	Integrated Pollution Prevention and Control
ISPA, PHARE, SAPHARD	European Union funds and programmes
IWG	Interministerial Working Group
JI	Joint Implementation
JISC	Joint Implementation Steering Committee
KP	Kyoto Protocol
LULUCF	Land Use, Land Use Change and Forestry
MAF	Ministry of Agriculture and Food.
MEE	Ministry of Economy and Energy
MEYS	Ministry of Education, Youth and Science
MF	Ministry of Finance
MFA	The Ministry of Foreign Affairs
MOEW	Ministry of Environment and Water
MRD	Ministry of Regional Development
NAPCC	National Action Plan on Climate Change
NFD	National Forestry Directorate
NGO	Nongovernmental Organization
NIMH	National Institute of Meteorology and Hydrology
NPP	Nuclear Power Plant
NSI	National Statistical Institute
PEC	Primary Energy Consumption
PRTR	Pollutant Release and Transfer Register
R&D	Research and Development
RES	Renewable Energy Sources
SAF	State Agricultural Fund
SC	Steering Committee
SME	small and medium-sized enterprises
TPP	Thermal Power Plant
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change

INTRODUCTION

The United Nations Framework Convention on Climate Change (UNFCCC) sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. It recognizes that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases.

The ultimate goal of UNFCCC 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.

UNFCCC entered into force on 21 March 1994. Bulgaria is signatory to the Convention since June 1992 and a Party to it after ratification by the Bulgarian Parliament since 1995. In conformity with Article 4.6 and 4.2(b) of UNFCCC, Bulgaria as a country in transition adopted 1988 as a base year for the implementation of the Convention instead of 1990. As an Annex I Party to UNFCCC Bulgaria adopted the target to stabilize emissions of greenhouse gases by 2000 at a level not exceeding the level in 1988, which was overachieved. On 11 December 1997 in Kyoto, Japan was adopted the Kyoto Protocol - an international agreement linked to the UNFCCC, setting internationally binding emission reduction targets for its Parties. It entered into force on 16 February 2005.

The Kyoto Protocol was ratified by the Bulgarian Parliament on July 17, 2002. According to Annex B of KP the quantified emission reduction commitment of Bulgaria for the first commitment period (2008-2012) was 92.0 % of the base year (1988) emissions.

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

The Third and Fourth National Communications of Bulgaria were elaborated for the Ministry of Environment and Water by the Energy Institute on a contractual basis and under coordination by the Interministerial Committee on Climate Change supported by independent organizations and experts in cooperation with the competent institutions - the Ministry of Agriculture and Forestry, Ministry of Economy and Energy, National Institute of Meteorology and Hydrology and Energy Efficiency Agency. They represent a further step in elaborating and implementing the national climate change policy and the new international commitments.

The Fifth National Communication was prepared for the Ministry of Environment and Water by the Energy Institute on a contractual basis in cooperation with the Ministry of Agriculture and Food, Ministry of Industry, Energy and Tourism and National Institute of Meteorology and Hydrology.

The Sixth National Communication follows the requirements of the Common tabular format for “UNFCCC biennial reporting guidelines for developed country Parties” (decision 19/CP.18); UNFCCC biennial reporting guidelines for developed country Parties (Annex, decision 2/CP.17); Guidelines for the preparation of the information under Art. 7 of the Kyoto Protocol (Annex, decision 15/CMP.1), the “Annotated Outline for Fifth National Communications of Annex I Parties under the UNFCCC, including Reporting Elements under the Kyoto Protocol” and the UNFCCC reporting guidelines on national communications (FCCC/CP/1999/7).

It outlines the national policy in the field of climate change and reflects the respective mitigation measures envisaged in the Third National Action Plan on Climate Change 2013 – 2020, approved by the Council of Ministers by Decision No 439/01.06.2012.

The Third National Action Plan on Climate Change provides specific measures for reduction of greenhouse gas emissions across all sectors and these measures are consistent with both the national policy on climate change and the potential of the national economy to reduce emissions. The overall effect of the measures will ensure the implementation of the commitments taken under the international agreements and the achievement of the legally binding objectives under the European legislation. In the Sixth National Communication projections for GHG emissions until 2020 are made, with accounting of the applied and planned measures.

Two projection scenarios are defined and clearly delimitated: “with existing measures” and “with additional measures”. In the scenario “with existing measures” only the applied and accepted measures are reported, while in the scenario “with additional measures” are considered also the measures planned for the time after the initial year of the projection. The implementation of the country’s climate change policy is responsibility of the Ministry of Environment and Water (MOEW). Given the horizontal nature of the climate change policy, the principle of integrating the climate considerations in key sectoral policies such as energy, households and services, industry, transport, agriculture, forestry and waste management is applied when envisaging the measures in the Third NAPCC. Taking into account the close interaction of the policies in these areas with the strategic planning related to climate change, the implementation and enforcement of the NAPCC requires an active involvement and commitment of all institutions responsible for carrying out the relevant policies.

The Communication presents the overall situation in the country for the period since the Fifth National Communication (second submission) till the end of 2013.

The Fifth National Communication is resubmitted due to the fact that on June 28 2010 Bulgaria was announced by the enforcement branch of the Compliance Committee to the Kyoto Protocol to be in non-compliance with the Protocol.

UNFCCC Expert Review Team (ERT) conducted an in-country review of Bulgaria’s 2009 annual inventory submission in accordance with the Guidelines for review under Article 8 of the Kyoto Protocol (Annex to decision 22/CMP.1) from 28 September to 3 October 2009. The ERT found that Bulgaria’s 2009 annual inventory submission was not sufficiently transparent, consistent, comparable, complete and accurate, as required by the UNFCCC reporting guidelines, the IPCC good practice guidance and the IPCC good practice guidance for LULUCF. In particular, the ERT found that the institutional arrangements and arrangements for the technical competence of its staff within the national system involved in the inventory development process were insufficient to enable the adequate planning, preparation and management of Bulgaria’s annual submission in accordance with the aforementioned guidelines.

The enforcement branch applies the following consequences:

a) Bulgaria is declared to be in non-compliance.

b) Bulgaria shall develop a plan and report on the progress of its implementation.

c) Bulgaria's eligibility to participate in the mechanisms under Articles 6, 12 and 17 of the Kyoto Protocol is suspended in accordance with the relevant provisions under those Articles pending the resolution of the question of implementation.

The enforcement branch has confirmed that there were unresolved problems with respect to implementation of the general and specific functions set out in the guidelines for national systems. A further subsequent in-country review will be required to assess Bulgaria's national system in accordance with the guidelines for national systems.

During the period after the in-country review and after the notification of the country on the subject of the question of implementation the country has undertaken significant effort to improve the status of the National System.

The conclusions and recommendations of ERT set out in the Report of the individual review of the 2010 annual submission of Bulgaria indicate that all activities for improvements of institutional, legal and procedural arrangements within the National Inventory System as well as for improvement of quality of inventory were adequately planned and implemented by the Bulgarian government in 2010. As a result from implemented activities for improvements "No questions of implementation were identified by the ERT during the review".

In accordance with Decision of Enforcement Branch CC-2010-1-17/Bulgaria/EB from 4 February 2011 Bulgaria is now fully eligible to participate in the mechanisms under Articles 6, 12, and 17 of the Kyoto Protocol.

The resubmitted Fifth National Communication reflects the national actions undertaken to reinstall the eligibility of the country.

1. Executive summary

1.1. Introduction

The United Nations Framework Convention on Climate Change (UNFCCC) sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. UNFCCC entered into force on 21 March 1994. Bulgaria is signatory to the Convention since June 1992 and a Party to it after ratification by the Bulgarian Parliament since 1995. On 11 December 1997 in Kyoto, Japan was adopted the Kyoto Protocol - an international agreement linked to the UNFCCC, setting internationally binding emission reduction targets for its Parties. It entered into force on 16 February 2005. The Kyoto Protocol was ratified by the Bulgarian Parliament on July 17, 2002.

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The Fifth National Communication was prepared for the Ministry of Environment and Water by the Energy Institute on a contractual basis in cooperation with the Ministry of Agriculture and Food, Ministry of Industry, Energy and Tourism and National Institute of Meteorology and Hydrology.

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Two projection scenarios are defined and clearly delimitated: “with existing measures” and “with additional measures”. In the scenario “with existing measures” only the applied and accepted measures are reported, while in the scenario “with additional measures” are considered also the measures planned for the time after the initial year of the projection.

1.2. National Circumstances

The Republic of Bulgaria is a parliamentary democracy. The Bulgarian unicameral parliament, the National Assembly consists of 240 deputies who are elected for 4-year-terms by popular vote. The Head of state is the President (Rosen Plevneliev since January 2012) directly elected for a 5-year term with the right to one re-election. Executive power is exercised by the government. Legislative power is vested in both the government and the National Assembly. The Judiciary is independent of the executive and the legislature.

The Council of Ministers is the principal organ of the executive branch, being chaired by the Prime Minister (Plamen Oresharski since 2013).

The Republic of Bulgaria is situated on the Eastern Balkan Peninsula in South-eastern Europe, along the Black Sea. With a territory of 111 001.9 square kilometres, Bulgaria is Europe's 14th-largest country. The neighbour states are Greece and Turkey to the South, FY Republic of Macedonia and Yugoslavia to the West. The River Danube separates it from Romania to the North. Its natural eastern border is the Black Sea.

Figure 1.1 Location of Bulgaria in Europe

Figure 1.2 Physical map of Bulgaria

60% of the total area is covered with hills and mountains. The mountains are part of the Alpine-Himalayan mountain chain situated on two continents - Europe and Asia. 33% of the country's territory is covered with forests (nonconiferous and coniferous). The varied environment is a natural habitat for valuable animal species.

The climate of Bulgaria is temperate continental with a transition towards a subtropical climate in its Mediterranean version (in the southern parts of the country), with four seasons.

The average annual temperature for the period 1988-2011 ranges between 10.6 and 13.0oC, The average precipitation in Bulgaria for the period 1988-2011 ranges between 377 and 924 millimetres per year .

As of 1 February 2011 the population of Bulgaria is 7 364 570 persons. The population density is 65.7 per sq km. During the period between the last two Censuses 2001-2011 the population in the country decreased by 7.1% due to the negative natural growth rate and due to international migration. The natural growth rate is negative for all years in the period between the two Censuses. The tendency of increasing the relative share of urban population and decreasing the relative share of rural population is kept. 72.5% live in urban areas and 27.5% live in rural areas.

The severe demographic decline is explained with low birth rates, high mortality rates and significant emigration. The age structure of the Bulgarian population has changed radically. Its median age increased from 30 in 1960 to 42 in 2012, the third-highest median age in the EU.

Average life expectancy in Bulgaria is 70 for male and 77 for female. In the decade leading up to EU accession in 2007, Bulgaria embraced difficult reforms to build macroeconomic stability and stimulate growth. It built fiscal buffers by accumulating fiscal surpluses between 2004 and 2008, and reduced public debt from over 70 % of GDP in 2000 to 16.3 % in 2010, one of the lowest debt levels in the EU today. Between 2000 and 2010, average annual growth reached 4.7 %. During that same period, Bulgaria's per capita income as a share of the EU average increased dramatically from 28 % to 44 %. Today Bulgaria remains among the most fiscally disciplined EU member states ─ an important feat in the context of global and European economic uncertainties.

In 2012 the economic growth in Bulgaria was slowed down due to the reduced export up to 0.8%, being 1.8% in 2011. The unemployment rate in 2012 was 12.3%, the average inflation was 2.4%. GDP per capita in 2012 was 10 633 BGN (5436 EUR). The export was increased by 13.9% and represents the main growth driver .With its strong banking system, Bulgaria is becoming an increasingly popular outsourcing location. Large companies such as BMW, Siemens, Lufthansa and Nortel have branches, production facilities or contract small programming firms in Bulgaria. Bulgaria's relatively cheap and qualified labour force, along with its low taxes and office rents, provide great benefits for business investors.

The governmental policy of rapid privatization led to almost complete privatization of industrial installations. As a result, the most inefficient enterprises were closed. The owners introduce various measures to save energy.

Bulgaria covers more than 70% of its gross energy demand by imports. The dependency on import of natural gas and crude oil is very high and has a traditional single origin - the Russian Federation. The Russian natural gas is supplied by one route through the Ukraine. Besides, our country relies completely on the import of nuclear fuel from Russia, although nuclear energy, according to a Eurostat methodology, is considered as indigenous energy source. The prevailing quantity of heat is produced on the basis of natural gas and the risks for the final consumers are much lower.

In the beginning of 2014 the Bulgarian Government should propose a new National Energy Strategy for the period before 2020. The new energy strategy of Bulgaria will have to deal with many challenges for the energy sector: guaranteeing the energy security by diversification of sources, suppliers and routes; improving the energy efficiency; renewables; diminishing carbon emissions; providing conditions for real energy trading and services; strengthening the regulatory body; and defining a balance between new investments and the price of energy for households and industrial consumers.

In the past, the main industry sectors of Bulgaria were metallurgy, machine manufacture, chemicals, and agriculture. Recently, however, the priority has shifted to sectors like energy, tourism, transportation, IT and telecommunications, food and beverage, pharmaceuticals, and textile and clothing.

The privatization of the road transport, the significant reduction of subsidies for the railway transport and the closure of railway routes lead to a shift in the transport structure – from rail to road – which is a reason for the registered relative growth in GHG emissions. The country's transport infrastructure is developing as an integral part of the common European transport network. The share of railway transport in Bulgaria is relatively not high. The clear tendency for further increase of the share of road transport will lead to a significant increase in passenger and goods flows as well as in GHG emissions. Priorities of the Government's policy in transportation include active investment strategies for developing a modern infrastructure, stabilization and modernization of the state-owned railway transportation and railway infrastructure companies through financing from the Government, EU funds, and other funding sources.

Agriculture sustains a major part of the Bulgarian economic landscape. The country enjoys a number of favourable geostrategic, climatic and natural endowments, which have significantly contributed to the development of century long traditions in both plant-growing and livestock breeding strong and promising sectors are the growing of roses, cotton and tobacco in the South Central parts of the country. Underdeveloped because of economic factors remain pepper, tomatoes, grapes and apples production, which are otherwise favoured by natural conditions. In terms of livestock breeding and livestock products processing, the country has excellent outlooks for increasing the exports of specific high quality milk and dairy commodities, as well as meat products. Predisposed by climatic and natural conditions, organic farming is also gaining speed in recent years. Investments in organic production are strongly encouraged by both Bulgarian and European authorities. Today, agricultural entrepreneurs in Bulgaria enjoy a number of competitive advantages and investment favourable factors. As a member of the EU, the country benefits from free access to the growing European market and are also subject to financial and technical support by the EU. Favourable conditions for the development of the sector are skilled and inexpensive workforce, sector supporting institutions, food and research centres, agricultural colleges, etc.

Forestry is a traditional important economic sector for Bulgaria with significant state investments for the last 40 years.

The forests cover some 34 % of the total area of the country, support valuable ecosystems and control erosion. A big share of these forests (39.8 %) has special function – protective and rehabilitation. A potential problem in the sector is the slow pace of reforms and restructuring. The tax policy of the Bulgarian Government in its main components is oriented to preservation of the stability of the economy in the conditions of economic crisis, stimulation of the business and the investment activities by means of:

- Relief in the taxation of the business and achieving minimal levels of taxation within the European Union;
- Simplification of the tax system and refining the tax legislation to eliminate internal contradictions and imperfections in the practices of taxation and control, and with the objective of a greater transparency and intelligibility to the taxpayers;
- Preserving the tax rates of the direct taxes in combination with lower social insurance burden to the employers in benefit of the economic growth and the employment;
- Preserving the higher share of the indirect taxes in comparison to the direct taxes.

The policy of the Government in the field of taxation is oriented towards decreasing the share of the shadow economy and combat tax evasion and avoidance.

The governmental programmes have set targets and have already achieved tangible reduction of waste generation. The measures for reduction of GHG emissions that are planned in this sector are related, most of all, to the management of solid municipal waste. The capture and recovery of landfill gas is not a common practice in Bulgaria and the whole amount of gas from the landfills is emitted into the atmosphere or (in rare cases) it is burnt.

The use of landfills is widespread in the country. The policy in this area foresees building of a system of 54 regional landfills and closing of all landfills that are not compliant with the legal requirements. The construction of these regional landfills will ensure environmentally sound waste disposal in the country.

1.3. Inventories of Greenhouse Gas Emissions by Sources and Removals by Sinks

Information for the annual GHG Inventory in Bulgaria for 2011 is presented. This Inventory is prepared according to the UNFCCC Guideline approved by the Subsidiary Body for Scientific and Technological Appliance on The 21st session on 06-14.12.2004 in Buenos Aires. The rules and the structure of the National GHG Inventory Report are formed by these Guidelines. The report is elaborated in compliance with the Revised IPCC Guidelines, 1996, IPCC Guidelines, 2006, and Good Practice Guidance for National GHG Inventories, 2000.

The Single Entity responsible for the preparation of National GHG inventories is ExEA.

Since 2008 the National System for GHG inventories is modified in accordance with the requirements of Article 5, paragraph 1 from the KP and the Marrakech Accord (respectively, Decision 20/CP.7). The legal basis for the Bulgarian National System for GHG inventories is provided in the Environmental Protection Act and in particular by the provisions of its Chapter 8, which establishes the National Environmental Monitoring System and lists all of its tasks.

To ensure the effective and timely functioning of the National System for GHG inventories, as well as complete reporting under the UNFCCC and the Convention of Long-Range Transboundary Air Pollution (CLRTAP), the Minister of Environment and Water has issued the Order № RD-54/25.01.2007, based on the EPA, which regulate in detail the institutional, legal and procedural arrangements and responsibilities for inventory preparation under the Secretariats of UNFCCC and CLRTAP. In additional, on the basis of Article 4 from the Council of Ministers Regulation on the organization of activities with regard to preparation and presentation of reports to the European Commission on the implementation of the legislative acts, which are part from the European Community legislation in the field of environmental protection, as well in accordance with Chapter III.2 of the above mentioned Order, is established an Order № RD-377/08.06.2007 by the Minister of Environment and Water.

Nevertheless on June 28 2010 Bulgaria was announced by the Enforcement Branch of the Compliance Committee to the Kyoto Protocol to be in non-compliance.

UNFCCC Expert Review Team (ERT) conducted an in-country review of Bulgaria's 2009 annual inventory submission in accordance with the Guidelines for review under Article 8 of the Kyoto Protocol (Annex to decision 22/CMP.1) from 28 September to 3 October 2009. The ERT found that Bulgaria's institutional arrangements and arrangements for the technical competence of its staff within the national system involved in the inventory development process were insufficient to enable the adequate planning, preparation and management of Bulgaria's annual submission in accordance with the aforementioned guidelines.

The enforcement branch applied the following consequences:

a) Bulgaria was declared to be in non-compliance;

b) Bulgaria was requested to develop a plan and report on the progress of its implementation;

c) Bulgaria's eligibility to participate in the mechanisms under Articles 6, 12 and 17 of the Kyoto Protocol was suspended in accordance with the relevant provisions under those Articles pending the resolution of the question of implementation.

The enforcement branch had confirmed that there were unresolved problems with respect to implementation of the general and specific functions set out in the guidelines for national systems. A further subsequent in-country review had been required to assess Bulgaria's national system in accordance with the guidelines for national systems.

During the period after the in-country review and after the notification of the country on the subject of the question of implementation the country has undertaken significant effort to improve the status of the National System. The recent resubmission of the National Communication reflects the national actions undertaken to reinstall the eligibility of the country.

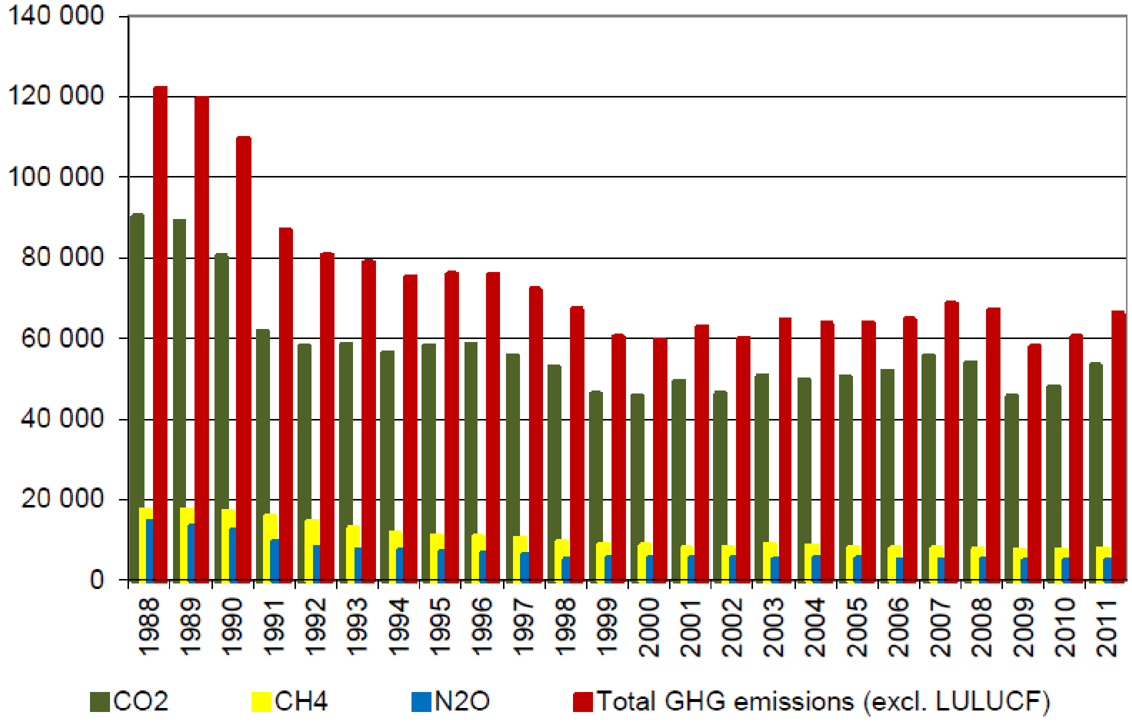
The conclusions and recommendations of ERT set out in the Report of the individual review of the 2010 annual submission of Bulgaria (FCCC/ARR/2010/BGR) indicate that all activities for improvements of institutional, legal and procedural arrangements within the National Inventory System as well as for improvement of quality of inventory were adequately planned and implemented by the Bulgarian government in 2010. *"The ERT concludes that the National system of Bulgaria is performing its required general and specific functions, as set out in the annex to decision 19/CMP.1 with respect to the institutional, legal and procedural arrangements to perform these functions; that the institutional, legal and procedural arrangements established and formalized by the "Ordinance on the way and order of organization of the national inventories of hazardous substances from greenhouse gases in the ambient air" (Ordinance No. 215) that entered into force on 21 September 2010 are fully operational; and that Bulgaria has in place the institutional arrangements and the capacity, including the arrangements for the technical competence of staff involved in the National system, to plan, prepare and manage inventories on an annual basis*". As a result from implemented activities for improvements "*No questions of implementation were identified by the ERT during the review*".

In accordance with Decision of Enforcement Branch CC-2010-1-17/Bulgaria/EB from 4 February 2011 Bulgaria is now fully eligible to participate in the mechanisms under Articles 6, 12, and 17 of the Kyoto Protocol.

The main greenhouse gases reported are as follows: Carbon dioxide - CO_2, Methane - CH_4, Nitrous oxide - N_2O, Hydrofluorocarbons – HFCs, Perfluorocarbons – PFCs and Sulphur hexafluoride - SF_6.

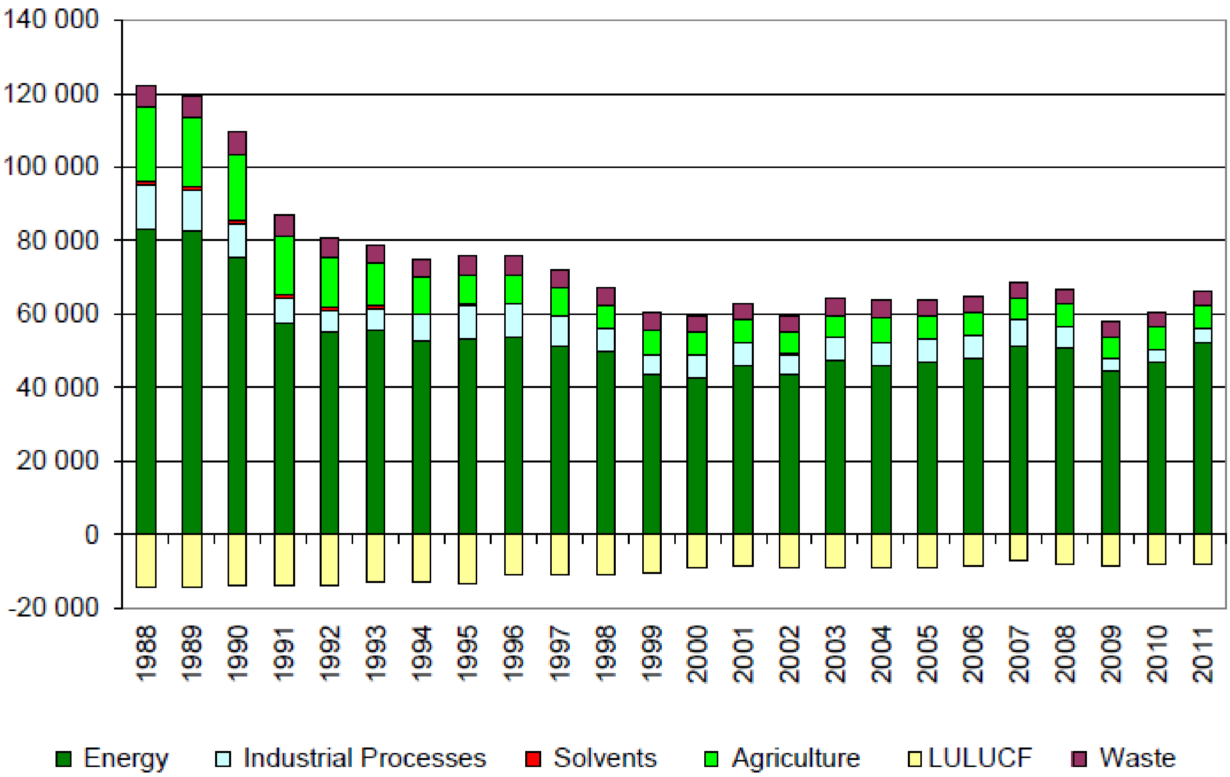
The change in the overall emissions for the period 1988–2008 is shown in Figure 1.3.

Figure 1.3 Total greenhouse gas emissions in CO2 eq. Gg



The aggregated GHG emissions trend for the period 1988 – 2011 by sectors in Bulgaria is shown on Figure 1.4 .

Figure 1.4 Aggregated GHG emissions by sector, Gg CO2 eq. for the period 1988-2011



Analysis shows the Energy sector, where GHG emissions come from fuel combustion, headed the list in 2011 with the biggest share – 79%. Sector Agriculture ranked the second place with 9% and sectors IP/Waste ranked the third place with 6%.

1.4. Policies and Measures

The Ministry of Environment and Water is responsible for the overall national environmental policy in Bulgaria including the climate change policy. It is responsible for applying the adopted legislation on national scale and developing new legislation. The environmental protection is a global issue and for this reason MOEW works in close cooperation with almost all other ministries. The following organizations support the climate change activities of MOEW: The Ministry of Economy and Energy (MEE), The Sustainable Energy Development Agency (SEDA), The Ministry of Agriculture and Food (MAF), The Ministry of Finance (MF), The Ministry of Regional Development (MRD), The Ministry of Education, Youth and Science (MES), The Ministry of Foreign Affairs, as well as the National Statistical Institute, the Bulgarian Academy of Sciences etc, which participate in the process of application, development and perfection of GHG mitigation measures, procedures and mechanisms. The coordination of climate change activities within interministerial working groups was accepted as a Good Practice and now the following are functioning: Joint Implementation Steering Committee (JISC) and Interministerial Working Group for Development of the National Allocation Plan (IWGNAP). In this way the efforts of all concerned Governmental Agencies, business and NGOs are united. Representatives of the public sector in the working groups are: Bulgarian Chamber of Commerce and branch organizations of the industrial branches that are covered by ETS – Bulgarian Association of the Cement Industry, Bulgarian Branch Chamber of the Energetic, Branch Chamber of the Pulp and Paper Industry, Branch Chamber of the Glass Industry, Branch Chamber of the Iron and Steel Industry, Branch Chamber of the Chemical Industry, Bulgarian Union of the Ceramics.

The Executive Environmental Agency (EEA) within MOEW performs monitoring of the implementation of climate change-related measures. The Agency is responsible for the preparation of the GHG inventories. It carries out the procedures on issuing the GHG emission permits – considers the operators' application forms and drafts the permits. EEA is the National Administrator of the National Registry for issuing, possession, transfer and cancellation of the GHG emission allowances.

Sustainable Energy Development Agency within MEE organizes the implementation of projects and measures in accordance with the national long- and short-term energy efficiency programs; approves projects for energy efficiency and controls their implementation; participates in the preparation of legal regulations in the field of energy efficiency: proposes development and improvement of energy efficiency standards in order to achieve approximation to the EU norms and to encourage energy efficiency at the demand side.

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

The main strategic documents of the country in the field of climate change are as follows:

- National Development Programme: "Bulgaria 2020";
- Energy Strategy of the Republic of Bulgaria until 2020;
- National Energy Efficiency Programme until 2015;
- National Energy Efficiency Action Plan (2011 – 2013)
- National Action Plan for Renewable Energy;
- National Programme for Promotion of the Biofuels Use in the Transport Sector 2008-2020**;**
- Strategy for Development of the Transport System of the Republic of Bulgaria until 2020;
- National Strategy for Development of the Forestry Sector in Bulgaria 2006-2015;
- National Strategy for Development of the Forestry Sector in Bulgaria 2013 – 2020;
- National Strategic Plan for Gradual Reduction of Biodegradable Waste Intended for Landfilling 2010-2020;
- Programme of measures for adaptation and mitigation of the negative climate change related effects on forests;
- Third National Climate Change Action Plan (2013-2020).

The Third National Action Plan on Climate Change provides specific measures for reduction of greenhouse gas emissions across all sectors and these measures are consistent with both the national policy on climate change and the potential of the national economy to reduce emissions. The overall effect of the measures will ensure the implementation of the commitments taken and the achievement of the legally binding European objectives.

NAPCC presents an assessment of the status and trends of greenhouse gas emissions in Bulgaria until 2009 in various sectors and the scenarios and projections of the emissions in these sectors by 2030 before and after the implementation of the measures.

The policies and measures planned to achieve the objectives of the country with regard to climate change are presented by sectors and represent the most significant and voluminous part of the Third Action Plan on Climate Change. The process of selection of specific measures in each sector includes consultations with the relevant government institutions, numerous consultations with stakeholders, businesses, NGOs and academic circles. The received comments and opinions on the proposed policies and measures have been taken into account. Thus transparency and coordination in preparing the Plan is ensured.

After specifying the policies and measures by sector, their feasibility was analyzed from economic point of view. The effective reduction of greenhouse gas emissions was assessed without need to reduce the production and the consumption on the basis of the baseline scenario for the economic development of the country by 2030.

NAPCC pays special attention to the administrative capacity necessary to implement the planned measures, as well as to the responsibilities for monitoring and reporting the implementation of the Plan. Besides the leading role of the competent institutions it underlines the specific role and functions of municipalities. A special feature of the activities on climate change is that they cover a large number of institutions and bodies both from the central and the local authorities because of their horizontal and cross-cutting nature.

The Energy Sector has the largest share in the total emissions of greenhouse gases in the country and that defines its paramount importance for the implementation of the national targets for reducing GHG emissions. The production of electricity and thermal energy from coal contributes for over 90% of the GHG emitted in the sector where the major potential for reduction of emissions is concentrated. The policies and measures in the Energy Sector provided in this Plan are based on those set out in the Energy Strategy of Bulgaria until 2020 and the National Action Plan for Renewable Energy. The implementation of the planned additional measures in this sector will lead to reduction of GHG emissions by 12.2% compared to the levels of the baseline scenario by 2020.

A particularly important sector with very high potential for emission reductions is the Waste Sector. The expected reductions after the implementation of the measures envisaged in the Plan are equivalent to 18.4% compared to the emissions in 2005. The sector is one of the major sources of GHGs in three main areas - emissions from waste landfills, wastewater treatment and waste incineration. The measures are focused mainly in the Waste Landfilling Subsector which has the largest share in the level of emissions. Many of the measures planned for this sector can be achieved by implementing the existing legislation without investments of very large financial resources which makes them highly effective.

The importance of taking steps in the Transport Sector is due to the fact that it is one of the largest emitters of GHGs with sustainable growth, but largely ignored until recently in terms of its impact on climate change. The most significant emitters of greenhouse gases are private cars, followed by the heavy-freight vehicles. In this regard, the main measures in the sector are aimed at achieving an optimal balance in the use of the potential of different types of transport. The implementation of the planned additional measures in the sector will lead to reduction of GHG emissions by 11.3% compared to those in the baseline scenario.

1.5. Projections and Total Effect of Policies and Measures

The most recent GHG projections were elaborated taking in consideration the trends of key macro-economic, technological, demographic and other indicators that determine the economic development of the country. The prognosis are developed based on the inventory reported in 2013.

Projections are based on the following documents, procedures and assumptions:

- Analysis of the emissions projections reported in the Third National Action Plan on Climate Change 2013 - 2020.
- Accounting for the actual GHG emissions and the underlying reasons for the trends (national and external factors).
- Sectoral plans for agriculture, forestry, industry and waste
- New rules and Directives after accession of Bulgaria to the EU
- Accounting for the influence of the world economic crisis 2008-2009 on the GHG emission forecasts.

As a result, two scenarios for GHG emission projections until 2030 were developed, analysed and compared:

- Scenario “with existing measures” - WEM
- Scenario “with additional measures” - WAM

The WEM scenario encompasses currently implemented and adopted policies and measures. It envisages a growth rate of electricity demand by 55% for the period 2005-2020. This scenario projects relevant measures in industry sector and residential and commercial/service sectors, while the rest of the sectors rely on already applied measures.

The key macroeconomic and energy characteristics of this scenario are provided in methodology section.

This projection integrates the assumption for increase in annual electricity export after 2006.

The Scenario with additional measures - WAM comprises planned policies and measures for GHG mitigation. While in the “with existing 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 and renewable. It is based on the same key macroeconomic characteristics.

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Table 1.1 Aggregate GHG emissions of Bulgaria - Gg CO2 eq. with both scenarios

1988	1995	2000	2005	2010	2015	2020	2030
with measures							
121 936	75 839	59 501	63 749	60 352	57 962	60 982	59580
with additional measures							
121 936	75 839	59 501	63 749.17	60 352	53 126	53 710	51 824

Table 1.2 Comparison between GHG emissions, aggregated for Bulgaria under the two scenarios

	2010	2015	2020	2030
Aggregate emissions in Gg CO2 eq. ΔWAM-WEM	**0**	-4 836	-7 273	-7 756

The total effect of the additional policies and measures that would be implemented within 2011 – 2015 is about 8.2 % emission reduction compared to the scenario WEM and 11.8% up to 2020 and 13.6 % up to 2030.

Only in case if a legally binding international agreement for the period beyond 2012 is approved and provided that other developed countries commit themselves to comparable emission reductions and developing countries contribute adequately according to their responsibilities and respective capabilities, and Bulgaria, as EU member state, will have to accept 30 % common EU reduction target for 2020, the country will need to implement additional measures.

Bulgaria as an Annex I Party of the UNFCCC and a country with economy in transition, accepts financial and technological support, mainly within the framework of the Joint Implementation (JI) mechanism, under Article 6 of the Kyoto Protocol. 28 projects have been approved in Bulgaria and 21 of them have already achieved and verified emission reductions. The execution of those projects leads to greenhouse gases emission reduction around 8 million tons carbon dioxide equivalent for the period 2008-2012.

1.6. Vulnerability Assessment, Climate Change Influence and Adaptation Measures

The observed warming of the climate in Bulgaria continued at the beginning of the 21st century. Climate in Bulgaria became not only warmer but also drier at the end of the 20th century (Figure 1.5). During the last decade however, precipitation totals have increased. Heavy rains caused severe floods damaging various socioeconomic sectors. Weather and climate extremes have increased during the last decades.

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

In the CLAVIER project, LMDZ-regional climate model was forced by the outputs of three global climate change scenarios from the models ECHAM-A1B, ECHAM-B1 and IPSL-A1B.

Significant summer warming in the western Balkan countries, were projected by the HadCM3 model for 2080. Air temperatures during this time of the year are expected to increase between 5º and 8ºC over most of the countries in the peninsula. Summer precipitation is projected to decrease in the region of interest. HadCM3 climate change scenarios were also created for every used weather stations from selected areas in Bulgaria.

Figure 1.5 Anomalies of annual temperature in Bulgaria during the period 1901-2010, relative to 1961-1990.

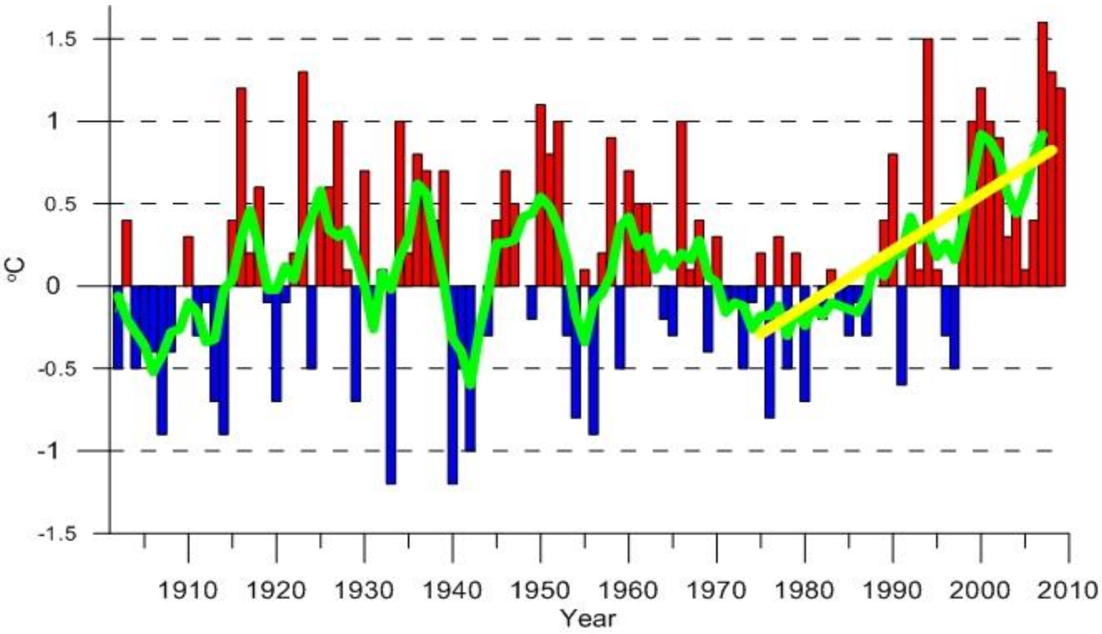
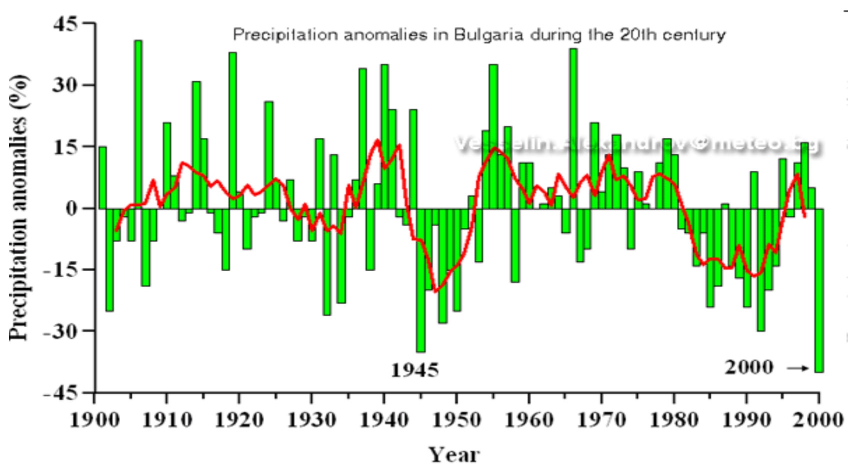


Figure 1.6 Anomalies of annual precipitation in Bulgaria during the 20th century



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

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

The climate change scenarios derived for Bulgaria were used to evaluate potential changes in forest vegetation.

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

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

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

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

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

1.7. Financial resources and transfer of technology, including information under Articles 10 and 11, of the Kyoto Protocol

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

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

In terms of technologies transfer, as a country in transition, Bulgaria has no obligations to support technology transfer, under Article 11 of the Kyoto Protocol, for countries out of Annex I of the Convention.

Article 10 of the Protocol

Until the in-country review in 2009 the country has not formulated programs to improve the quality of local emission factors, activity data and models which reflect national conditions. The country is more active in the field of development and implementation of national programs containing measures to mitigate climate change. In relation to the decision of the enforcement branch of the Compliance Committee to cease the eligibility of the country, specific inventory improvement programmes were developed and communicated to the enforcement branch.

1.8. Education, Training and Public Awareness

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

The role of the Government, media and communication channels in the raising of the public awareness are closely intertwined and hardly distinctive. What should be done in this area is:

- Issuing and distribution of brochures and other materials;
- Inclusion of climate change days in the national environmental campaigns;
- Information and education for the business for participation in the EU ETS;
- Distribution of adapted scientific findings and information on climate change;
- Popularization through their integrating in various specialized information flows;

- Regular actualization of the information about the current climate change policy at the MOEW web site.

Although they do not lead directly to measurable reductions in emissions NAPCC envisages measures in the field of education and science to promote targeting of R&D and educational activities on issues related to climate change.

The measures entail strengthening of this topic in the educational process (priority axis 1) and focus of research on its sectoral aspects (priority axis 2). 90 mln. BGN are foreseen for their implementation and the results thereof are to be considered in the long term and in the context of the flagship initiatives under the Strategy for Smart and Sustainable Growth “Europe 2020” related to promotion of innovations and transition to a more efficient use of resources and a low-carbon economy.

1.9. Research projects and systematic observation

The R&D system includes human resources and institutions. According to statistical data about 17 000 scientists are involved in research work most of whom are concentrated in public R&D organizations. Very few researchers (about 13% of their total number) are concentrated in business structures. For comparison, in some of the new EU countries this figure is over 30% and in others - over 60%. (Programme for Development of Education, Science and Youth Policies in the Republic of Bulgaria (2009-2013). In European countries the predominant share of people employed in research and development (R&D) works in the private sector and in the system of higher education. In Bulgaria almost 60% of the people engaged in R&D are in the public sector and paid from the budget, compared an average level of 13% in the EU (National Strategy for R&D Development 2020).

The aim of patenting and licensing activities is to provide links to practice and to encourage the search and implementation of new and/or updated products, technologies and services. The number of applications from European and world patent organizations is low, while the number of applications and patents granted to foreign organizations is higher than the number of national applicants. In Bulgaria there is no coordinated policy of activities concerning the relationship between science and innovation (Programme for Development of Education, Science and Youth Policies in the Republic of Bulgaria (2009-2013). The existing offices are inefficient and there is an insufficient number of transfer offices to provide a link with industry and to encourage the demand and implementation of new and/or updated products, technologies and services (Programme for Development of Education, Science and Youth Policies in the Republic of Bulgaria (2009-2013). Less than 10% of the active innovation companies have links with R&D organizations (National Strategy for R&D Development 2020). The different elements of the Bulgarian innovation system are not connected – the fundamental and sectoral studies develop separately.

The performance of Bulgaria, Latvia, Lithuania and Romania is well below that of the EU27 average in 2011. These countries are ‘Modest innovators’.

Bulgaria, Estonia, Romania, Portugal and Slovenia are the growth leaders with an average annual growth rate well above 5%. There continues to be a steady convergence, where less innovative Member States have – on average – been growing faster than the more innovative Member States.

Bulgaria is one of the modest innovators with a below average performance - 4,4% growth rate and defined as "Growth leader" in the "Modest innovators" group.

Infrastructural capacity

According to data provided by Ministry of Education regarding the financing of the purchased scientific equipment for the period 2005-2008 there is no funding for the infrastructure in the field of energy sources. A single purchase of expensive equipment without ensuring the necessary conditions for conducting research and an available long-term scientific program leads to its inefficient use and therefore to increase in the cost of the services for the business. This leads to a paradox in some cases where Bulgaria disposes of unique scientific equipment, but research organizations and companies send samples for research in other EU Member States due to lower prices.

A National Roadmap for R&D Infrastructure, developed by MEYS was approved in September 2010 by decision of the Council of Ministers. The map covers major scientific centres serving specific economic and social needs of the country, the region of South-eastern Europe and Pan-European infrastructures in which Bulgaria will participate. The main priority of the scientific infrastructure is in the field of energy, marine research, new materials for various applications, information and communication technologies, social studies. (National Strategy for R&D Development 2020).

Financial capacity

Since 2006 the total expenditure on R&D in Bulgaria is about 0.45% of the GDP without a significant upward trend. The structure of R&D financing is inversely proportional to that in EU countries. The largest percentage is paid from the state budget – more than 2/3, and 1/3 – by the business. This ratio has remained steady over the past 10 years.

The Research and Development Fund is a national instrument supporting research projects on competitive basis. Another instrument is the National Innovation Fund that finances applied scientific research projects and technical and economic projects that introduce new products, processes and services or improve existing ones. These two national funds are potential sources of financing also for the measures proposed under this action plan.

With regard to international scientific programs, Bulgaria is presented in the Seventh Framework Programme and the Programme COST. The country is represented also in the programme Intelligent Energy for Europe which includes the extension of the programmes SAVE - energy efficiency and ALTENER - renewable energy. The revenues from international scientific programs are currently allocated as follows: 40% for the business, 35% for universities and about 25% for BAS and the Agricultural Academy.

Main fields of scientific research

For the purposes of the National Action Plan a study and research was conducted on the main topics covered by the Bulgarian educational and scientific institutions, the NGOs and the other organizations.

The main fields of research and educational activities are:

• Meteorology, climatology and hydrology

These activities study the basic climate elements (air temperature, precipitation, atmospheric circulation) in Bulgaria and more specifically in its mountainous areas which are particularly sensitive to climate change.

The studies focus also on the climatic changes in the geological history of Earth in order to assess the effects of astronomical factors, earth's internal forces and environmental factors on climate formation. The analysis of time series and extreme events is improved and models are created of nonlinear systems, including climatic systems. The wind-solar renewable energy sources are studied with a view to establishing the wind and the solar energy potential on the territory of the country in meso- and macro-climatic aspects. The methods of monitoring climatic elements are automated.

- Air pollution

A single methodology for inventory of emissions of harmful substances was developed. Different scale models of atmospheric components were made in order to assess the quality of air environment and the origin/transportation of pollution on a large and on a small scale. A methodology was developed for calculating emissions and sinks of greenhouse gases from the plant cover. Research is conducted on the optimization of waste management in order to reduce greenhouse gases. Ground, oceanographic and space systems for monitoring of various objects in the environment, including in the air environment, are being improved.

- Technologies

Mathematical and computer models are created of the transportation of air pollutants and tested with model and real meteorological and emission data on the first Bulgarian supercomputer IBM Blue Gene/P. The possibilities and the costs of implementing Directive 97/68/EC on emissions of gaseous and particulate pollutants from non-road mobile machinery are studied. Materials, technologies and devices for efficient transformation of solar energy in two main areas - photovoltaic and photothermal – are developed and tested. Technologies involving the use of biomass and hydrogen raw materials as renewable energy sources are investigated. Unmanned flying systems for monitoring and GIS-interpretation of meteorological are introduced that determine the pollution of air. Energy saving and water saving technologies for production of good agricultural produce are being developed.

- Forests, Forestry and Agriculture; Land Use

Good agricultural practices leading to minimization of greenhouse gas emissions are being developed. The role of underground plant biomass in the annual fixation of CO2 by forest ecosystems is studied. The bio- and the energy potential of non-traditional plant species is examined. The applicability of the principles of forest management as a means of entering the carbon market is investigated; the amount of carbon dioxide presently stored in forest ecosystems in some areas is being estimated.

- Territorial structure

  – The Climate Friendly Cities Project aims to assist the development of a spatial structure of cities that is favourable for the climate through planning and zoning.

  – An index of regional "climate security" was established under the Regions for Sustainable Change Project based on data of greenhouse gas emissions, energy data, policy framework, institutional capacity, socio-political situation, financial instruments The index is adjusted to Bulgaria and applied to the monitoring system of regional development plans.

- Transport

The Green Corridor Development Programme ensures the development of pedestrian and bicycle routes both for tourism and transport. An online tool is currently being developed for planning a bicycle journey in Sofia as a measure to reduce the emissions in the city. The project "One Planet Mobility" aims to reduce CO2 emissions from transport under which several computer models were developed to project the reduction of emissions from transport in Sofia.

On 28 July 2011, the Bulgarian Parliament adopted the National Strategy for Research and Development 2020. At national level, the Strategy provides scientific organisations, universities and the academic research community with a research development framework with a set of priorities for the development of science in Bulgaria. These include:

- Energy, energy efficiency and transportation
- Development of green and eco-technologies
- Health and quality of life, biotechnology and organic food
- New materials and technologies, cultural and historical heritage
- Information and communication technologies.

Over the past 10 years there has been a trend of increased scientific interest in climate change: global, regional and national scale. The topic of climate change includes a number of scientific aspects. The Bulgarian Academy of Sciences BAS works in different directions: fluctuations and climate change, vulnerability assessment and adaptation of individual sectors (e.g. water resources, agriculture, forests, etc.) under climate change, solar-terrestrial influences and more. On the topic of climate change in more than 10 units of the Bulgarian Academy of

Sciences, work but the major one is the National Institute of Meteorology and Hydrology.

The Bulgarian Academy of Sciences (BAS) carries out research and other activities on climate change. Work is going on not only on planned tasks with national financing but also in cooperation with research organizations from EU member countries within the Sixth and Seventh Framework Programme.

Comprehending the significance of this problem, BAS established a National Coordination Centre for Global Change. The Scientific Coordination Centre for Global Change of the Bulgarian Academy of Sciences (SCCGC-BAS) is a voluntary association of representatives of academic research and development institutes and units, universities and higher educational establishments, institutions, agencies, organizations, companies and other entities in Bulgaria which organizes and conducts activities related to global change in environment, as well as to the economic, political, social and spiritual aspects of global change on society

The SCCGC-BAS is a consultative/advisory body of the Steering Committee of the Bulgarian Academy of Sciences on global change in Bulgaria. The SCCGC-BAS is a centre for coordination of research and scientific-methodological activities under the implementation of national and international projects and contracts in the field of global change.

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

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

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

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

An important and irrevocable part of the activities of The Geophysical Institute (GPhI) “Acad. L. Krastanov” is the unique for our country scientific and operative activity, concerning registration, processing, analysis and interpretation of the seismicity, geomagnetic field, the status of the ionosphere and UV radiation level above the country and surrounding lands. The unique for the country international geomagnetic standard with absolute and comparative geomagnetic measurements is maintained in Geomagnetic Observatory “Panagyurishte”. The parameters of the Earth’s Magnetic Field are registered daily and maps of variations of the elements are drawn. Main users of the collected information are Military Geographic service of the MA, Cadaster Agency at the Ministry of Regional Development of Bulgaria and all organizations working in the area of underground resources research with geomagnetic methods. Geomagnetic field data are used for navigation and radio-connections services as well.

The Institute of Oceanology, every year carries out complex seasonal expeditions studying physical, chemical and biological parameters of sea water and bed at the western part of Black Sea. Weather observations are done at every location of interest: air temperature, sea level pressure, wind speed and direction. The institute is currently trying to recover and improve some oceanographic systems for observations such as VOS (Volunteer Observing Ship) and TIDE GAUGES as well as to include them within international programmers.

The Bulgarian Institute for Space Research is participating in space-based observing programmes by development and execution of national and international space programmes as well as development of complex research tools.

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

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

Table 1.3 Government budget appropriations or outlays on R&D by socioeconomic objective

	2008		2009		2010		2011		2012	
	BGN x 1000	%	BGN x 1000	%	Thousand BGN	%	Thousand BGN	%	Thousand BGN	%
Exploration and exploitation of the earth	20385	9.6	2482	1.1	14751	7.6	12949	6.9	13619	6.9
Environment	1664	0.8	3355	1.4	9099	4.7	5600	3.0	4860	2.5
Exploration and exploitation of space	3966	1.9	836	0,4	1119	0.6	2947	1.6	3061	1.5
Transport, telecommunication and other infrastructures	2140	1.0	7118	3.1	1059	0.5	460	0.2	3824	1.9
Energy	19596	9.2	4985	2.2	400	0.2	1502	0.8	273	0.1
Industrial production and technology	22835	10.8	6462	2.8	17857	9,2	18358	9.7	21855	11.1
Health	899	0.4	5091	2.2	1289	0.7	2656	1.4	5820	2.9
Agriculture	48825	23,0	45005	19.5	27124	13.9	28842	15.3	32532	16.4
Education	4504	2.1	10947	4.8	23628	12.1	22531	12.0	15632	7.9
Culture, recreation, religion and mass media	293	0.1	816	0.3	1364	0.7	2365	1.2	2136	1.1
Political and social systems, structures and processes	5161	2.4	1734	0.8	1238	0.6	920	0.5	1130	0.6
General advancement of knowledge: R&D financed from General University Funds (GUF)	8912	4.2	23147	10.0	20581	10.5	19669	10.4	16291	8.2
General advancement of knowledge: R&D financed from other sources	72359	34.0	117130	50.8	69454	35.6	65381	34.7	73503	37.2
Defence	950	0.5	1329	0.6	6055	3.1	4400	2.3	3281	1.7

2. National circumstances relevant to greenhouse gas emissions and removals

2.1. Government Structure

The government type in Republic of Bulgaria is a parliamentary democracy. The Bulgarian unicameral parliament - the National Assembly consists of 240 deputies who are elected for 4-year-terms by popular vote. The Head of state is the President (Rosen Plevneliev since January 2012) directly elected for a 5-year term with the right to one re-election. Executive power is exercised by the government. Legislative power is vested in both the government and the National Assembly. The Judiciary is independent of the executive and the legislature.

The Council of Ministers is the principal organ of the executive branch, being chaired by the Prime Minister (Plamen Oresharski since 2013), The the central administration consists of 15 ministries. The main competencies and responsibilities related to climate change lie in the Ministry of Environment and Water. The Executive Environment Agency is responsible for the National inventories of GHG emissions, for monitoring, reporting and verification and for GHG permit issuance.

Given the horizontal nature of the climate change policy, the principle of integrating the climate considerations in key sectoral policies such as energy, households and services, industry, transport, agriculture, forestry and waste management is applied. Taking into account the close interaction of the policies in these areas with the strategic planning related to climate change, the government aims at an active involvement and commitment of all institutions responsible for carrying out the relevant policies.

2.2. Geographic Profile

The Republic of Bulgaria is situated on the Eastern Balkan Peninsula in South-eastern Europe, along the Black Sea. With a territory of 111 001.9 square kilometres[1], Bulgaria is Europe's 14th-largest country. The neighbour states are Greece and Turkey to the South, FY Republic of Macedonia and Yugoslavia to the West. The River Danube separates it from Romania to the North. Its natural eastern border is the Black Sea. 60% of the total area is covered with hills and mountains with lowlands in north and southeast. The mountains are part of the Alpine-Himalayan mountain chain situated on two continents - Europe and Asia, 33% of the country's territory is covered with forests (nonconiferous and coniferous). The varied environment is a natural habitat for valuable animal species.

The most notable topographical features are the Danubian Plain, the Balkan Mountains, the Thracian Plain, and the Rhodope Mountains. The southern edge of the Danubian Plain slopes upward into the foothills of the Balkans, while the Danube defines the border with Romania. The Thracian Plain is roughly triangular, beginning southeast of Sofia and broadening as it reaches the Black Sea coast.

[1] National Statistical Institute, Statistical Reference Book 2013.

The Balkan mountains run laterally through the middle of the country. The mountainous southwest of the country has two alpine ranges—Rila and Pirin, which border the lower but more extensive Rhodope Mountains to the east. Bulgaria is home to the highest point of the Balkan Peninsula, Musala, at 2,925 metres and its lowest point is sea level. Plains occupy about one-third of the territory, while plateaus and hills occupy 41 per cent. The country has a dense network of about 540 rivers, most of which are relatively small and with low water levels. The longest river located solely in Bulgarian territory, the Iskar, has a length of 368 kilometres. Other major rivers include the Struma and the Maritsa in the south.

The Danube river 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 m^3, and 23 dams with total area of 376 km² and water volume of 4,571 mln m^3. Bulgaria has three National Parks – Pirin, Rila and Central Balkan. They have a total area of 193,049 hectares and comprise more than one-third of all protected areas in Bulgaria. The National Parks belong to the state. They are managed and administered by Directorates, operating under the Ministry of Environment and Waters. The Bulgarian National Parks offer excellent opportunities for tourism, scientific research and education.

2.3. Climate Profile

The climate of Bulgaria is temperate continental with a transition towards a subtropical climate in its Mediterranean version (in the southern parts of the country), with four seasons. 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 average annual temperature for the period 1988-2011 ranges between 10.6 and 13.0^{o}C, The Black Sea coast features a milder winter as opposed to the harsher winter conditions in the central north plains. The air humidity is between 66 and 85 % in the different regions of the country. There is a stable snow cover during the winter of about 20-200 cm. The average wind speed is 1.2 m/s (1.3 m/s in winter time), while prevailing winds are west or northeast.

In the last few years the tendency is towards warmer and drier climate. 1998 had warm and dry winter, hot dry summer, cool dry spring, and cold and very rainy fall. The average precipitation in Bulgaria for the period 1988-2011 ranges between 377 and 924 millimetres per year. Dobruja in the northeast, the Black Sea coastal area, and parts of the Thracian Plain usually receive less than 500 millimetres. The remainder of the Thracian Plain and the Danubian Plateau get less than the country average; the Thracian Plain is often subject to summer droughts. Higher elevations, which receive the most rainfall in the country, may average over 2,540 millimetres per year.

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

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

The Balkan Mountains are the southern boundary of the area in which continental air masses circulate freely. The Rhodope Mountains mark the northern limits of domination by Mediterranean weather systems. The area between, which includes the Thracian Plain, is influenced by a combination of the two systems, with the continental predominating. This combination produces a plains climate resembling that of the Corn Belt in the United States, with long summers and high humidity. The climate in this region is generally more severe than that of other parts of Europe in the same latitude. Because it is a transitional area, average temperatures and precipitation are erratic and may vary widely from year to year.

The many valley basins scattered through the uplands have temperature inversions resulting in stagnant air. The coastal climate is moderated by the Black Sea, but strong winds and violent local storms are frequent during the winter. Winters along the Danube River are bitterly cold, while sheltered valleys opening to the south along the Greek and Turkish borders may be as mild as areas along the Mediterranean or Aegean coasts.

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 2500 on average annual basis.

There has been a tendency towards warming up in Bulgaria since the late 1970s, the winters were milder in the second half of the 20th century.

- 20 of the last 23 years since 1989 have positive anomalies of the average annual air temperature compared to the climate standard (1961–1990);
- The average annual temperature in 2011 was by 0,4°C higher than the climate standard. This is 14th year in a row with temperatures higher than typical temperatures for the country;
- The longest periods of drought occurred in 1940s and during the last two decades of the 20th century, while the most significant droughts - in 1945 and in 2000;
- There are more and longer periods of drought followed by severe storms and heavy floods incurring damage and casualties;
- Increased frequency of extreme weather and climate phenomena such as:
    - Significant increase in the average number of days with overnight volume of precipitation above 100 mm – by about 30% for the period 1991-2007 compared to the baseline period (1961-1990); increased

number of cases with heavy rainfall registered in the meteorological network; more frequent cases of cloudiness typical for spring and summer with rainfalls, thunderstorms and hailstorms during winter months like January and February; higher frequency of the average number of days with thunderstorms and hailstorms in April and September in the period 1991-2006 compared to the baseline period.

  - The annual amplitude between the maximum and the minimum air temperature decreases – the minimum temperature rises faster than the maximum.
  - The snowy months in the mountains decrease and the thickness of the snow cover shows a steady trend towards thinning.

- The upper forest limit of deciduous forests shifted to higher elevations;
- Data from the phenological observations indicate advanced development by 7-15 days in different climatic regions, which represents clear evidence of the warming up process over the past 30 years compared to previous periods.

SCENARIOS FOR BULGARIA

Source: NIMH, BAS

Most climate models simulate an increase in air temperature in Bulgaria from 2 to 5°C by the end of the century (the scenarios vary according to model simulations used). Winters classified as cold under the current climate will occur less often in the 2020s and will probably disappear by 2080s. In contrast, hot summers will occur more often and almost every summer is expected to be unusually hot in the 2080s. According to most climate scenarios winter precipitation will increase in Bulgaria by the end of this century but rainfall during the warm half of the year and especially during the summer is expected to decrease.

The results from the studies of water resources in Bulgaria, based on current trends of air temperature and precipitation as well as on simulation models and climate scenarios show that the annual river runoff is likely to decrease during this century. The main reasons for this - the observed trends of warming and rainfall deficit - are expected to persist over the coming decades as well.

The expected global warming will be accompanied by an increase in the frequency of the hot air waves combined with increased humidity and urban air pollution. The result will probably lead to a large number of heat strokes.

Besides the risk of further limitation of water resources, more forest fires, landslides and floods, the global warming means also a possible outbreak of infectious diseases (including diseases, such as malaria, that are not typical for our latitudes).

Since approximately 61% of forests in Bulgaria are in the zone below 800 m altitude, the majority of Bulgarian forests would be affected by drastic climate changes. Increasingly vulnerable in the future will be the spring crops sown on infertile soils and the arable land in south-eastern Bulgaria where the precipitations even under the current climate conditions are insufficient to ensure normal growth, development and yield of crops.

2.4. Population Profile

As of 1 February 2011 the population of Bulgaria is 7 364 570 persons. The population density is 65.7 per sq km. During the period between the last two Censuses 2001-2011 the population in the country decreased by 7.1% due to the negative natural growth rate and due to international migration. The natural growth rate is negative for all years in the period between the two Censuses. The tendency of increasing relative share of urban population and decreasing relative share of rural population is kept. 72.5% live in urban areas and 27.5% live in rural areas .

The severe demographic decline is explained with low birth rates, high mortality rates and significant emigration. Bulgaria's age structure has changed radically. Its median age increased from 30 in 1960 to 42 in 2012, the third-highest median age in the EU.

Table 2.1 Population profile

Social indicators	Period	
Population growth rate (average annual %)	2010-2015	-0.7
Urban population growth rate (average annual %)	2010-2015	0.1
Rural population growth rate (average annual %)	2010-2015	-2.8
Urban population (%)	2012	73.7
Population aged 0-14 years (%)	2012	14.1
Population aged 60+ years (females and males, % of total)	2012	28.1/21.6
Sex ratio (males per 100 females)	2012	93.4
Life expectancy at birth (females and males, years)	2010-2015	77.1/70.3
International migrant stock (000 and % of total population)	mid-2010	107.2/1.4
Refugees and others of concern to UNHCR	end-2011	7 072

2.5. Economic Profile

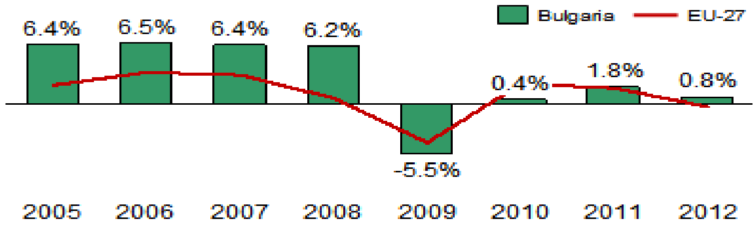
Bulgaria has an emerging market economy in the upper middle income range where the private sector accounts for more than 80 per cent of GDP. From a largely agricultural country with a predominantly rural population in 1948, by the 1980s Bulgaria had transformed into an industrial economy with scientific and technological research at the top of its budgetary expenditure priorities. The loss of COMECON markets in 1990 and the subsequent "shock therapy" of the planned system caused a steep decline in industrial and agricultural production, ultimately followed by an economic collapse in 1997.[The economy largely recovered during a period of rapid growth several years later, but individual mean income remains one of the lowest in the EU at 768 leva (393 euro) per month. More than a fifth of the labour force are employed on a minimum wage of 1 euro per hour. Wages, however, account for only half of the total household income, owing to the substantial informal economy which amounts to almost 32% of GDP. Bulgarian PPS GDP per capita stood at 47 per cent of the EU average in 2012 according to Eurostat data, while the cost of living was 49 per cent of the average. The currency is the lev (BGN), which is pegged to the Euro at a rate of 1.95 leva for one euro. Bulgaria is not part of the Eurozone and has abandoned its plans to adopt the euro.

Economic indicators have worsened amid the late-2000s financial crisis. After several consecutive years of high growth, GDP contracted with 5.5 per cent in 2009 and unemployment remains above 12 per cent. Industrial output declined with 10 per cent, mining with 31 per cent, and ferrous and metal production marked a 60 per cent drop. Positive growth was restored in 2010, although investments and consumption continue to decline steadily due to rising unemployment. The same year, intercompany debt exceeded 51 billion euro, meaning that 60 per cent of all Bulgarian companies were mutually indebted. By 2012, it had increased to 83 billion euro, or 227 per cent of GDP. The government implemented strict austerity measures with IMF and EU encouragement to some positive fiscal results, but the social consequences of these measures have been serious. Economic activities are fostered by the lowest personal and corporate income tax rates in the EU and the second-lowest public debt of all member states at 16.5 per cent of GDP in 2012. In 2012, GDP (PPP) was estimated at $104 billion, with a per capita value of $14,235. Sofia and the surrounding Yugozapaden planning area are the most developed region of the country with a per capita PPS GDP of $23,162 in 2009. Bulgaria is a net receiver of funds from the EU. The absolute amount of received funds was 589 million euro in 2009.

The labour force is 2.45 million people, of whom 7.1 per cent are employed in agriculture, 35.2 per cent are employed in industry and 57.7 per cent are employed in the services sector. Extraction of metals and minerals, production of chemicals, machinery and vehicle components, petroleum refinement and steel are among the major industrial activities. Mining and its related industries employ a total of 120,000 people and generate about five per cent of the country's GDP. Bulgaria is Europe's sixth-largest coal producer. Local deposits of coal, iron, copper and lead are vital for the manufacturing and energy sectors. Almost all top export items of Bulgaria are industrial commodities such as oil products, copper products and pharmaceuticals. Bulgaria is also a net exporter of agricultural and food products, of which two-thirds go to OECD countries. It is the largest global producer of perfumery essential oils such as lavender and rose oil. Agriculture has declined significantly in the past two decades. Production in 2008 amounted to only 66 per cent of that between 1999 and 2001, while cereal and vegetable yields have dropped by nearly 40 per cent since 1990. Of the services sector, tourism is the most significant contributor to economic growth. In recent years, Bulgaria has emerged as a travelling destination with its inexpensive resorts and beaches outside the reach of the tourist industry. Lonely Planet ranked it among its top 10 destinations for 2011. Most of the visitors are British, Romanian, German and Russian. The capital Sofia, the medieval capital Veliko Tarnovo, coastal resorts Golden Sands and Sunny Beach and winter resorts Bansko, Pamporovo and Borovets are some of the locations most visited by tourists.

After three consecutive years (2006–2008) of high economic growth of over 6% per annum, in 2009 GDP fell by 5.5%. The most affected sectors by the crisis were agriculture, industry and commerce, where gross added value decreased by 9.5%, 8.2% and 8.0% respectively. Attempts to revive the Bulgarian economy in the next two years showed little success. In 2010, a slight growth of 0.4% was accompanied by a collapse in the construction sector of minus 17.9% GVA and a continuing decline in industry and agriculture GVA. Lately there have been signs of recovery in industry GVA but generally all other sectors were in stagnation. In 2012 there was a GDP growth (0.8%) for the first time after the crisis.

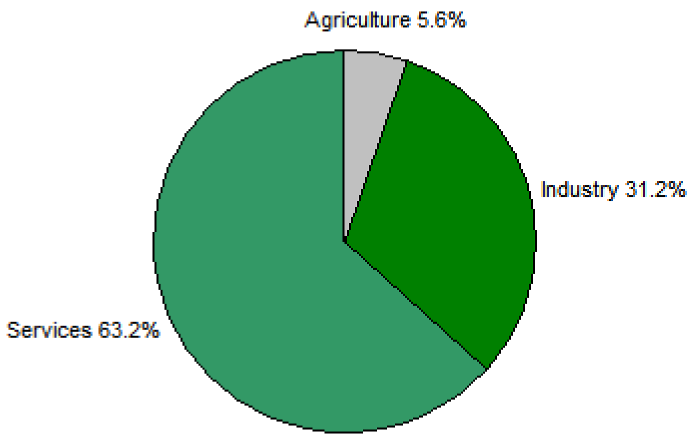
Figure 2.1 GDP Growth – Bulgaria



Source: Bulgarian National Bank

Economic growth over the past two years was entirely due to an increase in exports, while domestic consumption, which fell by 7.3% in 2009, remains at a low level. Investment activity is steadily declining. Gross capital creation for three consecutive years showed considerable slumps – minus 17.6% in 2009, minus 18.3% in 2010 and minus 9.7 % in 2011.

Figure 2.2 GDP Breakdown (2012)



Source: Bulgarian National Statistical Institute

This model of economic growth appears to offer little prospect for the country. Without an increase in domestic demand (consumer and investment), attempts to recover appear unlikely to succeed. From an income distribution perspective, labour compensation in the last three years is only 37–38% of GDP, one of the lowest levels in the EU. This points to low levels of labour participation in product distribution.

Increasing exports over the past two years have substantially improved the trade balance to render a positive position. According to the Consolidated Fiscal

Programme, the 2010 budget deficit amounted to BGN 2,822.8 million, representing 4% of GDP. Over 90% of the deficit was covered by domestic financing.

Inflation is influenced by three factors – international energy prices, state regulation of prices and a fall in domestic consumption. The average consumer price index in 2010 fell to 102.4, but increased the following year under the effect of continuous rise in energy prices.

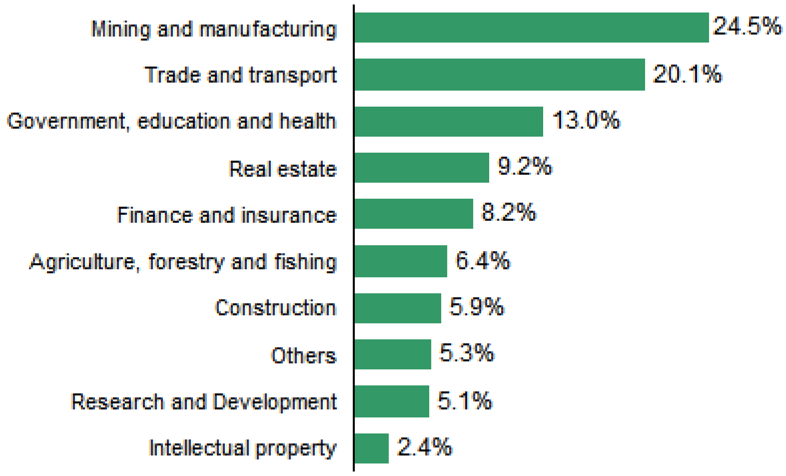
Employment continues to decline, with the biggest job losses in manufacturing and construction. More than 400,000 jobs were lost in three years, of which 180,000 were in manufacturing and 120,000 in construction. Unemployment characteristics worsened with rises in youth and long-term unemployment. Youth unemployment increased to 30% from 12% in 2011.

The population at risk of poverty and social exclusion in 2010 was 41.6%, with monetary poverty at a level of 20.7% (the highest reported by Eurostat for the EU27).

Table 2.2 Statistical information

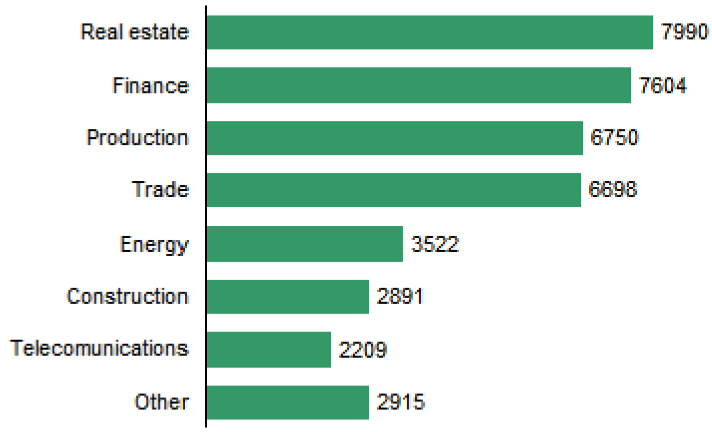
Industrial production index (2005=100)	2011	103
	2010	98
	2005	100
Agricultural production index (2004-2006=100)	2011	104
	2010	105
	2005	91
Food production index (2004-2006=100)	2011	105
	2010	106
	2005	91
Unemployment (% of labour force)	2011	11.2
	2010	10.2
	2005	10.1
Employment in industrial sector (% of employed)	2011	... European Labour Force Survey (Eurostat)
	2010	33.3 European Labour Force Survey (Eurostat)
	2005	34.2 European Labour Force Survey (Eurostat)
Employment in agricultural sector (% of employed) The indices are shown in terms of ISIC Rev. 3.	2011	... European Labour Force Survey (Eurostat)
	2010	6.8 European Labour Force Survey (Eurostat)
	2005	8.9 European Labour Force Survey (Eurostat)
Labour force participation, adult female pop. (%)	2011	48.6
	2010	48.5
	2005	44.9
Labour force participation, adult male pop. (%)	2011	60.3
	2010	60.0
	2005	56.5
Tourist arrivals at national borders (x 1000)	2011	6328
	2010	6047
	2005	4837

Figure 2.3 GDP breakdown by main subsectors, 2012 (%)



Source: Bulgarian National Statistical Institute

Figure 2.4 *Foreign direct investment* (*FDI*) flows by industry, 1996-2012 (€ mln)



Source: Bulgarian National Bank

Table 2.3 Macroeconomic parameters

		2005	2006	2007	2008	2009	2010	2011
Population	Mln.	7.72	7.68	7.64	7.61	7.56	7.5	7.33
GDP, real growth	% per year	6.4	6.5	6.4	6.2	-5.5	0.4	0.8
Real GDP per capita (PPP)*	EC=100	37	38	40	43	44	44	46
Export	EUR million	9 467	12 012	13 512	15 204	11 699	15 561	20 265
Import	EUR million	14 663	18 480	21 862	25 095	16 876	19 245	23 407
Average annual inflation	%	5.0	7.3	8.4	12.3	2.8	2.4	4.2
Exchange rate**	BGN/EUR	1.9558	1.9558	1.9558	1.9558	1.9558	1.9558	1.9558

Source: NSI, BNB

* Operating currency board and fixed exchange rate of BGN against the Euro

2.6. Sectors

The importance of the private sector in Bulgaria's GDP increases in the last few years. In relative structural terms, in regard to the private sector, the sector Services has the biggest importance. Just after it is rank the Industry sector, Table 2.4.

Table 2.4 Relative share of the private sector in GDP (%)

YEAR	1990	1995	2000	2001	2002
Private sector (total)	9,1	44,7	61,6	63,4	64,3
Agriculture and forestry	6	10,4	12,1	11,7	10,6
Industry	1,9	9,2	18	18,7	18,9
Services	1,2	25,1	31,5	33	34,8
YEAR	**2003**	**2004**	**2005**	**2006**	**2007**
Private sector (total)	64,5	66,9	68,2	64,3	64,5
Agriculture and forestry	9,9	9,2	7,8	12,1	11,4
Industry	20,2	20,9	22,2	29,1	29,7
Services	34,4	36,8	38,2	58,8	58,6
YEAR	**2008**	**2009**	**2010**	**2011**	**2012**
Private sector (total)	84,5	86,5	86,6	85,0	84,9
Agriculture and forestry	5,7	5,5	5,7	5,4	5,4
Industry	26,5	26,4	25,4	25,7	25,5
Services	52,3	54,6	55,6	53,9	54,0

Source: NSI

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

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

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

2.6.1. Land Use and National Resources

2.6.1.1. Land use

Common information on the Land Use in Bulgaria is shown on Table 2.5.

Table 2.5 Land use in Bulgaria – general information in ha, 2011

Utilised Agricultural Area	5 087 948
Arable land	3 227 237
Permanent pastures	1 678 308
Forests and woodland	4 148 114
Irrigated land	43

Source: Agricultural report for 2012 of the MAF

Land for agricultural purposes in 2011 was 5 486 572 ha, accounting for approximately 50% of the territory of the country.

Utilised Agricultural Area is composed of arable land, perennial crops, permanent grasslands, family gardens and greenhouse areas. In 2011 it was 5 087 948 or 45.8% of the territory of the country.

The UAA increased by 0.7% compared to the previous year.

Arable lands are lands included in crop-rotation, temporary meadows occupied by cereals and leguminous plants and fallow land. In 2011 the arable land increased by 2% compared to the previous year, occupying 3 227 237 ha or 63.4% of the Utilised Agricultural Area. This growth is mainly due to the expanded area growing wheat, maize, sunflower and industrial oil seed crops.

2.6.1.2. Mineral resources

In North Bulgaria, in the Moesian platform, which is build up mostly of sedimentary rocks, sedimentogenetic and hemogenetic resources prevail. Now there are deposits of oil, salt, gypsum, phosphorite, manganese ore; limestone and marlstones for the cement industry; sand and pebbles for building purposes; diverse clays for making bricks; sand for the glass industry are produced.

The Balkanids' zone is the most diverse one regarding the lithology and the natural resources. In the West Balkanids different types of ores (including polymetallic ores, gold, silver, copper, molybdenum, a little uranium, etc) are produced. From non-metal resources, different rock types and sands are important. They comprise mostly of limestone with beautiful texture, some of them build up of shells, other with higher density and differently coloured – from black, to white and with hues of yellow and gray. Despite of the tectonic reprocess they are eligible for big blocks to be gained at relatively low cost. In that zone, some intrusive rocks are produced (granites with rapakivi texture and reddish hue, marble breccias and differently colored, mostly Triassic, sands). In the region, there are many modern equipped factories for processing that rocks.

In the Central part of the Balkanids mostly copper and copper-gold ore is produced which is relatively poor in metal content, but its low price makes it valuable for many foreign mining companies.

Of great importance for Bulgaria are the mines for black and brown coals in the Central Balkan. The biggest open basin in the Balkan Peninsula for lignit coal is situated in the East Srednogorie.

The Rhodope tectonic zone is rich of ores: polymetallic ore, lead-zinc ore, gold and silver. Of great importance are the non-ore resources: marble, gneisses, schists and tuffs with Paleogene age. There are some big findings of travertine that are processed. Findings of zeolite and benthonite clay are basic for a whole branch of Bulgarian industry – making filters for water and for the brewer industry.

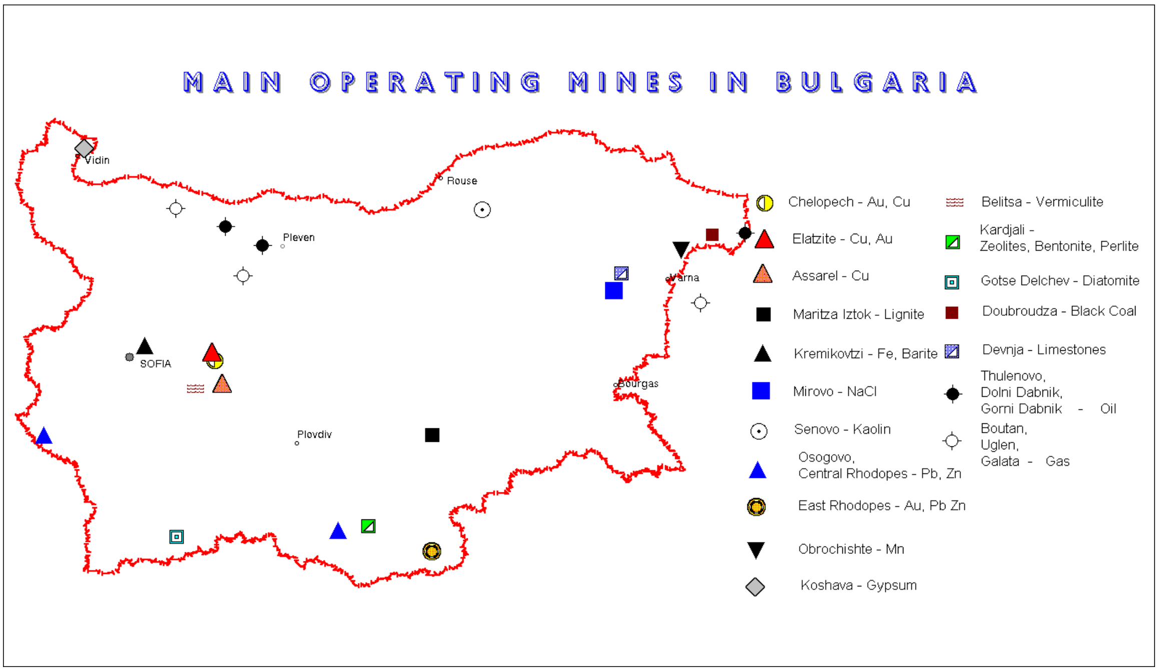
The Sakar-Stranja zone is relatively weak studied. In the most Eastern part Burgas' mines are operating. Important for the region is the Elhovo's finding of brown coal. From non-ore resources important are some marbles with pink/gray hue and some types of granites.

The abundance of mineral springs is a Bulgaria's asset. Everyone of them has its' characteristics, but the water is, in general, appropriate for drinking and competitive to other world's distinguished waters.

2.6.1.3. Mineral Exploitation

In the recent years in period of transition from state planned economy to market economy a lot of mines have been closed. The mines still in operation were privatized with exception of coal mines. The only one oil and gas production company in Bulgaria is also state owned. The main operating mines in Bulgaria are shown on Figure 2.5 and described below:

Figure 2.5 Operating mines in Bulgaria



2.6.2. Agriculture

Agriculture sustains a major part of the Bulgarian economic landscape. The country enjoys a number of favourable geostrategic, climatic and natural endowments, which have significantly contributed to the development of century long traditions in both plant-growing and livestock breeding strong and promising sectors are the growing of roses, cotton and tobacco in the South Central parts of the country. Underdeveloped because of economic factors remain pepper, tomatoes, grapes and apples production, which are otherwise favoured by natural condition. In terms of livestock breeding and livestock products processing, the country has excellent outlooks for increasing the exports of specific high quality milk and dairy commodities, as well as meat products. Predisposed by climatic and natural conditions, organic farming is also gaining speed in recent years. Investments in organic production are strongly encouraged by both Bulgarian and European authorities. Today, agricultural entrepreneurs in Bulgaria enjoy a number of competitive advantages and investment favourable factors. As a member of the EU, the country benefits from free access to the growing European market and is also subject to financial and technical support by the EU. Within the framework of the Common Agricultural Policy (CAP) and other cohesion funding policies of the EU, Bulgaria is due to utilize more than € 7 billion for the period 2007-2013, of which a total of € 3 241 million are for rural areas development. Finally, the country offers access to skilled and inexpensive workforce, sector supporting institutions, food and research centres, agricultural colleges, etc.

In 2012 for the first time a real increase of the added value in the sector Agriculture, Forestry, Hunting and Fishery was registered (3.5%). The labour productivity in the sector increased due to optimization of the employment, the investments during the last two years and increase of the credits in the sector. The effectiveness of the sector improves as well.

2.6.3. Forestry

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

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

In the following two tables – Table 2.6 and Table 2.7, data for the forest areas in Bulgaria is given and also – activities for afforestation.

Table 2.6 Total and wooded forest area, 1000 ha

Type of forest	1990	1995	2000	2001	2002
Total	3871	3876	3914	3980	4003
Coniferous	1330	1304	1282	1295	1291
Non-coniferous	2541				
High-stemmed		1579	1535	1541	1525
Low-stemmed		993	1097	1144	1187
of which: Wooded forest area	3348	3334	3375	3443	3489
Coniferous	1213	1154	1115	1123	1122
Non-coniferous	2135				
High-stemmed		1251	1237	1253	1256
Low-stemmed		929	1023	1067	1111
Type of forest	**2003**	**2004**	**2005**	**2006**	**2007**
Total	4015	4064	4077	4090	4108
Coniferous	1289	1288	1279	1271	1277
Non-coniferous					
High-stemmed	1501	1478	1460	1452	1436
Low-stemmed	1225	1298	1338	1367	1395
of which: Wooded forest area	3548	3648	3674	3347	3704
Coniferous	1148	1151	1147	1143	1139
Non-coniferous					
High-stemmed	1252	1278	1268	1264	1254
Low-stemmed	1148	1219	1259	1285	1311

Source: NSI

Table 2.7 Activities for afforestation

Year	1990	1995	2000	2001	2002
Preparation of area	22368	10911	6056	5475	8295
Afforestation	35551	14367	6313	5031	7134
Establishing of intensive plantation	1110	959	952	643	881
Reforestation of artificial forest	8840	4892	2086	2344	2733
Year	**2003**	**2004**	**2005**	**2006**	**2007**
Preparation of area	8105	6414	3658	3844	3586
Afforestation	8377	7532	5397	4591	3618
Establishing of intensive plantation	-	6	-	-	-
Reforestation of artificial forest	2352	2562	2065	1395	2352

Source: Forest Research Institute, Bulgarian Academy of Sciences

Forest Areas in Bulgaria - ownership distribution:

- Total forest area – 4 148 114 ha
- State forest area - 74,5% and non-state – 25.5%.
    - Forests managed by the EFA – 70.6%
    - Managed by MoEW – 4.1% (exclusive state ownership).
- Distribution of non-state forest ownership:
    - physical persons and other legal entities – 10.7%,
    - Municipal forests – 12.1 %,
    - religious communities – 0,6 %,
    - There are 1,9% forest afforested over abandoned agricultural lands
- The forests of individual owners are small most are less than1 ha.
- Only 150 of the individual estates > 50 ha
- Municipal forests - usually several hundreds of ha

Main documents:

- Agricultural report for 2012 of the MAF
- National Strategy for Development of the Forestry Sector in Bulgaria 2006 - 2015
- National Strategy for Development of the Forestry Sector in Bulgaria 2013 - 2020
- Strategic plan for the development of the Forestry Sector (2007 - 2011)
- Programme of measures for adaptation and mitigation of the negative climate change related effects on forests.

2.6.4. Biodiversity

The big variety of habitats and biogeographic conditions has lead to a diversity of the flora and fauna in the country, ranking Bulgaria amongst the first in Europe - Table 2.8.

Table 2.8 Biodiversity

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

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

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

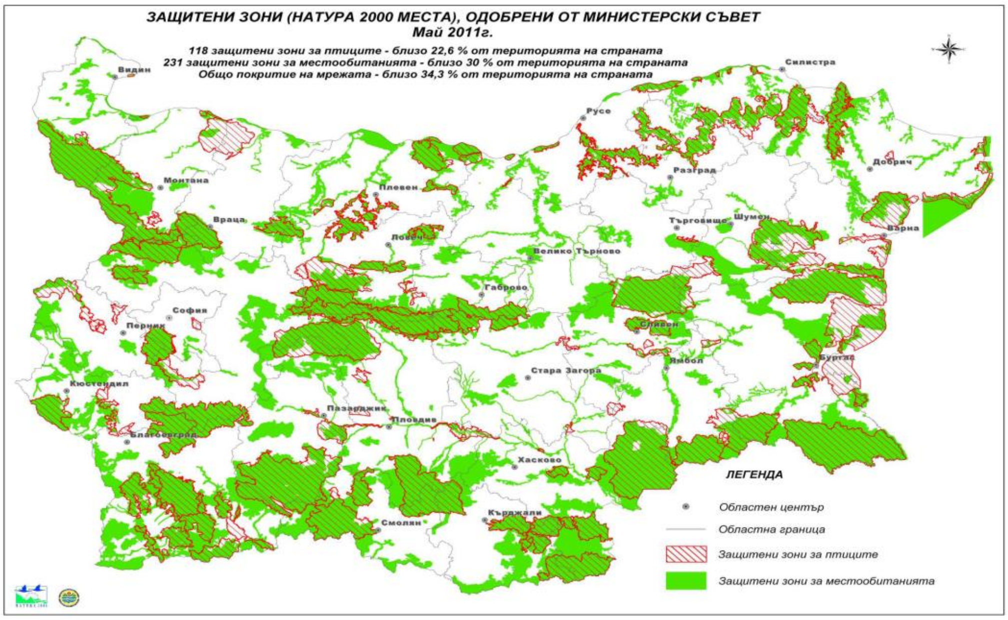
The protection of the genetic fund of forest wood species is carried out with the creation of seed-funds, plantations, dendrary botanical gardens and botanical gardens with an total are of 44 622 at present.

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

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

In 2010 in Bulgaria there were 953 protected areas covering 5.2% of the territory of the country. In May 2011 r. there were 118 protected zones under the Birds Directive (22.6 % of the territory of the country), and 231 protected zones according to the Habitats Directive (30 % of the territory of the country).

Figure 2.6 Protected areas in NATURA 2000 in Bulgaria



2.6.5. Taxes and Tax Policy

The Government program for the European development of Bulgaria in the period 2009-2013 was developed with the objective to overcome the consequences of the global financial and economic crisis, and to recover the Bulgarian economy. The Government has assigned seven main priorities. The first priority is oriented towards increase in the income of the Bulgarian citizens, growth and modernisation of the Bulgarian economy.

The marked out measures to this priority are preserving the macroeconomic stability, improving the business environment and the competitiveness of the economy, encouraging the investments and the entrepreneurship, in benefit of the development of the business tax and social security policy.

The tax policy is the essence of the economic and fiscal policy of the state and an important instrument in the regulation of the macroeconomic proportions.

The policy in the field of taxation besides being a key component in the fiscal policy shall be considered also as important lever for stimulating the foreign direct investment, the economic growth and the employment.

The tax policy of the Bulgarian Government in its main components is oriented to preservation of the stability of the economy in the conditions of economic crisis, stimulation of the business and the investment activities by means of:

- Relief in the taxation of the business and achieving minimal levels of taxation within the European Union;
- Simplification of the tax system and refining the tax legislation to eliminate internal contradictions and imperfections in the practices of taxation and control, and with the objective of a greater transparency and intelligibility to the taxpayers;

- Preserving the tax rates of the direct taxes in combination with lower social insurance burden to the employers in benefit of the economic growth and the employment;
- Preserving the higher share of the indirect taxes in comparison to the direct taxes.

The policy of the Government in the field of taxation is oriented towards decreasing the share of the shadow economy and combat tax evasion and avoidance.

- In Bulgaria income of any individual is subject to a flat income tax rate of 10%.
- Exemptions are granted to taxpayers with specific types of income.
- The standard rate of tax for a Bulgarian corporate tax is 10%.
- A special tax rate is applicable for companies dealing in shipping as well as companies engaged in games of chance and gambling.

2.6.6. Energy and Industrial Profile

2.6.6.1. Energy Profile

Bulgaria covers more than 70% of its gross energy demand by imports. The dependency on import of natural gas and crude oil is very high and has a traditional single origin - the Russian Federation. The Russian natural gas is supplied by one route through the Ukraine. Besides, our country relies completely on the import of nuclear fuel from Russia, although nuclear energy, according to a Eurostat methodology, is considered as indigenous energy source.

The prevailing quantity of heat is produced on the basis of natural gas and the risks for the final consumers are much lower. The structure of the Final Energy Consumption (FEC) for the Bulgarian economy predetermines a big share of secondary energies and necessity of transformation of a significant quantity of energy resources and lost of energy resources in the transformation processes.

Data on the structure of energy consumption in Bulgaria are given in Table 2.9 and Table 2.10.

Table 2.9 Structure of final energy consumption (Per cent)

	1990	1995	2000	2001	2002
Industry	51.9	52.2	40.9	40.3	38.2
Transport	15.2	6.1	21.8	23.2	24.1
Households	22.0	29.1	26.0	24.2	25.7
Others	10.9	12.6	11.3	12.4	11.9
Total	100	100	100	100	100
	2003	**2004**	**2005**	**2006**	**2007**
Industry	38.4	38.4	36.9	36.3	37.9
Transport	25.3	26.9	28.4	28.8	28.1
Households	25.1	24.1	22.2	22.5	21.8
Others	11.3	10.6	12. 5	12.4	12.2
Total	100	100	100	100	100
	2008	**2009**	**2010**	**2011**	**2012**
Industry	39,3	36,1	28,8	29,28	29,8
Transport	27,5	29,6	32,7	31,4	30,08
Households	21,3	22,2	25,3	25,9	26,4
Others	11,9	12,0	13,2	13,4	13,7
Total	100	100	100	100	100

Industry is the biggest energy consumer in Bulgaria's economy, but it's share in 2012 decreased with 22.1% compared to 1990. Instead energy consumption in transport sector in 2012 has doubled from 15% to 30% of the final energy consumption,

Table 2.10 Final energy consumption (PJ)

	1990	1995	2000	2001	2002
Industry	250.3	146.02	144.5	142.0	136.3
Transport	27.9	85.0	77.0	81.6	86.1
Households	145.0	94.2	91.7	85.1	91.8
Others	51.5	41.1	40.0	43.6	42.6
Total	519.7	478.97	353.26	352.3	356.8
	2003	**2004**	**2005**	**2006**	**2007**
Industry	147.5	143.23	143.60	147.78	150.84
Transport	97.1	100.33	110.52	117.24	111.84
Households	96.5	89.89	86.39	91.60	86.76
Others	43.4	39.54	48.64	50.48	48.56
Total	384.73	372.99	389.15	407.1	398
	2008	**2009**	**2010**	**2011**	**2012**
Industry	160,4	144,5	102,3	106,7	112,8
Transport	112,1	118,6	116,3	114,6	114,0
Households	86,8	89,0	90,0	94,7	100,1
Others	48,7	48,0	47,0	49,0	52,0
Total	408,0	399,9	355,5	365,1	378,9

Source: NSI

Data on the electricity consumption in Bulgaria are given in Table 2.11. The trend shows a decrease in the electricity consumption after 2007 due to the recession.

The largest relative share of input fuels for heat production was occupied by gaseous fuels - 48.8%, followed by imported coal - 31.8%, local coal - 16.8%, nuclear energy - 2.1%, liquid fuels - 0.3% and biofuels - 0.2 %.

The largest relative share of input fuels for heat production was occupied by gaseous fuels - 48.8%, followed by imported coal - 31.8%, local coal - 16.8%, nuclear energy - 2.1%, liquid fuels - 0.3% and biofuels - 0.2 % .

Table 2.11 Electricity - consumption (billion kWh)

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Bulgaria	35.49	33.18	34.42	32.52	32.52	32.71	31.75	37.4	30.5	28.8	29.9	28.3	28.3

Table 2.12 Main energy parameters

		2005	2006	2007	2008	2009	2010	2011
Primary energy production	1000 toe	10 539	11 011	9 738	9 966	9 553	10 188	11 919
Gross domestic energy consumption	1000 toe	20 122	20 761	20 163	19 889	17 447	17 783	19 107
End consumption of energy	1000 toe	9 512	9 880	9 748	9 568	8 504	8 728	9 059
Share of energy from RES in gross domestic energy consumption	%	11.8	11.2	7.5	7.4	9.8	15.1	9.8
Energy dependency*	%	47.5	46.2	51.3	52.1	45.3	40.1	36.6

The data for the period 2005-2010 are updated from the NSI yearbook for 2011.

* Eurostat data

In 2012, production of natural gas in Bulgaria marked a significant growth as a result of the two new fields developed in Kaliakra and Kavarna.

Public administration responsible for energy and industry includes:

- Ministry of Economy and Energy
- Sustainable Energy Development Agency (SEDA)
- State Energy and Water Regulatory Commission
- Agency for Nuclear Regulation
- Ministry of Environment and Water

2.6.6.2. Industrial Profile

In the past, the main industry sectors of Bulgaria were metallurgy, machine manufacture, chemicals, and agriculture. Recently, however, the priority has shifted to sectors like energy, tourism, transportation, IT and telecommunications, food and beverage, pharmaceuticals, and textile and clothing.

The governmental policy of rapid privatization led to almost complete privatization of industrial installations. As a result, the most inefficient enterprises were closed. The new owners introduce various measures to save energy which are mainly of organizational nature and “no cost” or “low cost” measures.

Table 2.13 Output of the industrial enterprises by kind of ownership (Per cent)

	1990	1995	2000	2001	2002
Total	100	100	100	100	100
Public sector	99,2	88,8	25,4	22,3	21,4
Private sector	0,8	11,2	74,6	77,7	78,6
	2003	**2004**	**2005**	**2006**	**2007**
Total	100	100	100	100	100
Public sector	16,6	15,6	10,8	8,3	8,7
Private sector	81,4	84,4	89,2	9197	91,3
	2008	**2009**	**2010**	**2011**	**2012**
Total	100	100	100	100	100
Public sector	2,1	2,1	2,0	1,9	1,9
Private sector	97,9	97,9	98,0	98,1	98,1

Source: NSI

2.6.7. Transport

In 2010 Bulgaria had 19,5 thousand km roads, 19,2 thousand km of them are asphalt paved. The length of the railway line operated is 5831 km. In structural terms the majority are category 3 roads with a 61.77 % share, followed by category 2 – 20.7 %, and category 3 – 15.26%. Highways are 418 km with the lowest relative share – 2.246 %.

The main policy and strategy documents in the sector are:

- National Strategic Reference Framework
- National Strategy for Integrated Development of Infrastructure of the Republic of Bulgaria for the period 2006–2015
- Strategy for the Development of the Transport System of the Republic of Bulgaria up to 2020
- General Transport Master Plan 2007–2010

According to data from the Bulgarian Transport Ministry, 92 percent of the total resources that the Operational program “Transport” provides have been utilized. More than 1 billion Euro has already been paid to the beneficiaries.

One of the priorities in the Transport sector is stabilization of the state rail company BDZ. One of the ambitious projects is modernizing the oldest rail line in Bulgaria linking the Danubean city of Russe with the Black Sea port of Varna. The line was built in 1866. Today its reconstruction would cost 306 million euro. Another priority is the construction of modern and integrated road infrastructure along European transport corridors.

Together with implementing the current program the ministry is simultaneously working on the priorities for the next program period, which would focus on environment-friendly transport, like the railroad. European financing will be used for construction of part of the Sofia-Vidin railway. Improving shipping on the Danube is another project that will be implemented together with neighbouring Romania. The list of projects in the transport sector is long but the challenge of finding a balance between the needs and possible financing remains.

Main projects successfully implemented:

- Danube bridge II – in the “Vidin-Kalafat” area;
- Motorway “Lyulin”;
- Construction of the south arc of the Sofia ring road motorway.

Current transport project with necessity for accelerated implementation:

- Rail road “Plovid-Svilengrad”;
- Rail road “Karnobat-Sindel”;
- Construction of a terminal for combined transport in the area of the city of Sofia (Kazichane);
- Motorway "Maritca".

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

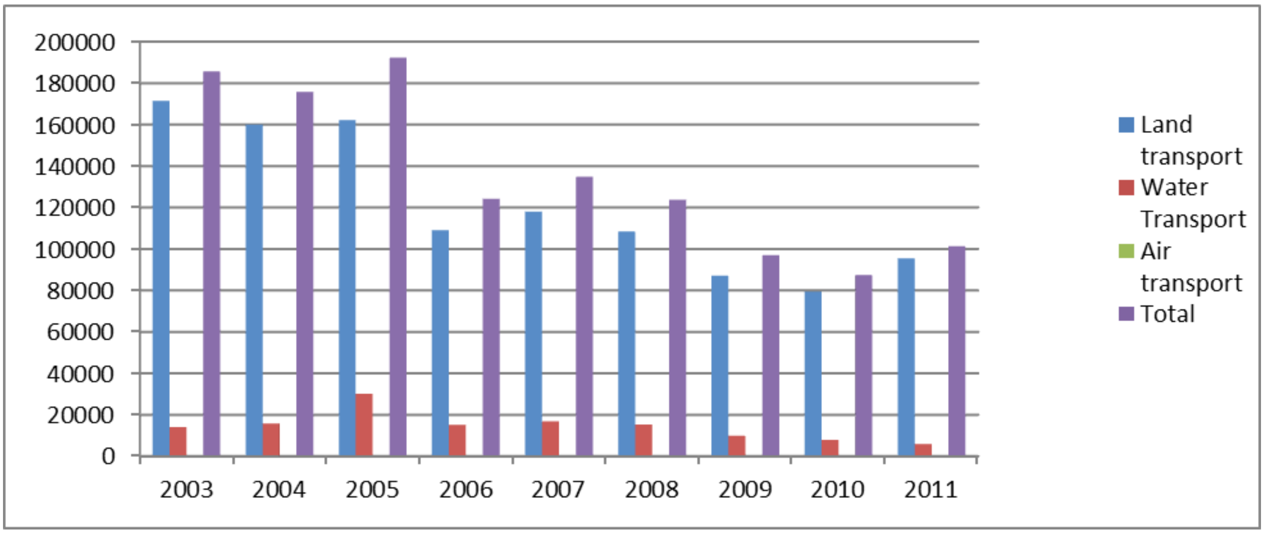
Data on transport of goods is presented in Table 2.14 and Figure 2.7 below.

Table 2.14 Goods carried by different transport modes2003 – 2011, thousand tonnes

<table>
<tr><th>Transport modes</th><th colspan="9">Goods carried – thousand tonnes</th></tr>
<tr><th></th><th>2003</th><th>2004</th><th>2005</th><th>2006</th><th>2007</th><th>2008</th><th>2009</th><th>2010</th><th>2011</th></tr>
<tr><td>Railway transport</td><td>20 070</td><td>20 387</td><td>20 298</td><td rowspan="2">109 131</td><td rowspan="2">117 978</td><td rowspan="2">108 372</td><td rowspan="2">87 079</td><td rowspan="2">79 441</td><td rowspan="2">95 431</td></tr>
<tr><td>Road transport</td><td>151 392</td><td>139 629</td><td>141 812</td></tr>
<tr><td>Maritime transport*</td><td>12 065</td><td>13 097</td><td>24 841</td><td rowspan="2">15127</td><td rowspan="2">16 854</td><td rowspan="2">15 294</td><td rowspan="2">9 947</td><td rowspan="2">7 964</td><td rowspan="2">5 899</td></tr>
<tr><td>Inland waterway transport</td><td>2 107</td><td>2 686</td><td>5 270</td></tr>
<tr><td>Air transport</td><td>13</td><td>24</td><td>21</td><td>13</td><td>2</td><td>5</td><td>19</td><td>11</td><td>8</td></tr>
<tr><td>Total</td><td>185 647</td><td>175 822</td><td>192 243</td><td>124 271</td><td>134 834</td><td>123 671</td><td>97 045</td><td>87 416</td><td>101 338</td></tr>
</table>

Source: National Statistical Institute (NSI) *Data includes all goods, transported by maritime transport – imported and exported.

Figure 2.7 Goods carried by different transport modes, 2003 – 2011, thousand tonnes



Data on carried passengers is given in Table 2.15.

Table 2.15 Passengers carried by transport modes 2003-2011, thousand tonnes

<table>
<tr><th>Transport modes</th><th colspan="9">Passengers carried – thousand tonnes</th></tr>
<tr><th></th><th>2003</th><th>2004</th><th>2005</th><th>2006</th><th>2007</th><th>2008</th><th>2009</th><th>2010</th><th>2011</th></tr>
<tr><td>Railway transport *</td><td>35 206</td><td>34 149</td><td>33 748</td><td>34 113</td><td>33 283</td><td rowspan="2">623 545</td><td rowspan="2">567 808</td><td rowspan="2">546 536</td><td rowspan="2">517 254</td></tr>
<tr><td>Road transport *</td><td>795 066</td><td>685 233</td><td>66 4266</td><td>623 249</td><td>594 879</td></tr>
<tr><td>Maritime transport</td><td>6</td><td>3</td><td>6</td><td>5</td><td>11</td><td>7</td><td rowspan="2">240</td><td rowspan="2">166</td><td rowspan="2">175</td></tr>
<tr><td>Inland waterway transport **</td><td>73</td><td>81</td><td>80</td><td>75</td><td>232</td><td>246</td></tr>
<tr><td>Air transport</td><td>1 471</td><td>1 782</td><td>2 071</td><td>2 320</td><td>2 237</td><td>2 636</td><td>2 184</td><td>2 327</td><td>2 693</td></tr>
<tr><td>Total</td><td>831 822</td><td>721 248</td><td>700 171</td><td>659 762</td><td>630 642</td><td>626 434</td><td>570 232</td><td>549 029</td><td>520 122</td></tr>
</table>

* Excl. free of charge travels by railways and road transport.
** Maritime and inland waterway transport for years 2009-2011.
Source: National Statistical Institute (NSI)

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

The vehicle park in Bulgaria is changing its structure not only in quantity but also in quality for the last few years. The increased number of passenger cars comes from the big import of second hand cars mainly from Germany, Austria and the Netherlands. This determines their relative high average age. The number of vehicles is 3 116 414 on 31.12.2010 and the unfavourable age related to the year of their initial registration. The respective number of the newly registered vehicles is 223 643. Special feature of Bulgarian vehicle fleet is its age structure. In 2011 more than 50% from the vehicles are above 15 years old and about 29% are more than 20 years old.

2.6.8. Waste

According to the official data published in the National Report on the State of Environment for 2012 (Executive Environment Agency), the total quantity of the generated waste in the country are 21 007 kt.

Table 2.16 Total quantity of generated wastes (2008-2012)

Type of wastes	Quantity in kt per year				
	2008	2009	2010	2011	2012
Dangerous wastes	760	708	646	202	159
Non-dangerous wastes	17 890	17 933	14 535	16 514	20 847

For the concerned period the quantity of hazardous waste has decreased by around 26% average, the decrease is mainly due to the hazardous waste in economic activities "Manufacture of wood and of products of wood and cork, except furniture; manufacture of products from straw and knitting materials" and "Basic metals manufacturing. Manufacturing of metal products, except machinery and equipment."

The increase in non-hazardous waste generated is caused by a change in the waste evaluation methodology of the NSI at national level and recalculation of the quantities generated in 'Collection and disposal of waste; recycling of materials."

In comparison on the latest available data from Eurostat (2010) regarding waste generated per person (kg/year per capita), excluding the main mineral waste (mainly waste from extractive industries) it is clear that our country is close to the EU-27 average (EU-27 rate of waste generated is 1847 kg/per capita, while for Bulgaria it is 1940 kg/per capita).

With the new law on waste management adopted in July 2012, the basic framework of the national policy on waste was defined, associated with the mitigation of the adverse effects on human health and the environment in waste generation and treatment and the use of resources by:

- implementation of the five-level hierarchy of waste management, which gives priority to the prevention and reduction of waste, preparation for reuse, recycling, other recovery (e.g. energy recovery) and disposal;
- introduction of targets for recovery and recycling of municipal and construction waste;
- promotion of the policy for recycling and recovery of waste in order to use the full potential of the country;
- introduction of separate collection of at least the following types of waste: paper, metal, plastic and glass by 2015;
- undertaking measures to encourage the reuse of products and preparation of reuse;
- revision of the scope and content of the waste management plans;

• establishment of a waste prevention program.

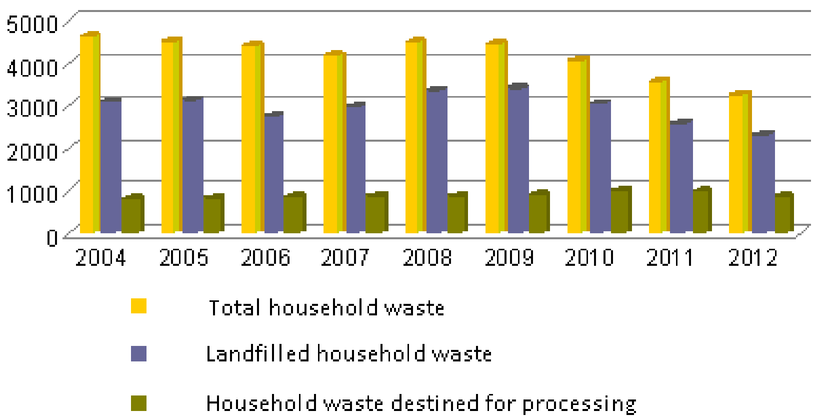
Currently, waste is increasingly seen as a resource and this is evident in the change of practices in the management of waste from disposal to recycling and recovery. Despite significant share of the submitted disposal incl. landfilled waste in 2012, an increase of about 2% of the share of waste delivered for disposal in tons is observed including recycling, compared to 2011. Recycling provides economic and social benefits: it generates economic growth, promotes innovation and facilitates the transition to a green economy.

To improve and update information on the quantities of waste and recovered domestic waste is, NSI initiated and implemented in 2012 monitoring In order to gather information on a national level on the domestic waste management processes leading to a change in EUROSTAT reported data and time series is smoothed by the year in which they began to collect data under the WMA. With appropriate statistical methods and questionnaires to companies that engage in the collection and storage of waste, information about existing practice was collected, for which so far there have been no appropriate statistical tools in order to be taken into account. The goal of the approach is to take account of the collected waste origin, i.e. whether natural or legal persons are concerned. The monitoring data of household waste and the results obtained at the regional and national level are taken into account.

Tracking the path of the waste from its origin to the transfer for treatment in the country or abroad is aimed. Based on this change in methodology a significant increase in the proportion of waste recycled and reduction of the proportion of landfilled to generated waste is observed.

The quantities of waste from households was restated and reported to Eurostat, as well as quantities of recovered waste and the adjusted series from the year in which data collection according to the WMA started.

Figure 2.8 Share of treated waste from total generated, kt



Source: NSI

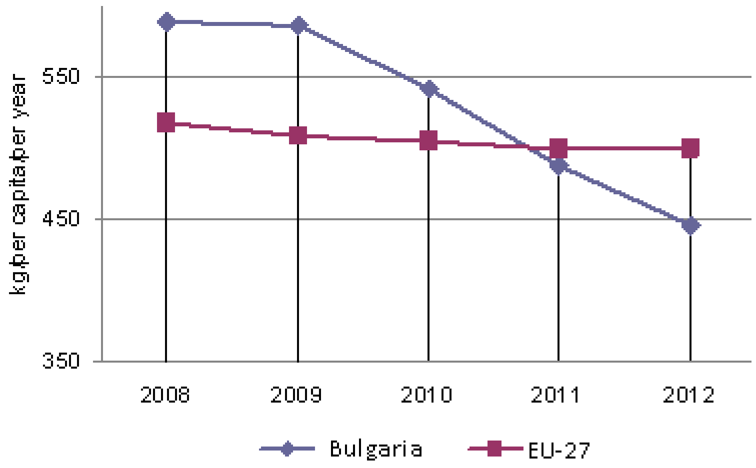
The update of data submitted for recycling household waste will allow for proper identification and reporting of objectives recycling of household waste under

Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste, and for repealing certain Directives. In 2012, the country changed its place in the general map of Europe and the deposited waste originating from households declined from 99% to 71%, while the share of the waste recovery originating from households has increased to 26%.

The benefits of environmentally sound waste management are not limited to a more efficient resource use and reduction of the burden of waste on the environment, but it is as well as an instrument for reducing greenhouse gas emissions from landfills as a result of an increase in the proportion of waste recycled and reduction in the share of landfilled biodegradable waste.

For a five year period (2008-2012) the amount of waste generated was reduced with an annual average of 8%, while the amount of disposed waste was reduced with an average annual rate of 9%.

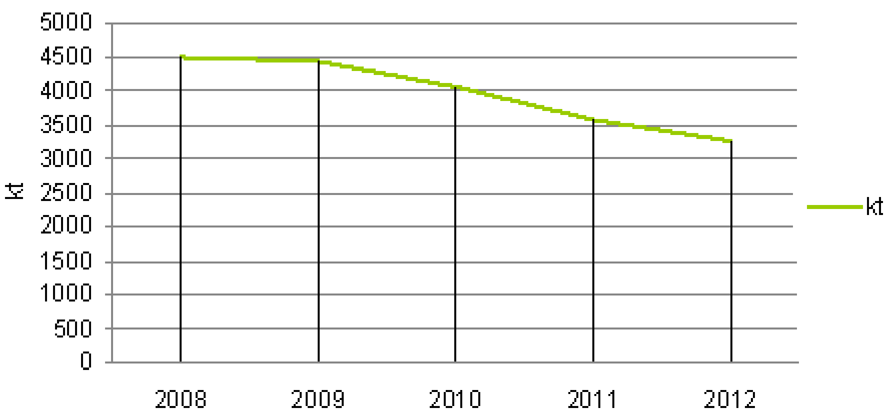
Figure 2.9 Accumulation rate in the period 2008 - 2012, kg / per capita



Source: NSI

The generated quantity of household waste for 2012 is 3249 kt. In a five year period (2008-2012) the tendency is towards reducing generated municipal waste.

Figure 2.10 Household waste generated during the period 2008-2012, kt



Source: NSI

In 2010 r. the National Strategic Plan for Gradual Reduction of Biodegradable Waste Intended for Landfilling 2010-2020 was adopted. The implementation of the Plan ensures the achievement of the targets and fulfilment of the requirements under Directive 1999/31/EC on landfilling of waste. The systems for separate collection of packaging waste cover 75 % of the population). In 2012 Bulgaria achieved in total 66 % recycling of materials and 68 % packaging waste utilization. In 2012, the country recovered a total of 222 070 t of packaging waste 218,761 t of which is recycled. This represents 6% more than the recycled packaging waste in 2011.

For 2012 the country has met national targets for recycling materials, as follows:

- Waste from glass packaging - 60,51%, under the set target of 59,6%;
- Waste from plastic packaging - 40,75%, under the set target of 22%;
- Paper packaging waste - 94,24, under the set target of 60%;
- Metal packaging waste - 75,57%, under the set target of 50%;
- Wood packaging waste - 53,06%, under the set target of - 15%.

The construction of 23 regional systems on waste management on the territory of the country is ongoing. They are financed through the Operational Program „Environment 2007 - 2013”. According to NSI data in 2008 there were 349 landfills for household waste, and in 2012 their number was decreased to 157.

Table 2.17 Household waste, thousand tons

	Measure	2008	2009	2010	2011	2012
Generated municipal waste	*thousand tons*	3615	3561	3091	2753	3249
Settlements served by municipal waste collection systems	*number*	3445	3988	4238	4364	4431
Share of population, served by municipal waste collection systems	*%*	94,4	96,6	98,2	98,9	99,2
Collected municipal waste per capita of served population	*kg/year per capita*	467	467	404	376	347
Landfill sites for municipal waste	*number*	349	278	172	164	157
Total municipal waste accepted at landfill sites	*thousand tons*	3987	3948	3725	3506	3257
Municipal waste landfilled	*thousand tons*	3359	3421	3067	2568	2323
Municipal waste temporary stored	*thousand tons*	11	265	0	0	0
Collected construction waste at landfill sites for municipal waste	*thousand tons*	410	396	380	508	554

Source: NSI

3. Greenhouse gas inventory information

3.1. Introduction

This chapter presents information about the annual GHG emissions in Bulgaria for 2011 (Bulgaria's 2013 annual inventory submission). This Inventory is prepared by the Executive Environmental Agency according to the UNFCCC Guideline approved by the Subsidiary Body for Scientific and Technological Appliance on the 21st session on 06-14.12.2004 in Buenos Aires. The rules and the structure of the National GHG Inventory Report are formed by this Guideline. The report is elaborated in compliance with the Revised IPCC Guidelines, 1996, IPCC Guidelines, 2006 and Good Practice Guidance for National GHG Inventories, 2000 and following the Updated UNFCCC reporting guidelines on annual inventories, incorporating the provisions of decision 14/CP.11.

The current report also presents the GHG emissions trends for the period 1988-2011. There are described as well:

- Methods and indices for uncertainty assessment of the annual GHG emissions and trends;
- Key GHG emission category according to method of the type Tier 1, specified in the Good Practice Guidance;
- Assessment of the quality assurance and control system.

Key sources

The method used to identify key source categories follows the Tier 1 method – quantitative approach described in the Good Practice Guidance (IPCC-GPG, 2000), Chapter 7 Methodological Choice and Recalculation and in the IPCC Good Practice Guidance for Land Use, Land Use Change and Forestry (IPCC GPG-LULUCF, 2003), Chapter 5.4 Methodological Choice – Identification of key categories.

The analysis includes all greenhouse gases reported under UNFCCC: CO_2, CH_4, N_2O, HFC, PFC and SF_6. All IPCC categories are included.

The identification of key categories consists of following steps:

- Identifying categories
- Level Assessment excluding LULUCF
- Level Assessment including LULUCF
- Trend Assessment excluding LULUCF
- Trend Assessment including LULUCF

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

According to the key source analysis the key category with the highest contribution to national total emissions is **1A1a Public Electricity and Heat Production - Solid fuels (CO_2)**. It ranked 1 in all level assessments and number 1 in trend assessment in 2011.

The **second** most important source for greenhouse gas emissions in Bulgaria is 1A3 Road transportation, Diesel (CO_2) and the **third** most important source in terms of its contribution to national total emissions is 6A **Solid Waste Disposal** on Land (CH_4) .

Table 3.1 Summary overview for key categories

KEY CATEGORIES OF EMISSIONS AND REMOVALS	Gas	Criteria used for key source identification			Key category excluding LULUCF [(1)]	Key category including LULUCF [(1)]
		L	T	Q		
Specify key categories according to the national level of disaggregation used:						
1A1a Public Electricity and Heat Production -Liquid Fuels	CO2	x	x		x	x
1 A 3 b. Road Transportation - Diesel Oil	CO2	x	x		x	x
1 A 3 b. Road Transportation - Gasoline	CO2	x	x		x	x
1 A 3 b. Road Transportation - Gasoline	N2O	x			x	
1 A 3 b. Road Transportation - LPG	CO2	x			x	x
1 A 4 b. Residential - Solid Fuels	CO2	x	x		x	x
1A1a Public Electricity and Heat Production - Gaseous Fuels	CO2	x	x		x	x
1A1a Public Electricity and Head Production -Solid Fuels	CO2	x	x		x	x
1A1b Petroleum Refining - Liquid Fuels	CO2	x			x	x
1a2a Gaseous Fuels	CO2	x			x	x
1A2a Solid fuels	CO2		x		x	x
1A2c Gaseous Fuels	CO2	x			x	x
1A2c -Solid Fuels	CO2	x			x	x
1A2e - Gaseous Fuels	CO2	x			x	x
1A2e Liquid Fuels	CO2		x		x	x
1A2f - Liquid Fuels	CO2	x	x		x	x
1A2f Gaseous Fuels	CO2	x			x	x
1A2f Solid Fuels	CO2	x	x		x	x
1A3e - Gaseous Fuels	CO2	x			x	x
1A4a - Liquid Fuels	CO2	x			x	
1A4b Biomass	CH4	x			x	
1A4b Liquid Fuels	CO2		x		x	x
1A4c Liquid fuels	CO2	x	x		x	x
1B1a	CH4	x	x		x	x
1B2b	CH4	x			x	x
2A7 - Other	CO2	x			x	x
2C1 - Iron and Steel	CO2		x		x	x
3 Solvent and Other Product Use	CO2		x		x	x
4B1 - Manure Management - Cattle	CH4	x			x	x
4B13 - Manure Management - Solid Storage and dry lot	N2O	x	x		x	x
4B9 Manure Management - Poultry	CH4	x			x	x
4D1 - Direct Soil Emissions	N2O	x	x		x	x
4D2 Pasture, Range and Paddock Manure	N2O	x	x		x	x
4D3 Indirect Emissions	N2O	x	x		x	x
5A1 - Forest Land remaining Forest Land	CO2	x	x			x
5A2 - Land converted to Forest Land	CO2	x	x			x
5B1 Cropland remaining Cropland	CO2	x	x			x

5B2 Land converted to Cropland	CO2	x	x			x
5C2 Land converted to Grassland	CO2	x	x			x
5E2 Land converted to Settlements	CO2	x	x			x
6A Solid Waste Disposal on Land	CH4	x	x		x	x
6B Wastewater handling	CH4	x	x		x	x
Ammonia production	CO2	x	x		x	x
Cement production	CO2	x			x	x
Enteric Fermentation - cattle	CH4	x	x		x	x
Enteric Fermentation - sheep	CH4	x	x		x	x
F-gases	HFCs	x	x		x	x
Lime production	CO2	x			x	x
Manure Management - swine	CH4		x		x	
N2O from Nitric Acid production	N2O	x			x	x

3.2. Summary Tables and Trends of Bulgaria's Greenhouse Gas Emissions

This chapter describes greenhouse gas emissions (GHGs) trends over time, covering period between 1988 and 2011.

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

- Carbon dioxide - CO_2
- Methane - CH_4
- Nitrous oxide - N_2O
- Hydrofluorocarbons – HFCs
- Perfluorocarbons - PFCs
- Sulphur hexafluoride - SF_6.

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

Table 3.2 represents the emission trends of the basic GHG, the overall emissions (excluding LULUCF).

Table 3.2 Summary of emission trend per source category and gas, Gg CO_2 eq

Source category	1988	1990	1991	1992	1993	1994	1995	1996	1997
1. All Energy	83 081,24	75 529,27	57 523,20	55 093,02	55 481,58	52 530,54	53 029,72	53 737,20	51 071,56
1A. Energy: fuel combustion	79 344,98	72 284,19	54 889,16	52 340,75	52 631,10	49 739,30	50 026,61	50 721,24	48 290,32
CO_2: 1. Energy industries	41 967,24	38 661,46	30 343,18	28 600,78	28 901,38	26 610,00	27 119,83	26 933,80	28 950,92
CO_2: 2. Man.Industry	17 477,04	19 538,76	15 324,50	14 593,24	13 549,19	13 760,62	14 609,47	15 078,63	12 044,44
CO_2: 3. Transport	7 204,65	6 578,22	3 808,39	3 991,18	4 498,01	4 115,48	4 369,99	4 300,18	4 331,91
CO_2: 4. Other sectors	6 198,48	7 476,41	5 365,50	5 097,33	5 605,80	5 207,13	3 873,14	4 334,12	2 934,06
CO_2: 5. Other	6 497,57	29,34	47,60	58,22	76,73	46,06	54,18	74,51	29,00
CH_4	3403,24	2898,34	2391,12	2504,16	2514,39	2418,92	2549,65	2552,47	2402,80
N_2O Gg	328,01	342,60	239,11	243,42	330,58	367,70	448,68	459,64	375,15
1B. Fugitive fuel emissions									
CO2	5,00	4,14	3,81	4,69	5,51	4,62	4,77	3,85	3,28
CH_4 Gg	2984,91	2545,12	2116,70	2185,63	2186,54	2146,82	2297,29	2266,67	2167,25
N_2O Gg	0,0176805	0,01332364	0,012843372	0,012021214	0,010141607	0,008481132	0,009957467	0,007459217	0,006508912
2. Industrial Processes (ISIC)	11 959,94	8 846,52	6 947,67	5 720,01	5 929,70	7 456,86	9 421,59	9 123,97	8 440,50
CO_2	9 856,62	7 058,42	5 713,25	4 673,96	4 993,56	6 435,46	7 926,00	7 591,99	7 266,73
CH_4	90,04	70,47	51,64	48,92	56,80	73,86	81,21	76,08	81,26
N_2O	2009,83	1713,76	1177,96	992,79	874,75	942,67	1406,85	1446,26	1080,40
HFCs	NA,NO	NA,NO	0,72	0,00	0,01	0,02	2,39	4,20	6,38
PFCs	NA,NO	NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO
SF_6	3,46	3,87	4,10	4,33	4,59	4,85	5,13	5,43	5,75
3. Solvent and Other Product Use	899,79	897,75	895,71	896,61	829,62	126,75	95,61	91,50	79,43

Source category	1988	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	866,61	864,57	862,53	863,43	796,31	90,80	64,30	57,90	44,24
N_2O	33,18	33,18	33,18	33,18	33,31	35,95	31,32	33,61	35,19
4. Agriculture	20 206,36	18 198,35	15 892,74	13 672,09	11 468,14	9 997,05	8 209,03	7 686,08	7 510,28
CH_4 Enteric fermentation	4 008,12	3 810,57	3 665,20	3 412,97	2 874,99	2 288,75	1 930,46	1 835,34	1 780,55
CH_4 Manure management	4 079,77	4 249,61	4 267,80	3 675,63	2 687,39	2 001,48	1 549,27	1 390,87	1 081,31
CH_4 Rice cultivation	114,24	88,96	68,91	38,01	26,20	6,95	11,59	21,89	31,87
CH_4 Field Burning of Agricultural Residues	34,07	35,11	39,71	26,92	19,83	20,72	22,91	13,19	20,01
N_2O Manure Management	1 637,40	1 558,46	1 452,64	1 301,81	1 108,17	964,38	866,18	810,80	780,51
N_2O Agricultural soils	10 318,14	8 439,95	6 380,25	5 204,02	4 742,71	4 705,78	3 817,90	3 607,29	3 807,00
N_2O Field Burning of Agricultural Residue	14,62	15,69	18,24	12,74	8,83	9,00	10,72	6,70	9,03
5. LULUCF	-14 340,02	-14 048,81	-13 931,71	-13 619,01	-12 852,79	-12 661,84	-13 177,57	-10 809,13	-10 843,25
CO_2	-14 504,38	-14 215,27	-14 096,24	-13 800,71	-13 081,36	-12 890,18	-13 342,24	-10 979,61	-11 008,75
CH_4	1,364	3,073	1,509	15,478	53,623	53,434	1,621	6,347	2,294
N_2O	162,99	163,38	163,02	166,22	174,94	174,90	163,05	164,13	163,20
6. Waste	5 789,11	6 069,00	5 483,90	5 111,00	5 006,16	4 963,04	5 082,79	5 063,67	4 972,59
CO_2	19,04	20,35	20,71	19,39	20,86	21,20	21,49	21,20	21,38
CH_4	5529,93	5816,15	5232,47	4864,31	4758,02	4715,26	4852,50	4834,85	4744,90
N_2O	240,15	232,49	230,72	227,30	227,28	226,58	208,81	207,63	206,32
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
NATIONAL TOTAL EMISSIONS	131 540	117 432	94 516	87 929	86 721	86 519	89 043	88 318	85 676

Source category	1988	1990	1991	1992	1993	1994	1995	1996	1997
International bunker	1 668,28	965,52	1 633,91	1 917,03	2 176,02	1 972,55	1 997,56	1 541,27	472,03

Source category	1998	1999	2000	2001	2002	2003	2004	2005	2006
1. All energy	49 691,26	43 432,42	42 350,76	46 003,95	43 482,32	47 276,43	45 925,31	46 624,37	47 785,40
1A. Energy: fuel combustion	53 251	46 920	45 559	48 836	46 001	50 806	48 840	49 393	51 008
CO_2: 1. Energy industries	27 748,66	24 134,62	23 976,71	27 841,81	25 184,89	27 057,95	26 753,34	26 933,79	27 245,08
CO_2: 2. Industry	10 803,76	8 813,65	8 445,77	8 419,90	7 936,37	8 999,78	8 318,39	8 025,39	8 085,18
CO_2: 3. Transport	5 482,42	5 718,16	5 492,45	5 662,04	5 897,25	6 490,43	6 893,11	7 578,61	8 197,19
CO_2: 4. Other sectors	3 102,99	2 604,10	2 160,06	1 998,63	2 362,17	2 512,96	2 095,84	2 106,39	2 339,99
CO_2: 5. Other	12,55	43,11	11,69	12,72	9,16	NO	NO	NO	NO
CH_4	2107,45	81,51	90,36	81,65	82,52	88,02	75,53	80,45	77,14
N_2O	430,19	403,66	363,34	351,19	356,60	364,33	262,31	265,84	274,10
B. Fugitive fuel emissions									
CO2	3,24	3,50	3,10	3,01	3,02	2,48	16,22	24,82	24,02
CH_4	1824,57	1470,94	1650,10	1498,57	1458,33	1550,90	1307,87	1418,98	1334,02
N_2O	0,00754590 1	0,0090632	0,0093797	0,0077042	0,0083325	0,0067539	0,0099661	0,0119712	0,0113682
2. Industrial Processes (ISIC)	6 151,14	5 407,00	6 234,58	6 167,89	5 578,27	6 199,43	6 248,11	6 636,83	6 455,04
CO_2	5 421,51	4 793,13	5 338,63	5 260,43	4 810,96	5 372,86	5 268,82	5 555,57	5 746,87
CH_4	65,43	55,87	56,81	55,27	48,36	59,26	49,63	46,98	45
N_2O	647,99	537,23	814,39	816,37	670,14	700,52	842,78	913,86	489,98
HFCs	10,14	14,34	17,95	28,62	41,20	58,73	78,35	111,86	164,29
PFCs	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO
SF_6	6,08	6,43	6,80	7,20	7,62	8,06	8,53	8,56	8,89
3. Solvent and Other Product Use	64,15	56,57	68,40	54,76	57,41	60,40	48,91	50,68	53,73
CO_2	25,15	19,70	31,39	16,97	17,21	23,63	16,95	23,94	27,86
N_2O	39,000	36,866	37,008	37,789	40,207	36,768	31,957	26,737	25,875

Source category	1998	1999	2000	2001	2002	2003	2004	2005	2006
4. Agriculture	6 386,96	6 777,70	6 237,32	5 990,38	6 142,62	5 967,79	6 527,83	6 206,78	6 098,03
CH_4 Enteric fermentation	1 736,75	1 798,20	1 747,92	1 505,52	1 554,30	1 612,24	1 586,45	1 540,62	1 499,00
CH_4 Manure management	770,54	687,07	459,79	359,53	437,67	548,52	586,71	612,05	686,15
CH_4 Rice cultivation	33,63	11,90	30,00	32,73	43,95	47,41	45,33	39,34	42,69
CH_4 Field Burning of Agricultural Residues	17,73	18,19	14,60	17,85	21,88	14,79	24,82	19,47	19,26
N_2O Manure Management	739,50	760,78	726,73	640,15	650,52	698,16	697,69	673,05	656,35
N_2O Agricultural soils	3 080,58	3 492,84	3 251,47	3 427,29	3 425,02	3 039,23	3 575,40	3 313,06	3 185,24
N_2O Field Burning of Agricultural Residue	8,23	8,72	6,82	7,30	9,28	7,44	11,42	9,20	9,35
5. LULUCF	-10 793,24	-10 765,99	-8 918,24	-8 755,57	-9 117,54	-9 025,79	-9 191,85	-8 934,39	-8 398,15
CO_2	-10 981,19	-10 958,75	-9 291,00	-8 991,43	-9 303,84	-9 206,99	-9 358,66	-9 102,31	-8 574,28
CH_4	20,568	24,477	170,977	59,554	19,228	15,072	3,365	4,269	10,942
N_2O	167,38	168,28	201,78	176,30	167,08	166,13	163,45	163,65	165,18
6. Waste	4 833,66	4 641,04	4 609,69	4 442,30	4 415,86	4 930,76	4 888,09	4 230,51	4 174,21
CO_2	35,42	28,89	62,99	40,24	39,32	44,52	70,40	56,06	52,77
CH_4	4587,23	4404,85	4325,91	4196,21	4173,11	4681,87	4603,43	3983,03	3932,35
N_2O	211,02	207,30	220,79	205,85	203,43	204,38	214,26	191,42	189,09
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
NATIONAL TOTAL EMISSIONS	56 333,94	49 548,73	50 582,51	53 903,71	50 558,95	55 409,02	54 446,40	54 814,78	56 168,26
International bunker	614,96	239,59	447,85	621,76	711,67	918,78	831,74	921,86	881,08

Source category	2007	2008	2009	2010	2011
1. All energy	51 456,00	50 677,36	44 593,46	46 741,63	52 203,74
1A. Energy: fuel combustion	53 251	46 920	45 559	48 836	51 400
CO2: 1. Energy industries	30 552,61	32 072,19	29 504,57	31 419,33	36 211,18
CO2: 2. Industry	8 768,98	6 333,99	3 637,28	3 800,16	3 639,54
CO2: 3. Transport	8 024,99	8 407,91	8 084,45	7 859,56	8 036,21
CO2: 4. Other sectors	2 066,77	1 821,32	1 581,01	1 725,49	1 971,28
CO2: 5. Other	NO	NO	NO	NO	NO
CH4	1746,63	1748,57	1537,07	1672,01	2042,37
N2O Gg	281,74	282,54	246,84	260,48	282,71
B. Fugitive fuel emissions					
CO2	14,29	10,85	2,24	4,59	20,44
CH4	1479,13	1479,63	1288,36	1394,16	1741,69
N2O	0,0086782	0,0074614	0,0056658	0,0057993	0,0092931
2. Industrial Processes (ISIC)	6 849,89	5 972,47	3 210,07	3 563,08	3 977,93
CO2	5 990,37	5 045,63	2 585,79	2 921,58	3 332,83
CH4	40,47	21,54	1,35	NA,NO	NA,NO
N2O	605,61	580,65	272,58	267,51	234,44
HFCs	204,20	315,05	340,36	360,88	395,74
PFCs	IE,NA,NO	0,00	0,01	0,04	0,05
SF6	9,24	9,60	9,97	13,07	14,87
3. Solvent and Other Product Use	50,13	51,10	47,84	45,78	41,29
CO2	25,28	25,87	24,62	25,61	22,28
N2O	24,848	25,230	23,221	20,173	19,013
4. Agriculture	6 014,93	6 186,88	5 986,25	6 185,58	6 148,50
CH4 Enteric	1 413,23	1 386,92	1 318,70	1 286,40	1 309,57

Source category	2007	2008	2009	2010	2011
fermentation					
CH4 Manure management	714,73	679,30	658,51	644,69	627,00
CH4 Rice cultivation	54,21	42,35	69,82	100,61	99,38
CH4 Field Burning of Agricultural Residues	10,31	22,72	21,31	24,31	24,29
N2O Manure Management	639,34	603,76	567,82	541,21	536,32
N2O Agricultural soils	3 177,98	3 441,07	3 339,65	3 576,21	3 540,09
N2O Field Burning of Agricultural Residue	5,14	10,76	10,44	12,14	11,85
5. LULUCF	-7 086,33	-8 281,14	-8 388,63	-8 109,04	-7 979,42
CO2	-7 406,56	-8 463,55	-8 559,55	-8 295,41	-8 168,08
CH4	128,227	16,057	6,704	19,276	21,150
N2O	192,00	166,35	164,21	167,09	167,52
6. Waste	4 117,06	4 054,87	3 967,56	3 816,33	3 761,83
CO2	35,44	43,19	33,89	14,17	9,66
CH4	3900,09	3827,64	3754,36	3632,52	3580,21
N2O	181,53	184,04	179,30	169,64	171,96
7. Other	NA	NA	NA	NA	NA
NATIONAL TOTAL EMISSIONS	61 401,68	58 661,54	49 416,54	52 243,36	58 153,88
International bunker	718,87	1 046,77	1 176,58	867,00	786,60

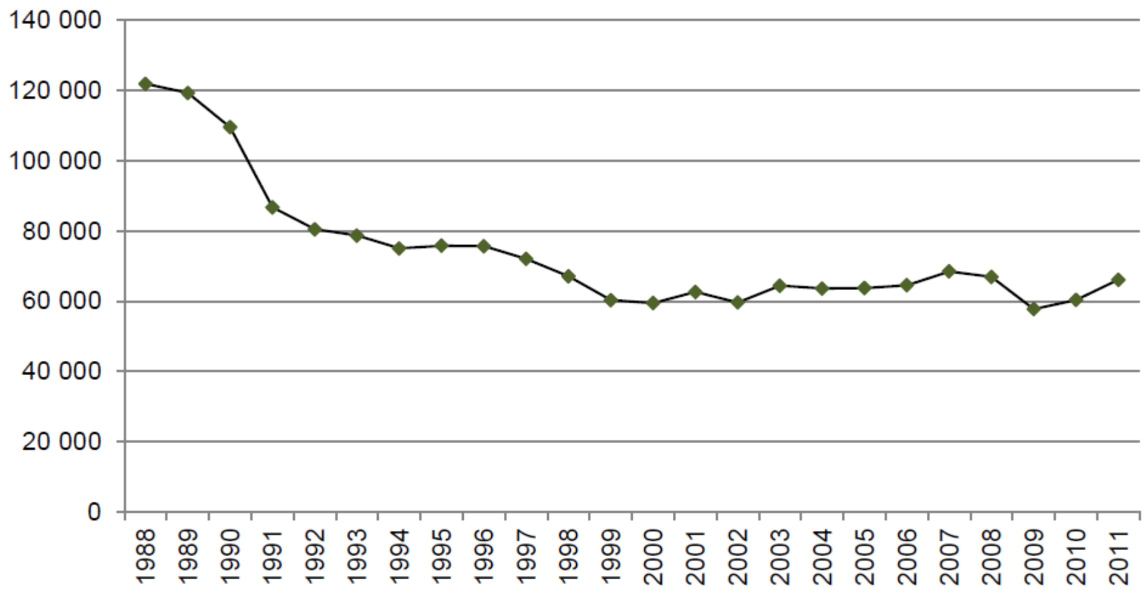
In 2011 Bulgaria's greenhouse gas emissions totalled 66 133,28 Gg CO2eq without reporting of sequestration from LULUCF sector. The emissions decreased by 45,8% compared with the base year and on 45.8% below the level of 122 000 Gg CO2eq to which Bulgaria should limit its emissions during the Kyoto Protocol's first commitment period between 2008 and 2012.

Emissions in 2011 were 9.6 % increase in comparison with the emissions of the previous year.

Compared to the base year the emissions of non-GHGs emissions decreased as follows:

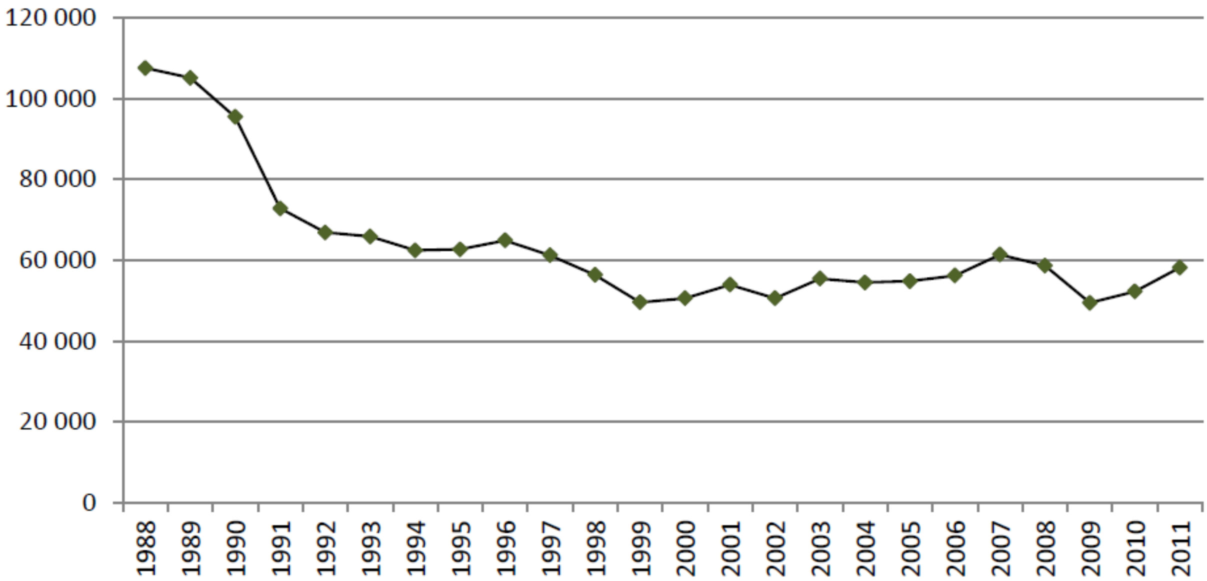
- NO_x with 44%
- CO with 60%
- SO_x with 7%
- NMVOC with 90%.

Figure 3.1 Total GHG emissions (without LULUCF) for 1988-2011, Gg CO2 eq



The net emissions including reporting of sequestration from LULUCF sector were 57 747.13 Gg CO2 eq. The emissions decreased by 46.4% compared with the base year.

Figure 3.2 Total GHG emissions (including LULUCF) for 1988 – 2011, Gg CO2 eq



The main reasons for the declining GHG emission trend in Bulgaria are the structural economic changes due to the radical transition process from a centrally-planned economy to a market-based economy. This led to a decrease of power production from thermal power stations (and an increase of the shares of hydropower and nuclear power), structural changes in industry (including a decline in production by energy-intensive enterprises and energy-efficiency improvements), introduction of energy efficiency measures in the residential sector and a shift from solid and liquid fuels to natural gas in energy consumption. This also led to a decrease in GHG emissions from the agricultural sector stemming from the decline in the cattle and sheep populations and the use of fertilizers.

Bulgaria experienced a steady declining population trend during the period 1990-2011, which resulted in the reduction of population by 13%.

The most important greenhouse gas in Bulgaria is carbon dioxide. The share of CO_2 emissions from the total greenhouse gas emissions varies around 80% excluding LULUCF and 77% including LULUCF. In absolute terms CO_2 emissions have decreased 40,9% since 1988. Around 75% of total CO_2 eq emissions originate from the Energy sector. The amount of energy-related CO_2 emissions has fluctuated much according to the economic trend, the energy supply structure (including electricity exports) and climate conditions.

Methane emissions (CH_4) have decreased by 55,4% from the 1988 level. This is mainly due to the improvements in waste collection and treatment and a reduction in animal husbandry in the Agriculture sector. Correspondingly, emissions of nitrous oxide (N_2O) have also decreased by 67% which has been occasioned mostly by the reduced nitrogen fertilisation of agricultural fields; the biggest decline was in the beginning of time series.

Figure 3.3 Total GHG emissions by gas and in total in Gg CO2 eq. for 1988 – 2011.

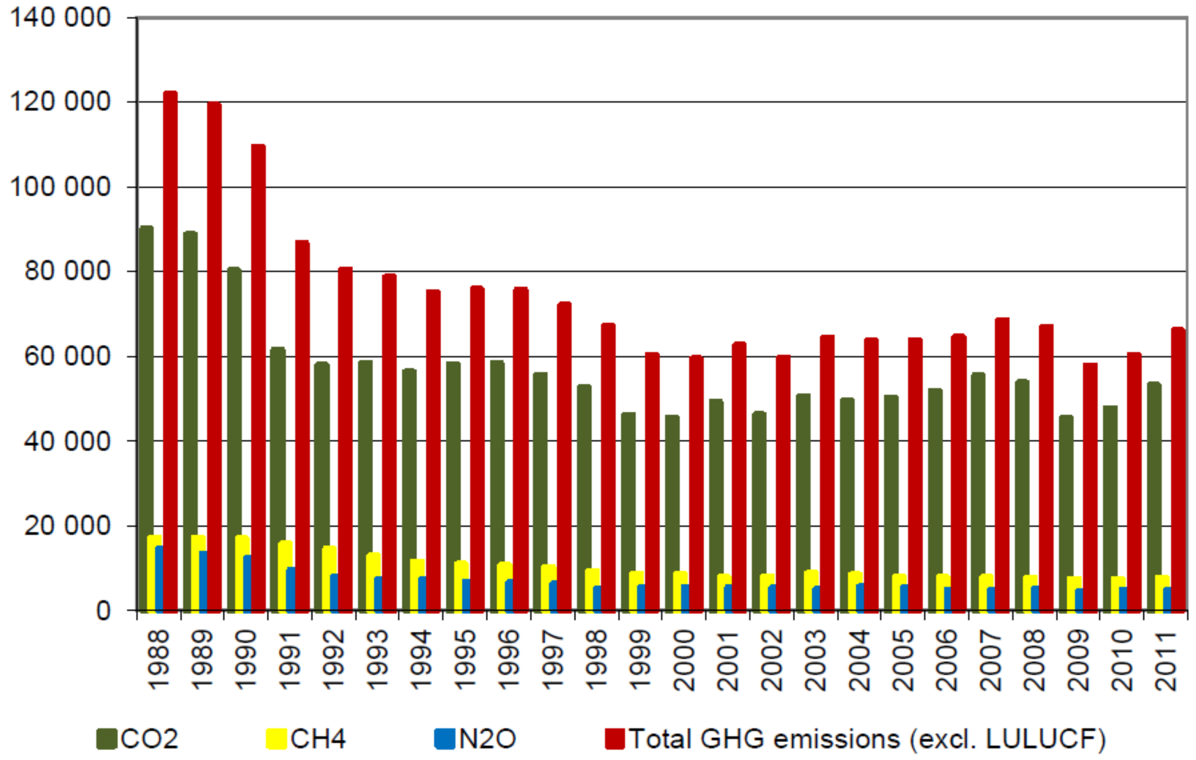
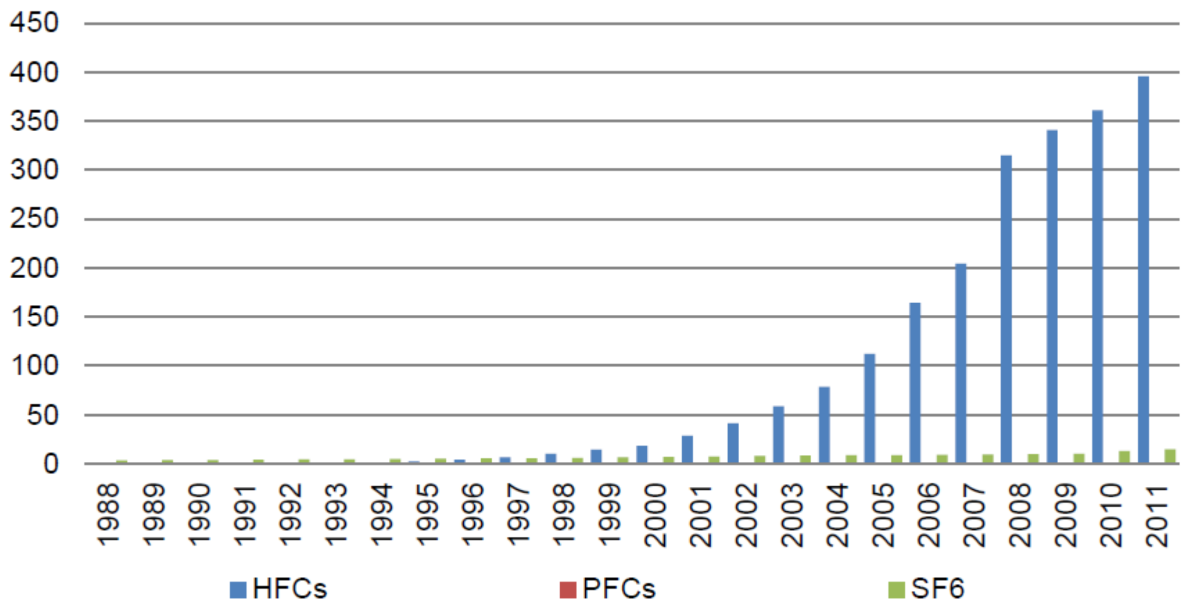


Figure 3.4 Actual emissions of HFCs, PFCs and SF6 for 1988 – 2011, Gg CO2 eq.



The emissions of F-gases have increased over tenfold during 1995-2011. A key driver behind the trend has been the substitution of ozone depleting substances (ODS) by F-gases in many applications.

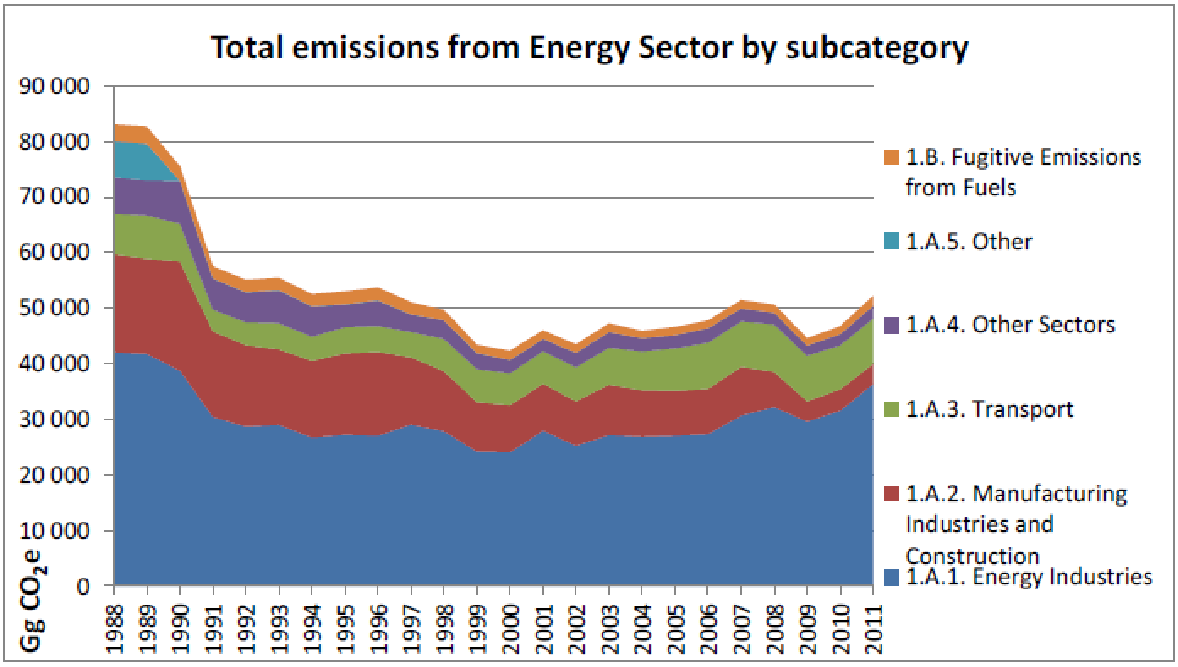
3.2.1. Energy

Emissions from the energy sector in 2011 decreased by 37% compared to the base year (52 203 Gg CO2 eq in 2011 compared to 83 081 Gg CO2 eq in 1988), although there is an increase of 12% compared to last year. Main source of emissions in the Energy sector is Fuel combustion of solid fuels, which is responsible for 65.8% of the emissions.

The main reasons for the decrease of the GHG emission trend in energy sector are the transition from a centrally-planned economy to a market-based economy, reconstructing of the economy and subsequent economic slowdown. This led to a sharp drop in demand for electricity production from thermal power production.

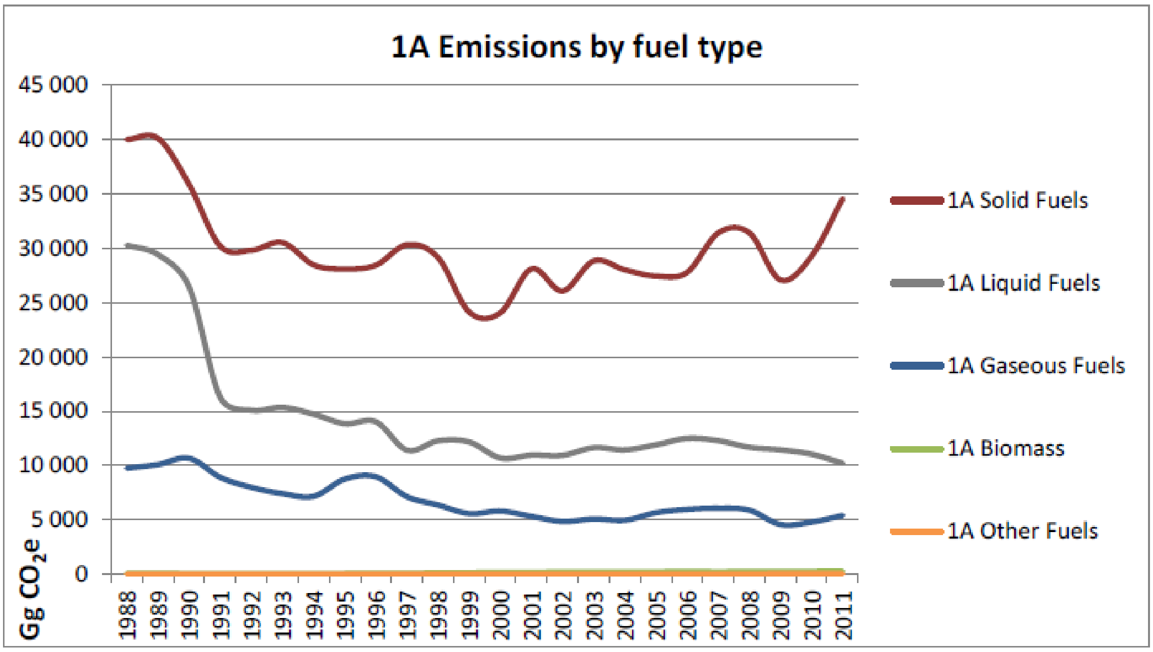
The trend of GHG emissions between 1988 and 2011 was defined by a substantial decrease of emissions from fuel combustion in energy industries (13.7%) and energy use in manufacturing industry and construction (79.1%) and in other sectors (64.9%), as well as a clear increase in GHG emissions from transport (10.1%).

Figure 3.5 Total GHG emissions from Energy Sector by subcategory



Main source of emissions in the energy sector is fuel combustion of solid fuels, which is responsible for 68.5% of the emissions from fuel combustion in 2011, followed by liquid fuels with 20.2% and gaseous fuels with 10.7%.

Figure 3.6 GHG emissions from fuel combustions by fuel type

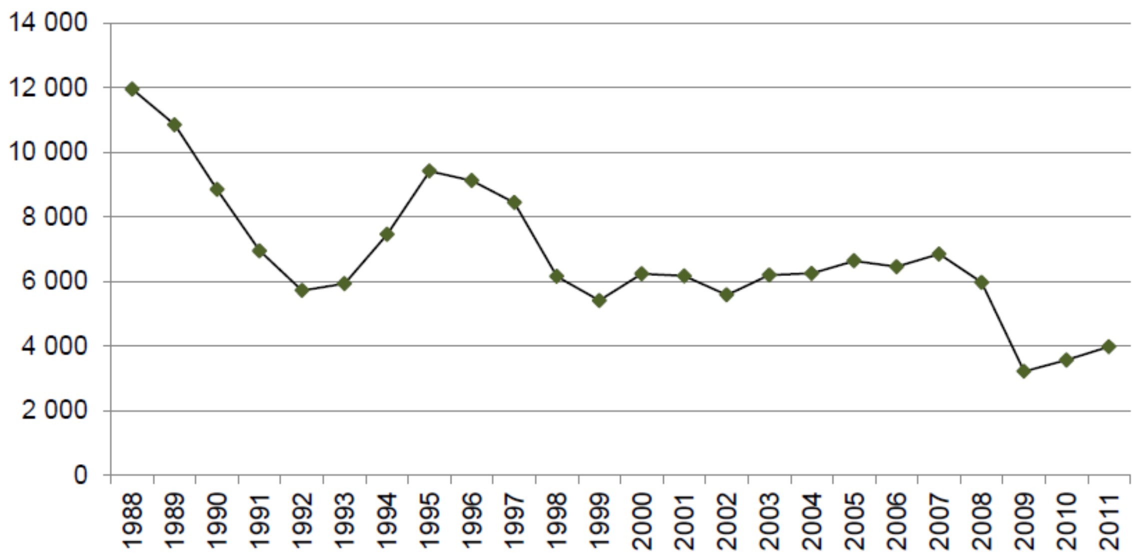


3.2.2. Industrial Processes

A steady trend towards emission reduction in this sector is observed since 1988. The emissions in 2011 decreased with 67% compared to the base year.

In the year 2011, 6.01% of national total greenhouse gas emissions (without LULUCF) originated from industrial processes, compared to 9.81% in the base year 1988. In 2011, greenhouse gas emissions from Industrial Processes are 3 977.93 Gg CO2 equivalent compared to 11 959.94 Gg in the base year. The Industrial processes GHG emissions trends are given in Figure 3.7.

Figure 3.7 GHG emissions from Industrial processes sector for 1988 – 2011, Gg CO_2 eq



In 2011 the most important emitting category is Mineral products (mainly clinker production), which share in the total Industrial processes emissions is 68.4%. The second category by share is Chemical Industry (ammonia and nitric acid production) with 19.6%, followed by Consumption of Halocarbons and SF6 with 10.3% share and finally Metal Production (steel) with 1.7%.

Greenhouse gas emissions from the Industrial Processes sector fluctuate during the period and reach a minimum in 2009. The reduction in 2011 for the whole sector is 66.7% while the biggest reduction (compared to the base year) can be seen in Metal Production category – 98.2%.

This is mainly due to economic crisis and in particular the world economic crisis in 2009. The periods around 1989/1991 and 1997/1999 represent the economic crisis time after which stabilization and increase in the production rates begins. After 1996 a process of privatization begins which leads to decrease in the plants' production. This process is followed by restructuring and modernization of the production while at the same time some of the enterprises cease operation. In 2010 – 2011 the market was recovered.

3.2.3. Agriculture

The overall emission reduction in the sector has amounted to 69.6% since 1988. In the year 2011 the sector agriculture contributed 9.3% to the total of Bulgaria's greenhouse gas emissions (without LULUCF).

Direct emissions result from:

- Soil fertilization with synthetic nitrogenous fertilizers;
- Nitrogen input from manure applied to soils (excluding manure from pasture animals);
- Decomposition of waste from N-fixing crops;
- Decomposition of vegetable waste from other cultures;
- Cultivation of histosols.

The emissions of **pasture animals** include emissions from the excretion on pasture range and paddock.

Indirect emissions include:

- Ammonia and nitrous oxides release in the ambient air after nitrogen fertilization;
- Emissions from drawing of water.

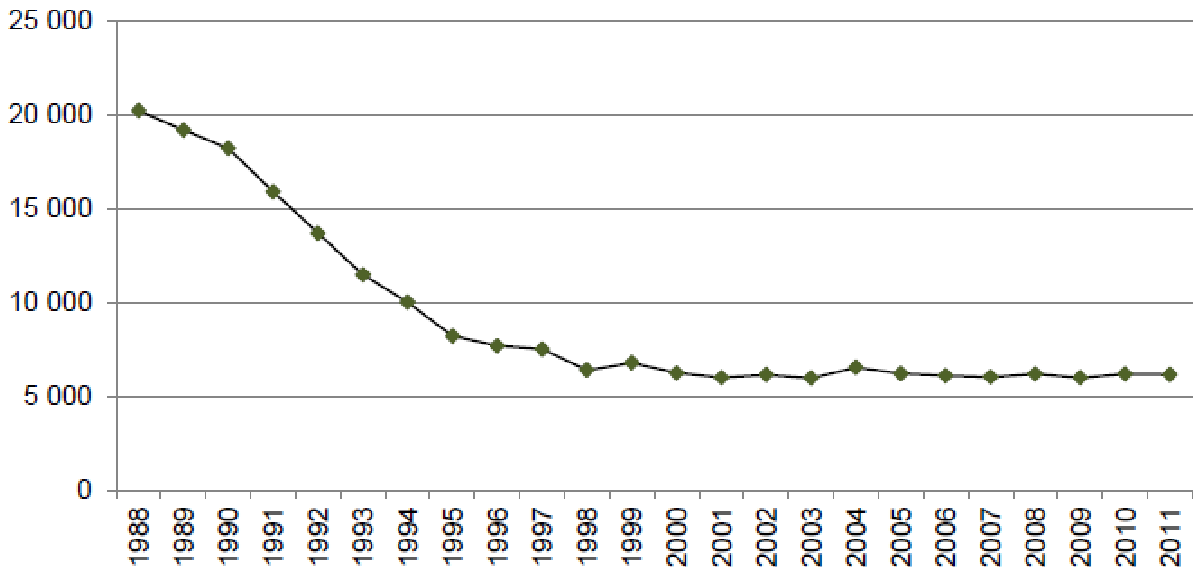
Activities described above are differentiated according to the IPCC classification. One has to take into consideration that the existing emissions of methane from soil are considered natural (non-anthropogenic) and is not subject of the inventory.

Direct N_2O emissions are 2057 Gg CO2-eq. in 2011. The emission decrease by 0,55% in 2011 compared to 2010.

Indirect N_2O emissions were 1206,3 Gg CO2-eq. in 2011. The emissions from this decrease by 2,37% compared to 2010.

The emissions from pasture animals decrease by 1,28% compared to 2010.

Figure 3.8 GHG emissions from Agriculture sector for 1988 – 2011, Gg CO2 eq



The emission reductions were mainly driven by systematic declines in the agricultural land area due to abandoning of arable lands and reduction in livestock population. Another driver for the emission reduction was the decline in the use of fertilizers.

3.2.4. Waste

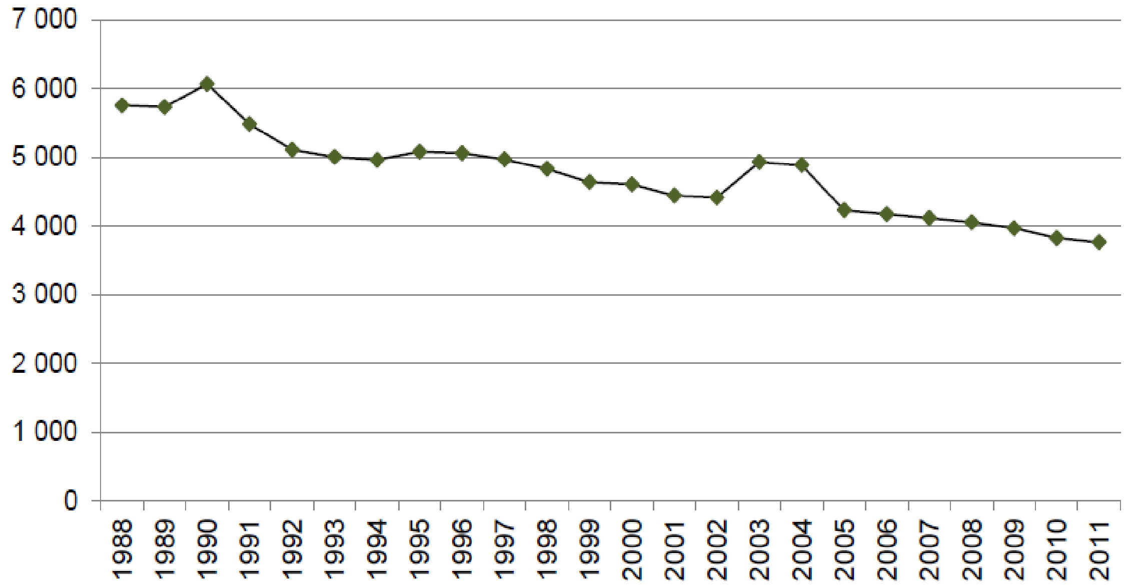
Emissions from the waste sector in the year 2011 are about 3 762 Gg CO2 equivalents, and they are around 7 % including LULUCF and around 6 % excluding LULUCF of national total GHGs emissions from Bulgaria.

Solid Waste Disposal on Land contributes over 77.08%, Wastewater Handling about 22.17%, Waste Incineration about 0.35% and compost production about 0.39% sectors total emissions.

Emissions from the waste sector in 2011 decreased by 34.67 % (3 761.83 Gg CO2-eq in 2011 compared to 5 758.08 Gg CO2-eq in 1988) compared to the base year.

Figure 3.9 below presents the total CO2 emissions from the whole waste sector.

Figure 3.9 GHG emissions from Waste sector for 1988 – 2011, Gg CO2 eq.

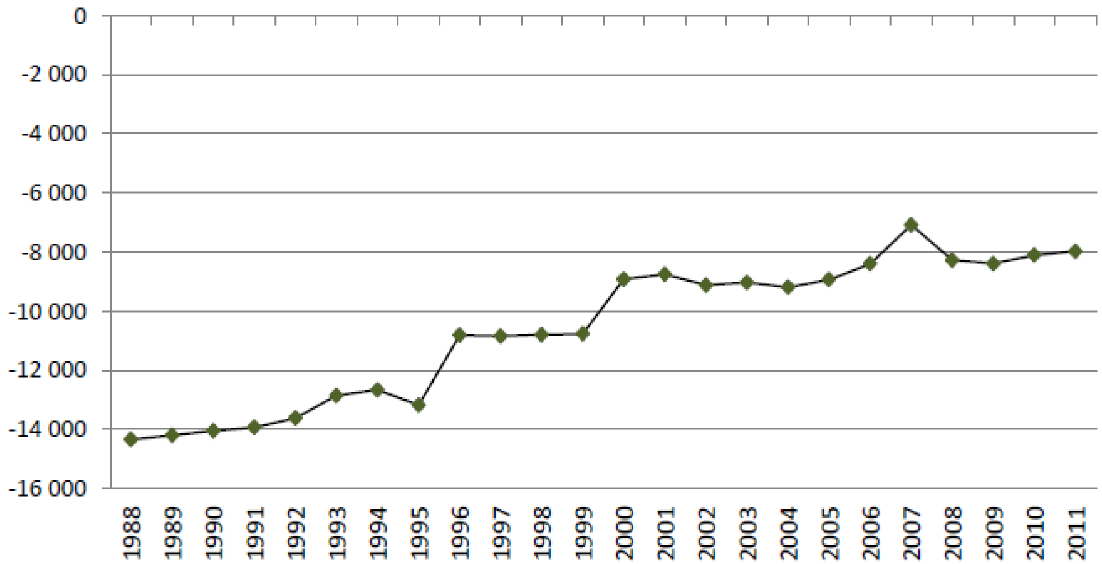


3.2.5. Land use, land use change and forestry

The trend of net CO_2 removals (CO2 eq) from LULUCF decreases by 40.63% compared with the base year, reaching its lowest points in years 2006 and 2007. The reason for the decrease of the uptakes of CO_2 emissions is mainly due to the change in wood stock, which in the 2000-ies was smaller than in the 90-ies. The trend of total removals after the year 2007 is going up due to an increase in net removals from Forest land and a slight decrease in croplands‟ emissions. The net changes of the carbon stock in the biomass cause biggest effect on the final results, obtained for the whole sector. Over the period 1990-2011 a permanent trend is observed for increasing the tree biomass stock (by 47% for the coniferous species and by 23% for the deciduous).

The emissions and the removals are presented in Figure 3.10.

Figure 3.10 CO_2 LULUCF emissions and removals for 1988 – 2011 CO2 eq.



In spite of the decrease observed, the share of the removals from the total GHG emissions (in CO2 eq) is still remarkable. The reason for this is that the emissions in the other sectors have dropped dramatically. The share of the removals in the base year has the figure of -11.8% from the total GHG emissions in CO2 eq, while in the inventoried year the share is - 12.1%.

Comparing with the base year an increase in the emissions in croplands, settlements and wetlands is observed. The total emissions from croplands fluctuate during the whole time series. The emissions from Wetlands and Settlements increase last couple of years due to changes from other land use to Settlements and Wetlands (mostly for reservoirs) according to the risen infrastructural activities since Bulgaria's joined the EU).

3.3. Summary of Methodology and Data Sources

Carbon dioxide emissions

The CO_2 emissions are derived by combustion of fuels in the energy sector, transport and households. The default emission factor and emission factor reported with the ETS for CO_2 are applied.

The activity data are based on the Eurostat Energy Balance. For the year 1988 and 1989 the IEA Energy balance is used. Both balances are harmonized:

- 1988 – 1989: IEA energy balance prepared and reported by NSI;
- 1990 – 2011: Eurostat energy balance prepared und reported by NSI.

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

Carbon dioxide sequestration

The inventory methodology for the greenhouse gases is based on the principles envisaged in the IPCC GPG. All the land use changes were traced down and reported for a transition period of 20 years after which they are reported in the respective categories.

To achieve the full time series of 1988-2011 for the areas staying in a certain category land-use and the converted lands, data form different statistical sources are used - the Forestry fund reports (Executive Forestry Agency), National Statistical Yearbook, Agrostatistics and Strategies Department at the MAF, Balance by Type of Territories as per their Designation, Cadastre Agency, Corine Land Cover - Executive Environmental Agency.

For the time being, Bulgaria reports on CO_2 sequestration from forestry only (category 5.A from sector “Land-Use Change and Forestry”). Data for C sequestration from forestry is on the basis of:

- Area of forestry used;
- Average annual forest growth by species (in m^3/ha/year)
- Annual felling (in m^3/year).

Methane

CH_4 emissions from fuel combustion were estimated by data from the Eurostat Energy Balance and the default emission factor (IPCC 1996 Reference Manual, Ch.1, Table 1-7, p. 1.35).

CH_4 emissions from road transport are estimated with the 2006 IPCC Guidelines default GHG EFs for liquid and gaseous fuels (2006 IPCC, Volume 2: Energy, table 3.2.1, page 3.16).

Fugitive CH_4 emissions from coal mining and the systems for extraction and distribution of oil and natural gas are estimated by method of the type IPCC Tier 1, as emission factors, given in IPCC GPG, were used.

The IPCC Tier 1 method has been used to estimate the emissions from all farm animal categories with the exception of cattle (IPCC Sub-category 4A1) for which a Tier 2 method is used with option B. CH_4 emissions are calculated using standard emission factors from the IPCC Guidelines in the framework of the Tier 1 method.

Methane emissions from solid waste disposal sites are estimated by the method of type Tier 2, specified in IPCC Guidance. The main source of activity data is NSI. Data on Municipal Solid Waste generation rate and on the quantity of MSW disposed to SWDSs and etc. are available and country specific data, IPCC Guidelines (Revised 1996 Guidelines, and 2006 IPCC Guidelines) were used.

Nitrous oxide

N_2O emissions from fuel combustion are estimated by data from the general energy balance of the country and default emission factors, referenced in IPCC 1996 Reference Manual, Ch.1, Table 1-8, p. 1.36.

The emissions from road transport are estimated by the 2006 IPCC Guidelines default GHG EFs for liquid and gaseous fuels (2006 IPCC, Volume 2: Energy, table 3.2.1, page 3.16).

N_2O emissions from chemicals include the *nitric acid production* only. Method (referred as Tier 3 in 2006 IPCC Guidelines, Chapter 3, p. 3.21) is applied. For the 2000 to 2011 emission data from plant operators were available; for the entire time series the production data were available. Following the recommendations of 2006 IPCC GL as a good practice in order to reduce uncertainty all activity data obtained were for 100 % HNO_3. For the years 2000 to 2011 a plant specific emission factor was calculated on the basis measured data from plants operators. For the period 1988 – 2000 the IEF was applied, assuming that technology and abatement types are similar. A default emission factor was applied for the third plant where no information is available and which stopped working in period 1999/2000.

N_2O emissions from *agriculture soils* are estimated in accordance with the IPCC methodology. The emission factors are selected from the IPCC Guidelines. The manure quantity is calculated using the prototype parameters for different types of animals in the Eastern Europe region, given in the IPCC Guidelines. The synthetic fertilizers quantities are provided by the National Service for Plant Protection at the Ministry of Agriculture and Food.

The IPCC default methodology is used for calculating N_2O emissions from *human sewage* based on annual per capita protein intake. Activity data come from NSI and from Waste Management Directorate of the MOEW.

3.4. Recalculations

The GHG emission recalculations for the period 1988-2011 (emission data 1988-2011) were made because of update and revision of activity data, EF and other parameters used for all sectors.

The main reason for recalculations is implementation of recommendations of the Expert Review Team as set out in the annual review report.

3.5. Description of the Institutional Arrangement for Inventory Preparation

The Bulgarian National Inventory System (BGNIS) changed over time two times because of decisions of the particular government. In the following table the national circumstances are outlined:

Table 3.3 Bulgarian National Inventory System

BGNIS until 2007 (submission 2007)	Present BGNIS (submission 2008 -2013)	Prospected BGNIS
Centralized inventory	Centralized inventory	Centralized inventory
Single institute	Single agency	Single agency
Out-sourced inventory	In-sourced inventory	In-sourced inventory
Consultant	Public/Governmental (submission with cooperation of consultants)	Public/Governmental (submission with cooperation of consultants)
National Inventory Focal Point: ExEA	National Inventory Focal Point: ExEA	National Inventory Focal Point: ExEA
National Focal Point: MoEW	National Focal Point: MoEW	National Focal Point: MoEW

Until 2007 the national emissions inventory as well as the relevant NIR under UNFCCC was prepared by an external company (Energy Institute) through an open tender procedure under the rules of the Public Procurement Law. The submissions 2003 – 2007 have been prepared on annual contractual basis by the Energy Institute. The annual inventory and the NIR were presented by the Energy Institute to the ExEA Expert Council for approval. The Council finally approved the Inventory and allowed its submission to the UNFCCC Secretariat.

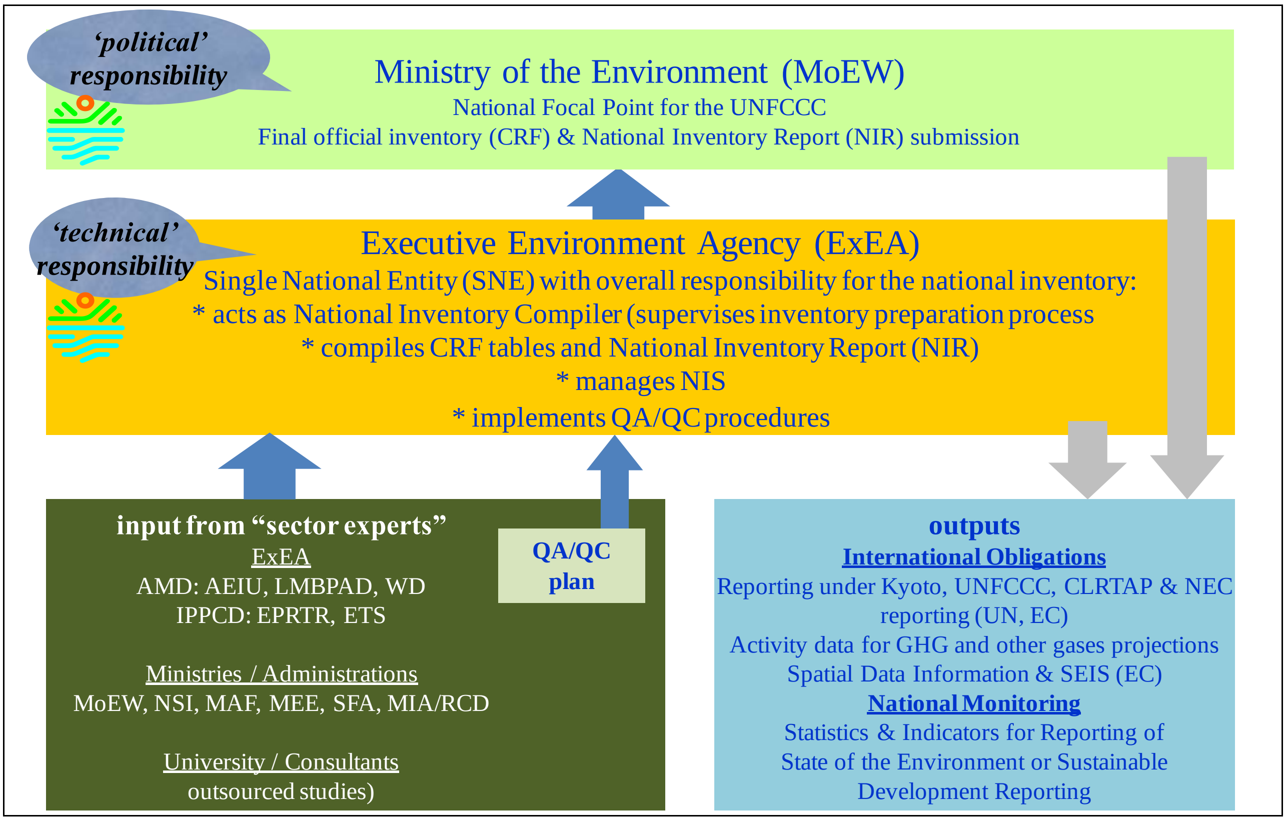
Since 2008 the Executive Environment Agency (ExEA) is responsible for the whole process of inventory planning, preparation and management.

The national system defines the "road map" in which Bulgaria prepares its inventory. This is outlined in the national inventory preparation cycle.

As it is illustrated in Figure 3.11 and outlined in the following chapters the preparation of the inventory has an institutional "home" that is ultimately responsible for managing the process and has a legal authority to collect data and submit it on behalf of the Bulgaria.

Bulgaria's reporting obligations to the UNFCCC, UNECE and EC are being administered by the MoEW. All activities on preparation of GHG inventory in Bulgaria are coordinated and managed on the state level by MoEW. The National Climate Change Focal Point is Ms. Diana Todorova, Senior Expert in the Climate Change Policy Directorate.

Figure 3.11 Organizational Chart of the Bulgarian National Inventory System



The Bulgarian Government by MoEW (Climate Change Policy Directorate) has the political responsibility for compliance with commitments under the UNFCCC and the Kyoto Protocol, including for functioning of BGNIS in accordance with the requirements of Decision 19/CMP.1 under Article 5, paragraph 1, of the Kyoto Protocol. In order to meet all challenges in this sphere, the Climate Change Policy has been transformed in a separate directorate and its staff has been increased with 6 experts. Now, it consists of 12 persons in total.

The national reporting obligations to the UNFCCC, UNECE and EC are administered by the MoEW.

The ExEA has been identified as the responsible organization for preparation of Bulgaria's National GHG Inventory under the UNFCCC and the Kyoto Protocol and designated as single national entity.

The ExEA is represented and managed by an Executive Director. The Emission Inventory Department is allocated in the Environmental Monitoring and Assessment Directorate. The ExEA's directorates and departments, which are directly involved in operation of the BGNIS are:

- **Environmental Monitoring and Assessment Directorate** with the Air Monitoring Department **(**AMD), Emission Inventory Department **(**EID), Land Monitoring Biodiversity and Protected Areas (LMBPAD), Waste Department (WD) and
- **Permit Regime Directorate with the** Integrated Pollution Prevention and Control Department **(**IPPCD) and Emission Trading Permit Department (ETPD).

The overall objective of the BGNIS is annually to produce a high quality inventory (National CRF, Kyoto and SEF tables and NIR) for compliance with its Kyoto commitment and to submit it by the required deadline.

The ExEA has been identified as the responsible organization for preparation of Bulgaria's National GHG Inventory under the UNFCCC and the Kyoto Protocol and designated as single national entity. ExEA has the technical responsibility for the national inventory:

- acts as National Inventory Compiler (supervises inventory preparation process);
- compiles CRF tables and NIR;
- manages BGNIS;
- implements QA/QC procedures;
- acts as National Inventory Focal Point.

The legal basis for BGNIS is formulated by the following documents:

1. Environmental Protection Act (EPA, State Gazette No. 91/25.09.2002; corrected, SG No. 96/2002; last amendment June 2010);
2. Statute on the organization and structure of ExEA (Decision of Council of ministers 162/03.08.2010);
3. Order № 110/30.04.2010 by the Executive Director of ExEA, replaced by new Order N 202/29.09.2010 (Sector experts/QC experts);
4. Order № RD-218/05.03.2010 by the Minister of Environment and Water (QA experts).

5. Regulation of the Council of Ministers 215/21.09.2010 SG 76/2010 on the way and order of organization of the National Inventories of hazardous substances from greenhouse gases in the ambient air

EPA establishes the National Environmental Monitoring System, The Act sets that the Minister of Environment and Water shall direct the National Environmental Monitoring System through the Executive Environment Agency (article 11 (2)).

Article 144: (1) of the EPA sets that the National Environmental Monitoring System shall comprehend the national networks for the system for information on, and control of, air emissions and the state of waste waters.

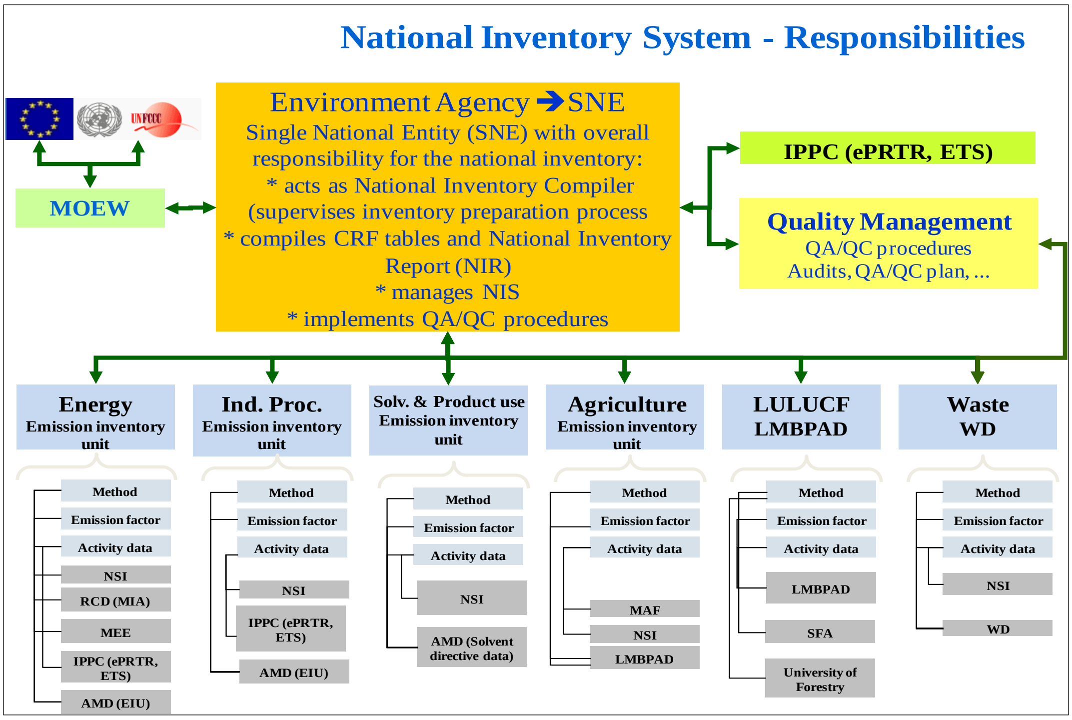
EPA establishes the national Executive Environment Agency (ExEA) according to Regulation on the organization and structure of ExEA (Decision of Council of Ministers 162/03.08.2010), which regulate it's responsibilities for monitoring of environment as well as the responsibility for preparation of emission inventories. The Emission Inventory Department of ExEA prepares and annually updates the air emissions inventories (according to article 14 (12) of the above Regulation).

To increase the capacity in ExEA for adequate planning, preparation and management of emissions inventory an Order № 110/30.04.2010 by the Executive Director of ExEA, replaced by new Order N 202/29.09.2010 has been issued. The order regulates the names and responsibilities of experts from different departments within the ExEA, which are engaged in preparation of National GHGs emission inventory (Sector experts/QC experts). The responsibilities of different departments are presented below on Figure 3.12: Bulgarian National Inventory System – Responsibilities).

To assure the quality of information reported to UNFCCC and UNECE and to support the single national entity, the Minister of Environment and Water has issued an order № RD-218/05.03.2010. The order regulates the names and responsibilities of the MoEW and ExEA QA experts for implementation of the requirements of National QA/QC Plan in emission inventory of sectors Energy, Industry, Solvents, Agriculture, LULUCF and Waste.

The BGNIS has been enshrined in law through a special Regulation of the Council of Ministers 215/21.09.2010 SG 76/2010. The new regulation establishes and maintains the institutional, legal and procedural arrangements necessary to perform the general and specific functions of BGNIS, defined in Decision 19/CMP.1 for national systems. The new regulation reinforces the existing institutional agreements by specifying the roles of all data providers.

Figure 3.12 Bulgarian National Inventory System – Responsibilities



3.1. National systems in accordance with Article 5, paragraph 1, of the Kyoto protocol

From 28 September to 3 October 2009 UNFCCC Expert Review Team (ERT) conducted an in-country review of Bulgaria's 2009 annual submission in accordance with the Guidelines for review under Article 8 of the Kyoto Protocol (Annex to decision 22/CMP.1). The ERT found that Bulgaria's 2009 annual submission was not sufficiently transparent, consistent, comparable, complete and accurate, as required by the UNFCCC reporting guidelines, the IPCC good practice guidance and the IPCC good practice guidance for LULUCF. In particular, the ERT found that the institutional arrangements and arrangements for the technical competence of its staff within the national system involved in the inventory development process were insufficient to enable the adequate planning, preparation and management of Bulgaria's annual submission in accordance with the aforementioned guidelines.

On 9 March 2010, the UNFCCC Secretariat received a question of implementation from the ERT, indicated in the report of the review of the annual submission of Bulgaria submitted in 2009 and contained in document FCCC/ARR/2009/BGR. In accordance with paragraph 1 of section VI and paragraph 2 of rule 10 of the rules of procedure, the question of implementation was received by the Compliance Committee on 10 March 2010.

In accordance with the Procedures and mechanisms relating to compliance contained in the annex to decision 27/CMP.1 and adopted under Article 18 of the Kyoto Protocol and the Rules of procedure of the Compliance Committee of the Kyoto Protocol, the Enforcement branch adopted final decision on 28 June 2010. The Enforcement branch determined that Bulgaria was not in compliance with the Guidelines for national systems for the estimation of anthropogenic GHG by sources and removals by sinks under Article 5, paragraph 1, of the Kyoto Protocol. Hence, Bulgaria did not meet the eligibility requirements under Articles 6, 12 and 17 of the Kyoto Protocol to have in place a National system in accordance with Article 5, paragraph 1, of the Kyoto Protocol and the requirements and guidelines decided thereunder.

3.1.6. Institutional Arrangements

In order to strengthen the institutional arrangements and to fulfil the required general and specific functions of BGNIS official agreements between MoEW and the main data providers were signed in 2010:

- National Statistical Institute (RD21-35/12.02.2010);
- Ministry of Agriculture and Food and its body Executive Forest Agency (04-00-517/26.02.2010 and RD 50-47/15.03.2010);
- Ministry of Economy, Energy and Tourism (14/06/2010);
- Ministry of Interior (MI) (08/06/2010).

The new agreements ensure the support from these organisations regarding the choice of the activity data and EFs and methods, in the compilation of emission estimates and QA/QC of these estimates.

The ExEA as Single National Entity coordinates all activities, related to collecting inventory data of GHG emissions by the following entities:

1. National Statistics Institute (NSI)
2. Ministry of Agriculture and Food (MAF) and their relevant services (Agrostatistic Directorate and Executive Forestry Agency)
3. Ministry of Economy, Energy and Tourism (MEET)
4. Ministry of Interior (MI)
5. Ministry of Environment and Water (MoEW)
6. Ministry of Transport, Information Technologies and Communications (MTITC)
7. Large industrial plants
8. Branch Business Associations

3.2. Collection of activity data by ExEA

The information is collected on the annual basis.

The ExEA sends every year letters with request for provision of the necessary activity data to every one of the information sources, including the deadline for response.

For NSI, MAF, SFA the type of the necessary data, as well as the deadlines for submissions to ExEA are regulated by the official agreements mentioned above as well as by the Regulation of the Council of Ministers 215/21.09.2010 SG 76/2010.

The annual national energy and material balances as well as the data related to the solid waste generation and the waste water treatment are prepared by NSI. NSI uses up-to-date statistical methods and procedures for data collection, summarizing and structuring that are harmonized with EUROSTAT.

The GHG inventory uses data, received directly from large point sources in the energy sector and the industry and this data is summarized by ExEA.

Table 3.4 Sources of activity data for preparation of national GHGs emission inventory

Sectors	Data Source of Activity Data	Data supplier	
1. Energy			
1.A Fuel Combustion	Energy balance (IEA - EUROSTAT - UNECE Energy Questionnaire	NSI	National Statistical Institute
1.A.3 Transport	Energy balance (IEA - EUROSTAT - UNECE Energy Questionnaire	NSI	National Statistical Institute
	Statistics vehicle fleet	MIA/RCD	Ministry of Internal Affairs/ Road Control Department
	Country specific parameters used in the COPERT IV related to car fleet and vehicle split.	NSI	National Statistical Institute
1.B Fugitive emissions	Energy balance (IEA - EUROSTAT - UNECE Energy Questionnaire	NSI	National Statistical Institute
	National statistics	MEE	Ministry of Economy and Energy
2. Industrial processes	National production statistics	NSI	National Statistical Institute
	National registers (EPRTR and ETS)	ExEA	Executive Environment Agency
	National studies	MoEW/ ExEA	Ministry of Environment and Water Executive Environment Agency
3. Solvents and Other product use	National production statistics National VOC register	NSI ExEA	National Statistical Institute Executive Environment Agency
4. Agriculture	National agriculture statistics	MAF	Ministry of Agriculture and Food /Statistics Department
5. LULUCF	National Forest Inventory	SFA	Ministry of Agriculture and Food Executive Forestry Agency
6. Waste	National statistics	NSI	National Statistical Institute
	National studies	ExEA	Executive Environment Agency/ Waste Department

3.3. Quality management system

As already mentioned, the Executive Environment Agency is responsible for the preparation of the National Emissions Inventories and the relevant National Inventory Reports under UNFCCC and UNECE/CLRTAP.

The ExEA is also responsible for coordinating QA/QC activities for the national inventory. A quality manger is in place.

The Bulgarian Quality Management System was established in the frame of project with Bulgarian Academy of Science, Geophysical Institute. The project was carried out and finished in 2008.

The QA/QC plan is an internal document to organise, plan and implement QA/QC activities. Once developed for the next submission, it is referenced and used in subsequent inventory preparation, or modified as appropriate.

The official QA/QC Plan for National emissions inventories was approved by the Ministry of Environment and Water in 2009.

The QA/QC plan was updated in August 2010 in order to implement the new established legal, institutional and procedural arrangements within the BGNIS. National QA/QC Plan includes following elements:

- Responsible institutions;
- Data collection;
- Preparation of inventory;
- QC Procedures;
- QA Procedures;
- Uncertainty evaluation;
- Organisation of the activities in quality management system;
- Documentation and archiving.

Figure 3.13: National quality assurance and quality control program

does NOT require knowledge of the emission source category	requires knowledge of the emission source category
general	**source specific**
QC procedures sector experts (1^{st} party) performed throughout preparation of inventory	
TIER 1	**TIER 2**
data validation, calculation sheet (check of formal aspects)	preparation of NIR, comparison with Guidelines (check of applicability, comparisons)
QA procedures quality manager (2^{nd} or 3^{rd} party; staff not directly involved, preferably independent) performed after inventory work has finished	
TIER 1 basic, before submission	
	MOEW experts **Internal audit / EU 'Initial check'** **(Expert Peer Review)**
	evaluate if TIER2 QC is effectively performed (check if methodologies are applicable)
TIER 2 extensive	
System audit (Audit)	**ICR by UNFCCC (Expert Peer Review)**
evaluate if TIER 2 QC is effectively performed	evaluate if TIER 2 QC is effectively performed (Check if methodologies are applicable)

must

The legal and institutional arrangements within the BGNIS regulate the responsibilities of all engaged institutions for implementation of the requirements of the National QA/QC Plan.

The QC procedures are performed by the sectors and experts, who are directly involved in the process of preparation of inventory with their specific responsibilities.

The QC procedures are implemented by all activity data providers and ExEA's sector experts (Order №110/30.04.2010 by the Executive Director of ExEA) and/or external consultants.

Table 3.5 QC experts within the BGNIS

Responsibility	QC experts
Activity data	MAF, MI, MTITC, MEET, NSI, EAF, ExEA, MOEW
Methodology and selection of emission factors	ExEA, MAF, MI, MTITC, MEET, NSI, EAF, MOEW
Sector inventories preparation	Sector experts ExEA and/or external consultants

The QC experts are:

- experts, responsible for activity data provision;
- experts, involved in the choice of method and selection of emission factors;
- sector experts and/or consultants, who prepare the sector inventories, including preparation of reporting tables and respective chapters from the national reports.

All institutions, engaged in the functioning of BGNIS are responsible for quality of information, provided by their competence to the ExEA for preparation of national emission inventories. The institutions are obligated to implement all requirements of the international and national standards for collection, processing and provision of activity data.

Quality Assurance (QA) is a planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process. The quality assurance process includes expert review conducted in two stages: a review of the initial set of emission estimates and, a review of the estimates and text of the Inventory Report.

QA experts could be:

- Sector experts from the MoEW, which are engaged through internal; administrative order by the minister of environment and water;
- Experts from research institutes in accordance with them competence;
- Other external reviewer (national and/or international).

The QA procedures include checks in accordance with FCCC/SBSTA/2006/9. QA procedures are implemented by sector experts within the MoEW and experts from the ExEA, who are not directly involved in the preparation of inventory (Order № RD-218/05.03.2010 by the minister) or external reviewers.

The expert peer review presents opportunity to uncover technical issues related to the application of methodologies, selection of activity data, or the development and choice of emission factors. The comments received during these processes are reviewed and, as appropriate, incorporated into the Inventory Report or reflected in the inventory estimates.

QA/QC activities of data provider

The QA/QC Plan is provided for implementation to all institutions, which are engaged in the process of preparation of emissions inventories under UNFCCC as provision of the relevant activity data.

Based on the National QA/QC Plan each of the institutions has nominated experts, responsible for preparation of the required information as well as for implementation of QA/QC procedures.

The QC experts are all experts from the institutions, who are engaged to participate in the activity of BGNIS and to implement the requirements of National QA/QC Plan

All institutions, engaged in the functioning of BGNIS are responsible for quality of information, which they are providing to the ExEA for preparation of national emission inventories. The institutions are obligated to implement all requirements of the international and national standards for collection, processing and provision of activity data.

The QC experts fill in check-list, which form is given in an annex to the National QA/QC plan. The QC experts fill the check-list for the sector they are responsible for and in the parts "Review of input data for calculation of emissions", "Activity data" and/or "Method and EF".

The check list contains all general and specific procedures for QC. It consist information for carried out review by the QC experts, including findings and corrections made.

The check lists are filled in by QC experts in accordance with their responsibilities and for each CRF category.

The check lists are exchanged between QC experts for correction of the findings within input data for calculation of emissions in the respective sectors.

Quality Management of the Sources of Initial Data

Each organization – data source, solves the quality management issues in accordance with its internal rules and provisions. With some of the sources as NSI, MAF, etc., those rules follow strictly the international practices. For example, quality assessment/quality control procedures with NSI have been harmonized with the relevant instructions and provisions of EUROSTAT. Strict rules on data processing and storage are harmonized with international organizations. Some of the large enterprises – GHG emission sources, have well arranged and effective quality management systems. Most of them have introduced quality management systems on the basis of ISO 9001:2000 standard.

Official consideration and approval of the inventory

Bulgaria's reporting obligations to the UNFCCC, UNECE and EC are being administered by the MoEW. All activities on preparation of GHG inventory in Bulgaria are coordinated and managed on the state level by MoEW. The ExEA is the responsible organization for preparation of Bulgaria's National GHG Inventory under the UNFCCC and the Kyoto Protocol and designated as single national entity (see Figure 3.11).

Quality improvement

Since November 2011, a project for “Improvement of National Quality Management System for GHG Inventories” had been started together with the Austrian Environmental Agency. The project is funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and German Federal Environment Agency with means of the Advisory Assistance Programme for Environmental Protection in the Countries of Central and Eastern Europe, the Caucasus and Central Asia.

The objectives of the project are:

Third-party audit of the current QMS according to ISO 19011 Guidelines for quality and/or environmental management system auditing. The outcome of the project is development of an efficient and optimal aligned QMS, that fulfils every quality requirement of the IPCC GPG (1996, Chap. 8) and the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Chap. 6). The project outcomes are partly implemented in Submission 2013 and are to be completed in Submission 2014.

Brief Description of the Inventory Preparation Process

The GHG inventory represents a process, covering the following main activities:

- Collecting, processing and assessment of input data on used fuels, produced output, materials and other GHG emission sources;
- Selection and application of emission factors for estimating the emissions;
- Determination of the basic (key) GHG emission sources and assessment of the results uncertainty.

Each year during inventory, some changes occur that affect directly the above listed activities. Important inventory stage is the process of data transformation into a form, suitable for CRF Tables format. During this process, aggregation of the fuels by type is made (solid, liquid and gaseous), and further data is added, regarding parameters and indices, specifying the systems for transportation and distribution of oil and natural gas, the systems for fertilizer processing, etc. These activities are just part of additional data, filled in the CRF Tables.

3.4. Brief General Description of Methodologies and Data Sources Used

According to Clean Air Act, article 25 (6) the Minister of Environment and Water in co-ordination with the interested ministers issues an order for the approval of a Methodology for the calculation, with balance methods, of the emissions of harmful substances (pollutants), emitted in the ambient air. The national Methodology (approved with Order RD 77 from 03.02.2006 of MEW) is harmonized with CORINAIR methodology for calculation of the emissions according to the UNECE/LRTAP Convention.

During 2007, MEW/ExEA had a project for development of Common methodology for emissions inventory under UNECE/LRTAP Convention and UNFCCC, i.e. to update the present Methodology under article 25 (6) CAA. (Approved with Order RD 40 from 22.01.2008 of MEW).

The aim of the project was harmonization of the national Methodology with IPCC, including the three main greenhouse gases – CO_2, CH_4 and N_2O (plus relevant ODS and SF_6).

The Bulgarian national GHGs inventory and NIR are compiled according to requirements of the following documents:

- IPCC 1996 Revised Guidelines for National Greenhouse Gas Inventories, which specify the reporting obligations according to Articles 4 and 12 of the UNFCCC (IPCC Guidelines, 1996)
- IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC GPG, 2000)
- IPCC Good Practice Guidance for Land-Use, Land-Use Change and Forestry (IPCC GPG-LULUCF, 2003)
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 IPCC GL)

The emission factors are mainly from:

- IPCC Revised Guidelines
- IPCC Good Practice Guidelines
- CORINAIR methodology
- Country-specific

3.5. Quality assurance and quality control (QA/QC)

The cycle of QA/QC activity for inventory consists of the following steps:

1. The QA/QC Manager prepares a Plan for implementation of QA/QC activities for the current submission. The check list with all specific QA/QC procedures are part of the plan;
2. The plan for QA/QC is sent to all engaged QC and QA experts for implementation;
3. In the process of preparation of inventory the QC experts (activity data provider and ExEA's sector experts) apply each of the specific procedures set in the check list for each of the sources categories they are responsible for;
4. The QA/QC Manager coordinates the exchange of the check lists between the QC experts for correction of the findings with input data for calculation of emissions (activity data and EF);
5. The QA/QC Manager send to the QA experts the prepared by ExEA's sector expert and/or external consultants CRF tables and respective chapters from NIR;
6. The QA/QC Manager coordinate the exchange of the check lists between the QA experts and ExEA's sector expert and/or external consultants for correction of the findings with quality of the inventory (CRF and NIR);
7. The QA/QC Manager prepares a summary of the results from implemented QA/QC checks;

8. The QA/QC Manager prepares an attendant file for implemented procedures;
9. The QA/QC Manager prepares a report to the executive director of the ExEA for results of the performed QA/QC procedures and improvement plan for the next reporting round;
10. The QA/QC Manager is responsible for documentation and archiving of all documents, related to the performed QA/QC procedures in the National System for documentation and archiving of inventory in ExEA.

3.5.7. QA/QC activities of data provider

The check lists were exchanged between QC experts for correction of the findings with input data for calculation of emissions in the respective sectors.

Table 3.6 Responsibilities in the exchange of check lists between QC experts for 2013 submission

Sector CRF	Activity data		Methodology/ emission factors		Emission calculations	
	Check	Correction	Check	Correction	Check	Correction
Energy CRF1	ExEA NSI MEET external consultant	NSI MEET	ExEA NSI MEET	ExEA external consultant	ExEA NSI MEET	external consultant
Transport CRF1A3	ExEA NSI MI MTITC external consultant	MTITC MI NSI	ExEA NSI MI MTITC	ExEA external consultant	ExEA NSI MI MTITC	Sector expert ExEA and external consultant
Industry processes CRF2	NSI ExEA	NSI ExEA	NSI ExEA	ExEA	NSI ExEA	Sector expert ExEA and external consultant
Solvents use CRF3	NSI ExEA external consultant	NSI ExEA	NSI ExEA	external consultant	NSI ExEA	external consultant
Agriculture CRF4	ExEA MAF	MAF	ExEA MAF	ExEA	ExEA MAF	Sector expert ExEA
LULUCF CRF5	ExEA EAF	EAF	ExEA EAF	ExEA	ExEA EAF	Sector expert ExEA and external consultant
Waste CRF6	NSI ExEA	NSI ExEA	NSI ExEA	ExEA	NSI ExEA	Sector expert ExEA

As it is written above for 2013 submission the **QA procedures** are implemented by sector experts within the MoEW and experts from the ExEA, who are not directly involved in the preparation of inventory (Order № RD-218/05.03.2010 by the minister) or external reviewers.

The QA experts fill a check list, which contains all general and specific procedures for QA. It consist information for carried out review by the QA experts, including findings and corrections made.

The check lists are exchanged between QA experts and sector expert in ExEA and/or external consultant for correction of the findings with reporting tables and respective chapters from national reports.

Table 3.7 Responsibilities in exchange of the check lists between QA experts and sector experts for 2013 submission

Sector - CRF	Reporting Tables - CRF		National Report - NIR	
	Check	Correction	Check	Correction
Energy CRF1	MOEW	external consultant	MOEW	external consultant
Industry processes CRF2	MOEW	Sector expert ExEA and external consultant	MOEW	Sector expert ExEA and external consultant
Solvents use CRF3	MOEW	external consultant	MOEW	external consultant
Agriculture CRF4	ExEA and/or external auditor	Sector expert ExEA	ExEA and/or external consultant	Sector expert ExEA
LULUCF CRF5	External auditor	Sector expert ExEA	External auditor	Sector expert ExEA
Waste CRF6	MOEW	Sector expert ExEA	MOEW	Sector expert ExEA

3.6. Inventory preparation

The ExEA coordinates all activities on preparation of inventory under UNFCCC.

The Executive director of the ExEA through internal administrative order and based on the Regulation on the organization and structure of ExEA appoints sector experts for preparation of emission inventory in Energy, Industrial process, Solvents and other products use, Agriculture, LULUCF and Waste.

The ExEA, agreed with the MoEW engages external consultants for preparation of tasks, which are out of competence of the Agency and are related with improvement of the inventory.

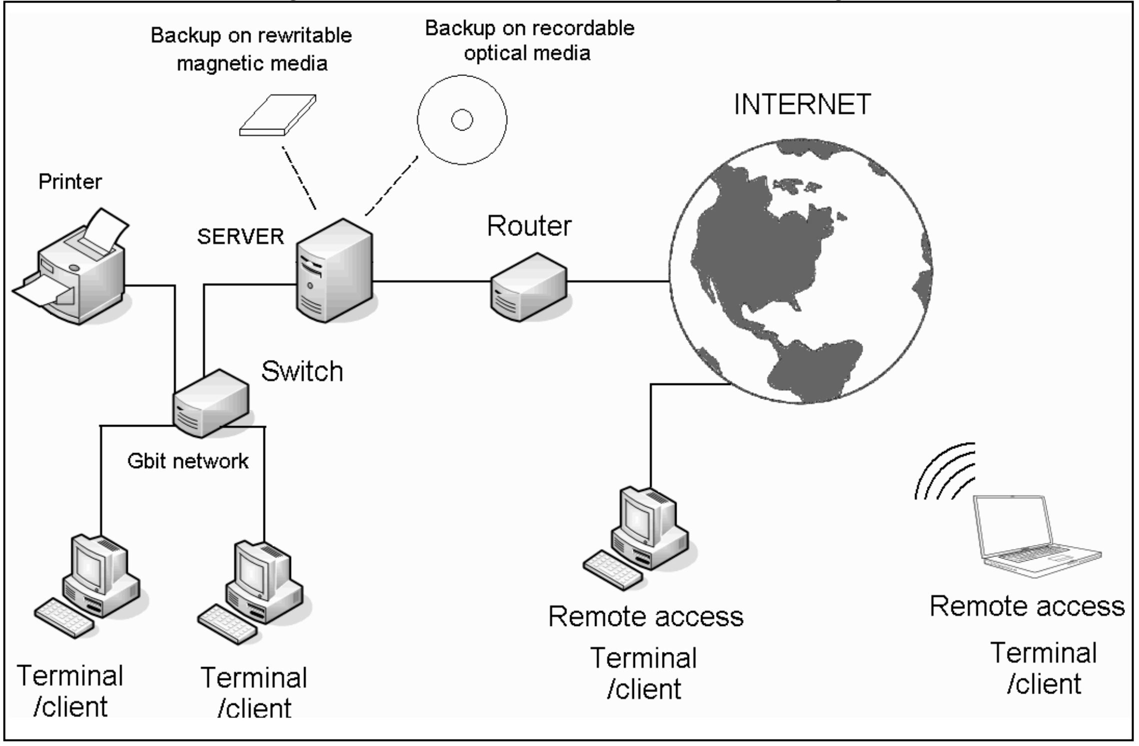
Table 3.8 Responsibilities for preparation of the national GHG inventory for 2013 submission

Responsibility under	Reporting tables	National report	Preparation	Approval
UNFCCC	CRF format	NIR	ExEA	MOEW

3.7. Documentation and data archiving

In August 2010 a new System for sector expert workflow organisation, inventory documentation and data archiving has been implemented in the ExEA.

Figure 3.14 Documentation and data archiving in ExEA



3.8. Information on the National Registry System

Directive 2009/29/EC adopted in 2009, provides for the centralization of the EU ETS operations into a single European Union registry operated by the European Commission as well as for the inclusion of the aviation sector. At the same time, and with a view to increasing efficiency in the operations of their respective national registries, the EU Member States who are also Parties to the Kyoto Protocol (25) plus Iceland, Liechtenstein and Norway decided to operate their registries in a consolidated manner in accordance with all relevant decisions applicable to the establishment of Party registries - in particular Decision 13/CMP.1 and decision 24/CP.8.

With a view to complying with the new requirements of Commission Regulation 920/2010 and Commission Regulation 1193/2011, in addition to implementing the platform shared by the consolidating Parties, the registry of EU has undergone a major re-development. The consolidated platform which implements the national registries in a consolidated manner (including the registry of EU) is called

Consolidated System of EU registries (CSEUR) and was developed together with the new EU registry.

Following the successful implementation of the CSEUR platform, the 28 national registries concerned were re-certified in June 2012 and switched over to their new national registry on 20 June 2012. During the go-live process, all relevant transaction and holdings data were migrated to the CSEUR platform and the individual connections to and from the ITL were re-established for each Party. Joint Implementation (JI) - Bulgaria approved 28 JI projects in total and 21 of them have already achieved and verified emission reductions. National Registry has successfully transferred reduction units to 20 of the projects.

All the conditions for the accession of the National registry for issuance, holding, transfer and cancellation of greenhouse gas emission allowances to the Union registry were met. In January 2012 year the National registry was successfully partially linked with the Union registry to include the aircraft operators in the European Emission Trading Scheme and on 20 June 2012 year after the go-alive and the successful migration of the data from the National registry to the Bulgarian registry successfully launched it's work as part of the Union registry.

In 2012, the EU registry has undergone a major redevelopment with a view to comply with the new requirements of Commission Regulation 920/2010 and Commission Regulation 1193/2011 in addition to implementing the Consolidated System of EU registries (CSEUR).

The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. The documentation is annexed to this submission.

During certification, the consolidated registry was notably subject to connectivity testing, connectivity reliability testing, distinctness testing and interoperability testing to demonstrate capacity and conformance to the Data Exchange Standard (DES). All tests were executed successfully and lead to successful certification on 1 June 2012.

Registry administrator

No changes to the Registry administrator of the national registry occurred during the reported period.

The registry administrator designated by Bulgaria to maintain the national registry is ExEA.

Procedures to minimize discrepancies

The overall change to a Consolidated System of EU Registries also triggered changes to discrepancies procedures, as reflected in the updated manual intervention document and the operational plan. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. The documentation is annexed to this submission.

Security measures

The overall change to a Consolidated System of EU Registries also triggered changes to security, as reflected in the updated security plan. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. The documentation is annexed to this submission.

For carrying-out a transaction the following is necessary:

To transfer allowances from one account to another designated representative should send a request by submitting an application in a form approved by the Executive Director of the ExEA and posted on the website of the ExEA. The application is sent to the registry administrator by email and on paper.

The application should contain:

1. name of the holder of the account, where the allowances shell be transferred from;
2. designation and number of the account, where the allowances shell be transferred from;
3. type and number of allowances to be transferred;
4. name of the holder of the account, where allowances to be transferred to;
5. designation and account number where allowances to be transferred to;
6. name of the receiving register;
7. information for the person making the transfer (or authorized agent registry administrator).

The application has to be signed and sealed by the account holder and the authorized representatives of the account in case the transfer has to be made by the registry administrator.

Executive Environment Agency

Address: 136 Tzar Boris III Blvd., P.O. Box 251, 1618 Sofia, Bulgaria

Tel.:+359 2 9559011, Fax: +359 2 9559015, E-mail: registry@ eaa.government.bg

Information publicly accessible

A list of the information publicly accessible by means of the user interface to the national registry.

According to paragraph 45 to decision 13/CMP, the necessary information is available at the

http://eea.government.bg/bg/r-r/r-te/registry/main2

No changes of the information publicly accessible occurred during the reported period.

The information of approved Joint Implementation projects and their documentation is added on the website of the competent authority (Ministry of the Environment and Waters) of JI projects and can be downloaded from the following link:

http://www.moew.government.bg/?show=top&cid=357&lang=en

The registry terms and conditions ,operators guide, forms and guidance for opening the holding accounts are availables at the website of Executive Environment Agency

http://eea.government.bg/bg/r-r/r-te/registry

No changes of the information publicly accessible occurred during the reported period.

The Internet address of the interface to Bulgarian registry in Union registry:

https://ets-registry.webgate.ec.europa.eu/euregistry/BG/index.xhtml

4. Policies and measures

4.1. Policy - making process

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

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

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

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

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

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

Steering Committee is an evaluation body for Joint Implementation projects under the Kyoto Protocol. It consists of representatives from the Ministry of Environment and Water, the Ministry of Economy, Energy and Tourism, the Ministry of Finance, the Ministry of Regional Development and Public Works, the Ministry of Agriculture and Food, the Ministry of Transport, Information Technology and Communications, the Ministry of Foreign Affairs, the Executive Environment Agency, the Energy Efficiency Agency and the Executive Forestry Agency. The Committee is chaired by Deputy Minister of MOEW. The SC evaluates proposed projects according to the existing internal environmental criteria and the JI national guidelines on Track 1 and Track 2. If necessary, additional expert opinions and statements from the relevant ministries and organizations are requested. The SC advises the Minister of Environment and Water in issuing/not issuing a Letter of Approval for each particular project proposal.

- **The Interministerial Working Group for Development of the National Allocation Plan (IWGNAP) for EU ETS**

The introduction of the EU Emissions Trading Scheme requires the country to possess National Plan for allocation of emission allowances. The Plan development is coordinated by an interministerial working group set by the ordinance of the Minister of MOEW No. RD-186/06.04.2005. Representatives of the MOEW, the MEET, the MRDPW, the MF, the NSI and representatives of NGOs: Bulgarian Chamber of Commerce and branch organizations of the industrial branches that are covered by the Scheme – Bulgarian Association of the Cement Industry, Bulgarian Branch Chamber of the Energetic, Branch Chamber of the Pulp and Paper Industry, Branch Chamber of the Glass Industry, Branch Chamber of the Iron and Steel Industry, Branch Chamber of the Chemical Industry, Bulgarian Union of the Ceramics. The Plan has been approved by the European Commission.

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

ExEA is an administration under the Minister of Environment and Water jurisdiction and is appointed to carry out management, coordination and information functions as regards the control and environmental protection in Bulgaria. It designs and manages the National Environmental Monitoring System for Environmental Monitoring and information on the state of environmental components and factors at national level. The Agency coordinates and performs the overall activities on the preparation of the GHG inventories and the National Inventory Report. The ExEA administrates the National GHG Registry.

- **Sustainable Energy Development Agency within MEE**

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

- **Municipalities**

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

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

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

4.2. Domestic and regional programmes, legislative arrangements

4.2.1. Domestic and regional programmes

In Bulgaria the Regions do not have a direct competence in the area of protection of global climate system. Nevertheless, the Regional bodies remain responsible for overall development of its territory and for addressing the needs of its population in general terms. This is the foundation of the regional role of responsible bodies in creation of Regional development concepts and plans including water management plans for river basins and flood prevention measures, principles of territorial development. Regional bodies are also involved in implementation of the below specified energy savings programmes and use of RES, restoration of housing fund (central heating supply systems, revitalization of housing estates) and improvement of transportation infrastructure. Regions also play a large role in preparation of waste management plans and in actual waste management (operation of landfills, composting facilities, facilities involved in energy and material recovery of waste etc.).

4.2.2. National programmes

An integrated and complex system of strategic and operational planning has gradually been created, which is further modified in line with international commitment of Bulgaria whether assumed pursuant to post-Kyoto processes or EU policies and legislation. Legislative measures also lay down rules for institutional responsibilities for coordination and implementation of various programmes.

- National Development Programme: “Bulgaria 2020”;
- Energy Strategy of the Republic of Bulgaria until 2020;
- National Energy Efficiency Programme until 2015;
- National Action Plan for Renewable Energy;
- National Programme for Promotion of the Biofuels Use in the Transport Sector 2008-2020;
- Strategy for Development of the Transport System of the Republic of Bulgaria until 2020;
- National Strategy for Development of the Forestry Sector in Bulgaria 2006-2015;
- National Strategic Plan for Gradual Reduction of Biodegradable Waste Intended for Landfilling 2010-2020.

The most important strategic documents and programme with direct or demonstrable indirect effect on greenhouse gas emissions:

– **National strategy for the Environment**

The Strategy was developed for the period 2005-2014. It is a continuation of the National Strategy for the Environment 2000-2006 and in this aspect keeps the long-term environmental policy objective. The National Strategy for the Environment is consistent with the principles of the prevention and reduction of the human health risk, integration of the environmental protection policy in the sectoral policies on the development of the economy and awareness of the citizens on the state of the environment. The objectives and actions of this National strategy have been developed, taking into account the opinion of a wide variety of representatives – state institutions, business, municipalities, NGO, the general public.

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

- **Green Investment Scheme**

In June 2010 an Amendment to the Environmental Protection Act (EPA) was approved by the Council of Ministers and the National Assembly. The new legislation creates the main legal framework of the Bulgarian National Green Investment Scheme (NGIS) and allows Bulgarian government to participate in the International Emission Trading mechanism according to the Article 17 of the Kyoto Protocol. EPA defines the entire process from selling of AAUs to "greening" of the revenues. EPA empowers the National Trust Eco Fund (NTEF) to administer and implement the NGIS. NTEF elaborates rules for selection, assessment and approval of projects that would reduce emissions and would be reimbursed by the NGIS.

- **Third National Climate Change Action Plan (2013 – 2020)**

The economic and political development in Bulgaria after the year 2007 along with changes in the international and domestic policy and regulatory framework required an update of the Second Action Plan.

In June 2012 the Third National Action Plan (2013 – 2020) was approved by the Council of Ministers. The Third National Action Plan on Climate Change outlines the framework for action on climate change for the period 2013-2020 in order to fulfill the obligations under The United Nations Framework Convention on Climate Change, The Kyoto protocol and the "Climate - Energy" package of the European Union.

The main objective of the Third National Action Plan on Climate Change (NAPCC) is to outline the framework for action to combat climate change for the period 2013-2020 and to focus the country's efforts on actions leading to reduction of the negative impacts of climate change and implementation of the undertaken commitments.

The Third National Action Plan on Climate Change provides specific measures for reduction of greenhouse gas emissions across all sectors and these measures are consistent with both the national policy on climate change and the potential of the national economy to reduce emissions. The overall effect of the measures will ensure the implementation of the commitments taken and the achievement of the legally binding European objectives, namely:

- 20% increase in energy efficiency;
- 20% reduction of greenhouse gas emissions compared to their 1990 levels;
- 20% share of renewable energy in the total EU energy consumption by 2020 including a 10% share of biofuels in transport.

The “three 20” are tightly interrelated. Achieving 20% reduction in greenhouse gas emissions would be impossible without progress in the other two relating to the promotion of renewable energy and energy efficiency.

Special attention is drew to the legislative package “Climate and Energy”. The package of legislative measures relates to: the revision of the existing *emission trading scheme* of the Community; the establishment of differentiated ceilings for greenhouse gases for *sectors outside the scheme* (transport, building, agriculture, waste); the formulation of binding national targets for increasing the *share of renewable energy* in the energy balance and introduction of rules to promote new *technologies for carbon capture and storage*. A number of flexibility mechanisms are provided for in order to achieve the objectives in a cost-effective way. 2005 was chosen as a reference year for setting the 2020 targets, because the first verified data on greenhouse gas emissions are since that year.

Reduction of greenhouse gas emissions from the sources within the scope of the scheme by 21% compared to their 2005 levels is set for all EU Member States through a linear factor for reducing the permitted emission ceiling for the sectors under the European Trading Scheme (ETS). The main flexibility mechanism in the revised scheme is the redistribution of rights for emission allowances trading (auctioning rights), which is expected to generate substantial financial resources for investment in the improvement of energy efficiency, promotion of renewable energy and reduction of greenhouse gas emissions. For the sectors outside the scheme the differentiated emission ceilings range from -20% to +20%. Bulgaria has an individual commitment allowing it to increase the emissions by 20% compared to their 2005 level. The national objectives of the Member States in terms of share of renewables in the final energy consumption by 2020 range from 10% to 49%. Bulgaria’s goal is set at 16%, including 10% share of biofuels in the final consumption of transport fuels.

The “Climate and Energy” package does not contain direct binding measures to improve energy efficiency although it has an indirect effect in this direction. The individual commitments of Member States in the field of energy efficiency are still taken on a voluntary basis and are rather political than legally binding. At this stage they are defined in the context of the strategy “Europe 2020” where resource (including energy) efficiency is a flagship initiative. According to the commitment undertaken within the framework of “Europe 2020” Bulgaria aims to reduce the energy intensity of GDP by 50% by 2020. The implementation of the energy efficiency measures and policies set in the National Energy Strategy until 2020 aims to lead to an improvement of the energy efficiency by approximately 25% or to saving more than 5 mln. toe. primary energy compared to the baseline development scenario by 2020.

NAPCC presents an assessment of the status and trends of greenhouse gas emissions in Bulgaria until 2009 in various sectors and the scenarios and projections of the emissions in these sectors by 2030 before and after the implementation of the measures.

The policies and measures planned to achieve the objectives of the country with regard to climate change are presented by sectors and represent the most significant and voluminous part of the Third Action Plan on Climate Change. The process of selection of specific measures in each sector includes consultations with the relevant government institutions, numerous consultations with stakeholders, businesses, NGOs and academic circles. The received comments and opinions on the proposed policies and measures have been taken into account. Thus transparency and coordination in preparing the Plan is ensured.

After specifying the policies and measures by sector, their feasibility was analyzed from economic point of view. The effective reduction of greenhouse gas emissions was assessed without need to reduce the production and the consumption on the basis of the baseline scenario for the economic development of the country by 2030.

NAPCC pays special attention to the administrative capacity necessary to implement the planned measures, as well as to the responsibilities for monitoring and reporting the implementation of the Plan. Besides the leading role of the competent institutions it underlines the specific role and functions of municipalities. A special feature of the activities on climate change is that they cover a large number of institutions and bodies both from the central and the local authorities because of their horizontal and cross-cutting nature.

- **Programme for Promotion of Biofuels Use in the Transport Sector 2008-2020**

The main goals are promoting diversification of energy supplies, encouragement of the production and use of biofuels in transport, environmental protection and establishing the conditions to achieve sustainable development at the local and regional level.

The national indicative targets on biofuel consumption are set. This programme is one of the instruments for meeting the fixed indicative targets. The possibilities of growing energy crops and producing biofuels in Bulgaria are considered.

The national competent authority for the implementation of the National Programme is the Ministry of Economy and Energy.

- **National Waste Management Programme (NWMP)**

Waste Management Programmes (WMPs) are developed and implemented by the mayors on the territory of the respective municipality.

- **Energy strategy of the Republic of Bulgaria until 2020**

The strategy covers four main areas: tackling adverse climate changes; reducing the energy intensity of economy and increasing energy efficiency; reducing the external dependency of the European Union on imported energy resources; promoting economic growth and employment; and provision of secure and affordable energy to users. The availability of a well-developed internal energy market is indicated as both an objective and a means of achieving the goals.

A number of steps are planned in the Medium-term Programme till 2013 of the Energy Strategy including adoption of strategies, plans and programmes in various sectors of energy management:

1. Energy security for the Bulgarian industry and population

- Diversification of the sources and routes for supply of natural gas.
- Provision of Regulatory incentives for investments in the network infrastructure and for development of the grids adequate to the needs of their users, including application of the „smart grids"concept.
- Development by the end of 2011 and adoption of a District Heating Sector Stabilization and Development Program.
- Institutional support and monitoring of projects of strategic significance to energy security, including those of investors in new power plants (required for balancing the generation by wind and solar power plants), as well as in a new nuclear capacity as a project with prevailing participation of foreign investors.
- Institutional support and monitoring of projects for construction of new and/or replacing capacities using indigenous coal and mandatorily using up-to-date highly efficient and low-emission carbon capture and storage technologies, including technologies for development and improvement of the power system.
- Construction of a national storage for radioactive waste and a dry storage for spent nuclear fuel in conformity with the best international standards.
- Updated Strategy for management of spent nuclear fuel and radioactive waste.
- Development of a system of adequate mechanisms for energy social protection.

2. Reduction of greenhouse gas emissions

- Timely creation of working mechanisms for conducting of bids for greenhouse gas emission allowance after 2013 and participation in a Common-European trading platform.
- Regulation of the spending of revenues from the bids for greenhouse gas emission allowance in projects for sustainable energy development, construction of „smart grids" and creation of administrative capacity and procedures for project selection and evaluation.
- Active participation of the state in the European procedures for financing of clean technologies – demonstration projects for capture and storage of carbon dioxide and innovative projects for renewable energy.

3. Increase of the share of renewable energy sources in the total final energy demand

- Increase the share of electric power generated by renewable energy sources (RES), using mechanisms for achievement of the quantitative targets at the least cost to users.

- Adoption of a National Action Plan for energy from renewable sources till 2020.
- Imposition of the requirements of Directive 2009/28/EU – adopting of a new law and secondary legislation on renewable energy with a view to removing the barriers hindering the integration of RES into the electricity and gas networks and implementation of a package of measures for promotion of investments in RES technologies, generation and consumption of energy from renewable sources and scientific research.
- Improvement of the existing support mechanisms for the generation and consumption of energy from renewable sources and financial incentives of projects through specialized credit lines, financing from European funds and programs and from other sources.
- Creation of favourable conditions for development of a market for electric road vehicles, including ones supplied by RES, as well as of systems for storage of energy.
- Acceleration of the work for implementation of joint projects for utilization of the existing hydro-power potential in the country.

4. Energy Efficiency Enhancement

- Development and adoption of a National Energy Efficiency Strategy of the Republic of Bulgaria till 2020 with emphasis on the promotion of measures for energy efficiency in the residential sector, in the public buildings, transport and industry.
- Changes in the Energy Efficiency Act (EEA) related to transposition of the requirements of Directive 2010/31/EU on the energy characteristics of buildings, stimulation of the energy services market and accelerated adoption of market mechanisms for promotion of energy efficiency.
- Development of a second National Energy Efficiency Action Plan the purpose of which is to detail the requirements towards programs in specific sectors and to formulate the high-priority measures for energy efficiency for the period 2011 –2014.
- Development, by the end of 2011, and adoption of a Program for Accelerated Gasification of the Republic of Bulgaria, the performance of which is expected to save considerable amounts of primary energy.
- Financial incentives for energy efficiency measures through schemes of the Energy Efficiency Fund, specialized credit lines, financing under European funds and programs and creation of additional schemes and instruments, including those for performance of the national program for refurbishment of residential buildings in the Republic of Bulgaria.

5. Building of a competitive energy market as a way to achievement of high priority objectives - competitiveness, energy security & sustainable development

- Amendments and supplements to the Law on Energy and the secondary legislation transposing the requirements of the Third Liberalisation Package for the purpose of creating an efficient energy market, transparency of the public energy companies in combination with better protection of the rights of consumers.

- Development, by the end of 2011, and adoption of a Programme for Accelerated Market Development of the Electric Power Industry.
- Creation of a power exchange.
- Enhancement of the professional capability and independence of the Regulatory body in the energy sector.
- Protection of the rights of consumers.

6. Better utilization of the indigenous energy resources

- Development, by the end of 2011, and adoption of a Programme for efficient use of the indigenous energy resources, taking also into account the opportunities for sustainable and ecologically sound use and management of soils with preservation of their environmental functions and prevention of their damage, as well as reclamation of already damaged soils and limiting and/or mitigation of damages to levels free of risk to the environment and human health.
- Updating of the legislative basis with a view to guaranteeing unified management of mineral resources.
- Standardization of the procedures and documents related to granting of rights for prospecting, exploration and production of mineral resources, inclusive of promotion of the development of new gas fields in the country.

7. Alternatives to the supply of natural gas

The security risks can be managed through diversification of the energy resource types, sources, suppliers and routes taking into account the regional and global trends in the energy markets. Viewed from that angle, the diversification of energy supply will assist the creation of competition between the main energy suppliers and will stabilize the prices of primary energy resources.
Construction of terminals for import of liquefied and compressed natural gas, through which alternative gas supply for the country will take place, as well as of the lacking infrastructure – interconnections with neighbour countries, will be an indispensable element of the set of measures for guaranteeing, in the long-term, the security of supply to the country, and also as a mechanism that will contribute to more flexible crisis response.
The access to alternative sources and routes for import will enable the achievement of more competitive conditions in the import of natural gas from gas-producing countries, such as the countries of the Caspian region and Asia Minor, as well as from Algeria, Egypt, Libya, Qatar, Oman, United Arab Emirates, Nigeria, etc.
Through the projects for interconnections the security of gas supply to Bulgaria will be improved and the negative effects from potential crises due to full or partial loss of supply from the single for the time being source on the national economy will be avoided.
In this connection the state will direct its efforts to implementation of the following alternatives:

- Possible construction of a regasification terminal for liquefied natural gas (LNG), through which natural gas will be supplied not only to Bulgaria, but to third countries as well, through the well developed Bulgarian gas transmission network;

- Implementation of a project for supply of compressed natural gas (CNG) from Azerbaijan across the Black Sea;
- Construction of gas interconnections with Turkey, Romania, Greece and Serbia

8. Expected results

- 20% lower energy intensiveness of GDP by 2013.
- Increase of the RES share to 12% of the total final energy consumption by 2013.
- Increased share of freely negotiated quantities of electricity in the internal market.
- Established power exchange.
- Higher-quality energy supply at affordable and predictable prices.

4.2.3. Legislative arrangements

The Bulgarian climate change policy follows the multilateral and bilateral international agreements, the EU legislation in the field of climate change as well as the national legislation. The most important legislative acts dealing with climate change issues are:

- **Environmental Protection Act (EPA) (SG 91/2002, last amended SG 42/2011)**

EPA is a framework law that regulates the basic conditions and principles of the management of the public relations related to environmental protection. It defines the competent authorities within the meaning of the act: the Minister of Environment and Water and the Director of the Executive Environment Agency are among the bodies holding powers with regard to EPA and the measures related to climate change, however all competent authorities under EPA may be involved with actions of other competent authorities under other laws - for example in the sectors “Energy”, “Land use, land use change and forestry” (LULUCF).

EPA establishes a scheme for trading greenhouse gas emissions. It regulates the existence of a National Plan for allocation of greenhouse gas allowances. EPA introduces a requirement for issue of greenhouse gas emission permits as a condition for execution of certain activities. The conditions and the procedures for issuing and revising a greenhouse gas emission permit and the consequences of this issuing are described in detail. A national register for reporting the issuance, holding, transfer and cancellation of greenhouse gas emission allowances is created. The Council of Ministers is delegated powers to issue bylaws detailing the management of activities related to greenhouse gas emissions. The obligations of aircraft operators and suppliers of transport liquid fuels are regulated. EPA designates the competent authorities in the field of environment responsible for Bulgaria’s relations with international and European institutions in this area as well as for the established administrative relationships. It specifies the boundaries of the competence of national authorities and EU bodies in the field of environment.

EPA regulates three of the most important horizontal mechanisms for management of activities related to environmental impacts and the effects of greenhouse gases – Environmental Impact Assessment (EIA) of specific investment proposals, environmental assessment (EA) of plans and programmes and access to information (AI) on the environment. The preparation of an environmental assessment is part of the procedure for preparation of all major plans, programmes and strategies in the fields related to activities that are sources of greenhouse gases – energy, agriculture, transport, waste management, etc. The purpose of EA and EIA is to integrate the considerations related to the environment in the process of development as a whole and the introduction of the sustainable development principle.

Relevant bylaws:

- Ordinance on the conditions and procedure for carrying out environmental impact assessment – SG 25/2003, last amended SG 3/2011;
- Ordinance on the conditions and the procedure for carrying out environmental assessment of plans and programmes – SG57/2004, last amended by SG 3/2011.

The EPA and the ordinances issued thereunder transpose and apply the international obligations under the Kyoto Protocol, Directive 2003/87/EC establishing a greenhouse gas emission allowance trading scheme within the Community and Directive 2004/101/EC amending Directive 2003/87/EC in respect of the Kyoto Protocol's project mechanisms. The provisions of Directive 2008/101/EC amending Directive 2003/87/EC to include aviation activities in the greenhouse gas emission allowance trading scheme within the Community have also been introduced.

Directive 2009/29/EC of the European Parliament and the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community should also be transposed in the EPA. The deadline for transposition of this Directive into the national legislation of Member States is 31.12.2012.

- **Energy Act (EA) SG 107/2003, last amended SG 47/2011)**

The Energy Act settles the public relations associated with the activities of production, import and export, transmission, transit, distribution of electricity, heat and natural gas, transmission of oil and oil products by pipelines, trade in electricity, heat and natural gas, and the powers of state bodies to define energy policy, to regulate and to exercise control. It designates the bodies carrying out the energy policy as well as the instruments underlying the energy policy.

The Council of Ministers proposes and the National Assembly adopts the Energy Strategy of Bulgaria on the basis of the EA.

The Energy Act lays down rules and principles for energy pricing - it regulates the prices of the produced electricity. The costs of energy companies arising from public obligations for environmental protection and energy efficiency are compensated by administrative measures determined by the State Energy and

Water Regulatory Commission (SEWRC) – a specialized state authority regulating the activities in the field of energy. The obligation to purchase electricity produced from renewable sources is also considered as such a cost.

The activities related to electricity production and connection to the energy transmission network may be effected only after issuance of the relevant license/permit.

The Energy Act regulates the production of electricity from thermal power plants using a combined mode of production. The entire quantity of electricity from highly efficient cogeneration of heat and electricity, registered with a certificate of origin, is subject to purchase at preferential prices.

A bylaw issued on the basis of EA:

- Ordinance on the issue of certificates of origin for electricity produced by cogeneration – SG 41/2007, last amended SG 85/2010.

The EA is the law where the proposals for legislative amendments in the energy sector as well as the proposals for establishment of regulatory mechanisms promoting the renovation and expansion of district heating networks formulated in the NAPCC should be included.

– **Renewable Energy Act (REA) (SG 35/2011)**

The Renewable Energy Act regulates the public relations associated with the production and consumption of electricity, thermal energy and cooling energy from renewable sources, gas from renewable sources, biofuels and energy from renewable sources in transport. The main purpose of this Act is to promote and support the production and consumption of energy and fuels from renewable sources. This is to be effected through the introduction of support schemes, by raising the awareness and by encouraging research.

It regulates the adoption of a National Action Plan for Renewable Energy (NAPRE) and national support schemes to promote the use of energy from renewable sources. The main focus is on joint projects and schemes for production of energy from renewable sources with other EU Member States. The municipal councils approve long term and short term programs to promote the use of energy from renewable sources and biofuels.

The Renewable Energy Act takes into account the need for interaction between several different bodies of central executive authorities and local government in order to achieve the objectives of the law. The implementing powers are divided between the Minister of Economy, Energy and Tourism, the Minister of Environment and Water, SEWRC, the Sustainable Energy Development Agency (SEDA), the district governor, the city council and the mayor of the municipality.

REA contains also specific measures to support the production of energy from renewable sources and biofuels.

Bylaws issued on the basis of REA are:

- Ordinance on the calculation of the total share of energy from renewable sources in the gross final energy consumption and the use of biofuels and renewable energy in transport (№ RD-16-869) SG 70/2011;
- Ordinance on the conditions and procedure for issuance, transfer, cancellation and recognition of guarantees of origin of the energy from renewable sources (№RD -16-1117) SG 84/2011.

– **Energy Efficiency Act (EEA) (SG 98/2008, last amended SG 35/2011)**

EEA regulates the public relations relevant to the state policy for improving energy efficiency of final energy consumption and the provision of energy services.

The National Assembly adopts a **National Energy Efficiency Strategy of the Republic of Bulgaria** that determines the national indicative target of energy savings, as well as the stages, the tools and the measures for its achievement. The National Strategy is updated every five years. The Council of Ministers adopts national action plans on energy efficiency and annual reports on the implementation of these plans. The Minister of Economy, Energy and Tourism prepares draft programmes on improvement of energy efficiency in final energy consumption and on the provision of energy services and submits them for approval by the Council of Ministers. The Executive Director of SEDA is responsible for the activities related to the implementation of the state policy for improvement of energy efficiency in final energy consumption and the provision of energy services. The local governments adopt energy efficiency programmes.

EEA contains detailed requirements to the content of the national action plans on energy efficiency. It establishes the legislative basis to link the different actions and steps for achievement of energy efficiency in the final energy consumption – setting individual and intermediate indicative energy saving targets, formulating specific actions to achieve energy efficiency, defining time frames for implementation, financing, division of obligations. The plans are reported on annual basis.

The national indicative targets determined in the action plans on energy efficiency are allocated as individual targets for energy savings to energy traders, owners of buildings with a total floor area over 1000 m^2 and owners of industrial systems with annual energy consumption over 3000 MWh.

The operated buildings with a total floor area over 1000 m^2 are subject to mandatory certification.

Air conditioning installations in buildings and hot water boilers with specific power according to the used fuel type are subject to energy efficiency checks. SEDA maintains a database of the inspected systems.

The industrial systems with annual energy consumption over 3000 MWh are subject to mandatory energy efficiency audits, conducted at least once every three years.

EEA provides for the implementation of energy efficiency management which is responsibility of the owners of the audited industrial systems and the installations inspected for energy efficiency. The management activities are specifically defined in the act. The administrative authority may impose fines or property sanctions in case of violations of the activities related to the energy efficiency management.

SEDA establishes and maintains a national information system on the state of energy efficiency in Bulgaria.

EEA defines the term “energy services” and the scope of entities that may provide energy services. The energy services include implementation of one or more activities and measures to improve energy efficiency.

The financial mechanisms for improving energy efficiency are: voluntary agreements, performance contracting and financing from the Energy Efficiency and Renewable Sources Fund. The Fund supports the implementation of actions and measures for increasing energy efficiency and promoting the production and consumption of energy from renewable sources, except for those activities that are funded by the state budget. The Fund operates under the Energy Efficiency Act and the donor agreements and it is not part of the consolidated state budget.

Bylaws related to energy efficiency:

- Ordinance on labelling requirements and the provision of standard information on products related to energy consumption with respect to energy and other resources consumption - SG 41/2011, last amended SG 93/2011;
- Ordinance № RD-16-267 of 2008 on estimation of the amount of electricity produced by cogeneration of thermal and electric energy – SG 37/2008, last amended SG 77/2010;
- Ordinance № 7 of 2004 on energy efficiency, heat and energy savings in buildings – SG 5/2005, last amended SG 2/2010;
- Ordinance on methodologies for setting national targets, the procedure for allocation of these targets as individual energy saving targets between the persons under art. 10, para. 1 of the Energy Efficiency Act, eligible energy efficiency measures, assessment methodologies and methods of verification of energy savings and for approval of the tariff for fees collected by the Energy Efficiency Agency for issuing energy savings certificates under art. 51 para. 1 of the Energy Efficiency Act – SG 27/2009, last amended SG 88/2011;
- Tariff of the fees collected by the Sustainable Energy Development Agency under the Energy Efficiency Act and the Renewable Energy Act - SG 14/2012;
- Ordinance on the conditions and the procedures for determining the amount and the payment of funds under performance contracts leading to energy savings in public and/or municipal buildings (№ RD-16-347) - SG 28/2009;
- Ordinance on energy consumption indicators, energy performance of industrial systems, on the conditions and the procedures for performing energy efficiency audits of industrial systems (№ RD-16-346) - SG 28/2009;
- Ordinance on the circumstances subject to entry in the register of persons carrying out certification of buildings and energy efficiency audits, on the procedure for receiving information from the register, the terms and conditions for acquiring qualification and the required technical facilities for performing audits and certification (№ RD-16-348) – SG 28/2009
- Ordinance on the conditions and the procedure for auditing the energy efficiency of hot water boilers and air conditioning systems pursuant to art. 27, para. 1 and art. 28, para. 1 of the Energy Efficiency Act and on the creation, maintenance and use of a database for these systems (№ RD-16-932) – SG 89/2009;
- Ordinance on the conditions and the procedure for energy efficiency auditing and certification of buildings, on issuing energy performance certificates and the categories of certificates (№ RD-16-1057) – SG 103/2009;

- Ordinance on indicators for energy consumption and energy performance of buildings (№ RD-16-1058) – SG 103/2009;
- Statutes of the Sustainable Energy Development Agency - SG 88/2011.

The requirements of Directive 2002/91/EC of the European Parliament and the Council of 16 December 2002 on the energy performance of buildings and of Directive 2006/32/EC of the European Parliament and the Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC have been transposed in the EEA.

The provisions of Directive 2010/31/EC of the European Parliament and the Council on the energy performance of buildings that must be transposed into the national legislation of the Member States no later than 9 July 2012 will also be introduced through the EEA.

- **Clean Ambient Air Act (CAAA) (SG 45/1996, last amended SG 42/2011)**

Clean Ambient Air Act regulates the limitation of emissions into the air from stationary sources and the quality requirements for liquid fuels – activities directly related to greenhouse gas emissions.

The marketing of liquid fuels that do not meet the quality requirements has been forbidden.

The Minister of Environment and Water jointly with the relevant ministers issues regulations that set emission limit values of harmful substances (pollutants) emitted into the atmosphere by facilities and activities with stationary emission sources. These standards are mandatory for all sites in Bulgaria. Exceptions are allowed for sites related to the national fuel and energy balance.

In addition, programmes to gradually reduce the total annual emissions of certain pollutants: sulphur dioxide, nitrogen oxides and other pollutants released into the air by certain operating facilities and activities such as large combustion plants and others, are also adopted.

Another approach in the Clean Ambient Air Act used to reduce air pollution is setting norms for harmful substances in exhaust gases from internal combustion engines. These norms are approved by the Minister of Transport, Information Technologies and Communications, jointly with the Minister of Environment and Water and the Minister of Health.

The Council of Ministers determines the measures for implementation of Regulation (EC) № 842/2006 of the European Parliament and the Council of 17 May 2006 on certain fluorinated greenhouse gases. The Minister of Environment and Water, the directors of the regional inspectorates for environment and water or their authorized officials monitor the application of the measures specified for stationary refrigerating and air conditioning systems, thermal pumps, high voltage switchgear, air conditioning systems in motor vehicles and other equipment containing fluorinated greenhouse gases.

The Clean Ambient Air Act defines the powers of the supervisory authorities to enforce the set standards, as well as the obligations of other government bodies such as the Customs Agency and the Directorate General of Fire Safety and Population Protection under the Ministry of Interior, to provide information to the Ministry of Environment and Water.

Bylaws issued on the basis of the CAAA:

- Regulation on the requirements to the quality of liquid fuels, the procedure and method for their control - SG 66/2003, last amended SG 36/2011;
- Ordinance № 10 of 2003 on emission limit values (concentrations in waste gases) of sulphur dioxide, nitrogen oxides and dust emitted in the air from large combustion plants – SG 93/2003, last amended SG 19/2011;
- Ordinance № 6 of 1999 on the procedure and method for measuring emissions of harmful substances emitted into the ambient air by stationary sources – SG 31/1999, last amended SG 34/2011;
- Ordinance establishing measures for implementing Regulation (EC) № 842/2006 on certain fluorinated greenhouse gases - SG 3/2009, last amended SG 7/2011.

- **Forestry Act (FA) (SG 19/2011, last amended SG 43/2011)**

Forestry activities are subject to planning. Forest planning is carried out at three levels and includes a National Strategy for Forest Development and a Strategic Plan for Forest Development, regional development plans for woodlands and forestry plans and programmes.

The forestry management plans and programmes determine the admissible level of use of forest resources and the guidelines to achieve the goals of forest management for a period of 10 years.

FA prohibits the reduction of the total percentage of forest land in the country. The change of land use in forest areas is possible only in certain specified cases.

Some of the activities planned in the NAPCC for the Land Use, Land Use Change and Forestry sector should be implemented through the planning mechanisms of the FA. An example of such activity is the support for increasing the share of certified forests which aims to increase the carbon capture potential of forests.

- **Local Government and Local Administration Act (LGLAA) (SG 77/1991, last amended SG 57/2011)**

Local governments take decisions on the establishment and approval of spatial development plans and their amendments for the territory of the municipalities under the **Spatial Planning Act** as well as strategies, forecasts, plans and programs for development of the municipalities that take into account also the European local community development policies.

Local governments set requirements to the activity of natural and legal persons on the territory of the municipalities arising from the environmental, social and other characteristics of the settlements.

The activities to combat climate change have a local dimension in almost all sectors – either because they are related to plans and programs adopted at municipal level, or because they are implemented through local projects. Therefore a reasonable and transparent regulation of these activities and projects at local level can benefit greatly those municipalities that take advantage of the powers delegated to them.

- **Spatial Planning Act (SPA) (SG 1/2001, last amended SG 80/2011)**

SPA regulates the procedures for preparation, approval and amendment of general and detailed spatial development plans of settlements. The bylaws issued on the basis of the SPA lay down the standards of urban planning and development of land.

The standards for planning and construction regulated at governmental level, as well as the specific management decisions taken at local level are directly related to the activities for sector Land Use, Land Use Change and Forestry proposed in the NAPCC.

- **Agricultural Land Protection Act (ALPA) (SG 35/1996, last amended SG 39/2011)**

ALPA allows land use change of agricultural land only in certain specific cases.

Burning of stubbles and other plant residues in agricultural lands is prohibited. The users of agricultural land are held responsible for the burning of stubble and other plant waste on the agricultural land and must participate in their extinguishing.

The owners and the users of agricultural land are entitled to tax and credit preferences when implementing the mandatory limitation on agricultural land use as well as when implementing projects to restore and improve the fertility of agricultural land.

ALPA contains a legal framework covering some of the activities envisaged for the Agriculture sector in the NAPCC, such as counteracting the burning of stubble and plant waste and promoting agricultural practices aimed at reducing greenhouse gas emissions.

- **Agricultural Producers Support Act (APSA) *(SG 58/1998 , last amended SG 8/2011)***

APSA regulates state support to farmers with regard to the implementation of the measures included in the National Plan for Agricultural and Rural Development. Support is provided to farmers that operate and are registered in disadvantaged areas or in areas covered by Natura 2000 network.

APSA envisages development and approval of a National Strategic Plan for Rural Development and a Rural Development Programme.

A bylaw issued on the basis of APSA is:

- Ordinance on the terms and conditions for providing support to producers of energy crops – SG 37/2007, last amended SG 4/2008.

APSA regulates some of the activities through which the measures envisaged for the Agriculture sector of the NAPCC can be implemented, as well as the activities related to biofuel production. APSA is the law regulating the key financial mechanism for management of agricultural activities. Most of the proposals – whether introduction of best practices for rice production or for encouragement of crop rotation, especially with nitrogen-fixing crops, for restoration of degraded agricultural lands, or the introduction of water saving irrigation technologies – can be applied using the financial mechanisms regulated by APSA.

- **Waste Management Act (WMA) (SG 86/2003, last amended SG 99/2011)**

WMA lays down the requirements for the establishment of regional waste management systems. They are set up by municipalities, on a regional basis, and consists of a regional landfill and/or other waste treatment facilities.

Bylaws issued under the WMA:

- Ordinance № 6 of 28 July 2004 on the conditions and requirements for construction and operation of waste incineration and co-incineration plants – SG 78/2004, last amended SG 98/2004;
- Ordinance № 8 of 24 August 2004 on the conditions and requirements for construction and operation of landfills and other facilities and installations for waste recovery and disposal – SG 83/2004, last amended SG 27/2011;
- Ordinance on packaging and packaging waste – SG 19/2004, last amended SG 29/2011;
- Ordinance establishing the terms and conditions for payment of product fees for products after the use of which wide spread waste is generated – SG 53/2008, last amended SG 29/2011;
- Ordinance on the way of utilization of sludge deriving from wastewater treatment through its use in agriculture – SG 112/2004, last amended SG 29/2011.

- **Statistics Act (SA) (SG 57/1999, last amended SG 97/2010)**

The National Statistical Institute collects and processes information that is used for decision making related to climate change.

- **Geological Storage of Carbon Dioxide Act (GSCDA) (SG 14/2012)**

This act regulates public relations relevant to the storage of carbon dioxide in suitable underground geological formations.

It formulates the assessment criteria and the conditions to be met by the geological formations for storage of carbon dioxide. The right to explore the earth for geological formations that are suitable to store carbon dioxide is provided through an **exploration permit**. **A permit is required also for underground storage of carbon dioxide.** The permits are issued by the Minister of Economy, Energy and Tourism. The permitting procedure is defined in the GSCDA.

The Council of Ministers determines the state policy on storage of carbon dioxide in geological formations by approving a programme for exploration of sites for storage of carbon dioxide.

GSCDA lays down obligations related to the periods of operation, closure and post-closure of carbon dioxide storage sites.

This law transposes Directive 2009/31/EC of the European Parliament and the Council of 23 April 2009 on the storage of carbon dioxide in geological formations into the Bulgarian legislation.

- **Draft Climate Act (DCA)**

This act is to govern the public relations relevant to the implementation of the European greenhouse gas emission trading scheme. It will regulate the activities related to the allocation of greenhouse gas emission allowances and the issue and modification of greenhouse gas emission permits. The law will also regulate: the relations involving plans for monitoring and reporting of greenhouse gas emissions; the operation of the national registry of greenhouse gas emission allowances and the activity of the national registry administrator; the issuance, surrendering and cancellation of allowances; the terms and conditions for closure of stationary installations; and the emission allowances trading.

Subject to regulation by DCA will be the implementation of joint implementation projects and voluntary schemes, the reduction of greenhouse gas emissions from the liquid fuels supplied to the transport sector, as well as the implementation of the obligations under Decision 406/2009/EC on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020.

DCA will consolidate the numerous provisions relating to its subject that are currently found in various regulatory acts. It will settle the connections between national legislation and EU standards in the field of the regulated matter. It will also provide for the mechanisms to fulfil the obligations of Bulgaria under the Kyoto Protocol.

Fiscal policy

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

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

4.2.3.1. Legislative arrangements and administrative procedures to ensure that the implementation of activities under Article 3, paragraph 3, and any elected activities under Article 3, paragraph 4, and also contribute to the conservation of biodiversity and sustainable use of natural resources

The following activities relate to implementation of Article 3.3 and are regulated by the Forestry Act, Biological Diversity Act And Protected Areas Act. They directly contribute to conservation of biodiversity and sustainable use of natural resources.

- The Forestry Act governs public arrangements pertinent to the protection, stewardship and use of wooded areas in the Republic of Bulgaria, for the purpose of assuring the multi-functional and sustainable management of forest ecosystems.The act pursues the following goals:

1. protection of, and increase of the area taken up by, forests;
2. maintenance and improvement of the state and condition of forests;
3. assurance and maintenance of the ecosystemic, social and economic functions of wooded areas;
4. assurance and increase of the production of timber and non-timber forest products by way of the environmentally sound management of wooded areas;
5. maintenance of biological and landscape diversity and improvement of the state and condition of the populations of wild flora, fauna and micota;
6. provision of recreation opportunities for the population and improving recreation conditions;
7. achieving a balance between the interests of society and those of the owners of wooded areas;
8. provision of support and encouragement to owners of landed property in wooded areas;
9. fulfillment of international and European commitments for the conservation of forest habitats.

To establish the state and condition of resources and prepare an assessment thereof, wooded areas are subject to inventory. For purposes of such inventory of wooded areas forest territorial units are defined.
Such territorial units are determined by an order of the Minister of Agriculture and Food and cover the area of one or more whole municipalities within the boundaries of a single region.

The certification of forests is a voluntary tool applied for evaluation and validation of forest management practices through a set of standards. The certification of forests is carried out by independent, non-state-owned certifying bodies. The entity responsible for stewardship of a wooded area is issued a certificate by the certifying body attesting that a certification has been performed in accordance with a procedure established by said certifying body.This certificate attests to the fact that the stewardship of wooded areas is carried out in a manner that strikes the right balance between environmental, economic and social benefits.

The Executive Forestry Agency is the administrative institution responsible for organizing inventory-taking in wooded areas; creating and maintaining an information system for wooded areas and the activities carried out therein; coordinating and supervise forest conservation and protection.

A National Ecological Network is developed under the Biological Diversity Act and comprehend special areas of conservation part of the European Ecological Network NATURA 2000, which may incorporate protected areas; protected areas outside special areas of conservation; CORINE sites, Ramsar sites, Important Plant Areas and Important Bird Areas are incorporated into the National Ecological Network on a priority basis.The National Ecological Network have the following purposes:

1. long-term conservation of biological, geological and landscape diversity;
2. provision of sufficiently spacious and high-quality sites for wild animals to breed, feed and rest, including during the period of migration, moulting and wintering;
3. creation of conditions for genetic exchange between geographically separated populations and species;
4. participation of the Republic of Bulgaria in the European and world ecological networks;
5. containment of the adverse impact of human activities on protected areas.

- According to the Protected Areas Act, the protected areas shall be dedicated to the conservation of biological diversity in ecosystems and of the natural processes occurring therein, as well as of typical or remarkable non-living natural features and landscapes.

There shall be the following categories of protected areas:
1. strict nature reserve;
2. national park;
3. natural monument;
4. managed nature reserve;
5. natural park;
6. protected site.

The activities under Article 3, paragraph 4 are not applicable for Bulgaria.

4.2.3.2. Public accessibility of the legislative arrangements

The State Gazette is an official publication of the Republic of Bulgaria which is being issued by the National Assembly. The State Gazette maintains a publicly accessible, free website /http://dv.parliament.bg/DVWeb/index.faces/.

Published in the official section of the State Gazette are:
1. Acts adopted by national referendum;
2. The Constitution;
3. Codes, laws, decisions, declarations and addresses of the Grand National Assembly and the National Assembly;

4. The Rules for organization and activities of the Grand National Assembly and the National Assembly;
5. Decrees of the President of the Republic;
6. Decisions of the Constitutional Court together with the reasons thereof, and by discretion of the Chairman of the Constitutional Court - also orders of the court together with the reasons thereof;
7. Decrees, rules and regulations of the Council of Ministers, and by discretion of the Prime Minister - also orders and decisions of the Council of Ministers;
8. International agreements to which the Republic of Bulgaria is a party;
9. Rules, regulations and instructions of ministers;
10. Decisions of the Supreme Administrative Court repealing statutory acts of the Council of Ministers and the ministers;
11. Statutory acts of other government authorities, where that has been explicitly provided by law.

4.3. Policies and measures and their effects

The information and the analysis of the provided national measures for the period until 2011 are provided on the basis of two groups of measures and reported based on the status of implementation of measures: “with measures” (WM) and “with additional measures” (WAM).

According to the official definition of the UNFCCC documents Implemented policies and measures are those for which one or more of the following applies: (a) national legislation is in force; (b) one or more voluntary agreements have been established; (c) financial resources have been allocated; (d) human resources have been mobilized. Here we do not consider measures that are supported by the national legislation as implemented. These measures are listed under additional measures. Those policies and measures for which an official government decision has been made are not considered under the “with measures” as well, because it is common practice in the country to cancel or postpone the implementation of legal or governmental decisions so there is no a clear commitment to proceed with implementation.

Planned policies and measures are options already adopted, but not implemented yet, or are under discussion and having a realistic chance of being implemented in future.

The policies and measures presented by sectors contribute to the reduction of greenhouse gas emissions in Bulgaria. The overall effect of their implementation will ensure the achievement of the legally binding targets for our country under the Climate and Energy package as well as the energy efficiency goals. The measures are summarized for each sector and the total effect of their implementation is reflected in *Section 5. Projections and total effect of policies and measures.*

These measures are selected from a larger number of proposed actions after coordination with governmental and non-governmental stakeholders. They are formulated so as to meet the main goal for reduction of greenhouse gas emissions in Bulgaria and implementation of the existing EU legislation on climate change.

Various tools were proposed to support their implementation. The measures are grouped in two directions - those with a measurable effect on the reduction of greenhouse gases and those with indirect effect. A performance indicator was set that is directly or indirectly related to the calculation of the expected effect, as well as target values by year.

4.3.1. Real and expected interaction with other relevant policies and measures and with the relevant policies and legislation of the European Community

Regulation on the conditions, order and way for preparing of the reports and for verification of reports of the installation operators, participating in the National Allocation Plan 2008 – 2012 was approved by DCM № 8/19.01.2007.

Regulation on the order and methods of working of the National registry for accounting of issuing, possession, delivery, transferring and cancelling of GHG emission allowances was approved by DCM №7/19.01.2007.

New regulations in 2010 have been introduced to further clarify the EU ETS process:

- DCM 297/13.12.2010 for Regulation on the order and way of issuing and reconsideration of allowances for GHG emissions from installations and for performance of the monitoring by the installation operators and aircraft operators – participants in the emission allowances trading scheme
- DCM 298/13.12.2010 for Regulation on the conditions, order and way of preparation of reports and for verification of the reports of the installation and aircraft operators;
- DCM № 313/12.2010 for Regulation on the order and way of functioning of the National Registry for accounting, issuing, possession, delivery, transferring and cancelling of GHG emission allowances.

Directive 2009/30/EC amending the Fuel Quality Directive introduce a requirement for fuel producers and suppliers to reduce by 2020 the greenhouse gas emissions throughout the fuel production chain by 6% and to realize additional reductions of 4% by applying new technologies (for instance CCS) and by using credits from projects under the “Clean Development” mechanism (CDM) in developing countries. Thus the target of 10% reduction of greenhouse gas emissions from transport fuels is distributed as follows:

- 6% reduction in greenhouse gas intensity of fuels (with interim indicative targets of 2% in 2014 and 4% in 2017); and additional
- 2% reduction of greenhouse gas intensity by applying new technologies (such as CCS) – depending on their level of development;
- 2% reduction by obtaining CDM credits.

Reaching this target **depends directly on achieving 10% share of biofuels in transport fuel consumption** as laid down in the RES Directive.

The achievement of the target is **directly dependent on achieving a 10% share of biofuels in transport fuel consumption** laid down in the Renewable Energy Directive.

The Fuel Quality Directive introduces the same requirements for biofuels as for renewable energy – in order to be taken into account their greenhouse gas emission indicators should be at least 35% lower than those of conventional fossil fuels (respectively - 50% from 2017 and 60% from 2018). They must also meet the sustainability criteria which are identical with those set out in the Renewable Energy Directive (for instance in order to recognize the targets, the raw material must not have been produced on a land with high biodiversity value or within Natura 2000 network).

National long-term program for reassurance of the bio fuels consumption in the transport sector 2008-2020 was developed. It was adopted by the Council of Ministers on 15.11.2007.

In connection with efficient realization of the politics and measures on climate changes and on purpose increase of the institutional capacity of the national level, the work on coordination of different aspects from these activities through interdepartmental working groups was approved as a good practice. With Orders from the Minister of Environment and Water were established: Interdepartmental committee on climate change, Interdepartmental working group for development of National Allocation Plan 2008-2012 and Steering Committee for evaluation of JI projects under the Kyoto Protocol.

4.3.2. Energy sector

4.3.2.1. Introduction

The Energy Sector covers the following activities:

- production and transmission of electricity, including cogeneration;
- production and transmission of heat for public needs;
- transmission of natural gas (maintenance of the pressure of compressor stations).

About 92-93% of the total aggregated greenhouse gas emissions in the sector are emitted in the production of electric energy due to the burning of fuels, 6-7% come from the production of thermal energy and about 1% is emitted by the transmission of natural gas.

4.3.2.2. Greenhouse gas emissions – state and trends

The greenhouse gases for which the Energy sector is responsible hold the largest and growing share in the total emissions, which determines their key importance for the implementation of the national emission reduction targets. This is due to the stable production of electricity in recent years, a growing proportion of which is intended for export, on the one hand, and to the larger share of electricity produced from coal after the decommissioning of nuclear power units and the commissioning of new coal power, on the other hand.

Table 4.1 Trends and structure of GHG emissions

	2000	2005	2009	2010	2011
Total emission, mln.t CO_2 eq., including:	59 501	63 749	57 805	60 352	66 133
Energy Sector (production of electric and thermal energy)	24 071	27043	29 624	31 546	36 360
Share of the Energy Sector, %	40.5	42.4	51.2	52.3	55.0

The analysis of GHG emissions by sources in the sector leads to the conclusion that the main reduction potential is concentrated in the generation of electric and thermal energy from coal because this production is responsible for over 90% of the emitted greenhouse gases. On the other hand, about 70% of the total emissions from electricity generation (excluding factory plants) come from the three large power plants burning local lignite coal - TPP “AES Galabovo”, TPP “Maritza East 2” TPP, “Enel Maritsa East - 3”. They are in the spotlight because their potential to reduce emissions by 2020 predetermines to a large extent the emissions trend for the sector as a whole.

4.3.2.3. Priority axes for development of the sector

The priority axes result from the current energy policy that is conditionally divided into two periods corresponding to the elaborated scenarios, namely:

- **Until 2009 (baseline scenario)**

The key policies and measures with a direct and significant impact on the behaviour of operators and investors in the energy sector, respectively – on the trends of GHG emissions – are the following:

- the requirements to reduce the emissions of sulphur dioxide, nitrogen dioxide and dust in accordance with the Implementation Programme for Directive 2001/80/EC on the limitation of emissions of certain pollutants into the air from large combustion plants and the integrated permits issued to the operators of individual installations pursuant to art. 117, para. 1 and 2 of Chapter 7, Section II of the EPA;
- policy to encourage investment in modernizing existing and building new coal power stations by signing long term contracts between power plants and NEC for buying energy.

- **From 2009 until now (scenario with measures)**

The key policies and measures adopted/planned/implemented since 2009, which will have significant and positive impact on the GHG emissions from the Energy sector are:

- contained in the Energy Strategy of Bulgaria until 2020, approved by Decision № 133 of the Council of Ministers of 9 March 2011 and by the National Assembly by decision of 01.06.2011;
- contained in the provisions of the Renewable Energy Act, as well as in the National Action Plan for Renewable Energy, developed on the basis of the

requirements of Directive 2009/28/EC with a view of achieving the binding national target of 16% share of renewable energy in the total energy consumption by 2020, including 10% renewable energy in the energy consumption of transport.

The measures aimed at reducing GHG emissions in the Energy sector are grouped into five priority axes as follows:

- Priority 1: Cleaner production of electricity from existing coal-fired plants;
- Priority 2: Transition to a low-carbon electricity mix;
- Priority 3: The district heating system – an instrument for low-carbon energy;
- Priority 4: Accelerated penetration of decentralized energy production;
- Priority 5: Development of low-carbon networks for transmission and distribution of electricity and natural gas.

Depending on the nature of their impact on the level of GHG emissions, the measures are grouped in two directions - measures with measurable/direct effect and measures with indirect effect. The measures with direct impact include those that lead to reduction of the total GHG emissions resulting from the production of heat and electricity by 2030. A number of measures included in the priority axes will not lead to reduction of GHG emissions in the Energy sector by 2030, but they are a step towards a low-carbon development of the sector and will have a multiplier effect in the coming decades. These include:

measures leading to reduction of the carbon intensity of the electricity generation mix (emissions per generated MWh) by additional production of decarbonized electricity);

measures leading to reduction of the carbon intensity of the supplied electricity by decreasing network losses and development of decentralized energy production (emissions per supplied MWh);

measures undertaken by energy companies with effect redirected to other sectors – to energy consumers.

Scenarios and projected outcomes

The two scenarios for reducing GHG emissions in the Energy sector by 2030, used in the development of National communication and related to different assumptions of the current/planned policies and implemented measures, lead to the following results:

- *baseline scenario (in the policy and measures by the reference year 2009)* – reduction of emissions by 3.1 mln.t CO_2 eq. or by 11,5% compared to 2005;
- *scenario “with measures”* – reduction of GHG emissions by 7.5 mln.t CO_2 eq. or by 27,7% compared to 2005.

This scenario is consistent with the target scenario of the Energy Strategy until 2020 in terms of policies and measures and in terms of their quantitative indicators, with analyses and assessments of the current implementation of the binding national target of 16% RES, as well as with the country's application for transitional free allocation of emission allowances in the energy sector and the accompanying draft National Investment Plan, which provides for over € 800 mln. grants for projects to modernize the national energy system by 2020.

A large number of the measures with indirect effect will contribute significantly to the reduction of GHG emissions over the next decade (2020-2030). Furthermore, if the Energy Strategy is successfully implemented in terms of development and application of technologies for capture and storage of carbon dioxide and construction of new nuclear capacity, the cumulative reductions in 2030 will reach 18.5 mln.t CO_2 eq. or 68% less GHG emissions compared to 2005.

4.3.2.4. Measures in the Energy Sector

PRIORITY AXIS 1: LOW-CARBON PRODUCTION OF ELECTRIC ENERGY FROM COAL-FIRED POWER PLANTS

Measures with direct impact on the reduction of GHG emissions

Measure 1: Improvement of production efficiency in existing coal-fired power plants

Characteristics: In 2007-2009 the average carbon intensity of electricity generation from coal-fired power plants is 1.2 t CO2 equivalent per MWh. Measures to increase the efficiency of production in a cost effective way can lead to reduction of this factor by approximately 5% -7% which is equal to 1.3 mln. tonnes annual reduction of carbon dioxide emissions from existing coal-fired power plants by 2020 or cumulatively 4.68 mln. tonnes of CO2 eq. for the entire period . The expected reductions in greenhouse gases is calculated on the basis of estimates as follows: 20% of the potential to be realized by 2014; additional 30% to be realized by 2016, 30% – by 2018, and 100% of the potential for reducing emissions as a result of the modernization of coal-fired plants within the period by 2020. These targets are cumulative respectively for the period until 2014 - the first two-year period, until 2016 – for a four-year period, until 2018 – for a six-year period and until 2020 - for the entire period by 2020.

Type of policy instrument:

Economic, fiscal, regulatory

European Emission Trading Scheme/National investment plan according to Art. 10c of Directive 2003/87/EC and legislative changes related to their implementation

Expected effect:

Total reduction by 2020 of 4 680 000 tonnes CO2 eq. monitoring indicator:

Ton reduced CO2 per MWh

Table 4.2 Cumulative emission reduction

Cummulative emission reduction k tCO2/year	2014	2016	2018	2020
	520	1300	2800	4680

Source TNAPCC

Measure 2: Fuel substitution – from coal to natural gas

Characteristics: The European Emission Trading Scheme and the competition on the electricity market encourage the transition to low-carbon technologies and fuels such as natural gas. Every 100 MW coal-based generating capacity substituted with natural gas will be reflected as a reduction of 450 thousand tonnes of CO_2 per year. The target values are calculated by years and the commissioning of 100 MW is envisaged for the period by 2014; additional 100 MW are envisaged by 2016, another 200 MW - for the period until 2018 and additional 200 MW until 2020, or a total of 600 MW new, substituting gas capacity for the period 2012-2020.

Type of policy instrument:

Economic, fiscal, regulatory

European Emission Trading Scheme/National investment plan according to Art. 10c of Directive 2003/87/EC

Expected effect:

Total reduction by 2020 of 11 700 000 tonnes CO_2 eq.

Monitoring indicator:

MWh energy, produced with substituted fuel

Measures with indirect impact on the reduction of GHG emissions

Measure 1: pilot projects with clean coal technologies

The Energy Strategy of the Republic of Bulgaria until 2020 envisages institutional support and monitoring of projects for building new and/or substituting capacities based on local coal with mandatory use of highly efficient and low-emission modern technologies with capture and storage of CO_2, including technologies for development and improvement of the energy system. The active measures undertaken by the state and consisting in the provision of financial support for training, participation in joint international projects and/or implementation of demonstration projects will contribute substantially to low-carbon developments of coal-fired power generating facilities. According to the projected energy balance the first project with installation for capturing and storing carbon dioxide will be commissioned in the period 2020-2025.

Characteristics: The preparation phase, subject to the proposed measure, will not lead to reduction of the GHG emissions in the period by 2020. The needed financial resources cannot be estimated at this stage given the lack of clarity regarding the potential for implementation of such projects during the new financial period 2013-2020 and the scientific research programmes and demonstrations in the Energy sector.

Measure 2: Geologic studies for CO2 storage sites

Characteristics: The Energy Strategy of the Republic of Bulgaria 2020 has set a target of 9.2 mln. tonnes CO2 from the GHG emissions emitted by the Energy sector to be captured and stored in geological formations by 2030. Besides the already existing legislative framework, an important factor for the implementation of this goal is the timely conducting of the necessary geological surveys, environmental impact assessments and activities to acquaint the public with the technology. The prompt actions of the governmental (municipal) authorities and private investors would create a good basis for the achievement of the targets set in the Energy Strategy of the Republic of Bulgaria. The state does not intend to use budget funds to finance the studies. The measure contributes to reducing greenhouse gas emissions after 2020.

Measure 3: Introduction of mandatory requirements to the efficiency of new coal-fired power stations

Characteristics: The measure envisages a legally binding requirement to use the best available technologies in the building of new coal-fired power plants. By this measure a lower emission factor of electricity generation from coal-fired power plants is achieved.

PRIORITY AXIS 2: REDUCTION OF THE CARBON INTENSITY OF THE ELECTRICITY GENERATION MIX

Measure 1: Increase of highly efficient co-generation

Characteristics: The Energy Strategy of the Republic of Bulgaria envisages that the co-generation of electric energy will account for 15% in the electric energy mix by 2020. The co-generation of heat and electric energy improves the overall efficiency of fuel use and saves the primary energy needed to produce the two types of energy separately. The increased share of electricity produced by co-generation and the saved primary energy will be reflected as a reduction in the carbon intensity of the electricity generation mix.

Type of policy instrument:

Economic, fiscal, regulatory

European Emission Trading Scheme and system of preferential prices for electricity produced with highly efficient methods

Expected effect:

Total reduction by 2020 of 1 600 000 tonnes CO_2 eq.

Monitoring indicator:

MWh generated energy

Table 4.3 Generated Electricity, MWh

Year	2014	2016	2018	2020
Target value by year, MWh	3 839 000	13 563 000	27 053 000	42 173 000

Measures with indirect impact on the reduction of GHG emissions

Measure 2: Institutional support for investments in decarbonised electricity generation capacities – nuclear energy

Characteristics: The measure stimulates the production of electricity from low-carbon and decarbonised sources. The Energy Strategy of the Republic of Bulgaria envisages provision of support to the nuclear energy not only as a promising resource for the production of decarbonised electricity, but also because of the accumulated successful experience and professional capacity for the operation of nuclear facilities. The support will be accompanied with strict requirements to the security, safety, and nuclear waste management and decommissioning. According to the projected electricity generation balance the share of nuclear energy in the electricity generation mix will grow from 42% in 2005 to 45% in 2020 and will contribute to reducing the carbon intensity in the production of electricity.

Expected effect:

45% share of nuclear energy in the electricity generation mix

Monitoring indicator:

Share of nuclear energy in the electricity generation mix

Type of instrument:

Institutional support

Measure 3: Increasing the share of electric energy from renewable energy sources in the electricity generation mix

Characteristics: The production of electricity from renewable sources will contribute significantly to reducing the carbon intensity of the country's electricity generation mix. The national policy in this area is well developed in the adopted National Action Plan for Renewable Energy by 2020 and the Renewable Energy Act. The production of electricity from renewable sources is expected to increase to 7.5 TWh by 2020 or to account for 15% in the electricity generation mix of the country which is equivalent approximately to 20% implementation of the national target for renewable energy share in the gross energy consumption in 2020. It will further contribute to reducing carbon intensity in the production of electric energy.

Expected effect:

15% share of electricity from renewable sources in the electricity generation mix and achievement of the national target for the share of electricity from RS in the gross energy end-use consumption

Monitoring indicator:

% of the energy mix

Type of instrument:

National action plan in the field of renewable energy

Measure 4: Increasing the capacity for generation of pumped-storage hydroelectricity

Characteristics: The measure is necessary to balance the production of electricity from wind farms that are expected to contribute to achieving 30% of the national target in the Energy sector by 2020. It will lead to further reduction of the carbon intensity of the electricity generation mix due to increased production and consumption of decarbonised energy

Expected effect:

Technical opportunity for achievement of the national target of renewable energy share

Monitoring indicator:

MW additionally installed capacities

Type of instrument:

National action plan in the field of renewable energy. National investment plan according to Art. 10c of Directive 2003/87/EC

PRIORITY AXIS 3: MODERNIZED DEVELOPMENT OF THE DISTRICT HEATING SYSTEM

Measures with direct impact on the reduction of GHG emissions

Measure 1:Increasing the share of heating and cooling based on renewable energy sources

Characteristics: The measure is intended to create conditions for sustainable development of the district heating sector in Bulgaria and for substitution of conventional fuel for production of thermal energy with renewable sources. The introduction of renewable thermal energy will be gradual and will start with generation of 2% thermal energy from renewable sources in 2014 reaching 10% of the generated thermal energy, mainly from biomass. The cumulative effect of the measure will lead to reduction of greenhouse gases emitted by the district heating systems by 488 000 t until 2020. The contribution of the measure towards the national target in the field of renewable energy sources is relatively small - about 1%.

Expected effect:

Total reduction of 488 000 tonnes CO2 eq. by 2020

Monitoring indicator:

MWh electricity generated

Instruments:

Stable legislative environment

National action plan in the field of renewable energy

Support schemes

Table 4.4 Generated Electricity, MWh

Year	2014	2016	2018	2020
Target value by year, MWh	70 000	256 000	556 000	978 000

Measures with indirect impact on the reduction of GHG emissions

<u>Measure 1:Rehabilitation of existing and building of new low-carbon district heating networks</u>

Characteristics: One of the barriers to the development of new district heating companies is the costly start-up investment in district heating networks. At the same time, the technological losses of existing heating networks account for about 23%. Well-targeted financial support is needed for rehabilitation of existing and construction of new heating networks in order to ensure the sustainable development of the sector and to reduce emission s of greenhouse gases associated with the consumption of thermal energy. Therefore, a national program to stabilize and to develop the district heating sector in Bulgaria should be developed in accordance with the Energy Strategy of the Republic Bulgaria by 2020. The funds required for implementation of the programme as well as the GHG emission savings will be estimated in the process of its development.

<u>PRIORITY AXIS 4</u>: ACCELERATED INTRODUCTION OF DECENTRALIZED ENERGY PRODUCTION

Measures with indirect impact on the reduction of GHG emissions

Measure 1:Provision of public information regarding resources, state and plans for development of the electricity generation networks

Characteristics: The provision of updated information on existing resources, the condition and the plans for development of the networks will support taking of investment decisions and the development of projects for decentralized sustainable production and consumption with low levels of GHG emissions.

PRIORITY AXIS 5: DEVELOPMENT OF LOW-CARBON NETWORKS FOR TRANSMISSION AND DISTRIBUTION OF ELECTRIC ENERGY AND NATURAL GAS

Measures with indirect impact on the reduction of GHG emissions

Measure 1:Energy efficiency in the transportation of energy and introduction of "smart" energy storage networks and facilities

Instruments:

Regulatory incentives for energy network operators

Indicator of implementation

% of energy loss reduction

Expected results:

30% fewer losses in energy transportation

4.3.3. Energy efficiency and RES – Household and Services Sector

4.3.3.1. General information on the Households and Services Sector

Economic environment

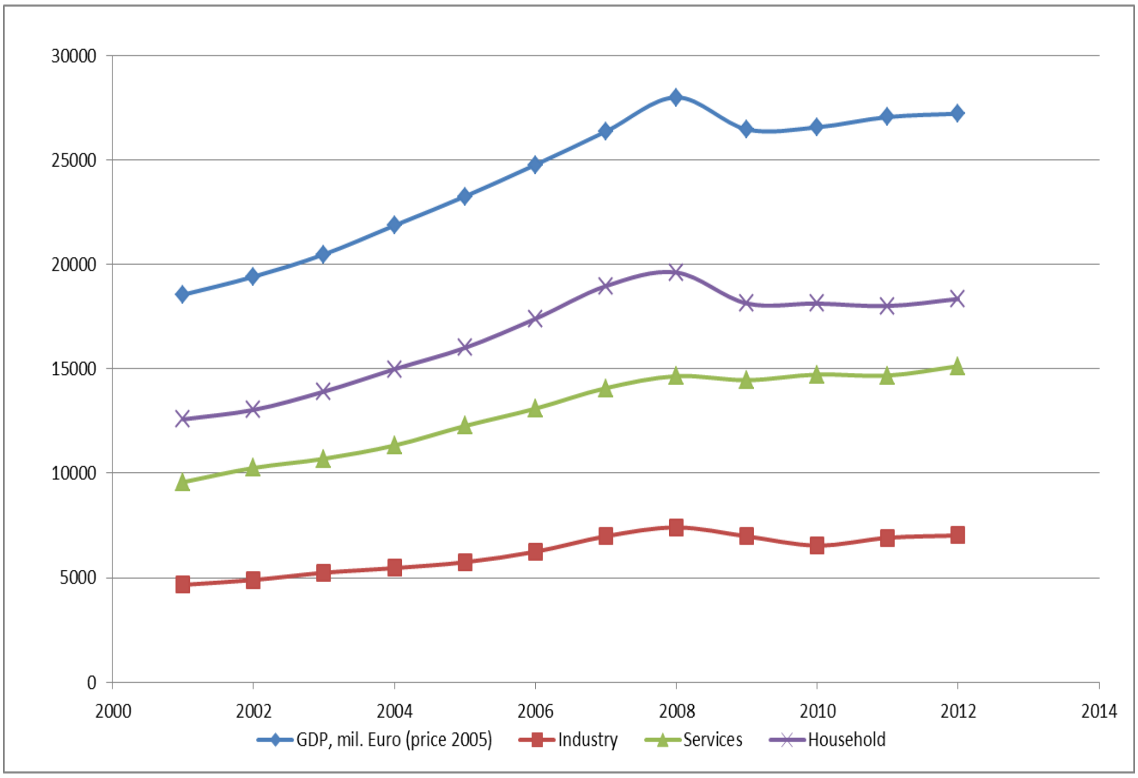
In the period 2001-2011 the Bulgarian economy shows a constant average annual growth rate of 5.8%, with GDP rising from € 18.5 bln. in 2001 to € 28 bln. in 2008 at constant prices of 2005. The global economic crisis hit the Bulgarian economy in 2009, when a drop in GDP to € 26.5 bln. (at constant prices of 2005) was recorded. Since next 2010 very slow increase is observed.

Table 4.5 Trend of the GDP for the period 2011-2012

Year	2001	2002	2003	2004	2005	2006
GDP, mil. Euro (price 2005)	18551	19414	20483	21865	23255	24770
Industry	4665	4896	5245	5465	5749	6245
Services	9581	10258	10700	11336	12269	13098
Household	12586	13038	13915	14986	16008	17397
Year	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**

GDP, mil. Euro (price 2005)	26367	27999	26466	26570	27059	27217
Industry	6989	7412	6988	6547	6917	7025
1Services	14082	14654	14463	14731	14679	15136
Household	18966	19615	18134	18130	18012	18349

Figure 4.1 Basic indicators of economic development



Source: NSI

- GDP grew by 5.8;
- % on average until 2008, in 2009 dropped by 5.5% and then slow increased;
- Industry grew by 63% until 2008, and in 2009 decreased by 5.7%;
- The services sector grew by 65% until 2008, in 2009 dropped by 2% in 2010 and by 1.03 % in 2012;
- Household consumption increased by 64% until 2008, in 2009 dropped by 7,6% and then slow increased.

Despite the economic crisis, the natural social development leads towards higher living standards which, in turn, lead to a steady trend of growing household consumption.

This factor is important as it directly affects the consumption of fuel and energy.

Energy consumption

The **Primary energy consumption (PEC)** decreased in absolute value from 18 666 ktoe in 2001 to 17 839 ktoe in 2012. The changes in PEC by fuel type over the same period is shown in Table 4.6.

Table 4.6 Primary energy consumption (PEC) ktoe

Year	2001	2002	2003	2004	2005	2006
Primary energy consumption, ktoe	18666	18601	18864	18261	19273	19945
Year	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Primary energy consumption, ktoe	19349	18913	16895	17361	18600	17839

Sourse: NSI

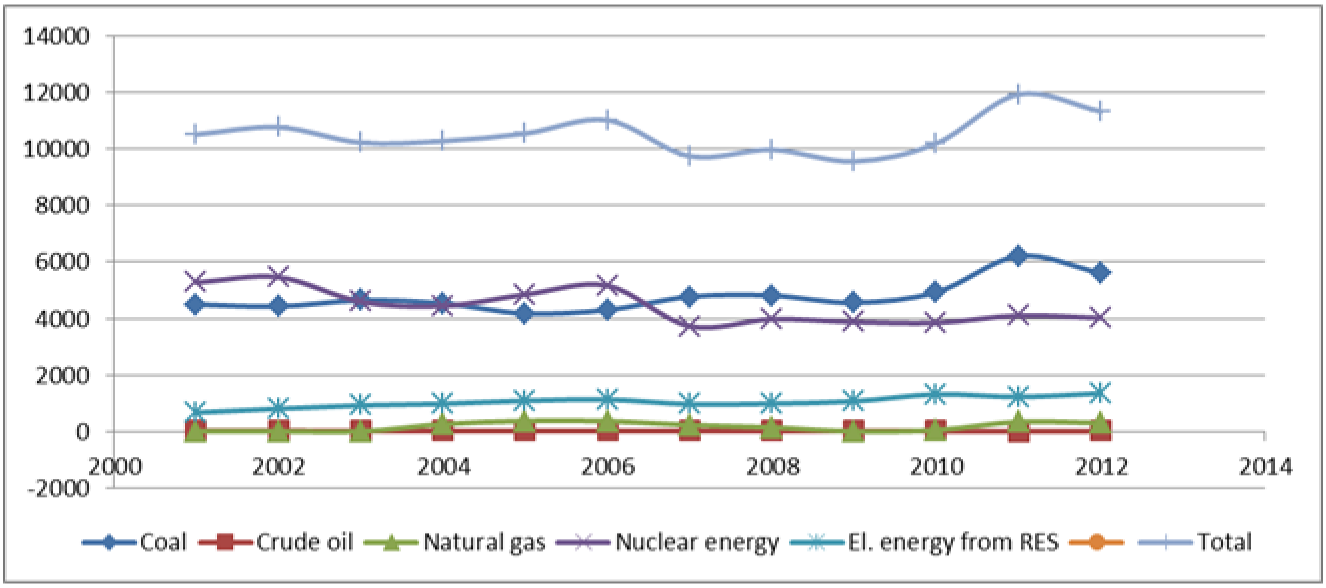
Production of primary energy by fuel type is presented in Table 4.7 and Figure 4.2

Table 4.7 Primary energy production by fuel type 2001-2012, *1000 toe.*

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Coal	4497	4428	4645	4537	4177	4307	4773	4814	4560	4931	6209
Crude oil	34	38	31	31	30	28	26	25	24	23	22
Natural gas	18	16	13	270	384	375	236	155	14	59	351
Nuclear energy	5277	5463	4594	4444	4851	5162	3728	3977	3878	3849	4105
El. energy from RES	681	816	931	989	1097	1139	975	995	1077	1326	1232
Total	**10507**	**10761**	**10214**	**10271**	**10539**	**11011**	**9738**	**9966**	**9553**	**10188**	**11919**

Sourse: NSI, MEE

Figure 4.2 Primary energy consumption by fuel type 2001-2011. Source: NSI, *MEE*



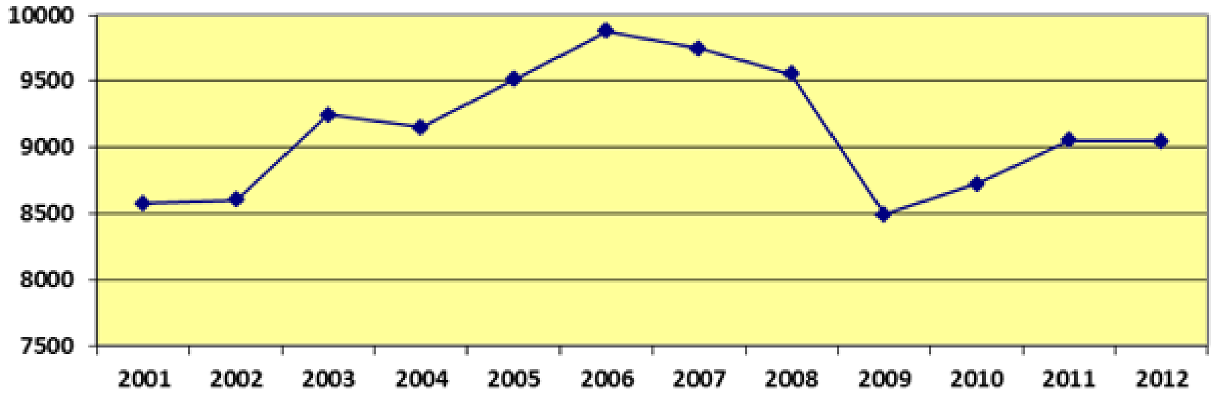
The **End-use energy consumption** in 2012 was 9.044 Mtoe which represents a negligible growth compared to the consumption of 8.574 Mtoe in 2001 (1.05 %).

Table 4.8 End-use energy consumption 2001-2012r. ktoe

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
End use energy consumption	8574	8601	9247	9150	9512	9880	9748	9552	8493	8720	9050	9044

Source: NSI, MEE

Figure 4.3 End-use energy consumption 2001-2012r. ktoe



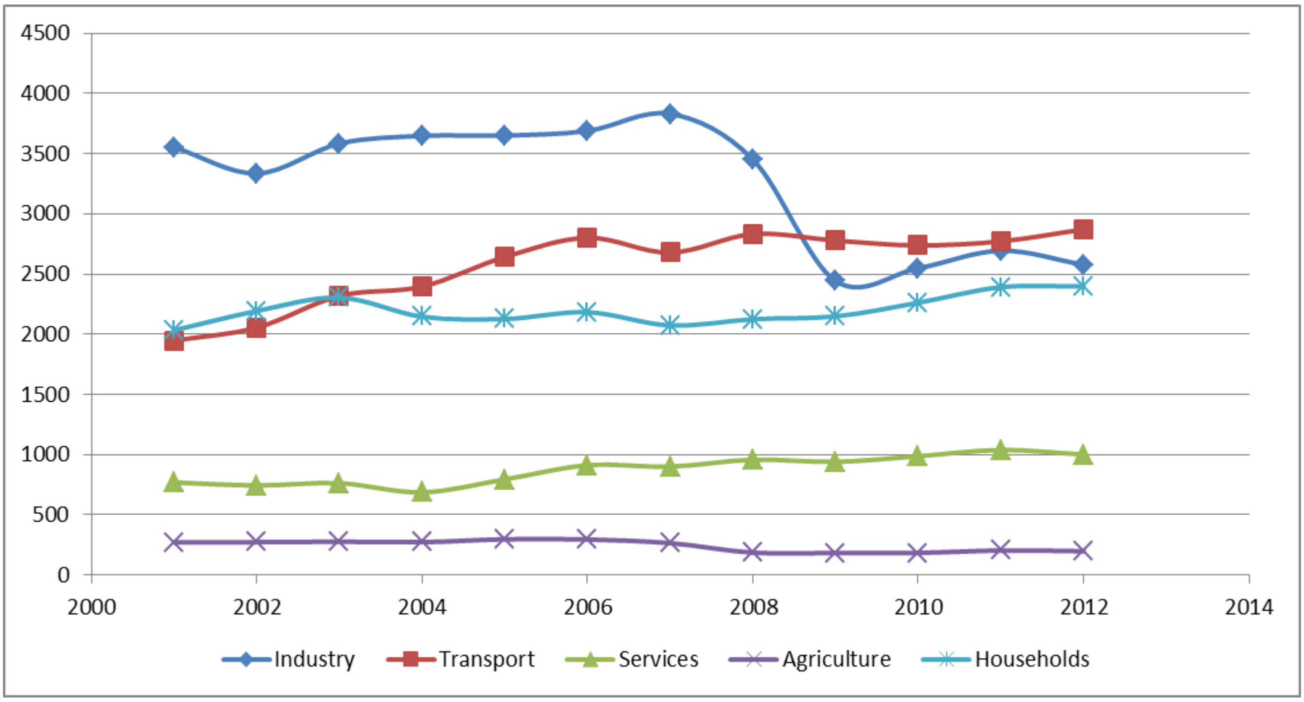
Changes in final energy consumption in Bulgaria by economic sectors over the period 2001-2012 is shown in Table 4.9.

Table 4.9 Final energy consumption by sectors, mtoe

Year	2001	2002	2003	2004	2005	2006
Industry	3553	3336	3584	3648	3651	3689
Transport	1948	2055	2319	2396	2642	2801
Services	769	744	763	687	795	912
Agriculture	271	273	277	273	297	295
Households	2033	2193	2304	2146	2127	2183
Year	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Industry	3831	3451	2443	2549	2694	2577
Transport	2678	2832	2778	2738	2772	2871
Services	901	958	940	987	1039	1001
Agriculture	265	186	183	184	204	198
Households	2073	2125	2149	2262	2391	2397

Sourse: NSI, MEE

Figure 4.4 Final energy consumption by sectors 2001- 2011



Source: NSI

As it can be seen from the figure, the change in the trend of the energy consumption for the period is mainly determined by the sector “Industry”.

The most commonly used energy sources in the sector are solid and liquid fuels, natural gas and electricity, whose share in the years varies between 20 and 25 %.

The consumption in the “Transport” sector increased until 2008 and was maintained at the same levels until 2012.

The trend in the energy consumption for the “Services” and “Households” sectors is similar.

At the end of the period the three sectors “Industry”, “Transport” and “Households” have almost the same relative share – around 30 %.

Despite the slight increase, the consumption in sector “Services” has a small relative share in the final energy consumption – around 10 %. Since the level of services remains at a lower level compared to the average standards in the other Member States in the EU, the energy consumption in the sector is expected to increase in the coming years.

The energy consumption in sector “Agriculture” has the lowest relative share in the structure of the final energy consumption. – around 2 %. The sector has experienced the largest decline in the considered retrospective period. Due to the insufficient subsidizing by the state, the agricultural production continues to be uncompetitive and with high cost. The reason for this is the small size of the farms. The fragmentation of the land resulted from the process of restitution of property, creates obstacles to the development of modern and efficient agriculture.

Energy intensity

Final energy intensity is the main indicator of energy efficiency consumption by end users and it decreases by over 5% on average per year during the period 2004-2012.

Table 4.10 Final Energy Intensity

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012
Toe per 1000 euro GDP (2005 = 100)	0,870	0,865	0,838	0,765	0,711	0,659	0,669	0,706	0,671

In the last two years the end-use energy intensity decreased from 0.706 toe/1000 EURO in 2011 to 0.671toe/1000 EURO in 2012. This reduction of end-use energy intensity corresponds to annual energy savings, respectively, the decrease of end-use energy intensity leads to direct reduction of GHG emissions. It should be noted that the downward trend of end-use energy intensity is independent of the economic development which is a step towards a "low-carbon economy".

Services

This is the sector with the lowest energy intensity (6.4 times lower than that of the industry in 2009), but in the period 2000-2009 the energy intensity of the sector decreased by only 10%, and has remained unchanged over the last two years. The impact of energy prices in this sector is weaker and therefore binding measures such as audits and certification, compulsory measures prescribed in audits, inspections of boilers and air conditioning installations, higher requirements to the energy performance of public buildings and others must be taken.

Households

The energy consumption by housing increases over the last two years from 2262 toe in 2010 to 2397 toe in 2012, *where the growth of electricity consumption is especially rapid*. The main factors affecting the growth of energy consumption are: growing size of new homes, higher levels of thermal comfort, of lighting, development of air conditioning and increasing use of household appliances and electronics. A significant barrier to the reduction of end-use energy intensity of households is the low efficiency of electricity generating facilities and the underdeveloped gasification of households.

Preconditions of the intended measures (policies, plans and programmes)

- **Energy Strategy of Bulgaria 2020**

The target for saving primary energy is set out in the *Energy Strategy of Bulgaria until 2020*. The target proposed in this document is reduction of the primary energy intensity (PEI) by 50% by 2020 as compared to 2005. The achievement of this target will save 5.8 Mtoe primary energy compared to the baseline scenario of development by 2020.

The result achieved so far is reduction of PEI from 0.563 koe/BGN00 in 2005 to 0.429 koe/BGN00 in 2009, or by more than 23%.

		BASELINE SCENARIO	TARGET SCENARIO
BENCHMARK INDICATORS	**2005**	**2020**	**2020**
Gross domestic product (000 M€05)	21.9	34.7	34.7
Gross domestic consumption (Mtoe)	20	21.6	15.8
Dependence on import of oil and natural gas (%)	38	36.7	48
End-use consumption (Mtoe)	9.6	11.1	9.16
Ration end-use/total (%)	48	51	58
Energy intensity (toe/M€05)	913.3	623.6	456
Energy from renewable sources (Mtoe)	1.1	1.71	1.96
Share of RES (%)	9.4	13	18.8

Source: Energy Strategy of Bulgaria by 2020

– **National indicative target for end-use consumption**

The national indicative target under Directive 2006/32/EC is indicated in FNAPEE[2]. This target is aimed at saving 7 291 GWh (627 ktoe) energy from the end-use energy consumption (within the scope of the Directive) by 2016 and the interim target is to save 2 430 GWh (209 ktoe) by 2010.

The report on the implementation of FNAPEE shows that the results surpassed considerably the set target. The energy saved until 2009 (only within the scope of the Energy Services Directive), calculated using the "top-down" method are not less than 5 168 GWh/year (444.3 ktoe) thus considerably exceeding the interim target of 2 430 GWh (209 ktoe).

SNAPEE3 was developed in accordance with the provisions of the Directive. It foresees activities that continue the current policy while taking into account the development of the European policy, respectively the new regulatory acts that are to be transposed into the national legislation. The SNAPEE was approved by the Council of Ministers on 28.11.2011. It covers the period 2011-2016 and contains projections until 2020. Its implementation will lead to the achievement of the national energy saving target set out in the FNAPEE (7.291 GWh annual savings). The evaluation of the possible savings show that the national target will be overachieved by 2016 reaching the value of 13.693 GWh.

According to preliminary estimates the achievement of such level of annual savings will lead to reduction of greenhouse gas emissions by more than 600 000 tonnes of CO2 eq. (by 2016) and the sectors of Household and Services alone will contribute to the reduction by more than 295 190 tonnes CO2 (by 2016). The projections made in SNAPEE on the impact of the measures by 2020 show that the total effect of the energy consumption reduction in these sectors will be 555 800 tonnes CO24 (by 2020).

[2] FNAPEE – First National Action Plan on Energy Efficiency

[3] SNAPEE – Second National Action Plan on Energy Efficiency

[4] In view of the crucial importance of the implementation of the measures under SNAPEE to mitigate climate change, this estimate is reflected in the calculations of the *total* expected emission reductions by 2020.

Table 4.11 Estimates of possible savings

	Targeted energy savings		Achieved energy savings	
	Value	Share of end-use energy consumption in the scope of the Directive	Value	Share of end-use energy consumption in the scope of the Directive
	GWh	%	GWh	%
2010 (interim period)	2 430	3	5 168	6.3
2016 (ultimate objective)	7 291	9	13 693 (projected)	16.9

4.3.3.2. Measures in the Household and Services sector

<u>**PRIORITY AXIS 1**</u>**:** PROACTIVE NATIONAL POLICY TO STIMULATE THE EFFICIENT USE OF ENERGY RESOURCES AND THE COST EFFECTIVE DEVELOPMENT OF RES

Measures with direct impact on the reduction of GHG emissions

<u>Measure 1: implementation of the measures in the programme for accelerated gasification (pag) of republic of Bulgaria</u>

Characteristics: The Energy Strategy of Bulgaria envisages creation of conditions for access to the gas distribution system to 30% of households in 2020 and substitution of electricity used for heating purposes which would save households more than 1 bln. BGN of energy costs.
The use of natural gas instead of electricity for heating and domestic purposes can save about 100kWh/year at least, and up to 1800 kWh/year per household.
The evaluation of the potential decrease of emissions was made with the following assumptions: a household with 3 members, an apartment with 70 m2 of heated area, without energy saving measures, using electricity for heating and household needs. The average annual consumption of energy for heating is about 11 188 kWh. In view of the delayed implementation of policies in this area a conservative scenario with 15% gasified domestic needs was considered when assessing this measure. An emission factor was adopted with regard to electric energy as in the National Programme for Renovation of Residential Buildings in the Republic of Bulgaria. In the absence of reliable data and projections a scenario of even development was used for a period of 7 years until the total percentage rate of gasified households is reached in 2020. The analysis assumes that 430 050 households will be gasified by 2020.

The effect of fuel substitution and the use of natural gas can be divided into direct effect – related to the efficiency of transformation, and additional effect – related to an environmentally cleaner fuel. The direct impact is related to immediate reduction of fuel and energy consumption, with the assumption that the energy consumption is reduced by 15% (pessimistic scenario) over the entire assessed period. It is assumed in this case that the old inefficient equipment (with higher coefficient of energy transformation) will be replaced by new one, while the different calorific value of fuels is not taken into account.

In this case the substitution of the fuel base will lead to direct fuel and energy savings of 721.7GWh or 492.9ktCO2. The indirect effect is estimated at about 1983.4ktCO2.[5] The total amount of reduced emissions will be 2476.4 ktCO2.

With the achievement of the 30% target set in the Strategy, the minimum savings of households will be 1443.5 GWh – direct savings resulting from the improvement of transformation efficiency, or 985.9ktCO2. In addition, the effect on the reduction of GHG emission will be a result of the use of an environmentally cleaner fuel and the total cumulative effect will be 4952.8ktCO2[6].

Main instrument for implementation of the measure is the introduction of institutional and fiscal incentives aimed at increasing the share of households using natural gas: creation of a competitive environment with respect to the used energy resources[7];introduction and promotion of flexible financial plans – contracts for sale of energy; incentives for combined and integrated solutions to reduce the energy consumption.

In case of 30% gasification in 2020 , the investments of households for switching to natural gas are estimated at approximately 5000 BGN (between 1800 and 7000 BGN depending on the technological solutions) - according to a study carried out by the Strategic Consultant of the Ministry of Economy, Energy and Tourism, selected at the end of 2011 under International Fund Kozloduy. The analysis is based on information provided by gas distribution companies and covers the households on the territory of Bulgaria that use natural gas for heating purposes.

The required investments are estimated at 774 mln. BGN as a minimum, depending on the technological solutions. The implementation of this measure will have long-term effect on the amount of GHG emissions also after 2020. It is expected that at least 2476.4 kt CO2 will be reduced cumulatively by 2020.

Indicator of implementation:

Reduced final consumption /minimum/ of households as a result of gasification, GWh

Expected effect:

Total reduction of 2 476 427 tonnes CO2 eq by 2020

Target value by year	2014	2016	2018	2020
GWh	144.3	144.3	216.5	216.5

Type of instrument:

5 The value is determined on the basis of emission factor 0.055ktCO2eq/TJ

6 Determined on the basis of eliminated emissions from electric energy.

7 With the current price of electricity and fossil fuels and taking into account two preconditions – relatively competitive gas prices and the need for private investment to change the used fuel/energy – it would be impossible to increase the level of consumption of domestic gas without functioning normal/competitive market conditions and the introduction of incentives .

Introduction of institutional and fiscal incentives. Creating a competitive environment for the used energy resources[8]. Introduction and promotion of flexible financial schemes - contracts for sale of energy. Incentives in case of combined and integrated solutions to reduce energy consumption.

PRIORITY AXIS 2: IMPROVEMENT OF THE ENERGY PERFORMANCE OF BUILDINGS. IMPROVEMENT OF THE EFFICIENCY AND SAVINGS IN THE FINAL CONSUMPTION OF FUEL AND ENERGY.

Measures with direct impact on the reduction of GHG emissions

Measure 1: after entry into force of the new Energy Efficiency Directive - sanitation of communal, public and state buildings at the percentage rate required by the directive (built up area over 250m2)

Characteristics: The measure will come into effect after adoption of the new Energy Efficiency Directive (EED) expected by the end of 2012. At this stage of negotiations within the EU legislative bodies the percentage of buildings that are to be retrofitted per year laid down in the draft directive is 3%, which is acceptable for our country according to the Bulgarian position on the proposal.

State-owned and municipal dwellings[9] account for 3,1% of the total number of buildings in the country according to data from the National Statistical Institute. 64% of them are two-room and three-room dwellings, while another 22,9% have four or more rooms (we assume that they fall into this group).

Assuming 3% annual sanitation means that 4562 buildings are to be retrofitted by 2020 (their number will be revised according to the scope and percentage laid down in the EED).

Pursuant to thematic objective 4 "Support for the transition to a low carbon economy" of the draft financial regulations for the period 2014 - 2020 it is envisaged for the next programming period OP Regional Development to support energy efficiency measures in buildings. Measures will be implemented in both public and residential buildings and their cost is estimated at about 950 mln.. BGN. In addition, the operational program for the next programming period will provide for energy efficiency measures to be applied horizontally to the public health, social, cultural, educational and sports infrastructures, along with the envisaged construction and repair activities

Indicator of implementation:

Number of retrofitted state-owned and municipal buildings

Expected effect:

[8] At the current price of electricity and fossil fuels and taking into account two preconditions – the relative competitive price of natural gas and the need for private investments for substitution of the fuel/energy – increase in the number of gasified households could not be achieved without functioning under normal/competitive market conditions and without the introduction of incentives.

[9] According to the definitions and the methodology of NSI.

Total reduction of 204 135 tonnes CO_2 eq by 2020

Target value by year	**2014**	**2016**	**2018**	**2020**
Number of retrofitted state-owned and municipal buildings		1614	1519	1429

Type of instrument:

Energy audits of buildings. Registry of state-owned and municipal buildings with total floor space over 250 m2.

Measure 2: introduction of mandatory energy efficiency scheme (reduction of fuel and energy consumption in the final energy consumption)

Characteristics: This measure is proactive and is consistent with the announced direction and actions of the EC aiming at reducing fuel and energy consumption.

Precondition for achieving the estimated effect are the regulatory changes with the view of introducing a requirement for specific (proportional) annual reduction of the amount of energy provided on the market by distribution companies and traders in energy (end-use consumption). Market mechanisms and incentives to reduce fuel and energy consumption need to be established along with mandatory schemes and market of energy services (market of “white” certificates/ certificates of energy savings).

The measure is consistent with the new policy proposed by the EC to improve the energy efficiency in end-use consumption by saving annually fuel and energy equivalent to 1.5% of the energy provided by distribution companies and traders in energy on the market for the previous year (excluding energy in transport). The annual energy savings, respectively obligations, will be constant value (expressed in percentage) until 2020. To introduce such a scheme it is necessary to undertake appropriate legislative changes and to prepare its structure and operation. The responsible persons will be determined in the course of development of the scheme.

These can be both traders in fuel and energy or end consumers. The actual reduction of fuel and energy consumption occurs in end-use consumption and should be a result of implemented measures.

The anticipated effect is determined on the basis of projected fuel and energy consumption in the Industry and Household sectors where the consumption is expected to decrease by 1,5% on an annual basis. The decrease in final fuel and energy consumption according to the objectives will lead to reduction of emissions as follows: 40.5ktCO2eq. (by 2016); 41.4 ktCO2eq. (by 2020).

Indicator of implementation:

Reduction of fuel and energy consumption on an annual basis compared to the consumption over the previous year in the Household and Services Sector

Expected effect:

Total reduction of 105 173 tonnes CO2 eq by 2020

Target value by year	2014	2016	2018	2020
GWh		34.4	34.34	34.64

Type of instrument:

Energy Efficiency Directive.

Measures with indirect impact on the reduction of GHG emissions

Measure 3: developing a national plan to increase the number of nearly zero energy buildings

Characteristics: The measure involves introduction of the requirements of Directive 2010/31/EC on the energy performance of buildings. The main objective is to increase the number of buildings with nearly zero net energy consumption. The plan will contain the necessary parameters, including financial ones, and will specify the effect consisting in GHG emissions reduction. The detailed plan for implementation of the Directive is described in SNAPEE and draft National Strategy on Energy Efficiency.

Indicator of implementation:

Developed national plan – by the end of 2014

Expected effect:

National plan to increase the number of nearly zero energy buildings – in effect as of 2015.

Measure 4: introduction of standards for sustainable buildings and energy management

Characteristics: Certification under these standards is voluntary. The introduction and application of the standards has an indirect effect on the overall reduction of greenhouse gas emissions. It impacts both energy consumption and the overall compliance of buildings with the regulations - safety, access, waste treatment, etc.

Indicator of implementation:

Number of certified buildings

Expected effect:

11 200 buildings by 2020

Two pilot projects for new nearly zero energy public buildings.

Measure 5: increasing awareness regarding the requirements to nearly zero energy buildings, new materials, practices and technologies

Characteristics: This measure aims to increase the awareness, as well as the knowledge and skills of the industry. There will be no direct impact on reducing emissions, but it will support the implementation of energy efficiency measures in the construction sector

Indicator of implementation:

Number of seminars/trainings per year until 2020

Expected effect:

4 seminars/trainings per year until 2020; increased awareness, knowledge and expertise in the construction sector and among consumers

PRIORITY AXIS 3: INCREASING EFFICIENCY OF TRANSFORMATION OF PRIMARY ENERGY CARRIER

Measures with direct impact on the reduction of GHG emissions

Measure 1: replacement of the obsolete and inefficient equipment for production of energy with new equipment

Characteristics: The process should be linked to the activities for control and inspection of heating and air conditioning installations. The financial incentives should combine existing schemes with mandatory co-financing by the beneficiary. The measure is linked also to the activities provided in SNAPEE in accordance with the Regulation adopted pursuant to Art. 15 of Directive 2009/125/EC establishing a framework for the setting of ecodesign requirements for energy-related products . The measure applies to the end-use consumption of fuels, their conversion into energy for heating, cooling and domestic hot water and to energy consumption. The assessment of the impact is made on the basis of the projected consumption of fuels in the Households and Services sector taking into account also other related measures.

Indicator of implementation:

Reduced consumption as a result of improvement of the efficiency in fuel and energy conversion GWh

Expected effect:

Total reduction of 72383 tonnes CO_2 eq by 2020

Target value by year	**2014**	**2016**	**2018**	**2020**
GWh		**261.2**	**175.1**	**176.8**

Type of instrument:

Financial and administrative

PRIORITY AXIS 4: ENCOURAGING DECENTRALIZED PRODUCTION OF ENERGY, INCLUDING ENERGY FROM RENEWABLE SOURCES

Measures with direct impact on the reduction of GHG emissions

<u>Measure 1: development and phased implementation of national programme "1000 sunny roofs"</u>

Characteristics: Commissioning of a bivalent system for preparation of hot water for domestic needs - evacuated tube solar collectors and heat pump units (air) for 1000 multi-family buildings (46 apartments, households with 3 members). The effect was evaluated on the basis of electricity, taking into account the consumption of the heat pump units. This program is not laid down in a national strategic document, however it is in line with the national RES policy and encourages the production of heat from RES.

164.9 GWh of electricity can be saved per year (by 2020) as a result of the development and implementation of this programme.

Indicator of implementation:

Implemented and commissioned installations by 2020

Expected effect:

Total reduction of 107200 tonnes CO2 eq by 2020

Target value by year	2014	2016	2018	2020
Installations		200	400	400

4.3.4. Industry Sector

4.3.4.1. General information on the Industry Sector

A trend towards reduction of greenhouse gas emissions has been observed in the Industry sector over the past few years. There are two reasons for that. One of the reasons is negative: the decrease is due to the crisis in some sub-sectors and is related to lower production, e.g. in the sub-sector of construction and respectively in the production of construction materials. The other is positive and is associated with increased energy efficiency in the use of energy resources in some enterprises. This is evident from the data obtained from the Sustainable Energy Development Agency (SEDA) following the audits of industrial systems completed so far.

Table 4.12 Review of the total emissions of the audited industrial systems in the sector by years

Year	Combustion plants[1]	Process emissions	Total emissions
	t CO_2	t CO_2	t CO_2
2007	7 952 426	5 099 583	13 052 009
2008	7 477 168	5 818 436	12 295 604
2009	6 706 823	1 640 887	8 347 710
2010	6 498 278	1 522 289	8 020 567

1 This sector is characterized by two sources of greenhouse gases: combustion plants and the so called process emissions emitted by some technological processes

Figure 4.5 Emissions from industry

Summarized results from the audits of industrial systems (IS)[10]

- IS subject to audits – 281
- Audited IS – 154
- Annual consumption - 2 927.3 GWh/y.
- Projected annual savings – 378.3 GWh/y.
- Equivalence in BGN – 52.1 mln. BGN/y.
- Required investments – 183.4 mln. BGN
- Equivalent emission savings – 187 700 tonnes CO_2/y,
- Share of economy – 12.6%
- Term of redemption – 3.5 years

Development of the sector in the period 2000-2011

- Reduction of the energy intensity of industry over 2 times (a key indicator of energy efficiency);

10 Source: SEDA

- Reduction of final energy consumption in 2012 by 28.5% compared to 2001 as a result of which the sector conceded the first rank to the Transport sector;
- Increase in the sector's added value to the GDP from 9.1 to 13.6 bln. BGN in 2011, or an overall growth of 49%;
- Energy audits are conducted on industrial systems with annual consumption equal to or higher than 3000 MWh. The owners are required to implement the measures within 2 years after the energy audit;
- €887 900 were invested in 79 small and medium-sized enterprises within the period 2007-2009 under the existing grant schemes.

During the period 2013-2020 the main instrument for reducing CO_2 emissions from industry is the European emission trading scheme. The following is envisaged for the industrial installations:

- A common cap for the emissions of the entire Community decreasing by a linear factor of 1.74%. Thus the EU's commitment to reduce its emissions by 2020 by 21% below 2005 levels will be met.
- Larger amount of allowances to be traded – at least 50% of allowances will be auctioned from 2013 on in contrast to 3% in 2008-2012. This will increase the environmental integrity and the economic efficiency of the system.
- As of 1 January 2013 the free allocation for installations covered by the ETS will be performed on the basis of *ex ante* parameters valid for the entire Community. The parameters are set on the basis of the 10% most efficient installations in the EU in terms of greenhouse gases. This seeks to promote the reduction of greenhouse gas emissions and the use of energy efficient technologies.

Priority axes for reduction of GHG in the industry

- Higher energy efficiency in the industry;
- Use of alternative fuels;
- Establishment of a technology park and a business incubator.

The expected effect (aggregate reduction in tonnes CO_2 eq. by 2020) from the measures in the sector is estimated at **5 658 000 tonnes CO_2 eq.**

4.3.4.2. Measures in the Industry Sector

PRIORITY AXIS 1: IMPROVEMENT OF ENERGY EFFICIENCY IN THE INDUSTRY

Measures with direct impact on the reduction of GHG emissions

Measure 1: audits for energy efficiency and implementation of the prescribed measures

Characteristics: Industrial systems with annual energy consumption over 3 000 MWh are required to have their energy efficiency audited every three years. The prescribed measures are mandatory. Energy Efficiency for Competitive Industry is a new programme that provides low-interest loans to small and medium-sized enterprises. The total amount of funds under the programme is €300 mln.. €150 million of this amount will be provided by Operational Program Competitiveness and the remaining amount -from EBRD credit lines through the Bulgarian commercial banks.

Eligible projects for funding are, for example:

- New co-generation plants for thermal and electric energy;
- Rehabilitation of boiler aggregates/boilers, improved thermal insulation, etc.;
- Replacement of old boiler aggregates with condensing boilers;
- Switching from electricity heating to heating based on direct burning of fuels;
- Improvement of technological processes, including improved control and management;
- Reconstruction of steam distribution systems, installation of steam traps, increasing the efficiency of the condensate recovery process, etc.;
- Building of new or reconstruction of existing plants for heat recovery from processes – so called "utilizators";
- Installation of absorption chillers;
- Installation of variable speed drive motors;
- Reconstruction of compressed air systems - so called compressor installations;
- Reconstruction of power distribution systems;
- Introduction of systems for energy management of production or of offices and other buildings, etc.

Large industrial enterprises will be financed under the green industry procedure of Operational Program Competitiveness.

Indicator of implementation:

Tonne CO_2 saved per year

Expected effect:

Total reduction of 1 778 000 tonnes CO2 eq. by 2020

Target value by year	2014	2016	2018	2020
t CO2 eq		1 260 000	280 000	238 000

Instrument:

Legislative - Energy Efficiency Act

PRIORITY AXIS 2: USE OF ALTERNATIVE FUELS

Measure 1: use of biomass in the combustion units of installations

Characteristics: The aim is to increase the use of waste as an alternative fuel such as: separately collected household waste (RDF); sludge from domestic sewage water; agricultural waste and waste from the food industry; industrial waste mixed with biomass. It is related to the ban on landfilling of biodegradable waste.

The procedure for a green industry is intended to attain more efficient use of waste products.
It is proposed to finance in the next programming period facilities that enable the utilization of sludge from urban wastewater treatment plants in industrial installations.

Indicator of implementation:

Tonne CO2 saved per year

Expected effect:

Total reduction of 3 880 000 tonnes CO2 eq. by 2020

Target value by year	**2014**	**2016**	**2018**	**2020**
t CO2 eq	1 940 000	647 000	647 000	646 000

Instrument:

Legislative - Waste Management Act

PRIORITY AXIS 3: ESTABLISHMENT OF A TECHNOLOGY PARK AND A BUSINESS INCUBATOR

Measures with indirect impact on the reduction of GHG emissions

Measure 1: establishment of a technology park and a business incubator

Characteristics: The technology park will bring together the scientific developments with marketing potential, the business that needs them and the financial institutions that will support this process. From 2013 on the beneficiaries under OP Competitiveness will have access to funding for further development and introduction of innovations purchased by them.

Indicator of implementation

Established technology park

Expected effect:

Scientific research realized on the market

Instrument:

Operational Programme Competitiveness

4.3.5. Waste Sector

4.3.5.1. General information on the Waste sector

Waste management and in particular waste treatment is a source of greenhouse gases.

According to the National GHG inventory the Waste sector includes the following sub-sectors:

- Emissions from landfill of waste;
- Emissions from wastewater treatment;
- Emissions from waste incineration.

The sector is one of the major sources of GHGs. The main GHGs emitted into the atmosphere as a result of waste treatment are methane and nitrous oxide emitted during the process of waste disposal and wastewater treatment. Worldwide, about 5-20% of the total methane is released during the anaerobic processes of waste decomposition.

According to the national inventory report of 2013 (representing data from base year 1988 to 2011) the contribution of the Waste sector to the total amount of GHG emissions (without taking into account LULUCF) is 5.7% thus ranking it after the Energy sector - 78% and the Agriculture sector - 9% and the Industry sector - 6%.

During the period 1988-2011 the share of emissions from the Waste sector has grown from 4% to 8%, but in the last five years it has stabilized at 5-6%. In absolute terms the GHG emissions from the Waste sector have decreased by 35.02% compared to the base year. The reduction is significant in view of the fact that changes in the quantities of municipal waste and wastewater is a conservative value, a function of the number of inhabitants, the living standards and the public attitudes towards measures to reduce waste generation. Sudden changes in input values from year to year cannot be expected.

Emissions from the waste sector in the year 2011 are about 3 762 Gg CO2 equivalents, and they are around 7 % including LULUCF and around 6 % excluding LULUCF of national total GHGs emissions from Bulgaria.

Solid Waste Disposal on Land contributes over 77.08%, Wastewater Handling about 22.17%, Waste Incineration about 0.35% and compost production about 0.39% sectors total emissions.

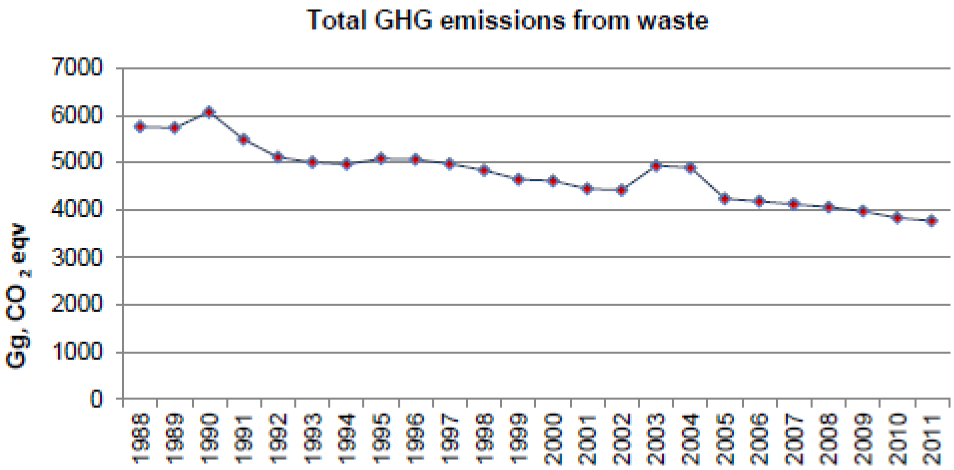
Emissions from the waste sector in 2011 decreased by 35.02 % (3 761.83 Gg CO2-eq in 2011 compared to 5 789.11 Gg CO2-eq in 1988) compared to the base year.

The emissions from the Waste Sector are summarized and aggregated for the period 1988-2011 in CO2 eq and are presented in the following table.

Year	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Gg CO2 eq	5789	5 767	6 069	5 484	5 111	5 006	4 963	5 083	5 064	4 973	4 834	4 641
Year	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Gg CO2 eq	4 641	4 610	4 442	4 416	4 931	4 888	4 231	4 174	4 117	4 055	3 968	3 762

Figure 4.6 below represents the total emissions from the whole waste sector.

Figure 4.6 GHG emissions from Waste sector

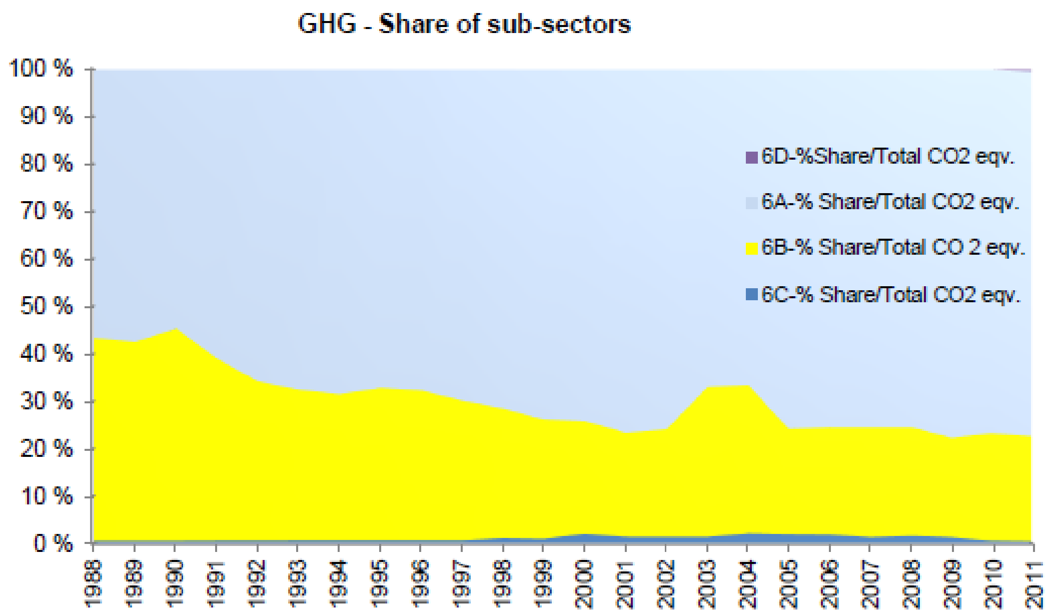


Sourse:NIR

The GHG emissions from landfilled waste represent about 77% of the total amount of waste from this sector, the emissions from waste water treatment - about 22.19% and the GHG emissions from waste incineration - less than 0.79% (National Inventory Report 2013 for Greenhouse Gas Emissions).

Taking into account the share of the three sub-sectors in the emitted GHG it is evident that a substantial amount of the emissions from the Waste sector can be reduced primarily by implementing measures in subsector Landfill of waste and to a lesser extent in subsector Wastewater treatment.

Figure 4.7 GHG share of sub-sectors



– **Waste disposal on land**

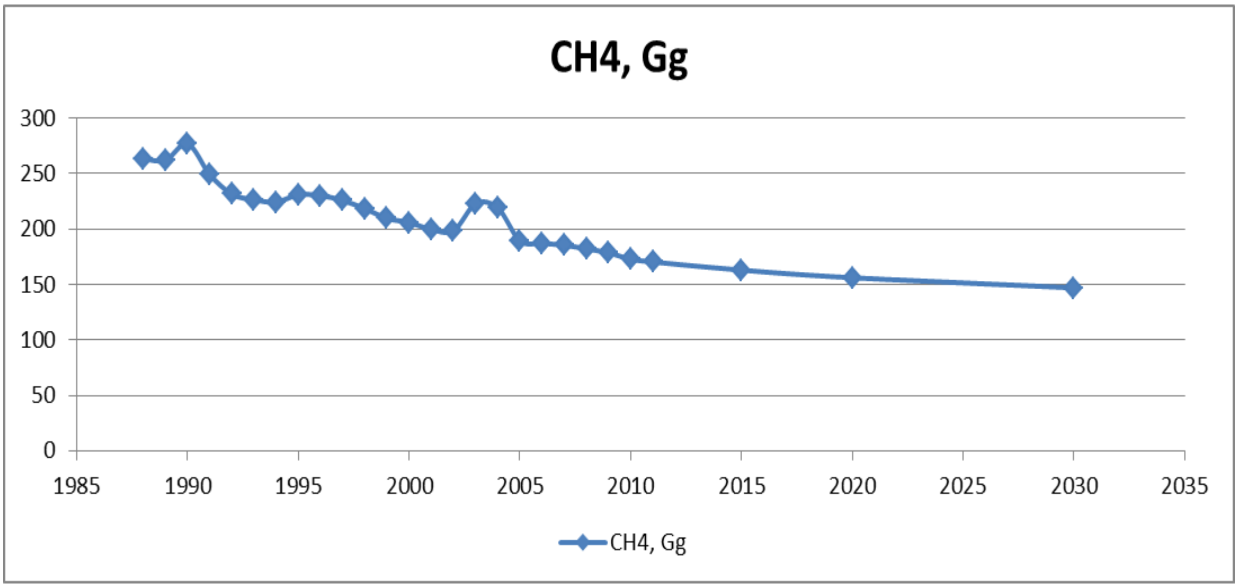
The emissions of methane emitted during the anaerobic degradation processes due to methanogenic bacteria in landfilled waste are estimated in this sub-sector.

The waste management policies carried out in the EU and in Bulgaria contribute to reducing GHG emissions. A priority is the prevention of waste which will reduce the amount of waste going to landfills.

Another major line in the waste policy in Bulgaria is the building of waste treatment infrastructure with the financial support of Operational Programme Environment (OPE) 2007-2013. The waste in the country is mainly disposed at the so-called "controlled" and "uncontrolled" landfills. The proportion of waste disposed of in the relevant landfills is distributed according to the population whose waste is disposed there. The implementation of the measures under OPE will allow all municipal waste to be covered by the systems for controlled treatment and all waste to be disposed of in controlled landfills.

The diagram below shows the emissions of methane emitted from landfilled waste in the period 1988-2011 and the projected emissions for the period 2011-2030 taking into account the construction of controlled regional landfills in time.

Figure 4.8 Emissions CH_4 in Gg/year



The measures to reduce GHG emissions from landfilled waste include:

- Prevention of waste for disposal by promoting the efficient use of resources, further development of the collective systems for separate waste collection , linking the amount of the municipal waste charge to the quantities of generated waste, creation of stable conditions for marketing of materials obtained from recycled waste, reducing the amount of biodegradable waste going to landfills;
- Reducing biogas emitted from landfilled waste by: introducing capture and flaring of biogas in all new and existing regional landfills for waste, as well as

in the old municipal landfills that are to be closed; studying the energy potential of biogas generated in landfills that are to be closed; measuring the amount (flow) of the captured biogas in the combustion systems in order to meet the requirement for measuring and recording for the purpose of recognizing the recovery of methane.

– **Wastewater treatment**

Methane and indirect N2O emissions are emitted into the atmosphere during the treatment of domestic and industrial wastewater under anaerobic conditions. The emission levels are shown in the following graphs.

Figure 4.9 Trend in CH4 emissions in Sectors Waste disposal on land and Wastewater handling

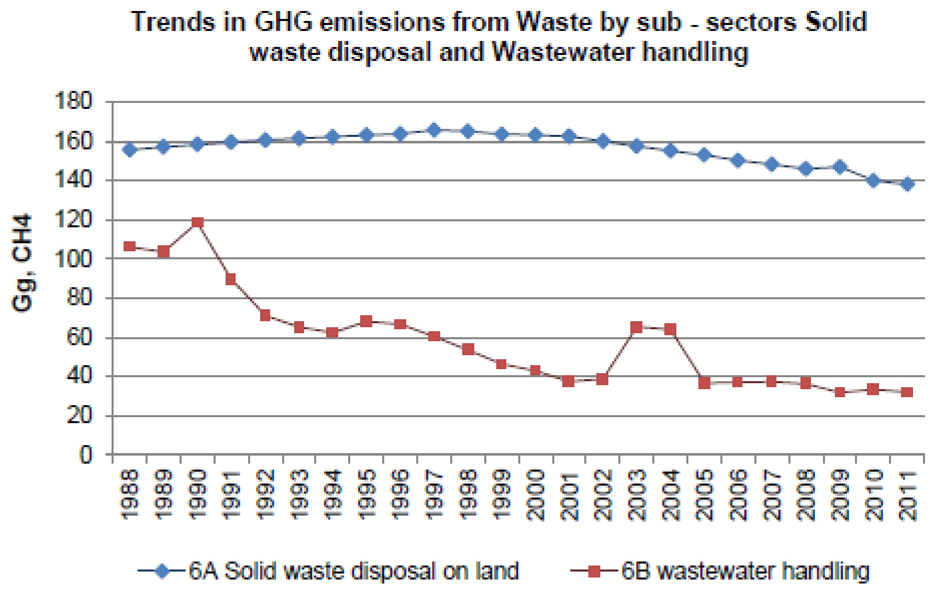
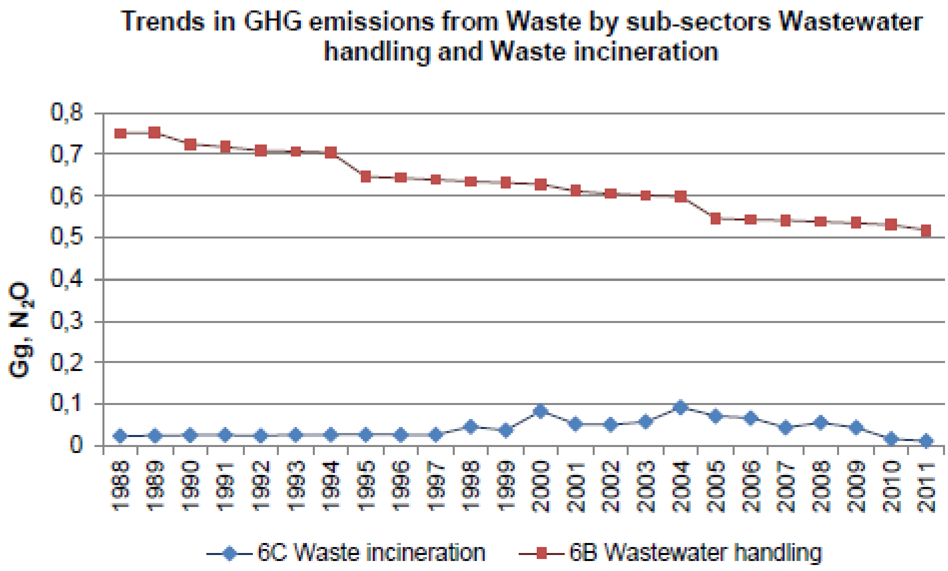


Figure 4.10 Trend in N2O emissions in Sectors Waste incineration and Wastewater handling



Methane emissions from industrial water show a consistent and significant decline over the years. The peak in 2003-2004 was due to release of water after its stay in tailing ponds of mining enterprises.

Methane emissions from the treatment of domestic sewage water in the last 20 years show a steady trend of decline.

The emissions of nitrous oxide also mark a steady decrease following the decrease of the population.

In 2008 emissions of methane from domestic wastewater represented about 60% of the GHG emissions from wastewater in Bulgaria.

The treatment of sludge that is the main generator of methane emissions is taken into consideration in the National Programme for Priority Construction of Urban Wastewater Treatment Plants (NPPCUWWTP) and the National Waste Management Programme .

Figure 4.13 in the report on the implementation of the requirements of Directive 91/271/EEC concerning urban wastewater (2011) provides the following data and projections for the recovery and disposal of sludge from UWWTP in tonnes of dry matter per year:

Table 4.13 Projections for the recovery and disposal of sludge from UWWTP in tonnes of dry matter

Year	Recovery in agriculture	Other recovery	Disposal at landfill	Incineration	Other disposal
31/12/2010	13 644	11 850	12 031	0	20 508
2014	43 587	-	34 863	8 718	-
2015	47 546	-	38 030	9 509	-

Practice has shown that it is technologically feasible and economically viable to produce electricity from the biogas generated in the methane tanks of large wastewater treatment plants (more than 50 000 PE) in order to cover the main share of the energy needs of the plants. The energy balance of small and medium-sized wastewater treatment plants (less than 20 000 PE) is negative (from -27 to -32 W/PE) thus making the capture and utilization of biogas economically inexpedient.

In 2008 the WWTPs treated approximately 58 000 tonnes of sludge. According to the NPPCUWWTP around 94 500 tonnes of sludge will be generated in the country by the end of the programme period (2014), 72% of which will be treated in WWTP for over 20 000 PE. This means that the methane from about 60% of the wastewater may be captured and treated. The measures for reduction of GHG emissions envisage introduction of capture and treatment of biogas from urban wastewater treatment plants for over 20 000 PE by introducing anaerobic stabilization of sludge with capture and combustion of biogas in new and renovated plants, repair, reconstruction and commissioning of methane tanks in existing plants completed with an installation for controlled combustion of the gas and for measuring the quantity (flow) of the captured biogas in the combustion systems in order to meet the requirement for measuring and recording the recovery of methane for recognition purposes.

- **Incineration of waste**

This subsector includes only emissions from combustion processes without energy recovery while the emissions from waste incineration with energy recovery are included in the Energy sector. Incineration of waste is seen as a source of emissions of CO_2, CH_4 and N_2O.

Currently, the GHG inventory includes emissions from incineration of hospital waste and hazardous waste. The trends in emissions from burning waste in incinerators without energy recovery are presented in the chart above.

The NWMP envisages construction of only two new incinerators for hospital waste. No substantial changes in the amount of emissions from this sector are expected and no special measures for their reduction are planned.

4.3.5.2. Measures at the Waste Sector

PRIORITY AXIS 1: REDUCTION AND PREVENTION OF THE QUANITTIES OF WASTE THE DISPOSAL

Measures with direct impact on the reduction of GHG emissions

Measure 1: construction of installations for mechanical and biological treatment (mbt) and installations for treatment and recovery of compost and biogas

Characteristics: The measure is incorporated into the National strategic plan for gradual reduction of biodegradable waste intended for landfilling 2010-2020. As a result of its implementation for the period 2013-2020 5 289 000 tonnes of biodegradable waste will be diverted from landfills. An additional impact of the measure will be the substitution of phosphate fertilizers in agriculture with compost produced at waste treatment installations.

Indicator of implementation:

Number of installations built

Expected effect:

Total reduction of 5 823 763 tonnes CO_2 eq. by 2020

Target value by year	2014	2016	2018	2020
Number of installations built	12	32	42	54

Instrument:

National Programme for Waste Management Activities 2009-2013
National strategic plan for the phased reduction of the amount of biodegradable waste intended for disposal at landfills 2010-2020

Measures with indirect impact on the reduction of GHG emissions

<u>Measure 1: further development of collective systems for separate collection of waste from the population</u>

Characteristics: The measure is included also in the National Waste Management Programme 2009-2013. It aims to increase the efficiency and the scope of separate collection systems among the population, the enterprises and the governmental institutions at all levels. 130 000 tonnes/year are expected to be diverted from disposal at landfills as a result of separate collection and recycling of waste paper and cardboard

<u>Measure 2: introduction of differentiated charges for the generated waste</u>

Characteristics: The measure is laid down in the National Waste Management Programme 2009-2013. Methodological guidelines will be developed to determine the amount of household waste charge and to introduce differentiated charge for landfilling of waste where the recyclable waste delivered for landfilling will be charged at the highest rate. Linking the amount of discharged waste to the amount of the charges and fees for household waste will motivate citizens and companies to reduce the quantities of waste and to re-orient towards various schemes for separate collection and recycling of waste.

<u>Measure 3: introduction of separate collection of “green” waste in municipalities</u>

Characteristics: The measure is included in the National strategic plan for gradual reduction of biodegradable waste intended for landfilling 2010-2020. The municipal ordinances are to regulate the method of separate collection of “green” waste, while the programmes should include more specific measures regarding: prevention of biodegradable waste; recycling of waste paper and cardboard; composting of “green” waste; introduction of home composting. At a subsequent stage, after adoption of a national plan for waste prevention, the programmes will be expanded to cover biodegradable waste from food (catering establishments, markets, shops, etc.)

Expected results:

264 municipalities with separate collection by the end of 2020

<u>PRIORITY AXIS 2</u>: CAPTURE AND FLARING OF BIOGAS FROM LANDFILLED WASTE

Measures with direct impact on the reduction of GHG emissions

<u>Measure 1: capture and flaring of biogas in all new and existing reginoal landfills</u>

Characteristics: The requirement for design and operation of landfills is provided for in Ordinance №8/2004. It is necessary to improve the control over its implementation. 360 mln. Nm3 methane will be burned by 2020 with the introduction of systems for capture and flaring of biogas in all regional landfills.

Indicator of implementation:

By 2020 all regional landfills for municipal waste will be equipped with installations for biogas capture and flaring

Expected effect:

Total reduction of 5 070 122 tonnes CO_2 eq. by 2020

Target value by year	2014	2016	2018	2020
Built installations for biogas capture and flaring:	6	22	30	54

<u>Measure 2: capture and flaring of biogas in old municipal landfills to be closed</u>

Characteristics: The mechanism for development of waste management infrastructure with the support of Operational Programme Environment 2007-2013 and Decree № 209/2009 of the Council of Ministers on the provision of funding for the construction of regional systems for household waste management, regional pre-treatment facilities for household waste and closure of municipal landfills envisages allocation of funds for the closure of old municipal landfills and the cost is determined on the basis of €14 000 per decade. The assessment whether a facility to capture and burn biogas is necessary is made on a case-by-case basis.

Indicator of implementation:

Number of closed landfills with constructed installations for biogas capture and flaring

Expected effect:

The effect is calculated in Measure 1

Measures with indirect impact on the reduction of GHG emissions

Measure 1: evaluation of the energy potential of the biogas from landfills that are planned to be closed

Characteristics: There was interest in the energy potential of the landfills and it was studied in the landfills of Sofia (Suhodol), Plovdiv (Tzalapitza), Burgas and Ruse after 1999, and before that - in Sliven and Gabrovo. Municipal landfills are to be closed and the largest of them (20 landfills) will be inspected in order to select 5 where significant amount of generated methane may be expected. Audits will be carried out to identify their energy potential with a view to its possible utilization.

Measure 2: measuring the amount (flow) of biogas captured in combustion systems

Characteristics: The effect from the introduction of measurement of the amount of recovered methane gas will be reflected in the reporting of GHG emissions. The Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC GPG, 2000) requires measurement and documentation for the purpose of recognition of the methane recovery.

PRIORITY AXIS 3: CAPTURE OF BIOGAS FROM URBAN WASTEWATER TREATMENT PLANTS (UWWTP) AND ITS BURNING

Measures with direct impact on the reduction of GHG emissions

Measure 1: introduction of anaerobic stabilization of sludge with capture and burning of biogas in new plants and plants under reconstruction in settlements with over 20 000 population equivalent

Characteristics: A cost-benefit analysis for each project should justify or discourage the recovery of methane. Practice has shown that it is technologically feasible and economically viable to produce electricity from the biogas emitted from the methane tanks of large wastewater treatment plants (more than 50 000 PE) in order to cover the main share of the energy needs of the plants. An additional effect of the stabilization of sludge at UWWTP will be achieved as a result of the possibility to use the stabilized sludge in agriculture so as to recycle the nutritional substances, to preserve the fertile soils and to limit the use of agricultural chemicals and synthetic fertilizers

Indicator of implementation:

Number of plants with anaerobic stabilization of sludge

Expected effect:

Total reduction of 1 025 589 tonnes CO2 eq. by 2020

Target value by year	2014	2016	2018	2020
Number of plants with anaerobic stabilization of sludge		8		20

4.3.6. Agriculture Sector

4.3.6.1. General information of the Agriculture sector

In 2011 the GHG emissions from the Agriculture Sector were 9.3% of the total GHG emissions in Bulgaria. A decrease of 69.57% was reported for the period 1988-2011 – mainly due to reduced production and structural changes in the sector. According to the National GHG Inventory (2011) the emissions of methane (CH_4) account for 33.5% of the emissions in the sector (CO_2 eq./2011). The emissions of nitrous oxide were 66.4% in 2011.

Three are the main sources of greenhouse gas emissions from agriculture in Bulgaria:

- agricultural soil - 57.6%;
- biological fermentation in animal husbandry - 21.29%;
- management of manure - 18.91%.

The remaining 2.19% are due to burning of stubble (0.58%) and rice production (1.61%).

4.3.6.2. Overview of the state of the Agriculture sector

After Bulgaria's accession to the EU there were significant structural changes in the field of agriculture involving mainly reduction of the number of farms and increase in the average size of the land used by them.

In 2010 the farms in Bulgaria were 370222, according to inary data from the farming census11. This represents a decrease of 44% compared to the number of farms in 2003. The agricultural holdings of individuals are 363 700 or 98% of all farms. They are followed by those of companies - 1%, sole traders - 0.6%, cooperatives - about 0.3% and other holdings - about 0.1%.

One farm holding operates an average of 10.1 ha of utilized agricultural area (UAA). Individuals manage 33.8% of UAA, companies manage 31.6% of UAA of the country, cooperatives - 17.7%, sole traders - 14.9%, and other holdings - 2%.

[11] *Ministry of agriculture and food, Department of Agrostatistics – Census of Agricultural Farms in the Republic of Bulgaria in 2010,* 170/May 2011.

The farms with UAA from 0.00 to 1.99 ha in 2010 are 83.2% of all farms, but manage only 144 300 ha. Over 78.2% of the UAA (2 830 300 ha) is in farms with area of 100ha or more, and the average UAA of these holdings is 534 ha.

The agricultural soils remain the major source of emissions in agriculture, although direct emissions from agricultural soil decreased during the period 1988-2008 more than 2 times as a result of the structural changes in agricultural enterprises and the overall reduction of agricultural activities in the country.

The agricultural land (AL) in 2012 is 5 481 222 ha and occupies 50% of the country's territory. The utilized agricultural area (UAA) is 5 122983 ha, or 0.7% more than previous year. The arable land in 2012 occupied an area of 3 294 685 ha, which was 63.3% of the utilized agricultural area in the country. The area of arable land increased by 2.1% compared to 2011.

In 2012, the area with grain crops was 1 953272 ha, which represents an increase of 2,8% compared to 2011. Their share is still the largest in the country's arable land – 59.28%. In 2012 the areas with wheat were 1 194 141 ha or an increase of 3.56% compared to 2011. Wheat occupies 61.13% of the area with grain crops in the country, 36.2% of the arable land. In 2012 the area with barley was 176 556 ha or 1.46 more than in 2011. The share of barley is 9.03% of the area with grain crops.

In 2011 the area with maize was 525 412 ha and increased by 21.92% compared to 2011. This crop occupies 26.89% of the area with grain crops and 15.94% of the arable land in the country.

The areas with oil seed crops are 999 195 ha. Sunflower crops occupy 854 738 ha, which is 7.4% more compared to 2011. In 2011, sunflower crops held 25.9% of the arable land and 85.5% of oil seed crops in the country.

In 2011 the fallow land occupies 128 097 ha – down by 26.4% compared to 2011. The share of fallow land is 3.88% of arable land in the country.

Temporary meadows with legumes and cereals in 2011 occupy 82 590 ha, or 2.5% of the arable land of the country. These areas have decreased by 1.09% compared to 2011.

The continuously productive meadows, alpine meadows, grasslands with low productive potential and meadow orchards in 2011 occupy an area of 1 646 991 ha or 32.15% of the country's UAA, which represents a decrease by 1.8% compared to 2011..

The vineyards in 2011 occupied 77 341 ha, which is a decrease by 1.4% compared to 2011.

The orchards cover 1.4% of the UAA (69 494 ha), and they have negligible decreased 0.02% compared to the previous year.

The mixed perennial plantations occupy 8529 ha, there was an small decrease compared to 2011 (8629 ha). Their size is 0.2% of the country's UAA.

Table 4.14 Use of agricultural land

Category	2012		2011		2009		2008		1990	
	area (ha)	% of the area of the country	area (ha)	% of the area of the country	area (ha)	% of the area of the country	area (ha)	% of the area of the country	area (ha)	% of the area of the country
Agricultural land	5481222	49.38	5 486 572	49,4	5 490 113	49,5	5 648 206	50,9	6 159 000	55,7
Utilized agricultural land	5122983	46.1	5 087 948	45,8	5 029 585	45,3	5 100 825	46	No data	No data
Natural land	358239	3.2	398 624	3,6	460 528	4,1	547 381	4,9	No data	No data
of which	area (ha)	% of UAA	area (ha)	% of UAA	area (ha)	% of UAA	area (ha)	% of UAA	area (ha)	% of UAA
Arable land	3294685	64.3	3 227 237	63,4	3 122 516	62,1	3 060 543	60	4 347 000	70,6
Permanent crops	159079	3.1	159 886	3,1	164 536	3,3	183 525	3,7	296 000	4,8
Pastures and meadows	1646993	32.14	1 678 308	32,9	1 719 028	34,1	1 828 865	35,8	1 516 000	24,6

Source: MAF, BANSIK 2013

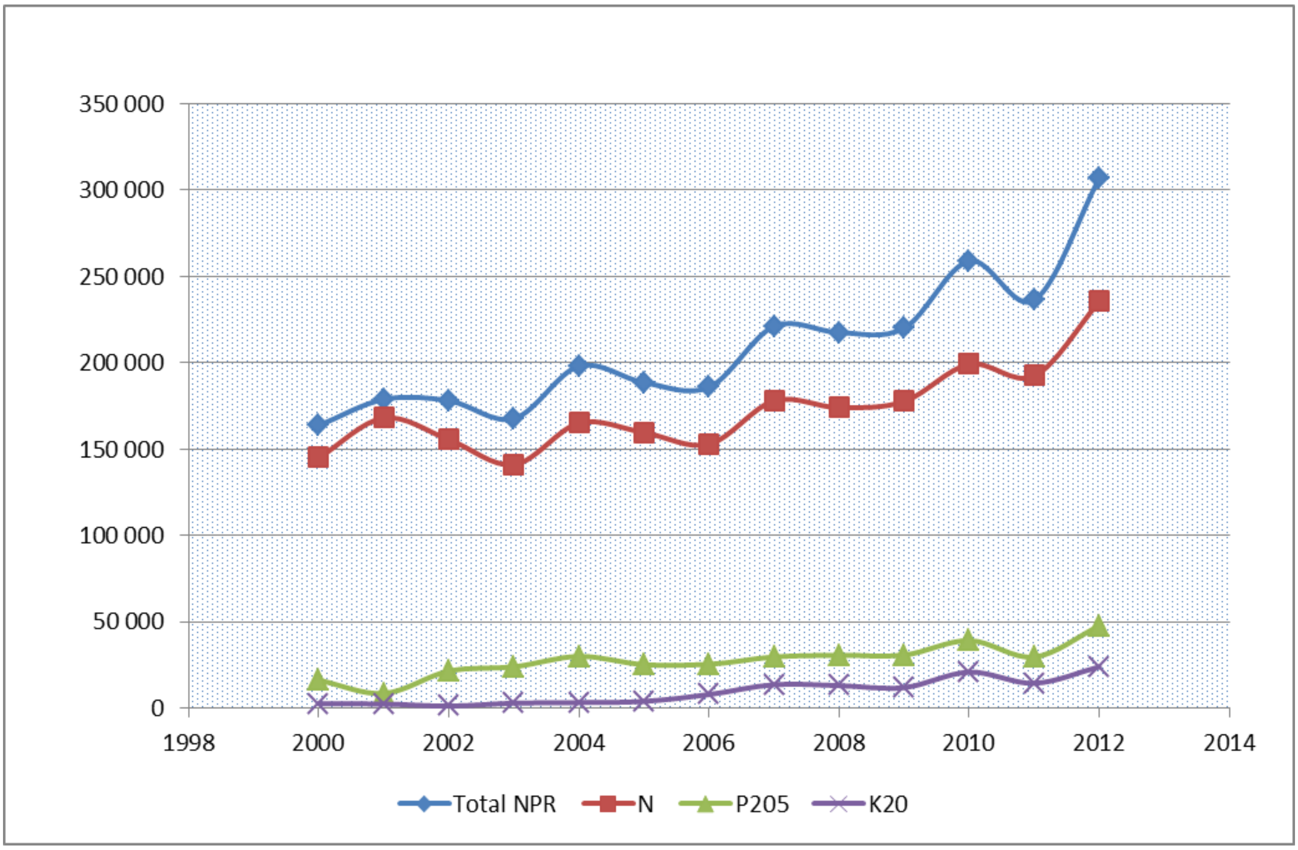
Fertilization of agricultural soils is a source of emissions of the greenhouse gas nitrous oxide (N_2O). Over the recent years data have shown that the amount of applied mineral fertilizers constantly grows as well as the areas (until 2011) treated with mineral fertilizers, mainly unilateral nitrogen fertilization.

Table 4.15 Used amounts of mineral fertilizers – tonnes of active substance

Year	Total NPK	N	P_2O_5	K_2O
	tonnes			
2000	163 569	144 928	16 104	2 537
2001	178 734	167 962	8 474	2 298
2002	177 935	155 411	21 400	1 124
2003	167 607	140 930	23 874	2 803
2004	197 980	164 958	29 904	3 118
2005	188 452	159 506	25 113	3 833
2006	185 847	152 766	25 278	7 803
2007	221 059	177 936	29 607	13 516
2008	217 425	173 917	30 558	12 950
2009	220 037	177 553	30 661	11 823
2010	258 916	199 083	39 034	20 799
2011	236 258	192 357	29 550	14 351
2012	306 867	235386	47633	23848

Source: MAF, Agrarian reports

Areas fertilized with nitrogen, phosphorus and potassium fertilizers (thousand ha)



Another major source of emissions in the sector is animal husbandry. The amount of emissions there from has decreased as well, mainly due to reduction in the number of animals in the country as a consequence of the crisis in the sector and the structural changes in agriculture.

There are 153 500 animal farms in the country at the end of 201212. The tendency is decrease with 45.2% in comparison with previous year.

Overall, there was continuous downward trend in the number of animal farms.

The number of cattle in 2012 is 526112. The number of cattle decreased in half over the period 1988-2008. In 2009 the number of cattle decreased by 4.5% compared to 2008. In 2012 the number of cattle decreased by 5.7% compared to 2011.

The number of buffaloes in the country in 2012 is 9212 declined more than twice over the period 1988-2008. In 2012 the number of buffaloes decreased by 6.8% compared to 2011.

In 2012 the sheep were 1 361545, and their number decreased 6 times over the period 1988-2008 which is due to lower interest in sheep's milk and the low prices of imported wool. The number of sheep in 2012 decreased by 6.4% compared to 2011.

[12] MAF, Department of Agrostatistics – Census of Agricultural Farms in the Republic of Bulgaria in 2010 – preliminary data 170/May 2011.

The number of goats substantially increased in the period 1988-1999, and then declined again to nearly reach in 2008 the number of 1988. In 2012 the goats are 293639 and decreased by 14% compared to 2011.

The number of pigs in 2012 was 530945 and decreased almost 5 times over the period 1988-2008 due to the high costs of cultivation and the low prices of imported pork.

The number of horses in the country is relatively constant over the period 1988-2008. The numbers of mules and donkeys decreased almost 2 times over the period 1988-2008 due to the increasing degree of mechanization of agriculture and decreasing rural population in the country.

The number of horses, mules and donkeys in 2012 is 131463 and decreased by 3.2% compared to 2011

The production, the processing, the storage and the management of manure is a major source of emissions of the greenhouse gas CH_4 in agriculture. Apart from the decrease of the total number of farm animals in recent years, there is also reduction of the amount of used manure and the treated areas in 2009 and 2010 and then significant increase in next year. Manure is used mainly for vegetables, potatoes, fruit and vineyards and for organic farming.

Table 4.16 Used manure

Year	Used manure *(thousand tonnes)*	Average for the period	Area fertilized with manure *(thousand ha)*
2000	323.0	2000-2003:	10.40
2001	282.0	252.5 thousand tonnes	13.90
2002	240.5		11.90
2003	164.4		6.90
2004	118.2	2004-2007:	5.08
2005	209.4	200 thousand tonnes	10.60
2006	296.0		90.50
2007	173.9		84.70
2008	122.9	2008 -2010	5.60
2009	74.4	83.5 thousand tonnes	6.18
2010	71.3		6.96
2011	200.118		15.06
2012	312.698		23.73

Source: Agrarian reports

Figure 4.11 Applied manure

Measure 121 “Modernization of agricultural holdings” of the Rural Development Programme (RDP) for 2007-2013 allocated over €70 million for investment projects in animal farms involving construction of facilities for storage of manure and purchase of equipment for its proper use (Council Directive 91/676/EEC). In 2012 the interest in these investments increased sharply. Since the start of implementation of this measure 4410 projects have been approved (228 in 2012) totalling €614 527 000, which is the result of both increased EU requirements and of the significantly higher subsidy (up to 85% for such projects)[13].

4.3.6.3. Objectives and priorities in the Agriculture sector

To achieve the objectives in area of Climate Change for the Agriculture sector 25 measures were developed and grouped in 2 priority goals and 6 priority axis. The proposed measures are aimed at reducing emissions from the major sources in the sector. The measures are consistent with the condition of the sector and the main priorities of the CAP for the period 2014-2020. One of the main challenges facing CAP is finding a solution to the increasingly aggravated production conditions in agriculture due to climate change and the need for farmers to reduce their share of greenhouse gases, to play an active role in mitigating climate change and to provide energy from renewable sources. In this regard there is an opportunity to promote the implementation of a number of measures in the field of direct

[13] MAF, Annual Report on the Implementation of RDP (2007-2013) in the Republic of Bulgaria for the period 01.01.2010 – 31.12.2010.

payments, market support and rural development in order to mitigate climate change.

Based on the analysis of the major sources of emissions the following two main objectives are defined in the Agriculture sector:

- Reduction and/or optimization of emissions from the agricultural sector;
- Increasing the awareness and the knowledge of both farmers and the administration in terms of actions and their effect on climate change.

The following priorities refer to these main objectives:

- Reduction of emissions from agricultural land;
- Reduction of methane emissions from the biological fermentation in animal husbandry;
- Improving the management of manure;
- Optimization of the use of plant residues in agriculture;
- Improving the management of rice fields and technology for rice production;
- Improving the knowledge of farmers and the administration regarding reduction of emissions from the Agriculture sector.

4.3.6.4. Measures in the Agriculture Sector

PRIORITY AXIS 1: REDUCTION OF EMISSIONS FROM AGRICULTURAL LAND

Measures with direct impact on the reduction of GHG emissions

Measure 1: encouraging the use of suitable crop rotation, especially with nitrogen fixing crops

Characteristics: Rotation means science-based successive rotation of crops in time and place on a farmland. The period required for all crops to pass through all fields following the order of the crop rotation scheme is called rotation period or rotation. The introduction of sustainable crop rotations that include plant cover in winter and legumes (beans, soybeans, alfalfa, clover) will prevent soil erosion and will retain organic carbon (carbon sequestration), which is a potential tool for reducing greenhouse gases.

The proposed budget for the measure is based on:

350 BGN/ha is the current payment for biological field crops under Measure 214 of RDP 2007-2013;

150 BGN/ha is the current payment for the introduction of rotation under Measure 214 of RDP 2007-2013.

This measure covers: 20 000 ha, of which 60% in organic production.

Organic production: 12 000 ha X 350 BGN/ha = 4 200 000 BGN

Crop rotation: 8000 ha x 150 BGN/ha = 1 200 000 BGN

Indicator of implementation:

8000 ha with improved crop rotation;

12 000 ha treated biologically;

Expected effect:

Total reduction of 6356 Gg CO2 eq

<u>Measure 2: management of degraded agricultural land through:</u>

1. biological reclamation with typical for the region grass species
2. implementation of erosion control measures and soil treatment methods

Characteristics: Soil erosion is a process of mechanical destruction and weathering of soil by the action of water and wind. It gradually reduces the amount of nutrients and the humus in soil. Erosion aggravates the structure, as well as the water and air regime of soil. The combination of the specific natural and economic conditions in Bulgaria is a reason for the high risk of degradation processes in agricultural soils. The most common processes of soil degradation include water and wind erosion, pollution, reduction of organic matter stocks (humus), compaction, acidification, salinization, loss of biodiversity. More than 60% of the country is affected by varying degrees of erosion. 11.8 % of the country's territory is severely eroded. 65% of agricultural land is threatened by water erosion and 24% is threatened by wind erosion. The average annual intensity of soil erosion varies according to land use, but soil loss in agricultural lands is estimated at 12.256 tonnes/ha a year on average. The water erosion of soil controls the stocks of organic carbon and their distribution on the landscape which affects the circulation of carbon, the content of carbon dioxide in the atmosphere and the global warming.

The proposed budget for the measure is based on reclamation of 2500 ha:

2500 ha x 380 BGN/ha = 950 000 BGN

Erosion control practices for 2500 ha

2500 ha x 145 BGN/ha = 362 500 BGN

The amounts used are under the current Measure 214 Agri-environmental payments under RDP 2007-2013

Indicator of implementation:

ha with control erosion practices and recultivated agricultural land

Expected effect:

Total reduction of 20 000 tonnes CO2 eq. by 2020

Target value by year	2014	2016	2018	2020
ha biologically recultivated agricultural land or recultivated agricultural land	500 500	1000 1000	2500 2000	 2500

Measures with indirect impact on the reduction of GHG emissions

Measure 1: improving the knowledge of farmers regarding humus conservation activities (fertilization - precise fertilization, green manure, liming, soil cultivation, prevention of stubble burning, anti-erosion measures, etc.)

Characteristics: By improving carbon storage ability of soils carbon dioxide can be removed from the atmosphere, and will have at the same time an important role in improving the long-term quality and fertility of soils.

It is necessary to improve the knowledge of farmers regarding the most appropriate tilling methods in terms of maintaining and improving the humus layer as well as the overall decrease in the number of soil treatments. They are determined at regional and even local level depending on the specific characteristics of the area. Namely these specific characteristics and their relation to reducing carbon emissions should be subject to consultation and training of farmers.

The proposed budget for the measure is based on:

410 BGN is the current amount for training through information activities under Measure 111 of RDP 2007-2013.

975 BGN is the amount paid to NAAS for provision of consultations under Measure 214 Agri-environmental payments of RDP 2007-2013.

5000 trained farmers by 2020 X 410 BGN = 2 050 000 BGN

Consultations:

2000 farms x 975 BGN = 1 950 000 BGN

Measure 2: introduction of water saving and energy saving irrigation technologies

Characteristics: The irrigation of agricultural land will have an increasingly important role in the parallel impacts of the agricultural sector development on one hand, and the effects of climate change on the other hand. The efficient and rational use of water is essential for the good condition of soil and for the reduction of the need to use extra energy in irrigation.

PRIORITY AXIS 2: REDUCTION OF METHANE EMISSIONS FROM THE BIOLOGICAL FERMENTATION IN ANIMAL HUSBANDRY

Measures with indirect impact on the reduction of GHG emissions

Measure 1: encouragement of the extensive grassland husbandry

Characteristics: The extensive livestock farming and the maintenance of optimum density of livestock units depending on environmental, climatic and soil conditions ensure the good ecological condition of meadows and pastures and permanent grass cover thus leading to preservation of carbon stocks in soil.

PRIORITY AXIS 3: IMPROVEMENT OF THE MANAGEMENT OF MANURE

Measures with direct impact on the reduction of GHG emissions

Measure 1: improvement of the management and use of manure

Characteristics: Production, processing and management of manure is one of the most significant sources of the greenhouse gas CH4 in agriculture. All activities aimed at storage and handling of manure should take into account both the type of manure - solid or liquid - and the technologies for gathering and processing. The investment support is crucial to motivate the farmers to build such expensive facilities.

The proposed budget for the measure is based on:

The average cost of building facilities for storage of manure for one farm with 50 cows is 130 000 BGN.

1000 x 130 000 BGN = 130 000 000 BGN

For training: 300 livestock holdings x 690 BGN = 207 000 BGN

Indicator of implementation:

Number of livestock holdings with improved storage;

Number of investment projects

Expected effect:

Total reduction of 1171 tonnes CO2 eq. by 2020

Target value by year	2014	2016	2018	2020
Number of livestock holdings with improved storage; **Number of investment projects**	50 300	100 600	200 800	300 100

Instrument: Development and implementation of measures under RDP 2014-2020 for building manure storage facilities; Training; Model farms.

Measure 2: introduction of low-carbon practices for processing manure, e.g. composting, transformation of manure into biogas under anaerobic conditions

Characteristics: The introduction of low carbon practices for the processing of manure can reduce the emissions from its storage. This requires considerable accumulation of knowledge and experience at regional level, since the efficiency of the implementation of the measure depends on the conditions under which it is implemented. It is therefore advisable to establish model farms in different production areas of the country in order to accumulate practical experience that can be presented to the farmers.

Given the resources required by such investments and the need for changes in the production process it is advisable to provide also investment support.

The reduction of emissions depends on the type of animals:

- holdings that breed pigs: 811 kg CO_2 eq. per head
- holdings that breed cattle: 78 kg CO_2 eq. per head
- holdings that breed sheep: 4 kg CO_2 eq. per head
- holdings that breed birds: 18.4 kg CO_2 eq. per head

Indicator:

Number of trained livestock holdings

Model farms with introduced low-carbon practices

Expected effect:

Total reduction of 753 tonnes CO_2 eq. by 2020

Target value by year	2014	2016	2018	2020
Number of trained livestock holdings Model farms with introduced low-carbon practices			model pig farms with average number of animals 150 2 model cattle farms with average number of cows 50 by 2018	200

Instrument: Development and implementation of measures under RDP 2014-2020 for building manure storage facilities; Training; Model farms

Measures with indirect impact on the reduction of GHG emissions

<u>Measure 1: establishment of a resource centre for low-carbon practices in processing manure</u>

Characteristics: The resource centre is an independent specialized unit under research institutions or NGOs that creates, collects and disseminates the results of applied research and publications, good practices and experience with low carbon practices for processing manure adapted to Bulgarian conditions and the needs of farmers. It should specify the main topics and approaches for training farmers, as well as provide recommendations regarding the measures to be developed and promoted.

PRIORITY AXIS 4: OPTIMIZATION OF THE USE OF PLANT RESIDUE IN AGRICULTURE

Measures with direct impact on the reduction of GHG emissions

Measure 1: technical support for farmers for tilling soil/stubble

Characteristics: The use of plant residues in agriculture requires both a change or adjustment of the production processes as well as investment in new equipment and machinery. This requires substantial financial resources and supporting them is appropriate.

The efficient recovery of waste will reduce the need for burning stubble.

The reduction of emissions is estimated at 3.62 kg CO_2 eq. per tonne production.

The proposed budget for the measure is based on:

5000 holdings x 45 000 BGN = 225 000 000 BG

Indicator:

Number of technically prepared holdings

Expected effect:

Total reduction of 655 tonnes CO_2 eq. by 2020

Target value by year	2014	2016	2018	2020
Number of technically prepared holdings		1000 holdings x 10 ha	3000 holdings x 10 ha	5000 holdings x 10 ha

Instrument:

- Targeted financing of investments in small and medium-sized farms.
- A possibility to develop such thematic programmes exists in the draft Regulation on rural development 2014-2020

Measures with indirect impact on the reduction of GHG emissions

Measure 1: improvement of the awareness and the knowledge of farmers regarding the possible use of plant residues and the threats posed by stubble burning

Characteristics: Knowledge and understanding of the problem on the part of farmers is one of the key elements related to reduction of the burning of stubble

PRIORITY AXIS 5: IMPROVEMENT OF THE MANAGEMENT OF PADDY FIELDS AND TECHNOLOGIES FOR PRODUCTION OF RICE

Measures with direct impact on the reduction of GHG emissions

Measure 1: financial support for improving the equipment and the technology of production

Characteristics: In recent years, rice production in the country has been gradually recovering its potential. The introduction of low carbon technologies and methods is necessary, feasible and appropriate in this specific period

Indicator of implementation: Number of supported rice producers

Expected effect: Total reduction of 10 tonnes CO2 eq. by 2020

Target value by year	2014	2016	2018	2020
Number of t supported rice producers		10 x 10 ha	20x 10 ha	50x10 ha

PRIORITY AXIS 6: RAISING THE AWARENESS AND IMPROVING THE KNOWLEDGE OF FARMERS AND ADMINISTRATION REGARDING THE ACTIONS AND THEIR EFFECT ON CLIMATE CHANGE

Measures in this priority axis are with indirect impact on the reduction of GHG emissions.

4.3.7. Land Use, Land Use Change and Forestry Sector

4.3.7.1. General information on the sector

The sector of Land Use, Land Use Change and Forestry (LULUCF) is not addressed and no measures are proposed to reduce emissions or to increase the absorption of greenhouse gases in the previous two Action Plans on Climate Change (2000, 2005). Accounting for the activities in the sector is necessary in order to make a comprehensive analysis of the carbon balance in the country.

The national reports on greenhouse gas inventories sector LULUCF is presented in accordance with the requirements of the Good Practice Guidance (IPCC GPG, 2003) only for the last four years of inventory (2008. 2009.2010 and 2011). The present analysis is based on data from the last inventory that covers the period from 1988 (base year for Bulgaria) to 2011.

According to the Good Practice Guidance the sector covers six major categories of land: “Forests”, “Arable land”, “Pastures and meadows”, “Wetlands”, “Settlements” and “Other land”. Each of these categories is divided into subcategories: “Land remaining in the same category of land use” and “Lands converted to other land uses”. The determination of removals or emissions of greenhouse gases is based on carbon stocks in soil and plant biomass on the area covered by the relevant category of land use.

The analysis of the structure and the changes in land use for the period 1988-2011 shows a positive trend with regard to forest areas.

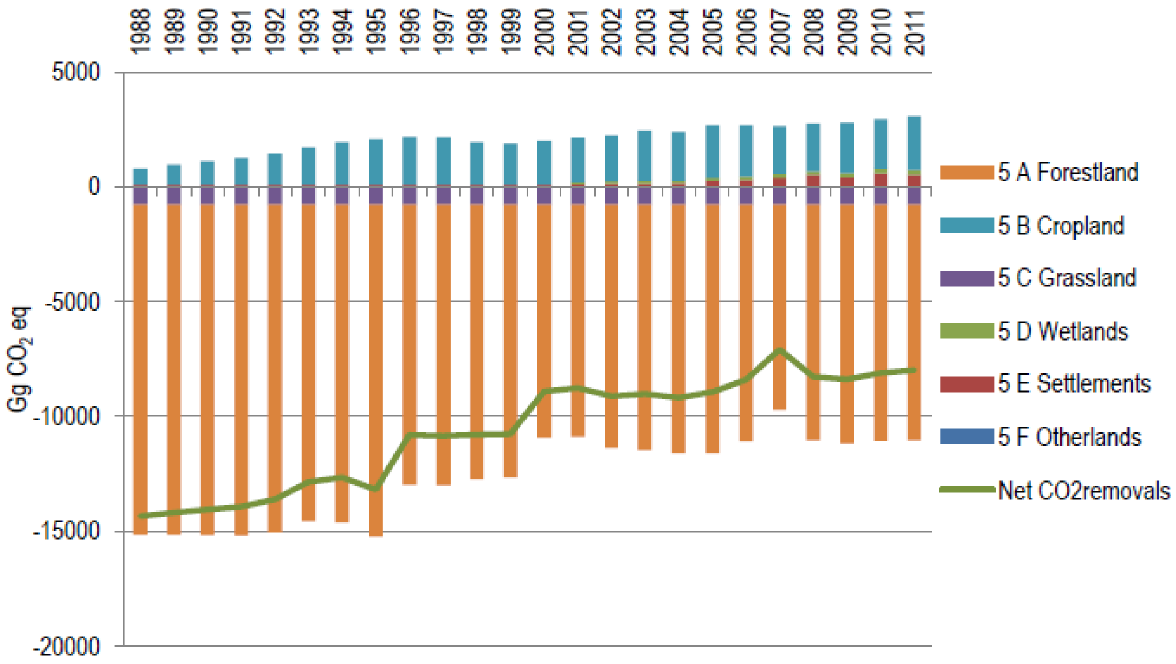
The balance between emissions and removal of greenhouse gases in the LULUCF sector is in favour of the sequestration. Sinks are territories occupied by forests, grasslands and meadows. A major source of emissions in the sector is the change in land use and the conversion of forests, grassland into cropland and urban areas.

Table 4.17 Net emissions and removals of GHG from LULUCF by categories in CO2 eq.

Year	Total CO_2 removals	5 A Total Forestland	5 B Total Cropland	5 C Total Grassland	5 D Total Wetlands	5 E Total Settlements	5 F Total Other land
1988	-14340,02	-14343,51	706,95	-786,64	NE, NO	83,17	NO
1989	-14198,09	-14363,25	868,62	-786,64	NE, NO	83,17	NO
1990	-14048,81	-14370,70	1025,35	-786,64	NE, NO	83,17	NO
1991	-13931,71	-14406,90	1178,65	-786,64	NE, NO	83,17	NO
1992	-13619,01	-14269,08	1353,54	-786,64	NE, NO	83,17	NO
1993	-12852,79	-13785,46	1636,14	-786,64	NE, NO	83,17	NO
1994	-12661,84	-13821,21	1862,84	-786,64	NE, NO	83,17	NO
1995	-13177,57	-14449,51	1975,41	-786,64	NE, NO	83,17	NO
1996	-10809,13	-12184,45	2078,78	-786,64	NE, NO	83,17	NO
1997	-10843,25	-12201,25	2061,47	-786,64	NE, NO	83,17	NO
1998	-10793,24	-11946,80	1857,02	-786,64	NE, NO	83,17	NO
1999	-10765,99	-11863,69	1801,16	-786,64	NE, NO	83,17	NO
2000	-8918,24	-10132,95	1918,17	-786,64	NE, NO	83,17	NO
2001	-8755,57	-10107,55	1949,66	-786,64	90,83	98,13	NO
2002	-9117,54	-10580,89	2016,93	-786,64	103,11	129,95	NO
2003	-9025,79	-10677,34	2188,55	-786,64	115,14	134,50	NO
2004	-9191,85	-10807,10	2133,13	-786,64	127,12	141,64	NO
2005	-8934,39	-10813,90	2270,66	-786,64	139,59	255,91	NO
Year	**Total CO_2 removals**	**5 A Total Forestland**	**5 B Total Cropland**	**5 C Total Grassland**	**5 D Total Wetlands**	**5 E Total Settlements**	**5 F Total Other land**
2006	-8398,15	-10284,09	2224,81	-786,64	151,64	296,13	NO
2007	-7086,33	-8929,65	2075,97	-786,64	163,97	390,01	NO
2008	-8281,14	-10241,76	2061,55	-786,64	176,04	509,67	NO
2009	-8388,63	-10391,77	2189,79	-786,64	188,87	411,11	NO
2010	-8109,04	-10261,36	2162,86	-786,64	200,68	575,40	NO
2011	-7979,42	-10250,84	2322,47	-786,64	212,42	523,16	NO

Over the past 21 years the absorption of greenhouse gases in the sector compensated between 11.35% -19.9% of the total greenhouse gas emissions in Bulgaria. Biggest role in the sequestration and storage of carbon (93-95% of the total absorption in the sector) have the territories occupied by forests (Figure 4.12)

Figure 4.12 LULUCF emissions and removals 1988 – 2011 CO2eq.



Forests are a major sink of carbon dioxide (CO_2) and play a key role in the absorption of carbon through photosynthesis. They are an important link in the global carbon cycle due to their ability to capture CO_2 from the atmosphere and store it in their biomass, forest litter (dead matter on the forest floor) and forest soil. The growth of tree species represents to a large extent net carbon stocks and with this respect evaluation and projections related to the state and the productivity of forests are essential to the analysis of the development of carbon emissions. Furthermore, the growth of woody biomass in forests plays a role in reducing greenhouse gas concentrations in the atmosphere. For these reasons, the analysis of forest ecosystems and the methods of managing forest resources are important for the possibility of increasing the potential of forests as sinks. To develop the measures in this NAPCC the current status of Bulgarian forests, as well as the possibilities provided by this resource for managing carbon emissions in the future were analysed.

Bulgaria has a significant forest resource and its sustainable management and development is important for reducing greenhouse gases. Forested areas in the country occupy one third of its territory, amounting to 4.138 mln. ha, of which 3.831 mln. hectares are forests. The distribution of woodlands in groups of forests is as follows: coniferous - 30.5 % and deciduous - 69.5%. The total stock of forests is estimated at 644 mln. m^3 of standing volume, including: coniferous - 287 mln. m^3 (44.6%) and deciduous trees - 357 mln. m^3 (55.4%). The average annual growth is 14.4 mln. m^3 of wood, and the average annual yield is less than 50% of the average annual growth. The projections of the forest resources dynamics for the period 2015-2030 is prepared according to the European Forest Information Scenario Model (EFISCEN) which is a matrix model based on the area occupied by tree species or by forest types and is suitable for policy analysis for large territories (D. Kostov, 2009). The following results for the stock of standing timber in Bulgarian forests and the average annual growth were estimated using the simulations with this model in the baseline scenario: 2015 – 705.3 mln. m^3 of stock and growth of 16.763 mln. m^3; 2020 – 743.5 mln. m^3 of stock and growth of 16.734 mln. m^3; 2025 – 780.3 mln. m^3 of stock and growth of 16.669 mln. m^3; 2030 - 812 mln. m^3 of stock and growth of 16.195 mln. m^3. This analysis shows that Bulgarian forests are now a reservoir of 229 mln. tonnes of carbon that will reach 264 mln. tonnes of C in 2020, and in 2030 - 288 mln. tonnes of C. EU forests, including Bulgarian forests, absorb a total of 0.5 bln. tons of CO_2 eq. per year, while greenhouse gas emissions from the industry in the EU-27 amount to 5 bln. tons of CO_2 eq. per year.[14].

In the long term it is necessary to continue the development of the concept for sustainable and multifunctional forest management aimed at maintaining or increasing the supplies of timber and respectively of carbon in forests, while ensuring, at the same time, a sustainable annual yield of timber and timber products. The current National Strategy "Sustainable Development of Forestry in Bulgaria 2006-2015" points out the need of overall improvement of the role and contribution of forests to climate change mitigation by increasing the carbon stocks in existing and in new forests. The increase in the use of wood as a resource that can substitute other energy-intensive materials and as a renewable energy source will have a positive impact on the carbon balance and will contribute to reducing the use of fossil fuels. The expansion of forest areas through afforestation of abandoned agricultural land, barren and deforested areas, eroded and threatened by erosion land, and the acceleration of measures for cultivation of forests and improvement of forest health will allow forests to better perform their productive, environmental and preservation functions that also will have, on the other hand, a positive effect on the growing accumulation of carbon in forest areas. The significant adverse effect of forest fires on the gas composition of the atmosphere can be minimized by anticipating and taking appropriate measures, activities and campaigns aimed both at the forestry sector and the related persons and organizations as well as at the general public.

Sixteen measures were developed to achieve the objectives on Climate Change for the Land Use, Land Use Change and Forestry sector and were grouped into four priority axes, comprising several popular approaches to managing the carbon balance.

The first priority axis combines measures to increase the sequestration of greenhouse gases and the necessary measures are associated with increase of the areas of land use categories - sinks of greenhouse gases - forests, pastures and meadows, and measures for their sustainable maintenance in order to increase the amount of biomass. The increase of green areas in urban territories is also a measure with positive impact on carbon balance. This axis reflects the need for additional legislative and administrative measures to regulate the changes in the designation of areas of land use categories that are sinks of greenhouse gases.

Another group of measures is aimed at conservation of carbon stocks in forests. This priority axis comprises activities aimed primarily at maintaining and improving the condition of forests as a carbon pool.

The third priority axis contains measures related to increasing the potential of forests for carbon sequestration. There are administrative, regulatory and financial

[14] Green Paper on Forest Protection and Information in the *EU.*

measures aimed at increasing the country's forest resources and improving their condition and potential as a major carbon sink.

The last priority axis includes measures aimed at the long-term retention of carbon in wood products through the expansion of their use at the expense of other non-renewable materials with high carbon content which can be achieved by raising the awareness and the interest of society.

4.3.7.2. Measures in the Land Use, Land Use Change and Forestry Sector

<u>PRIORITY AXIS 1:</u> INCREASING GREENHOUSE GAS SEQUESTRATION

Measures with direct impact on the reduction of GHG emissions

Measures with direct impact on the reduction of GHG emissions

<u>Measure 1: utilization of „non-wooded areas intended for afforestation “ in forest areas</u>

Characteristics: The measure is consistent with the requirements set out in the Forestry Act (2011). The needed financial resources are estimated on the basis of the accepted mean values of investments. The implementation of the measure is important for achieving the goals of NAPCC because forests are a major carbon sink and a reservoir of 90-95% of the total amount of sequestered carbon in the LULUCF sector. Increasing forest area has an important role in offsetting the greenhouse gas emissions from other sectors. The afforestation of non-wooded areas in the long term will increase the capacity of the forests as sinks of greenhouse gases.

Indicator of implementation:

490 ha utilized areas

Expected effect:

Total reduction of 13 378 tonnes CO_2 eq by 2020

Target value by year	2014	2016	2018	2020
ha utilized areas	120 ha utilized areas	130 ha utilized areas	120 ha utilized areas	120 ha utilized areas

Type of instrument:

Development of a programme for afforestation of non-wooded areas intended for afforestation in forest areas; Organization of afforestation campaigns; Publishing and distribution of explanatory leaflets.

<u>Measure 2: afforestation of abandoned agricultural land, barren and deforested areas, eroded and threatened by erosion land outside forest areas</u>

Characteristics: The proposed measure corresponds to those with codes 223 and 226 under the Rural Development Programme. It is possible to apply under this programme with projects and to obtain appropriate funding. The needed financial resources are estimated on the basis of accepted mean values of investments. There is a potential for creating new forests outside the forested areas especially over the last two decades, when large territories of the agricultural land is not cultivated. The implementation of the measure will increase the absorption of greenhouse gases and thus contribute to climate change mitigation, to the protection of biodiversity and of the soil against erosion. To achieve the objective of the measure it is necessary, before undertaking afforestation activities, to make an inventory of the areas that are suitable for afforestation and to conduct applied scientific studies to evaluate their suitability and possibility for afforestation; appropriate recommendations for suitable species should be provided on the basis of the conditions of the places where they grow.

Indicator of implementation:

1400 ha afforested areas

Expected effect:

Total reduction of 35 112 tonnes CO2 eq by 2020

Target value by year	2014	2016	2018	2020
ha afforested areas	300 ha afforested areas	300 ha afforested areas	400 ha afforested areas	400 ha afforested areas

Type of instrument:

Inventory of the areas; Applied scientific studies to assess their suitability for and possibility of afforestation; Development of projects for financing.

<u>Measure 3: increase of areas for urban and suburban parks and green zones</u>

Characteristics: The proposed measure corresponds in part to measure with code 322 form the Rural Development Programme that provides funding opportunities. The measure is also related to Ordinance № 5 on Spatial Planning Rules and Standards, setting standards for the surface area of public green areas in cities.

The needed financial resources are estimated on the basis of the accepted mean values of investments.

The expansion of urban areas and the intensive building in recent years is a prerequisite for significant emissions of greenhouse gases. Increasing the areas of urban and suburban parks and green zones and keeping them in good condition will contribute to increased absorption of greenhouse gases and to better quality of the living environment. The measure will contribute also to the gradual achievement of the standards for green areas laid down in the General Development Plans.

Indicator of implementation:

100 ha increased areas

Expected effect:

Total reduction of 2 508 tonnes CO2 eq by 2020

Target value by year	**2014**	**2016**	**2018**	**2020**
ha increased areas	20 ha increased areas	30 ha increased areas	30 ha increased areas	20 ha increased areas

Type of instrument:

Municipal development programmes; General development plans; Development of projects.

<u>Measure 4: restoration and sustainable management of wetlands. protection and preservation of wetlands in forest areas, peatlands, marshlands</u>

Characteristics: The main instrument for the protection of wetlands is the Convention on Wetlands which is transposed in the Biological Diversity Act. The wetlands are designated as protected areas with priority or are included in Natura 2000. They will be subject to management plans that are currently being developed and that will be supplemented by special programmes for management in view of climate change.

The needed financial resources are estimated on the basis of the accepted mean values of investments.

Wetlands are characterized by great biological diversity and play an important role in carbon retention because they are among the most productive ecosystems. The restoration and the conservation of wetlands and woodlands and their proper management will enhance their efficiency as carbon stores.

Indicator of implementation:

- 200 ha restored /
- preserved wetlands;
- inventory and assessment of 1300 ha peatlands in forest areas

Expected effect:

Total reduction of 4 681 tonnes CO_2 eq by 2020

Target value by year	**2014**	**2016**	**2018**	**2020**
ha restored/ preserved wetlands	30 ha restored/ preserved wetlands	50 ha restored/ preserved wetlands	60 ha restored/ preserved wetlands	60 ha restored/ preserved wetlands

Type of instrument

Development of programmes for restoration and protection of wetlands in forest areas; Applied Research

Measures with indirect impact on the reduction of GHG emissions

Measure 1: development of a financial mechanism to support the activities for creation of new forests

Characteristics: The aim is to build administrative capacity for provision of financial resources to support afforestation activities in order to increase the areas covered by forests. The needed financial resources are estimated by experts.

The setting up of a functioning financial mechanism will improve the conditions for management and expansion of activities to increase the forested areas in woodlands. The measure will also support the implementation of activities for afforestation of non-wooded areas designated for afforestation in woodlands (Measure 1 with direct effect).

Measure 2: analysis of the effectiveness of the existing legal framework for regulation of land use change of different types of land and recommendations for its improvement

Characteristics: The aim is to produce an analysis of the effectiveness of the legislative framework regulating the changes in the land use of different types of land and to provide recommendations for improvement.

The financial resources are defined by experts.

The existing regulations and their practical application facilitate, in many cases, land use change towards increasing the urban areas that are sources of greenhouse gas emissions. The implementation of this measure will identify the problems and the effectiveness of the legislative framework and its implementation and will propose specific actions and measures for its improvement.

PRIORITY AXIS 2: PRESERVATION OF CARBON STOCKS IN FORESTS

Measures with direct impact on the reduction of GHG emissions

Measure 1: restoration and maintenance of protective forest belts and new anti-erosion afforestation

Characteristics: The first step is to update the programme for restoration of shelter belts and the specific activities will commence after its approval. Besides the direct effect for absorption of carbon by the new forests in these zones, there are also significant indirect effects associated with preventing wind erosion after the restoration of belts. The information on the areas and the funds necessary for the restoration is provided by EFA.

Indicator of implementation:

350 restored forest belts

Expected effect:

Total reduction of 8 360 tonnes CO2 eq by 2020

Target value by year	2014	2016	2018	2020
ha restored forest belts	50 ha restored forest belts	150 ha restored forest belts	250 ha restored forest belts	350 ha restored forest belts

Type of instrument:

Updating the programme for restoration of shelter belts and provision of funding for related investments.

Measures with indirect impact on the reduction of GHG emissions

Measure 1: supporting preservation and maintenance of forests of high conservation value and extensive approach for their use

Characteristics: Such approved national methodology will play a role in the spatial determination of such forests with high conservation value. Relevant standards and norms for their management will be developed.

Measure 2: preservation and improvement of the condition of urban and suburban parks

Characteristics: The measure should include all urban and suburban parks regardless of ownership. Given the large number and area of these parks the improved condition of the ecosystems will have a positive impact on the uptake and retention of carbon. Amendments need to be made to RDA.

Measure 3: prevention of forest fires through introduction of early warning systems

Characteristics: The data of the required funding to implement such prevention programme is estimated by EFA.

PRIORITY AXIS 3: INCREASING THE POTENTIAL OF FORESTS TO CAPTURE CARBON

Measures with direct impact on the reduction of GHG emissions

Measure 1: increasing the density in the listed natural and artificial plantations

Characteristics: A first step can be the assignment of scientific studies followed by amendments to the regulations. Activities will commence on this basis with the view of increasing the density in the listed plantations by supporting their natural regeneration or using other methods. The information on the areas and the necessary funding is provided by EFA.

Indicator of implementation:

3500 ha plantations with density increased by at least 20 %

Expected effect:

Total reduction of 16 720 tonnes CO2 eq by 2020

Target value by year	2014	2016	2018	2020
ha plantations with increased density	500 ha plantations with increased density	1500 ha plantations with increased density	2500 ha plantations with increased density	3500 ha plantations with increased density

Type of instrument:

Assignment of a scientific task to be implemented into practice. Pilot implementation of modern silvicultural systems to maintain highly productive mixed forests.

Measures with indirect impact on the reduction of GHG emissions

Measure 1: introduction of appropriate systems to manage forest plantations under changing weather conditions aimed to create highly productive and sustainable mixed forests

Characteristics: The scientific task may be assigned in connection with article 4 of Ordinance № 8 of 5 August 2011 on forest logging.

Measure 2: supporting the increase of the percentage of certified forests

Characteristics: The measure aims to improve forest potential to capture carbon through implementation of the criteria for certification of forests - sustainable management of forest ecosystems, preservation of forest litter and old trees, independent monitoring and control over forest management processes, minimization of opportunities for illegal logging. The information of the areas and the necessary funding is provided by the EFA.

Measure 3: development of good practices for the establishment and management of intensive forest crops for biomass production and establishment of standards for residual biomass after logging

Characteristics: The plantations for accelerated production are not managed as a forest under the Forestry Act, so the environmentally sound management of such cultures requires relevant methodological guidelines in the form of guidance or "best practices". The development may be assigned pursuant to art. 4 of Ordinance № 8 of 5 August 2011 on forest logging.

Measure 4: development of a part in the new strategic documents concerning the forestry sector that involves measures aimed at improving the role and the contribution of forests to carbon accumulation

Characteristics: The strategic documents are prepared pursuant to art. 9 of the Forestry Act as an essential element of forestry planning.

PRIORITY AXIS 4: LONG-TERM CARBON STORAGE IN WOOD PRODUCTS

Measures with indirect impact on the reduction of GHG emissions

Measure 1: extend the use of wood products as substitutes for products from non-renewable, polluting and energy-intensive materials

Characteristics: Initiatives by stakeholders in the forestry sector – state and scientific institutions, representatives of the forestry business, branch organisations and NGOs – concerning the advantages of wood products. The measure is related to training and awareness raising of citizens, including with respect to the effective use of wood products.

4.3.8. Transport Sector

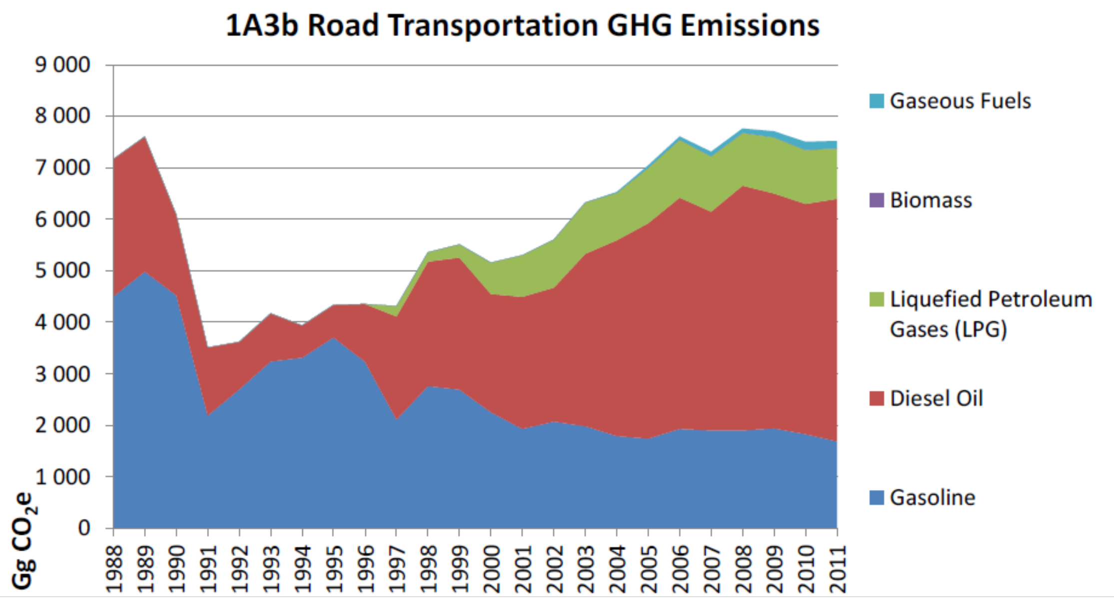
4.3.8.1. General information on the Transport sector

The analysis of the development of the Bulgarian transport sector over the recent years shows significant structural changes and a tendency for growing share of road transport in the overall transport activity.

According to the latest inventory of GHG emissions in Bulgaria road transport in 2011 accounted for 91% of total energy consumption in the sector. For the period of the inventory (1988-2011) the share of diesel fuel sharply increased after 2000 until 2007 due to its use by private cars and trucks. The upward trend of the amount of consumed gasoline is maintained throughout the period.

Overall, the GHG emissions from road transport increased by 4,9% compared to base year levels being 7 169,5 Gg CO2e in 1988 and reached levels of 7 521,3 Gg CO2e in 2011. However, that growth in 2011 compared to 1991 is calculated at 114,1%. This sudden change was brought with the economic recovery, preceded by the introduction of a currency board regime in 1997 and rigorous economic and political reforms.

Figure 4.13 GHG emissions Road transport 1988-2011



The most significant contributor to GHG emissions is passenger cars, followed by heavy-duty vehicles, light-duty vehicles and motorcycles and mopeds. As it can be noticed from the following figure, in 2011, passenger cars and heavy duty vehicles account for 61,7% and 19,9% of total GHG CO_2e emissions respectively, dependent on the intensification of passenger and goods transportation. The remaining 18,4% were shared among light-duty vehicles, buses and mopeds and motorcycles.

The White Paper “Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system” (COM (2011) 144 final) refers to the Commission’s analysis[15] which shows that while other sectors can achieve greater reductions, the transport sector is expected to reduce its greenhouse gases (GHG) by at least 60% by 2050 compared to 1990 levels, however it remains a significant and growing source of GHG. The aim of the transport sector is to reduce GHG emissions by about 20% below their level in 2008 by 2030. Given the significant increase of transport emissions over the past two decades, this reduction would nevertheless lead them to a level higher by 8 % than the level in 1990.

According to Decision 406/2009/EC (Efforts Sharing Decision) Bulgaria is assigned an individual target allowing it to increase the emissions from sectors outside the ETS, such as the transport sector, with 20% by 2020 compared to their level in 2005. Although this individual commitment facilitates the national objectives in the course of time the Transport sector undoubtedly requires drastic changes in order to achieve stability. One of the biggest challenges is to reduce dependence of the transport system and the Bulgarian economy on oil.

In this regard, the main measures in the sector should be directed at achieving an optimal balance in the use of the potential of different types of transport.

15 Communication from the Commission “A Roadmap for moving to a competitive low carbon economy in 2050”, (COM (2011)112).

4.3.8.2. Measures in the Transport sector

The main measures in the sector are divided into four priority axes as follows:

PRIORITY AXIS 1: REDUCTION OF TRANSPORT EMISSIONS

Measures with direct impact on the reduction of GHG emissions

Measure 1: rehabilitation and modernization of the existing road infrastructure to ensure optimum speed and optimum driving modes of automobile engines

Characteristics: Assessment of the emission saving potential of projects for rehabilitation and modernization – within the EIA. Existing methodology of the European Investment Bank. (http://www.eib.org/attachments/strategies/footprint_summary_of_the_methodologies_en.pdf)

Indicator of implementation:

Emission savings from km. rehabilitated infrastructure

Expected effect:

Total reduction of 542 496 tonnes CO_2 eq by 2020

Type of instrument:

1.Updating the regulatory basis on design

2.Development and implementation of specific projects

Measure 2: introduction of intelligent transport systems along the national and the urban road network

Characteristics: Intelligent Transport Systems (ITS) encompass a wide range of technical solutions designed to improve transport by improving mobility and increasing the safety of road traffic. Telematics (a combination of telecommunications and informatics) uses advanced technologies to meet transport needs. Intelligent transport systems and telematic solutions help improve road safety, promote the efficiency of the used existing infrastructure and contribute to the reduction of environmental pollution through control over traffic flows and management of traffic volume. The intelligent transport systems in urban settings can include integrated management of public transport charges, enhanced management of customer relationships, traffic forecasts, improved traffic management, traveler information and toll collection. These systems apply advanced technologies to collect more and better data, to make a precise analysis of these data and to link them through more effective networks. The result: more effective, more efficient and better oriented towards citizens on the move services.

Indicator of implementation:

Number of introduced ITS

Expected effect

Total reduction of 1 017 180 tonnes CO_2 eq by 2020

Type of instrument

Project-oriented approach – specific implementation

Financial policy

<u>Measure 3: increasing the share of biofuels</u>

Characteristics: Biofuels are fuels produced from biomass and used in transport. They diversify the energy mix and reduce the dependence on fossil fuels.

The main types of biofuels are bioethanol, biodiesel, biogas, synthetic biofuels, bio-hydrogen, pure vegetable oils. The most promising projects in Bulgaria are the projects for production of ethanol and biodiesel. The consumption of biodiesel in Bulgaria in 2010 amounted to 38 911.13 tonnes. In the previous two years these amounts were respectively 4260 t and 6566 t.

The Renewable Energy Sources Act (Art. 47(1)) introduces stages for the introduction of certain percentages of biodiesel and bioethanol content in the relevant fuel, as well as requirements to the types of biofuels and sustainability criteria which they must meet.

Indicator of implementation:

% content of biofuel

Expected effect:

Total reduction of 406 872 tonnes CO2 eq by 2020

Target value by year	**2014**	**2016**	**2018**	**2020**
Number of retrofitted state-owned and municipal buildings	According to art. 47 of RESA	According to art. 47 of RESA	According to art. 47 of RESA	According to art. 47 of RESA

Type of instrument:

Renewable Energy Sources Act

Measures with indirect impact on the reduction of GHG emissions

<u>Measure 1: developing and promoting the use of “hybrid” and electric vehicles</u>

Characteristics: The indirect effect from the introduction of the measures is estimated at 135 624 tCO2 eq.

On 14.12.2010 a Memorandum of Understanding – “Electric Mobility” – for development and use of electric vehicles was signed by Sofia Municipality and CEZ Bulgaria. The purpose of the Memorandum is the development of a common strategy and an action plan for electric vehicles. CEZ and Sofia Municipality agreed to promote the introduction of electric vehicles on the streets of Sofia. The Municipality is committed to establishing alleviated procedures for granting permits for installation of charging stations for electric cars. The electricity distribution company, on its part, will apply alleviated procedures for the provision of transit capacity, connection points and power. The first 7 electric stations were installed at the end of 2011 in Sofia. The initiative is part of the pilot project that the company Full Charger - Bulgaria, developed together with CEZ Bulgaria and Sofia Municipality. The charging stations are located in the “Blue Zone” in central city areas. Cars will be charged through prepaid vouchers. Activation through contactless debit and credit cards will be introduced later. Full Charger - Bulgaria plans to build a network of 150-200 charging stations by the end of 2012 in Sofia and in other big cities. After that stations will be built along motorways and inter-city roads.

The factory of "Litex Motors" in Lovech will be ready to produce electric cars in the spring of 2012.

PRIORITY AXIS 2: REDUCTION OF FUEL CONSUMPTION

Measures with direct impact on the reduction of GHG emissions

Measure 1: reduction of the relative share of trips with private motor vehicles through improvement and development of urban public transport and development of non-motorized transport

Indicator of implementation:

Change in the share of private and public transport

Expected effect:

Total reduction of 678 120 tonnes CO2 eq by 2020

Type of instrument:

Project-oriented approach – specific implementation

Measure 2: developing and promoting the use of bicycles for transport

Indicator of implementation:

Km of bicycle alleys

Expected effect:

Total reduction of 1 017 180 tonnes CO2 eq by 2020

Type of instrument:

Project-oriented approach – specific implementation

1. Design and construction of new cycling infrastructure

2. Developing systems for use of municipal bicycles

Trainings and campaigns

Measures with indirect impact on the reduction of GHG emissions

<u>Measure 1: fiscal policy to stimulate economies and to limit consumption of conventional fuels</u>

Characteristics: The indirect effect from the introduction of this measure is estimated at 406 872 tCO2 eq.

The measures is proposed in the White Paper "Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system" (COM (2011) 144 final).

<u>Measure 2: reduction of the number of motor vehicles using conventional fuels in public transport by 2020</u>

Characteristics: The measures is proposed in the White Paper "Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system" (COM (2011) 144 final).

National action plan to encourage green public procurement for the period 2012-2014 – one of the Plan's objectives is to reduce GHG emissions and one of the major product groups are the clean and energy efficient transport vehicles.

<u>PRIORITY AXIS 3</u>: DIVERSIFICATION OF TRANSPORT

Measures with direct impact on the reduction of GHG emissions

<u>Measure 1: increasing the share of public electric transport – railway, metro, trolley, tram and metro</u>

Characteristics: OP "Transport" 2007-2013, Priority axis 1 "Development of railway infrastructure along the major national and Pan-European transport axes" provides for: modernization of the railway line Sofia – Plovdiv; reconstruction and electrification of railway line Svilengrad - Turkish border; renewal of sections of railway infrastructure on the railway line Plovdiv - Burgas (along Trans-European Transport Network); modernization of railway line Sofia - Dragoman (along TEN-T); design of the construction of railway line Vidin - Sofia.

Given the crucial importance of the central section of Line 2, it is currently a separate Sofia Metro Expansion Project which is included in Operational Programme Transport, with financing by the European Regional Development Fund, with national and local co-financing. This stretch covers the section: "Road junction Nadezhda - Central Railway Station – Sv. Nedelya Square - Cherny Vrah Blvd." International tender procedures were conducted in 2007-2008 for selection of contractors of this project and the contracts entered into force in December 2008 with a time limit for completion - autumn 2012.

The expected effect of the implementation of such measures is reduction of hazardous and greenhouse gases – 90 500 tonnes CO2 per year.

Indicator of implementation:

Share of public electric transport

Expected effect:

Total reduction of 1 017 180 tonnes CO_2 eq by 2020

Type of instrument:

Project-oriented approach – specific implementation

- Increasing the share of electric railway transport - infrastructure improvements;
- Increasing the share of electric railway transport - renovation of vehicles;
- Increasing the share of electric mass public transport - infrastructure improvements;
- increasing the share of electric mass public transport - renovation of vehicles.

<u>Measure 2: development and construction of intermodal terminals for combined transport</u>

Characteristics: The measure aims to achieve a two-sided effect, consisting, on one side, in increase of the degree of utilization of more environmentally friendly modes of transport and, on the other side, in the creation of favorable conditions for increasing the added value of transport activity with overall reduction of transport costs per unit of GDP.

The expected results of its implementation are:

- more efficient use of rail and water transport;
- development of transport schemes and technologies meeting contemporary requirements with regard to environment and climate;
- increased coordination and integration of different transport modes;
- lower cost for passenger and cargo transport;
- integration of the Bulgarian transport system with that of the EU and increasing its competitiveness.

Indicator of implementation:

Construction of 5 intermodal terminals by 2020

Expected effect:

Total reduction of 406 872 tonnes CO2 eq by 2020

Target value by year	2014	2016	2018	2020
Number of terminals		1 term.	2 term.	2 term.

Type of instrument:

Project-oriented approach – specific implementation

Measures with indirect impact on the reduction of GHG emissions

Measure 1: reduction of cargo intended for transportation by motor vehicles at a distance of more than 300 km by redirecting it to more environmentally sound modes of transport, e.g. railway

Characteristics: The measures is proposed in this format in the White Paper - Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system (COM (2011) 144 final).

Measure 2: connecting the central network airports – Sofia, Varna, Burgas, Plovdiv and G. Oryahovitza with railway lines

Characteristics: The measures is proposed in this format in the White Paper - Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system (COM (2011) 144 final).

PRIORITY AXIS 4: INFORMING AND TRAINING CONSUMERS

Measures with indirect impact on the reduction of GHG emissions

Measure 1: sustainable transport statistics

Measure 2: informed selection of a transport vehicle

Measure 3: instruction in economic driving

4.3.9. Education and science

4.3.9.1. Measures in the field of education and science

Objective and direction of the measures in the field of science and education

The measures in the field of science and education are consistent, on the one hand, with the needs of the relevant sectors and, on the other hand, with the National Strategy of Scientific Research by 2020 and with the Programme for Development of Education, Science and Youth Policies in Bulgaria. Those two documents contain several leading national research priorities that are focused on areas closely related to the possibilities to reduce greenhouse gas emissions - energy sources and energy saving technologies; addressing and control of harmful and hazardous municipal and industrial waste; new raw materials and other materials.

The main objective of the measures is to focus the research and development activities and the educational activity on the issue of reducing greenhouse gas emissions, the identification and the study of the natural and the anthropogenic factors in order to ensure their sustainable management on the basis of practical experience and within a more competent administrative and organizational, technological, information and financial environment.

The contribution of science and education to the achievement of the national targets for reducing greenhouse gas emissions is in two directions:

– **Establishing the condition:**

- contribution to the definition of the mechanisms and the specifics of the origin and the generation of greenhouse gases in the relevant sectors;
- contribution to the monitoring of the implementation of the plan;
- involvement in fundamental research that contributes to the identification of problems at global level.

– **Building the capacity of human resources and institutions to contribute to the reduction of the anthropogenic impact on climate change:**

- Establishment of general knowledge and understanding of the anthropogenic impact on climate change at all levels of the educational system and setting up strategies to reduce this impact (through the system of general secondary education)
- Preparation of specialists for the different sectors.

In the first two National Action Plans on Climate Change (NAPCC) education and science are included in the package of measures at national level (respectively in the first NAPCC) as well as an important tool in the policy of the Government of Bulgaria on Climate Change (in the second NAPCC). No specific measures on science and education are identified in the second action plan.

The national policy in the field of research and education is conducted by the Ministry of Education and Science (Ministry of Education), and in the field of innovation - the Ministry of Economy, Energy and Tourism (MEET). The ministries are supported by the National Council for Scientific Research (NCSR) and the National Council for Innovation. The other ministries are also actively involved in the implementation of the state policy to encourage research and innovation by supporting, performing or financing/co-financing specific tasks in that sphere.

Some specific features of the sector should be taken into account in order to identify measures in the field of science and education that will contribute to meeting the national targets for reducing greenhouse gases as follows:

- Although specific research institutes, departments or educational institutions are directly involved with measures to reduce greenhouse gases the manner of functioning of the whole educational system determines the possible contribution of these departments;

- The priorities in the "Education and Science" Sector are essential for the analysis of the trends and the direction of the proposed measures related to reducing GHG emissions.

The current environment for conducting research and educational activities in this field is characterized by the following capacity.

- **Institutional and expert capacity**

School education in the country has 2700 schools and 64000 teachers. (Programme for Development of Education, Science and Youth Policies in the Republic of Bulgaria (2009-2013). The decreasing number of school-age children in recent years was a precondition for significant optimization of the number of the staff employed in school education. On the other hand, there was also observed a negative trend of decreasing number of young people that are interested and motivated to become teachers. They account for 11% of the total number of school teachers. (*Public Expenditure Review: Education - condition, problems and opportunities. Ministry of Finance. www.minfin.bg/document/2892:1*). These people usually bring new thinking and initiatives of innovations, new technologies and topics to school.

Higher education includes 53 higher schools (37 state and 16 private), including 43 universities and specialized higher schools and 10 independent colleges. The teaching staff includes over 22 000 people.

According to the Programme for Development of Education, Science and Youth Policies in the Republic of Bulgaria (2009-2013) the academic staff in Bulgaria is marked by poor motivation and inadequate social status, lack of interest in academic career and shortage of adequately trained human resources in priority areas, little research work in the preparation of students, lack of innovation and inadequate links between higher educational institutions and science. Another serious problem is the age of the faculty. It features a large structural imbalance - 69% of professors are aged over 60 years and only 4% are aged up to 49 years. 47.06% of the total number of teachers are aged over 50 years (*Public Expenditure Review: Education - condition, problems and opportunities. Ministry of Finances*. *www.minfin.bg/document/2892:1).*

The R&D system includes human resources and institutions. According to statistical data about 17 000 scientists are involved in research work most of whom are concentrated in public R&D organizations. Very few researchers (about 13% of their total number) are concentrated in business structures. For comparison, in some of the new EU countries this figure is over 30% and in others - over 60%. *(Programme for Development of Education, Science and Youth Policies in the Republic of Bulgaria (2009-2013)*. In European countries the predominant share of people employed in research and development (R & D) works in the private sector and in the system of higher education. In Bulgaria almost 60% of the people engaged in R&D are in the public sector and paid from the budget, compared an average level of 13% in the EU *(National Strategy for R&D Development 2020).*

The aim of patenting and licensing activities is to provide links to practice and to encourage the search and implementation of new and/or updated products, technologies and services. The number of applications from European and world patent organizations is low, while the number of applications and patents granted to foreign organizations is higher than the number of national applicants. In our Bulgaria there is no coordinated policy of activities concerning the relationship between science and innovation (*Programme for Development of Education, Science and Youth Policies in the Republic of Bulgaria (2009-2013*). The existing offices are inefficient and there is an insufficient number of transfer offices to provide a link with industry and to encourage the demand and implementation of new and/or updated products, technologies and services (*Programme for Development of Education, Science and Youth Policies in the Republic of Bulgaria (2009-2013*). Less than 10% of the active innovation companies have links with R&D organizations (*National Strategy for R&D Development 2020*). The different elements of the Bulgarian innovation system are not connected – the fundamental and sectoral studies develop separately.

According to Eurostat data for 2008 the share of high technology products in total export is 3.57%, while the figures of other new Member States are between 4 and 6.5%, and an average rate of 15% for EU 27. According to the European map of innovations, Bulgaria together with Romania, Latvia and Lithuania, are defined as "humble innovators" (*European Innovation Scoreboard 2010, http://www.proinno-europe.eu/inno-metrics/page/innovation-union-scoreboard-2010*), yet the country is one of the rapidly advancing Member States in the field of innovation. The Bulgarian summary innovation index (SII) for 2010 is 0.226, with an average index for EU27 - 0.516.

- **Infrastructural capacity**

According to data provided by MEYS regarding the financing of the purchased scientific equipment for the period 2005-2008 there is no funding for the infrastructure in the field of energy sources. The share of scientific equipment in the field of environmental and marine sciences and in engineering sciences. A single purchase of expensive equipment without ensuring the necessary conditions for conducting research and an available long-term scientific program leads to its inefficient use and therefore to increase in the cost of the services for the business. This leads to a paradox in some cases where Bulgaria disposes of unique scientific equipment, but research organizations and companies send samples for research in other EU Member States due to lower prices.

A National Roadmap for R&D Infrastructure, developed by MEYS was approved in September 2010 by decision of the Council of Ministers. The map covers major scientific centres serving specific economic and social needs of the country, the region of South-eastern Europe and Pan-European infrastructures in which Bulgaria will participate. The main priority of the scientific infrastructure is in the field of energy, marine research, new materials for various applications, information and communication technologies, social studies. (*National Strategy for R&D Development 2020*).

- **Financial capacity**

Since 2006 the total expenditure on R&D in Bulgaria is about 0.45% of the GDP without a significant upward trend. The structure of R&D financing is inversely proportional to that in EU countries. The largest percentage is paid from the state budget – more than 2/3, and 1/3 – by the business. This ratio has remained steady over the past 10 years.

The Research and Development Fund is a national instrument supporting research projects on competitive basis. Another instrument is the National Innovation Fund that finances applied scientific research projects and technical and economic projects that introduce new products, processes and services or improve existing ones. These two national funds are potential sources of financing also for the measures proposed under this action plan.

With regard to international scientific programs, Bulgaria is presented in the Seventh Framework Programme and the Programme COST. The country is represented also in the programme Intelligent Energy for Europe which includes the extension of the programmes SAVE - energy efficiency and ALTENER - renewable energy. The revenues from international scientific programs are currently allocated as follows: 40% for the business, 35% for universities and about 25% for BAS and the Agricultural Academy.

– **Main fields of scientific research**

For the purposes of the National Action Plan a study and research was conducted on the main topics covered by the Bulgarian educational and scientific institutions, the NGOs and the other organizations.

The main fields of research and educational activities are:

- Meteorology, climatology and hydrology

These activities study the basic climate elements (air temperature, precipitation, atmospheric circulation) in Bulgaria and more specifically in its mountainous areas which are particularly sensitive to climate change.

The studies focus also on the climatic changes in the geological history of Earth in order to assess the effects of astronomical factors, earth's internal forces and environmental factors on climate formation. The analysis of time series and extreme events is improved and models are created of nonlinear systems, including climatic systems. The wind-solar renewable energy sources are studied with a view to establishing the wind and the solar energy potential on the territory of the country in meso- and macro-climatic aspects. The methods of monitoring climatic elements are automated.

- Air pollution

A single methodology for inventory of emissions of harmful substances was developed. Different scale models of atmospheric components were made in order to assess the quality of air environment and the origin/transportation of pollution on a large and on a small scale. A methodology was developed for calculating emissions and sinks of greenhouse gases from the plant cover. Research is conducted on the optimization of waste management in order to reduce greenhouse gases. Ground, oceanographic and space systems for monitoring of various objects in the environment, including in the air environment, are being improved.

- Technologies

Mathematical and computer models are created of the transportation of air pollutants and tested with model and real meteorological and emission data on the first Bulgarian supercomputer IBM Blue Gene/P. The possibilities and the costs of implementing Directive 97/68/EC on emissions of gaseous and particulate pollutants from non-road mobile machinery are studied. Materials, technologies and devices for efficient transformation of solar energy in two main areas - photovoltaic and photothermal – are developed and tested. Technologies involving the use of biomass and hydrogen raw materials as renewable energy sources are investigated. Unmanned flying systems for monitoring and GIS-interpretation of meteorological are introduced that determine the pollution of air. Energy saving and water saving technologies for production of good agricultural produce are being developed.

- Forests, Forestry and Agriculture; Land Use

Good agricultural practices leading to minimization of greenhouse gas emissions are being developed. The role of underground plant biomass in the annual fixation of CO_2 by forest ecosystems is studied. The bio- and the energy potential of non-traditional plant species is examined. The applicability of the principles of forest management as a means of entering the carbon market is investigated; the amount of carbon dioxide presently stored in forest ecosystems in some areas is being estimated.

- Territorial structure

The Climate Friendly Cities Project aims to assist the development of a spatial structure of cities that is favourable for the climate through planning and zoning.

An index of regional “climate security” was established under the Regions for Sustainable Change Project based on data of greenhouse gas emissions, energy data, policy framework, institutional capacity, socio-political situation, financial instruments The index is adjusted to Bulgaria and applied to the monitoring system of regional development plans.

- Transport

The Green Corridor Development Programme ensures the development of pedestrian and bicycle routes both for tourism and transport. An online tool is currently being developed for planning a bicycle journey in Sofia as a measure to reduce the emissions in the city. The project “One Planet Mobility” aims to reduce CO2 emissions from transport under which several computer models were developed to project the reduction of emissions from transport in Sofia.

4.4. Status of implementation and quantitative evaluation of the sectoral policies

In the period 1988 – 2011 Bulgaria has reached significant reduction of the GHG emissions equal to 66.995 Mt, which is about 53 % of the emissions in the basic 1988. Main reasons for the GHG emissions level are:

- intensive application of the legislation in the field of activities, connected with the climate changes;
- successful application of government policies and measures for transition to market economy, industry structure change, privatisation and liberalisation;
- applied policies and measures, particularly directed to GHG emissions limitation;
- energy policy to liberalisation of the energy markets and subsidies removal;
- replacement of the fossil solid and heavy liquid fuels with natural gas and other gaseous fuels;
- energy efficiency increase and increase of the share of produced energy from RES
- increased institutional capacity, engaged with coordination of climate change activities;
- population decrease.

Due to the early termination of the operation of four nuclear units in the end of 2002 and in the end of 2006, and due to the economic and demographic development, increase of the emissions took place in 2003 and 2007,. The rate of increase of the emissions in the years to come will depend on policies and measures, which will be undertaken by the Government.

Although the country has much lower emissions from the admissible, according the Kyoto Protocol, it has potential for additional decrease of GHG emissions. This potential might be realized, in case of extension of implementation of purposive politic for emissions reduction, expressed as implementation of additional measures. The implementation of political decisions and measures set in the Second National Action Plan on Climate Change and the development and implementation of the Third National Action Alan on Climate Change would allow avoiding of part of the projected growth of GHG emissions.

The analysis of the statute in the implementation of the policies and measures for the review period 2008-20010 gives reason for formation of expectations for GHG emissions reduction level for 2015, 2020 and 2030 by sector. The estimates by sector are given in the next Tables 4.18 to 4.23.

Table 4.18 Summary of policies and measures for Energy Sector

Name of policy or measure	Objective and/or activity affected	GHG affected	Status	Estimate of mitigation impact, (for a year, not cumulative, in Gg CO_2 eq)			
				2015	2020	2025	2030
Improvement of the operation of NPP-Kozloduy	Increase of the loading factor of a nuclear power plant	CO_2	Implemented.	1150	1000	1000	1 000
Construction of hydro cascade Gorna Arda and Sredna Vucha	Renewable electricity	CO_2	The projects are implemented under Memorandum of understanding regarding bilateral cooperation for the realization of Joint Implementation.	212	200	200	200
Construction of small and micro HPP in different country regions	Renewable electricity	CO_2	A number of applications for the construction of small and micro HPP has built	200	250	250	250
Upgrading of cogeneration plants and district heating boilers by natural gas turbines	Low emitting electricity production	CO_2	During the reporting period the operation of following small cogeneration plants were established: gas fired turbine in "Biovet"- Peshtera; Toplofikacia- Pleven and Toplofikacia Veliko Tarnovo	867	950	950	950
Decreasing of losses in the distribution and transmission networks	Electricity losses reduction	CO_2	Regulation framework for stimulating the reduction of electricity losses was adopted.	1000	1100	1000	1 000
Decreasing of losses in the heat transmission networks	Heat losses reduction	CO_2	A significant number of campaigns, workshops and training sessions have taken place for the last years.	950	1000	1000	1 000
Biomass for electricity and heat production	Renewable electricity	CO_2	A law for stimulating the usage of renewable energy sources and bio fuels was adopted.		600	600	600
Improvement of production efficiency in existing coal-fired power plants	Increase of the energy efficiency	CO_2	Adopted. Starting year of implementation is 2013.	325	466	585	585

Fuel substitution – from coal to natural gas	Decrease of the emissions by fuel substitution	CO_2	Adopted. Starting year of implementation is 2013.	450	2700	2700	2700
Increase of the high efficiency combined production	Production of electricity in a more efficient manner	CO_2	Adopted. Starting year of implementation is 2013.	200	200	200	200
Increasing the share of heating and cooling based on renewable energy sources	Promotion of the renewable energy production	CO_2	Adopted. Starting year of implementation is 2013.	41	61	66	70

Table 4.19 Summary of policies and measures for the Industry Sector

Name of policy or measure	Objective and/or activity affected	GHG affected	Status	Estimate of mitigation impact, (for a year, not cumulative, in Gg CO_2 eq)			
				2015	2020	2025	2030
Reduction of thermal losses in industry	Industrial enterprises	CO_2	Implemented since 2009.	120	140	140	140
Increased use of natural gas in industry by new gas infrastructure	Gas distribution networks	CO_2	Gas supply networks are under construction.	70	90	90	100
Monitoring systems for energy use in industry	Industrial enterprises	CO_2	Regulation framework for inquiring industrial energy use is under implementation. A large number of information campaigns have taken place.	70	120	120	120
Energy efficiency Audits and implementation of the prescribed measures	Industrial system with annual energy consumption over 3000 MWh	CO_2	Implementation of the measures started in 2008.	140	119	119	119
Use of biomass in the combustion units of installations	Decrease the use of fossil fuels and increase the share of alternative fuels	CO_2, CH4, N2O	Start in 2014	NE	554	554	554

Table 4.20 Summary of policies and measures for the Residential Sector and commercial/institutional buildings

Name of policy or measure	Objective and/or activity affected	GHG affected	Status	Estimate of mitigation impact, (for a year, not cumulative, in Gg CO_2 eq)			
				2015	2020	2025	2030
Gas supply to households	Households and public buildings	CO_2	Several gas supply networks are under construction. A number of schools are under gasification. Due to the high price of gas the residential sector is with low rates.	2000	2500	2 500	2 500
Installation of solar collectors	Households and public building	CO_2	Due to substantial need of investment it is still difficult for implementation.	15	20	25	40
Development and staged implementation of national programme "1000 sunny roofs"	Promotion of the renewable energy sources	CO_2	Planned. Starting year of implementation 2015	7	17	14	14
Implementation of the measures in the programme for accelerated gasification (PAG) in Bulgaria	Reduction of end-use energy intensity	CO_2	Adopted. Starting year of implementation is 2013.	196	370	310	310
Restoration of the specified annual percentage of the overall public and government buildings (with total area over 250m2) after the entry into force of the new directive on energy efficiency	Improving the energy efficiency of municipal dwellings	CO_2	Starting year of implementation is 2015. The measure will come into force after adoption of the new Energy Eficiency Directive. Adopted.	12	25	26	26
Introduction of mandatory energy efficiency scheme (reduction of the	Improvement of the energy efficiency	CO_2	Planned. Starting year of implementation 2014	18	18	18	18

consumption of fuel and energy in the energy end-use consumption)							
Replacement of the obsolete and inefficient equipment for production of energy with new equipment	Improvement of the energy efficiency	CO_2	Planned. Starting year of implementation 2014	9	9	9	9

Table 4.21 Summary of policies and measures for the Sector Agriculture

Name of policy or measure	Objective and/or activity affected	GHG affected	Status	Estimate of mitigation impact, (for a year, not cumulative, in Gg CO_2 eq)			
				2015	2020	2025	2030
Improvement of Manure use and management	Animal farms	CH_4	Planned Some projects are under implementation. Campaigns, workshops and training sessions for good practices have taken place	0,146	0,146	0,146	0,146
Improved fertilization and irrigation practices	Farms	CH_4, N_2O	Measures 121 and 125 from the Operational programme "Rural development programme" for the period 2007-2013 are under implementation.	170	170	170	170
Encouraging the use of suitable crop rotation, especially with crops fixing atmospheric nitrogen	Prevent soil erosion and retain organic carbon (carbon sequestration)	CH_4	Adopted .	1	1	1	1
Management of degraded agricultural land	Prevent soil degradation and loss of biodiversity	CH_4	Planned	2,5	2,5	2,5	2,5
Technical support for farmers for tilling soil/ stubbles	The efficient recovery of waste will reduce the need for burning stubble	CH_4	Planned	0,094	0,094	0,094	0,094

Table 4.22 Summary of policies and measures for the Transport Sector

Name of policy or measure	Objective and/or activity affected	GHG affected	Status	Estimate of mitigation impact, (for a year, not cumulative, in Gg CO_2 eq)			
				2015	2020	2025	2030
Transports cargo dispatching system	Idol traffic reduction	CO_2	Implemented	20	30	30	30
Transport railway power dispatching system	Electricity losses reduction	CO_2	adopted.	50	90	90	90
Modernization of Railway	Electricity and diesel consumption	CO_2	adopted	30	60	60	60
Improving public transportation, reducing transportation flows in cities and renewing the transportation park	Traffic in the cities	CO_2	Operational programme "Regional development" for the period 2007-2013 and operation 1.5 "Systems for sustainable public transport" is under implementation.		NE	301	678
Design and construction of new road infrastructure and rehabilitation and modernization of the existing road infrastructure to ensure optimum speed and optimum driving modes of automobile engines	Road infrastructure	CO_2	Planned 2014	54	80	60	70
Introduction of intelligent transport systems along the national and the urban road network	Better control of the traffic flow and management of the traffic volume	CO_2,	Planned		170	170	170
Increasing the share of public electrical transport - railways, trolley, tram,	Public transport	CO_2,	Planned	90.5	127	127	127

metro							
Development and promotion of cycling	Cycling	CO_2,	Adopted				
Development and construction of intermodal terminals for combined transport	Increase of the degree of utilization of more environmentally friendly modes of transport and creation of favourable conditions for increasing the added value of transport activity with overall reduction of transport costs per unit of GDP	CO2,	Planned	58	58	58	58
Increasing the share of biofuels	diversification of energy mix and reduction of dependence on fossil fuels	CO2	adopted	101	101	101	101
Reduction of the relative share of trips with private motor vehicles through improvement and development of urban public transport and development of non-motorized transport			planned	75	75	75	75

Table 4.23 Summary of policies and measures for the Waste Sector

Name of policy or measure	Objective and/or activity affected	GHG affected	Status	Estimate of mitigation impact, (for a year, not cumulative, in Gg CO_2 eq)			
				2015	2020	2025	2030
Capture and burning of biogas in all new and in the existing reginoal landfills	Waste disposal methane and electricity production	CH_4, CO_2	29 regional landfills are fully equipped during the period- 2006-2007 with methane capture and utilization systems under the requirements of the landfill Directive 1999/31/EC	634	`634	634	634
Construction of installations for mechanical and biological treatment (mbt) and installations for treatment and recovery of compost and biogas	Waste management	CH_4	Adopted - gradual reduction of biodegradable waste intended for landfilling 2010-2020.	728	728	728	728
Introduction of anaerobic stabilization of sludge with management capture and burning of biogas in new plants and plants under reconstruction in settlements with population equivalent over 20 thousand residents	Waste management	CH_4, CO_2	Planned	128	128	128	128

Table 4.24 Summary of policies and measures for the LULUCF sector

Name of policy or measure	Objective and/or activity affected	GHG affected	Status	Estimate of mitigation impact, (for a year, not cumulative, in Gg CO_2 eqv.)			
				2015	2020	2025	2030
Utilization of „non-wooded areas intended for afforestation " in forest areas	Increasing forest area	CO_2	Start in 2013	1.6	1.7	1.6	1.6
Afforestation of abandoned agricultural land, barren and deforested areas, eroded and threatened by erosion land outside forest areas	Creating new forests outside the forested areas	CO2	Start in 2013	4	4	4.8	4.8
Increase of areas for urban and suburban parks and green zones	Increasing the areas of urban and suburban parks and green zones	CO2	Adopted Start in 2013	0.3	0.3	0.3	0.3
Restoration and sustainable management of wetlands. Protection and preservation of wetlands in forest areas, peatlands, marshlands	enhance efficiency as carbon stores.		Planned	0.3	0.5	0.7	0.7
Restoration and maintenance of protective forest belts and new anti-	Absorption of carbon by the new forests in		Planned	0.5	0.8	1.2	1.5

erosion afforestation	these zones						
Increasing the density in the listed natural and artificial plantations	Increasing of absorption of carbon by the new forests in these zones		Planned	0.5	1	2.5	4

4.5. Policies and measures pursuant to Article 2 of the Kyoto Protocol

Activities aimed at promoting decisions by the ICAO and IMO in favour of emissions reduction

The Parties to the Kyoto Protocol have committed themselves to continuing their efforts to limit or reduce emissions from air and sea transports in the framework of the International Civil Aviation Organisation (ICAO) and the International Maritime Organisation (IMO) (to date, quantitative reduction obligations only for Annex 1). To date, neither of the two bodies has approved regulations / procedures for limiting greenhouse-gas emissions.

IMO

The IMO deals with GHG-emissions issues via its Maritime Environmental Protection Committee (MEPC).

The EU Commission has announced that it will propose relevant measures of its own if the IMO fails, by the end of 2011, to make a concrete proposal for ways of including maritime transports in reduction measures. Currently, the EU is having various relevant possibilities studied, including emissions-differentiated port fees, emissions standards, levies and emission trading.

ICAO

The International Civil Aviation Organisation (ICAO) considers environmental aspects within the framework of its Committee on Aviation Environmental Protection (CAEP), which comprises a range of different working groups. To deal with greenhouse-gas issues, the ICAO has also established a Group on International Aviation and Climate Change (GIACC), alongside the CAEP. That group has been in existence since early 2008. A politically high-ranking group, the GIACC turns to the CAEP for advice on technical matters whenever the GIACC's members deem such reliance to be necessary. The group is working toward the aim of developing a strategy, by mid-2016, for limiting aviation-related CO_2 emissions.

While the ICAO is working on a CO_2-based certification standard, such a standard would not address air-transport growth and would require decades to make an impact, via the composition of aircraft fleets. Along with such technical measures, the CAEP is also considering market-economic instruments. A central focus of such efforts is on linking existing emission trading schemes with mechanisms for offsetting emissions.

Since the beginning of 2012, emissions from international aviation are included in the EU Emissions Trading System (EU ETS). Like industrial installations covered by the EU ETS, airlines receive tradable allowances covering a certain level of CO2 emissions from their flights per year. The legislation, adopted in 2008, applies to EU and non-EU airlines alike. Emissions from flights to and from Iceland, Liechtenstein and Norway are also covered.

In April 2013 the EU temporarily suspended enforcement of the EU ETS requirements for flights operated from or to non-European countries, while continuing to apply the legislation to flights within and between countries in Europe. The EU took this initiative to allow time for the International Civil Aviation Organization (ICAO) Assembly in autumn 2013 to reach a global agreement to tackle aviation emissions – something Europe has been seeking for more than 15 years.

In October 2013 the EU's hard work paid off when the ICAO Assembly agreed to develop by 2016 global market-based mechanism (MBM) addressing international aviation emissions and apply it by 2020. Until then countries or groups of countries, such as the EU, can implement interim measures.

In response to the ICAO outcome and to give further momentum to the global discussions, the European Commission proposed amending the EU ETS so that only the part of a flight that takes place in European regional airspace is covered by the EU ETS.

In March 2014 the Council of the EU and European Parliament reached agreement to limit the aviation coverage of the EU ETS to emissions from flights within the European Economic Area (EEA) for the period from 2013 to 2016. This applies to all (also third country) aircraft operators. The European Parliament voted in favour of this agreement on 3 April 2014.

All options are left open for the EU to react to the developments of the ICAO Assembly in 2016 and to re-adjust the scope of the EU ETS from 2017 onwards.

Shipping is a large and growing source of the greenhouse gas emissions that are causing climate change. The European Union works towards a global approach taken to reducing emissions from international shipping. As a first step towards cutting emissions, the European Commission has proposed that owners of large ships using EU ports should report their verified emissions from 2018.

4.6. Information on minimization of adverse effects (including adverse effects of climate change) on developing countries in the implementation of policies and measures

Bulgaria is of the view that taking the actions on mitigation, adaptation, development technology and transfer and capacity building in developing countries is very important for international climate change policy.

In this regard, in 2012 completed the project "Bulgarian contribution to the "short-term financing" 2011-2012: Sharing Bulgarian experience of monitoring, reporting and verification of greenhouse gas in the Republic of Macedonia for participation in the European Union Emission Trading Scheme of greenhouse gases". Through this project, Bulgaria has fulfilled its obligation, which made at the summit of the European Union in December 2009, to provide short-term financing of climate activities.

More information under Article 3.14 is available on page 498-499 of the NIR.

http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/8108.php

4.7. Policies and measures no longer in place

The following measures have not been implemented and have not been considered for the calculation of the GHG projections in the current report:

1) Financial support for improving the equipment and the technology of production in rice fields.
2) Introduction of low-carbon practices for processing manure, eg. composting, transformation of manure into biogas under anaerobic conditions
3) Transports dispatching system
4) Introduction of railway transport power dispatching system
5) Reconstruction and modernization of the existing railway infrastructure to ensure optimum speed and optimum driving mode

5. Projections and total effect of policies and measures

5.1. Emission projection scenarios

The most recent GHG projections were elaborated taking in consideration the trends of key macro-economic, technological, demographic and other indicators that determine the economic development of the country.

During the development of the projection scenarios the available data from the National Statistics Institute, the Plan for development of the energy sector of Bulgaria for the period 2008-2030, Third National Action Plan on Climate Change for the period 2013-2020 (NAPCC 2013-2020), comments of analysts of the World Bank and publications in the press were used. The projections were elaborated in line with Decision No. 280/2004/EC and Decision No. 2005/166/EC.

As a result, two scenarios for GHG emission projections until 2030 were developed, analysed and compared:

- with measures - WEM
- with additional measures - WAM

In the scenario **"with measures"** reflects all implemented and adopted policies and measures to reduce GHG emissions in the country by the end of 2011, while in the scenario **"with additional measures"** are considered also the measures that are planned for the time after the initial year of the projection.

The key macroeconomic and energy characteristics of "with measures" scenario are provided in methodology section.

This projection integrates the assumption for increase in annual electricity production and export.

The "with additional measures" scenario comprises planned for period after 2011 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 and renewables.

The emission analysis address mainly the period 2005-2020, for the "with measures" and "with additional measures" scenarios.

These projections were compiled on the basis of 2011 data as long as the work was carried out in 2013 when only 2011 data were available.

5.2. Sectoral forecast

5.2.1. Energy

GHG emissions projections in the energy sector have some particularities, connected with the different structures, which are used during GDP composition and definitions for energy sector in GHG inventories. Especially duplicating of part of the sub-sectors in the two types of structures is observed. For example in the GDP sector Industry is included in Energy sector in the inventory. Usually macro economic projections are made for the sub-sectors, transport, utilities, services while all they are part of the energy sector in the inventory. That is why in some EU countries additional classification is introduced to differentiate the two parts of industrial activities – activities with fossil fuel combustion and activities connected with technological processes in the industrial production.

On Table 5.11 and 5.2 are presented projection for total GHG emissions expressed in Gg CO2 eq for Energy sector until 2030 under both scenario. The applied until 2011 measures are accounted, as well as the emission from fuels combustion in transport, households, services and agriculture and forestry.

Table 5.1 Emission projections for sector Energy - scenario with measures, Gg CO_2 eq

	1988	2000	2005	2010	2011	2015	2020	2030	Δ (2020 – 2005), %	Δ(2030 - 2005), %
Aggregate emissions in CO2 eq	83 081	42 351	46 624	46 742	52 204	44 697	46 640	44 201	0.03	-5.20

Table 5.2 Emission projections for sector Energy - scenario with additional measures, CO_2 eq, Gg

	1988	2000	2005	2010	2011	2015	2020	2030	Δ (2020 – 2005), %	Δ(2030 - 2005), %
Aggregate emissions in CO2 eq	83 081	42 351	46 624	46 742	52 204	41 307	40 937	37 398	-12.2	-19.8

Table 5.3 CO_2 emission projections for sector Energy, Gg CO_2

1988	2000	2005	2010	2011	2015	2020	2030
With measures							
7 935	40 090	44 669	44 809	49 879	42 313	43 810	41 231
With additional measures							
48 921	49 900	53 389	54 682	49 879	40 519	40 520	37 941

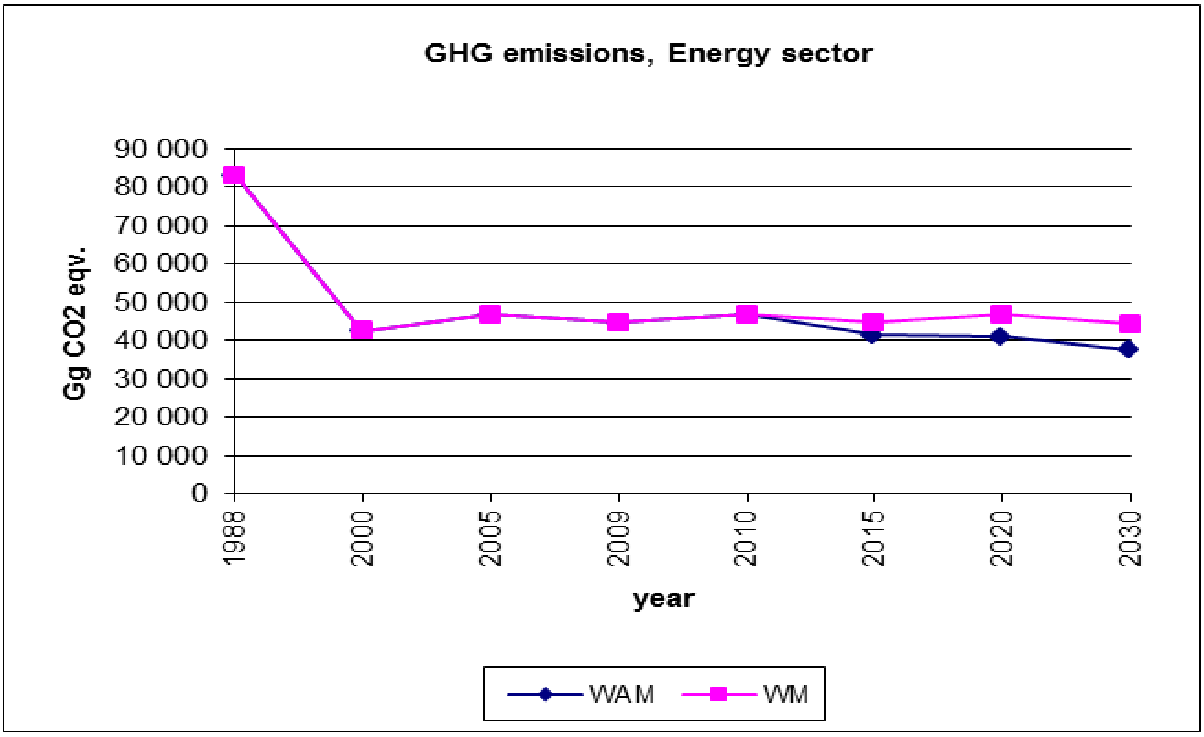
Table 5.4 CH_4 emission projections for sector Energy, Gg CO2 eq

1988	2000	2005	2010	2011	2015	2020	2030
With measures							
3 403	1 898	1 690	1 672	2 042	2 110	2 524	2 609
With additional measures							
3 403	1 898	1 690	1 672	2 042	2 110	2 523	2 608

Table 5.5 N_2O emission projections for sector Energy, Gg CO2 eq

1988	2000	2005	2010	2011	2015	2020	2030
With measures							
328.01	363	266	261	283	274	307	361
With additional measures							
328.01	363	266	261	283	267	294	348

Figure 5.1 Emission projections for sector Energy, Gg CO_2 eq



The biggest source of greenhouse gases in the country is the power companies for production of electric and thermal energy.

The combined effect of the measures in power sector, industry, transport, agriculture, residential sector and services is given in the above GHG emission projections.

The reason for the decrease in GHG emission intensity is the reduced consumption of coal by households. This lower consumption is the result of policies and measures implemented by the Ministry of Economy and Energy that partially compensated the significant increase in emissions caused by the early decommissioning of nuclear facilities.

An essential part of the emission reduction was due to improved operation of Units 5 and 6 at Kozloduy NPP and improved operation of district heating companies through the following measures:

- conducted rehabilitation, reduction of losses from transmission of thermal energy and replacement of the subscriber stations;
- introduction of the thermal energy accounting system that allows for regulation and reporting of the actually consumed thermal energy.

The Energy Strategy of Bulgaria outlines the framework of the national energy policy and the planned major reforms in this sector. The Bulgarian energy sector will continue to be based on two main foundations: nuclear energy and local lignite coal that will be given priority in the development of a competitive energy market in the future. All other priorities are directly related to the following:

- Security of supply;
- Competition at the energy market;
- Environmental protection.

In the course of its development the energy sector in Bulgaria has implemented various measures that lead to stabilization and reduction of GHG emissions. Following the earlier decommissioning of Units 3 and 4 of NPP Kozloduy (2006), the emissions from the energy sector have been growing. This is due to the development plans introduced by the energy plants using local and imported coal with high GHG emission potential. The production of local coal only has already reached 32 mln. tonnes in 2011.

5.2.2. Energy industries

This sector includes emissions from burning fuel for generation of electricity and heat, from production and processing of fuels and from other energy industries in Bulgaria.

The facilities for generation of electricity and thermal energy in this sector represent the foundations of the energy sector in the country. They form an energy mix that includes the large lignite-fired thermal power plants in the Maritsa East basin, NPP Kozloduy, the power plants with co-generation of electricity and thermal energy for public needs and power plants operating on the same principle for the factory needs. The prevalent fuel used in the process of co-generation in Bulgaria is natural gas.

As a whole this sector accounts for 90% of domestically produced energy. Therefore it is representative for the Energy Sector and its essential characteristics.

- **Scenario with measures – WM**

Table 5.6 Energy industries– scenario with measures, Gg CO_2 eq.

	1988	2000	2005	2010	2011	2015	2020	2030	Δ (2020 – 2005), %	Δ (2030 – 2005), %
Aggregate emissions in Gg CO2 eq.	42 117	24 072	27 044	31 547	36360	26 581	24 007	11 887	-11.2	-56.0

It is difficult to forecast the energy mix because such forecast would require combination of opposite trends in the development of its elements. This is determined by the differences in technologies and their historical development which depends on:

- the development of fuel prices;
- the safety in operation and the impact of large accidents on the decisions taken by the competent authorities;
- economic indicators and energy efficiency;
- reduction of GHG emissions.

Leading criterion is the reduction of GHG emissions. Therefore, this scenario with existing measures provides for development of the subsector that ensures a smooth transition from the development until 2011. From a methodological point of view this scenario contain the measures outlined in the country's Energy Strategy from 2011. It assumes that the subsector develops by implementing already existing measures, as well as guidelines and policies adopted by the EU. Table above provides the projections of the aggregate GHG emissions under the scenario with existing measures as well as the changes over two main periods – 2005-2020 and 2005-2030.The analysis shows:

- in both periods GHG emissions decrease, especially so after 2020;
- obviously this scenario combines circumstances related to the overall development of the country where the level of GHG emissions in 2020 is equal to that in 2000.

This fact is assessed by the authors of the Energy Strategy as a negative one and motivated the development of the scenario with additional measures.

– **Scenario with additional measures – WAM**

The scenario with additional measures reflects all adopted or planned policies and measures for reduction of GHG emissions in the country after 2011 with respect to this sector and includes the impact of policies and measures presented in this report that have a quantitative assessment at this stage.

Table 5.7 Aggregate GHG emissions from the Energy Industries Sector, Gg CO2 eq. – scenario with additional measures

	1988	2000	2005	2010	2011	2015	2020	2030	Δ (2020 – 2005), %	Δ (2030 – 2005), %
Aggregate emissions in Gg CO2 eq.	42 117	24 072	27 044	31 547	36 360	24 779	20 704	8 584	-23.4	-68.3

The proposed scenario with additional measures served as a basis of the country's Energy Strategy adopted in 2011. It contains measures along several priority axes or directions and the following directions refer to this sector:

- cleaner production of electricity from coal-fired plants and
- reduction of carbon intensity in the energy mix.

Currently, the average emission intensity of electricity generation from coal-fired power plants is 0.672 t CO_2 eq. per MWh. Through measures to **improve the production efficiency** this factor can be reduced by about 5-7% or in terms of emissions reduction – 1.3 mln. tonnes CO_2 per year from existing coal-fired power plants by 2020.

The European Emissions Trading Scheme and the competition on the electricity generation market provide incentives for transition to **low-carbon technologies and**

fuels such as natural gas. Every 100 MW coal-based generating capacity substituted with capacity based on natural gas will lead to a reduction of 450000 t of CO_2 per year.

The Energy Strategy of the Republic of Bulgaria 2020 provides for 9.2 million t CO_2 from the GHG emissions emitted by the Energy Sector to be captured and stored in geological formations by 2030. Besides the legislative framework that is currently being adopted, an important factor for the implementation of this goal is the quality of the related geological surveys, environmental impact assessments and activities to inform and acquaint the public with the technology.

Institutional support and monitoring of projects is envisaged for building new capacities and/or substituting capacities based on local coal with mandatory use of highly efficient and low-emission modern technologies involving capture and storage of CO_2. Proactive measures undertaken by the state and consisting in provision of financial support for preparation of and participation in joint international projects will contribute substantially to low-carbon development of the coal-fired power generating facilities.

A key feature of the second priority axis in the Strategy is the support to the **nuclear energy** not only as a promising resource for the production of low carbon electricity, but also because of the accumulated successful experience and professional capacity for operation of nuclear facilities. The support will be accompanied by strict requirements to the security, safety, nuclear waste management and decommissioning. According to the projected electricity generation balance the share of nuclear energy in the electricity generation mix will rise by 45% by 2020 and will contribute to reducing the carbon intensity in electricity production.

The production of electricity from **renewable energy sources** will contribute significantly to reducing the carbon intensity of the country's electricity generation mix. The national policy in this area is well developed in the adopted National Action Plan for Renewable Energy by 2020 and the Renewable Energy Act. The production of electricity from renewable sources is expected to grow by 2020 and to account for 17-20% in the electricity generation mix of the country.

The Energy Strategy of the Republic of Bulgaria envisages that the **co-generation** of electric energy will account for 15% in the electric energy mix by 2020. The co-generation of heat and electric energy improves the overall efficiency of fuel use and saves primary energy. The increased share of electricity produced by co-generation and the saved primary energy will be reflected as a reduction in the carbon intensity of the electricity generation mix.

The analysis of Table 5.5 shows changes of GHG emissions similarly to those in the scenario WM but one step further towards reduction.

– **Comparison between the two scenarios**

Error! Reference source not found. 5.8 below shows the comparison between the two scenarios. A typical feature here is:

- almost twice as much difference between the emissions under the scenarios in the period by 2015 and in the period by 2020;
- equal changes in the emissions under the scenarios for the period 2020-2030 – i.e. they decrease at the same rate;

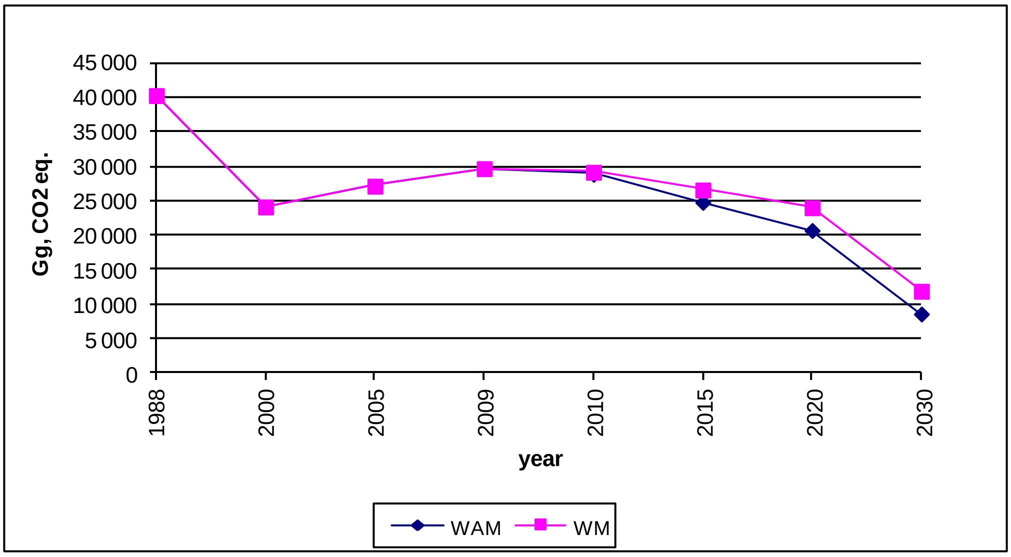
- the implementation of the measures under the scenario WAM also has a multiplier effect that leads to permanent reduction of emissions over the entire projected period 2015-2030, from 6.8% in 2015 to 27.8% at the end of the period. In relative terms, this makes about 4 times.

Table 5.8 Comparison between GHG emissions under the two scenarios, Energy Industries Sector

	2010	2015	2020	2030
Aggregate emissions in Gg CO2 eq Δ WAM - WM	0	-1 802	-3 303	-3 303
Δ WAM - WM, %	0	-6.8	-13.8	-27.8

Figure 5.2 shows a comparison between projections of the aggregate emissions from the sector, expressed in CO_2 eq. The nature of the curve remains unchanged compared to the curves of different GHGs. The relative peak in 2009 that marks the end of a period of rising economic development, followed by a collapse as a result of the global economic crisis, is also preserved. In fact, due to a number of country-specific manifestations of the crisis this subsector is characterized by delay and shift of the negative results in time. This is observed mainly after 2008-2009 when the industry was hardest hit.

Figure 5.2 GHG emissions, Energy Industries Sector under the two scenarios



5.2.3. Manufacturing Industries and Construction

This sector includes emissions from burning fuel for generation of electricity and thermal energy for the manufacturing industry and the construction sector in Bulgaria. The variety of combustion and transformation processes of primary fuels is too large and is determined by different technologies in mining, metallurgy, mechanical and electrical engineering, light industry, printing, chemical industry, construction, etc.

Historically, the development of this subsector underwent two dramatic changes - in 2000 and in 2009 - characterized by different driving forces, preconditions and results.

– **Scenario with measures – WM**

Table 5.9 Aggregate GHG emissions from the Industry Sector (fuel emissions), Gg CO_2 eq. – scenario with measures

	1988	2000	2005	2010	2011	2015	2020	2030	Δ (2020 – 2005), %	Δ(2030 - 2005), %
Aggregate emissions in CO2 eq	17 563	8 479	8 065	3 829	3 668	4 294	5 312	7 353	-34.1	-82.3

The findings of the experts indicate that the decrease of activity in the sector in the period by 2000 is mainly due to domestic reasons – collapse of management, restitution of property, changes in the domestic and foreign markets and restructuring involving shifts in priorities. This period is followed by some revival in 2008 characterized by sustained annual growth of 5-6%. A new downturn occurred in 2009 caused by external factors - the global financial crisis. It reached Bulgaria as an economic crisis, affecting mainly the industry.

This is reflected in the scenario with measures that is developed on the precondition that this sector would not be fully recovered during the entire period of the forecast. This means projections of lower production volumes leading to lower GHG emissions that remain under the level of 2005. The reduction in 2020 compared to 2005 is 34,1 % for the aggregate emissions of the sector (Table 5.9).

– **Scenario with additional measures – WAM**

The scenario with additional measures reflects all adopted policies and measures to reduce GHG emissions in the country after 2009 and includes the impact of policies and the measures presented in this Plan that have a quantitative assessment at this stage.

Table 5.10 Aggregate GHG emissions from the Industry Sector (fuel emissions), Gg CO2 eq. – scenario with additional measures

	1988	2000	2005	2010	2011	2015	2020	2030	Δ (2020 – 2005), %	Δ (2020 - 1988), %
Aggregate emissions in CO2 eq	17563	8479	8065	3 829	3668	3 655	4 870	6 742	-48.8	-76.1

Measures from the following priority axes of the Energy Strategy which are directly related to the optimization of the fuel base and the reduction of GHG emissions were applied to the development of the scenario with additional measures – WAM:

- audit of industrial systems and implementation of the recommended measures;
- change of the fuel base;
- introduction of renewable energy sources in the industrial installations;
- introduction of co-generation modules in the enterprises.

Error! Reference source not found.shows GHG projections under the scenario WAM. The nature of emission changes compared to the scenario with measures remains unchanged and the implementation of the above measures leads to additional decrease of the total emissions in CO_2 eq. between 8-15% for the period 2010-2020.

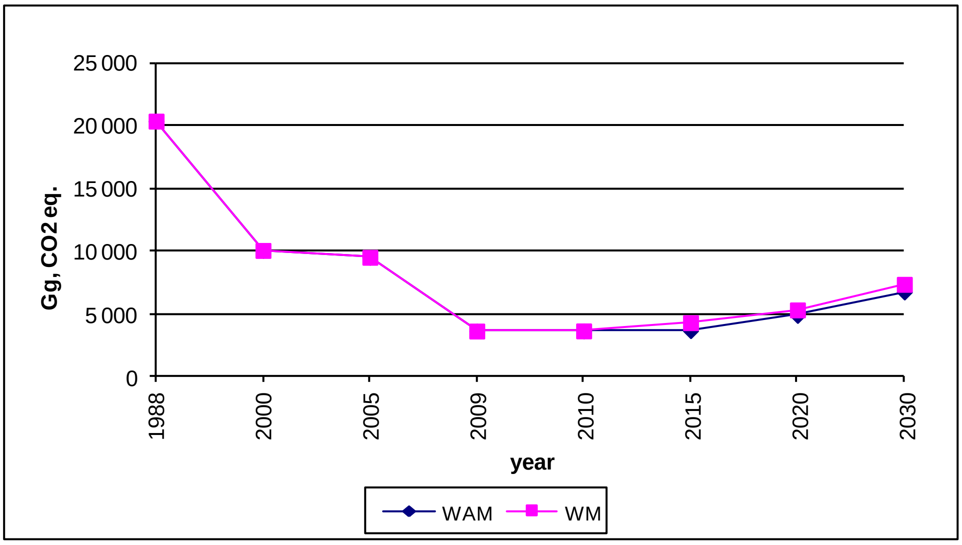
– **Comparison between the two scenarios**

Table 5.11 Comparison between GHG emissions under the two scenarios, Industry Sector (fuel emissions)

	2010	2015	2020	2030
Aggregate emissions in Gg CO_2 eq $_{\Delta\ WAM\ -\ WM}$	0,0	-639	-442	-612
Δ WAM - WM, %	0,0	-14.9	-8.3	-8.3

Error! Reference source not found. 5.11 shows the comparative evaluations between the two scenarios. There is a clear trend of emission reduction in the scenario WAM compared to the scenario with measures.

Figure 5.3 GHG emissions, Manufacturing Industries and Construction (fuel emissions), under the two scenarios



5.2.4. Transport Sector

The Transport Sector includes emissions from road, rail, sea and air transport. In accordance with the IPCC Guidelines the emissions from the sea and air transport are not included in the aggregate emissions.

The development of this sector has always been a priority due to its special position as part of the country's infrastructure.

The present measures are oriented towards the following main areas:

- reduction of transport emissions;

- reduction of consumption (decrease in transportations);
- diversification of transport;
- information and training of consumers.

– Scenario with measures - WM

Table 5.12 Aggregate GHG emissions from the Transport Sector, Gg CO_2 eq. – scenario with measures

	1988	2000	2005	2010	2011	2015	2020	2030	Δ (2020 – 2005), %	Δ(2030 - 2005), %
Aggregate emissions in CO2 eq	7380	5739	7697	7954	8129	9 956	12 743	19 757	65.6	156.6

– Scenario with additional measures – WAM

The scenario with additional measures reflects all adopted policies and measures to reduce GHG emissions in the country after 2011 with respect to this sector and includes the impact of policies and measures presented in this report that have a quantitative assessment at this stage.

Table 5.13 Aggregate GHG emissions from Transport Subsector, Gg CO_2 eq. – Scenario with additional measures

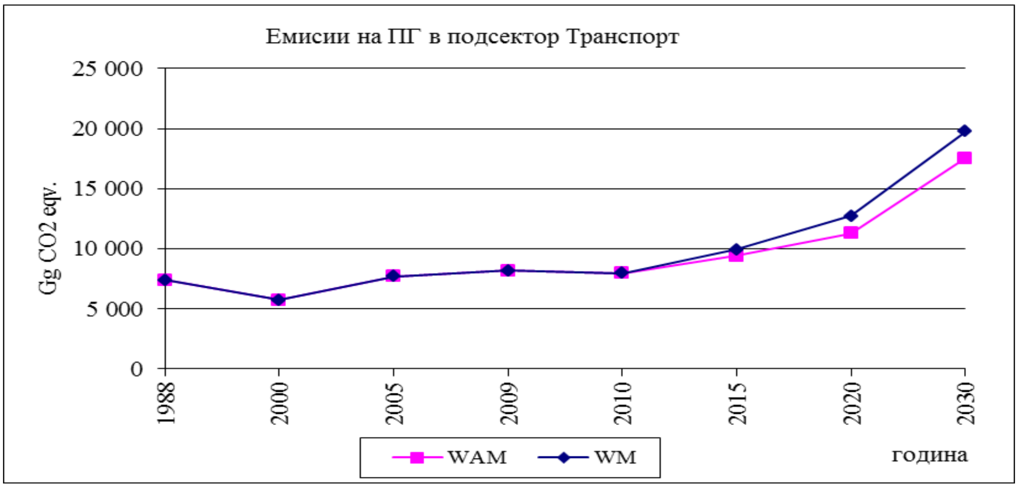
	1988	2000	2005	2010	2011	2015	2020	2030	Δ (2020 – 2005), %	Δ(2030 - 2005), %
Aggregate emissions in CO2 eq	7 380	5 739	7 697	7 954	8 129	9 390	11 307	17 530	46.9	127.8

– Comparison between the two scenarios

Table 5.14 Comparison between GHG emissions under the two scenarios, Transport Sector

	2010	2015	2020	2030
Aggregate emissions in CO2 eq Δ WAM - WM	0	-566	-1 436	-2 227
Δ WAM - WM, %	0.0	-5.7	-11.3	-11.3

Figure 5.4 GHG emissions, Transport Sector under the two scenarios



5.2.5. Households and Services Sector

– Scenario with measures - WM

Table 5.15 Aggregate GHG emissions from the Households and Services Sector Gg CO_2 eq. – scenario with measures

	1988	2000	2005	2010	2011	2015	2020	2030	Δ (2020 – 2005), %	Δ(2030 - 2005), %
Aggregate emissions in CO2 eq.	6 514	2 396	2 374	2013	2284	2 027	2 374	3 002	-0.02	26.5

– Scenario with additional measures – WAM

The scenario with additional measures reflects all adopted policies and measures to reduce GHG emissions in the country after 2009 in this sector and includes the impact of policies and measures presented in this report that have a quantitative assessment at this stage.

Table 5.16 Aggregate GHG emissions from the Households and Services Sector, Gg CO_2 eq. – scenario with additional measures

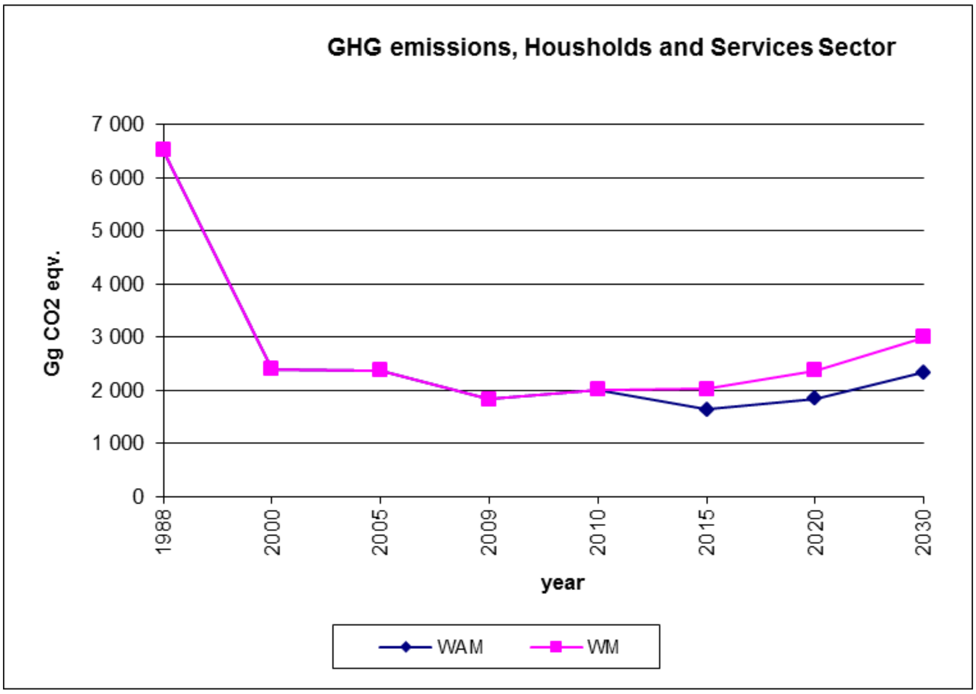
	1988	2000	2005	2010	2011	2015	2020	2030	Δ (2020 – 2005), %	Δ(2030 - 2005), %
Aggregate emissions in CO2 eq	6 514	2 396	2 374	2013	2284	1 644	1 851	2 341	-22.2	-1.4

– **Comparison between the two scenarios**

Table 5.17 Comparison between GHG emissions under the two scenarios for the Households and Services Sector

	2010	2015	2020	2030
Aggregate emissions in Gg CO_2 eq. $_{\Delta\ WAM - WM}$	0	-383	-523	-661
Δ WAM - WM, %	0.0	-18.9	-22.0	-22.0

Figure 5.5 GHG emissions, Households and Services Sector under the two scenarios



5.2.6. Waste Sector

This sector includes emissions from landfills for municipal solid waste, treatment of municipal and industrial water and incineration of various types of waste.

– **Scenario with measures – WM**

Table 5.18 Aggregate GHG emissions from the Waste Sector, Gg CO_2 eq. – scenario with measures

	1988	2000	2005	2010	2011	2015	2020	2030	Δ (2020 – 2005), %	Δ(2030 - 2005), %
Aggregate emissions in CO2 eq	5789	4610	4231	3816	3762	3602	3453	3251	-18.4	-36.7

– **Scenario with additional measures – WAM**

The scenario with additional measures reflects all adopted policies and measures to reduce GHG emissions in the country after 2011 in this sector and includes the impact of policies and measures presented in this report that have a quantitative assessment at this stage.

Table 5.19 Aggregate GHG emissions from the Waste Sector, Gg CO_2 eq. – scenario with additional measures

	1988	2000	2005	2010	2011	2015	2020	2030	Δ (2020 – 2005), %	Δ(2020 - 1988), %
Aggregate emissions in CO2 eq	5 789	4 610	4 231	3 816	3 762	2 159	1 887	1 770	-48.0	-59.8

– **Comparison between the two scenarios**

Table 5.20 Comparison between GHG emissions under the two scenarios, Waste Sector

	2010	2015	2020	2030
Aggregate emissions in Gg CO2 eq Δ WAM - WM	0	-1 443	-1 565	-1 481
Δ WAM - WM, %	0,0	-40.1	-45.3	-45.6

Figure 5.6 GHG emissions, Waste Sector under the two scenarios

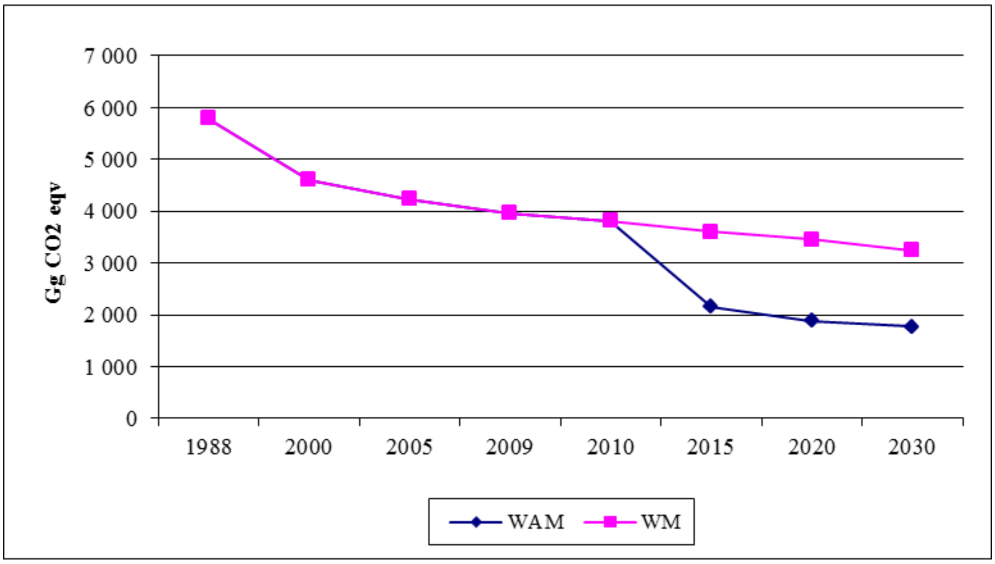


Table 5.21 CH_4 emission projections for Waste sector, Gg CO_2 eq.

1988	2000	2005	2010	2011	2015	2020	2030
With measures							
263	205	189	173	170	163	156	147
With additional measures							
263	205	189	173	170	0	0	0

Table 5.22 N_2O emission projections for Waste sector, Gg CO_2 eq.

1988	2000	2005	2010	2011	2015	2020	2030
With measures							
0.774	0.712	0.617	0.547		0.521	0.504	0.470
With additional measures							
0.774	0.712	0.617	0.547		0	0	0

5.2.7. Agriculture Sector

- **Scenario with measures – WM**

Table 5.23 Aggregate GHG emissions from the Agriculture Sector, Gg CO_2 eq. – scenario with measures

	1988	2000	2005	2010	2011	2015	2020	2030	Δ (2020 – 2005), %	Δ(2030 - 2005), %
Aggregate emissions in CO2 eq	20 206	6 237	6 207	6 186	6 148	6 119	6 675	7 250	7.5	16.8

- **Scenario with additional measures – WAM**

The scenario with additional measures reflects all adopted policies and measures to reduce GHG emissions in the country after 2011 in this sector and includes the impact of policies and measures presented in this report that have a quantitative assessment at this stage.

Table 5.24 Aggregate GHG emissions from the Agriculture Sector Gg CO_2 eq. – scenario with additional measures

	1988	2000	2005	2010	2011	2015	2020	2030	Δ (2020 – 2005), %	Δ(2030 - 2005), %
Aggregate emissions in CO2 eq	20 206	6 237	6 207	6 186	6148	6 116	6 672	7 246	2.1	16.7

– **Comparison between the two scenarios**

Table 5.25 Comparison between GHG emissions under the two scenarios, Agriculture Sector

	2010	2015	2020	2030
Aggregate emissions in Gg CO2 eq Δ WAM - WM	0.00	-3.16	-3.29	-3.57
Δ WAM - WM, %	0.00	0.05	0.05	0.05

Figure 5.7 GHG emissions, Agriculture Sector under the two scenarios

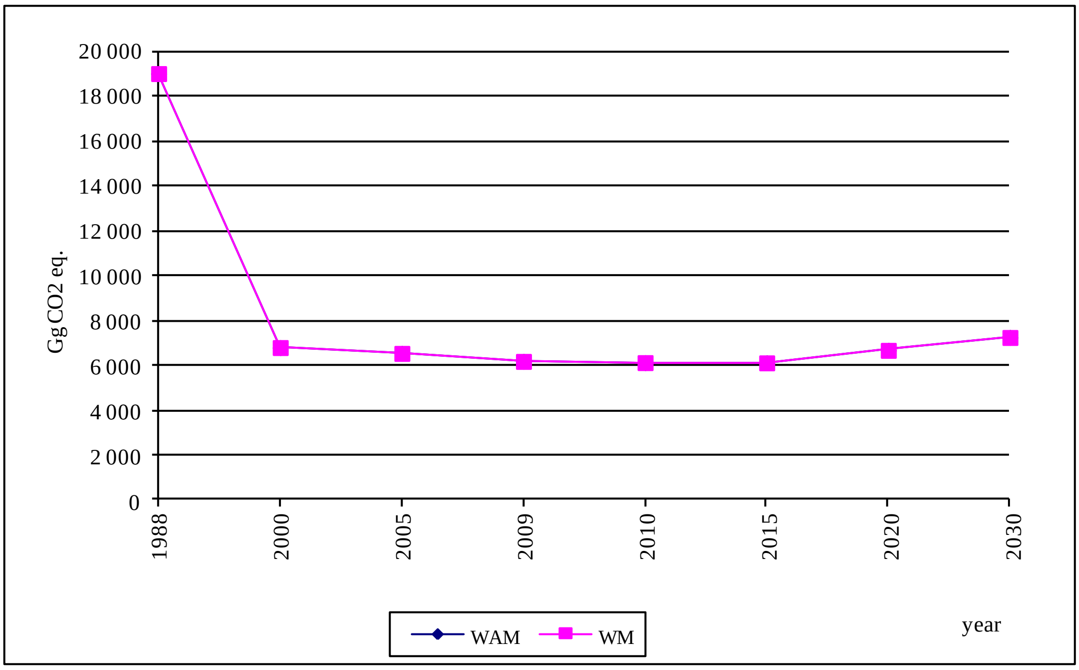


Table 5.26 CH_4 emission projections for Agri sector, Gg CO_2 eq.

1988	2000	2005	2010	2011	2015	2020	2030
With measures							
392.2	107.3	105.3	97.9		96	104	113
With additional measures							
392.2	107.3	105.3	97.9		96	104	113

Table 5.27 N_2O emission projections for Agriculture Sector, Gg CO_2 eq.

1988	2000	2005	2010	2011	2015	2020	2030
With measures							
38.6	12.9	12.9	13.3		13,3	14,5	15,7
With additional measures							
38.6	12.9	12.9	13.3		13	14	15

5.2.8. Land Use, Land Use Change and Forestry (LULUCF)

- **Scenario with measures - WM**

Table 5.28 Aggregate GHG emissions from the Land Use, Land Use Change and Forestry Sector – scenario with measures

	1988	2000	2005	2010	2011	2015	2020	2030	Δ (2020 – 2005), %	Δ(2020 - 1988), %
Reduced CO2, Gg	-14340	-8918	-8934	-8109	-7979	-11795	-11806	-11828	4.1	-16.5

- **Scenario with additional measures – WM**

The scenario with additional measures reflects all adopted policies and measures to reduce GHG emissions in the country after 2011 in this sector and includes the impact of policies and measures presented in this report.

Table 5.29 Aggregate GHG emissions from the Land Use, Land Use Change and Forestry Sector – scenario with additional measures

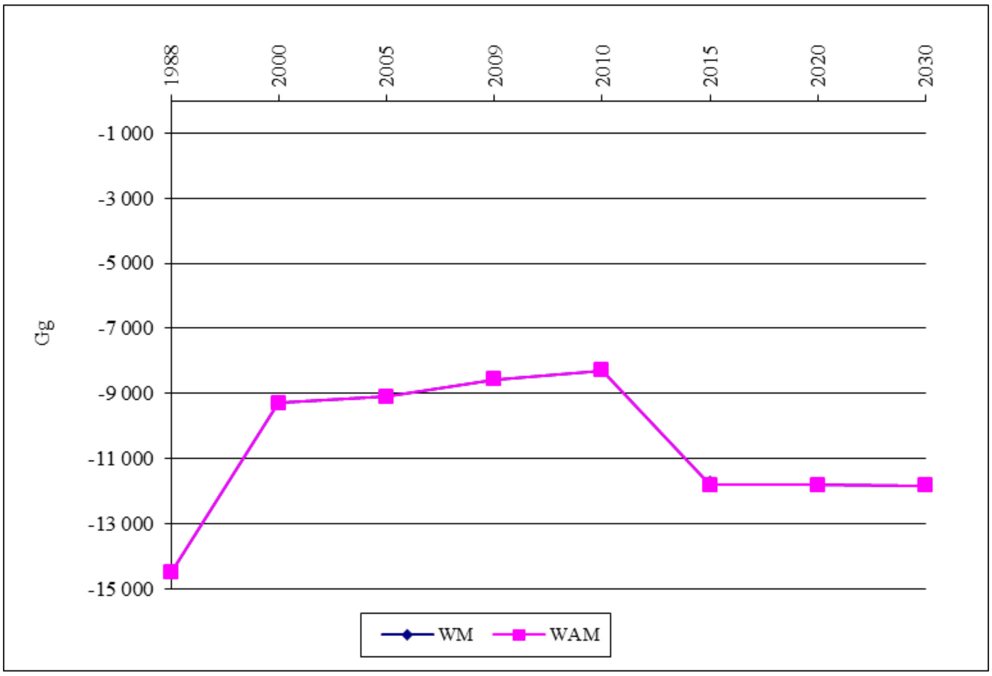
	1988	2000	2005	2010	2011	2015	2020	2030	Δ (2020 – 2005), %	Δ(2020 - 1988), %
Reduced CO2, Gg	-14340	-8918	-8934	-8109	-7979	-11 805	-11 817	-11 839	4.2	-16.4

– **Comparison between the two scenarios**

Table 5.30 Comparison between GHG emissions under the two scenarios, from the Land Use, Land Use Change and Forestry Sector

	2010	2015	2020	2030
Reduced CO2, Gg Δ WM - WOM	0.00	10.08	11.19	11.21
Δ WAM - WM, %	0.00	0.09	0.09	0.09

Figure 5.8 Reduction of CO_2, from the Land Use, Land Use Change and Forestry Sector under the two scenarios



5.3. Projections of total GHG emissions and total effect of policies and measures

The scenario with existing measures reflects all approved and implemented policies and measures to reduce GHG emissions in the country by the end of 2011.

The scenario with additional measures reflects all adopted policies and measures to reduce GHG emissions in the country after 2011 and includes the impact of policies and measures presented in this report that have a quantitative assessment at this stage.

Table 5.31 Aggregate GHG emissions of Bulgaria (excl. LULUCF)– Gg CO_2 eq. - scenario with measures and % reduction in comparison with 1988 and 2005

1988	1995	2000	2005	2010	2015	2020	2030	Δ (2020 – 2005), %	Δ (2030 – 2005), %
121 937	75 839	59 501	63 750	60 352	57 962	60 982	59 580	-4.3	-5.7

The scenario with additional measures reflects all adopted policies and measures to reduce GHG emissions in the country after 2011 and includes the impact of policies and measures presented in this Plan that have a quantitative assessment at this stage.

Table 5.32 Aggregate GHG emissions of Bulgaria - Gg CO_2 eq. - scenario with additional measures

1988	1995	2000	2005	2010	2015	2020	2030	Δ (2020 – 1988), %	Δ (2030 – 1988), %	Δ (2020 – 2005), %	Δ (2030 – 2005), %
121 936	75 839	59 501	63 749	60 352	53 126	53 710	51 824	-55.24	-56.82-	-16.22	-19.19

Comparison between the two scenarios is presented in the following Table 5.33.

Table 5.33 Comparison between GHG emissions, aggregated for Bulgaria under the two scenarios

	2010	2015	2020	2030
Aggregate emissions in Gg CO2 eq. ΔWAM-WEM	0	-4 836	-7 273	-7 756
Δ WAM - WEM, %	0			

5.4. Supplementary relating to mechanisms under Article 6, 12 and 17, of the Kyoto Protocol

Bulgaria has essential potential for further reduction of the carbon intensity of the economy. This potential might be realized with the implementation of targeted policies and measures. These policies and measures apply one or more political instruments, for example:

- Legislative instruments: implementation of the EU and national legislative acts and others;
- Market orientated: participation in the international emission trading, EU Emissions trading scheme;
- Financial instruments: funds and different investment sources, as the green investment scheme, energy efficiency funds, and state guarantee of loans;
- Scientific and research activities;
- Voluntary agreements and others.

Bulgaria as an Annex I Party of the Kyoto Protocol is participating in two of the flexible mechanisms to the Kyoto Protocol: Joint Implementation under Article 6 and International Emission Trading under Article 17.

The **European greenhouse gas emission allowance trading scheme (EU ETS)** is a Community market mechanism established in 2005 in order to encourage investments in low carbon production. The scheme is based on the „cap and trade” principle and the first two trading periods (2005-2007 and 2008-2012) are regulated by Directive 2003/87/EC.34. It functions at Member State level on the basis of National Allocation Plans (NAPs) developed by each country and approved by decisions of the European Commission.

Currently the ETS covers over 11000 installations in 30 countries (EU27, Norway, Iceland and Liechtenstein). Pursuant to Directive 2008/101/EC 35, the scope of the ETS is enlarged to cover also aviation activities as of 1 January 2012.

Bulgaria was de jure included in ETS after it joined the EU in 2007, but de facto its actual participation started after the NAP was approved for the second trading period (2008-2012) by decision of the Commission from April 2010. At the time of the approval of the NAP Emissions Trading Scheme in Bulgaria covers 132 installations. The total amount of allowances for allocation is determined at just under 206 mln. For the 5 year period and includes the allowances for the installations covered by the scheme, as well as those reserved for new entrants and projects under the Joint Implementation mechanisms of the Kyoto Protocol.

Table 5.34 below gives information on the results of the Second trading period (2008-2012) in terms of amounts of allowances allocated for free for the and the respective verified emissions per sectors.

Table 5.34 Free allocation and verified emissions during the Phase II (2008-2012) of the EU ETS in Bulgaria

Sector	Information	2008	2009	2010	2011	201
TPP and District heating	EUA free allocation	29 806 768	30 709 261	26 631 131	32 373 874	34 374
	verified emissions	29 806 768	27 258 839	29 094 980	34 108 079	29 925
	Difference	**0**	**3 450 421**	**-2 463 849**	**-1 734 205**	**4 448**
Other combustion facilities	EUA free allocation	1 090 840	1 264 586	1 115 885	1 134 561	1 218
	verified emissions	1 090 840	724 568	826 961	1 102 713	986 0
	Difference	**0**	**540 018**	**288 924**	**31 848**	**232 8**
Refineries	EUA free allocation	2 503 782	2 790 746	2 405 085	2 423 553	2 526
	verified emissions	2 503 782	1 158 853	1 683 138	1 354 207	1 350
	Difference	**0**	**1 631 893**	**721 947**	**1 069 346**	**1 176**
Metal Industry	EUA free allocation	334 115	419 651	361 658	361 661	377 0
	verified emissions	334 176	236 849	239 397	276 418	203 7
	Difference	**-61**	**182 802**	**122 261**	**85 243**	**173 3**
Cement	EUA free allocation	3 463 141	4 060 564	3 515 870	3 515 903	3 432
	verified emissions	3 463 141	1 800 790	1 414 417	1 356 622	1 684
	Difference	**0**	**2 259 774**	**2 101 453**	**2 159 281**	**1 747**
Lime	EUA free allocation	263 733	278 862	240 325	240 327	287 8
	verified emissions	263 733	230 290	241 119	238 398	204 4
	Difference	**0**	**48 572**	**-794**	**1 929**	**83 4**
Glass	EUA free allocation	401 818	458 600	395 225	395 229	412 0
	verified emissions	401 818	372 499	373 693	438 950	406 0
	Difference	**0**	**86 101**	**21 532**	**-43 721**	**5 99**
Ceramic products	EUA free allocation	287 045	358 266	311 371	328 065	343 7
	verified emissions	287 045	146 160	140 084	146 723	171 1
	Difference	**0**	**212 107**	**171 287**	**181 342**	**172 6**
Pulp&Paper	EUA free allocation	151 758	255 294	289 987	289 990	302 3
	verified emissions	151 758	75 940	88 315	92 869	89 4

	Difference	**0**	**179 354**	**201 672**	**197 121**	**212 9**
Total	**EUA free allocation**	38 303 000	40 595 830	35 266 537	41 031 715	43 298
	verified emissions	38 303 061	32 004 788	34 102 104	39 114 979	34 998
	Difference	**-61**	**8 591 041**	**1 164 433**	**1 916 736**	**8 299**

The Joint Implementation Mechanism in Bulgaria

The position of the Republic of Bulgaria on Joint Implementation Mechanism (JI) according to Article 6 of the Kyoto Protocol under the UNFCCC is as follows: JI is economically effective and it allows GHG emission reductions under minimal expenses. The JI mechanism contributes to more easy and rapid introduction of the new and "state of art" technologies in the country.

Bulgaria is amongst the first Annex I countries in the world which hosted JI projects. As a result, the country has already gained experience in various aspects of the JI mechanism, amongst which: A number of memorandums of understanding/Cooperation agreements were concluded with other Annex I countries, consultancy on the possibilities for realization of JI projects was implemented, procedures for support and approval of JI projects on both Track 1 and Track 2 were adopted, 28 JI projects were approved (26 on Track 1 and 2 on Track 2), transactions of verified emission reductions were made to 20 of the projects.

The Climate Change Policy Directorate within MOEW is responsible for the application of the flexible mechanisms of the Kyoto Protocol and for the execution of the procedures for assessment, approval and administration of JI projects in Bulgaria. The Directorate is also responsible for the application of the EU Climate Change Policy in Bulgaria.

The legislation on JI projects in Bulgaria includes the Laws on ratification of the UNFCCC and the Kyoto Protocol, the Environmental Protection Act and the national guidelines for approval of JI projects under Track 1 and Track 2.

A procedure for approval of JI projects has been set and is in place, and it requires the assessment of each project by a Steering Committee for JI projects (SC JI). The committee is formed by Order of the Minister of Environment and Water and consists of members – experts from different institutions concerned – the Ministry of Environment and Water, the Ministry of Economy, Energy and Tourism, the Ministry of Finance, the Ministry of Regional Development and Public Works, the Ministry of Agriculture and Food, the Ministry of Transport, Information Technology and Communications, the Ministry of Foreign Affairs, the Executive Environment Agency, the Energy Efficiency Agency and the Executive Forestry Agency. The Committee is chaired by Deputy Minister of MOEW. The SC evaluates proposed projects according to the existing internal environmental criteria and the JI national guidelines on Track 1 and Track 2. The SC advises the Minister of Environment and Water in issuing/not issuing a Letter of Approval for each particular project proposal.

Several Memorandums of Understanding/Cooperation Agreements have been signed aimed at JI cooperation with: The Kingdom of Netherlands, The Swiss Confederation, The Kingdom of Denmark, Republic of Austria, the Kingdom of Belgium, Prototype carbon Fund at World Bank, Japan and the Kingdom of Sweden. Since the adoption of the national guideline for approval of JI projects under Track 1 in April 2010, Memorandums of understanding/ Cooperation Agreements are no longer a necessary condition for approval of new projects. The Track 1 national guideline allows every Annex I country to be a buyer of projects' emission reductions.

As it is mentioned above, Bulgaria considers that the Joint Implementation mechanism is important initiative for attraction of investments in energy efficiency, renewable energy sources, cogeneration and new low carbon or carbon-less technologies.

The JI projects for which Letter of Support and JI projects for which Letter of Approval have been issued by MOEW are listed bellow:

Letter of Approval

- Biomass Steam Boiler in Vinprom Peshtera
- Portfolio of new co-generation power stations for combined production of heat and electricity in District heating system Pleven and District heating system Veliko Turnovo, Bulgaria;
- New co-generation power station for combined production of heat and electricity in District heating Bourgas, Bulgaria;
- Cogeneration gas power station AKB Fores PLC Financial Industrial Group;
- Cogeneration power station Biovet;
- TPP Plovdiv South co-generation project;
- Industrial Energy Efficiency and cogeneration, Nikopol;
- Energy efficiency investment program at Svilocell Pulp Mill, Bulgaria;
- Bulgarian Energy Efficiency and Renewable Energy Portfolio Project;
- Biomass and Energy Efficiency Project, Paper Factory Stambolijski;
- Biomass Utilization in Svilosa Inc;
- Rehabilitation of District heating system in Sofia;
- Rehabilitation of District heating system in Pernik;
- Reduction of greenhouse gas by gasification in Varna Municipality;
- Reduction of GHG by gasification of Sofia municipality;
- Reduction of Greenhouse gases by gasification in the Zapad region of Bulgaria
- Reduction of GHG by gasification of the towns of Veliko Turnovo, Gorna Oryahovitsa and Lyaskovets;
- Reduction of greenhouse gases by gasification of Burgas Municipality;
- Vacha Cascade JI Project;
- Rehabilitation of Dolna Arda hydropower cascade;
- Sreden Iskar cascade HPP portfolio project in Bulgaria;
- Small Hydropower Station SHPS Potochnitsa;
- Bulgarian Small Hydro Power Plants (SHPP) portfolio;
- Kaliakra Wind Power Plant;
- Methane capture and electricity production at Kubratovo WwTW, Sofia, Bulgaria;
- Reduction of N_2O at Agropolychim Devnya;
- Sunflower and rape seed - bio diesel fuel production and use for transportation in Bulgaria;
- Emission Reduction of Nitrous Oxide in Nitric Acid Production at Neochim PLC.

There were no any emission reductions' transfers from the Bulgaria National Registry to the registries of other countries up to the end of 2009 but in 2010, 3 329 743 emission reductions generated by 13 approved Joint Implementation projects were transferred towards Nederland, Japan, Denmark ect. This process continues in 2011 as 1 954 312 emission reductions were transferred to 15 projects by August. For the period 2012-2013 emission reductions were transferred to 20 projects.

At present, the approval of new projects, leading to direct or indirect reduction of emissions of installations under EU ETS, is impossible in practice because of the necessity EU allowances to be cancelled when ERUs are transferred to the buyer. These are allowances from the set aside of allowances for avoiding the so called double counting of greenhouse gas emission reductions for JI projects, on the account of allowances for the installations covered by the EU ETS. For that reason the Bulgarian government refrains from approval of new projects of installations under the EU ETS sector to the end of 2012. Eligible for approval are projects that do not lead to direct or indirect double counting.

During the second trading period (2008-2012) the maximum share of ERU and CER, which can be used to fulfil the operators' obligations, is limited to 12,5 % of their allocated allowances for the entire period. The Bulgarian EU ETS installations will appear as buyers to the secondary ERU and CER market.

http://www.moew.government.bg/?show=top&cid=357&lang=en

The implemented 21 projects under the JI mechanism have already achieved and verified emission reductions. The implementation of those projects lead to greenhouse gases emission reduction around 10million tons carbon dioxide equivalent until 2012.

The results are presented in Table 5.35.

Table 5.35 Emissions reduction by implemented JI project

№	Project Name	Issued AAU	Issued ERU	TOTAL
1	Portfolio of new cogeneration power stations for combined production of heat and electricity in District Heating Company Pleven and District Heating Company Veliko Tarnovo, Bulgaria	50 067	770 772	820 839
2	Energy efficiency investment programme at Svilocell Pulp Mill	6 004	672 065	678 069
3	New cogeneration power station for combined production of heat and electricity in District Heating Bourgas, Bulgaria	104 498	348 920	453 418
4	Cogeneration gas power stations AKB Fores	0	42 416	42 416
5	Reduction of Greenhouse Gases by Gasification in the Varna municipality	29 208	86 522	115 730
6	Sofia District Heating Project	925 462	158 538	1 084 000
7	Pernik District Heating project	157 000	626 834	783 834
8	Co-generation Gas Power Station Biovet	97 823	333 648	431 471
9	Reduction of Greenhouse gases by gasification of Sofia municipality	90 960	431 612	522 572
10	Reduction of Greenhouse gas by gasification of the towns of Veliko Turnovo, Gorna Oryahovitsa and Lyaskovets	65 032	198 354	263 386
11	Svilosa Biomass Project	145 882	293 037	438 919
12	Methane gas Capture and Electricity Production at Kubratovo Wastewater Treatment, Sofia Bulgaria	36 212	536 185	572 397
13	Nitrous Oxide Reduction at Agropolychim Fertilizer Plant	808 184	1 565 070	2 373 254
14	Reduction of greenhouse gases by gasification of Burgas Municipality	0	60 323	60 323
15	Kaliakra Wind power project	0	299 281	299 281
16	Sunflower and rape seed – bio diesel fuel production and use for transportation in Bulgaria	0	258 435	258 435
17	Bulgarian Small Hydro Power Plant (SHPP) Portfolio	0	41 067	41 067
18	Bulgarian Energy Efficiency and renewable Energy portfolio project	91 511	136 694	228 205
19	Emission Reduction of Nitrous Oxide in Nitric Acid Production at Neochim PLC	0	105 593	105 593
20	Biomass Steam Boiler at Vinprom Peshtera	0	0	0
21	Sreden Iskar Cascade HPP Portfolio Project	0	98 180	98 180
	TOTAL	2 607 843	7 063 546	9 671 389

Legislative instruments:

The main documents of the environmental policy are the Environmental Protection Act, the secondary legislation, the National strategy for the environment. They offer a base for the activities in the area of environmental policies including climate change. The second Action Plan on climate change played the role to formulate the goals in this strategy through determination of specific policies and measures, including actions on their introduction. This approach is being developed in The Third Action Plan on Climate Change, which is approved by the Council of Ministers on 01.06.2012. In addition, a set of political instruments for application of the corresponding EU legislation measures and actions to meet the Kyoto protocol requirements is available.

Multilateral international agreements:

- United Nations Framework Convention on Climate Change (UNFCCC), enforced in 1995.
- Kyoto Protocol to the UNFCCC, enforced in 2005

European legislation:

1. Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC
2. Directive 2004/101/EC of the European Parliament and of the Council of 27 October 2004 amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, in respect of the Kyoto Protocol's project mechanisms.
3. Commission Decision of 29 January 2004 establishing guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council
4. Decision No 280/2004/EC of the European Parliament and of the Council of 11 February 2004 concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol
5. Commission Regulation (EC) No 2216/2004 of 21 December 2004 for a standardised and secured system of registries pursuant to Directive 2003/87/EC of the European Parliament and of the Council and Decision No 280/2004/EC of the European Parliament and of the Council
6. Directive 2008/101/EC of the European Parliament and the Council of 19 November 2008 amending Directive 2003/87/EC so as to include aviation activities in the scheme for greenhouse gas emission allowance trading within the Community
7. Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC

8. Directive 2009/29/EC of the European Parliament and the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community
9. Directive 2009/31/EC of the European Parliament and the Council of April 23 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No 1013/2006
10. Decision no 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020
11. Commission Decision №278/2011 of 27 April for determining transitional Union-wide rules for harmonised free allocation of emission allowances pursuant to Article 10a of Directive 2003/87/EC of the European Parliament and of the Council
12. Commission Regulation (EU) № 600/2012 of June 2012 on the verification of greenhouse emission reports and tonne-kilometre and the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and the Council.
13. Commission Regulation (EU) № 601/2012 of 21 June 2012 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council Text with EEA relevance

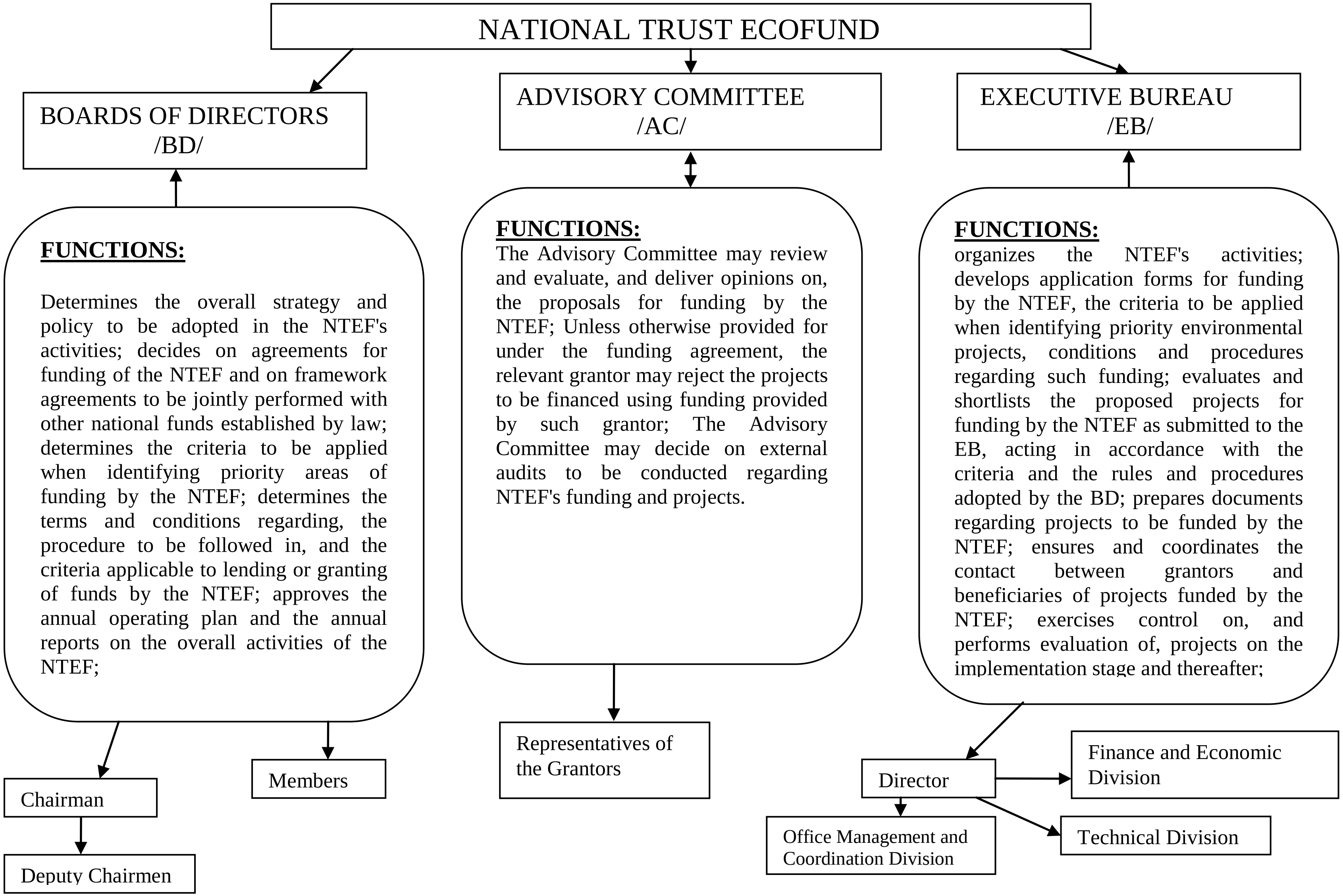
National legislation:

1. Ratification act of the United Nations Framework Convention on Climate Change (UNFCCC)(published in State Gazette, No 28/28.03.1995)
2. Ratification act of the Kyoto Protocol (published in State Gazette, No 72/25.07.2002)
3. Draft Climate Change Mitigation Act
4. Environmental Protection Act as amended
5. Amendment of the Environmental Protection Act in order to introduce The National Green investment scheme (published in State Gazette, No 46/18.06.2010)
6. Decision of the Council of Ministers No1012/21.12.2004 approving the Second National Action Plan on climate change
7. Decision of the Council of Ministers No439/01.06.2012 approving the Third National Action Plan on climate change
8. Five Acts for ratification of the Bilateral Cooperation Agreements in the field of the Joint implementation mechanism under the Kyoto Protocol, respectively with the Netherlands, Austria, Switzerland, Denmark and the Prototype Carbon Fund of the World Bank, Sweden

In June 2010 an Amendment to the Environmental Protection Act (EPA) was approved by the Council of Ministers and the National Assembly. The new legislation creates the main legal framework of **the Bulgarian National Green Investment Scheme (NGIS)** and allows Bulgarian government to participate in the International Emission Trading mechanism according to the Article 17 of the Kyoto Protocol. EPA defines the entire process from selling of AAUs to “greening” of the revenues. EPA empowers the National Trust Eco Fund (NTEF) to administer and implement the NGIS. NTEF elaborates rules for selection, assessment and approval of projects that would reduce emissions and would be reimbursed by the NGIS.

The Regulation on Organization and Activities of the National Trust Ecofund is presented on the next figure.

Figure 5.9 Structure and functions of the National Trust Ecofund



Management bodies of NTEF are Boards Of Directors, Advisory Committee and Executive Bureau.

In October 2011 the Republic of Bulgaria and the Republic of Austria signed an Agreement for the Purchase of Assigned Amount Units under the NGIS. The revenues of the transaction are used for financing projects, related to an increase of energy efficiency of buildings (thermal insulation of schools and pre-schools), and biomass- and biogas plants in Bulgaria.

All measures will result in a significant decrease of greenhouse gas emissions. In April 2012 Bulgaria and Austria signed second Agreement for the Purchase of Assigned Amount Units under NGIS.

Both Agreements for the Purchase of Assigned Amount Units under the Green Investment Scheme between the Republic of Bulgaria and the Republic of Austria – regulate conditions for the sell of Assigned Amount Units and the obligations and responsibilities of the two parties.

Priority areas for funding are:

- Reduction of air pollution and energy efficiency;
- Clean water protection;
- Clean up of past pollution;
- Protection of biodiversity

Under the NGIS are funded 85 public projects for energy efficiency in 29 municipalities in Bulgaria as follows:

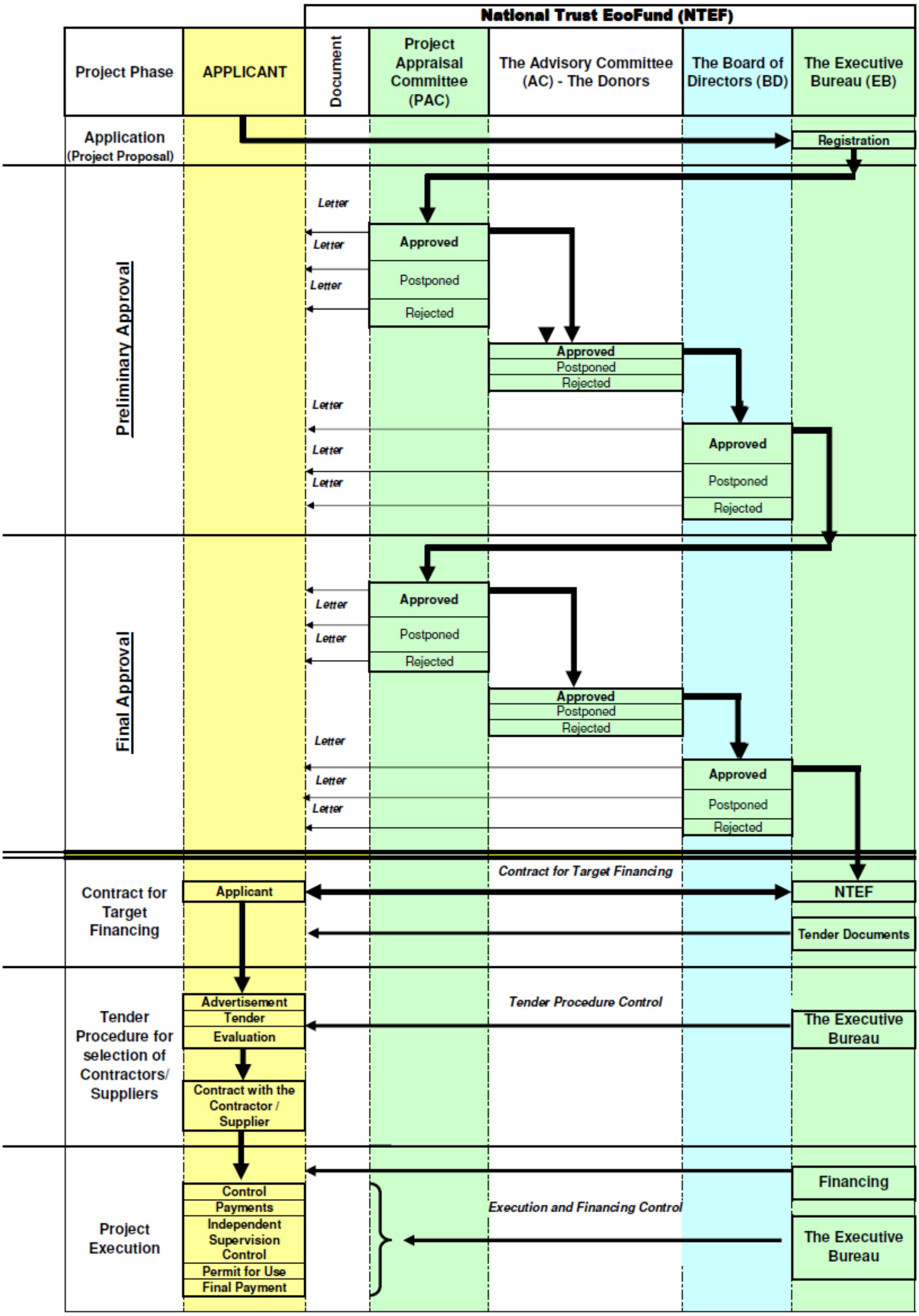
- Kindergarten -17;
- Schools - 44;
- Community cultural centers – 7;
- Universities – 2;
- Administrative buildings – 3;
- Sports Halls – 2;
- Theater – 1;
- Hospitals – 5.

In Table 5.36 are presented environmental, financial and social results from the implementation of the GIS in Bulgaria. Procedure for the process of assessment and approval of applications and projects are shown on Figure 5.10.

Table 5.36 Environmental, financial and social results from the GIS

	Reduced GHG emissions (tCO2eq/year)	Achieved savings of financial resources (BGN/year)	Number of people affected
AAUPA I	7 017	1 813 827	23 612
AAUPA II	8 413	2 522 493	46 367
TOTAL	15 430	4 336 320	69 979

Figure 5.10 Schematic diagram showing the application handling procedure by NTEF



5.5. Methodology used for the presented GHG emission projections

The development of projections for GHG emissions is based on economic projections and analysis of the possibility to undertake measures by sector.

The baseline scenario for the economic development by 2030 is based on the projections of the MF used for the elaboration of budget 2012 as key indicators, which were extended until 2030. Thus the scenario for economic development is conform to the main official document of the Bulgarian government in the period of preparation of the NAPCC.

Since the scope of projections of the Ministry of Finance is narrower than the needs of NAPCC, they are complemented with the necessary economic indicators the behaviour of which corresponds to the proposed development scenario.

Table 5.37: Basic macroeconomic indicators (2005 prices)

Basic indicators	2010	2011	2012	2015	2020	2025	2030
GDP (billion euro)	26.5	27.2	28.0	31.1	38.5	45.6	52.2
GVA (billion euro)	23.0	23.2	23.9	26.4	32.9	40.1	47.2
Population (million)	7.50	7.36	7.35	7.14	6.91	6.68	6.45
Employment (15+, million)	3.05	3.06	3.07	3.08	3.14	3.01	2.93
Employment rate (15+, %)	47.2	47.8	48.5	50.2	52.8	51.8	51.6
GDP per capita (euro)	3 532	3 700	3 815	4 361	5 565	6 823	8 089
GVA per employee (euro)	7 539	7 605	7 782	8 546	10 468	13 304	16 124

Source: NSI, MF projections, own calculations

Table 5.38: Basic macroeconomic indicators - growth

Growth (average annual, %)	2011	2012	2010 2015	2015 2020	2020 2025	2025 2030	2010-2030
GDP	2.80	2.90	3.28	4.32	3.44	2.75	3.45
GVA	0.96	2.82	2.75	4.54	4.02	3.32	3.66
GDP per capita	4.76	3.12	4.31	5.00	4.16	3.46	4.23
GVA per employee	0.87	2.34	2.54	4.14	4.91	3.92	3.87
Population	-1.87	-0.21	-0.99	-0.65	-0.69	-0.69	-0.75
Employment	0.09	0.47	0.20	0.39	-0.85	-0.57	-0.21

Source: MF projections, own calculations

After the downturn and the slowdown as a result of the economic crisis in 2009 and 2010 it is expected that the economic growth will be recovered and accelerated after 2011. The GDP annual growth rate for the period 2010-2015 is projected at 3.3% and estimated to grow to 4.3% during 2015-2020. The gross value added (GVA) behaves in the same way and is estimated to reach a growth rate of 4.54% in the period 2015-2020. This accelerated economic growth is combined with growth of employment rates estimated to reach 52.8% by 2020. This behaviour of employment allows for implementation of the national employment targets under the Strategy “Europe 2020”. However, the negative demographic trends in population decline will continue (by about 1.05 mln. for the period 2010-2030), which will lead to lower employment rates in the period 2020-2030 and will reduce the growth rates of GDP and GVA. The employment rate in 2030 will be sustained above the levels of 2010.

The GDP per capita is expected to grow by 4.23% and the GVA per employee - by 3.87% a year for the entire period until 2030 which suggests accelerated convergence of the economy to the average levels of the EU.

Table 5.39 GDP on the demand side – real growth (%)

	2011	2012	2010 2015	2015 2020	2020 2025	2025 2030	2010 2030
GDP	2.80	2.90	3.28	4.32	3.44	2.75	3.45
Consumption	1.28	1.90	2.36	4.11	2.70	3.61	3.19
Consumption of households	0.64	1.87	2.38	3.99	2.46	3.77	3.15
Domestic investments	-5.00	4.70	3.89	6.70	2.19	1.43	3.53
Export	11.72	5.36	6.80	4.75	4.00	1.63	4.28
Import	6.22	4.89	5.88	5.42	2.82	1.96	4.01

Source: MF projections, own calculations

The recovery of the Bulgarian economy after the recession of 2009 is due to the favourable developments in exports which is expected to be a major factor for economic growth until 2025. The exports will grow at accelerated rates in this period compared to the total GDP growth and its relative share in GDP will reach 75%. Investments will also recover from their downward trend in 2009-2011. The period by 2020 will be characterized by high rate of investment that will create the necessary conditions for improving economic competitiveness and export growth. The investments reach their maximum in the period after 2010 as a relative share of GDP (28.7%) in 2020. The high growth of investments is accompanied by increased imports of investment goods which boosts the high growth rate of import in the period by 2020. Consumption will be a key factor for growth at the end of the assessed period (after 2025) when its relative share will reach 79.2%.

Table 5.40: GDP on the production side – real growth (%)

	2011	2012	2010 2015	2015 2020	2020 2025	2025 2030	2010 2030
GVA	0.96	2.82	2.75	4.54	4.02	3.32	3.66
Agriculture	-1.82	2.26	-0.01	1.76	1.17	0.49	0.85
Industry	4.07	2.35	3.03	4.35	4.03	3.33	3.68
Mining industry	9.74	3.70	3.64	3.45	3.44	3.10	3.41
Processing industry	6.83	2.69	3.84	4.49	4.04	3.35	3.93
Generation and distribution of electric and thermal energy and of gaseous fuel	9.63	2.61	4.02	3.95	3.93	3.34	3.81
Water supply; sewerage services, waste management and recovery	9.82	9.33	7.54	6.15	6.53	5.01	6.30
Construction	-10.38	-0.50	-1.18	3.99	3.44	2.75	2.23
Services	-0.35	3.11	2.83	4.77	4.11	3.42	3.78
Trade; repair of motor vehicles and motor cycles	1.31	2.55	3.03	4.51	3.68	3.55	3.69
Transport, storage and posts	1.66	3.12	3.27	5.06	5.16	3.81	4.32

Source: MF projections, own calculations

The major industrial sectors except for agriculture and construction are expected to recover in 2011. The services sector will also be hesitant, however, its growth will speed up and overtake the growth of GVA in the coming years. The relative share of services will be increasing and will reach 59.3% of GDP in 2030.

The fluctuating performance of agriculture will continue throughout the period while the average annual economic growth will remain below the overall growth rate of GVA. This determines the reduction of its relative share which will reach 3.4% of GDP by 2030.

The high growth rates in the construction sector in the period before the crisis are not expected to be repeated. The period by 2015 will be characterized by a small average annual decline in construction. After 2015 the industry will have positive growth rates and after 2020 its relative share will stabilize at levels of 4.6% of GDP.

The industrial sector will be characterized by growth rates (3.68%) very close to those of GVA (3.66%) throughout the period, and its relative share will reach 26.6% in 2030. In 2011 the industry will begin to recover from the crisis at expected relatively high rates of growth.

Among the industrial sectors with highest expected rate of growth is the sector of "Water supply; sewerage, waste management and recovery". This sector will mark the highest growth rates during the period. Waste management is a sector with the greatest potential for development and the relative share of the treated waste is expected to increase significantly at the expense of the untreated waste.

The mining industry will realize relatively lower growth rates than the overall growth of GVA, and its relative share in GDP at the end of the period will be 11.9%, which does not represent a significant change compared to 2010 when it was 12%.

The processing industry will grow at a faster pace than the overall growth of GVA and at the end of the period it will reach a relative share of 15.6% of GDP.

5.6. Economic analysis of the possibility to undertake measures by sectors

The analysis is based on the scenario for economic development by 2030. The goal is to assess the feasibility of measures by sectors in terms of economic development. In principle, the reduction of greenhouse gas emissions is assessed under stable and unchanged macroeconomic indicators. Thus the effective reduction of emissions is estimated without reducing the actual production and consumption.

The effects of the measures proposed to reduce the emissions may be assessed on the side of production (supply) by sectors – improvement of the quality of human capital, technologies and efficiency and on the demand side – through the investment required to implement the measures.

The assessment of investment possibilities should take into account that the total amount of investments for the entire economy for the period 2012-2020 is 214 bln. BGN at current prices of 2011 (because the investments proposed in individual sectors are also at current prices). The total cost of the planned measures is 10.575 bln. BGN or 4.9% of the total investments in the economy for that period. The expected reduction in emissions as a result of the intended measures is estimated at 44.832 mln. tonnes of CO_2 eq., which means that the cost of each saved tonne of emissions is estimated at 236 BGN. It should be taken into account that measures include implementation of both existing (in 2012) and planned (by 2020) strategies and sectoral policies.

The conservation, the rational and responsible use of resources is essential not only for improving and protecting the environment, but for achieving sustainable economic growth and increasing the competitiveness of the Bulgarian economy. The introduction of low carbon, energy efficient and low waste technologies, as well as the recovery and recycling of greater amounts of waste contribute to improving productivity and resource efficiency. This creates opportunities for finding new sources of growth and jobs through cost savings, marketing of innovation and better management of resources throughout their life cycle.

5.6.1. Energy

The measures in the Energy Sector are consistent with the Energy Strategy of Bulgaria by 2020. This suggests security of resources as a prerequisite for the approval of the document. The main sources of financing are to be the Structural Funds, the green investment scheme, Kozloduy Fund, the state budget and private investments that would ensure high cost efficiency of projects. The planned investments in direct and indirect measures are more than 6189 mln. BGN, which is a considerable resource and accounts for nearly 2.9% of the total investment in the economy over the entire period. The investments planned for direct measures are 1753 mln. BGN and will lead to saving 18 mln. tonnes of emissions at an average cost of 97.4 BGN per tonne of saved emissions.

According to the macroeconomic scenario n Section 7.1 the sector “Production and distribution of electric and thermal energy and gaseous fuels” will grow on average by 3.8% in the period by 2030 and its relative share in GDP will slightly rise from 3.3% to 3.6 %.

The specific measures are aimed at improving the efficiency of energy production and transition from coal to natural gas in some plants, improving the technologies used to produce energy from coal, including the use of “clean” coal technologies. Changes are to be effected also in the energy mix, aimed at increasing the target values of the shares of electricity from nuclear sources and from renewable sources – 15% of the electricity mix, as well as at increasing the use of high efficiency cogeneration.

In order to reduce the amount of greenhouse gas emissions, to use less resources and to achieve respectively lower cost of energy, concrete measures for more efficient production in existing plants amounting at 240 mln. BGN are envisaged for the period 2013-2020. In addition, replacement of technologies will be undertaken to allow transition from coal to natural gas, where the required investments worth 720 mln. BGN. The expected effect from these measures in terms of reduced emissions is respectively 4.68 mln. and 11.7 mln. tonnes of CO2 eq. which means that the average cost of saved emissions is respectively 51 BGN/tonne and 62 BGN/tonne. This means that these measures have the lowest cost per tonne of saved emissions in the energy sector . In addition, the main sources of funding will be private investments, European programmes and revenues under art. 10c of Directive 2003/87/EC, which will significantly limit the use of public funds.

Another important tool for reducing emissions is the use of high efficiency cogeneration, where the investment is estimated at approximately 790 mln. BGN for the period 2013-2020 and will lead to emissions reduction of 1.6 mln. tonnes CO2eq.

The estimated average price of a tonne saved emissions is 494 BGN, which significantly exceeds the results of the previous two measures.

Immediate effect from an increased share of electricity from renewable sources is the reduction of greenhouse gas emissions as this production does not generate any emissions. Bulgaria has a significant potential of renewable energy sources and the encouragement of investments therein directly contributes to diversification of the energy mix and to slowing down the process of exhaustion of local energy resources. An important aspect here is the decentralized production of energy and the consumption of energy from renewable sources by households. The specific measure to be implemented is to increase the share of energy for heating and cooling from renewable sources which will contribute to reducing greenhouse gas emissions by 488000 tonnes by 2020.

The most prominent of the indirect measures is the one aimed at increasing the share of electricity from renewable sources in the electricity mix and that is related and contributes to the implementation of the national target with regard to the share of renewable energy in the gross final energy consumption by 2020. The investments required for this measure are estimated at 4183 mln. BGN.

5.6.2. Energy efficiency

The improvement of the efficiency of energy production and consumption will increase the competitiveness of enterprises and the possibilities to generate higher added value. The total amount of foreseen investment is about 950 mln. BGN that will lead to reduction of emissions by 3.5 mln. tonnes. The average cost per ton of saved emissions in the sector is 270 BGN , and the main sources to finance these investments are the European funds, different financial schemes in this field, credit lines, the state budget and private investments.

The growing use of natural gas in households has a positive energy saving and environmental effect, but increases the dependency on imported energy resources. The supply of natural gas to 30% of households by 2020 will increase the import of natural gas and the dependence on imported oil and natural gas will rise from 36.7% in the baseline scenario to 48% in case of gasification. The risk of supply disruption will be managed through diversification of the sources of natural gas supply by building gas system interconnections with Greece, Romania, Turkey and Serbia, by participation in major international projects and expansion of the country's existing gas storage facilities.

Reducing the consumption of electricity by substituting it with natural gas will lead to more efficient use of resources, lower costs and better and healthier environment. The use of natural gas in households and in the provision of services is substantiated by the measure for accelerated gasification which is part of the Second National Action Plan for Energy Efficiency covering the period 2011-2016 and will probably be extended to the next action plan. According to this measure 430000 households will have access to natural gas, the investment needs are estimated at 774 mln. BGN and the expected reduction is respectively 2.4 mln. tonnes CO_2eq. The cost of this measure per saved tonne of greenhouse gas emissions is 322.5 BGN however without its application it would be impossible to secure access to natural gas for households by 2020, neither to achieve the results of the accompanying measures that are important in terms of efficiency of energy consumption and in terms of reducing emissions.

Improvement of the efficiency and savings in the final fuel and energy consumption will be carried out largely through sanitation of at least 3% of the public and state-owned buildings with total floor space of over 250m2 per year in order to ensure the fulfilment of the minimum requirements to the energy performance of these buildings. The investments are estimated at 34.2 mln. BGN, and the reduced emissions are equivalent to 204000 tonnes of CO_2. Sources of financing the measure are the structural funds, the green investment scheme, the state budget. The cost of one tonne saved emissions is 168 BGN which makes the measure significantly more effective than the average level for the Energy efficiency sector as a whole.

Decentralization of production is to be realized through the national programme "1000 sunny roofs" that will be implemented during the period 2015-2020. The investment is estimated at 140.5 mln. BGN to be provided by the European funds, the Energy Efficiency Fund, private investments and other sources and will contribute to reducing emissions by 107 200 tonnes of CO_2 eq. The relative cost per tonne of saved emissions is 1308 BGN and is the highest one for all proposed measures in the sector.

5.6.3. Industry

The measures in the Industry Sector are aimed at improving the energy efficiency and at optimal utilization of resources. The main source of funding is the programme "Competitiveness" and its eventual extension in the next programming period. The planned investments amount to 361.6 mln. BGN, of which 261.6 mln. BGN have a direct effect and the remaining 100 mln. BGN have an indirect effect. The investments are relatively small in volume with respect to the total investments in the economy. The estimated savings in CO_2 emissions from the measures with direct impact amount to 5.6 mln. tonnes, i.e. the investment per reduced tonne of emissions is slightly more than 46 BGN which makes the measures relatively efficient.

The direct measures involve, on one hand, the technology used in the industry thus creating preconditions for increase in production competitiveness by reducing the energy intensity in the sector and the final energy consumption.

Other measures are aimed at the utilization of alternative fuels such as biodegradable waste, thus increasing resource efficiency, decreasing the dependence on imported fuels and meeting the requirements related to the prohibition of landfilling of biodegradable waste. The measure is consistent also with the estimates in the macroeconomic scenario in Section 7.1 according to which the value added in the industrial sector "Water supply, sewerage, waste management and remediation activities" grows by 94% in 2020 compared to 2009 due to waste management. Moreover, the added value in this sector is expected to increase by additional 75% by 2030 compared to 2020 as a result of the measures and the expectations for economic development.

The establishment of a technology park and a business incubator is a measure with indirect impact on the reduction of greenhouse gases. Its effects can be sought mainly in the following areas: introduction of incentives to encourage private sector investments in R&D and innovations of widely used production methods aiming at optimal efficiency of resources; development of market instruments to encourage environmentally friendly products through efficient use of resources; encouraging the exchange of good practice between enterprises with respect to the efficient use of raw materials in production.

5.6.4. Transport

Structure of the sector has been changing over the recent years towards increasing the share of road transport which accounted for 98% of the energy consumption in the sector in 2009. The share of diesel in fuel consumption significantly increased in the sector and reached 46.3%. Private cars in 2009 were a source of 60% of the total emissions in the sector. The analysis shows that the main objective of the measures in the sector is to achieve optimal balance in the use of different modes of transport. Measures will be taken to reduce transport emissions, fuel consumption, to diversify transportation services, to inform and to train the consumers.

According to the macroeconomic scenario presented in Section 7.1 there will be an increase in the relative share of transport services, where the share of the sector "Transport, storage and posts" will reach 5.6% of the GDP by 2030 and an average growth rate of 4.3% which indicates potential for growth and reinforces the need for optimization of the various transport modes.

The main sources of financing for the proposed measures are the European funds with state and municipal co-financing, the state budget and the municipal budgets. The planned investments amount to 2071.8 mln. BGN and seem feasible and justified in terms of implementation of the European and national priorities. 5.6 mln. tonnes of emissions will be saved at an average cost of 370 BGN per tonne.

With regard to the priority axis for reductions of transport emissions there are two direct measures which require substantial funding. The first measure involves rehabilitation and modernization of road infrastructure to reduce emissions with foreseen investments of 440 mln. BGN. The measure aims to ensure optimal speeds and optimal operation of motor vehicle engines. The second measure is aimed at the development and the construction of intelligent transport systems which requires financial resources of 410 mln. BGN. These systems will contribute to the enhancement of mobility and safety and the reduction of pollution. Another direct measure is the increase of the share of biofuels.

The rehabilitation and modernization of the road infrastructure is a key priority of the Government and is directly related to an increased growth potential through the development of transport connectivity and the improvement of access to markets. The intelligent transport systems increase efficiency in the use of existing infrastructure and help reduce environmental pollution through the prediction and management of traffic flows and volume. The increased share of biofuels will contribute to increasing resource efficiency.

The reduction of fuel consumption implies less travel by private cars and will be achieved mainly through two measures that require substantial financial resources. The first one provides for the development of non-motorized transport and improvement of the urban public transport which requires investments of 200 mln. BGN. The second measure envisages development of cycling through the construction of bicycle tracks and lanes and a system for using public bicycles, at estimated cost of 150 mln. BGN. The measures will lead to less travel by private cars, better traffic management, less traffic congestion, less noise and fewer emissions. This will improve transport connectivity and will increase the economic efficiency.

Diversification of transport will be achieved by increasing the share of public electrical transport (840 mln. BGN) and by establishing intermodal terminals for combined transport (30 mln. BGN). The increase of the share of public electrical transport includes both renovation and construction of the relevant infrastructure (railway and mass public infrastructure, mainly metropolitan), as well as renewal of vehicles. The implementation of this measure will help Bulgaria implement its commitments related to the national and trans-European transport networks and to optimize its public transport. It will also improve traffic management, transport connectivity, access to markets, and thus increase the opportunities for international trade and will save time and costs of households and businesses.

It is envisaged that 30% of truck cargoes transported at a distance of over 300 km are to be redirected to more environmentally sound modes of transport such as railway. In order to make the combined modes of transport more efficient the central network airports in Sofia, Varna, Burgas, Plovdiv and Gorna Oryahovitsa will be connected to railway lines.

Measures for training and informing consumers with indirect effect on the reduction of emissions are planned under priority axis 4.

5.6.5. Agriculture

Emissions in the Agriculture sector are mainly due to several sources – agricultural soils (58%), biological fermentation in animal husbandry (21.8%), management of manure (19.3%), burning of stubble (1.7%) and rice production (1.1 %). After Bulgaria joined the EU the major structural changes in this sector consisted in reducing the number of farms and increasing their average area.

According to the macroeconomic scenario for development presented in section 7.1, the sector of agriculture, forestry and fisheries will grow at an annual rate of 0.85% by 2030 which will lead to reduction of its relative share in the GDP down to 3.4% at the end of the period.

The main sources of investment financing are the RDP and the state budget. The total planned investment is 411.8 mln. BGN, which corresponds to the scenario of economic development. The direct measures are worth 372.3 mln. BGN, the expected emission savings are 30 tonnes at an average cost above 12000 BGN per tonne thus making the measures relatively expensive. This is mainly due to the need for significant capital investment for restructuring and mechanization of farms, for building new installations and facilities and for purchase of equipment.

The direct measures under the priority axis for reducing emissions from agricultural soils include organic farming (12000 ha by 2020) and scientifically justified crop rotation (on 8000 ha by 2020); biological recultivation (2500 ha) and anti-erosion measures (2500 ha), with total investment of 6.7 mln. BGN. These measures will cover less than 1% of the arable land in the country. The expected effects are associated with the preservation of organic carbon in the soil, improvement of the quality of arable land and production and modernization of technologies and competitiveness. The expected amount of saved emissions is 26000 tonnes at an average cost of 258 BGN/tonne.

The indirect measures related to soils include enhancement of the competencies and skills of farmers to improve soil quality and to use energy and water saving irrigation technologies, which will increase the quality of human capital, the productivity and the efficiency of the used resources. The required investment amounts to 4.1 mln. BGN.

One indirect measure is planned under the priority axis for reduction of methane emissions in stock-breeding – encouragement of extensive grassland husbandry.

Training of farmers is envisaged with the view of increasing the quality of human resources and permanent pastures are to be maintained with payment per hectare. The financial resources required for the measure are estimated at 34 190 000 BGN.

The direct measures related to management of manure include construction of the necessary storage installations. The investments required for that purpose are the most significant amounting to 130 mln. BGN. These installations will cover 16% of the number of cows (over 2 years old) by 2009. Trainings will be conducted and model farms will be built to process manure that will cost 1.4 mln. BGN. The direct measures are expected to save 1924 tonnes which in terms of cost means 68400 BGN per tonne. The indirect measures involve building a resource center for scientific research, and development of training methods and practices. This would boost R&D expenses, improve the quality of human capital and technologies.

Substantial financial resources amounting to 230 mln. BGN are planned for the optimization of the use of crop residues/waste in agriculture. The direct measures are worth 225 mln. BGN and will save 655 tonnes of emissions at an average cost of 343 000 BGN per tonne which makes the measure the most expensive one in relative terms. Its implementation will address the problems with stubble burning. Investments are foreseen for equipment and machinery as well as for changes and adaptation of the production process. 5000 farms will be covered which is about 1.4% of their total number. The indirect measures are aimed at improving the awareness and knowledge of farmers and at strengthening the prevention of stubble burning. The resource efficiency will be enhanced, the technologies, as well as the human capital will improve as a result of the measures.

Other training measures besides those specified above are also envisaged for the farms and their staff in order to improve the quality of human capital, resource efficiency and productivity.

5.6.6. Land use, land use change and forestry

The balance between emission and absorption of greenhouse gases in the LULUCF sector is in favour of the absorption. Sinks are territories occupied by forests, grasslands and meadows. The main source of emissions in the sector is the change in land use and the conversion of forests, grassland and pastures into cropland and urban areas.

Over the past 21 years the absorption of greenhouse gases in the sector has been offsetting between 11.35% and 19.9% of the total greenhouse gas emissions in Bulgaria. The most important role in the uptake and storage of carbon (94-95% of the total absorption in the sector) have the areas occupied by forests, which explains the focus of many of the measures.

The main sources of investment financing are RDP, OP Environment, EMEPA, state and municipal budgets, interested private individuals and entities. The total proposed investment is 54.8 mln. BGN, justified by the importance and the impact of the measures. The direct measures worth 27.9 mln. BGN and will save 80800 tonnes of CO_2 emissions at an average cost of 345.3 BGN per tonne.

The first priority axis consists in increasing the absorption of greenhouse gases and with this respect part of the measures are aimed at afforestation in both existing forests and parks as well as in newly abandoned agricultural or eroded lands. The total value of these measures is estimated at 10.45mln. BGN. The effect is reduction of emissions by 51 000 tonnes at a cost of 205 BGN per tonne. The most expensive measure is related to wetland management in forest areas, peatland and marshland – 15 mln. BGN with expected effect of emission reductions amounting to 4.7 tonnes, i.e. at a cost of 3200 BGN per tonne. This makes the measure relatively expensive, but it is important for preserving biodiversity and natural development of forest ecosystems. The envisaged indirect measures are related to the financial mechanism aimed at supporting the activities and the analysis of existing legislation. The implementation of these measures will contribute to the sustainable growth and development of the wooded forest areas, the maintenance of the ecosystems therein, the possibilities to develop tourism, to increase the share of wood pulp as energy source, and to increase the value of the forestry sector.

The second priority axis affects the storage of carbon stocks in forests and envisages restoration and maintenance of forest shelter belts and new anti-erosion afforestation. The needed financial resources are estimated at 1.75 mln. BGN with expected effect of 8360 tonnes CO2 reduction, i.e. at a cost of 209 BGN per tonne, which is comparable to the cost of the afforestation measures in the first axis. Most important among the indirect measures is the prevention of forest fires through the establishment of an early warning system worth 25 million BGN, which includes the purchase of new equipment. The implementation of these measures will contribute to the protection, conservation, development and expansion of forest areas, to the improvement of the methods and technologies used, which will increase the efficiency and promote the growth and the added value of the forestry sector.

The third priority axis is focused on the potential of forests to capture carbon and plans increase of tree density worth 0.7 mln. BGN. The expected effect is reducing emissions by 16 720 tonnes, at cost of 42 BGN per tonne, which makes the measure highly effective. The indirect measures include the development of new systems, good practices, forest certification and updating strategic documents. The implementation of these measures will contribute to sustainable growth and development of forest areas as well as to increased value added in the sector.

The fourth priority axis is aimed at the long-term retention of carbon in wood products through campaigns and initiatives for expanding the use of wood products as substitutes for products from non-renewable, polluting and energy-intensive materials. This will increase resource efficiency and the value added in the sector.

5.6.7. Waste

The GHG emissions from landfilled waste is about 77% of the total amount in the sector, the emissions from waste water treatment are about 22% and from waste incineration – less than 1%. Therefore, the measures in the waste sector are targeted as a priority at the subsector of waste disposal and to a lesser extent at the subsector of wastewater treatment.

The main sources of funding are OP Environment, private investments, own funds of recovery organizations, EMEPA.

The planned investments in the sector amount to 536.3 mln. BGN, which is achievable from a financial standpoint. The investments and the measures undertaken in the sector correspond to the projections in the macroeconomic scenario in Section 7.1 according to which the value added in the industrial sector of “Water supply, sewerage, waste management and remediation activities” increases throughout the period 2010-2030 by 6.3% on average with total value added growth of 3.66%, while its relative share in the value added grows from 0.86% in 2009 to 1.55% at the end of period. The direct measures will require investments of 455 mln. BGN and will save 12 mln. tonnes of emissions at an average cost of 38 BGN per tonne which makes the measures in this sector highly efficient.

With regard to the landfilling of waste the main efforts are directed towards the prevention of waste which will help reduce the amount of waste for disposal, as well as to build infrastructure for waste treatment. The measure “Development of systems for mechanical and biological treatment (MBT) plants for treatment and utilization of compost and biogas” has a relatively high effect and requires 221 mln. BGN (41.2% of the planned investments in the sector) however 5.8 mln. tonnes of emissions will be saved by 2020 at an average cost of 38 BGN which makes the measure highly efficiency. As an indirect measure is referred the further development of the collective schemes for separate waste collection worth 80 mln. BGN, which will increase the efficiency and the scope of the systems and will contribute to the diversion of 130000 tonnes of waste from landfills every year. Prevention of waste disposal will be effected also through market based incentives for households. The amount of the waste charges is to be bound to the quantities of generated waste thus encouraging households to reduce the amount of disposed waste, to use various waste collection schemes and waste recovery at home. Standards are to be introduced for the recycled materials and compost, which will allow the marketing of these materials, reduce transaction costs and increase the cost efficiency. Separate collection of “green waste” is to be introduced in all municipalities through the updating of their regulations and waste management programmes.

The already landfilled waste also has a high potential to be used as energy and resource. Measures will be implemented to capture and use the biogas in both new and existing landfills and in landfills pending closure, which will improve resource efficiency, reduce dependence on imported energy resources and create added value that is currently being lost without the construction of these installations. The total cost of direct measures under this priority axis is 60 mln. BGN, the expected amount of saved emissions is 10.9 mln. tonnes at an average cost of 5.5 BGN per tonne which makes the measure very highly efficient. The indirect measures include measuring and estimation of the amount of biogas in landfilled waste.

Measures will be taken to capture and flare the biogas in urban waste water treatment plants, which will enable these plants to meet their own energy needs and to improve their profitability and efficiency. The cost of these measures is estimated at 174 mln. BGN and the expected amount of saved emissions is 1.025 mln. tonnes which makes an average cost of 170 BGN/tonne.

The measures in this sector will lead to increased resource efficiency and better management of resources throughout their life cycle, will increase the added value, reduce the dependence on imported energy resources thus reducing the costs of households and businesses and increasing the competitiveness of the economy.

5.7. Projections, sensitivity analysis, focused on the key input variables.

There are 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 methodology that allows scrutinizing the interrelationships between macroeconomic development, sectoral development (including the energy sector), and GHG emissions is used.

The macroeconomic forecasts, including GDP and population growth, were provided by the Bulgarian Agency for Economic Analysis and Forecasts within the Ministry of Finance.

The macroeconomic data are key inputs to the MACRO module in ENPEP complex. The DEMAND module estimates the useful and final energy demand by sector, including households, industry, services and transport.

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

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

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

- Restructuring of economy and increased share of private sector
- Access to the markets of EU and Balkan countries
- 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 of energy prices
- Energy efficiency policy at supply and demand side.

The final energy demand forecast envisages two models of development: max and min, matching optimistic and pessimistic expectations for the energy intensity in the country. The expected energy demand according to the max scenario (that has become the basis for Scenario with existing measures - WEM) is shown on Table 5.41.

Table 5.41 Final energy consumption – PJ

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

The forecast final energy structure is shown in Table 5.42.

Table 5.42 Forecast of structure energy demand by sector, %

Sectors	2005	2010	2015	2020
Industry	38.2	33.7	31.8	29.9
Transportation	25.6	31.9	33.4	32.2
Residential	24.4	21.7	21.4	24.2
Others	11.7	12.7	13.4	13.7
Total	100.0	100.0	100.0	100.0

5.9. Sensitivity and Energy intensity

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. Sensitivity calculations are one of the approaches for defining the area of forecasts. This area is the real space of variation of all parameters of the forecast. The limits are the energy intensity of GDP.

The energy intensity of the GDP in Bulgaria is higher compared to the developed countries.

Increasing energy efficiency is one of the basic objectives for the future development of the energy sector; expected to be achieved mainly by implementing the following structural changes in the national economy:

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

Decrease of the energy intensity of the GDP is almost two time less at the end of prognosis period as is shown on Table 5.43.

Table 5.43 Energy intensity of GDP

Year	Gross electricity demand/GDP, kWh/€ 2001	Gross energy demand/GDP, MJ/€ 2001
2005	1.917	20.20
2010	1.775	18.35
2015	1.388	13.94
2020	1.119	10.38

6. Vulnerability assessment, climate change impacts and adaptation measures

6.1. Background

Bulgaria is located on the Balkan Peninsula in south-eastern Europe. The country includes 31 % low-lands (0–200 m), 41 % hills (200–600 m), 25 % high-lands (600–1,600 m), and 3 % mountains (>1,600 m).

Considering its small area, Bulgaria has an unusually variable and complex climate. The country lies between the strongly contrasting continental and Mediterranean climatic zones. 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.

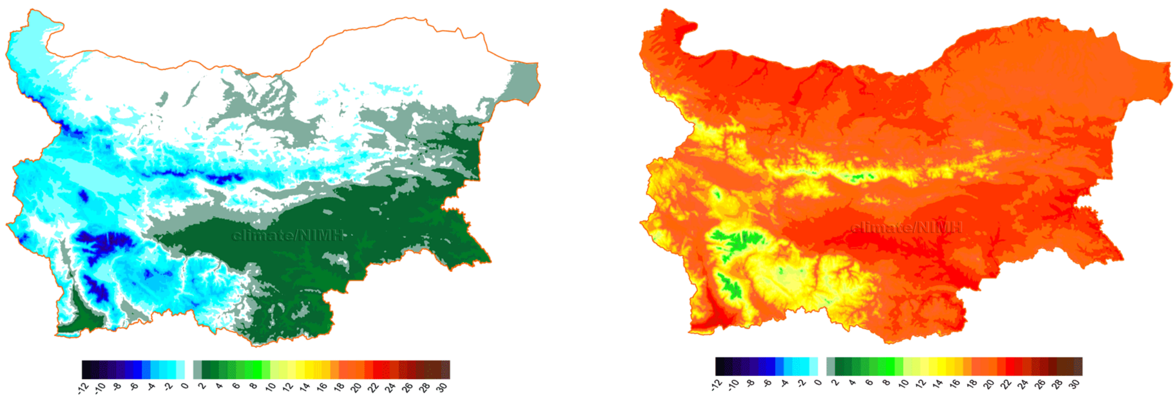
Bulgarian mountains and valleys act as barriers or channels for air masses, causing sharp contrasts in weather over relatively short distances. The continental zone is slightly larger, because continental air masses flow easily into the unobstructed Danubian Plain. The continental influence, stronger during the winter, produces abundant snowfall; the Mediterranean influence increases during the summer and produces hot, dry weather. The barrier effect of the Balkan Mountains is felt throughout the country: on the average, northern Bulgaria is about one degree cooler and receives about 192 more millimetres of rain than southern Bulgaria. Because the Black Sea is too small to be a primary influence over much of the country's weather, it only affects the immediate area along its coastline. The Balkan Mountains are the southern boundary of the area in which continental air masses circulate freely. The Rhodope Mountains mark the northern limits of domination by Mediterranean weather systems. The area between, which includes the Thracian Plain, is influenced by a combination of the two systems, with the continental predominating.

Bulgaria has five climatic zones - Moderate Continental, Intermediate, Continental-Mediterranean, Maritime and Mountainous. The main factor distinguishing the first three zones is the latitude, the terrain for the mountainous and the Black Sea for the maritime. The coastal climate is moderated by the Black Sea, but strong winds and violent local storms are frequent during the winter. Winters along the Danube River are bitterly cold, while sheltered valleys opening to the south along the Greek and Turkish borders may be as mild as areas along the Mediterranean or Aegean coasts. The many valley basins scattered through the uplands have temperature inversions resulting in stagnant air.

There are some interesting areas from a climatic point of view, such as the Sofia Plain, the regions of Sliven and Varna, where strong winds blow almost throughout the year. In the first two cases they are due to the proximity with the Balkan Mountains and its passes, which let all winds blow constantly through them. In the case with Varna this phenomenon is due to the specific microclimate of the Bay of Varna and the sea air-currents coming from the north.

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. Winter temperatures vary between 0° and 7°C below zero (**Error! Reference source not found.**). Very rarely temperatures may drop below 20°C below zero. Typical continental and changeable is the climate in spring. It is exceptionally favourable for the growth of fruit-bearing trees, for whose fruit Bulgaria has been renowned in Europe for centuries. Summer is hot and sweltering in Northern Bulgaria, especially along the Danube River. The climate in Southern Bulgaria is determined by the air-currents from the Mediterranean. Summer temperatures do not reach the extremes as in Dobrudzha and along the Danube and are usually moderate: about 28°-30°C. The highest readings are usually taken in the towns of Rousse and Silistra, sometimes reaching above 35°C. Autumns are mild and pleasant in Bulgaria.

Figure 6.1 Air temperature in winter (left) and summer (right) during the current climate

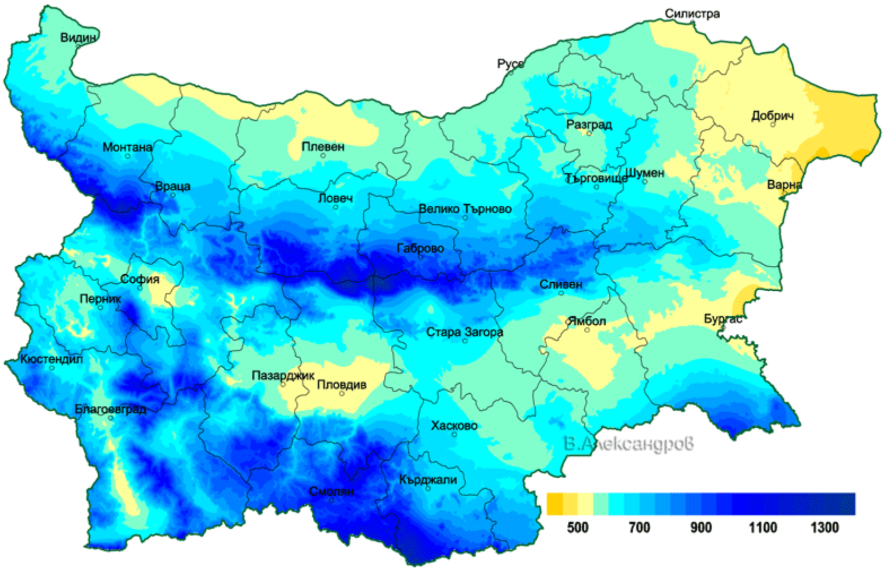


The heating season varies between 160 and 220 days for different locations. An important indicator describing the duration of the heating season and roughly the energy requirements for heating is the number of degree days. The heating degree days for indoor temperatures of 20°C vary between 2,100 and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

The average wind speed is 1.2 m/s (1.3 m/s in winter time), while prevailing winds are west or northeast. 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. 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 (Figure 6.2). Dobrudja in the northeast, the Black Sea coastal area, and parts of the Thracian Plain usually receive less than 500 millimetres. The remainder of the Thracian Plain and the Danubian Plateau get less than the country average; the Thracian Plain is often subject to summer droughts. Higher elevations, which receive the most rainfall in the country, may average over 2,540 millimetres per year. The highest monthly values are measured in June, and at some places in May, with the mean total varying between 55 and 85 mm. February, and sometimes March and September, are the driest months, with mean totals varying between 30 and 45 mm. Mean precipitation during the warm months, e.g. April through September, is 333 mm, with a standard deviation of 72 mm. Mean precipitation varies from a maximum of 573 mm in the Balkan Mountain to a minimum of 211 mm in south-eastern Bulgaria

Figure 6.2 Annual precipitation (in mm) during the current climate



In the last years the tendency of air temperature is towards warmer climate (Figure 6.3, Figure 6.4). Warming is observed from the middle of 1980s. In fact, since 1997 all annual temperature anomalies are positive. 2007 was the warmest year recorded during the period of measurements in Bulgaria, temperature was 1.6 degrees centigrade above The climactic normal (1961 1990). The years 1994, 2000, 2002 and 2009 were among the warmest years on record in Bulgaria. The average annual temperature for 2008 was 1.3 ± 0.4°C above the average temperature for the period 1961-1990. In northern Bulgaria warming was slightly larger (+1.4 ± 0.3°C) than in southern Bulgaria (+1.1 ± 0.3°C). The coldest month was January with 0.8°C below normal, and the warmest - March and August respectively by 3.2 and 3.1°C above normal.

Figure 6.3 Anomalies of annual temperature in Bulgaria during the period 1901-2010, relative to 1961-1990.

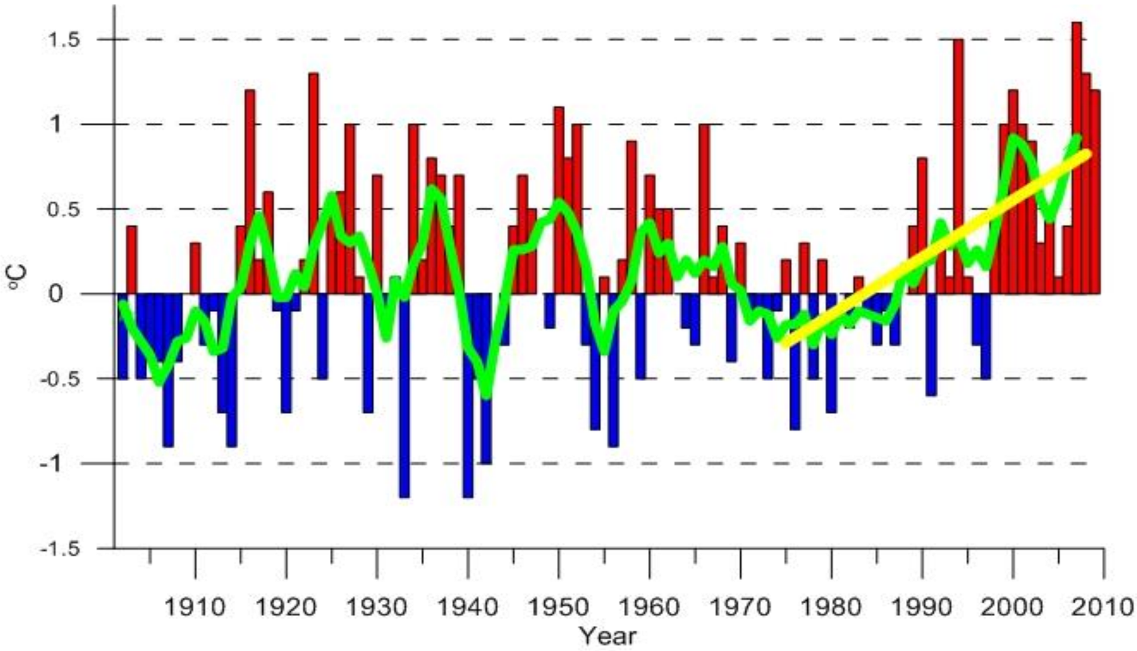
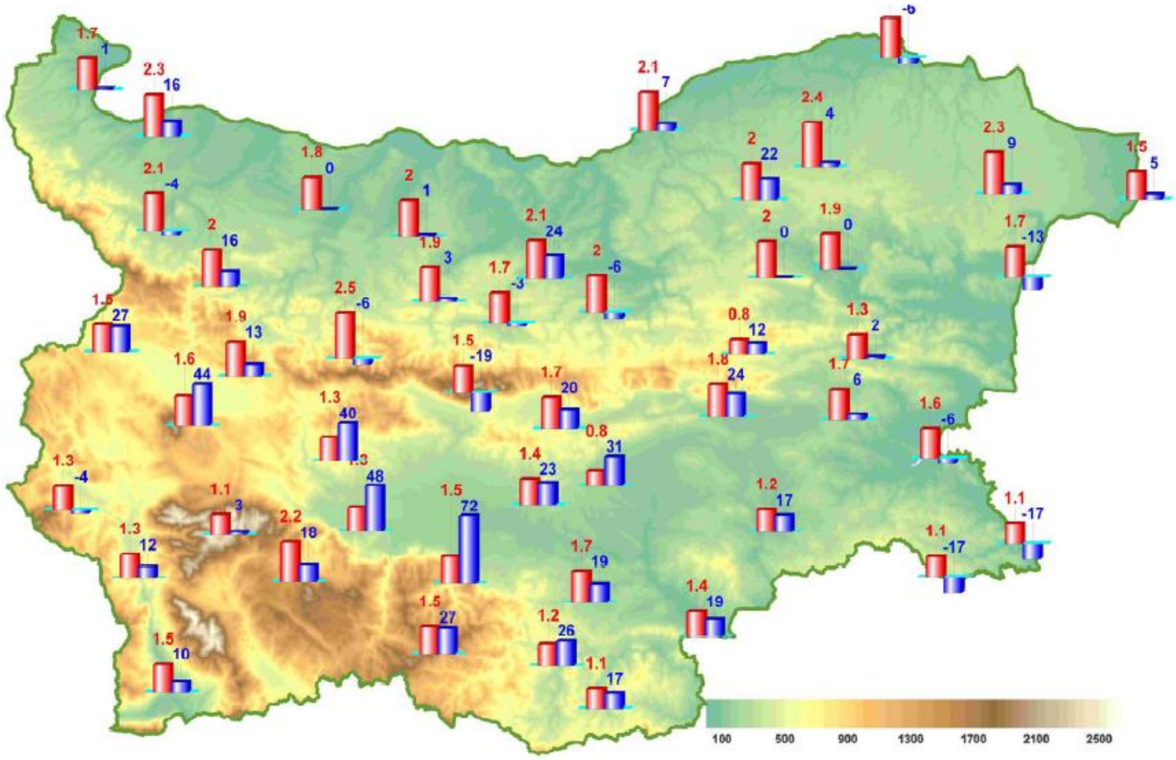


Figure 6.4 Deviations of annual average air temperature (in °C) and annual precipitation (in %) in 2007, relative to the climate normals for the period 1961-1990.



Climate in Bulgaria became not only warmer but also drier at the end of the 20th century Figure 6.5). During the last decade however, precipitation totals has increased (Figure 6.5, Figure 6.6). (Heavy rains caused severe floods damaging various socioeconomic sectors.

Figure 6.5 Anomalies of annual precipitation in Bulgaria during the 20th century

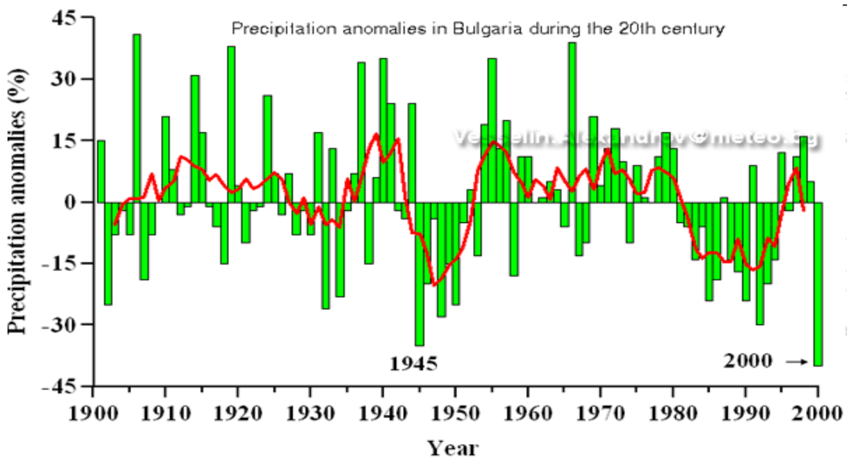
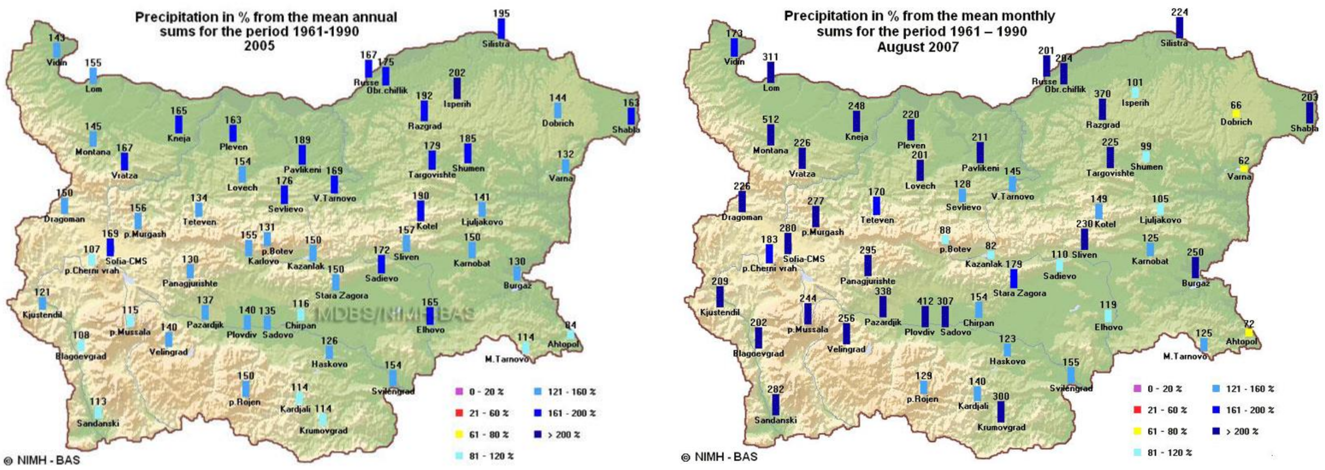


Figure 6.6 Annual precipitation in 2005 and monthly precipitation in August 2007 (as % from the norm)



Weather and climate extremes have increased during the last decades. As is shown on Figure 6.7.

Figure 6.7 Weather and climate extremes.

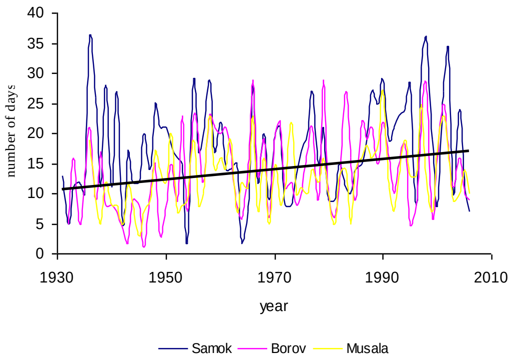


Fig. 6.7a. Number of warm days (Tmin> 0ºC) during the winter

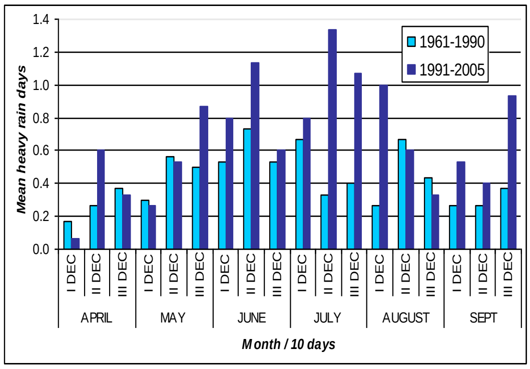


Fig. 6.7b. Intra-monthly distribution of heavy precipitation days during the warm half of the year

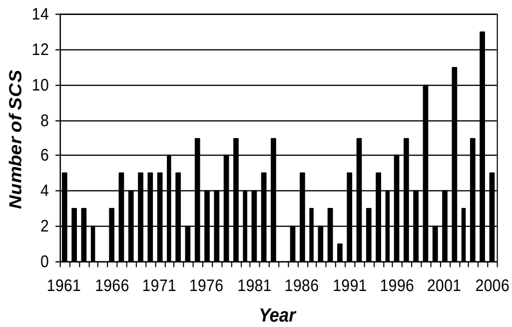


Fig. 6.7c. Tendency of seasonal (April-September) number of severe convective storms.

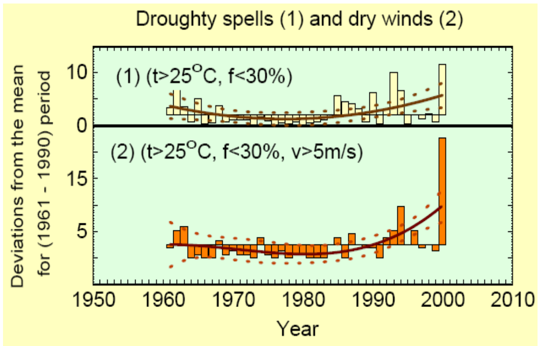


Fig. 6.7d. Distribution of dry winds and t – f drought spells by years

6.2. Expected Impacts of Climate Change for Eastern Europe including Bulgaria

6.2.1. Climate Scenarios for 2050

In the CLAVIER project, LMDZ-regional climate model was forced by the outputs of three global climate change scenarios from the models ECHAM-A1B, ECHAM-B1 and IPSL-A1B. All the three simulations cover the period from 2000 to 2050 and follow the IPCC-defined emission scenarios. Two additional simulations were performed for the period from 1951 to 2000 following the 20th-century simulations with the global climate models ECHAM and IPSL.

Figure 6.8 plots the temporal evolution of annual-mean surface air temperature, averaged for the CLAVIER domain (Hungary + Romania + Bulgaria). The black curve indicates the 20th century ECHAM simulation for the period 1951-2000. The counterpart from IPSL is represented in orange curve. We can observe a general warming trend for the last two decades of the 20th century for the two curves, but the

IPSL result is about 2°C cooler than the ECHAM result. The green and yellow curves (from 2001 to 2050) are the A1B and B1 scenarios from ECHAM, respectively. The A1B scenario is generally warmer than the B1 scenario, but the difference is small for our considered time scale, around 2050. The red curve is the A1B scenario from IPSL for the period 2001-2050. Despite the general cool feature of IPSL in the 20th century, the future warming is more important, the surface air temperature reaches a very similar level as in ECHAM. This indicates that the temperature increase is about 2°C larger in IPSL than in ECHAM, which is directly related to a different behaviour of simulated climate sensitivity in the two IPCC-AR4 models developed and used in Hamburg (ECHAM) and Paris (IPSL) respectively.

Figure 6.8 Annual-mean air temperature at 2m (upper, °C) and precipitation rate (lower, mm/day) in function of time from 1951 to 2050. The spatial average was performed for the CLAVIER region (Hungary, Romania and Bulgaria).

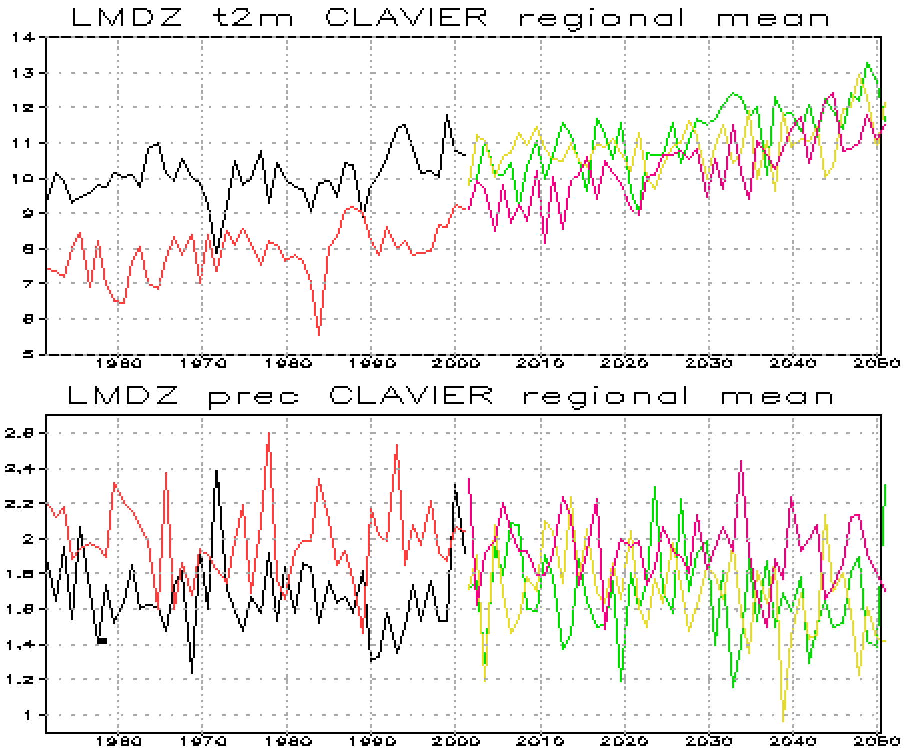
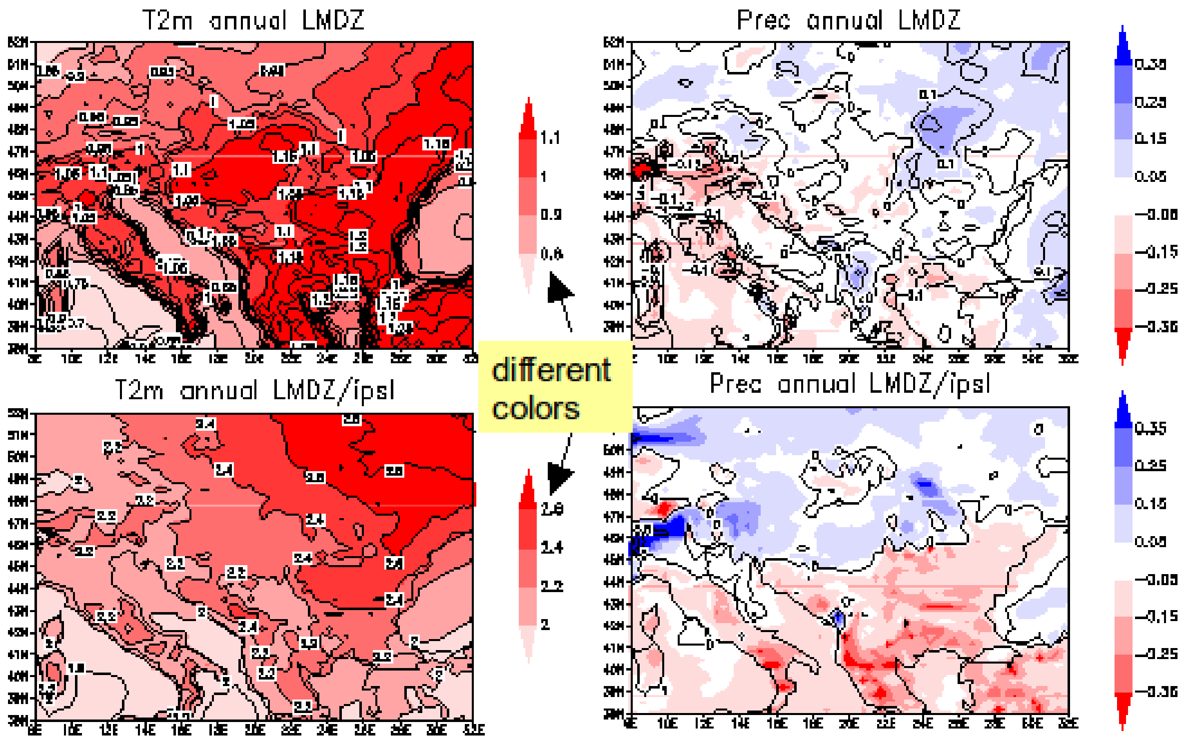


Figure 6.9 gives the geographic distribution of annual-mean changes in surface air temperature and precipitation for the A1B scenario. ECHAM and IPSL can be compared against each other. For surface air temperature, the warming in IPSL is much more important in IPSL with maxima in the Northeast of the domain. The warming in ECHAM is modest and with a more uniform spatial distribution. Concerning the precipitation, a general tendency of decrease is depicted in the South part of the domain and an increase in the North. The variation in the CLAVIER domain is small. Again we can observe that IPSL shows larger changes than ECHAM does.

Figure 6.9 Changes of surface air temperature (left, °C) and precipitation rate (right, mm/day) as predicted by LMDZ-regional (2001/2050 - 1951/2000). The upper panels are from LMDZ-regional forced by the MPI global climate model



Error! Not a valid bookmark self-reference. shows the averaged surface air temperature for Bulgaria s and for the two emission scenarios respectively.

Table 6.1 Spatial average of surface air temperature in Bulgaria for the two A1B scenarios (from respectively MPI and IPSL) and the B1 scenario from MPI global climate model:

	1961/1990	2021/2050 B1	2021/2050 A1B
LMDZ forced by ECHAM	10.63	11.87(+1.25)	12.41 (+1.78)
LMDZ forced by IPSL	8.5		11.31 (+2.81)

Table 6.2 gives the results on precipitation.

Table 6.2 Spatial average of precipitation rate (mm/day) for the two A1B scenarios (from respectively MPI and IPSL) and the B1 scenario from MPI global climate model:

		1961/1990	2021/2050 B1	2021/2050 A1B
LMDZ forced by ECHAM	**Bulgaria**	1.50	1.41 (-0.09)	1.52 (+0.02)
LMDZ forced by IPSL	**Bulgaria**	2.05		1.91 (-0.14)

The eventual increase of weather and climate extremes due to a shift in mean climate (global warming) is a heavily discussed issue, as extremes present first-order menaces for the general public, the economy and the natural environment. According to IPCC an extreme weather event is an event that is rare within its statistical reference distribution at a particular place. Definitions of “rare” vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile. Extreme parameters, which are listed in the table below, and their trends were investigated for the CLAVIER study region between 1951 and 2050 (Figure 6.10, Figure 6.11). The analysis is based on the empirical-statistical error corrected data from the STAT-CLIMATE-ECA-REMO57_a1b scenario.

Table 6.3 Parameters for extremes

Name	Unit	Description
mean temperature	K	mean surface(2m) air temperature
90th percentile of maximum temperature	°C	90th percentile of daily maximum temperature(tas_dx)
10th percentile of minimum temperature	°C	10th percentile of daily minimum temperature(tas_dn)
The number of frost days	days	number of days with minimum temperature (tas_dn)
summer days	days	number of days where the maximum temperature (tas_dx) exceeds 25°C
tropical nights	days	number of days where the minimum temperature (tas_dn) exceeds 20°C
90th percentile heat wave duration	days	maximum number of days per year (at least 6) where the maximum temperature (tas_dx) exceeds its long term (30 years) 90th percentile calculated in 5-day windows
precipitation amount	mm/day	mean surface precipitation amount
precipitation intensity	mm/day	mean daily precipitation sum on rainy days (days where pr_24h exceeds 1mm/day)
90th percentile of wet day precipitation	mm	90th percentile of daily precipitation sums (pr_24h)
90th percentile of wet day precipitation	mm	90th percentile of daily precipitation sums (pr_24h) on wet days (pr_24hc >= 1mm)
greatest 1-day rainfall	mm	maximum precipitation sum in one day
greatest 5-day rainfall	mm	maximum precipitation sum in 5 consecutive days
intense precipitation	days	number of days where the daily precipitation sum (pr_24hc) exceeds 10 mm/day
consecutive dry days	days	maximum number of consecutive dry days

Regarding the temperature-related indices for extremes, a throughout significant warming signal can be found in the entire CLAVIER domain with warming maxima in winter and autumn. Most drastically this can be seen in the summer months for tropical nights (tnn20, minimum temperature > 20°C) in Bulgaria. The duration of heat waves notably increases till the mid century. A comparison of the CLAVIER countries shows comparable trends in all three countries in most parameters, but on a higher level in Bulgaria. Regarding precipitation-related indices for extremes, only few significant trends are found. In all three countries all parameters (mean precipitation and parameters for extremes) have the tendency to decline in summer and to increase in winter. Bulgaria again stands out with a strong increase in consecutive dry days.

6.2.2. Climate Scenarios for the 2080s and end of 21 Century

Significant summer warming in the western Balkan countries, were projected by the HadCM3 model for 2080. Air temperatures during this time of the year are expected to increase between 5° and 8°C over most of the countries in the peninsula. Summer precipitation is projected to decrease in the region of interest. HadCM3 climate change scenarios were also created for every used weather stations from selected areas in Bulgaria. Figure 6.12 shows the monthly climate values of air temperature and precipitation in Novachene (north Bulgaria) under the HaDCM3 climate change scenarios for the years 2020, 2050 and 2080. It could be seen that the newer HadCM3 model simulates higher increases for monthly air temperature in comparison to the previous HadCM2 ones. Even air temperatures in July and August are projected to be in 2080 near 8°C higher than air temperatures, relative to the period 1961-1990 (Figure 6.11). Simulated HadCM3 precipitation has a similar direction for the 21st century as for the HadCM2 and ECHAM4 models – a decreasing one. Monthly precipitation in Novachene from May to September is projected to be about 50 % reduced in 2080. Only precipitation in February and March as well as December is expected to increase during the 21st century.

Additional findings from the CECILIA project are listed below:

- Obviously winters will be milder in the next decades reaching up to 10°C and even more in some areas
- Recent summers will gradually disappear as it will be hotter with average maximum air temperatures often above 30°C in most lowland areas in the country.
- Ice days will decrease, higher min temperature will affect the period of vernalisation in winter and crop growth in summer
- It is clear that by increasing maximum and minimum air temperatures will caused respective increase of mean air temperature both in winter and summer
- The number of summer days increases up to 90 days in the period 2021-2050. Percentage of summer days is projected to rise from 18-20 % nowadays to more than 40 % in most flat locations in south Bulgaria
- The hot days would increase as well, up to 30 % till the end of the 21st century.

Figure 6.10 Trend analysis for tropical nights

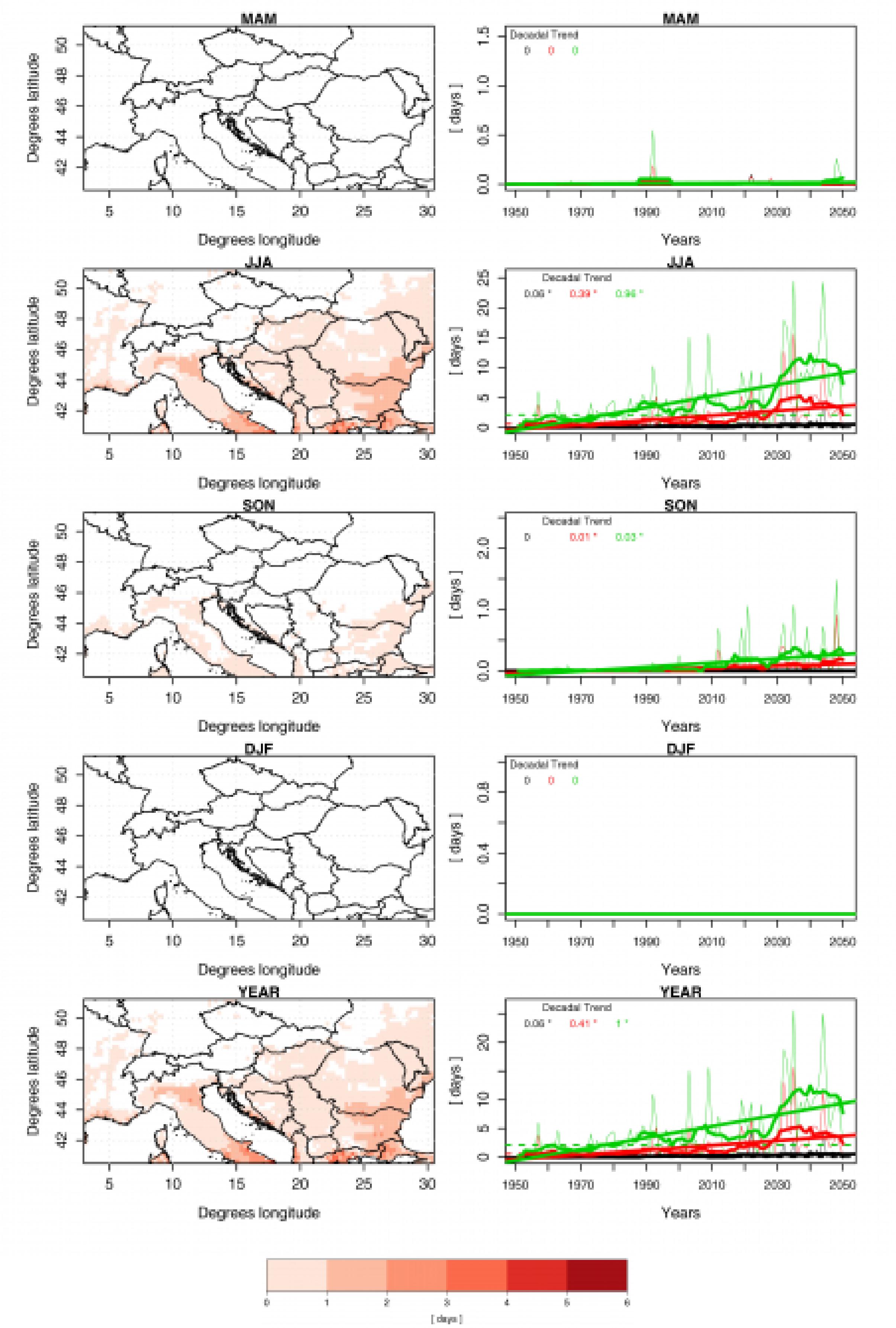


Figure 6.11 Trend analyses for the greatest 5-day rainfall

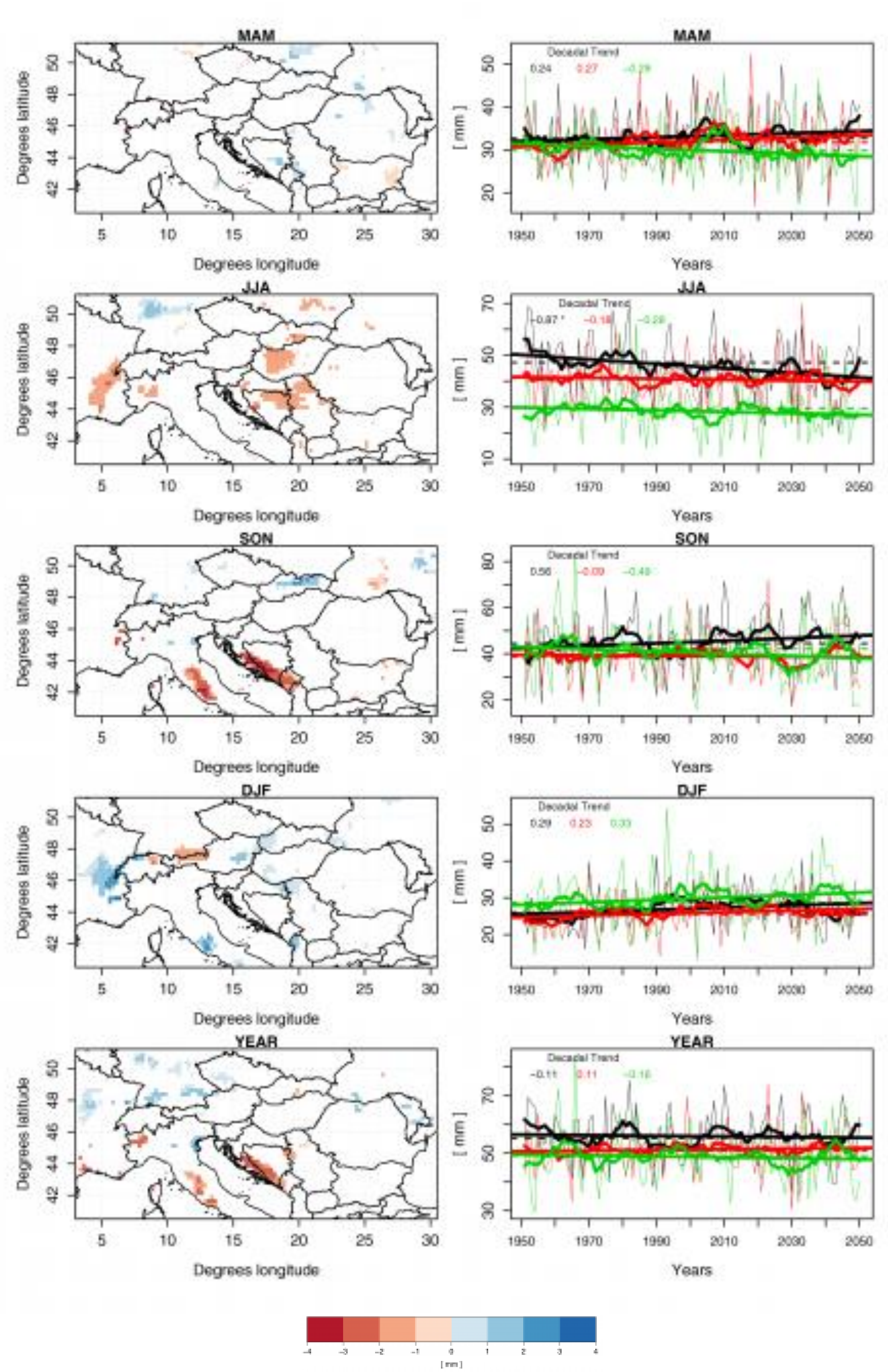
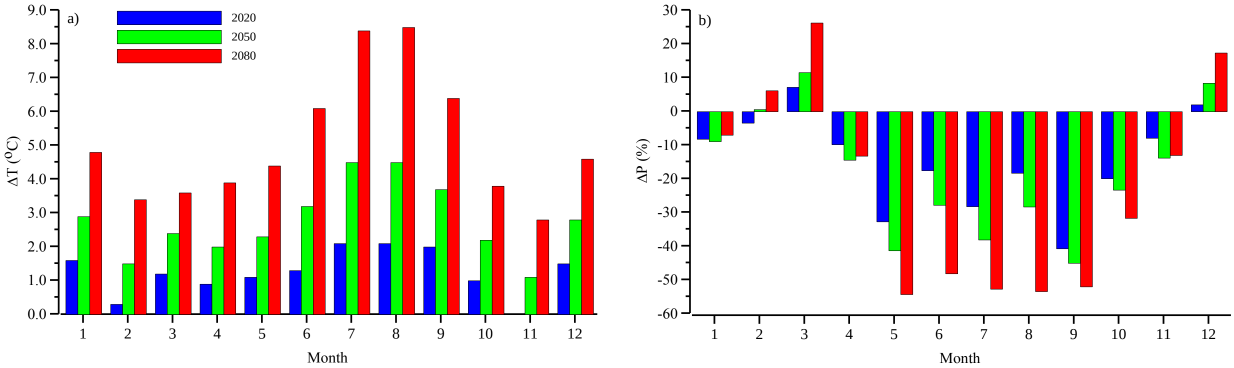
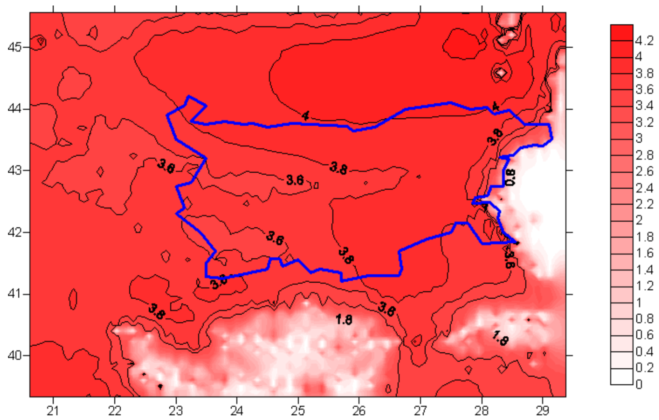


Figure 6.12 Monthly HaDCM3 climate change scenarios values of air temperature (a) and precipitation (b) in Novachene (north Bulgaria) for the 2020, 2050 and 2080.

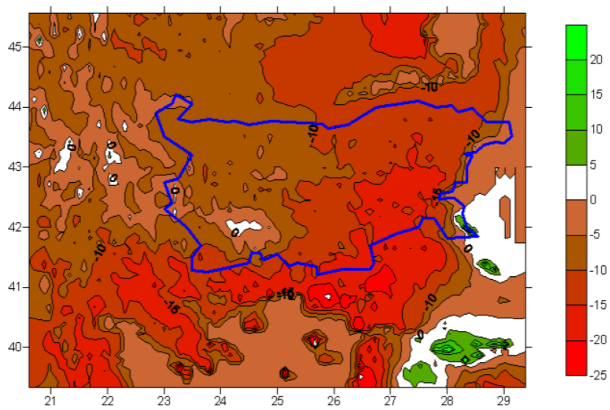


Under the umbrella of the CECILIA project climate change scenarios for Bulgaria were also simulated by applying the ALADIN regional model (Figure 6.13)

Figure 6.13 Climate change scenarios in Bulgaria for the end of the 21st century

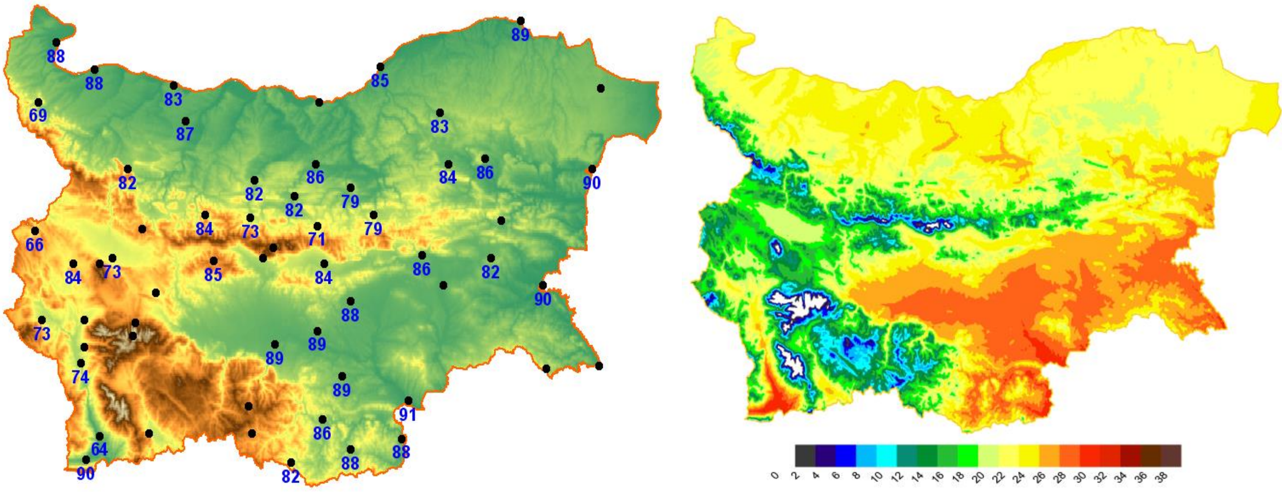


Annual temperature changes (in ºC) at the end of the 21st century, relative to 1961-1990



Annual precipitation changes (in %) at the end of the 21st century, relative to 1961-1990

Figure 6.14 Summer days (Tmax>25ºC), 1961-1990 (left). 2021-2050 (right)



6.3. Vulnerability Assessment

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

A Case Study (North East Region)

Meteorological conditions have an impact on crop yields. A CLAVIER case study assesses the importance of the impacts in the past, and provides future scenarios of various crop yields using a statistical climate-crop model. For this purpose, multiple linear regressions (MLR) are used with selected meteorological parameters as independent predictors and regional crop yields as dependent variable (Bulgaria – NUTS 3 regions Varna, Razgrad, Ruse, Silistra, Dobrich, Turgovishte and Shumen). The most important crop yields for each region, chosen from the crop types wheat, maize, barley, sunflowers and potatoes are taken into account. As climate simulations the STAT-CLIMATE ECA-REMO57-era40 (training dataset) and STAT-CLIMATE-ECA-REMO57-a1b (control and scenario dataset) datasets have been used.

Climate-crop yield model evaluation is realised by using meteorological predictors from the “hindcast” simulation. A hindcast is considered to represent the observed local weather conditions in the past. Under the assumption that the estimated relationship between the predictors and the predictand remains unchanged over time, scenarios for Bulgaria and for Romanian regions are produced for the period 1951-2050. The scenarios are tested for significant linear trends. However, the interest of this report lies in the prediction of absolute values of crop yields, especially in yield anomalies and not in the prediction of growth rates in crop yields. The applied meteorological predictors have been selected using expert knowledge and objective model selection criteria. Non-climatic influences like technological advancements, political changes, etc. are eliminated in advance, defining them as slowly developing trends. Various model set ups have been tested against observations (black line)

Main Message: Firstly, the effects of climate change—as simulated by the three applied scenarios—on the economic results of crop production in the case study region are positive. The reasons for this are complex and need to be examined additionally. Secondly, the effect of the investigated climate caused change in crop output on the regional economy is again positive, but much more modest.

Quantified economic impacts: Firstly, the impact of climate changes on crop yields, measured as variation of gross agricultural output, is positive. It varies between 11 % and 23 % for the different climate scenarios. Secondly, the impacts of this climate caused crop yield changes on the regional economy are expected to be positive with increases between 2 % and 4 % in the total output compared to the baseline scenario (see Table 6.4).

Table 6.4 Economic impacts of climate caused crop yield changes on gross agricultural output and total regional output in the North East Region

	Scenario			
	Baseline	**REMO-A1B**	**LMDZ-A1B**	**LMDZ-B1**
Gross agricultural output [mill. €]	1,340.87	1,495.04	1,651.46	1,595.39
Difference to the baseline scenario [%]		+11.50	+23.16	+18.98
Total regional output [mill. €]	15,598.67	15,902.11	16,214.95	16,102.83
Difference to the baseline scenario [%]		+1.95	+3.95	+3.23

The main natural disasters in Bulgaria are forest fires, floods, wind throws and disturbances by insects. Recently these seriously damage the Bulgarian forests. During the last 5 years more than 500 thousands ha forests were damaged by forest fires. Most of them (about 80 %) are not restored until now. These forest territories are with high capacity to be damaged further by insects and diseases and they contribute to soil erosion and floods. In addition private forest owners do not have enough financial resources to restore these forest areas. Without financial support these forest areas will be transformed in abandoned.

Other natural disasters important for forests are wind throws. During the last 5 years more than 120 thousands m^3 (250 thousands ha) are damaged. Only 50 % from these forests are restored and mainly In state forest fund. As a result huge damaged territory I still not restored like the areas damaged by forest fires, especially in small private and communal forest lands.

These serious threats for Bulgarian forests lead to loss of capacity for CO_2 absorption and production of forest products.

Without financial funding from the rural Development Programme, forest areas will be further damaged and the damaged areas will not be restored.

37 % of the territory of Bulgaria are forests, which are distributed mainly in mountain areas. The main regions with intensive agriculture are in northern Bulgaria and around Maritsa river and are with forest cover less than 10 %. A big part of the former agriculture lands in mountain and semi-mountain regions is still not used, which leads to big ecological, social and economic problems.

In the plains, because of the low forest cover, the forests and other forest lands are divided in pieces. For protection of biodiversity at least natural bridges are needed.

In addition the extension of forest resources contributes to the climate change combat and increases CO_2 absorption. For this purpose the abandoned agricultural lands have huge capacity, because of the appropriate conditions for fast growth of the young forests.

In the mountain areas there is high level of land degradation and regressive succession. These areas lose soil as a result from wind and water erosion. Their opportunities to combat with natural disasters like floods, soil erosion and to improve the water quality are very small.

Through increasing the forest cover (with native tree species) the water balance in the adjacent territories will be improved, which is important problem for the southeast countries. (Table 6.5)

Table 6.5 Forest cover and non-forestry areas

year	Total forest area not designated for wood production	including.					
		Arable land	meadows	lawns	nurseries	Roads, openings	rocks, rivers, screes
	hectares						
1988	285 834	3 301	1 881	85 241	2 654	25 630	167 127
1989	283 182	4 125	1 804	86 434	2 637	30 215	157 967
1990	281 714	4 077	1 848	87 762	2 634	31 706	153 667
1991	281 118	4 082	1 885	87 420	2 703	32 554	152 474
1992	280 735	3 948	1 881	88 449	2 667	33 172	150 617
1993	282 627	4 416	1 942	89 479	2 555	33 803	150 432
1994	269 097	4 821	1 902	86 158	2 298	32 011	141 907
1995	291 157	4 991	1 957	97 418	2 406	36 186	148 199
1996	295 057	5 518	2 086	101 325	4 096	36 954	145 078
1997	297 485	4 916	1 993	103 437	2 263	37 557	147 319
1998	301 068	4 820	2 119	106 120	2 300	39 091	146 618
1999	275 952	5 800	2 004	98 300	2 494	35 420	131 934
2000	295 832	4 659	4 001	104 203	2 344	37 610	143 015
2001	298 233	6 041	2 809	105 682	2 499	38 215	142 987
2002	302 027	4 515	4 105	108 649	2 898	39 564	142 296
2003	298 846	4 589	3 236	109 518	2 551	338 812	140 140
2004	303 056	4 294	4 620	110 883	2 292	40 273	140 694
2005	302 792	4 178	4 389	109 328	2 146	42 201	140 550
2006	301 429	4 155	4 645	108 803	2 037	42 657	139 132
2007	310 889	4 239	3 934	110 508	2 027	43 442	146 739
2008	314 205	4 782	4 138	112 961	2 034	43 426	146 863

Some 1.5 million hectares have been afforested during the last 50 years. By 1989 the rate of afforestation had decreased significantly (5,000 - 7, 000 ha per year) while some 15,000 ha was envisaged in the Forest Management Plans (FMPs). The decline in afforestation was due to a decrease in the level of investment and increased priority for natural regeneration.

Sustainability of forest plantations is achieved by an increase in the proportion of native broadleaved tree species, a decrease in the initial stocking rate of plantations, the establishment of mixed plantations and afforestation using forest tree and shrub species in their natural areas. Establishment operations are undertaken principally on state forest fund territories and particularly on areas destroyed by fire, stands and plantations damaged by drought, clearings and bare areas.

The reserve for the future expansion of the forests is estimated as nearly 300 000 ha. According to expert evaluation there are about 100 000 ha of bare lands, suitable for afforestation.

There are some regulatory preconditions - internal (amendments to the Law on Forest) and external (mechanisms for mutual implementation of the Kyoto Protocol) - for ensuring sustainable contribution of our country towards decreasing CO_2 emissions and increasing renewable energy sources through the establishment of new forests, including plantations for biomass.

An especially important task for the management of forest resources, particularly in that part of the country – with an altitude of up to 800 m, is the implementation of the activities concerning the adapting of forest vegetation to the climate changes.

The average growing stock per hectare in 2008 was 159 m^3. During the last 35 years the total growing stock more than doubled from 252.2 million m^3 to 591 million m^3. Total annual increment of the forests is estimated as 14 million m^3.

The large-scale afforestation activities from the middle of the last century resulted in a sudden increase in the area covered by coniferous forest. After 1990 the area of conifer forests started to decline and now represent only 30.2 % of the forest area. This trend is expected to continue into the future.

The forest area managed mainly for the purpose of harvesting and environmental functions during 2008 was 68.1 %; protective forests and forests for recreation represented 19.8 % and the forests and lands in protected areas covered 8.2 % of the forest fund of the country. Some 13.4 % of Bulgarian forests have as a primary function the protection of the soil against erosion and water balance maintenance.

In the context of the regulated carbon markets, forestry and land-use projects have played a very small role in producing emission reductions so far, even though it is estimated that around 20 percent of greenhouse gases emissions globally are linked to the forestry and land-use sector. On the voluntary market the picture is quite different, with forestry projects representing as much as 15 percent of all.

Developing carbon forestry projects for the voluntary market is another possibility that should be explored. Again some of the limitations associated with JI projects could be mitigated. Since buyers on the voluntary market are not necessarily time bound by a dated emissions reduction target, the project implementation period can be longer.

Another opportunity that needs to be considered in the forestry sector is the use of biomass in energy production. The use of local fuel-wood and wood waste (bark, shavings, etc.), industrial waste wood, or agricultural residues for heating, energy production, or combined heat and power plants could have a large potential in rural areas in Bulgaria. Improved forest management and thinning operations could increase the access to fuel-wood and wood waste. The benefits would potentially include lower fuel costs, reduced local air pollution, and access to locally-produced energy sources. The greenhouse gases emission reductions depend on the fuel that is replaced. In addition methane emissions from the decay of wood waste would be reduced, which could also have large emission reduction and carbon revenue potential. Carbon revenues could be generated from the emission reductions associated with switching fuels (from a carbon intensive fuel like mazut to a relatively less carbon intensive fuel source like wood).

6.3.1. Agriculture

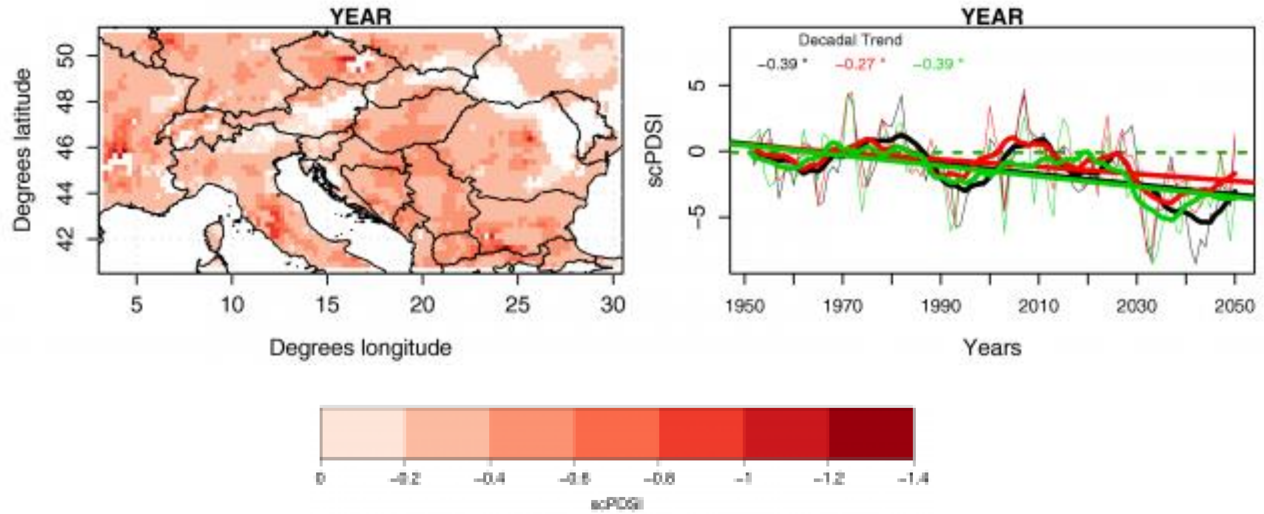
The Palmer Drought Severity Index (PDSI) was invented in 1965 by Wayne Palmer and belongs to the group of the agro-meteorological drought indices. The index is based on the calculation of a climatic soil water balance and requires long term temperature, precipitation data on a monthly time scale and the available water holding capacity (AWC) as a soil parameter, whereas the AWC is the amount of water which can be held in the root-zone between the wilting point of the plants and the field capacity. The PDSI is arranged into 12 classes (from extremely wet to extremely dry). The Classification is mentioned in the table below.

Table 6.6 Classification

PDSI	CLASS
≥4	extremely wet
3.00 to 3.99	very wet
2.00 to 2.99	
1.00 to 1.99	slightly wet
0.50 to 0.99	incipient wet spell
0.49 to -0.49	near normal
-0.50 to -0.99	incipient drought
-1.00 to -1.99	mild drought
-2.00 to -2.99	moderate drought
-3.00 to -3.99	severe drought
≤-4	extreme drought

Within the CLAVIER project the PDSI declines in Bulgaria and all seasons by about 0.35 classes per decade. This would, e.g., shift present day mild droughts (class -1 to -1.99) to future severe droughts (class -3 to -3.99) within less than 60 years. The annual cycle of the climate change signal for Bulgaria seems to be at higher drought risk in future than Romania (shift of more that 3 classes towards drier conditions are expected) - future extreme droughts (class -4 and lower).

Figure 6.15 Seasonal and yearly time series



The times series on Figure 6.15 and the respective trends are calculated and evaluated for the PDSI between 1951 and 2050. The respective left panel shows seasonal and yearly maps of decadal trends of only significant grid cells in the entire domain. The trend direction and magnitude is colour-coded. The right panel of each plot shows seasonal and annual regional averages for the three CLAVIER countries Hungary, Romania and Bulgaria (thin line), the 1961-1990 mean value (dashed line), 10 year moving averages of the regional mean (bold line) and the linear trend of the unsmoothed regional mean represented by the thin line (bold straight line). The magnitude of the respective trend is indicated in the top left corner of each plot with significant trends being marked by an asterisk (*).

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

For example, in a result of expected warming crop-growing duration of sunflower over the Balkan Peninsula is projected to decrease, especially at the end of the 21st century (Figure 6.16). The yield changes in the selected region show different trends depending on the latitude, altitude, soil properties as well as the time slices during the current century (Figure 6.17).

Figure 6.16 HadCM3 B2 changes (in days) in sunflower growing duration in the Balkan Peninsula for 2071- 2080, relative to current climate; RoIMPEL model

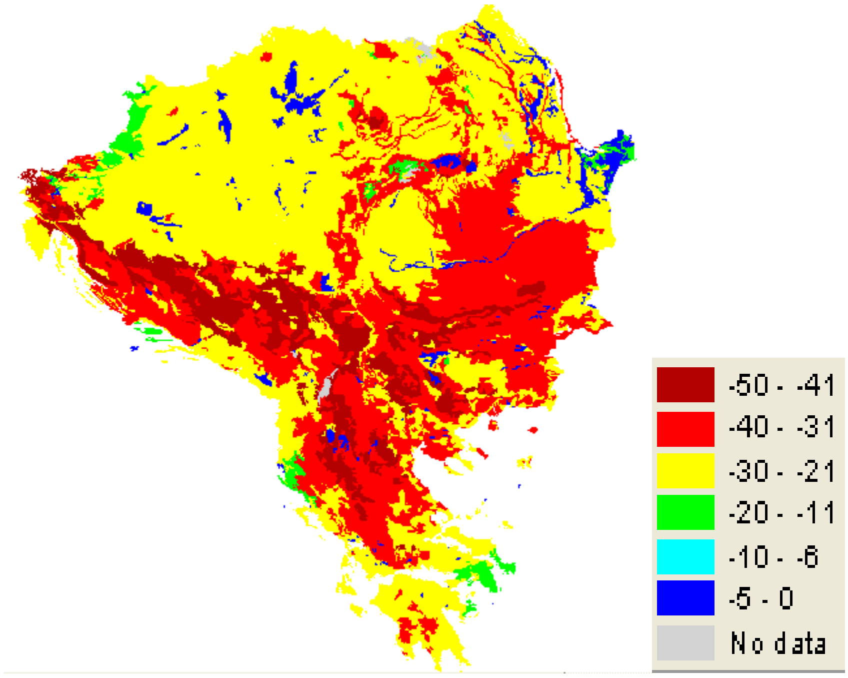
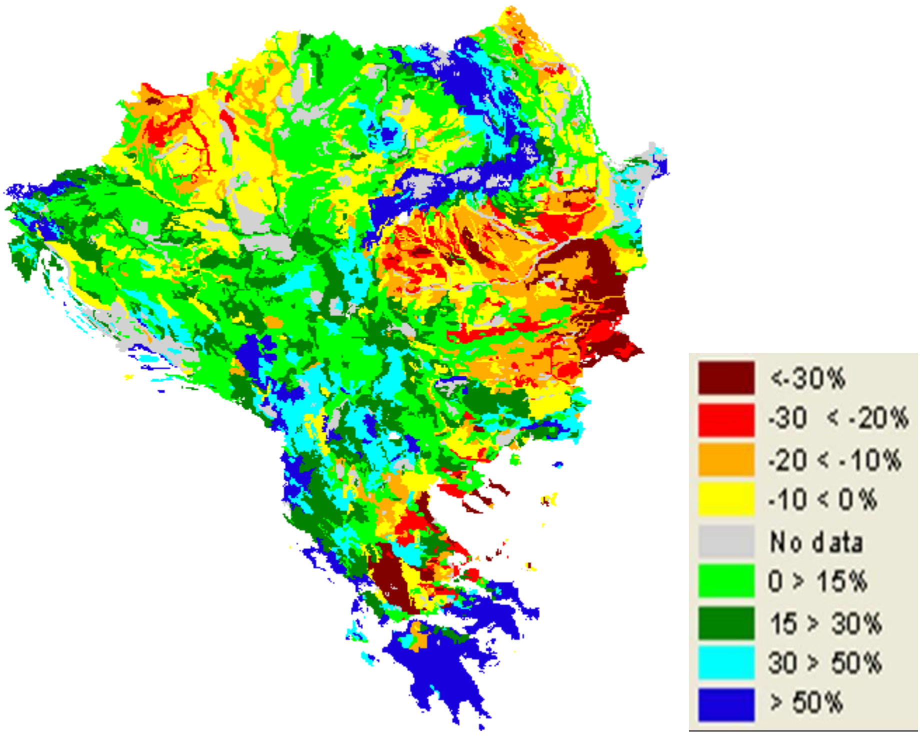


Figure 6.17 HadCM3 A2 changes (in %) in sunflower yield in the Balkan Peninsula for 2071-2080, relative to current climate; RoIMPEL model



6.3.2. Forestry

In order to define the forest ecosystem vulnerability under the possible climate changes, as well as to find measures for their adaptation to the new conditions, an information is necessary for the Bulgarian forests calibrated to a basic period. 1990 has been chosen as a base year in the study. The meaning “status of Bulgarian forests” includes information about the areas, tree species, growth rates, volumes, etc. The status of the Bulgarian forest was thoroughly described in the First National Communication. In general, the total area of the forests in the country, the 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. m3 (in 1955) up to 396.02 mil. m3 (in 1990), i.e. the amount of standing wood has increased by 61.8 % in 35 years.

The consequences of this favourable effect 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.

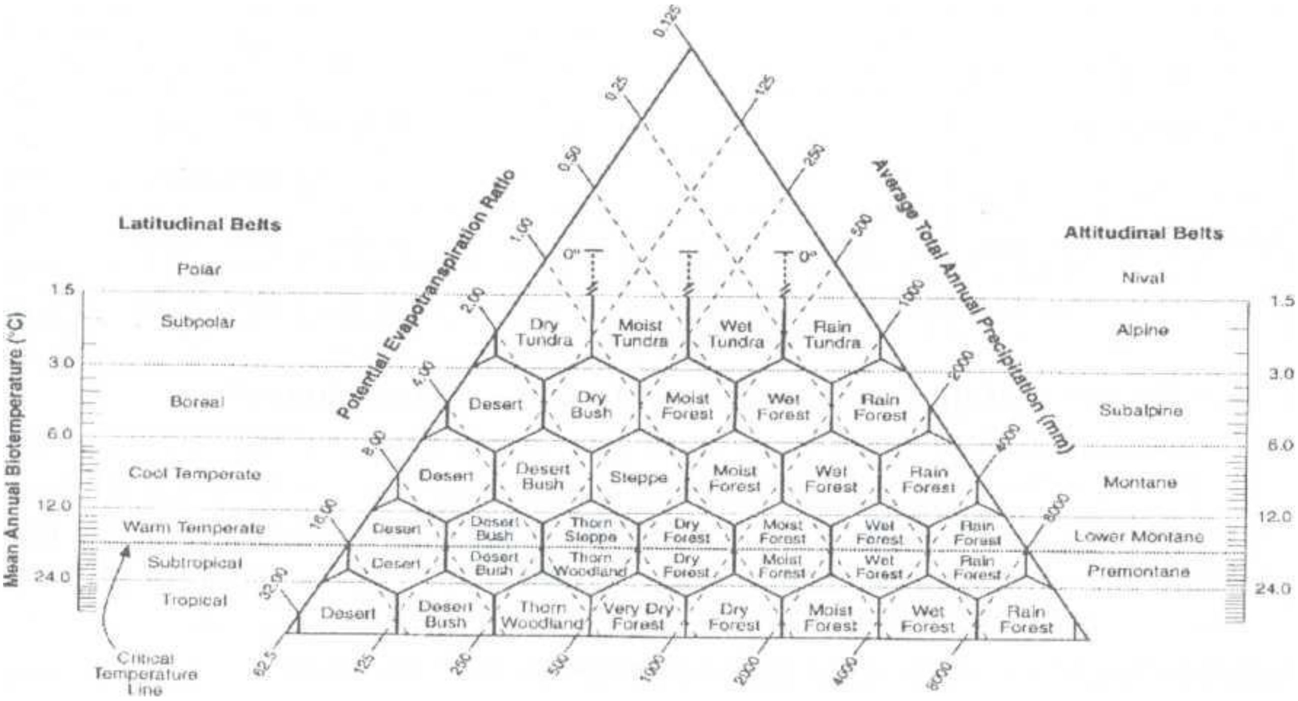
Analysis on the condition of the forest vegetation from the last decade in Bulgaria shows that the coniferous forest vegetation which was widely introduced during the last decades below 800 m a.s.l., i.e. out of its natural habitats, forms very unstable forest ecosystems. The main reason is the discrepancy 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.

Defining the vulnerability zones using the Holdridge method

The Holdridge model connects the spatial distribution of the present vegetation to the factors of the climate system (ANL, 1994; Holdridge, 1967). This model is appropriate for studying the wide distributed structure of the vegetation according the climate factors and can be used for evaluation of the climate change on the capability of one region or another to maintain the development of different forest types. The Holdridge model is climatic classification scheme which connects the distribution of the main ecosystem complexes to the climate indexes as bio temperature, annual precipitation and the relation between the potential evapotranspiration to the precipitation (Holdridge, 1967):



One additional side of Holdridge is that the classification is based on the appearance of the phenomenon “killing” frost. This is the critical temperature which divides the hexagons 12°C and 24°C to “warm” temperature and subtropical zone. The life zones are explained with series of hexagons in one triangle coordination system (ANL, 1994). The tow climatic elements - bio temperature and annual precipitation - modify the vegetation classification. The bio temperature in the particular case is the temperature sum above 0°C during one calendar year. The entire Holdridge classification includes 39 life zones (ANL, 1994):

Index	Description	Index	Description
1	**Ice**		
2	**Polar desert**	**21**	**Warm temperate dry forest**
3	**Subpolar dry tundra**	**22**	**Warm temperate moist forest**
4	**Subpolar moist tundra**	**23**	**Warm temperate wet forest**
5	**Subpolar wet tundra**	**24**	**Warm temperate rain forest**
6	**Subpolar rain tundra**	**25**	**Subtropical desert**
7	**Boreal tundrt**	**26**	**Subtropical desert scrub**
8	**Boreal dry scrub**	**27**	**Subtropical thorn woodland**
9	**Boreal moist forest**	**28**	**Subtropical dry forest**
10	**Boreal wet forest**	**29**	**Subtropical moist forest**
11	**Boreal rain forest**	**30**	**Subtropical wet forest**
12	**Cool temperate desert**	**31**	**Subtropical rain forest**
13	**Cool temperate desert scrub**	**32**	**Tropical desert**
14	**Cool temperate steppe**	**33**	**Tropical desert scrub**
15	**Cool temperate moist forest**	**34**	**Tropical thorn woodland**
16	**Cool temperate wet forest**	**35**	**Tropical very dry forest**
17	**Cool temperate rain forest**	**36**	**Tropical dry forest**
18	**Warm temperatedesert**	**37**	**Tropical moist forest**
19	**Warm temperate desert scrub**	**38**	**Tropical wet forest**
20	**Warm temperate thorn scrub**	**39**	**Tropical rain forest**

In the conditions of present climate bigger part the forest cover in the semi-mountain and mountain part of the country, according the calculations done, comes in the category „cool temperate moist forest”. In 2020 and 2050 the participation of this category of forests is decreasing and on their place are established conditions for transition to „warm temperate dry forest” (projections). In 2080, particularly for the pessimistic scenario, the type „subtropical thorn woodland” can be reached. This is true mostly for the Danube plain, the Thracian lowlands and the Struma river valley.

From the presented above we can see that the vulnerability zones are defined in the best way with De Marton method. The biggest advantage of this method is the fact that it works with available information - average annual air temperature and annual precipitation. Besides this, they are connected in certain extend with the altitudes. This is reason why this method will be proposed as a base for defining the vulnerability zones of the forest vegetation in terms of climate changes in the forests of Bulgaria.
Defining the vulnerability zones through the method of De Marton

The values of De Marton index and their ecological meaning have the following parameters:

- Zone A - index with value under 20 (in red color on the map): lasting deficit in moistening, which leads to destruction of the forest ecosystems;

- Zone B - index from 21 to 30 (in yellow color on the map): lasting disturbances in the moistening;

- Zone C - index from 31 to 40 (in green color on the map): disturbances in the moistening in some years;

- Zone D - index from 41 to 70 (in blue color on the map): optimal conditions in the moistening;

- Zone E - index above 70 (in purple color on the map): over moistening.

According the calculations and the elaborated maps, in conditions of present climate there is no zone with value of De Marton index under 20, in which case the forest vegetation degrades.

In 2020 realistic scenario we can expect the appearance of values under on significant parts of North-East Bulgaria. This process increases in 2050 with a strip along Danube River near the town of Svishtov, and in 2080 this zone expands from Black Sea to the town of Tutrakan, from Svishtov to the town of Vidin, as well as in parts of Thracian Lowland - In pessimistic scenario for 2080 the picture is too unfavorable: lasting deficit in moistening appears on almost entire South Dobrudja, bigger part of the Danube plain and Thracian lowland, as appears also in the region of Petrich and Sandanski (South-West towns).

Zone A can be qualified as the most dangerous vulnerability zone in future climate changes as there is lasting deficit of moistening.

At present time **Zone B** covers significant territories with altitude a.s.l. from 0 to-200 m. It includes the Northern part of Danube plain, South Dobrudja, parts of the Thracian lowland and the Black Sea coastal area without Strandja mountain. In 2020 zone B covers almost entire Danube plain, the West part of Dobrudja, almost entire Thracian Lowland, the fields around Petrich and Sandanski, the south coastal area of Black Sea and other lands under 300 m a.s.l. In 2050 zone B reaches 600 m a.s.l. and covers Danube plain, Dobrudja, the foothills of Balkan mountain, the entire Thracian Lowland, the East Rhodope mountain, big parts of Sredna Gora mountain and Strandja mountain, Sofia field, the valleys of Struma and Mesta rivers. In 2080 zone B covers bigger part of the territories from 200 to 900 m a.s.l.. In pessimistic scenario for 2080 zone B covers all territories from 200 to 1000 m a.s.l..

Zone C at present time covers large territories in the range 200-800 m a.s.l. in the South half of the Danube plain, the foothills of Balkan, Sredna Gora, the high fields of West Bulgaria, the valleys of Struma and Mesta rivers, East Rhodope and Strandja. In 2020 it covers territories from 300 to 900 m a.s.l. ; in 2050 from 600 to 1000 m a.s.l. , to reach in 2080 from 900 to 1500 m a.s.l.. In pessimistic scenario in 2080 zone C is getting smaller in the range of 1000 to 1500 m a.s.l. - only in the high Bulgarian mountains.

Zone D is the optimal zone for growing of forest tree vegetation. Now this zone covers significant parts of the mountains from 800 to 2000 m a.s.l. - Balkan, Sredna Gora, Rilo-Rhodope massive, the Western mountains. In 2020 is expected to start from 900 m a.s.l. - up to the highest parts of the mountains. In 2050 the border of the zone moves to 1000 m a.s.l., and in 2080 probably will start from 1500 m a.s.l. - it will remain only in the highest Bulgarian mountains.

Zone E is the zone with over moistening, which is also not favorable for the forest ecosystems. This zone exists only in the conditions of the present climate. It covers the highest parts of Rila and Pirin on altitude above 2000 m a.s.l. In conditions of warming and drying climate this zone dose not exists — it is not present in 2020, 2050 and 2080.

The distribution of the forest area (ha) is given according vulnerability zones for the different climate scenarios (present climate, 2020, 2050 and 2080). The data is obtained by overlapping of the map of the forests in Bulgaria from the project CORINE LAND COVER 2006 on the maps of the vulnerability zones defined with De Marton for present climate, 2020, 2050 and 2080. The territories of the forest cover show that the most vulnerable zone A, in which the forest vegetation starts to fell apart increases 1,43 times in 2050 compared to 2020 and with 4,05 times for realistic scenario in 2080 compared with 2020. For the pessimistic scenario in 2080 this increasing is over 11 times.

For the forests in vulnerability zone B with lasting water deficit, the increasing of the territories in 2020 compared to present condition is with 1,89 times; in 2050 - 3,66 times, and in 2080 for realistic scenario - 4,1 times.

In contrast to the above tendencies, the areas in zone C, in which the moistening is not sufficient only in particular years, show the opposite regularity: in 2050 compared with the present climate they decrease with 18,6 %, and in 2080 for realistic scenario with 21,1 %.

The forests in vulnerability zone D - with optimal moistening, where are the most productive Bulgarian forests, in 2020 it decreases with 25,7 %, in 2050 - 58,2 %, and in 2080 for realistic scenario with 70,4 %.

The forests in vulnerability zone E with over moistening in 2020 are decreased by half compared with the present situation and from 2050 practically does not exists.

Therefore, the climate changes in 21st century will lead to clearly notices worsening of the moistening of the Bulgarian forests, especially on lower altitude above sea level. This will have influence on the productivity and sustainability of the forest ecosystems and watersheds.

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

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

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

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

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

C. Both in lowlands and mountains – Increased biomass productivity would be accompanied by increased CO2 absorption.

Conclusions

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. It is found that for the purposes of the forestry production the most appropriate is the dryness index of De Marton for defining the vulnerability zones.

The changing of the climate to warmer and dryer leads to worsening of the forest soils characteristics. On the other hand, the change in the moisture and temperature regime of the soils leads to appearance of conditions for stress in the forest ecosystems. It is pointed that bigger part of the regions with observed stress regarding the soil moisture are located in the South Border forest vegetation zone and others are located in the North East and East Bulgaria in the low forest vegetation zone. In these regions the conditions are unfavorable and cause anomalies in the growth and development of the forest stands.

It is found out that on the territory of Bulgaria predominant are the warm (meso) temperature regimes. The warm and dry (thermo-xeric) regime of the soils is typical for the South Black Sea coast and far South regions, as well as for lands in the lower stream of Maritsa river. These regions in bigger extend overlap some sub zones of the South Border forest vegetation zone for example Low Maritsa and Strandja Black Sea coast. The cool and wet regime is typical for the soils in the mountain regions, there is growing forest vegetation and high mountain pastures.

The presence of sandy soils, more vulnerable to dryness is outlined in the territories along Danube in North Bulgaria and in some parts of North East Bulgaria, as well as rocky or “young” soils, which can be vulnerable to soil drying, but are met in mountain regions, where the precipitation as a principle are higher. The heavy clayey soils are met mostly in Thracian lowland and reach the Black Sea coast. They are also met singly and scattered in West Bulgaria. There soils can also be vulnerable to drying despite the clay containing.

Regions in Bulgaria, vulnerable in terms of climate drying and resulting effects

The climate change, despite the direction, leads to change in the composition of the vegetation and animal habitats. Some species migrate to territories with more favorable climate regime, corresponding to their ecological and biological requirements, and in more drastic and rapid changes and lack of possibility to migrate they can die. In the particular case the main importance is not in the direction of climate change but in the quantitative changes of the climate characteristics. The different biological species are distinguished with their plasticity, and because of this, their reactions to the climate changes are expected to be different.

According to Raev et al. (1996) the forest territories in Bulgaria are relatively divided into two vulnerability zones in terms of climate drying:

- Low forest vegetation zone (from 0 to 800 m a.s.l.);
- Forests in the higher parts of the country (above 800 m a.s.l.).

If we take into account the forest vegetation zoning in Bulgaria from Zahariev et al. (1979), the first zone can be divided in several smaller groups. In the lower forest vegetation zone can be differentiated three conditional groups of territories. The first group includes the forest areas close to Black Sea, mostly the far East slopes of Balkan, the East part of Strandja and some particular places on the North Black Sea coast. These territories, because of their close location to Black Sea, receive enough mostly air humidity and is expected to be affected by the processes of temperature increasing and drying on a very small scale. The second group territories includes the forest ecosystems, dominated by deciduous tree species, mostly representatives of Quercus sp., which cover the plain and hilly parts and slopes of the mountains up to 800 m a.s.l. The third group of territories is this, located by Zahariev et al. (1979) in the South Border forest vegetation zone, and in some areas of Thracian forest vegetation zone. Here the Sandanski-Petrich valley, big percentage of the low parts of East Rhodope and parts of West Rhodope are situated.

According to the realistic scenario for 2020 it is expected the De Martons’ index to be with values bellow 20 in North East Bulgaria and mostly in Dobrudja. This could lead to changes in the species composition, and areas with English oak (Q. robur) is expected to be substituted with the Pubescent Oak. The tree species, which is expected to decrease their relevant participation in the stands are: Quercus robur - English oak, Fraxinus oxycarpa - Caucasian Ash, Staphyllea

pinnata - Bladdernut, Fagus sylvatica ssp. moesiaca - beech, low mountain sub species, Crataegus monogyna - Common Hawthorn, Smilax excelsa, Alnus glutinosa - Black Alder, Carpinus betulus

- common hornbeam.

Tree species, for which is expected to increase their participation, are the following: Quercus pubescens

- Pubescent Oak, Crataegus pentagyna - small-flowered black hawthorn, Comus mas - European Cornel, Carpinus orientalis - Oriental Hornbeam, Quercus frainetto - Flungarian Oak.

From the rest of the vegetation diversity the most affected will the representatives of the mesophyll forests, because due to the disturbance of their structure is changed the light regime and this can lead to decreasing of the quantity of a number of species or to their entire extinction. Such are mostly the following species: Nectaroscordium siculum - Honey garlic, Primula vulgaris - Primrose, Cirsium creticum, Carex acuta - Acute Sedge, Leucojum aestivum - Summer snowflake, Humulus lupulus - Common hop and others.

The fauna is expected to be less affected.

The expected changes in this region can affect the coniferous monocultures as well. As in the composition of some of them exist mesophyll species as the Douglas fir, silver fir and others, they are expected to be the most affected and gradually to be excluded from the composition of the cultures. According the Budiko index for 2020 other region, which can be related to the zones with high vulnerability (zone A), are the flooded forests along Danube, which water regime most likely will be changed. This can lead to decreasing the number of some hydrophilic, the appearance of top dryness and particularly increasing of the areas, covered with amorpha (Amorpha fruticosa), which is invasive species, despite it prefers more humid areas it has significant ecological flexibility and is better than our species, typical for this region, reading this characteristic.

To the regions with moderate vulnerability degree (zone B) can be added mostly the North part of Strandja, parts of East Balkan, the region of Ludogorie, some parts of East Rhodope and Sandanski- Petrich valley.

The change in Strandja and East Balkan is expected to be not till degradation of the stands, but mostly in direction of their xerophytization. It is foreseen small increasing of the participation of xerothermic and mesoxerophyte flora elements as Hungarian Oak (Quercus frainetto), Pubescent Oak (Quercus pubescens), South European Flowering Ash (Fraxinus ornus), Pyrus elaeagrifolia, Cistus incanus and others. At the same time is possible to observe decrease of the participation of mesophyte elements as Holly (Ilex colchica), Cherry laurel (Prunus laurocerasus), Daphne pontica, Smilax excelsa, Pontic Rhododendron (Rhododendron ponticum), Euonymus latifolius, and from the grass species - Epimedium pubigerum, Primula vulgaris, Trachystemon orientalis and others. Changes in the shrub habitats, growing mostly on limestone and rocky grounds, are not expected. It is also possible the increasing of some species, rare at the moment and Sideritis taurica, Teucrium lamiifolium, Phyllirea latifolia. Another possibility is the appearance of new individuals of the newly discovered tree species in Strandja -Kumarka (Arbutus unedo).

The relevantly lower dryness can cause drying in the black pine cultures, which are predominant in Strandja and to increase the fire danger rating. The dryness is expected to cause the beginning of entering of invasive species in the stands, mostly in the coniferous cultures.

Similar changes are expected in the region of East Balkan, where the highly productive stands from Sessile Oak can be transformed gradually in mixed stands with the participation of Turkey oak and Hungarian oak.

Within the same group of territories are the plain forests in Thracian lowlands - the so called “korii”, which are the only places in the plain, preserving the natural biodiversity. Such are Aytos, Konevska, Yulevska, Tulovska, Chirpanska korii, the forest near the town of Parvomay and others. In some of them at the present moment is observed invasion of the Quercus pubescent and this process is expected to become stronger. A process of decreasing of canopy cover is expected, which will increase the lighting of the ground storey and will increase the process of development of the ruderal grass vegetation. Besides this, in the composition of these forests will increase their participation xeromorphic elements as Prunus spinosa, Paliurus spina-christi, more intensive invasion of acacia (Robinia pseudoacacia) is also possible, a species does not “allowed” by the oaks in the stands.

In East Rhodope and in the South part of Struma valley the changes are expected to be the most insignificant. This prognosis is based on the fact that in these areas at the present moment the climate is traditionally dry and the relevantly small changes till 2020 cannot cause serious changes in the vegetation, which is adapted to these conditions. Similar to Strandja, here is also possible the increasing of number of Mediterranean elements as Arbutus andrachne, Arbutus unedo and others.

The gene-selective measures, that can be considered as appropriate for the described conditions and prognosis, should be pointed in several directions. The first direction is the development of long term selective Programme for the choice and creation of more dry resistant poplar cultivars (cultivated varieties), which can grow successfully even in conditions of not sufficient soil moisture. Here are existing reserves for more adequate usage of autochthonous gene fund of the black and white poplar.

Other direction of the gene-selective activities, which is expected to be appropriate for these conditions, is the selection of appropriate oak origins and particularly of appropriate individuals. This includes the establishment of a network from ecological experimental cultures and mostly - posterity experiments, in which to be studied the inheritance of valuable indicators from economic point of view, with particular attention on the drought resistance. This can allow the preservation of natural species composition in the forests, even with the price of occasional usage of sampling material from other populations. From one side, the positive effect is the preservation of the natural species compositions and from other side - the change of the natural gene fund of the populations. It is obvious that we will have to look for compromise between the positive and negative sides of the gene-selective methods application.

Further information regarding the vulnerability zones of the forest ecosystems towards climate changes for present climate (1961-1990), for the years 2050 and 2080, the different scenarios and methodologies used for Bulgaria, as well as using calculations of some of the complex climate indexes: De Marton, Budiko, Selyaninov and the Holdridge (1967) can be found in the Programme of measures for adaptation of the forests in the Republic of Bulgaria and mitigation the negative effect of climate change on them, part of the national efforts of Bulgaria in implementation of FUTUREforest Project under INTERREG IV C Programme of the EU.

6.4. Adaptation Policy and Measures

In order to decrease the vulnerability of the country to the effects of climate change and increase the capacity of the natural, social and economic systems to adapt to the negative impacts of climate change, the Ministry of Environment and Water of Bulgaria has started preparation of Bulgarian National Adaptation Strategy.

A two-phased approach has been approved in developing the strategy. The first phase is preparation of a framework document *Climate Change Risk and vulnerability assessment of the socio-economic sectors in Bulgaria*, which currently is in a process of implementation.

The main objective of this document is to assess the risk of climate change related natural disasters in Bulgaria on the basis of various climate models and scenarios. The economic sectors included in the document are: agriculture, water, urban environment, energy, transport, construction and infrastructure, ecosystems and biodiversity, human health and tourism. A cross-border cooperation on issues related to the impact of climate change is taken into consideration in the draft document. The implementation procedure of the document started with the signing of contract with executor in December 2013 and it is expected to be completed in June 2014.
The second phase of the development of the National Adaptation Strategy should be built on data collected and evaluated in the framework document. By formulating concrete measures it should represent the strategic actions for reducing our country's vulnerability to the impacts of climate change. The strategy is envisaged to cover the period until 2030.

The forestry sector is the only one in which a specific programme of measures for adapting Bulgarian forests to climate change was developed and approved. The *Programme of measures for adaptation and mitigation of the negative climate change related effects on forests* was officially adopted by the Ministry of Agriculture and Foods on 03.05.2011.

For the purposes of drafting the document a vulnerability assessment of forestry by vulnerability zones of the forest eco-systems was carried out.

The Programme goes through four stages:

Stage 1: Preparation of "Analysis on the state of the main components in the forest ecosystems" in the context of climate change;

Stage 2: Elaboration of climate scenarios based on contemporary data and state-of-art models on the evolution of climate in Bulgaria during XX and XXI centuries;

Stage 3: Ddefinition of the "zones of vulnerability" in the forest ecosystems of Bulgaria;

Stage 4: Elaboration of a comprehensive programme with concrete measures for adaptation of forests to climate change, according to zones of vulnerability, for some of the main components of the forest ecosystems in Bulgaria.

The Ministry of Environment and Water with the financial and technical support of the World Bank has started preparation of a document *Financial Disaster Risk Management and Insurance Options for Climate Change Adaptation in Bulgaria.* This report will be part of the National Adaptation Strategy. Its objective is to analyse the role of the insurance sector in risk reduction and climate change adaptation in Bulgaria.

6.4.1. Agriculture

Two main types of adaptation are autonomous and planned adaptation. Autonomous adaptation is the reaction of, for example, a farmer to changing precipitation patterns, in that she changes crops or uses different harvest and planting/sowing dates.

Planned adaptation measures are conscious policy options or response strategies, often multisectoral in nature, aimed at altering the adaptive capacity of the agricultural system or facilitating specific adaptations. For example, deliberate crops selection and distribution strategies across different agriclimatic zones, substitution of new crops for old ones and resource substitution induced by scarcity.

Farm level analyses have shown that large reductions in adverse impacts from climate change are possible when adaptation is fully implemented. Short-term adjustments are seen as autonomous in the sense that no other sectors (e.g. policy, research etc.) are needed in their development and implementation.

Long-term adaptations are major structural changes to overcome adversity such as changes in land-use to maximize yield under new conditions; application of new technologies; new land management techniques; and water-use efficiency related techniques. FAO defines the following “major classes of adaptation”:

- seasonal changes and sowing dates;
- different variety or species;
- water supply and irrigation system;
- other inputs (fertilizer, tillage methods, grain drying, other field operations);
- new crop varieties;
- forest fire management, promotion of agroforestry, adaptive management with suitable species and silvicultural practices (FAO, 2005).

Accordingly, types of responses include:

- reduction of food security risk;
- identifying present vulnerabilities;
- adjusting agricultural research priorities;
- protecting genetic resources and intellectual property rights;
- strengthening agricultural extension and communication systems;
- adjustment in commodity and trade policy;
- increased training and education;
- identification and promotion of (micro-) climatic benefits and environmental services of trees and forests (FAO, 2005).

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

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

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

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

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

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

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

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

- improvement of management, use and protection of water resources in irrigated agriculture;

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

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

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

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

The ROIMPEL model of crop was also used for evaluation of vulnerability. It is a module simulation model for crops, limited by available soil – water and nitrogen, using limited data that is easy to book in. Various practices for the nitrogen and water management can be considered easily, as outside files parameters that are easy for explanation are asked. ROIMPEL gives the work day statistical data (optimally, very humid soil or very dry), that can be used for optimizing of the use of technique and the labour in the farm. The nitrogen concentrations that are possibly dangerous for underground waters pollution are possible to be received. The minimal requirements of data for soil are the constitution of the soil and class of organic substances. The minimum data for the weather, necessary for the model are the monthly values of the average daily air temperatures and the total quantity of monthly rainfall. Therefore, ROIMPEL is a very suitable model for research of climate change projects, where the disturbances, concerning the climate parameters are decreased proportionally from the GCMs on monthly base.

A Case Study on Irrigation Measures

Agroecosystems in southern Europe would be threatened mainly by reduced precipitation and subsequent increases in water scarcity. Although measures are being taken to reduce greenhouse gas emissions, and these measures will probably reduce the rate and magnitude of climate change, it is unlikely that greenhouse gas emissions can be reduced enough to stabilize climate; therefore, adaptation will be necessary. The goals of agricultural adaptation measures are the promotion to sustainable development and to minimize the impact of climate change by reducing vulnerability to its effects.

The altered temperature and precipitation databases corresponding to each of the respective climate change scenarios were used to run the CERES GENERIC 3.0

simulation model of maize. Crop management, technology, and distribution of cultivated land were assumed to be constant. Agricultural production is very sensitive to change and variation in weather conditions during the regular growing season. All the developmental processes, starting as early as the germination process immediately after planting, and as late as the ripening process during physiological maturity, are affected and controlled by temperature. All scenarios projected a shorter vegetative (sowing-silking) and reproductive (silking-full maturity) growing season of maize. These changes were driven by the temperature increases of the scenarios. Simulated grain maize yield decreases in Bulgaria were caused primarily by warming and precipitation deficit during the growing season of this crop.

The DSSAT Seasonal Analysis program was run in order to determine the most appropriate timing and water amount of irrigation applications under the expected climate change during the growing season of maize. Both biophysical and economic analyses were done. The strategic analysis, was done in respect to the simulated value of harvest maize yield and net return. The tested treatments of the irrigated numerical experiment assumed maize growth and development under rainfed conditions, different date(s) and water amount of irrigation. The economic analysis of the Seasonal Analysis computer program calculates means, standard deviations, maxima and minima of the economic returns, and plots these as box plots, cumulative function plots, or mean-variance diagrams. Formal strategy evaluation of all treatments is carried out using mean-Gini stochastic dominance. In contrast to the biophysical analysis returns per hectare of the 6th treatment are lower than returns of the 4th and 5th treatments due to more water being applied.

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

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

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

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

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

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

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

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

- Irrigation will be the main factor for the sustainable development of Bulgarian agriculture, giving guarantee for stable and quality plant production in years, varying in terms of the climate and accepting the challenges due to the expected periods of drought and water deficit in the years to come;
- Fast restoration and development of the irrigation sector and irrigation agriculture should become a main priority of the state policy in the agricultural sector supported by real, active and sound investment program, based on the use of national and international financial resources;
- Completion of the economic efficiency assessment of the existing irrigation facilities and taking a decision for the restoration and reconstruction of economically effective, suitable and unsuitable facilities at the present moment;
- Development and application of proper irrigation investment program for the next few years, with state subsidies aimed at the most efficient regions and such with active or to be established soon irrigation associations;
- Reconstruction and reorganization of the existing irrigation systems, aimed at their use in the condition of water deficit, implementing proper models in representative regions in the country;
- Elaboration of the present irrigation technologies and equipment, aimed at compliance with the new needs of the irrigated cultivars and increasing their efficiency, development and use of new water saving and energy saving technologies and equipment;
- Assessment of the energy demand of the irrigation systems and developing measures to increase their energy efficiency;

- Development and application of technologies and systems for regulation and control of technological processes for distribution and use of water for irrigation.

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

New zoning of the agroclimatic resources and agricultural crops

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

New cultivars and hybrids to be adapted to climate change

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

Optimization of soil treatment

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

Adaptation phytosanitary measures

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

6.4.2. Forestry

6.4.2.1. Summary

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

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

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

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

The forest fund covers 4.1 million ha, which is 37 % of the Bulgarian territory. Broadleaved forests account for 68 percent of the forest area, and conifers account for 32 percent of the area. The Bulgarian forests are relatively young forests with an average age of about 51 years. Its total growing stock is 591 million m^3 with an annual increment of 14 million m^3. In 2008, 50 % of the annual increment was harvested, exactly 7.31 million m^3, of which ¾ have been used by the Bulgarian forest products industry and ¼ was used as fuel wood. ¾ of the Bulgarian forests are state owned, while the rest is owned by private individuals, companies, municipalities and institutions. The GDP contribution of the sector is 2.5 %. There app. 150,000 people are directly employed in the sector, primarily in rural areas and there are thousands of local timber based manufacturers and small scaled industries. On the territory of the country a few big and international oriented pulp, paper and board producers, which exports 90 % of its production.

The forests give wide range of essential public products and services; such as water production, protection functions, erosion control, fire prevention, social timber supply, etc.

One of the most important ecological function of the forests at the moment is the prevention/reduction of climate changes through carbon absorption. Forests are also natural obstacle against degradation and soil erosion and its desertification and influence very much the water balance.

Along with this the Executive Forest Agency directs its efforts towards ensuring additional energy resources by means of establishing new forests and plantations. A great potential in that respect is available, considering the large areas of burnt forests and abandoned agricultural lands. (Table 6.7)

Table 6.7 Potential of the forestry areas for establishing new forests and plantations.

year	Total non-forested area, subject for forestation	Incl.		
		Burned areas	Bare areas	Harvested areas
	ha			
1988	132 693	1 233	98 350	33 110
1989	132 245	1 060	98 357	32 828
1990	132 553	1 496	97 399	33 658
1991	132 413	1 670	95 857	34 886
1992	131 373	2 456	96 264	32 653
1993	139 305	7 194	95 053	37 058
1994	121 610	6 437	91 252	29 321
1995	121 391	7 028	92 588	21 775
1996	121 478	4 530	90 595	26 353
1997	121 066	3 802	90 337	26 927
1998	120 190	3 619	87 138	29 433
1999	123 647	9 637	84 212	29 798
2000	138 671	22 049	83 961	32 661
2001	138 472	21 882	86 036	30 554
2002	126 418	15 377	82 180	28 861
2003	117 419	10 233	78 280	28 906
2004	108 549	5 943	77 829	24 777
2005	96 121	2 746	74 369	19 006
2006	95 230	3 200	74 365	17 665
2007	93 081	5 364	71 612	16 105
2008	78 898	5 189	61 562	12 147

Table 6.8 shows the data of the distribution of the forest area (by forest types) for the period 1988-2008.

During the last 50 years about 1.5 million ha forests are forested. The main aims of these forestations were increase of forest area, their productivity and soil erosion control. Bulgarian forests provide about 85 % of the water flow in the country or nearly 3.6 billion m^3 of clear drinkable water. They play a significant role for decreasing the emissions of greenhouse gases in the atmosphere accumulating carbon in the biomass through CO_2 absorption.

As a country signatory to the Pan-European process for the protection of forests, to the UN Convention on Climate change (the Kyoto Protocol respectively), Bulgaria defined its support for the effective production and usage of bio-energy from renewable forest resources, managed in a sustainable way, as a main priority in its national forest policy.

Table 6.8 Economic impacts of distribution of the forest area (by forest types) for the period 1988-2008.

year	Total forest area	Total forested area with Pinus mugo	Pinus mugo	Coniferous		Broadleaved		Total forested area without Pinus mugo	Unforested area subject to forestation	Non-wood production designated forest area	Forest pastures
				Total	Forested	Total	Forested				
1988	3 868 330	3 363 768	21 646	1 331 974	1 214 567	2 536 356	2 149 201	3 342 122	132 693	285 834	106 801
1989	3 870 819	3 366 629	20 939	1 328 635	1 212 127	2 542 184	2 154 502	3 345 690	132 245	283 182	108 813
1990	3 871 447	3 334 140	7 048	1 330 126	1 212 952	2 541 321	2 114 140	3 327 092	132 553	281 714	109 148
1991	3 873 543	3 351 538	20 940	1 327 665	1 210 554	2 023 873	2 120 044	3 330 598	132 413	281 118	108 474
1992	3 872 938	3 350 747	21 269	1 323 072	1 205 504	2 027 675	2 123 974	3 329 478	131 373	280 735	110 083
1993	3 897 384	3 366 707	21 541	1 317 841	1 196 968	2 048 866	2 148 198	3 345 166	139 305	282 627	108 745
1994	3 675 786	3 176 092	21 982	1 244 738	1 127 780	1 931 354	2 026 330	3 154 110	121 610	269 097	108 987
1995	3 876 272	3 356 876	22 620	1 304 293	1 176 919	2 052 583	2 157 337	3 334 256	121 391	291 157	106 848
1996	3 878 405	3 354 933	22 555	1 293 269	1 166 773	2 061 664	2 165 605	3 332 378	121 478	295 057	106 937
1997	3 878 794	3 353 101	22 627	1 280 960	1 154 646	2 072 141	2 175 828	3 330 474	121 066	297 485	107 142
1998	3 899 655	3 371 269	22 654	1 280 162	1 149 474	2 091 107	2 199 141	3 348 615	120 190	301 068	107 128
1999	3 794 797	3 296 984	709	1 188 794	1 073 354	2 108 190	2 222 921	3 296 275	123 647	275 952	98 214
2000	3 914 355	3 398 307	23 190	1 282 319	1 137 837	2 115 988	2 237 280	3 375 117	138 671	295 832	81 545
2001	3 980 032	3 464 572	23 770	1 296 790	1 147 552	2 167 782	2 293 250	3 440 802	138 472	298 233	78 755
2002	4 003 755	3 512 623	23 760	1 291 264	1 145 711	2 221 359	2 343 152	3 488 863	126 418	302 027	62 687
2003	4 015 236	3 547 456	21 172	1 288 758	1 147 712	2 258 698	2 378 572	3 526 284	117 419	298 846	51 515
2004	4 063 555	3 648 005	23 313	1 288 331	1 150 649	2 359 674	2 474 043	3 624 692	108 549	303 056	3 945
2005	4 076 464	3 674 320	23 077	1 278 514	1 147 348	2 395 806	2 503 895	3 651 243	96 121	302 792	3 231
2006	4 089 762	3 691 868	23 073	1 271 344	1 142 599	2 420 524	2 526 196	3 668 795	95 230	301 429	1 235
2007	4 108 494	3 704 015	23 631	1 277 494	1 138 444	2 426 521	2 541 940	3 680 384	93 081	310 889	509
2008	4 114 552	3 721 451	23 640	1 279 809	1 142 306	2 441 642	2 555 505	3 697 811	78 898	314 205	0

6.4.2.2. Policies and measures and their effect

Very important for forest restoration, resp. for CO_2 absorption has Art. 42 (2) of Forestry act:

"Art. 42. (amend. SG 16/03) (1) (amend. – SG 64/07; amend. – SG 80/09) The afforestation in the forest fund shall be carried out according to the forest development projects, technical projects for fighting with the erosion and landslides, plans and programmes under the conditions and by the order, determined with ordinance by the Minister of Agriculture and Food.

(2) (amend. – SG 43/08) Not renewed felling grounds and fire plots from the forest fund shall be afforested by their owner up to two years after felling or fire. If there are objective reasons the term can be extended by the director of the regional directorate of forestry with one year."

The Bulgarian Government Programme 2009-2013 has identified the following main priorities in the area of forestry:

"Improvement of the protection and support of adaptation of Bulgarian forests to climate changes"

Measures

- Improvement of the forest database through implementation of remote sensing technology. Adoption of National forest inventory as Pan-European method for control of forest management plans
- Statutory prohibition for forest land exchange and the change of the purpose of forest land for the period of 20 years, except for important public services
- Formation of inter-institutional scientific board, participation in realization and implementation of European and world projects and initiatives, regarding prevention and adaptation of forest to climate change
- Adoption of measures for forest protection and forest safeguarding together with police services, NGO's, municipalities, etc.
- Updating the National plan for forest fire prevention and protection and improvement of the control of the activities against forest fires
- Development and adoption of updated close to nature regimes for forest management in the protected areas and NATURA 2000 sites
- Public awareness campaigns for forest benefits and the ways of their protection
- Implementation of the common European methods for evaluation of non-wood forest functions and services and their future financial and functional support Coordination of the implementation of the principle "The user pays" for forest resources, together with all stakeholders
- Stimulating the biological production of products and extension of ecological services in the forests."

In addition to the above stated the contribution of the Rural Development Programme to climate change combat is realized through acceleration of the CO_2 absorption in the atmosphere – strengthening the CO_2 absorption through forestation of different territories. The total measured quantity, equivalent to CO_2, fixed through afforested or reforested areas within the Rural development Programme is about 1.4 million tonnes. This is an expert estimation, based on the study of the annual forest growth during their whole life cycle and prognosis for the CO_2 absorption rate.

This will be realized through two so called “Forest measures” closely related to forestation and climate change impact:

Afforestation of non-agricultural lands - Measure 223

Main aims of the measure:

- Increasing the forest cover with the aim contribution to the climate change mitigation and increasing the biodiversity
- Reducing soil erosion and protection of the lands from marginalization
- Improvement of the water balance in the strengthen territories

Restoration of forest capacity and implementation of preventive activities - Measure 226

Main aims of the measure:

- Restoration of the forests, damaged by forest fires or other natural disasters – Reforestation of the affected forests, using native tree species; Increasing the tree species diversity through transformation of the coniferous ecosystems in mixed forest or broadleaved ecosystems
- Improving the prevention activities for combat against forest fires.

6.4.3. Vulnerability assessment, climate change influence and adaptation measures

6.5. Soils

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

Optimization of soil treatment includes:

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

7. Financial resources and transfer of technology

7.1. Provision of new and additional financial resources

This is not applicable for Bulgaria.

7.2. Assistance to developing country Parties that are particularly vulnerable to climate change

This is not applicable for Bulgaria.

7.3. Provision of financial resources, including financial resources under Article 11 of the Kyoto Protocol

This is not applicable for Bulgaria.

7.4. Activities related to transfer of technology

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

The Republic of Bulgaria being a country in Currency Board and its restrictions imposed does not have significant own financial resources for the management of its environmental policy and relies mainly of different forms of international cooperation.

As a new EU member, Bulgaria is a recipient of technology transfer support and uses various EU funds that facilitate the country's ability to reach compliance with certain environmental standards, as well as to carry on an improved environmental policy. For the continuation of this tendency contributes the growth of foreign investments and international cooperation. The foreign developmental cooperation of the Republic of Bulgaria has exhibited a constant increase in recent years that is as result of the country membership in the EU.

In terms of technology transfer, as a country in transition, Bulgaria has no obligations to support technology transfer, under Article 11 of the Kyoto Protocol, for countries out of Annex I of the Convention.

National and international sources for financing of environmental policy, including climate change mitigation measures in Bulgaria

The main national and international sources for financing of environmental policy, including climate change mitigation measures to be put into practice are:

- **National:** State budget; National Trust Eco Fund
- **EU Environmental Funds:** "Operational Programme Environment 2007-2013", ISPA, "The PHARE-Programme" and "Programme SAPARD"

- **Other EU Funds, Programs and Initiatives**
- **International:** Within the framework of the Joint Implementation (JI) mechanism under the Kyoto Protocol, Green investment scheme, Bilateral cooperation agreements, International organizations and Financial institutions

State budget: Each year, in addition to the Annex to the Law on the State Budget of the Republic of Bulgaria, the financing of environmental installations and sites at the municipalities is approved such as: municipal waste water treatment plants, collectors to them, sewage pumping stations, municipal solid waste landfills for household waste, etc.

Also, in the draft of the Law on the State Budget, in addition to the List of environmental installations and sites, envisaged for construction are included not completed projects from the previous year, which are transitional; some of them are co-financing from foreign donor programs; listed in the National waste management program and the National program for priority construction of urban waste water treatment plants and collectors for settlements of over 10 000 population equivalent, adopted by the Council of Ministers.

National Trust Eco Fund: The fund has been established as independent legal entity by the Law for Environmental protection to manage the funds, given to Bulgaria as a grant by the government of the Swiss Confederation during the swap deal "Debt for Environment" between Bulgaria, Switzerland and other donors. Priority areas of the fund are: elimination of past damages to the environment, reduction of air pollution, protection of water purity and protection of biodiversity.

"Operational Programme Environment 2007-2013" **(OPE)** sets the country strategic objectives and priorities in environment sector. It is directed to implementation of the commitments taken in the negotiation process in the sector and achievement of compliance with EU requirements in the field of environment.

OPE sets the objectives, priorities and types of activities to be financed, following the national policy in environmental protection as well as EU policy and legislation.

The two funds providing financing in the field of environment:

- European Regional Development Fund (ERDF) - aimed at strengthening the economic and social cohesion in the EU, recovering the disturbed balance between the regions. ERDF finances direct aid to research and innovation, telecommunications, environment, energy and transport, financial instruments (capital risk funds, local development funds, etc.) to support regional and local development.
- Cohesion Fund (CF) - aimed at helping less developed member states to overcome the economic and social situation and stabilize their economy.

As a member of European Union the Republic of Bulgaria for some measures in its environmental policy has opportunity to use finance means by follow funds and programs:

European Regional Development Fund 2007 – 2013:

- **The Urban Development Network** (Programme URBACT II - An Exchange and learning programme for cities contributing to the European Commission Initiative "Regions For Economic Change");

- **Interregional Cooperation Programme** “INTERREG IVC” (Contributing to the European Commission Initiative “Regions for Economic Change”;

South East Europe (SEE) - Transnational Co-operation Programme for a moving European area in transition on the way to integration;

ESPON 2013 Programme - European observation network on territorial development and cohesion, adopted by European Commission Decision C(2007) 5313 of 7 November 2007;

Good Governance of Territorial Cooperation Programmes INTERACT 2007-2013 under the “European Territorial Cooperation” Objective based on Article 6 pt. 3 lit. b of Regulation 1080/06

IPA Cross-Border Programs:

BULGARIA – SERBIA (CCI Number: 2007CB16IPO006);

BULGARIA - THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA (CCI Number: 2007CB16IPO007);

BULGARIA – TURKEY (CCI Number: 2007CB16IPO008;

Cross-Border Cooperation Programme ROMANIA – BULGARIA 2007-2013;

European Territorial Cooperation Programme GREECE-BULGARIA 2007-2013;

Joint Operational Programme Black Sea Basin 2007-2013

7.5. Information under Article 10 of the Kyoto Protocol

The country has not formulated programs to improve the quality of local emission factors, activity data and models which reflect national conditions. The country is more active in the field of development and implementation of national programs containing measures to mitigate climate change. The First National Climate Change Action Plan was developed in 1999 and approved by the Government in 2000. The Second National Action Plan on Climate Change (SNAPCC) was developed in the period 2003-2004 and approved by the Government in 2004. The Plan envisions a set of coordinated actions in line with Bulgaria’s international obligations in the context of UNFCCC as well as the Climate Change Program of the European Union (EU). The Plan covers the period 2005-2008. The cumulative effects from the applied measures in respect of GHG emission reductions are annually evaluated.

The Second SNAPCC defines mainly the legislative framework and the institutional structure, requirable for implementing the climate change-related policies executing Bulgaria’s obligations to the UNFCCC and the Kyoto Protocol.

The evaluation of the plan fulfilment was performed in 2009. Essentially the plan assessment was a procedure of evaluation of the policies and measures in it. The implemented extensive analysis gives possibility for synonymous answers to questions like:

- Is the purpose of the plan set correctly?
- Is it correctly estimated what measures are necessary and are they precisely formulated and addressed to the relevant institutions?

The analysis shows that the purpose is set correctly and the measures are addressed precisely. The measures, provided in the plan were conformed with actions for their implementation on national and European level. The post analysis showed that despite the declarations of some branches, the conditions for measure implementation are changed and for some of them the provided potential is not realized. Some of the provided actions dropped out and the measures were not realized in optimum degree.

The negative moments are reported in the assessment. The key question for every plan is – are the emissions reduced in absolute rate and as a trend and what is the proportion between the economy growth and the growth/reduction of the emissions.

As far as the correct introduction of specific European Directives and Decisions is necessary condition for the successful implementation of some measures, the necessary legislation acts and documents are described in detail in the development. It is shown how their non-introduction discredits the implementation of specific measures.

The implementation of the provided in the Second Plan policies and measures is analysed in detail It was concluded that they are mostly realized and they led to GHG emissions for unit GDP reduction of the order of 15 % from the annual emissions of the country for the accounted period.

On the basis of new programs, initiatives and decisions of EU new policies and measures are formulated, which shall be an object of the new Third Climate Change Action Plan that is scheduled to be developed in 2012.

Each Party included in Annex 1 shall report on the steps it has taken to promote facilitate and finance the transfer of technology to developing countries and to build their capacity, taking into account Article 4, paragraphs 3,5 and 7, of Convention, in order to facilitate the implementation of Article 10 of the Kyoto Protocol.

Republic of Bulgaria's Roadmap for participation in the international development assistance delineates the country's geographic priorities for projects sponsorship. States that are geographically closely situated are identified as the most appropriate beneficiaries - Armenia, Former Yugoslav Republic of Macedonia, Moldova, Kosovo, Serbia and Georgia.

Moreover, since the Bulgarian contribution is not large enough to allow the execution of an independent project, the Ministry of Environment and Water has decided to sponsor an "off-the-shelf" project which allows a certain degree of customization.

Taking into consideration Bulgarian foreign policy priorities and a proposal by the Ministry of Finance, the Ministry of Environment and Water contacted United Nations Development program with the goal of identifying a project which fulfils the aims of EU Fast Start Financing initiative.

After a period of prolonged negotiations the project "Bulgarian Fast Start Finance Contribution 2011-2012: Utilizing Bulgarian Experience in the Development of Administrative Capacity for the Conduct of Monitoring, Reporting and Verification of Greenhouse Gas Emissions" was acknowledged as the best available mean of delivering Bulgaria's FSF contribution.

The main aim of the project is to support the implementation process of the EU Directives 2003/87/EC and 2009/29/EC in Former Yugoslav Republic of Macedonia by utilizing Bulgarian expertise and capitalizing on best practices and lessons learned of Republic of Bulgaria in the field of monitoring, reporting and verification of greenhouse gas emissions as well as emission trading. This is achieved through direct interaction between the Ministries of Environment in the two countries and information exchange between the national and Bulgarian institutions and experts.

It is expected that the project will contribute to achieving national consensus on the actions and measures that need to be undertaken to address the climate change related issues relevant for the country in regards to the EU ETS on a short and long term. This should also open dialogues on the need for allocation of adequate financial means for realization of the agreed actions and measures.

8. Research projects and systematic observation

8.1. General policy on research and systematic observation

Green Paper on European Research Area except the emphasis on regional cooperation recommends "the creation of joint programs for research driven society”. Therefore, the overall objective of a general policy on research and systematic observations is: strengthening and development of the national scientific potential, and providing public information on: monitoring, evaluation and forecasting of the situation and global changes in the system: atmosphere-biosphere-hydrosphere and analysis of the impact on socio-economic sectors of society and natural ecosystems in the region of Balkans and Black Sea basin. Specific objectives include: 1.) Conduct interdisciplinary research aimed at scientific and application service of socio-economic sectors of society in the country and region 2.) Maintenance and upgrading of existing and new components of the monitoring networks, assessment and analysis of state and changes in the atmosphere, biosphere, hydrosphere 3.) Development and improvement of methods, models and systems for forecasting the short, medium and long-term changes in atmosphere and related hazardous weather phenomena and changes in the biosphere and hydrosphere, 4) Development and improvement of methods and models for quantitative assessment and analysis of the impact of state and changes in the atmosphere, biosphere, hydrosphere on socioeconomic sectors of society and natural ecosystems; 5.) Developing proposals for making management decisions to adapt to the adverse global changes; 7.) Interaction with the institutions in the preparation of strategies related to these tasks.

The section on systematic observations activities in the country follows the detailed guidance for required information as provided in the UNFCCC reporting guidelines on global climate observing systems. It includes summary information on the current status of national plans, programs and support for ground and space-based climate observing systems. It should be pointed out that up to now activities in this field have been undertaken separately from the climate change policies and measures. They were more closely linked to the general commitments of the country in the field of meteorology.

8.2. Research

Over the past 10 years there has been a trend of increased scientific interest in climate change: global, regional and national scale. The topic of climate change includes a number of scientific aspects. The Bulgarian Academy of Sciences BAS works in different directions: fluctuations and climate change, vulnerability assessment and adaptation of individual sectors (e.g. water resources, agriculture, forests, etc.) under climate change, solar-terrestrial influences and more. On the topic of climate change in more than 10 units of the Bulgarian Academy of Sciences, work but the major one is the National Institute of Meteorology and Hydrology.

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

Comprehending the significance of this problem, BAS established a National Coordination Centre for Global Change. The Scientific Coordination Centre for Global Change of the Bulgarian Academy of Sciences (SCCGC-BAS) is a voluntary association of representatives of academic research and development institutes and units, universities and higher educational establishments, institutions, agencies, organizations, companies and other entities in Bulgaria which organizes and conducts activities related to global change in environment, as well as to the economic, political, social and spiritual aspects of global change on society.

The SCCGC-BAS is a consultative/advisory body of the Steering Committee of the Bulgarian Academy of Sciences on global change in Bulgaria. The SCCGC-BAS is a center for coordination of research and scientific-methodological activities under the implementation of national and international projects and contracts in the field of global change.

The SCCGC-BAS Tasks:

- To coordinate and support research on aspects of global change in Bulgaria;
- To coordinate and support the scientific, methodological and informational needs related to implementation of the national programs on global change;
- To coordinate and support scientific, methodological and informational needs related to implementation of the country's commitments under international conventions, contracts and agreements on the subject of global change;
- To assist contacts among scientists and their participation in national, regional and international global change programs;
- To coordinate and assist the information exchange among scientists and stakeholders in the country and abroad through establishment and maintenance of a scientific network on global change in Bulgaria;
- To organize and perform assessments and evaluations, to provide expertise, and to develop reviews and position papers as required by governmental institutions, international organizations, business entities, NGOs and other organizations or individuals on aspects of global change;
- To organize and support scientific conferences, courses for training and skill enhancement for specialists, as well as the publication of research, information, applied science and materials for the public in the field of global change;
- To play the role of a focal point, information centre and representative of the Bulgarian Academy of Sciences before national and international bodies, organizations, programs and projects within the scope of the major objectives and goats of the Centre.

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

On international level, the centre supports participation in projects, publications and reports on climate change and global change. The SCCGC-BAS organized an international conference, held in Sofia, 19-21 May 2008: "Global environmental change: challenges to science and society in south-eastern Europe".

Major projects:

- Climate change and variability: Impact on Central and Eastern Europe, 2007-2009
- Adaptation of agriculture in European regions at environmental risk under climate change, 2007-2009
- Central and Eastern Europe climate change impact and vulnerability assessment, 2006-2009
- Impacts of climate change and variability on European agriculture, 2006-2010
- Establishing a European phenological data platform for climatological applications, 2005-2009
- Application of European experience on utilization of climate change results, 2005-2007
- Introducing models under climate change conditions by establishment of contacts between users and model developers, 2005-2007
- Snow variability and change in Bulgaria, 2005-2007
- Long-term variations of soil moisture and climate change in Bulgaria, 2005-2007
- Monitoring social, economic and environmental differences of municipalities in Bulgaria in 2003-2005
- Climate change impact on water balance in Balkan Peninsula, 2002-2005

National institute of meteorology and hydrology at Bulgarian academy of science, NIMH at BAS is the major Bulgaria research institute in meteorology, agrometeorology, and hydrology, performing research-related practical application.

NIMH carries out an efficient exchange of knowledge both with the industry and with the general public by means of all kinds of national media.

The programs of the World Meteorological Organization (WMO) and the best achievements of related hydrometeorological services lead us in our daily work, which is being performed in compliance with the Articles of Association of BAS, the Rules and Regulations of NIMH, the requirements of the Ministry of Education and Science, and the updated documents of the Commission of the European Communities.

NIMH is the official representative of Bulgaria in WMO, EUMETSAT, EUMETNET (OPERA), UNESCO's International Hydrological Program, and the International Association for Danube Research, etc.

Among the Scopes of Activity of NIMH is: Provision of expert opinions, information, analyses, various forecasts of the hydrometeorological processes, climate change and water resources on the territory of Bulgaria, including the western part of the Black Sea.

Through its activities NIMH implements at a national level our international commitments such as the United Nations Framework Convention on Climate Change and the Kyoto Protocol, the Convention to Combat Desertification, the EU Water Initiative, the Contribution of the Intergovernmental Panel on Climate Change, and the Earth Monitoring Initiative.

The Institute takes an active part in EC Framework Programs V, VI, and VII and is open for research workers from Europe and other countries through joint projects and a modern Training Centre. The main NIMH research is consistent also with the EU research policies, defined in the priority areas of the 7th Framework Program., for example: “Environment, including Climate Change”.

Major publications:

- Aksoy, H, N.E. Unal, V. Alexandrov, S. Dakova and J.Y. Yoon, 2008. Hydrometeorological analysis of north-western Turkey with links to climate change. International Journal of Climatology 28(8): 1047 – 1060
- Alexandrov, V. and J. Eitzinger, 2005. The Potential Effect of Climate Change and Elevated Air Carbon Dioxide on Agricultural Crop Production in Central and South-eastern Europe. Journal of Crop Improvement 13(1-2): 291-331.
- Alexandrov, V., 2006. The climate change impact on ecosystems in the Balkan Peninsula and Central Europe. Meteorology and Hydrology 9: 88-98 (in Russian)
- Alexandrov, V., M.Genev and H.Aksoy, 2005. Climate variability and change effects on water resources in the western Black Sea coastal zone. Proceedings of the European Water Resources Association (EWRA’2005) Conference: “Sharing a common vision for our water resources”, 7-10 September 2005, Menton, France, (CD) 12 pp.
- Alexandrov, V., M.Genev and H.Aksoy, 2005. The impact of climate variability and change on water resources in the western coastal zone of Black Sea. Regional Hydrological Impacts of Climatic Change - Impact Assessment and Decision Making (Proceedings of symposium S6 held during the Seventh IAHS Scientific Assembly at Foz do Iguaçu, Brazil, April 2005). IAHS Publ. 295, pp.62-71.
- Bocheva L., Ch. Georgiev and P. Simeonov. A climatic study of severe storms over Bulgaria produced by Mediterranean cyclones in 1990-2001 period. Atmos. Research, 83, Nos.2-4, 2007, 284-293.
- Brown R. and N. Petkova, 2006, Snow Cover Variability in Bulgarian Mountainous Regions, 1931-2000, International Journal of Climatology
- Eitzinger, J., Thaler, S., Kubu, G., Trnka, M., Alexandrov, V. 2009 Der Klimawandel, seine absehbaren Folgen für die Landwirtschaft in Oberösterreich und Anpassungsstrategien. Amt der OÖ Landesregierung, 60
- Eitzinger, J., V. Alexandrov and M. Trnka, 2006. Climate Change Impacts on Yield and Crop Water Use in Austria using Crop Models. Proceedings of the International conference on Soil Physics and Rural Water Management, 28–29 September 2006, Vienna, Austria, pp. 199-202.
- Eitzinger, J.,H. Formayer, S. Thaler, M. Trnka, Z. Zdenek, V. Alexandrov, 2008. Results and uncertainties of climate change impact research in agricultural crop production in Central Europe. Journal for Land Management, Food and Environment 59: 1-4.
- Gocheva, A., L. Trifonova, T. Matrinova, L. Bocheva (2006) Complex approach for assessment of dry wind and droughty spells in Bulgaria, International

Conference BALWOIS, 23 – 26 May 2006, Ohrid, Republic of Macedonia, 12 pages (www.balwois.org)

- Gocheva, A., L. Trifonova, T. Matrinova, L. Bocheva (2006) Extreme hot spells and heat waves on the territory of Bulgaria, International Conference BALWOIS, 23 – 26 May 2006, Ohrid, Republic of Macedonia, 11 pages (www.balwois.org)
- Eitzinger, J, G. Kubu, V. Alexandrov, A. Utset, D. T. Mihailovic, B. Lalic, M. Trnka, Z. Zalud D. Semeradova, D. Ventrella, D. P. Anastasiou, M. Medany, S. Altaher, J. Olejnik, J. Lesny, N. Nemeshko, M. Nikolaev, C. Simota and G. Cojocaru, 2009. Adaptation of vulnerable regional agricultural systems in Europe to climate change – results from the ADAGIO project. Adv. Sci. Res., 3, 133–135
- Kazandjiev V., N. Shopova 2006. Agrometeorological observations and data Base Management for Farmers Support in Bulgaria, 8-th Conference on Meteorology – Climatology and Atmospheric Physics COMECAP 24-26 May 2006, Athens
- Kazandjiev V., N. Slavov 2006. Phenological development as indicator of meteorological conditions, BALWOIS Conference, Ohrid, Macedonia.
- Koleva Ek., V.Alexandrov, 2008. Drought in the Bulgarian low regions during the 20th century. Theoretical and Applied Climatology 92(1-2): 113-120.
- Marinova, T., L. Bocheva, V. Sharov, 2005. On some climatic changes in the circulation over the Mediterranean area. IDŐJÁRÁS, Vol.109, No 1, 55–67.
- Neytchev, P., Zucchini,W., Hristov, H. and Neykov, N.M. (2006) Development of a multisite daily precipitation model for Bulgaria using hidden Markov models. In: Proc. of the XXIIIrd conference of Danubian countries on the hydrological forecasting and hydrological bases of water management. Belgrade, Serbia, 28-31 August.
- Orlandini S, Nejedlik P, Eitzinger J, Alexandrov V, Toulios L, Calanca P, Trnka M, Olesen JE. 2008 Impacts of climate change and variability on European agriculture: results of inventory analysis in COST 734 countries.Ann N Y Acad Sci. 1146: 338-353.
- Petkova N., 2007, Snow cover variability in Bulgarian Mountainous Regions, International conference on „Climate change and problems”, 20-22 April, Sofia, Bulgaria
- Petkova N., R. Brown, E. Koleva and V. Alexandrov, 2005. Snow Cover Changes in Bulgarian Mountainous Regions, 1931-2000, Croatian Meteorological Journal 40: 662-665.
- Simeonov P., R. Petrov, L. Bocheva and T. Marinova Pre-project Study on Meteorological Conditions for Hail Suppression and Rain Enhancement aim in South- East Bulgaria, Paper submitted at 9th WMO World Weather Modification Conference, 22-25 Oct. 2007, Antalya, Turkey, (Ext. abstract, pp. 4).

The topic of climate change is reflected in other research units of the Academy and Universities:

- Geophysical Institute

- Central Laboratory of Solar-Terrestrial Influences
- Geographical Institute
- Institute of Oceanology
- Institute of Botany
- Institute of Water Problems
- Forest Research Institute
- Space Research Institute
- Institute of Nuclear Research and Nuclear Energy
- Institute of Astronomy
- Sofia University
- New Bulgarian University
- South-western University, Blagoevgrad
- University of Veliko Turnovo
- University of Plovdiv
- Agricultural University, Plovdiv
- Forestry University

Financial Sources for Environmental Projects in Bulgaria

The main sources for financing of environmental projects in Bulgaria are:

- State budget;
- An enterprise for managing activities on environmental protection;
- National trust ecofund;
- National Research fund;
- ✓ The Principality of Monaco.
- International organizations and financial institutions:
- ✓ EC/EU programmes
- ✓ United Nations Development Program;
- ✓ Nordic-funds;
- ✓ CIM-projects;
- ✓ Central European Initiative;
- ✓ United States Agency for International Development;
- ✓ European Bank for Reconstruction and Development;
- ✓ The World Bank.

8.3. Systematic Observation

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

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

Table 8.1 RBSN stations in Bulgaria

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

Table 8.2 RBCN stations in Bulgaria

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

The UNFCCC Guidelines Table 1 can be presented as follows:

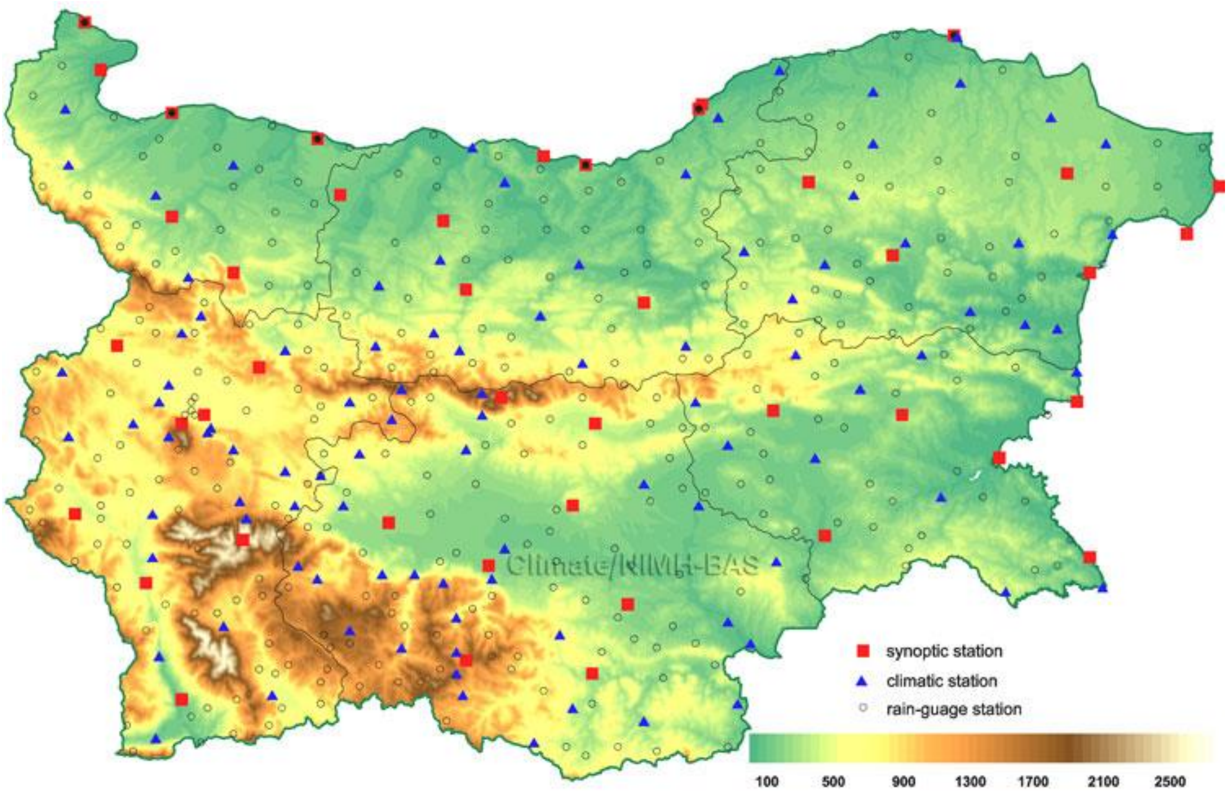
Table 8.3 Participation in the global atmospheric observing systems

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

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

In addition to the above information, the National Institute of Meteorology and Hydrology in Sofia, Bulgaria has about 40 synoptic and more than 90 climatic stations across the country, Figure 8.1.

Figure 8.1 NIMH metheorological network



Bulgarian hydro-meteorological observation stations are of two types, with respect to the data transmission:

- Operational stations transmitting data at real or near real time. The most important 12 river level gauging stations are transmitting daily data to the NIMH regional branches and headquarters. The rest 32 the operational stations are transmitting daily data at weekly intervals. On Wednesday each week NIMH receives daily data for the previous 7 days. Similarly the groundwater observation stations transmit daily or weekly data at weekly or monthly intervals from 160 wells and 25 springs. 200 operational rain gauges are transmitting daily precipitation totals every day, when it is raining. The location of the stations is given on the schemes below.
- Regime stations are not transmitting data. Different paper forms are prepared by the observers and posted to the NIMH branches at monthly intervals.
- Some of the hydrometeorological parameters regularly observed over the Bulgarian territory are relevant for the analysis of the variability of the groundwater recharge. Those are: precipitation, thickness of the snow pack, river and spring discharge, and groundwater tables. General information on the monitoring practices and data pre-processing for those parameters is given below

Discharges are received via rating curve through the observations of the water levels. The levels are generally observed manually with foot gauge by observer at 8 o'clock a.m. local time. Because of the high variability of the levels in the small basins, mechanical level recorders are working at approximately half of the stations, using weekly paper tapes. Observers of small amount of stations at larger basins are transmitting daily levels via telegram/telephone, while their reporting tables are collected monthly by post. Discharges are measured 8-12 times per year by current meters, or floats in case of dangerous floods. Small springs are measured via volume method. Most of the stations are equipped with measurement bridges. Cross-section profiles are measured one or twice per year, which generally do not include the floodplains. The frequency of those observations depends on the stability of river bed at the measuring section. Provisional rating curves are maintained for the cross-sections with daily data transmission, while for all stations rating curves and daily mean discharges are validated annually. Certain amount of small river basins having an area of 50-100 km^2 are observed above the hydrotechnical structures (dams, derivation channels), while the others with measuring sections located at the lowlands have an area of 200-400 to 1000-5000 km^2. Reservoir cascades regulate more than 50 % of the surface waters.

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

In 1995 Bulgaria was involved in the European space-based observing programmes on meteorology after signing an Agreement on Use of Images from the EUMETSAT Meteosat Satellites between the National Institute of Meteorology and Hydrology (NIMH) and EUMETSAT, the European Organisation for the Exploitation of Meteorological Satellites. High Resolution Image (HRI) data from Meteosat-7 in three channels (0,5-0,9 μm, 5,7-7,1 μm and 10,5-12,5 μm) are processed and utilized for operational and research purposes. Daily imagery analysis is made subjectively for the purposes of short-range weather forecasting. The observations from the three channels of Meteosat-7 are received every 30 minutes at NIMH by operating a Primary Data User Station (PDUS).

The Geophysical Institute "Acad. L. Krastanov" is a leading scientific institution in the country, which carries out fundamental and applied research in the fields of:

- Physics of the solid Earth
    - Department "Seismology";
    - Department "Geomagnetism and Gravimetry";
    - Palaeomagnetic laboratory
    - Physics of the Earth's environment
    - Department "Physics of the Atmosphere";
    - Department "Physics of the Ionosphere".

The main research activity of the Institute is entirely subordinated to the national priorities:

- Protection of the population and risk mitigation of unfavourable natural phenomena and disasters;
- Facilitating sustainable development and use of the natural and raw-material resources in Bulgaria;
- Providing national authorities with expert geophysical information

An important and irrevocable part of the Institute's activities is the unique for our country scientific and operative activity, concerning registration, processing, analysis and interpretation of the seismicity, geomagnetic field, the status of the ionosphere and UV radiation level above the country and surrounding lands.

The unique for the country international geomagnetic standard with absolute and comparative geomagnetic measurements is maintained in Geomagnetic Observatory

- State budget;
- An enterprise for managing activities on environmental protection;
- National trust ecofund;
- National Research fund;
- European Union pre-accession funds for candidate member countries – ISPA, PHARE, SAPHARD;
- “Joint Implementation” mechanism within the framework of the Kyoto Protocol to the United Nations Framework Convention on Climate Change;
- Agreements for bilateral cooperation with:
  - The Kingdom of the Netherlands;
  - The Federal Republic of Germany;
  - Denmark;
  - Austria;
  - The Kingdom of Belgium;
  - The United Kingdom;
  - The Principality of Monaco.
- International organizations and financial institutions:
  - EC/EU programmes
  - United Nations Development Program;
  - Nordic-funds;
  - CIM-projects;
  - Central European Initiative;
  - United States Agency for International Development;
  - European Bank for Reconstruction and Development;
  - The World Bank.

The unique for the country international geomagnetic standard with absolute and comparative geomagnetic measurements is maintained in Geomagnetic Observatory “Panagyurishte”. The parameters of the Earth’s Magnetic Field are registered daily and maps of variations of the elements are drawn. Main users of the collected information are Military Geographic service of the MA, Cadaster Agency at the Ministry of Regional Development of Bulgaria and all organizations working in the area of underground resources research with geomagnetic methods. Geomagnetic field data are used for navigation and radio-connections services as well.

The Ionospheric station “Plana” performs daily registration, processing and analysis of the condition of the ionosphere above the country and surrounding areas. On the basis of these observations, forecasts for ionospheric radio wave propagation, and short-wave radio-circuits on the territory of Bulgaria is provided. Based on the contract with the Defence Ministry, these forecasts are forwarded for exploitation to all interested authorities.

The Network for the ground measurements of the bioactive UV radiation and the ozone thickness consists of three stationary stations, which will be installed in Sofia (GPhI), v. Shkorpilovci in the base of the Oceanology Institute and in Geophysical observatory “Vitosha”. From these three permanent stations information for the bioactive UV radiation level in the capital, on the coast and in the Bulgarian mountain resorts will be collected. Two portable stations for measurement of erythemal UV exposure will be used in a planed field works and for relative calibration as well.

The Departments of the Institute of oceanography related to observations are;

Marine Physics:

- Measurements and analysis of the main hydrophysical parameters of sea water and meteorological components of the adjacent atmosphere;

Marine Chemistry:

- Monitoring on the main chemical parameters as main ions, dissolved gases, biogenic elements in the western part of the Black Sea and coastal lakes;

Marine Biology and Ecology:

- Study the taxonomic and functional biodiversity of the Black Sea and the food chain interactions
- Investigate the response of biota to external forcing - anthropogenic pressure and global climatic impact

Coastal Zone Dynamics:

Studies wind-wave climate and wave transformation in shallow water; wind-wave structure and non-linear relations; sea level fluctuations; coastal morpho- and lythodynamic processes; sediment balance; geodynamic coastal processes.

Marine Geology and Archaeology:

- Studies on structure and composition of the Black Sea sediment complex and stages in its development; recent geological processes; geocatastrophic phenomena;
- Investigations on alternative energy resources; geophysical fields;

Ocean Technologies

- Collects, processes, quality controls, archives and keeps various oceanographic data.

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

In 2004 National Centre for Oceanographic Data was established in the Institute. It is included in the international system for data exchange IODE of IOC.

Bulgarian National Oceanographic Data Centre (BGODC) serves as a local portal for the national and international exchange of oceanographic data.

The main objectives of BGODC are:

- To acquire the marine data sampled by Bulgarian institutes and agencies, archive it and maximise its utilization by promoting data exchange on national and international level
- To meet Bulgarian's international data exchange obligations to intergovernmental Oceanographic Commission (IOC), SEADATANET, ASCABOS and ARENA projects regarding monitoring of the Black Sea.

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

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

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

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

The Institute has participated in the creation of the scientific base and the development of the instrumentation of the following satellites and rockets: satellites "intercosmos"- 8, 12, 14, 19; "intercosmos-bulgaria-1300" and "meteor-priroda"; satellites (with 24 original scientific instruments) "vertical" - 3,4, 6, 7, 9 and 10 rockets as well as in scientific programs of the first and second Bulgarian cosmonauts on board of "salyut-6" and "mir", space stations "vega", "activen", "granat", "interball" and other projects, "apex" satellite, and "phobos" missions.

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

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

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

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

Bulgaria is an active participant at the investigation of the Earth surface by aero-space tools. The country has its own contribution (project teams from the Institute for Space Research and some other space laboratories in the country) to utilization of spectral-reflector characteristics of various natural forms. Bulgarian specialists created a catalogue of the major soil types in the country. Since 1989 Bulgarian scientists have participated during two stages of an international project “Earth cover” by using satellite data. The satellite images are received by: participation of various national and international projects and programmes (e.g. CD, DVD); Internet (e.g. FTP servers); purchase (e.g. CD, DVD).

9. Education, training and public awareness

9.1. Introduction

At the beginning of the 21st century the issue of global change in nature and impact on society and natural ecosystems is a major priority in the work plans of the scientists and unfailing interest to politicians and the media. Society shows an increasing concern to climate change, related environmental issues and potential measures to adapt to the negative impacts of these changes. Development of adequate policies can be done only with joint efforts, and when based on accurate scientific assessments and projections, taking into account the causal relationships of different nature.

9.2. Education

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

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

The main results from the work in the area of climate change are given in Table 9.1

Table 9.1 Reasons, specific objectives and assets

PRIORITY PROBLEM: **Insufficient participation of the interested parties and general public in the national and international climate change activities**	**STRATEGIC OBJECTIVE:** **Active participation of the interested parties and general public in the formulation, development, execution and assessment of the climate change policies and measures**	
Complex reason: Lack of sufficient information on the subject or the information is hard to obtain	Specific objective: To create conditions the information on climate change, the international and national policy on this problem to be available and with easy accessed for everybody interested	
Main reasons: Lack of national program or plan for education, training and information on public awareness on climate change Lack of journalists competent in this area Media information are of	Tasks: Development and adoption of national program or plan for education, training and information on public Creation of informal group of journalists and experts	Direct assets: A huge amount of information exists in Internet on climate change A company on environmental protection management activities

sensational or campaign character, there are no fundamental and in-depth analysis Lack of coordination amongst the administration in regard to presenting information to various customers Lack of effective information system for the ongoing work, results and achievements in various climate change areas Lack of purpose financing for the activities defined in the New Delhi Program on Article 6 of the UNFCCC Media do not contact experts on the topic	to prepare and present information on climate change Journalists trained on the subject Create mechanism for Information Exchange (CHM) on climate change causes, its effect and prevention activities in various areas and sectors Improved inter administration coordination for detailed and in-time presentation of information Adapted scientific publications and information on climate change and popularizing through integration in various special information flows	exists There are environmental NGOs with experience in education and public awareness MOEW has an information centre and Internet site on climate change Ministries and Agencies have public awareness units Indirect assets: There is a mechanism for Information Exchange (CHM) on biodiversity Specialized radio and TV broadcasts exist (for ex. “Brazdi”, “Ecocambana”, etc.)
Complex reason: There is no general education on the subject	Specific objective: Climate change subject integrated at all educational levels	
Main reasons: Lack of enough teaching materials and books in Bulgarian Lack of specialized information materials for teachers on climate change Training aids on natural science and humanitarian subjects do not include climate change and its impact in the respective area	Tasks: Development of educational and information materials in Bulgarian Development of specialized educational programs on climate change for teachers and lecturers Purpose financing is ensured on activities on the national program and for science and research in High schools Training aids on natural science and humanitarian subjects that include climate change and its impact on the respective area	Direct assets: MOEW have an expert on Education and Environment The Ministry of Education carries out reforms in the system for improvement of teachers’ training Indirect assets: There are some educational materials in small circulation State educational requirements are under way
Complex reason:	Specific objective:	

Lack of sufficient expert potential for business, local authorities, NGOs and academics	Established expert potential in regard to climate change for business, local authorities, NGOs and academics	
Main reasons: Insufficient targeting of scientific and research activities toward compliance and meeting the requirement of UNFCCC Lack of sufficient financing for research on this subject Ignoring the gravity of the problem by the parties concerned Lack of good opportunities for employment and professional growth	Tasks: To ensure financing on this subject from the National Science Fund Special educational practices (seminars, courses, information campaigns) Improved interconnection of business and science for popularizing and financing the research on the subject	Direct assets: There are highly qualified experts and scientists with interest on climate change subject There are experienced teams in climate change projects There is a limited number of experts with good knowledge on climate change Indirect assets: There are chamber organizations that support information dissemination and protection of member interests EPA requires the development and application of national and municipal environmental protection programs There is experience in the development of municipal programs on EE There are regional centres and local units on energy efficiency

There is already planning of the tasks from Table 9.1 and some positive results are in place.

9.3. Environmental Education in Schools

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

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

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

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

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

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

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

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

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

9.5. Ecotourism

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

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

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

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

ANNEX I –Biennial report

Bulgaria’s
FIRST BIENNIAL REPORT

in Compliance with the Obligations under the
United Nations Framework Convention on Climate Change,
according to Decisions 2/CP.17 and 19/CP.18
of the Conference of the Parties,

CONTENTS

Introduction

The first Biennial Report of Bulgaria (BR1) was prepared under Decision 2/CP.17 of the Conference of the Parties to the UNFCCC and was submitted as an Annex to the Bulgaria Sixth National Communication under the UNFCCC (NC6).

This document is structured according to an outline defined in Annex 1 of the Decision 2/CP.17. Provisions of many chapters are reflecting information already provided in the Bulgaria Sixth National Communication in its corresponding chapters.

Information on greenhouse gas emissions and trends

The main reasons for the declining GHG emission trend in Bulgaria are the structural economic changes due to the radical transition process from a centrally-planned economy to a market-based economy. This led to a decrease of power production from thermal power stations (and an increase of the shares of hydropower and nuclear power), structural changes in industry (including a decline in production by energy-intensive enterprises and energy-efficiency improvements), introduction of energy efficiency measures in the residential sector and a shift form solid and liquid fuels to natural gas in energy consumption. This also led to a decrease in GHG emissions from the agricultural sector stemming from the decline in the cattle and sheep populations and the use of fertilizers.

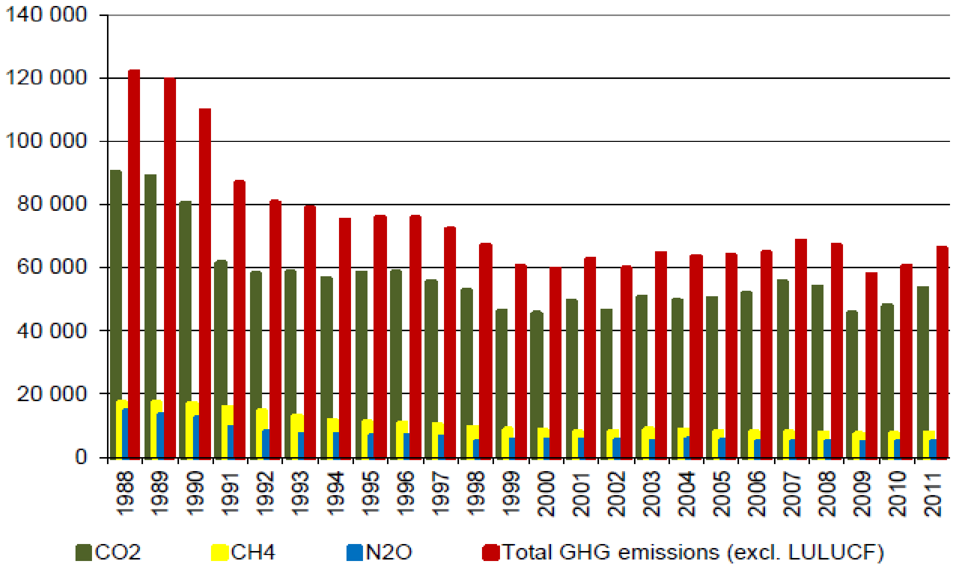
Bulgaria experienced a steady declining population trend during the period 1990-2011, which resulted in the reduction of population by 13%.

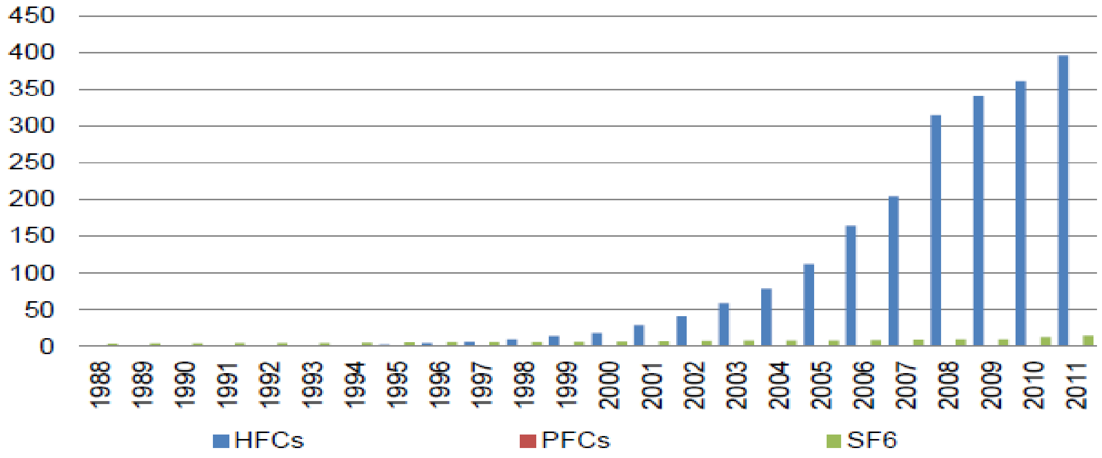
The most important greenhouse gas in Bulgaria is carbon dioxide. The share of CO_2 emissions from the total greenhouse gas emissions varies around 80% excluding LULUCF and 77% including LULUCF. In absolute terms CO_2 emissions have decreased 40,9% since 1988. Around 75% of total CO_2 eq emissions originate from the Energy sector. The amount of energy-related CO_2 emissions has fluctuated much according to the economic trend, the energy supply structure (including electricity exports) and climate conditions.

Methane emissions (CH_4) have decreased by 55,4% from the 1988 level. This is mainly due to the improvements in waste collection and treatment and a reduction in animal husbandry in the Agriculture sector. Correspondingly, emissions of nitrous oxide (N_2O) have also decreased by 67% which has been occasioned mostly by the reduced nitrogen fertilization of agricultural fields, the biggest decline was in the beginning of time series.

The following 2 figures describe the trend of the emissions by gas in Gg CO2 eq. for the period 1988 – 2011.

1.
2.





More detailed information on inventory data and inventory arrangements can be found in the Bulgarian National Inventory Report 2013.

Quantified economy-wide emission reduction target

Bulgaria ratified the KP in August 2002 taking the commitment to reduce its national GHG emissions for the first commitment period (2008-2012) by 8% compared to 1988 (base year). Under these international agreements Bulgaria is committed to provide annually information on its national anthropogenic greenhouse gas emissions by sources and removals by sinks for all greenhouse gases not controlled by the Montreal Protocol.

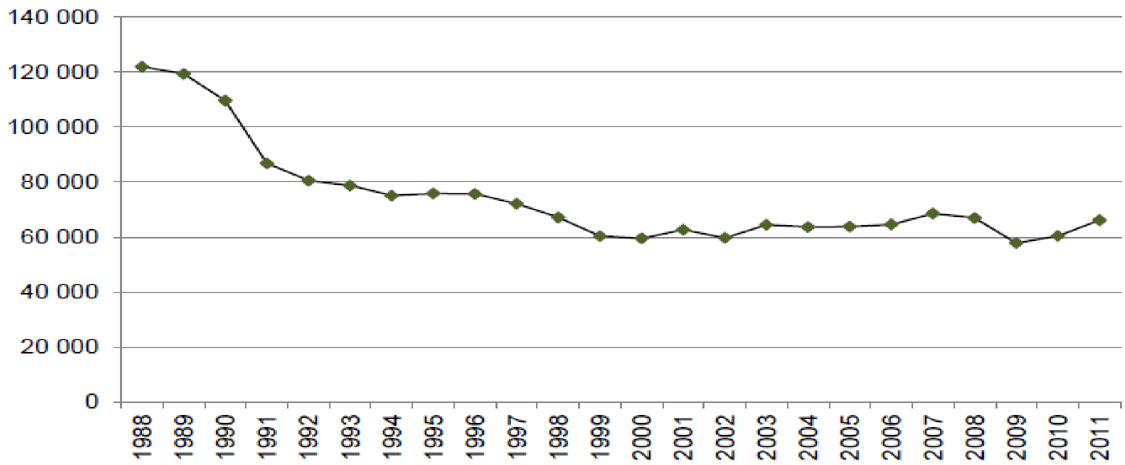
In the second commitment period, Bulgaria will fulfill its quantified objective jointly with other EU Member States. For the period until 2020 the EU and its Member States communicated an independent quantified economy-wide emission reduction target of a 20 per cent emission reduction by 2020 compared with 1990 levels. This is documented in the UNFCCC document CCC/SB/2011/INF.1/Rev.1 of 7 June 2011.

No individual target for Bulgaria is included in document FCCC/SB/2011/INF.1/Rev.1, as this 20 % reduction target will be fulfilled jointly by the EU and its Member States. In the EU submission to the UNFCCC from 20 March 2012, document FCCC/AWGLCA/2012/MISC.1, the EU target is explained further, including information on the use of carbon credits from international market-based.

Progress in achievement of quantified economy-wide emission reduction targets and relevant information

In 2011 Bulgaria's greenhouse gas emissions totaled 66 133,28 Gg CO2 without reporting of sequestration from LULUCF sector. The emissions decreased by 45,8% compared with the base year and on 45.8% below the level of 122000 Gg CO2 to which Bulgaria should limit its emissions during the Kyoto Protocol's first commitment period between 2008 and 2012. Emissions in 2011 were 9.6 % increase in comparison with the emissions of the previous year.

The following figure presents the total GHG emissions (without LULUCF) for the period 1988 – 2011 in Gg CO2 eq.



28 JI projects have been approved in Bulgaria and 21of them have already achieved and verified emission reductions. The implementation of those projects leads to greenhouse gases emission reduction around 8 million tons carbon dioxide equivalent for the period 2008-2012.

Projections

The most recent GHG projections were elaborated taking in consideration the trends of key macro-economic, technological, demographic and other indicators that determine the economic development of the country.

During the development of the projection scenarios the available data from the National Statistics Institute, the Plan for development of the energy sector of Bulgaria for the period 2008-2030, Third National Action Plan on Climate Change for the period 2013-2020 (NAPCC 2013-2020), comments of analysts of the World Bank and publications in the press were used. The projections were elaborated in line with Decision No. 280/2004/EC and Decision No. 2005/166/EC.

Total GHG emissions (without LULUCF) in the scenario “with measures” are expected to decrease with 4,5% in 2020 compared to 2005 and 6.1% in 2030. The scenario “with additional measures” shows a sharper decrease from 63.7 Mt in 2005 to 53.1 Mt in 2020 (-18.7 %), and to 51.8 Mt in 2030 (-23 %).

	1988	**2000**	**2005**	**2009**	**2010**	**2015**	**2020**	**2030**	**Δ (2020 - 2005),%**	**Δ (2030 - 2005), %**
WEM scenario Aggregate emissions in Gg CO2 eq.	121 936	59 501	63 749	57 805	60 352	57 962	60 982	60 112	-4,5	-6,1
WAM scenario Aggregate emissions in Gg CO2 eq.	121 936	59 501	63 749	57 805	60 352	53 126	53 710	51 824	-18,7	-23,0

Projected emissions according to sector and gas are listed in CTF Tables 6 (a) and 6 (c) in the Annex. Key variables used in the projections are listed in CTF Table 5.

More details on results, assumptions, methods and changes compared to previously reported projections can be found in Chapter 5 of Bulgaria’s Sixth National Communication.

Provision of financial, technological and capacity-building support to developing country Parties

The implemented and planned for implementation policies and measures have no adverse impact on developing countries.

Republic of Bulgaria’s Roadmap for participation in the international development assistance delineates the country’s geographic priorities for projects sponsorship. States that are geographically closely situated are identified as the most appropriate beneficiaries - Armenia, Former Yugoslav Republic of Macedonia, Moldova, Kosovo, Serbia and Georgia.

Moreover, since the Bulgarian contribution is not large enough to allow the execution of an independent project, the Ministry of Environment and Water has decided to sponsor an “off-the-shelf” project which allows a certain degree of customization.

Taking into consideration Bulgarian foreign policy priorities and a proposal by the Ministry of Finance, the Ministry of Environment and Water contacted United Nations

Development program with the goal of identifying a project which fulfills the aims of EU Fast Start Financing initiative.

After a period of prolonged negotiations the project “Bulgarian Fast Start Finance Contribution 2011-2012: Utilizing Bulgarian Experience in the Development of Administrative Capacity for the Conduct of Monitoring, Reporting and Verification of Greenhouse Gas Emissions” was acknowledged as the best available mean of delivering Bulgaria’s FSF contribution.

The main aim of the project is to support the implementation process of the EU Directives 2003/87/EC and 2009/29/EC in Former Yugoslav Republic of Macedonia by utilizing Bulgarian expertise and capitalizing on best practices and lessons learned of Republic of Bulgaria in the field of monitoring, reporting and verification of greenhouse gas emissions as well as emission trading. This is achieved through direct interaction between the Ministries of Environment in the two countries and information exchange between the national and Bulgarian institutions and experts.

It is expected that the project will contribute to achieving national consensus on the actions and measures that need to be undertaken to address the climate change related issues relevant for the country in regards to the EU ETS on a short and long term. This should also open dialogues on the need for allocation of adequate financial means for realization of the agreed actions and measures.

Other reporting matters

No other reporting matters supplied in this submission

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REPUBLIC OF BULGARIA
SIXTH NATIONAL COMMUNICATION ON CLIMATE CHANGE