REPUBLIC OF BULGARIA

SEVENTH
NATIONAL COMMUNICATION
ON CLIMATE CHANGE

UNITED NATIONS
FRAMEWORK CONVENTION ON CLIMATE CHANGE

SOFIA, 2018

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 was prepared for the Ministry of Environment and Water in cooperation with the Ministry of Agriculture, Food and Forestry, Ministry of Energy, Ministry of Transport, Information Technology and Communications, National Institute of Meteorology and Hydrology and Bulgarian Academy of Science.

The Seventh 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 Sixth National Communication till the end of 2015.

1. Executive summary

1.1.Introduction

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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 (Rumen Radev since January 2017) 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 (Boiko Borisov since May 2017).

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 16th-largest country. The neighbour states are Greece and Turkey to the South, FY Republic of Macedonia and Serbia 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. 34% 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.

In the period 1988-2016 (Source: NIMH-BAS), the average annual air temperature for the lower part of the country (for areas up to 800 m altitude) is increased on average with 0.8°C relative to the climatic normal for the reference period 1961-1990 and ranges between 10.6°C and 13.0°C. The tendency in the long-term variations of the average annual air temperature remains positive. Temperature anomalies for all years after 2007 (except 2011) are equal or over 1°C. Against this background, 2016 (with an average annual temperature 12.6°C) is one of the four hottest years (including 1994, 2007 and 2015) in the period 1988-2016. The average amount of rainfall in 2016 (for areas up to 800 m altitude) is 621 mm, which is about the climatic normal.According to calculated data, Bulgaria's population is 7 153 784 people at the end of 2015. The population density is 64.8 per sq. km at the end of 2015. During the period between the last two Censuses 2001-2011 the population in the country decreased by 9.8% due to the negative natural growth rate and due to international migration. The progressive decrease of the Bulgarian population is hindering economic growth and welfare improvement, and the management measures taken to mitigate the negative consequences do not address the essence of the problem. The tendency of increasing relative share of urban population and decreasing relative share of rural population is kept. 73.1% live in urban areas and 26.9% live in rural areas

The average age of the population for the country is 43.3 for 2015. The aging process is observed not only in the villages but also in the cities, while the average age for the villages is higher than in the cities.Average life expectancy in Bulgaria is 70.51 for male and 77.55 for female for the period 2011-2015.

In total, women continue to be more (51.4 %).

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 (Council for Mutual Economic Assistance) 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 country has successfully achieved and continues to deliver macroeconomic stability after 1998. The introduced Currency Board, sound fiscal policy, limited pay raise, etc. have been rules, administrative in their nature, which are in the basis of the macroeconomic and financial stability. The functioning of the companies of the real economy, despite some positive trends, mainly in the sales growth, is still not leading to overcome the crisis in the real economy.

After the introduction of the currency board and the denomination of the lev in 1999, a slow increase in GDP is witnessed in the country. The economic growth is stable and within a moderate range. Still, GDP levels are far below the desired levels.

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

Real GDP grew 3% in 2015, driven mainly by exports and falling oil prices. Growth in 2015 was stronger than in 2014 mainly because of higher net exports.

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 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.

Industry is the biggest energy consumer in Bulgaria's economy, but it's share in 2015 decreased with 55.5% compared to 1990. Instead energy consumption in transport sector in 2015 has doubled from 15% to 34.7% of the final energy consumption.

The largest relative share of input fuels for electricity 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 %.

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.

Currently, the ‘Industry’ comprises the activity of industrial enterprises, classified in the mining and quarrying industry, manufacturing, electricity, gas, steam and air conditioning supply and water supply, sewerage, waste management and remediation activities.

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 the period 1988-2015is presented. This Inventory is prepared according to the UNFCCC Guideline approved by the Subsidiary Body for Scientific and Technological Appliance. The rules and the structure of the National GHG Inventory Report are formed by these Guidelines. The report is elaborated in compliance with the 2006 IPCC Guidelines.

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

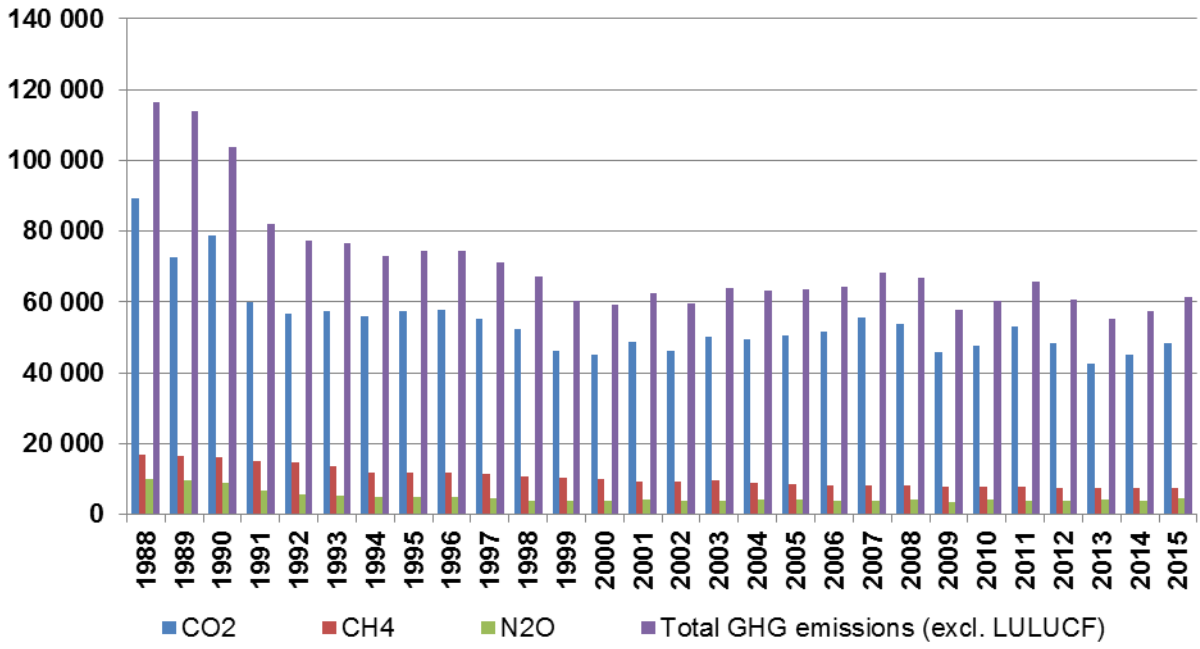
The annual inventory and reporting of greenhouse gas emissions and removals provide an information base for the planning and monitoring of climate policy. The Kyoto Protocol obliges its parties to establish a national greenhouse gas inventory system by the end of 2006. Bulgaria's National Greenhouse Gas Inventory System was set up at the beginning of 2007.

The national system produces data and background information on emissions and removals for the UNFCCC, the Kyoto Protocol and the EU Commission. In addition, the scope of the system covers the archiving of the data used in emission estimations, the publishing of the results, participation in inventory reviews and the quality management of the inventory.

The National Inventory Report (NIR) of Bulgaria for the 2017 submission to the EU, the UNFCCC and the Kyoto Protocol includes data of the anthropogenic emissions by sources and removals by sinks of all greenhouse gases (GHGs) not controlled by the Montreal Protocol, i.e. carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), nitrogen trifluoride (NF3) and sulphur hexafluoride (SF6).

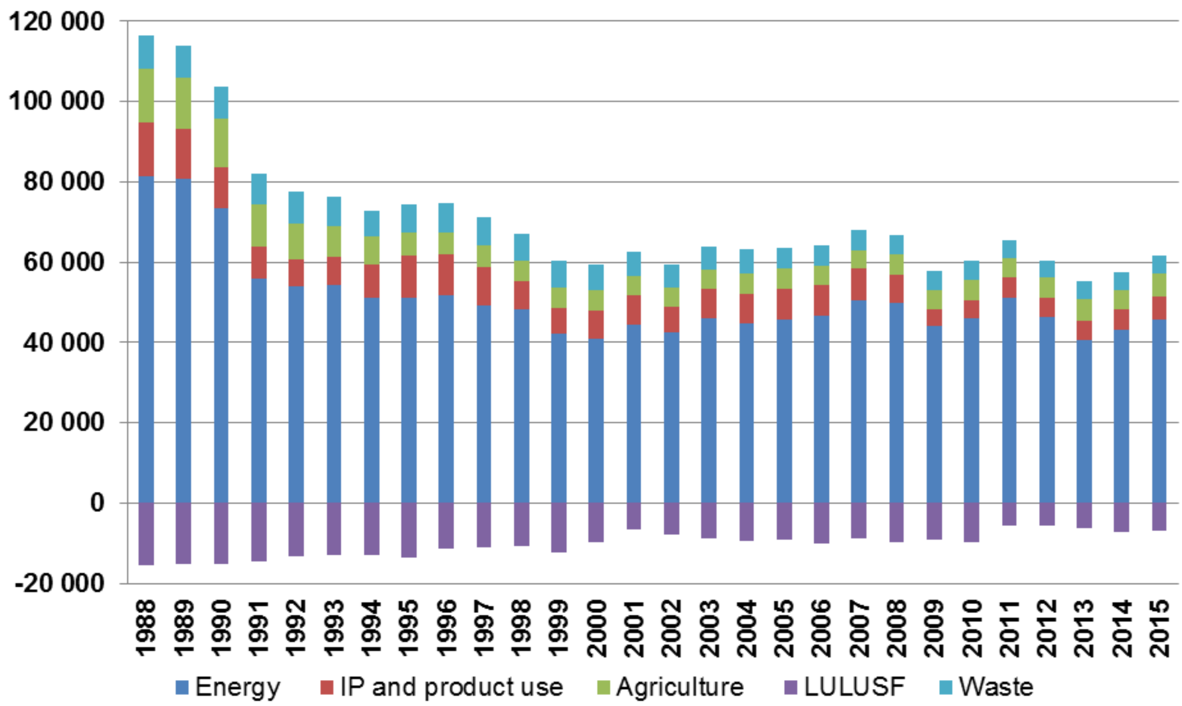
Each of these gases has a different warming effect. As an example, the gases HFCs, PFCs, NF3 and SF6 (so called F-gases) have much greater warming effect, in some cases over one hundred times, compared to methane (25), nitrous oxide (298) and carbon dioxide (1). The change in the overall emissions for the period 1988–2015 is shown in **Error! Reference source not found.**.

Figure 1.3 Total greenhouse gas emissions in CO2 eq. Gg



The aggregated GHG emissions trend for the period 1988 – 2015 by sectors in Bulgaria is shown on **Error! Reference source not found.**.

Figure 1.4 Aggregated GHG emissions by sector, Gg CO2 eq. for the period 1988-2015



The Energy sector, where GHG emissions come from fuel combustion, headed the list in 2015 with the biggest share – 74.2%. Sector Agriculture ranked the second place with 9.7% and sectors IP ranked the third place with 9.3 % and Waste with 6.8%.

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 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, Ministry of Energy , Ministry of Transport, Information Technology and Communications (MTITC), The Energy Efficiency Agency (EEA), The Ministry of Agriculture Food and Forestry (MAFF), 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 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 2014-2020;
- National Action Plan for Renewable Energy;

- Third National Climate Change Action Plan (2013 – 2020);
- National Programme for Promotion of the Biofuels Use in the Transport Sector 2008-2020;
- Integrated Transport Strategy for the period until 2030;
- Strategic Plan for Development of the Forestry Sector in the Republic of Bulgaria 2014-2023;
- National Strategy for the Development of the Forestry Sector in the Republic of Bulgaria for the period 2013-2020;
- National Strategic Plan for management of building demolution waste 2011-2020;
- National Strategic Plan for management of the sludge from urban wastewater treatment plants 2014-2020;
- National waste prevention programme (NWPP) 2014 – 2020;
- National Waste Management Plan (NWMP) 2014 – 2020;
- National Regional Development Strategy.

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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 2017.

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 scenario with existing measures reflects all approved and implemented policies and measures to reduce GHG emissions in the country by the end of 2015.

The scenario with additional measures reflects all adopted policies and measures to reduce GHG emissions in the country after 2015 and includes the impact of policies and measures presented in this report that have a quantitative assessment at this stage.

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Table 1.1 Aggregate GHG emissions of Bulgaria (excl. LULUCF)– Gg CO2 eq. - scenario with measures

	2015	2020	2025	2030
Total emissions, WM	61482,75	59086,83	55580,88	55492,74

Table 1.2 Aggregate GHG emissions of Bulgaria - Gg CO2 eq. - scenario with additional measures

	2015	2020	2025	2030
Total emissions, WAM	61482,75	53325,5	49650,4	49826,8

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.

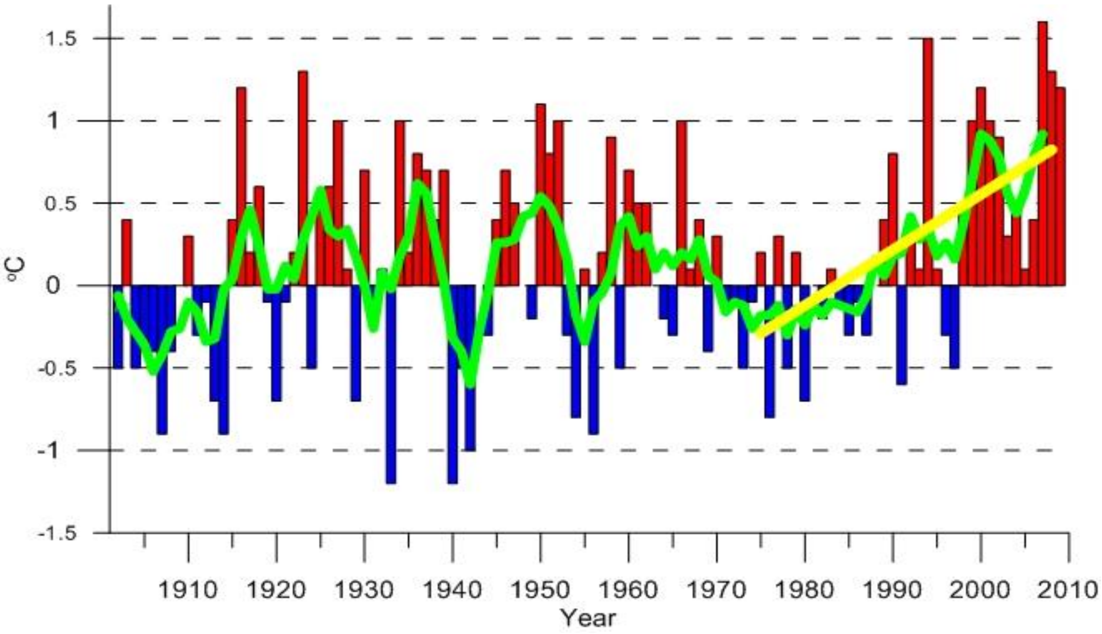
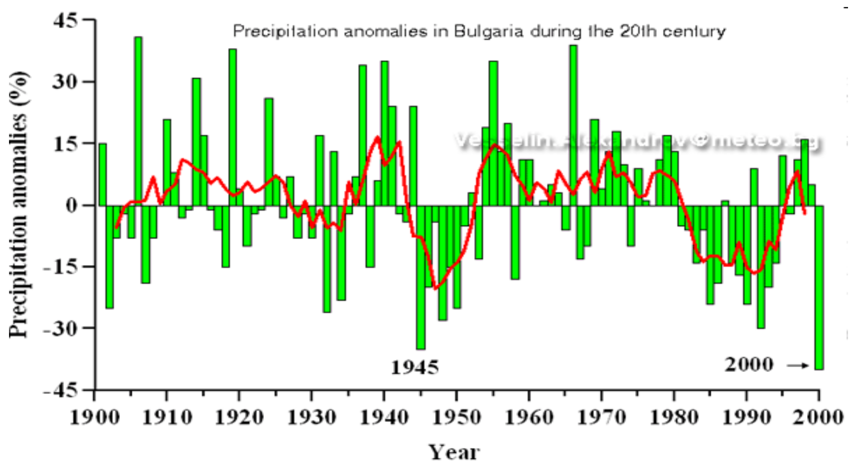


Figure 1.6 Anomalies of annual precipitation in Bulgaria during the 20th century



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.

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

	2013		2014		2015		2016	
	BGN x 1000	%	BGN x 1000	%	Thousand BGN	%	Thousand BGN	%
Exploration and exploitation of the earth	8659	4,3	13947	6,7	20785	9,8	18601	9.9
Environment	3024	1,5	1182	0,6	1007	0,5	709	0.4
Exploration and exploitation of space	3979	2	3261	1,6	3143	1,5	2 966	1.6
Transport, telecommunication and other infrastructures	2212	1,1	7055	3,4	9630	4,5	4 947	2.6
Energy	354	0,2	634	0,3	1105	0,5	661	0.4
Industrial production and technology	15675	7,8	16358	7,9	20908	9,8	20 620	11.0
Health	4067	2	4638	2,2	4607	2,2	3 373	1.8
Agriculture	40036	20	34387	16,7	33824	15,92	30 732	16.4
Education	14592	7,3	11808	5,7	13697	6,4	11 296	6.0
Culture, recreation, religion and mass media	2220	1,1	1397	0,7	2049	1	1 809	1.0
Political and social systems, structures and processes	3438	1,7	2996	1,5	3775	1,8	3 192	1.7
General advancement of knowledge: R&D financed from General University Funds (GUF)	18143	9,1	8310	4	10773	5,1	11 329	6.0
General advancement of knowledge: R&D financed from other sources	81221	40,5	100531	48,7	86955	40,9	77 199	41.2
Defence	2803	1,4	80	0	212	0,1	31	0.0

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 (Rumen Radev since January 2017) 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 (Boiko Borisov since May 2017), The central administration consists of 20 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, Bulgaria is Europe's 16th-largest country. The neighbour states are Greece and Turkey to the South, FY Republic of Macedonia and Serbia 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, 34% of the country's territory is covered with forests (deciduous 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.

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 km^2 and water volume of 211 mln m^3, and 23 dams with total area of 376 km^2 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 the subtropical climate of the Mediterranean type and has four distinct seasons. Considering its small area, Bulgaria has unusually various climate conditions due to the influence of the strongly different continental and Mediterranean climates and diverse landscape. Bulgarian mountains and valleys act as barriers or channels for air masses, causing sharp contrasts in weather over relatively short distances. The barrier effect of the Balkan Mountains is felt throughout the country: on the average, Northern Bulgaria is cooler with about 1°C and receives about 192 mm more precipitation than Southern Bulgaria. 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 intermediate area, which includes the Thracian Lowland, is influenced by a combination of the two systems but the continental one predominates. The climate in this region is generally more severe than that in other parts of Europe at the same latitude. 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, but strong winds and local storms are frequent during the winter. Depending upon the depth to which they study the area, climatologists list four or more climatic subzones. Commonly used classification subdivides Bulgaria into five climatic zones: Moderate-Continental zone; transitional zone; Continental-Mediterranean zone; Black Sea coastal zone; and alpine zone in the mountains above 1000 m altitude.

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 valleys scattered between the uplands have temperature inversions resulting in increased air pollutions and smog in the industrial and urban zones. Much of the higher land remains white well into springtime. Lower elevations are snow covered an average of twenty-five to thirty days per year. Abundant snowfalls may occur throughout the country from December to mid-March, especially in some higher mountainous areas. The heating season varies between 160 and 220 days for the different locations. An important indicator of the energy requirements for heating is the number of degree days. The heating degree days for indoor temperatures of 20°C vary between 2100 and 3500 on average annual basis (2500 for Sofia). Typical continental and changeable is the climate in spring. The temperatures range from 15°C to 25°C, steadily increasing from March to June. Summer starts in the beginning of June, when temperatures can reach above 30°C. July and August are the hottest months and sometimes temperatures reach above 35-38°C. Summer usually ends in mid-September, when temperatures drop and the days become shorter. September and October can still be quite warm and pleasant with temperatures between 10°C and 25°C; autumns are not particularly rainy compared to the west and central parts of Europe.

The long-term annual mean air temperatures in Bulgaria vary from -3.0°C 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 -10.4°C to 2.8°C in January and from 5.2°C to 25.2°C in July. During severe winters, minimum temperatures may drop below -20°C, even below -30°C. Dobrudzha in the northeast, the Black Sea coastal area, and parts of the Thracian Lowland usually receive less than 500 mm precipitation per year. The Thracian Lowland is often subject to summer droughts. High altitude areas, which receive the most precipitation amount in the country, may average over 1000-1100 mm per year. The air humidity is between 66 and 85% in the different areas of the country. Average cloudiness is about 55-56 percent. The prevailing winds are northwest/west. The average wind speed varies between 1.2 and 4.0 m/s in non-mountainous areas. In some mountainous regions and northern coastal zone, the average wind speed is over 5 m/s, which is the threshold for effectiveness of wind energy projects.

In the period 1988-2016 (Source: NIMH-BAS), the average annual air temperature for the lower part of the country (for areas up to 800 m altitude) is increased on average with 0.8°C relative to the climatic normal for the reference period 1961-1990 and ranges between 10.6°C and 13.0°C. The tendency in the long-term variations of the average annual air temperature remains positive. Temperature anomalies for all years after 2007 (except 2011) are equal or over 1°C. Against this background, 2016 (with an average annual temperature 12.6°C) is one of the four hottest years (including 1994, 2007 and 2015) in the period 1988-2016. The average amount of rainfall in 2016 (for areas up to 800 m altitude) is 621 mm, which is about the climatic normal.

Since 1970s, a tendency towards global warming is observed. As a whole, the winters were milder in the second half of the 20th century. In Bulgaria, 26 of the last 29 years since 1988 have positive anomalies of the average annual air temperature compared to the climatic reference period 1961-1990. There are many hot and droughty spells followed by severe storms and heavy floods incurring damage and casualties. The annual amplitude between the maximum and the minimum air temperature decreases – the minimum temperature rises faster than the maximum one. Data from the phenological observations indicate an accelerated active growth of about 7-10 days in the different climatic regions, which represent clear evidence of the global warming over the past 30 years compared to previous periods. Since the beginning of the 21st century a significant increase in the average number of days with 24-hour precipitation above 100 mm has been observed (above 30%). Convective precipitation, which is typical for spring and summer become more frequent during the winter months. The snow cover persistence in the mountains decreases and the average snow cover depth shows a positive tendency towards thinning. The areal of deciduous forests is shifted to higher elevations.

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.

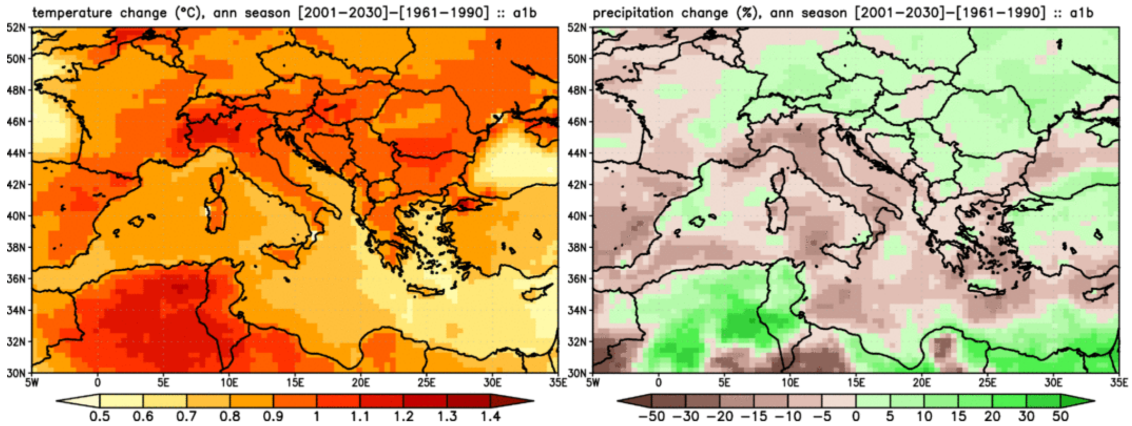
The results from the studies of water resources in Bulgaria based on current trends of air temperature and precipitation as well as on simulation models and climate scenarios show that the annual river runoff is likely to decrease during this century. The main reasons for this – the observed trends of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

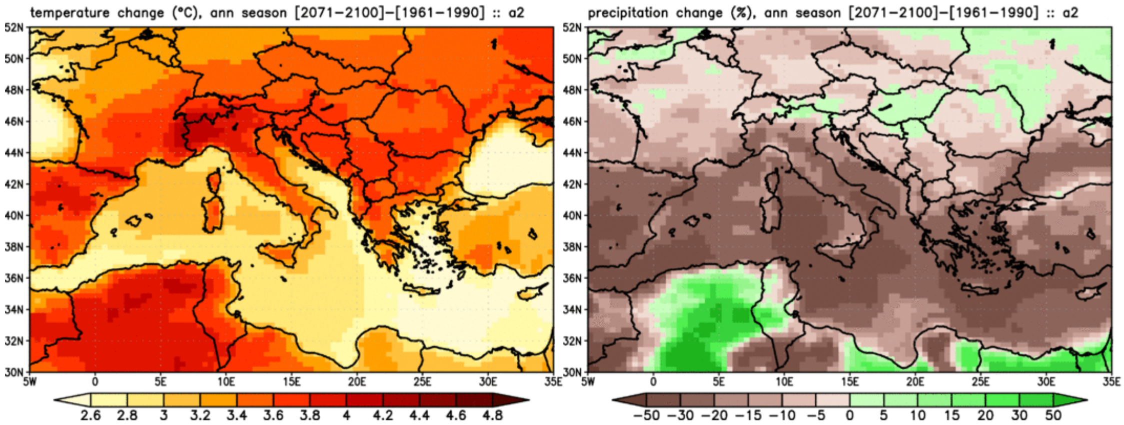
The expected global warming will be accompanied by an increase in the frequency of the hot air waves combined with increased humidity and urban air pollution. The result will probably lead to a large number of heat strokes. Besides the risk of further limitation of water resources, more forest fires, 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 precipitation even under the current climate conditions insufficient to ensure normal growth, development and yield of crops.

South East European Virtual Climate Change Center (SEEVCCC) provides results of climate projections over Euro-Mediterranean region obtained with coupled atmosphere-ocean Regional Climate Model (RCM-SEEVCCC). Climate simulations are performed for three time slices (1961-1990, 2001-2030 and 2071-2100), using two IPCC scenarios (A1B and A2). A1B is characterized as a "medium sensitivity" and A2 as a "high sensitivity" scenario, in sense of carbon dioxide concentration. On Figure 1 are shown anomalies of the annual air temperature (°C) and annual precipitation amount (%) for the periods 2001-2030 (A1B scenario) and 2071-2100 (A2 scenario). For the whole model domain temperature increases, in first 30 years (2001-2030) with about 1-1.5°C and in last 30 years (2071-2100) with more than 3°C. During the last thirty years generally the whole model domain is drier than in the first 30 years of the century (on average over 20% for Bulgaria). These results are consentient with results obtained from a set of 21 global climate models (IPCC Fourth Assessment Report).

Figure 1 Temperature and precipitation annual change for periods 2001-2030 (A1B scenario) – upper panel, and 2071-2100 (A2 scenario) – lower panel





The climate scenarios for Bulgaria, obtained in NIMH-BAS within the framework of the CECILIA project (http://www.cecilia-eu.org/description.htm), present the regional climate for the "near future" (2021-2050) and "distant future" (2071-2100) periods like a trends for the average annual air temperature and the mean annual precipitation amount in comparison to the current reference climate period. The expected increase of mean annual temperature is about 1.5-2°C for the "near future" and about 2.5-3.5°C for the "distant future". The difference in spatial distribution of annual precipitation amount in some parts of the country is observed. The negative trend with an average of 5-10% (in individual regions up to 15-20%) in both periods is expected for east half of the country. In the second period the areas with negative trends for precipitation become larger and cover also parts of West Bulgaria.

2.4.Population Profile

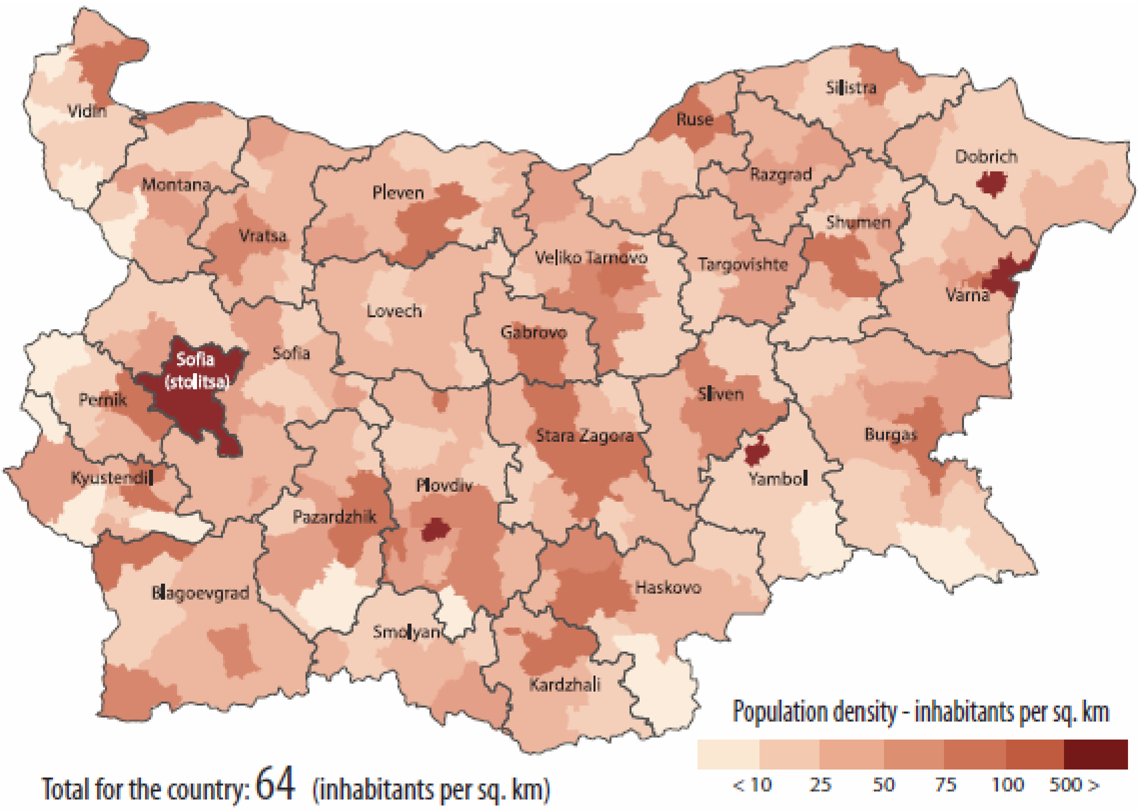
The demographic picture in Bulgaria is unfavourable at the beginning of the XXI century. It ranks the country amongst those in Europe with negative rate of natural increase, low birth rate, high adult mortality and child death rate, decreasing average age of population, Table 2.1.

Table 2.1 Demographic parameters

	1960	1970	1980	1990	2000	2010	2012	2013	2014	2015
Birth rate ‰	17,8	16,3	14,5	12,1	9,0	10,0	9,5	9,2	9,4	9,2
Natural increase ‰	9,7	6.0	3,4	-0,4	-5,1	-4,6	-5,5	-5,2	-5,7	-6,2
Marriage rate,‰	8,8	8,6	7,9	6,9	4,4	3,2	2,9	3,0	3,4	3,9
Average age of population	32,4	34,4	35,8	37,5	38,9	41,9	42,8	43,0	43,2	43,3
Population annual average (mil)	7,87	8,49	8,86	8,72	8,41	7,5	7,28	7,24	7,2	7,15

According to calculated data, Bulgaria's population is 7 153 784 people at the end of 2015. The population density is 64.8 per sq. km at the end of 2015. During the period between the last two Censuses 2001-2011 the population in the country decreased by 9.8% due to the negative natural growth rate and due to international migration. The progressive decrease of the Bulgarian population is hindering economic growth and welfare improvement, and the management measures taken to mitigate the negative consequences do not address the essence of the problem. The Government Program for the period 2017 - 2021 is the first one that aims at overturning the trend. The program also identifies the priority means for achieving this goal: measures to increase the birth rate, reduce youth emigration, and build up regulatory and institutional capacity to implement a modern immigration policy tailored to the needs of the Bulgarian business.The tendency of increasing relative share of urban population and decreasing relative share of rural population is kept. 73.1% live in urban areas and 26.9% live in rural areas .

Figure 2.1. Density of population per sq. km by district as of 31.12.2015



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

The average age of the population for the country is 43.3 for 2015. The aging process is observed not only in the villages but also in the cities, while the average age for the villages is higher than in the cities.

Average life expectancy in Bulgaria is 70.51 for male and 77.55 for female for the period 2011-2015. In comparison, the average life expectancy for 1935-1939 was respectively 50.98 and 52.56, and for the period 1984-1986 it was 68.17 for male and 74.44 for female.

In total, women continue to be more (51.4 %).

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 43,5 in 2015,.

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 (Council for Mutual Economic Assistance) 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 country has successfully achieved and continues to deliver macroeconomic stability after 1998. The introduced Currency Board, sound fiscal policy, limited pay raise, etc. have been rules, administrative in their nature, which are in the basis of the macroeconomic and financial stability. The functioning of the companies of the real economy, despite some positive trends, mainly in the sales growth, is still not leading to overcome the crisis in the real economy.

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. 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.

As a result the economic growth for the last five years was 3.0 % and the inflation was decreasing.

After the introduction of the currency board and the denomination of the lev in 1999, a slow increase in GDP is witnessed in the country. The economic growth is stable and within a moderate range. Still, GDP levels are far below the desired levels. The trends of GDP change in mln. lev is given in **Error! Reference source not found.**.

GDP growth is at moderate, balanced pace with no sudden fluctuations, typical for past periods. During the last few years of the analysis, the pace of GDP growth is bigger due to favourable economic climate in the country. The main economic indicators are given in **Error! Reference source not found.**.

The registered average annual real rate of growth (3.0 %) in last 5 year is far beyond the rate of the European economies, which facilitates Bulgaria becoming closer to the EU.

Table 2.2 Statistical information

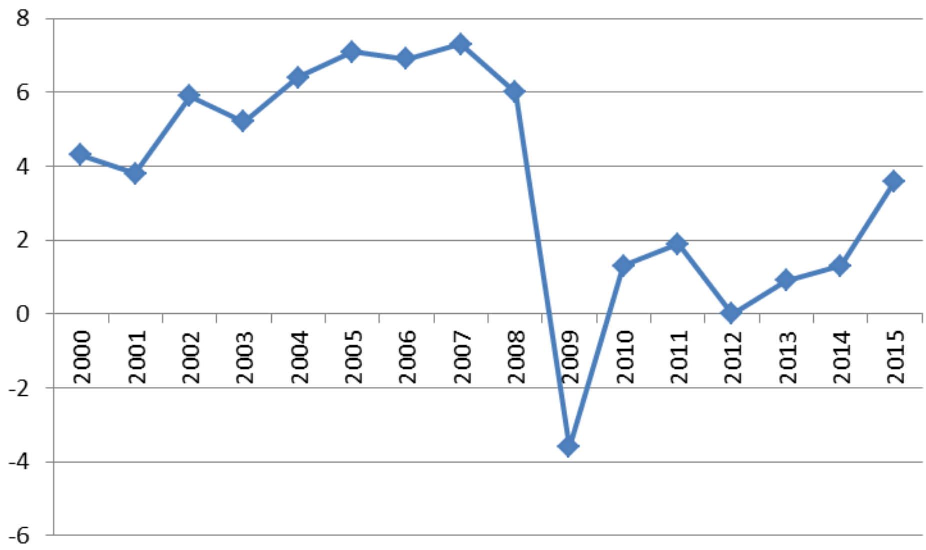
	Gross Domestic Product	GDP, real growth	Real GDP per capita (PPP)*	Export	Import	Average annual inflation	Unemployment
	mil. Lv	% per year	EC=100	EUR million	EUR million	%	%
2005	46651	6,9	32	10224	13747	5,0	10,1
2006	53219	7,3	34	12876	17561	7,3	9,0
2007	63464	6,0	37	16997	23107	8,4	6,9
2008	72756	-3,6	39	19546	26896	12,3	5,6
2009	72986	1,3	38	15797	18886	2,8	6,8
2010	74771	1,9	38	19183	20273	2,4	10,3
2011	80759	0,0	39	24390	24235	4,2	11,3
2012	82040	0,9	39	25504	26835	3,0	12,3
2013	82166	1,3	39	27161	27333	0,9	12,9
2014	83634	3,6	40	27800	28204	-1,4	11,4

2015	88571	3,9	41	29031	28965	-0,1	9,10

Source: National Statistical Institute

Real GDP growth is approximately 5% for the period 2000 - 2003, and after this it is 6% for the period 2004-2008. (Fig. 2.1). The international financial and economic crisis followed and in 2009 GDP has negative real growth, while in 2010 the real growth is close to zero (0.2%). Following 2011 a slow economic recovery started and from 1.6% for 2011 the real GDP growth reached 3.6 % in 2015.

Figure 2.2 GDP Growth – Bulgaria



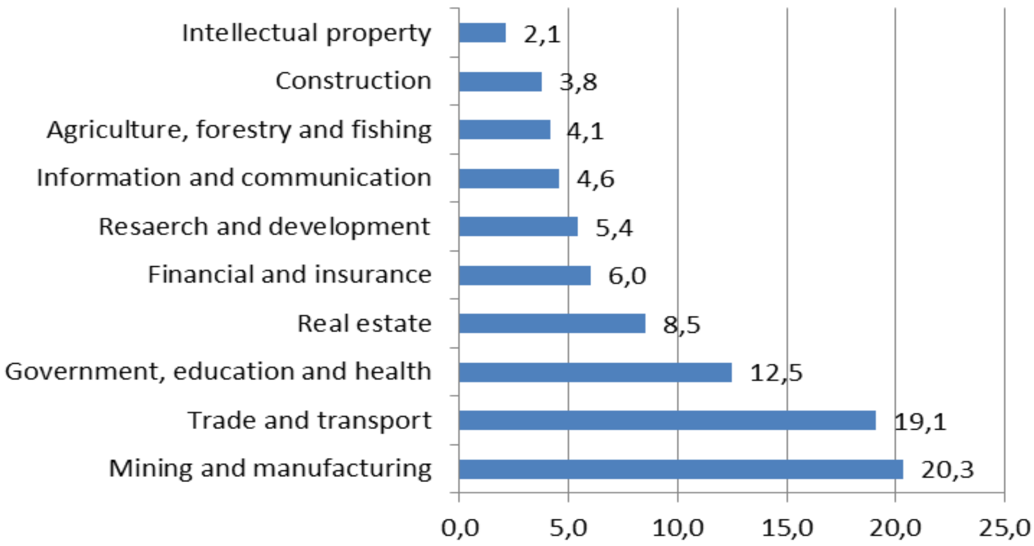
Source: National Statistical Institute

Real GDP grew 3% in 2015, driven mainly by exports and falling oil prices. Growth in 2015 was stronger than in 2014 mainly because of higher net exports. Amidst favourable financing conditions and the rise of capacity utilisation in the manufacturing sector above its historic average, the slowdown of the implementation of projects co-financed by the EU is still set to supress investment in 2016-17.

GVA in total and by regions

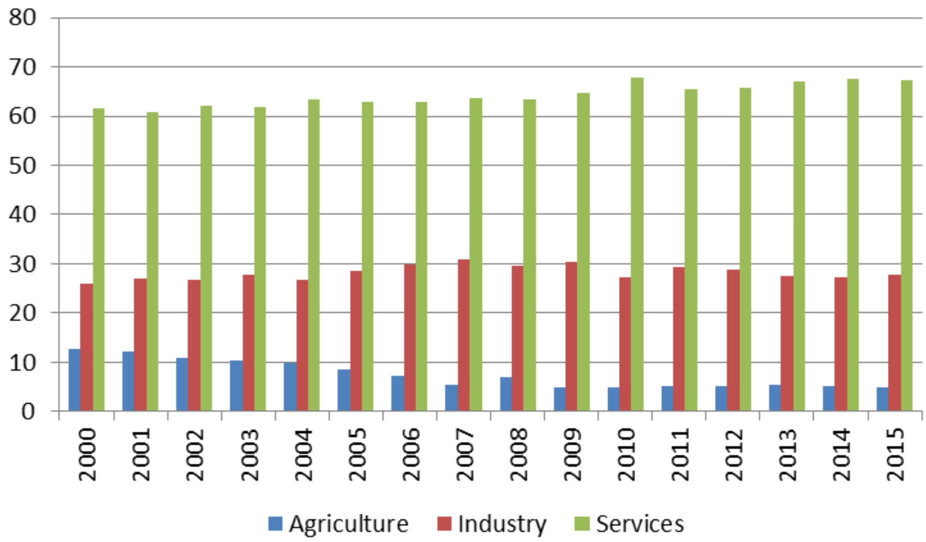
On the average, GVA is 86.06% of GDP, determined on the basis of the period 2007 – 2013, and for the agricultural sector, GVA was 4.69% of GDP, for the industrial sector it was 25.17% of GDP and for the services sector it was 56.20% of GDP. The largest share of GVA is the services sector - 65.31% of the total added value. The industrial sector accounts for 29,24% and the agricultural sector has the lowest share of 5,45%.

Figure 2.1 GDP breakdown by main subsectors, 2015 (%)



Source: Bulgarian National Statistical Institute

Figure 2.4 GDP Breakdown (2000-2015)

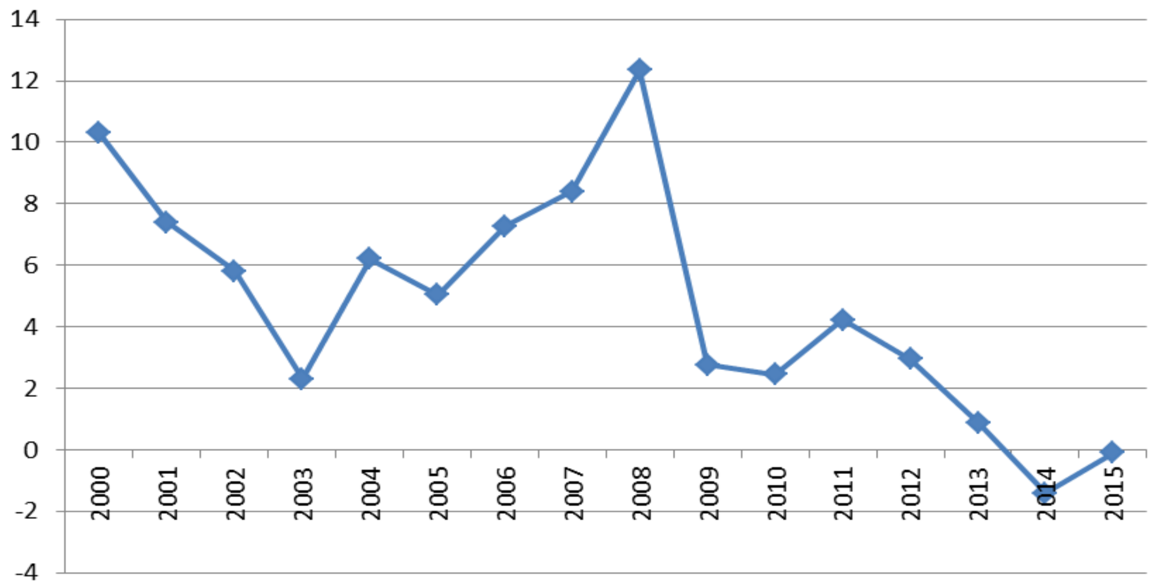


Source: National Statistical Institute

Inflation is influenced by three factors – international energy prices, state regulation of prices and a fall in domestic consumption. Inflation in Bulgaria has an average growth for the period 2000 - 2005 from 6.17% in contrast to the post, in which we have a peak in 2008 of 12,3% and a sharp decline thereafter to levels of 2-3% due on the impact of the global financial and economic crisis and started a period of low interest rates and deflation. In the period 2014 - 2015 is deflation. The period of deflation may persist, while the economies of developed countries achieve higher economic growth and after the move to increase interest rates.

The introduction of the Currency Board lowered the inflation and became an important prerequisite for the revival of the economic activities. The inflation was reduced significantly and has come nearer the level of the industrial states.

Figure 2.4. Average annual inflation, %

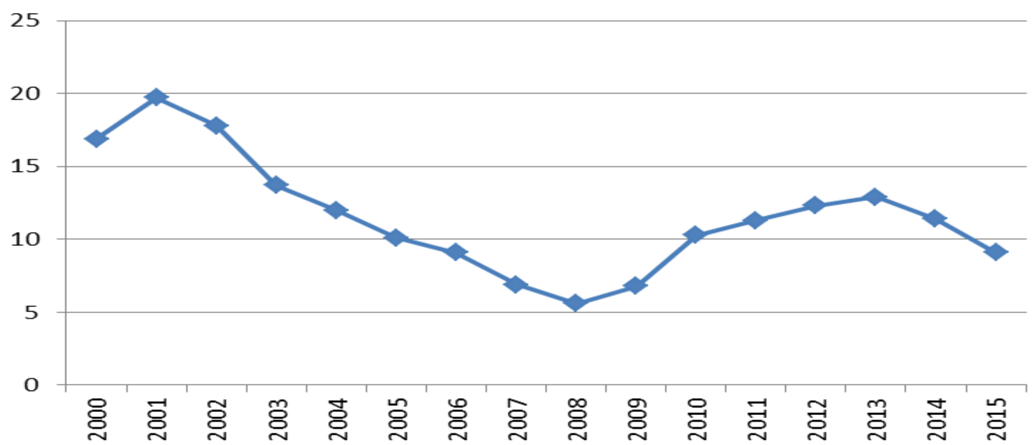


Unemployment

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

As seen from the chart (Fig. 2.5.) in the Republic of Bulgaria the objective unemployment has decreased and has reached levels lower than the EU average in 2008. Following this, there is increase, again due to the impact of the global economic crisis. After 2013 the economy began to recover and the unemployment rate began to decline and for 2015 was 11.4%..

Figure 2.5. Unemployment, %



Currency exchange rate

Since the beginning of 1999 Bulgaria has pegged the euro at 1.95583 lev./€.

The external trade of the country shows the level of economic development, currency stability, technological development, etc. Data on external trade and trade balance is given in Table 2..

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.

Import significantly surpasses export and this negative trend increases.

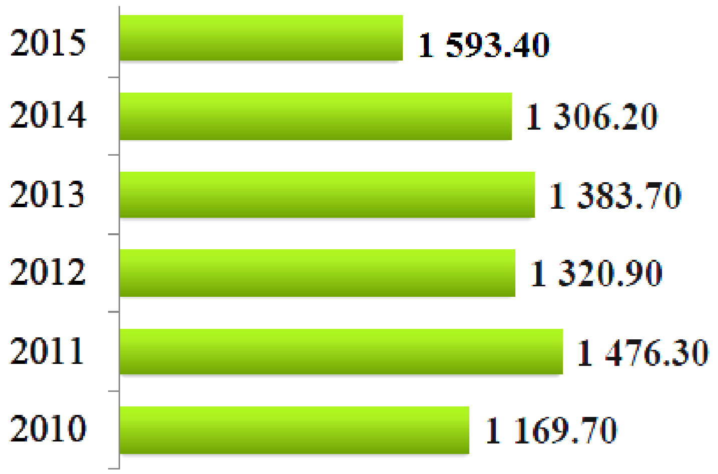
Table 2.3. Trade balance

Year	Export mil. EURO	Import mil.	Trade balance
2005	9466,3	14667,7	-5201,4
2006	12011,9	18479,3	-6467,4
2007	13511,9	21861,2	-8349,3
2008	15204,0	25094,2	-9890,2
2009	11699,2	16875,4	-5176,2
2010	15561,2	19244,8	-3683,6
2011	20264,4	23406,2	-3141,8
2012	20770,2	25459,2	-4689,0
2013	22271,5	25828,2	-3556,7
2014	22105,0	26125,8	-4020,8
2015	22982,3	26356,7	-3374,4
2016	24126,0	26181,4	-2055,4

Source: NSI

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

Figure 2.5. Foreign direct investment (FDI) flows by industry (€ mln)



Source: Bulgarian National Bank

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 2.3.

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

YEAR	2000	2001	2002	2003	2004	2005
Agriculture and forestry	12,6	12,1	11,0	10,4	9,9	8,6
Industry	**25.8**	**27.0**	**26.8**	**27.7**	**26.8**	**28.4**
Services	**61.6**	**60.9**	**62.2**	**61.9**	**63.3**	**63.0**
YEAR	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Agriculture and forestry	**7.3**	**5.5**	**7.0**	**4.9**	**4.8**	**7.3**
Industry	**29.9**	**30.8**	**29.6**	**30.4**	**27.4**	**29.3**
Services	**62.8**	**63.7**	**63.4**	**64.7**	**67.8**	**65.5**
YEAR	**2012**	**2013**	**2014**	**2015**		
Agriculture and forestry	**5.3**	**5.3**	**5.3**	**4.8**		
Industry	**28.9**	**27.6**	**27.1**	**27.9**		
Services	**65.8**	**67.1**	**67.6**	**67.3**		

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 2.4.

Table 2.4 Land use in Bulgaria – general information in ha, 2015

Utilised Agricultural Area	5 011 494
Arable land	3 493 688
Permanent pastures	1 368 665
Forests and woodland	4 222 874

Source: Agrostatistical Reference Book MAF-2000-2015

Land for agricultural purposes in 2015 was 5 202 752 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 2015 it was 5 011 494 or 45% 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 2015 the arable land increased by 0.7% compared to the previous year, occupying 3 493 688 ha or 69.7% 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.

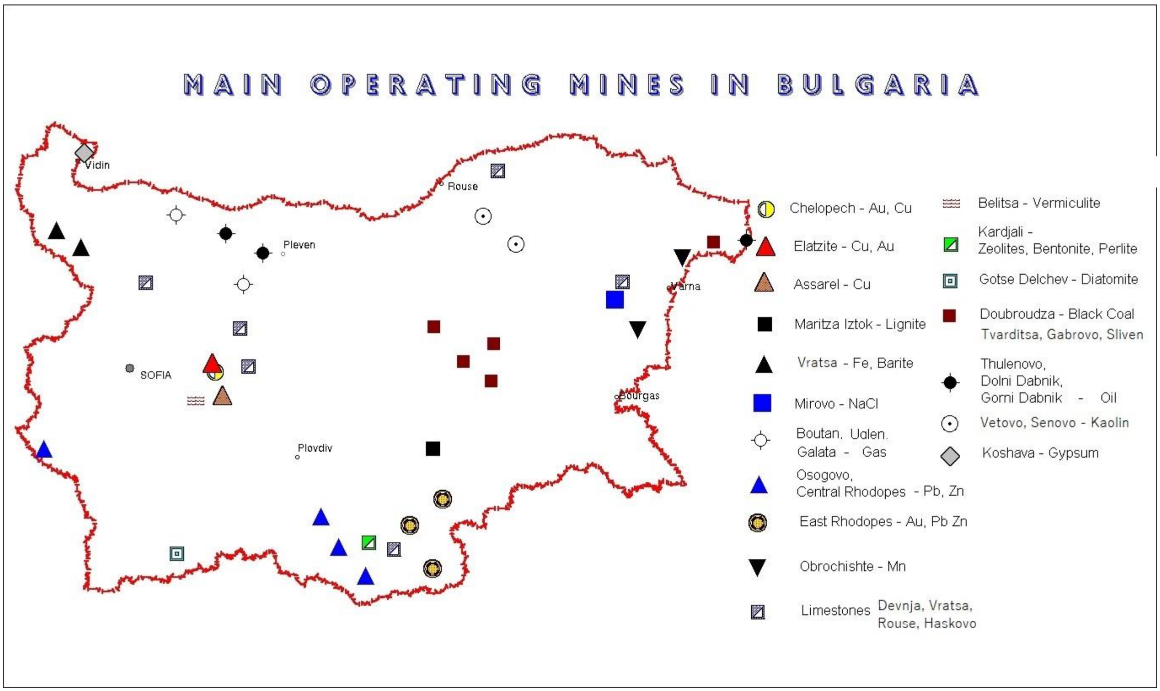
The Sakar-Stranja zone is relatively weak studied. In the most Eastern part Burgas' mines are operating. Important for the region is the Elhovo's finding of brown coal. From non-ore resources important are some marbles with pink/gray hue and some types of granites.

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. and described below:

Figure 2.6. 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.

In the period from 2014 to 2020, around €7.4 billion1 is expected to be invested in Bulgaria's farming sector and rural areas through the CAP. Certain key political priorities for which CAP funding should be used have been defined at European level - jobs and growth, sustainability, modernisation, innovation and quality. However, Bulgaria also has the flexibility to adapt both direct payments and its rural development programme to its specific needs.

The 2014-2020 rural development programme for Bulgaria focuses on the following priorities:

• improving the competitiveness of the agricultural sector and farm viability and ensuring quality food production (around 24 % of the funding)

• preserving ecosystems and the sustainable use of natural resources in agriculture, forestry and food processing (around 46 %)

• the economic and social development of rural areas – creating jobs, reducing poverty, improving social inclusion and quality of life (around 30 %).

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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 2.5 and Table 2.6, data for the forest areas in Bulgaria is given and also – activities for afforestation.

Table 2.5 Total and wooded forest area, 1000 ha

Type of forest	1990	1995	2000	2005	2010
Total	3871	3876	3914	4077	4138
Coniferous	1330	1304	1282	1279	1279
Deciduous	2541				2859
High-stemmed		1579	1535	1460	904
Low-stemmed		993	1097	1338	1955
of which: Wooded forest area	3348	3334	3375	3674	3761
Coniferous	1213	1154	1115	1147	1146
Non-coniferous	2135				2615
High-stemmed		1251	1237	1268	846
Low-stemmed		929	1023	1259	1769
Type of forest	**2011**	**2012**	**2013**	**2014**	**2015**
Total	4148	4164	4180	4202	4223
Coniferous	1271	1267	1263	1261	1261
Deciduous	2877	2897	2917	2941	2962
High-stemmed	908	912	919	926	938
Low-stemmed	1969	1985	1998	2015	2024
of which: Wooded forest area	3775	3796	3811	3836	3858
Coniferous	1141	1138	1134	1133	1134
Non-coniferous	2634	2658	2677	2703	2724
High-stemmed	850	856	861	868	878
Low-stemmed	1784	1802	1816	1835	1846

Source: National Statistical Institute, Statistical Reference Book 2017

Table 2.6 Activities for afforestation

Year	1990	1995	2000	2005	2010
Preparation of area	22368	10911	6056	3658	764
Afforestation	35551	14367	6313	5397	1727
Establishing of intensive plantation	1110	959	952	-	432
Reforestation of artificial forest	8840	4892	2086	2065	1062
Year	**2011**	**2012**	**2013**	**2014**	**2015**
Preparation of area	1603	1164	1337	1137	2025
Afforestation	1498	1119	1252	1204	1592
Establishing of intensive plantation	666	619	622	431	787
Reforestation of artificial forest	634	558	550	322	298

Source: National Statistical Institute, Statistical Reference Book 2017

Forest Areas in Bulgaria in 2015 - ownership distribution:

- Total forest area – 4 222 874 ha
- State forest area - 74,5% and non-state – 25.5%.
  - Forests managed by the EFA – 70.6%
  - Managed by MoEW – 5 % (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:

National Strategy for Development of the Forest Sector in the Republic Bulgaria (*NSDFSRB*) 2013–2020 is an integrated document for the development of the forest sector until 2020, defining the national priorities, in relevance with the European framework for planning in the sector. The vision, mission and aims of the NSDFSRB 2013-2020 are defined in the context of strategic vision and main targets for the development of the country, set in the National Programme for Development: Bulgaria 2020. The NSDFSRB is developed after broad analyses on the forest sector and on the implementation of the previous strategic documents, including climate change modeling. It consists of 3 strategic aims, 4 priorities and 20 measures.

The strategic aims are: 1) Ensuring sustainable development of the forest sector by achieving optimal balance between the ecological functions of the forests and their long term ability to support material goods and services; 2) Strengthening the role of the forests for supporting the economic growth of the country and more balanced territorial social-economic development; 3) Increasing the contribution of the forest sector in the green economy.

The Strategic plan for the development of the forest sector for the period 2014 – 2023 has 20 Operational targets (OT), corresponding with the NSDFSRB and 102 Activities for their achievement. All Operational Targets are related to climate change adaptation as some of them are as follows:

- „Increasing the forests area, growing stock and carbon storage in the forest territories";
- „Improvement of the management and utilization of the forests";
- „Increasing the effectiveness of the prevention from forest fires and illegal activities in the forests, and restoration of the damages from them";
- „Increasing the sustainability and ability for adaptation of the forest ecosystems towards the climate changes";
- „Improvement of the system for planning and conducting of activities, connected with the protection of biological and landscape diversity in the forest territories;
- "Development of the protected areas network, including by extending the implementation of the financial mechanisms for improvement of the forest management in the NATURA 2000 protected zones;
- „Maintenance and development of the system for protection of the forest genetic resources";
- „Improvement and increasing the populations of game and fish species for the protection of the biological diversity and sustainable development of the forest ecosystems;
- „Ensuring a sustainable planning of the activities in the forest territories";
- „Sustainable production and usage of biomass as renewable energy source";
- „Supporting the process of certification of the forest territories";
- „Effective and sustainable usage of the touristic potential of forests and development of recreation activities in them";
- „Establishment of conditions for sustainable and paid usage of ecosystem services, ensured by the forest territories".

The Plan clearly defines budget and funding resources, expected results, deadlines for implementation, performance indicators and responsible institutions. Its performance is monitored, evaluated and updated trough specially developed Rules for Monitoring.

2.6.4. Biodiversity

The big variety of habitats and biogeographic conditions has led to a diversity of the flora and fauna in the country, ranking Bulgaria amongst the first in Europe - Table 2.7.

Table 2.7 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 the Ministry of Agriculture, Food and Forestry (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.

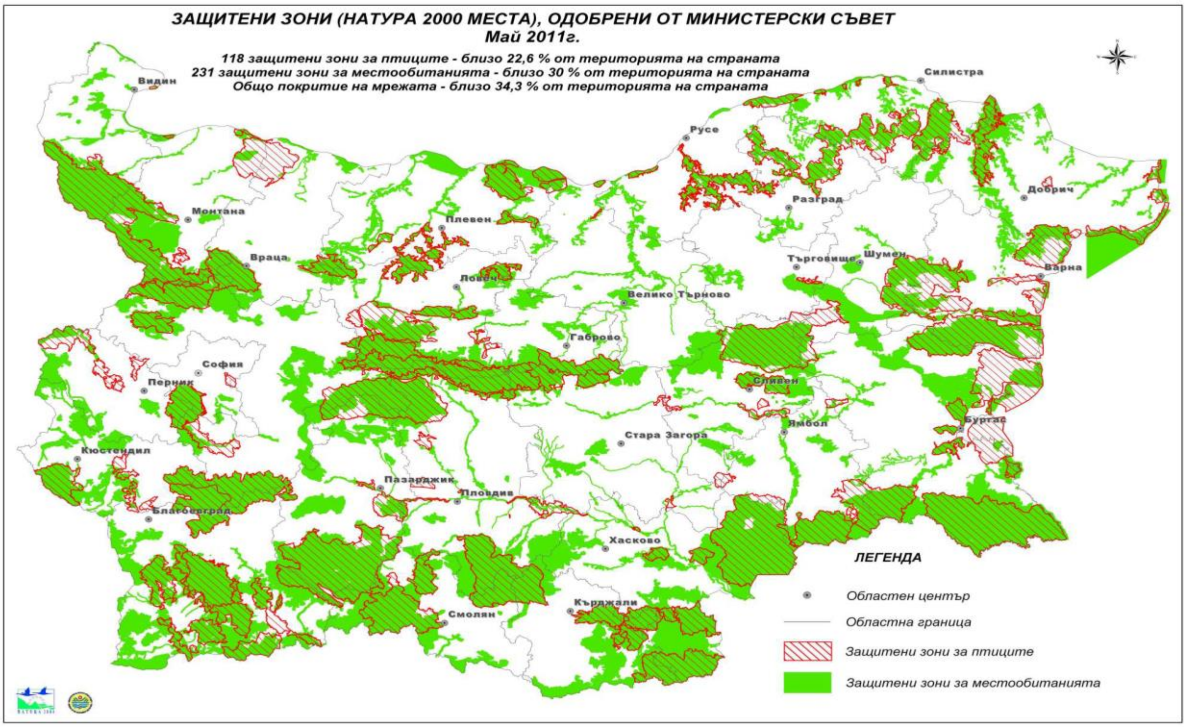
The hunting grounds encompass 140 127 ha area and are located in territories, where the genetic fund of the game and its population is being preserved and increased.

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

Bulgaria is a country of rich biodiversity. Its diverse physical geography and location on the border of different climatic and vegetation regions creates favorable conditions for the existence of nearly 41,493 plant and animal species – 26 percent of the European species, incl. 25 percent of those in the Red Book of Europe. For their conservation, Natura 2000 sites, which in occupy more than 34 percent of the territory, protected areas with a range of 584,498.5 ha or 5,3 percent of the country's area, are dedicated. They include UNESCO biosphere reserves and wetlands under the Ramsar Convention.

As of 31.12.2015, 1,012 protected areas (PAs) were recognized with a total area of 584,501.2 ha, approximately 5.3% of the country’s territory . This includes 3 national parks, 35 managed reserves, 55 reserves, 11 nature parks, 344 natural landmarks and 564 protected areas.

Figure 2.2 Protected areas in NATURA 2000 in Bulgaria



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2.6.5. Taxes and Tax Policy

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

The main priorities of the Government's Programme 2014 - 2018 are: keeping the rule of law and consolidation of institutions working in an effective and transparent manner in the interest of the citizens and ensuring conditions for a worthy life and personal development, preserving the tax system and the low share of GDP reallocated by the state, as well as maintaining a favourable tax environment.

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

The effective tax policy aimed at ensuring fiscal and macroeconomic stability and supporting economic growth, investment and employment will be carried out by means of:

• Making a comprehensive analysis of the taxation policy of the Republic of Bulgaria;

• Elaboration of a concept paper for a new effective model of tax policy and reforms relating to tax relief in accordance with EU's state aid legislation in the 2014-2020 period;

• Making an assessment of the impact of the new tax policy model on budget revenues, economic development, investment and employment;

• Holding a public debate on the country's overall tax policy;

• Making a roadmap for implementation of the new tax policy and reform model in the tax system;

• Making an analysis of the tax system by types of taxes and structural elements;

• Reducing the administrative burden and expenses for businesses and citizens;

• Effective tax concessions urging investment, innovation and employment.

The Government's taxation policy is oriented towards decreasing the share of the shadow economy and combating tax evasion and avoidance.

- In Bulgaria income of any individual is subject to a flat income tax rate of 10% in 2015.
- Exemptions are granted to taxpayers with specific types of income.
- The standard rate of tax for a Bulgarian corporate tax in 2015 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

- **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 2.8 Structure of final energy consumption (Per cent)

	1990	1995	2000	2005	2010
Industry	51.9	52.2	41,8	38,4	29,2
Transport	15.2	6.1	21,5	27,8	31,4
Households	22.0	29.1	25,6	22,4	25,9
Others	10.9	12.6	11,2	11,5	13,4
Total	100	100	100	100	100
	2011	**2012**	**2013**	**2014**	**2015**
Industry	29,8	28,5	30,0	29,5	28,8
Transport	30,1	31,7	30,3	33,2	34,7
Households	26,4	26,3	26,3	24,7	23,6
Others	13,7	13,5	13,5	12,6	12,8
Total	100	100	100	100	100

Source: NSI

Industry is the biggest energy consumer in Bulgaria's economy, but it's share in 2015 decreased with 55.5% compared to 1990. Instead energy consumption in transport sector in 2015 has doubled from 15% to 34.7% of the final energy consumption,

Table 2.9 Final energy consumption (PJ)

	1990	1995	2000	2005	2010
Industry	250.3	146.02	150	153	107
Transport	27.9	85.0	77	111	115
Households	145.0	94.2	92	89	95
Others	51.5	41.1	40	46	49
Total	519.7	478.97	359	398	365
	2011	**2012**	**2013**	**2014**	**2015**
Industry	113	108	108	109	113
Transport	114	120	109	123	136
Households	100	100	94	91	93
Others	52	51	49	47	50
Total	379	379	360	370	392

Source: NSI

Data on the electricity consumption in Bulgaria are given in **Error! Reference source not found.**.

The largest relative share of input fuels for electricity 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 2.10 Electricity - consumption (billion kWh)

Country	2000	2005	2010	2011	2012	2013	2014	2015
Bulgaria	35.49	40.11	41.66	45.4	42.9	40.05	42.94	33.5

Source: NSI

Table 2.11 Main energy parameters

		2005	2010	2011	2012	2013	2014	2015
Primary energy production	1000 toe	10 539	10184	11916	11318	10218	10910	11509
Gross domestic energy consumption	1000 toe	20 122	17789	19110	18305	16954	17752	18536
End consumption of energy	1000 toe	9 512	8720	9050	9044	8597	8847	9367
Share of energy from RES in gross domestic energy consumption	%	9.4	14.1	14,3	16,1	19,0	18,0	18,2
Energy dependency	%	47.5	40.5	37.0	37,0	38,6	35,4	36,7

Source: NSI

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

➢ 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.

Currently, the ‘Industry’ comprises the activity of industrial enterprises, classified in the mining and quarrying industry, manufacturing, electricity, gas, steam and air conditioning supply and water supply, sewerage, waste management and remediation activities. The indicator ‘Production value of industrial enterprises’ refers to the entire of the industrial enterprises i.e., it includes receipts from their non-industrial activities. The production value comprises the following elements: receipts from sales of industrial production and services; expenditure on acquisition of tangible fixed assets on own account of the enterprises, other receipts, changes in stocks of finished goods and changes in stocks of work-in-progress.

Table 2.13 Output (Production value) of industrial enterprises, Thousand BGN

	2011	2012	2013	2014	2015
Total	59659708	62710629	62623923	61978163	645483388
Mining and quarrying	2802188	2969775	2557007	2432698	2578600
Manifacturing	46974358	48728136	49685725	50933970	52666985
Electricity, gas, steam and air-conditioning Supply	8524327	9638391	9023288	725631	7882904
Water supply, sewerage, waste management and Remediation	1358835	1374327	1357903	1354564	1478627

Source: NSI

2.6.7. Transport

In 2015 Bulgaria had 19,9 thousand km roads. .In structural terms the majority are class III roads with a 61,15 % share, followed by class II – 20,27 %, and class I – 14.88 %. Highways are 734 km with the lowest relative share – 3.70 %.

The total length of the railway network is 6 474 km, which, when related to the area of Bulgaria, makes an average density of the railway network of 58.9 km / 1,000 km^2.

In Republic of Bulgaria there are 10 civil airports, 5 of which have the status of international airports (Sofia, Varna, Burgas, Plovdiv, Gorna Oryahovitsa), 6 airports serve the agricultural aviation and there are 150 aircraft movement areas to be used by airline operators with scope of business performing specialized aviation flights and other type of aviation activity.

The port system of the Republic of Bulgaria consists of two port types - sea and river ports:

• The seaports are situated on the Black Sea coast, representing the eastern border of Bulgaria respectively.

• The river ports are situated along the Bulgarian section of the Danube, representing the northern border of the country.

As of now, the national port system of the Republic of Bulgaria has 14 628 m total length of the quay front in the public transport sea ports and 13 964 m in the public transport river ports.

The main policy and strategy documents in the sector is the Integrated Transport Strategy for the period 2030.

Data on transport of goods is presented in Table 2.14

Table 2.12 Goods carried by different transport modes 2003 – 2015, thousand tonnes

Year	Goods carried – thousand tonnes			
	Land transport	Waterway transport	Air transport	Total
2003	92 826	14 172	13	107 011
2004	91 952	15 783	24	107 759
2005	102 100	16 315	21	118 436
2006	109 131	15 127	13	124 271
2007	117 978	16 854	2	134 834
2008	108 372	15 294	5	123 671
2009	87 079	9 947	19	97 045
2010	79 441	7 964	11	87 416
2011	95 431	5 899	8	101 338
2012	102 155	5 023	6	107 184
2013	117 493	3 031	4	120 528
2014	112 719	1 837	2	114 558
2015	123 626	1 867	5	125 498

Source: National Statistical Institute (NSI)

Data on carried passengers is given in Table 2.15.

Table 2.13 Passengers carried by transport modes 2003-2015, thousand tonnes

Year	Passengers carried – thousand tonnes				
	Land transport	Waterway transport	Air transport	Urban electrical transport	Total
2003	830 272	79	1 471	329 444	1 161266
2004	719 382	84	1 782	299 850	1 021098
2005	698 014	86	2 071	288 410	988 581
2006	657 362	80	2 320	286 339	946 101
2007	628 162	243	2 237	293 794	924 436
2008	623 544	253	2 636	299 100	925 533
2009	567 808	240	2 184	286 252	856 484
2010	542 536	166	2 327	291 167	836 196
2011	517 254	175	2 693	280 181	800 303
2012	471 654	195	2 211	285 859	759 919
2013	452 835	143	2 269	269 448	724 695
2014	450 230	90	2 375	254 588	707 283
2015	464 770	115	2 240	248 081	715 206

Source: National Statistical Institute (NSI)

Figure 2.16. Number of vehicles by type

	Passenger cars	LDV and HDV	Busses	Motorcycles	Mopeds
1988	1 220 784	210 805	5 486	217 360	276 901
1990	1 317 437	227 782	7 468	225 533	281 270
1995	1 647 571	289 430	15 371	233 365	285 901
2000	1 992 748	326 204	17 290	236 327	286 047
2005	2 544 198	393 565	12 584	97 754	48 667
2010	2 602 461	368 195	20 458	70 394	54 983
2011	2 694 862	382 324	20 120	73 805	58 019
2012	2 806 814	402 648	20 040	77 972	61 840
2013	2 910 235	424 299	20 277	82 481	65 479
2014	3 013 863	449 458	20 685	88 035	68 982
2015	3 162 037	483 945	21 265	93 869	71 885

Registered road vehicles

The largest share is of the vehicles above 20 years – 1,475,443, whereas the total number of the vehicles registered by July 2014 is 3,769,117.

The vehicles aged 15 – 20 years in the country are 1 104 166, and those of age 11 - 15 years – 652,346. The road vehicles of age below 5 years are 133,941 for 2014 and those of age 6 – 10 years – 403,191.

The age structure of the fleet of vehicles shows that the largest share - 39% - is for the existing vehicles of age exceeding 20 years, which confirms the trend of excessive ageing of the vehicles fleet;

The lowest share, only 4% is of motorised road vehicles below 5 years;

Concerning is also the share of vehicles of age 15-20 years - 30% of all existing road vehicles;

The share of the new registered motor vehicles, including cars for the reporting period shows a decrease. This fact results in ageing of the motor fleet in Bulgaria. The disadvantageous age structure has a negative environmental impact.

Environmental categories of the road vehicles

The age of most of the vehicles is above 20 years and that determines their existence at a lower environmental category.

Only 4.20% of the vehicles comply with Euro standard 5. The largest share is of vehicles without Euro standard – 33.40%. This is due to the great number of registered vehicles of more than 20 year age. 24.40% of the vehicles have Euro 1..

Current transport projects with necessity for accelerated implementation:

- Struma Motorway, LOT 3 “Blagoevgrad – Sandanski;
- Construction of metro line 3 of Sofia Metro;
- Modernisation of the railway line Sofia – Septemvri, the sections Elin Pelin – Ihtiman and Ihtiman – Septemvri;
- Rehabilitation and modernisation of the railway section Plovdiv- Burgas Phase II.

Transport generates effects with negative impact on the environment and people by emissions of pollutants and greenhouse gases. The limitation thereof is an element of the sustainable development of the transport system. The key indicators for the assessment of the negative impact of transport on the environment and human health are the energy consumption, emissions of pollutants (ozone precursors, unsyav, acidifying substances and precursors of PM10) and greenhouse gases.

2.6.8. Waste

After the global economic and political change and regime change of government in our country start to lay the groundwork for approval of plans and strategies outlining guidelines on sustainable management.

At the beginning of the nineties years in the country began to develop practices for separate collection of household waste and their subsequent recycling.

During the last couple of years the measures in national legislation aimed at decreasing CH4 emissions from landfills - limiting the disposal of municipal waste, measures for closure and rehabilitation of municipal landfills with terminated operation; coverage of all household waste in a managed system of waste treatment, including all waste to be disposed of in managed landfills and capturing, utilizing or flaring of landfill gas.

- New waste management law 2012 - separate bio-waste collection (yards, park and garden wastes, green wastes must be treated via composting or anaerobic digestion); reducing the amount of biodegradable waste, sent to landfills).
- National strategic plan for diversion of biodegradable waste going to landfills (2010-2020)
- National strategic plan on sewage sludge management (2012-2020)
- Ordinance for the treatment of bio-waste and separate bio-waste collection (2016)
- Third National Action Plan on Climate Change (2013-2020)
- National Waste Management Plan (2014-2020)

Bulgarian legislation introduce the specific quantitative targets for separate collection, recycling and recovery of municipal bio waste as well as targets for diverting biodegradable municipal waste from landfills. The provisions of the Waste Management Act require that by 31 December 2020 there shall be limiting the amount of biodegradable municipal waste to 35 percent of the total of those wastes in the Republic of Bulgaria in 1995. This is compliant with the requirements of the European directive on the landfill of waste.

The effect of the legislative measures will be visible in the future. Currently, some positive tendencies are observing, concerning SWD on the managed and unmanaged disposal sites.

Since 2000 the share of population, land filling on unmanaged sites decreases and the share of population, which dispose of wastes on managed sites is increasing.

The landfills are classified as managed and unmanaged (see below: Activity data).

As the main criteria for whether landfills are managed and unmanaged, is considered the fact if the landfills meet the requirements laid down in EU Directive 1999/31/EC on the landfill of waste.

Landfilling as a method of waste disposal still holds the biggest share in the management of municipal waste, but there is a steady decline in this indicator in recent years (the percentage of waste disposed in landfills drop from 95% in 1990 to 66% in 2015). Recyclable waste collection, which was a scarce practice at the beginning of the nineties, has been increased. In 2013, legislation on bio-waste management was promulgated, which combined with the existing economic instruments as well as the introduced in 2011 landfill tax per ton led to the present positive trends.

The total amount of municipal waste generated in Bulgaria in 2015 is 3 011 kt which is in average 1.15 kg per capita. The total amount of municipal waste generated in the country is following a positive trend towards permanent decrease.

The amounts of separately collected fractions from municipal waste are gradually increasing. Since 2009, collection schemes have been improved for management of six special waste categories - packaging waste, waste oils, end-of-life vehicles, waste electrical and electronic equipment, waste tires, batteries and accumulators. This resulted in increased quantities of collection and recovery of those waste streams and decrease in per capita waste generation. Bulgaria is among the member-states with close to the average level of recycling in recent years.

In the country exist regional systems for waste management where before land filling the waste is subjected to pre-treatment (separation) as recyclable fractions such as paper and cardboard, metals, glass, plastics and wood are sent to recycling facilities. This practice reduces the amount of waste which going to landfills, additionally development of composting activities concerning the decreased land filled degradable fraction of MSW.

The emissions from SWDS are emitted from MSW (including AMSW-assimilated municipal solid waste and sludge from wastewater treatment plant) which are landfilled. MSW are disposed of on managed and unmanaged disposal sites as from 2000 the share of population, landfilling waste on unmanaged is decreasing and the share of population, landfilling on managed MSW sites is increasing.

Generally the number of MSW disposal sites in the country is decreasing gradually since 2000 and after 2010 this tendency is increasing which is in line with national legislation.

Sludge from wastewater treatment plants has also been considered, because it can be disposed of at the same landfills as municipal solid waste, once it meets a specific requirements. The fraction of sludge, disposed at ladfill sites has been estimated to be 17.9 Gg in 2004 (extrapolated value) decreasing to 8.53 Gg in 2015.

On the basis of its characteristics, sludge from wastewater treatment plants is also used in agriculture, in compost production with red Californian worms, landfilled or temporarily stored on special platforms.

Information about sludge is available from 2005 (Regulation EC No 2150/2002 on waste statistics).

Data are collected by NSI from public water supply companies, dealing with water collection, treatment, water supply and wastewater collection, discharge and treatment (water supply companies/urban wastewater treatment plants operators and irrigation systems).

Another source of information is Executive Environment Agency through National legislation (Ordinance on the way of recovery of sludge from wastewater treatment through its use in agriculture; Ordinance No 1 on the procedures and forms for providing information about waste management activities and the procedure for keeping public records).

Table 2.17 Time series of sewage sludge production and landfilling is reported

Year	2004	2005	2006	2007	2008	2009
Sewage sludge production (Gg)	40.38	41.70	38.00	39.90	42.90	39.40
Sewage sludge landfilled (Gg)	17.90	23.40	16.40	20.80	17.80	11.10
Year	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Sewage sludge production (Gg)	49.80	51.40	59.30	60.30	54.94	57.36
Sewage sludge landfilled (Gg)	13.97	7.05	6.64	10.49	8.47	8.54

Industrial waste

Industrial waste assimilated to municipal solid waste (AMSW) could be disposed of to the same landfills as MSW. It originate from commercial establishments and related handicraft activities, recreation and entertainment; from professional services, hotels, restaurants, schools and etc.

According to the official data published in the National Report on the State of Environment for 2016 (Executive Environment Agency), the total quantity of the generated waste in the country are 22 940 kt (141 kt dangerous an 19 929 kt non-dangerous including 3 011 kt household).

Table 2.18. Total quantity of generated wastes (2008-2012)

Type of wastes	Quantity in kt per year							
	2008	2009	2010	2011	2012	2013	2014	2015
Dangerous wastes	760	708	646	202	159	123	118	141
Non-dangerous wastes	17 890	17 933	14 535	16 514	20 847	14 650	15 637	17 773

For the period 2008 - 2014 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." After that the quantity of hazardous waste has increase by around 16 %.

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 (2015) regarding waste generated per capita (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 481 kg/per capita, while for Bulgaria it is 419 kg/per capita).

With the new law on waste management adopted in July 2012 (last amendment SG 105/2016), 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.

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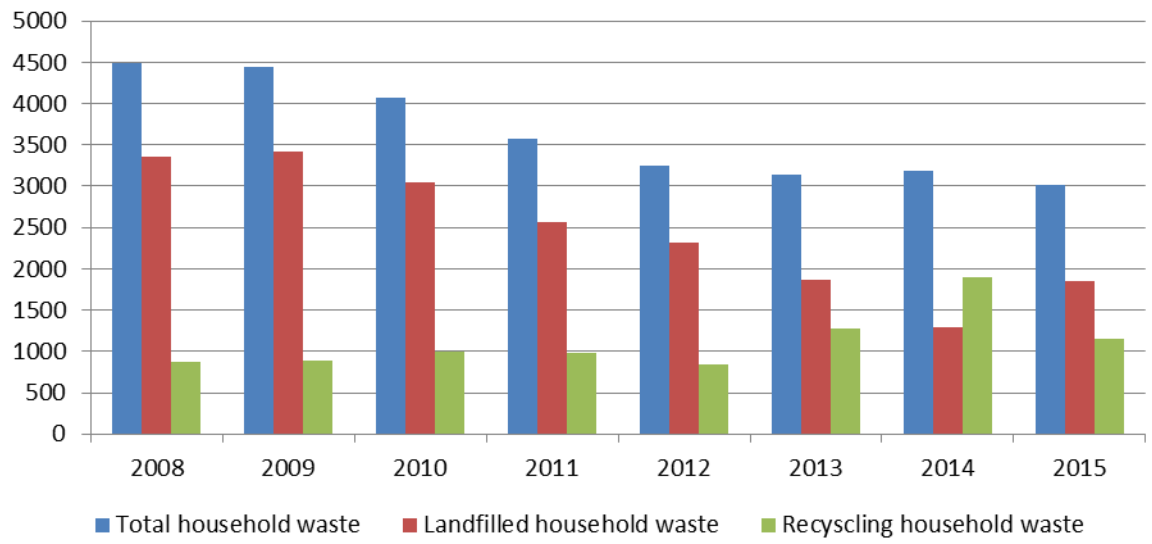
To improve and update information on the quantities of waste and recovered domestic waste is, NSI initiated and implemented in 2012 monitoring In order to gather information on a national level on the domestic waste management processes leading to a change in EUROSTAT reported data and time series is 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 2.7 Share of treated waste from total generated, kt



Source: NSI

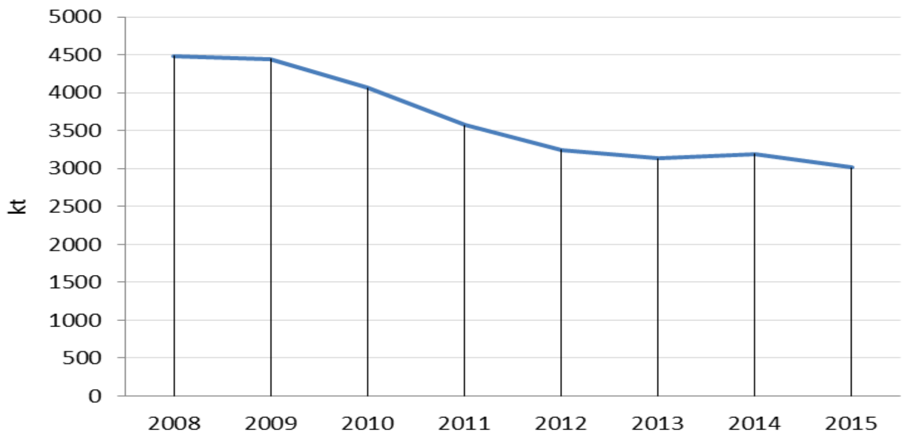
The update of data submitted for recycling household waste will allow for proper identification and reporting of objectives recycling of household waste under Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste, and for repealing certain Directives. In 2012, 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%. In the next period 2013 – 2015 the amount of municipal waste delivered for preliminary treatment and recycling was about 40 % of total municipal solid waste generated.

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 eight year period (2008-2015) the amount of waste generated was reduced with an annual average of 32%, while the amount of disposed waste was reduced with an average annual rate of 45%.

The generated quantity of household waste for 2015 is 3011 kt. In a eight year period (2008-2015) the tendency is towards reducing generated municipal waste.

Figure 2.3 Household waste generated during the period 2008-2015, kt



Source: NSI

In 2010 г. 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 2015 the country has met national targets for recycling materials, as follows:

- Waste from glass packaging - 62,92%, under the set target of 59,6%;
- Waste from plastic packaging - 60,82%, under the set target of 22%;
- Paper packaging waste – 78.73, under the set target of 60%;
- Metal packaging waste - 69,25%, under the set target of 50%;
- Wood packaging waste - 32,72%, under the set target of - 15%.

According to NSI data in 2008 there were 349 landfills for household waste, and in 2015 their number was decreased to 134.

Table 2.19 Household waste, thousand tons

	Measure	2008	2009	2010	2011	2012	2013	2014	2015
Generated municipal waste	*thousand tons*	3615	3561	3091	2753	3249	3135	3193	3011
Settlements served by municipal waste collection systems	*number*	3445	3988	4238	4364	4431	4556	4578	4593
Share of population, served by municipal waste collection systems	*%*	94,4	96,6	98,2	98,9	99,2	99,5	99,6	99,6
Collected municipal waste per capita of served population	*kg/year per capita*	590	587	542	488	446	434	442	419
Landfill sites for municipal waste	*number*	349	278	172	164	157	144	147	134
Total municipal waste accepted at landfill sites	*thousand tons*	3987	3948	3725	3506	3257			
Municipal waste landfilled	*thousand tons*	3359	3421	3067	2568	2323	1860	1297	1856
Municipal waste temporary stored	*thousand tons*	11	265	0	0	0	0	0	0
Collected construction waste at landfill sites for municipal waste	*thousand tons*	410	396	380	508	554	999	534	466

Source: NSI

3. Greenhouse gas inventory information

3.1. Introduction

This chapter presents information about the National Inventory System and greenhouse gases emissions trends for the period 1988-2015 in Bulgaria. The source of information is the National Inventory Report 2017, prepared by the Executive Environmental Agency.

The annual inventory and reporting of greenhouse gas emissions and removals provide an information base for the planning and monitoring of climate policy. The Kyoto Protocol obliges its parties to establish a national greenhouse gas inventory system by the end of 2006. Bulgaria's National Greenhouse Gas Inventory System was set up at the beginning of 2007.

The national system produces data and background information on emissions and removals for the UNFCCC, the Kyoto Protocol and the EU Commission. In addition, the scope of the system covers the archiving of the data used in emission estimations, the publishing of the results, participation in inventory reviews and the quality management of the inventory.

The National Inventory Report (NIR) of Bulgaria for the 2017 submission to the EU, the UNFCCC and the Kyoto Protocol includes data of the anthropogenic emissions by sources and removals by sinks of all greenhouse gases (GHGs) not controlled by the Montreal Protocol, i.e. carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), nitrogen trifluoride (NF_3) and sulphur hexafluoride (SF_6).

Each of these gases has a different warming effect. As an example, the gases HFCs, PFCs, NF3 and SF6 (so called F-gases) have much greater warming effect, in some cases over one hundred times, compared to methane (25), nitrous oxide (298) and carbon dioxide (1).

Because of that, a common assessment criterion for the effect of each GHG on the atmosphere warming should be introduced. This criterion is the so-called Global Warming Potential (GWP), representing GHG emissions as CO2-eq. emissions. It allows totalling the effect of all GHGs, adjusted to a common base.

For defining of GWP, the Parties to the Convention and Kyoto Protocol accept values, over a time horizon of 100 years, as mentioned in the IPCC Fourth Assessment Report of 2007.

As an Annex I Party to the Convention, Bulgaria reports annually its GHG inventory emissions from the base year to the year proceeding the year of reporting.

Annex I Parties to the KP should report also additional elements as assigned amount information, changes in national system, changes in national registry and voluntary submission of information relating to activities under Articles 3, paragraphs 3 and 4, of the Kyoto Protocol.

3.2. Background information on supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol and international agreements

Bulgaria has made a commitment to follow the United Nations Framework Convention on Climate Change that entered into force on 21 March 1994. The Kyoto Protocol negotiated in

1997 under the UN Framework. The Kyoto protocol took effect on 16 February 2005 and became legally binding.

The Kyoto Protocol (Article 5.1) requires that the parties have in place a National System by the end of 2006 at the latest for estimating anthropogenic greenhouse gas emissions by sources and removals by sinks not controlled by the Montreal Protocol. The guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol (Decision 19/CMP.1) provide the requirements for the general and specific functions of the national systems. Bulgaria's inventory system was reviewed successfully as part of the review of the Bulgaria's initial report under Protocol in 2007.

Under the UNFCCC and the Kyoto Protocol, Bulgaria is required to submit annually to secretariat of the Convention a national greenhouse gas inventory covering emissions and removals of direct greenhouse gases from the five sectors (Energy, Industrial processes and product use, Agriculture, Land use, Land use change and Forestry and Waste) and for all years from the base year or period to the most recent year. The preparation and reporting of the inventories are guided by the UNFCCC guidelines (UNFCCC 2014) and are based on the following IPCC methodologies to ensure the transparency, accuracy, consistency, comparability and completeness of the inventories:

- 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 IPCC GL);
- 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol (KP supplement);
- 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands (Wetlands Supplement);
- EMEP/EEA air pollutant emission inventory guidebook – 2013.

3.3.Description of the National inventory arrangement

3.3.1. Institutional, legal and procedural arrangements

The Bulgarian National Inventory System (BGNIS) is developed following the requirements of the provisions of Decision 19/CMP.1 Guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol.

History of GHG inventory preparation

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

BGNIS until 2007 (submission 2007)	Present BGNIS (submission 2008-2017)	Prospected BGNIS
←	Centralized inventory	→
Single institute	Single agency	→
Out-sourced inventory	In-sourced inventory	→
Private consultants	**Public/Governmental** (submission with	→

BGNIS until 2007 (submission 2007)	Present BGNIS (submission 2008-2017)	Prospected BGNIS
	cooperation of consultants)	
National Inventory Focal Point: Private consultants	National Inventory Focal Point: ExEA	→
←	National Focal Point: MoEW	→

Until 2007 the national emissions inventory as well as the relevant NIR under UNFCCC was prepared by an external company through an open tender procedure under the rules of the Public Procurement Law.

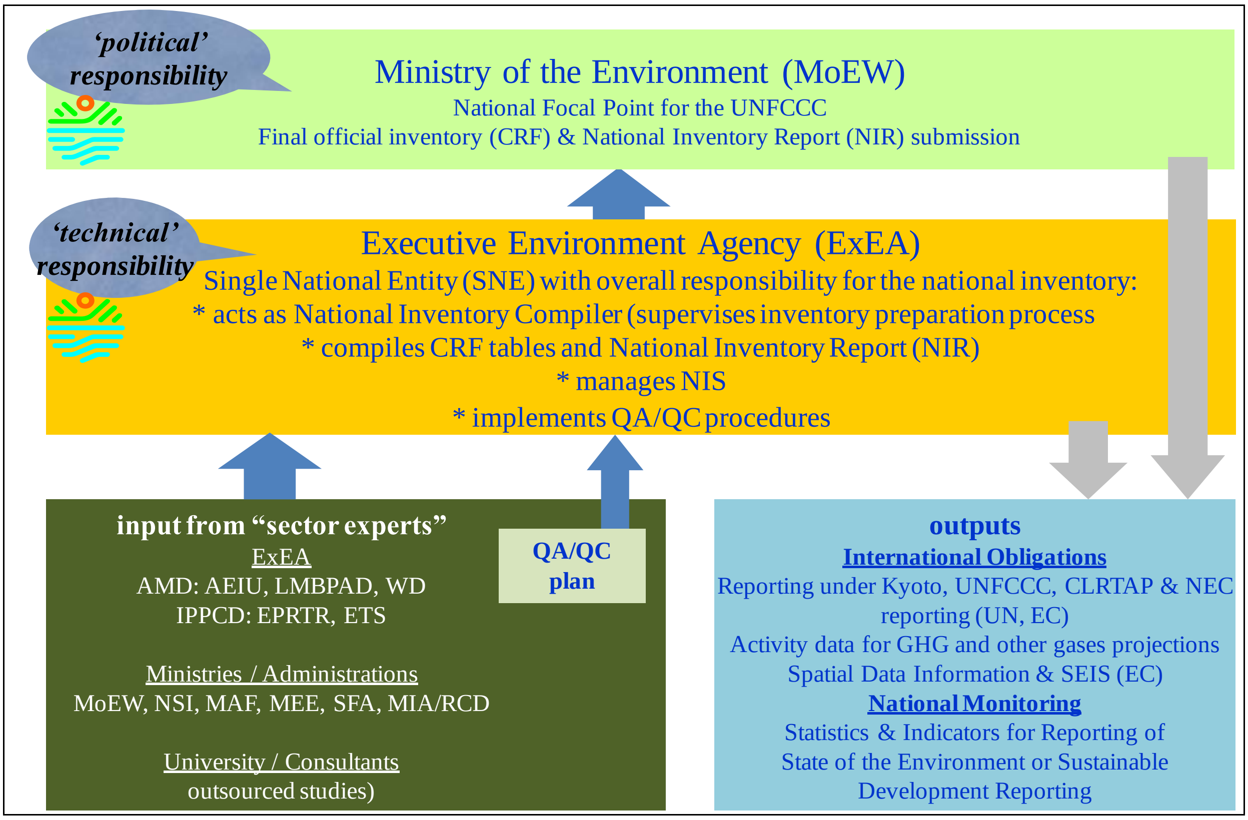
Since 2008 the Executive Environment Agency (ExEA) is responsible for the whole process of inventory planning, preparation and management.

The national system defines the "road map" in which Bulgaria prepares its inventory. This is outlined in the national inventory preparation cycle (see below part Fulfilment of paragraph 10(a) from Decision 19/CMP.1 Guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol).

As it is illustrated in figure 1 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.

Figure 3.1 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 10 persons in total.

The following strategic goals in climate change area were achieved by the Ministry of Environment and Water in 2015:

Climate change mitigation law

Climate change mitigation law adopted on first reading in the National Assembly on 23.10.2013, the in order to incorporate the requirements of the new legislation in 2013. It regulates public relations in implementation of the policy on climate change - powers and duties of the competent authorities and individuals. Absolute prerequisite for the timely implementation of Bulgaria's obligations as a party to the UNFCCC and the Kyoto Protocol and as a country - member of the European Union, is the effective involvement of the competent authorities and private operators in the procedures, which requires clear and comprehensive regulation of their powers, rights and obligations. As a member of the European Union the Republic of Bulgaria has a number of obligations on the legislative package "Climate & Energy" and participating in the scheme for trading greenhouse gas emissions within the European Union (EU ETS), introduced by Directive 2003/87 / EC. This fact is linked to the performance of many obligations that form the whole sector in climate policy and the implementation of which our country should strike a balance between the interests of industry and the ambitious EU targets for the progressive reduction of greenhouse gases.

National Green Investment Scheme

In order to exploit the possibilities for financing projects to reduce greenhouse gas emissions through the National Green Investment Scheme is a decision of the Council of Ministers № 546/12 September 2013 for addition to the agreement with Austria for the purchase of AAUs in Scheme green investments. It is accepted and a decision of the Council of Ministers № 547/12 September 2013 in connection with the implementation of projects under the Green Investment Scheme.

The funds from the sale of AAUs of the Republic of Austria have implemented projects for energy efficiency of the 77 public facilities state and municipal property in Bulgaria. Public projects to improve energy efficiency in municipal buildings, kindergartens and primary schools. Realized are energy efficiency projects at 13 public sites throughout the country.

National adaptation strategy

Steps have been taken to prepare national adaptation strategies in order to determine the necessary adaptation measures for vulnerable sectors to the impacts of changing climatic conditions in the region and climatic zone (due to climate change). As a first step was draft document "Analysis of the contribution of the insurance sector and financial instruments to the prevention of risks posed by climate change and the management of loss and damage in Bulgaria" prepared by the Ministry, with the support of the World Bank. His purpose is to analyze the role and importance of the insurance business for the prevention of risks that occur as a result of climate change and taking measures to adapt. The analysis will be included in the national adaptation strategy.
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's directorates and departments, which are directly involved in operation of the BGNIS, are Environmental Monitoring and Assessment Directorate with the Emission Inventory Department (EID) and Waste Department (WD) and Permit Regime Directorate with the Integrated Pollution Prevention and Control Department (IPPCD) and Emission Trading Permit Department (ETPD).

3.3.2. Overview of inventory planning, preparation and management

Legal basis of the Bulgarian NIS – General functions

Fulfillment of paragraph 10(a)

The Republic of Bulgaria joined the UNFCCC in 1992 and the Parliament ratified it in March 1995. As an Annex I Party to the Convention, Bulgaria is committed to conduct annual inventories on greenhouse gas (GHG) emissions by sources and removals by sinks, using the GHG inventory methodology, approved by the UNFCCC. The inventories started with the country base year – 1988. The first inventories covered the period 1988-1994 as a part of the international project "Country Study to Address Climate Change".

Legal basis of the BGNIS

As illustrated in Figure 3.1 and outlined shortly the 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 Bulgarian Government by MoEW has the political responsibility for compliance with commitments under 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:

National Focal Point;

QA experts from Climate Change Policy Directorate;

Approval of inventory;

Submission of CRF / NIR / Kyoto Tables / SEF.

ExEA has the technical responsibility for the national inventory:

- acts as National Inventory Compiler (supervises inventory preparation process);
- manages BGNIS;
- compiles CRF tables and NIR;
- coordinates the work of engaged consultants for supporting inventory;
- coordinates and implements the activity of National QA/QC Plan;
- National Inventory Focal Point.

The bases for BGNIS are:

Environmental Protection Act (EPA, State Gazette No. 91/25.09.2002; corrected, SG No. 96/2002; last amendment November 2012);

Statute on the organization and structure of ExEA (Decision of Council of ministers 162/03.08.2012 – final update 25.03.2014);

Order № 296/04.12.2015 by the Executive Director of ExEA (Sector experts/QC experts);

Order № RD-218/05.03.2010 by the Minister of Environment and Water (QA experts).

Regulation of the Council of Ministers 261/05.09.2014 SG 76/2014 on the way and order of organization of the National Inventories of hazardous substances and greenhouse gases in the ambient air

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 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 and aggregates the data relevant for GHG emissions on a national level by the following state authorities:

- National Statistics Institute (NSI);
- Ministry of Agriculture and Food (MAF) and their relevant services (Agrostatistic Directorate and Executive Forest Agency);
- Ministry of Energy (ME);
- Ministry of Interior (MI);
- Ministry of Environment and Water (MoEW);
- Ministry of Transport, Information Technologies and Communications (MTITC).

Other arrangements of the Bulgarian National inventory system

The Executive Environment Agency (ExEA) coordinates all activities, related to the large industrial plants and Branch Business Associations.

- Large industrial plants – official letters (questionnaire)
- Branch Business Associations – official letters (questionnaire)

For validation of the activity data we gather reliable country specific data from Branch Business Associations in Bulgaria and aggregate the data relevant for GHG emissions on a national level. Please see the list of all branch business associations in Bulgaria: http://www.bia-bg.com/memberCategory/278. The data must be representative for the whole period since 1988 (base year for Bulgaria).

3.4. Inventory preparation, data collection, processing and storage

3.4.3. 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, MI and ME the type of the necessary data, as well as the deadlines for submissions to the ExEA are regulated by the official agreements mentioned above as well as by the Regulation of the Council of Ministers 261/05.09.2014 (SG 76/2014).

The annual national energy and material balances as well as the data related to the solid waste generation and the wastewater 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 use data, received directly from large point sources in the energy sector and in the industry and these data are summarized by ExEA.

Table 3.1 Sources of activity data for preparation of national GHGs emission inventory

Sectors	Data Source of Activity Data	Activity 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	MI/RCD	Ministry of Interior/ Road Control Department
	Country specific parameters used in the COPERT IV related to car fleet and vehicle split	MTITC	Ministry of Transport, Information Technologies and Communications
1.B Fugitive emissions	Energy balance (IEA - EUROSTAT – UNECE Energy Questionnaire)	NSI	National Statistical Institute
	National statistics	ME	Ministry of Energy
2. Industrial processes and product use	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
	National VOC register	ExEA	Executive Environment Agency
4. Agriculture	National agriculture statistics	MAF	Ministry of Agriculture and Food/Statistics Department
	Synthetic fertilizers	NSPP	National service for Plant Protection
5. LULUCF	National Forest Inventory	EFA	Executive Forest Agency
	National statistics of the balance of territory of Bulgaria	MAF	Ministry of Agriculture and Food
6. Waste	National statistics	NSI	National Statistical Institute
	National database	ExEA	Executive Environment Agency/ Waste Monitoring Department

3.4.4. Inventory preparation

The inventory preparation process covers:

- Identification key source categories[1];
- Prepare estimates[2] and ensure that appropriate methods are used to estimate emissions from key source categories;
- Collect sufficient activity data, process information, and emission factors as are necessary to support the methods selected for estimating anthropogenic GHG emissions by sources and removals by sinks;
- Make a quantitative estimate of inventory uncertainty[3] for each source category and for the inventory in total recalculations[4] of previously submitted estimates of anthropogenic GHG emissions by sources and removals by sinks;
- Compile the national inventory in accordance with Article 7, paragraph 1, and relevant decisions of the COP and/or COP/MOP;
- Implement general inventory QC procedures (tier 1) in accordance with its QA/QC plan following the 2006 IPCC GL;
- Apply source category specific QC procedures[5] (tier 2) for key source categories and for those individual source categories in which significant methodological and/or data revisions have occurred;
- Collection of all data collected together with emission estimates in a database (see below), where data sources are well documented for future reconstruction of the inventory.

The Figure 3.1 presents the general responsibilities of all engaged institutions in functioning of Bulgarian National Inventory System.

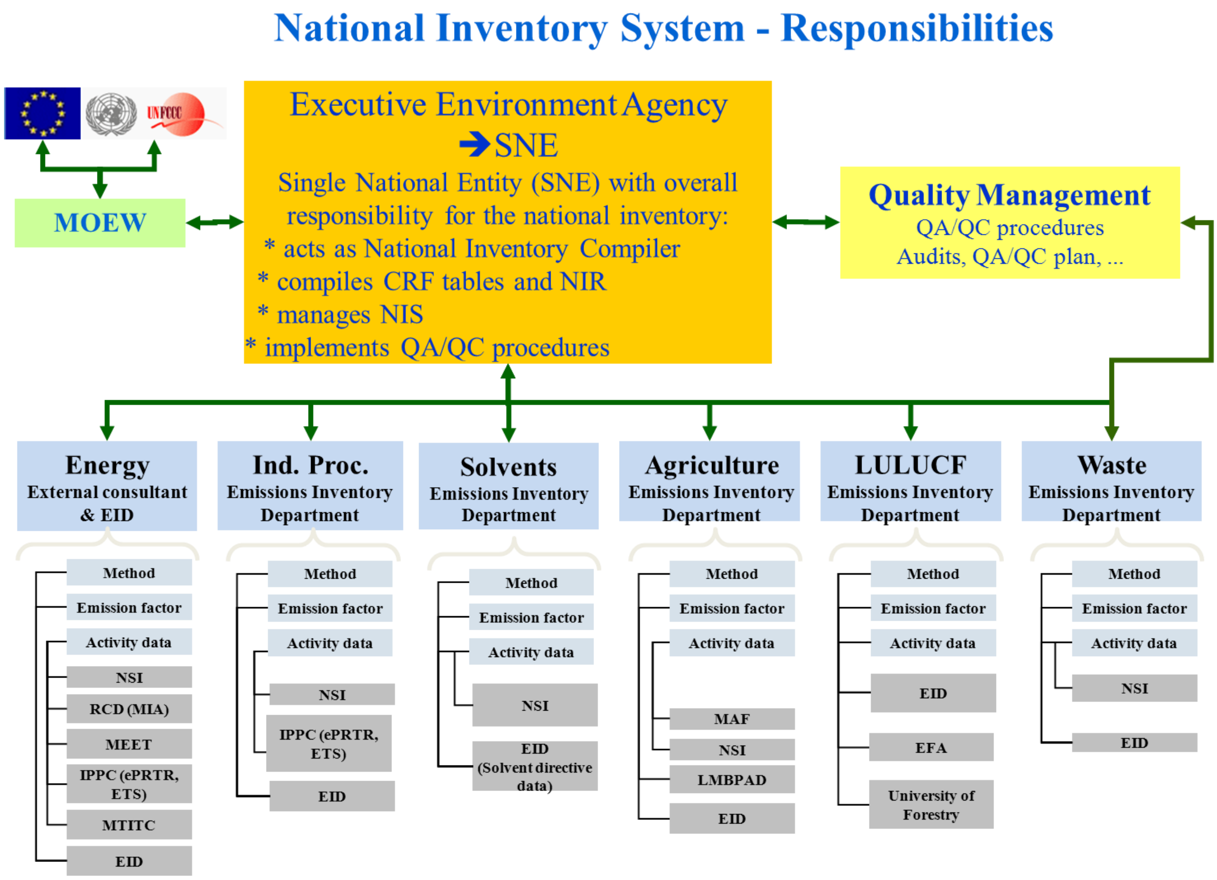
The ExEA coordinates all activities on preparation of inventory under UNFCCC.

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 processes and 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.

[1] following the methods described in the 2006 IPCC GL (chapter 4, section 4.2);
[2] in accordance with the methods described in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories
[3] following the 2006 IPCC Guidelines for National Greenhouse Gas Inventories
[4] prepared in accordance with the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and relevant decisions of the COP and/or COP/MOP;
[5] in accordance with the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Figure 3.1 Bulgarian National Inventory System – Responsibilities



The following table presents the responsibilities of all engaged institutions for preparation of GHGs emission inventory for 2017 submission.

Table 3.2 Preparation of GHGs emission inventory for 2017 submission

Sector CRF	Activity data	Methodology and selection of emission factors	Preparation of Sector inventories
Energy CRF1A1 CRF1A2 CRF1A4	NSI	ExEA, NSI	Sector expert ExEA External consultants
Energy/Transport CRF1A3	NSI MI MTITC	ExEA, NSI MI, MTITC	Sector expert ExEA External consultants
Energy CRF1B	NSI ME	ExEA, NSI, ME	Sector expert ExEA External consultants
Industry processes and product use CRF2	NSI ExEA MOEW	ExEA, NSI, Installations operators	Sector expert ExEA

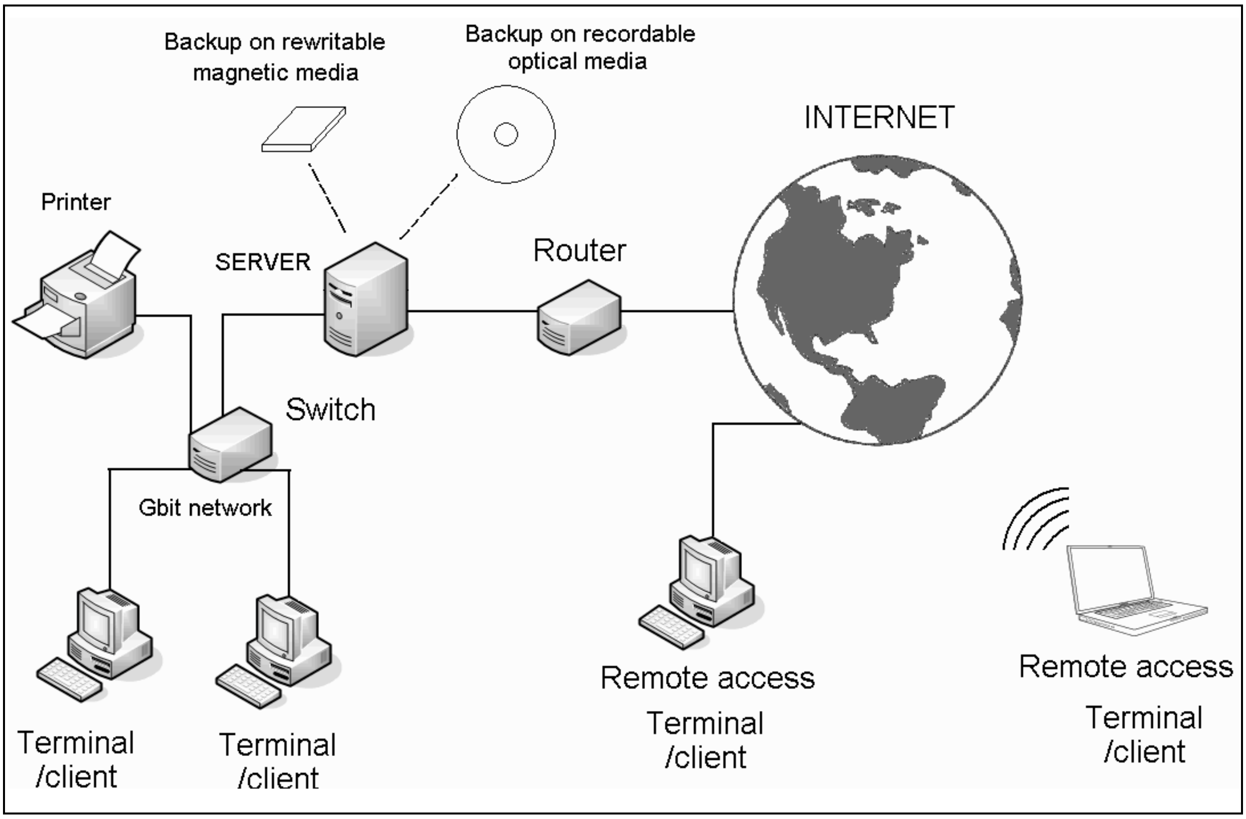
	NSI ExEA		
Agriculture CRF3	MAF NSPP	ExEA, MAF	Sector expert ExEA
LULUCF CRF3	EAF MAF	ExEA, EAF	Sector expert ExEA
Waste CRF4	NSI ExEA	ExEA, NSI	Sector expert ExEA

The National Inventory Compiler compiles the national GHGs inventory (CRF-tables and NIR) for the submission under the UNFCCC.

3.4.5. Documentation and data archiving

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

Figure 3.2 Documentation and data archiving in ExEA



3.4.6. Quality assurance, quality control and verification

Fulfilment of paragraph 12(d)

As it is written above the Executive Environment Agency is responsible for the preparation of the GHGs Emission Inventory and the relevant National Inventory Reports under UNFCCC.

The ExEA is also responsible for coordination and implementation of 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 QA/QC plan has been updated in 2014 in order to implement the new established legal, institutional and procedural arrangements within the BGNIS. The updated National QA/QC Plan was approved by the Ministry of Environment and Water in December 2014.

National QA/QC Plan includes following elements:

- Responsible institutions;
- Data collection;
- Preparation of inventory;
- Category-specific QC procedures;
- QA and review procedures;
- Uncertainty analyses;
- Organisation of the activities in quality management system;
- Verification activities;
- Reporting, documentation and archiving.

Figure 3.3 National quality assurance and quality control program

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

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 Quality Control (QC) procedures are performed by the sectors, who are directly involved in the process of preparation of inventory with their specific responsibilities.

The QC procedures are implemented by all activity data provider and ExEA’s sector experts (Order № 296/04.12.2015 by the Executive Director of ExEA) and/or external consultants.

Table 3.3 QC experts within the BGNIS

Responsibility	QC experts
Activity data	MAF, MI, MTITC, ME, NSI, EAF, ExEA, MOEW
Methodology and selection of emission factors	ExEA, MAF, MI, MTITC, ME, 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, which are 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 from them competence.

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 was 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).

For 2017 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 expert peer review present 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 National Inventory Report or reflected in the inventory estimates.

Information of the QA/QC activities

According to the 2006 IPCC GL the QA/QC system, that should be implemented for GHG Inventories consists of an inventory agency responsible for coordinating QA/QC activities, a QA/QC plan, general QC procedures (Tier 1), source category-specific QC procedures (Tier 2), QA review procedures and verifications as well as procedures regarding reporting, documentation and archiving.

The QA/QC plan is a basic element of the QA/QC system. The plan outlines QA/QC activities that are implemented and includes the scheduled time frame for inventory preparation from its initial development through the final reporting in any year. It contains an outline of the processes and schedule to review of all source categories.

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 main parts of the National QA/QC Plan for emissions inventories are presented in the next table:

Table 3.4 Comparison of 2006 IPCC GL and ISO 9001

	2006 IPCC GL	ISO 9001
1. Scope	✓	✓
2. Definitions	✓	✓
3. Administrative requirements	✓	✓
4. Organisation and management	✓	✓
5. Quality system	✓	✓

	2006 IPCC GL	ISO 9001
6. Personnel	✓	✓
7. Facilities and equipment	✓	✓
8. Handling of inspection samples and items	✓	✓
9. Records	✓	✓
10. Reports	✓	✓
11. Sub-contracting	✓	✓
12. Complaints and appeals	✓	✓

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

The QA/QC Manager prepares a Plan for implementation of QA/QC activities for the current submission. The check lists with all specific QA/QC procedures are part of the plan;
The plan for QA/QC is sent to all engaged QC and QA experts for implementation;
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.
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).
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;
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);
The QA/QC Manager prepares a summary of the results from implemented QA/QC checks.
The QA/QC Manager prepares an attendant file for implemented procedures;
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;
The QA/QC Manager is responsible for documentation and archiving of all documents, related to perform QA/QC procedures in the national System for documentation and archiving of inventory in ExEA.

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 are 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 from them competence.

The QC experts fill in a check-list, which is 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 part "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 them responsibilities and for each category (CRF).

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

Table 3.5 Responsibilities in the exchange of check lists between QC experts for 2017 submission

Sector CRF	Activity data		Methodology/ emission factors		Emission calculations	
	Check	Correction	Check	Correction	Check	Correction
Energy CRF1	ExEA NSI ME external consultant	NSI ME	ExEA NSI ME	external consultant	ExEA NSI ME	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 and product use CRF2	NSI ExEA	NSI ExEA	NSI ExEA	ExEA	NSI ExEA	Sector expert ExEA
Agriculture CRF3	ExEA MAF	MAF	ExEA MAF	ExEA	ExEA MAF	Sector expert ExEA
LULUCF CRF3	ExEA EAF	EAF	ExEA EAF	ExEA	ExEA EAF	Sector expert ExEA
Waste CRF4	NSI ExEA	NSI ExEA	NSI ExEA	ExEA	NSI ExEA	Sector expert ExEA

General (QC) procedures are described in Checklists that is part of QA/QC Plan.

As it is written above for 2017 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 in the part "Review of reporting tables and National report" in the sector of them competence.

The check list 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 filled out by QA experts in accordance with them responsibilities for each category (CRF).

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 3.6 Responsibilities in exchange of the check lists between QA experts and sector experts for 2017 submission

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

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, 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 1 Organizational Chart of the Bulgarian National Inventory System).

Quality improvement

Fulfilment of paragraph 13

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.

3.5. Brief general description of methodologies (including tiers used) and data sources used

Fulfilment of Para 14(b) (c) (e) (f)

The most recent greenhouse gas inventory for the period 1988 to 2015 (NIR 2017) was compiled according to the recommendations for inventories set out in the UNFCCC reporting guidelines according to Decision 24/CP.19, the Common Reporting Format (CRF) and the 2006 IPCC Guidelines.

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 activities above enlisted. 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 a part of additional data, filled in the CRF Tables.

National Inventory Methodology

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:

- 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 IPCC GL)
- EMEP/EEA air pollutant emission inventory guidebook – 2013

The emission factors are mainly from:

- 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 IPCC GL)
- EMEP/EEA air pollutant emission inventory guidebook – 2013.
- Country-specific

The following tables summarise the ‘Applied method’ and ‘Emission factor’ of the inventory 2015, submission 2017.

Table 3.7 Methods and the emission factors applied (CO_2, CH_4, N_2O)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
1. Energy	T1,T2	CR,CS,D	T1,T2	CR,D	NA,T1,T2	CR,D,NA
A. Fuel combustion	T1,T2	CR,CS,D	T1,T2	CR,D	NA,T1,T2	CR,D,NA
1. Energy industries	T1,T2	CS,D	T1	D	NA,T1	D,NA
2. Manufacturing industries and construction	T1,T2	CS,D	T1	D	T1	D
3. Transport	T1,T2	CR,CS,D	T1,T2	CR,D	T1,T2	CR,D
4. Other sectors	T1,T2	CS,D	T1	D	T1	D
5. Other	T1,T2	CS,D	T1	D	T1	D
B. Fugitive emissions from fuels	NA	NA	NA	NA	NA	NA
1. Solid fuels	NA	NA	NA	NA	NA	NA
2. Oil and natural gas	NA	NA	NA	NA	NA	NA
C. CO_2 transport and storage	NA	NA				
2. Industrial Processes	D,T1,T2	CR,CS,D, PS	D,NA	D,NA	T1,T3	CS,D,PS
A. Mineral industry	T1,T2	CS,D,PS				
B. Chemical industry	T2	CS,PS	D	D	T3	PS

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
C. Metal industry	T1,T2	CS,D	NA	NA		
D. Non-energy products from fuels and solvent use	D,T1	CR,D				
E. Electronic industry						
F. Product uses as ODS substitutes						
G. Other product manufacture and use					T1	CS,D
H. Other	D	D			NA	NA
2. Agriculture			D,T1,T2	CS,D	D,T1	D
A. Enteric fermentation			T1,T2	CS,D		
B. Manure management			T1,T2	CS,D	T1	D
C. Rice cultivation			T1	D		
D. Agricultural soils(3)					T1	D
E. Prescribed burning of savannas						
F. Field burning of agricultural residues			D	D	D	D
G. Liming						
H. Urea application	NA	NA				
I. Other carbon-containing fertilizers	NA	NA				
J. Other						
4. LULUCF	T1,T2	CS,D	T1	D	T1	D
A. Forest land	T1,T2	CS,D				
B. Cropland	T1,T2	CS,D				
C. Grassland					NA	NA
D. Wetlands					NA	NA
E. Settlements						
F. Other land	T1	D				
G. Harvested wood products						
H. Other	T1,T2	CS,D	T1	D	T1	D
5. Waste	NO,T1	D,NO	NO,T1,T2	CS,D,NO	NO,T1	D,NO
A. Solid waste disposal	NA	NA	T2	CS,D		
B. Biological treatment of solid waste			NO,T1	D,NO	NO,T1	D,NO
C. Incineration and open burning of waste	NO,T1	D,NO	NO,T1	D,NO	NO,T1	D,NO
D. Waste water treatment and discharge			NO,T2	CS,NO	NO,T1	D,NO
E. Other	NO	NO	NO	NO	NO	NO
7. Other (specified in Summary 1.A)	NO	NO	NO	NO	NO	NO

Table 3.8 Methods and the emission factors applied: HFCs, PFCs, SF_6

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFCs		PFCs		SF_6		NF_3	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
2. Industrial processes	T2	D	T2	D	T2	D	NO	NO
A. Mineral industry								
B. Chemical industry								
C. Metal industry								
D. Non-energy products from fuels and solvent use								
E. Electronic industry								
F. Product uses as ODS substitutes	T2	D	T2	D	T2	D	NO	NO
G. Other product manufacture and use								

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFCs		PFCs		SF_6		NF_3	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emision factor
H. Other								

3.6. Brief description of key categories

Fulfilment of paragraph 14(a)

The key category analysis follows the Approach 1 and Approach 2 is performed according to the 2006 IPCC Guidelines (IPCC 2006, chapter 4).

According to method of the Approach 2 assessment of the key sources is made by identifying the uncertainty of each source. The uncertainty is the combined uncertainty of the assessment, which is a mean quadratic assessment of the uncertainty of the data and of the emission factors.

The key source identification of the Bulgarian inventory includes all reported greenhouse gases CO_2, CH_4, N_2O, HFC, PFC, NF_3 and SF_6, and all IPCC source categories, including LULUCF. The key source analysis is performed by the ExEA with data for greenhouse gas emissions of the corresponding current submission and comprises a level assessment for all years between 1988 and the last reported year and trend assessments for the trend of the latest reported years with respect to base year emissions.

Emissions and removals from LULUCF are included in the key category analysis which is performed according to the 2006 IPCC Guidelines.

The key category analysis is used to prioritize improvements that should be taken into account for the next inventory submissions. First of all, it is important that emissions of key categories, being the most significant in terms of absolute weight and/or combined uncertainty, are estimated with a high level of accuracy.

Table 3.9 Summary overview for key categories

KEY CATEGORIES OF EMISSIONS AND REMOVALS	Gas	Criteria used for key source identification		Key category excluding LULUCF	Key category including LULUCF
Specify key categories according to the national level of disaggregation used:		L	T		
1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	CO_2	X	X	X	X
1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CO_2	X	X	X	X
1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	CO_2	X	X	X	X
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	CO_2	X	X	X	X
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	CO_2	X	X	X	X
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	CO_2	X	X	X	X
1.A.3.b Road Transportation	CO_2	X	X	X	X

KEY CATEGORIES OF EMISSIONS AND REMOVALS	Gas	Criteria used for key source identification		Key category excluding	Key category including
1.A.3.e Other Transportation	CO_2		X	X	X
1.A.4 Other Sectors - Liquid Fuels	CO_2	X	X	X	X
1.A.4 Other Sectors - Solid Fuels	CO_2	X	X	X	X
1.A.4 Other Sectors - Gaseous Fuels	CO_2	X	X	X	X
1.A.5 Other (Not specified elsewhere) - Liquid Fuels	CO_2		X	X	X
1.A.5 Other (Not specified elsewhere) - Solid Fuels	CO_2		X	X	
1.A.5 Other (Not specified elsewhere) - Gaseous Fuels	CO_2		X	X	X
1.B.1 Fugitive emissions from Solid Fuels	CH_4	X		X	X
2.A.1 Cement Production	CO_2	X		X	X
2.A.4 Other Process Uses of Carbonates	CO_2	X	X	X	X
2.B.1 Ammonia Production	CO_2	X	X	X	X
2.B.2 Nitric Acid Production	N_2O		X	X	X
2.B.7 Soda Ash Production	CO_2	X	X	X	X
2.C.1 Iron and Steel Production	CO_2		X	X	X
2.F.1 Refrigeration and Air conditioning	Aggre-gate F-gases	X	X	X	X
3.A Enteric Fermentation	CH_4	X	X	X	X
3.B Manure Management	CH_4		X	X	
3.B Manure Management	N_2O	X		X	X
3.D.1 Direct N2O Emissions From Managed Soils	N_2O	X	X	X	X
3.D.2 Indirect N2O Emissions From Managed Soils	N_2O	X		X	X
4.A.1 Forest Land Remaining Forest Land	CO_2	X	X		X
4.A.2 Land Converted to Forest Land	CO_2	X			X
4.B.1 Cropland Remaining Cropland	CO_2	X	X		X
4.C.2 Land Converted to Grassland	CO_2	X	X		X
4.D.2 Land Converted to Wetlands	CO_2		X		X
4.E.2 Land Converted to Settlements	CO_2	X	X		X
4.F.2 Land Converted to Other Land	CO_2	X	X		X
4.G Harvested Wood Products	CO_2	X	X		X
5.A Solid Waste Disposal	CH_4	X	X	X	X
5.D Wastewater Treatment and Discharge	CH_4	X	X	X	X
1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	CO_2	X	X	X	X
1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CO_2	X	X	X	X
1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	CO_2	X	X	X	X
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	CO_2	X	X	X	X
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	CO_2	X	X	X	X
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	CO_2	X	X	X	X
1.A.3.b Road Transportation	CO_2	X	X	X	X
1.A.3.e Other Transportation	CO_2		X	X	X
1.A.4 Other Sectors - Liquid Fuels	CO_2	X	X	X	X
1.A.4 Other Sectors - Solid Fuels	CO_2	X	X	X	X

KEY CATEGORIES OF EMISSIONS AND REMOVALS	Gas	Criteria used for key source identification		Key category excluding	Key category including
1.A.4 Other Sectors - Gaseous Fuels	CO_2	X	X	X	X
1.A.5 Other (Not specified elsewhere) - Liquid Fuels	CO_2		X	X	X
1.A.5 Other (Not specified elsewhere) - Solid Fuels	CO_2		X	X	

3.7. General uncertainty evaluation, including data on the overall uncertainty for the inventory totals

This section provides an overview of the approach to uncertainty analysis adopted for the Bulgarian inventory. The mandatory, detailed reporting table of the analysis for all the emission sources (key and non-key) and emission factors is provided in as Approach 1 Uncertainty calculation and reporting'.

The present approach consists of two levels: screening and detailed analysis. Screening is done with Approach 1 uncertainty analysis. The key categories are discussed with the sectoral experts during the annual quality meetings.

Separate uncertainty calculation was performed using a spreadsheet prepared specifically according to the Approach 1 (2006 IPCC GL).

GHG INVENTORY

As a whole, the uncertainty assessment of the GHG inventories follows the methodology of the 2006 IPCC GL.

The overall uncertainty is closely related to the GHG emission sources data uncertainty (fuels, activities, processes, etc.) and to the emission factor uncertainty.

The uncertainty of the GHG emission sources can be defined during data collection and processing and it is a part of procedures, applied by the statistical authorities, differences between the production, import, export and consumption of fuels, expert assessment, etc.

The uncertainty of emission factors depends on the origin of the factors applied. In case the emission factors result from direct periodical measurements, the uncertainty is determined by the relevant methodology, related to the measuring methods and apparatuses.

The overall uncertainty of the GHG inventory is determined by combining the emission sources uncertainty and the emission factors uncertainty.

Two rules are applied in this process:

Rule A - combination of the uncertainty by summing;

Rule B - combination of the uncertainty by multiplying.

Since the GHG inventories are sums of the products of emission sources, multiplied by emission factors, the two rules above can be used for determining the overall uncertainty of the inventory.

Rules A and B represent the foundation of the Approach 1 method, recommended in the IPCC Guidance.

The uncertainties for all the emission sources (key and non-key) and emission factors are presented in the table below.

Combined uncertainty as a part of overall emissions for 2015 for every source has been calculated as following equation:

$$MCU_i = (EM_i/EM_{total}) x\ CU_i$$

where MCUi – measured combined uncertainty,

EM_i - source emissions for 2015,

EM_{total} – total country emissions for 2015,

CN_i – combined uncertainty of the i-th source.

Uncertainty of the overall emissions trend for 2015 for every source has been calculated as HTi – overall emissions trend uncertainty brought in by the i-th source. This uncertainty calculates in column M of Table 3.2 of p.3.31 of the 2006 IPCC GL.

The calculated uncertainties, in %, of the overall national GHG emissions for the year 2015 (row 7, column H in Table 3.2 of the 2006 IPCC GL), and the overall emission trend related to the base inventory year until 2015 (row 7, column M in Table 6.1.) are given in Table 12. The relevant data for the previous inventory for 2015 are given for comparison (NIR 2016 and NIR 2017).

Table 3.10 Uncertainty in total GHG emissions, %

Uncertainty	Uncertainty NIR 2016	Uncertainty NIR 2017
Uncertainty in total GHG emissions	12.48 %	12.75 %
Overall uncertainty into the trend in total GHG emissions	1.99	1.84

3.8. Trends in greenhouse gas emissions

This chapter describes greenhouse gas emissions (GHGs) trends over time, covering period between 1988 and 2015.

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.

The table below represents the emission trends of the basic GHGs, the overall emissions (excluding LULUCF).

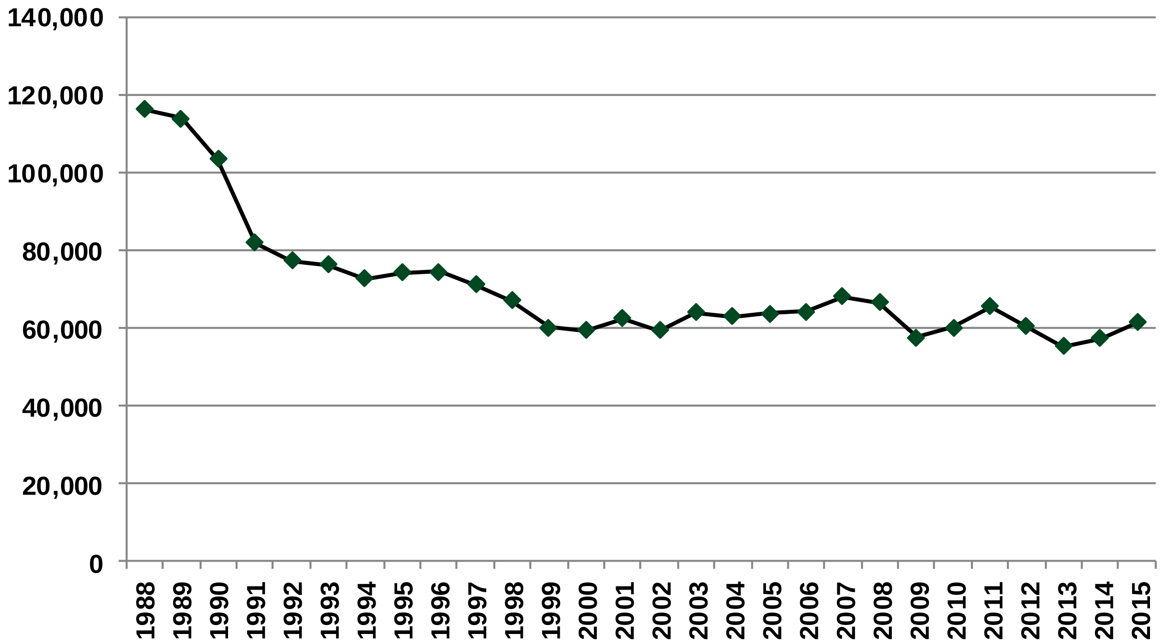
Table 3.11 Summary of emission trend per source category, Gg CO_2 eq

Source category	1988	1990	1995	2000	2005	2010	2015
1. Energy	**81275,3**	**73471,98**	**51217,79**	**40777,25**	**45659,28**	**46009,32**	**45646,28**
A. Fuel combustion (sectoral approach)	*78843,08*	*71150,99*	*49122,09*	*39399,03*	*44580,41*	*44880,35*	*44461,84*
1. Energy industries	42179,4	38676,85	27259,83	24076,86	27148,08	31638,28	30316,87
2. Manufacturing industries and construction	17503,42	17768,46	13084,57	7228,39	7088,83	3156,71	2862,07
3. Transport	7134,34	6572,96	4421,4	5514,73	7831,03	7973,33	9362,2
4. Other sectors	6917,5	8102,97	4291,85	2567,09	2512,47	2112,03	1858,58
5. Other	5108,42	29,75	64,44	11,97	NO	NO	62,12
B. Fugitive emissions from fuels	*2432,22*	*2320,98*	*2095,7*	*1378,22*	*1078,87*	*1128,97*	*1184,44*
1. Solid fuels	2179,2	2046,66	1846,37	1165,16	811,15	949,71	983,51
2. Oil and natural gas and other emissions from energy production	253,03	274,33	249,33	213,06	267,71	179,26	200,93
2. Industrial Processes	**13438,62**	**10046,88**	**10453,73**	**7210,14**	**7683**	**4438,37**	**5699,26**
A. Mineral industry	3691,75	3235,85	2692,25	1604,7	2164,67	1811,79	2385,67
B. Chemical industry	5422,48	4943,27	4206,76	2764,01	2784,7	1501,86	1790,3
C. Metal industry	4024,37	1629,35	3360,4	2631,42	2370,52	288,66	224,06
D. Non-energy products from fuels and solvent use	225,18	165,06	98,15	96,66	109,42	103,64	87,27
F. Product uses as ODS substitutes	NO	NO	3,33	33,02	195,16	663,11	1152,19
G. Other product manufacture and use	67,99	67,82	85,3	76,28	55,26	65,43	54,62
H. Other	6,85	5,53	7,54	4,06	3,27	3,89	5,15
3. Agriculture	**13408,7**	**12127,18**	**5716,02**	**4987,47**	**4963,06**	**5245,13**	**5937,8**
A. Enteric fermentation	5071,33	4804,47	2329,64	2113,81	1869,67	1566,56	1529,27
B. Manure management	1932,97	1911,15	873,39	640,64	672,09	596,69	596,59
C. Rice cultivation	126,99	95,37	12,43	32,16	40,53	107,87	111,77

Source category	1988	1990	1995	2000	2005	2010	2015
D. Agricultural soils	6167,12	5225,27	2459,5	2166	2338,95	2929,79	3600,89
F. Field burning of agricultural residues	37,4	37,57	23,62	15,34	20,33	26,17	32,02
H. Urea application	72,9	53,34	17,45	19,52	21,49	18,05	67,27
4. Land use, land-use change and forestry	**-15388,06**	**-15023,3**	**-13685,2**	**-9610,01**	**-9260,09**	**-9607,34**	**-6874,74**
A. Forest land	-14198,1	-14260,7	-14456,3	-10956	-10190	-10157,3	-6072,56
B. Cropland	-1007,87	-598,71	-111,9	781,36	895,04	658,08	1008,36
C. Grassland	-2,22	26,64	67,61	-1252,39	-1211,52	-1166,35	-1730,38
D. Wetlands	IE,NE,NO	IE,NE,NO	13,67	92,04	172,55	252,53	277,08
E. Settlements	478,34	468,64	444,47	494,92	511,83	753,19	776,98
F. Other land	-1,73	-2,73	-5,26	1088,31	703,54	420,22	-590,22
G. Harvested wood products	-656,48	-656,48	362,5	141,7	-141,5	-367,77	-544,01
5. Waste	**8259,32**	**8007,54**	**7015,54**	**6391,43**	**5384,5**	**4608,1**	**4199,4**
A. Solid waste disposal	4922,42	4944,8	4932,99	4753,49	4098,33	3613,08	3135,01
B. Biological treatment of solid waste	NO	NO	NO	NO	NO	NO	53,34
C. Incineration and open burning of waste	19,96	21,39	22,55	67,61	59,15	14,48	10,88
D. Waste water treatment and discharge	3316,93	3041,35	2060	1570,33	1227,01	980,55	1000,17
Total CO2 equivalent emissions without LULUCF	**116381,94**	**103653,6**	**74403,08**	**59366,29**	**63689,84**	**60300,91**	**61482,75**
Total CO2 equivalent emissions with LULUCF	**100993,88**	**88630,25**	**60717,85**	**49756,29**	**54429,75**	**50693,57**	**54608,01**

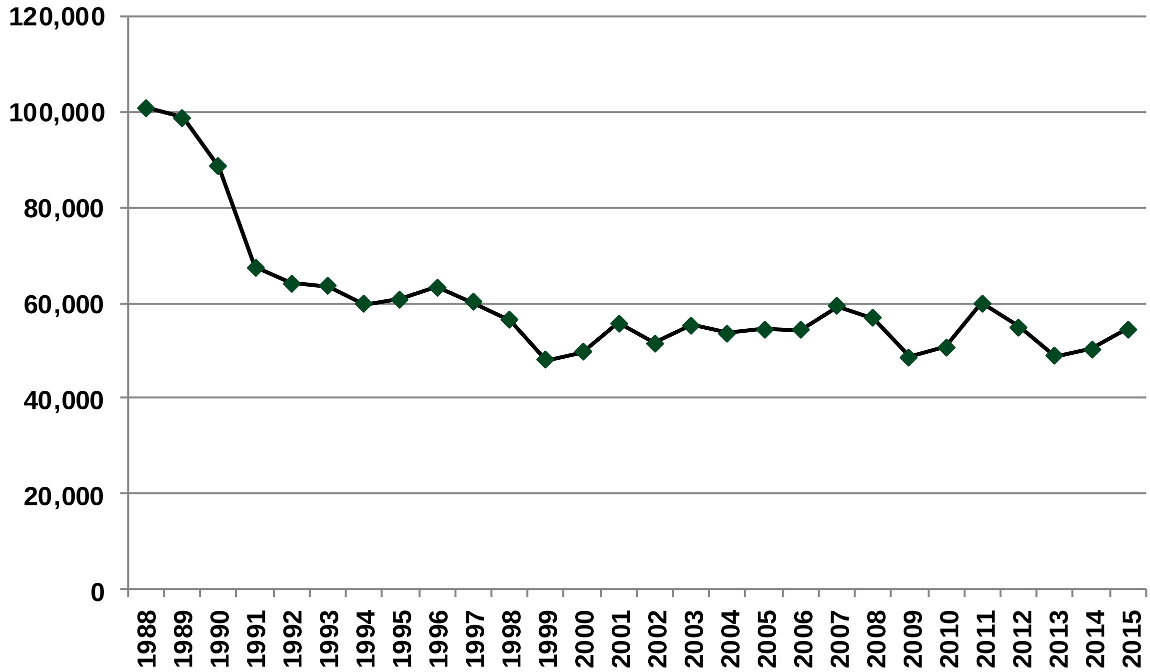
In 2015 Bulgaria's greenhouse gas emissions totalled 61 483 Gg CO_2 without reporting of sequestration from LULUCF sector. The emissions decreased by 47.17 % compared with the base year. Emissions in 2015 were 6.9 % increase in comparison with the emissions of the previous year.

Figure 3.4 Total GHG emissions (without LULUCF) for 1988 – 2015, Gg CO2 eq.



The net emissions including reporting of sequestration from LULUCF sector were 54 608 Gg CO_2 eq. The emissions decreased by 45.93 % compared with the base year.

Figure 3.5 Total GHG emissions (with LULUCF) for 1988 – 2015, 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 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 1988-2015, which resulted in the reduction of population by 20%.

The most important greenhouse gas in Bulgaria is carbon dioxide. The share of CO_2 emissions from the total greenhouse gas emissions varies around 78.5% excluding LULUCF and 75.7% including LULUCF. In absolute terms CO_2 emissions have decreased 46% since 1988. Around 74.2% 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 56.6% 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 53.6% which has been occasioned mostly by the reduced nitrogen fertilisation of agricultural fields, the biggest decline was in the beginning of time series.

Figure 3.6 Total GHG emissions in Gg CO_2 eq. for 1988 – 2015

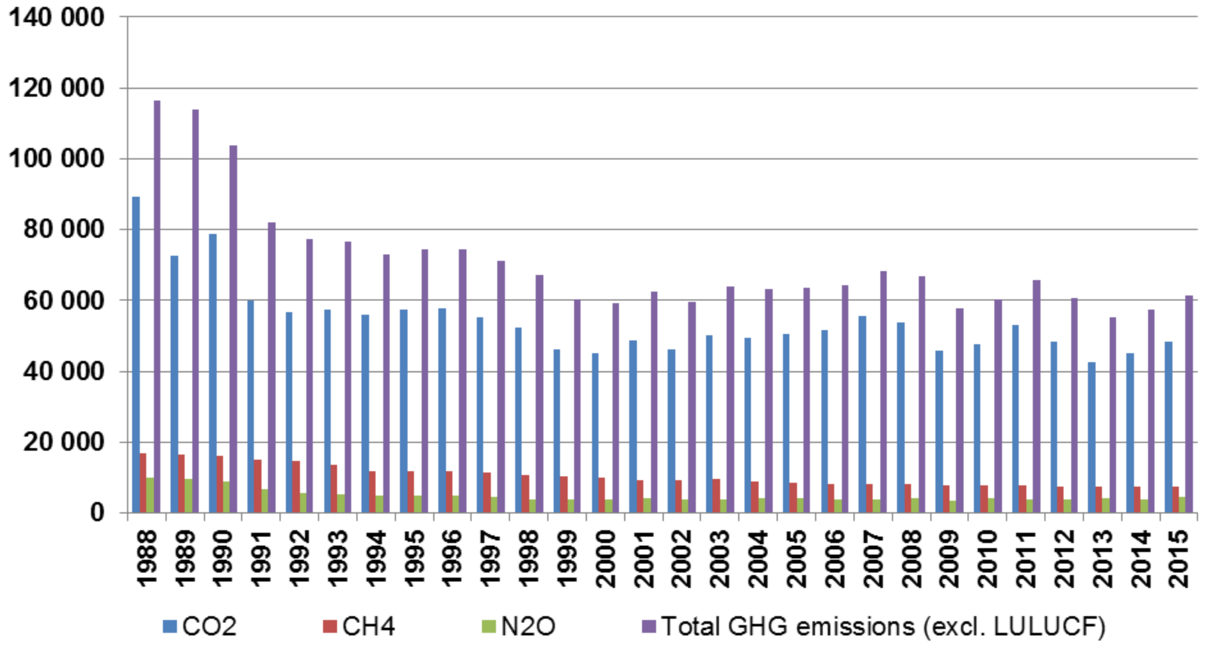
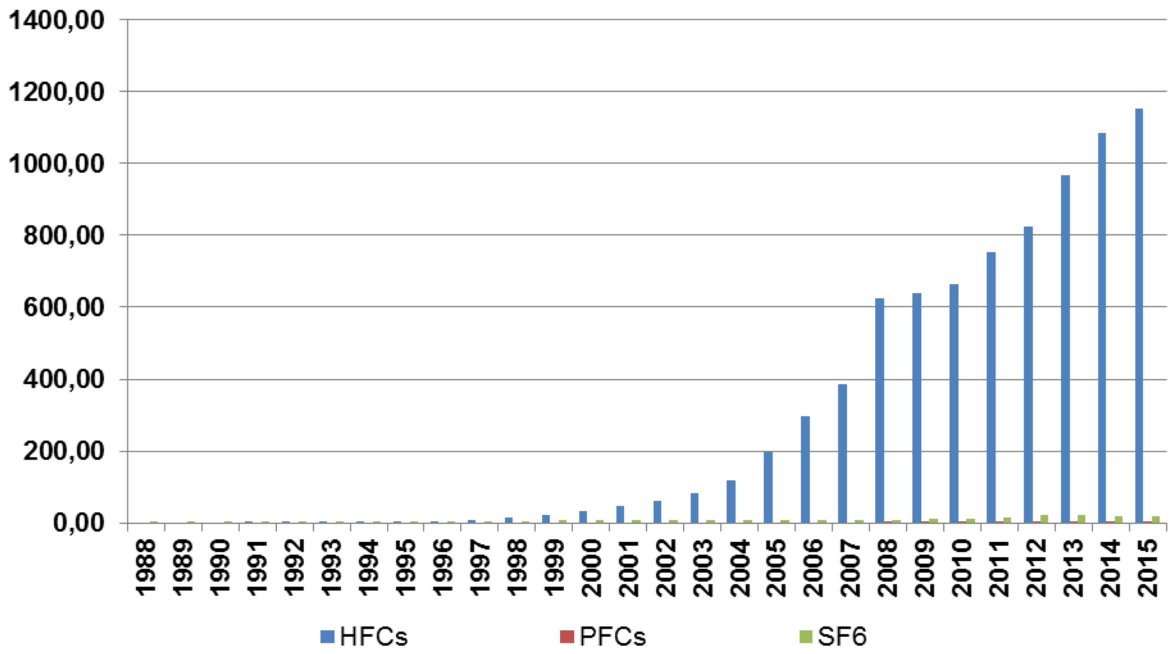


Figure 3.7 Actual emissins of HFCs, PFCs and SF6 for 1988 – 2015, Gg CO2 eq.

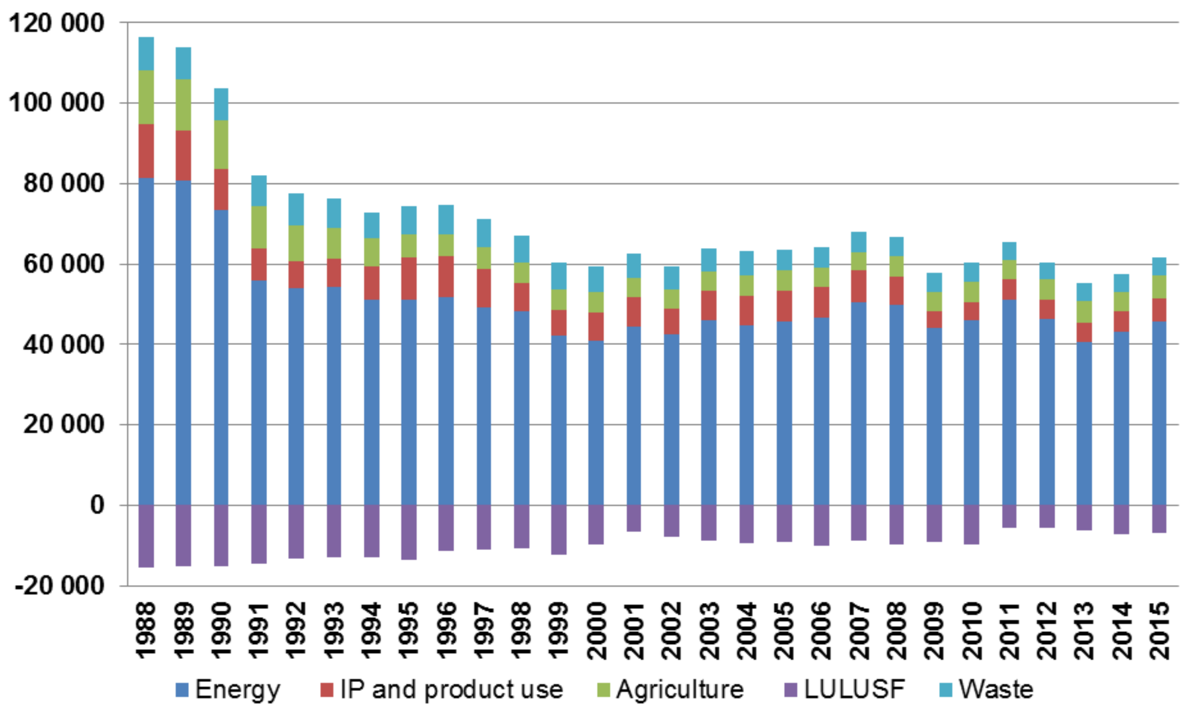


The emissions of F-gases have increased over tenfold during 1995-2015. A key driver behind the trend has been the substitution of ozone depleting substances (ODS) by F-gases in many applications.

Emission trends by sector

Figure below shows the GHG aggregated emission trends by IPCC sectors. The Energy sector, where GHG emissions come from fuel combustion, headed the list in 2015 with the biggest share – 74.2%. Sector Agriculture ranked the second place with 9.7% and sectors IP ranked the third place with 9.3 % and Waste with 6.8%.

Figure 3.8 Total greenhouse gas emissions in CO_2-eq. per IPCC sector 1988-2015



3.8.7. Energy

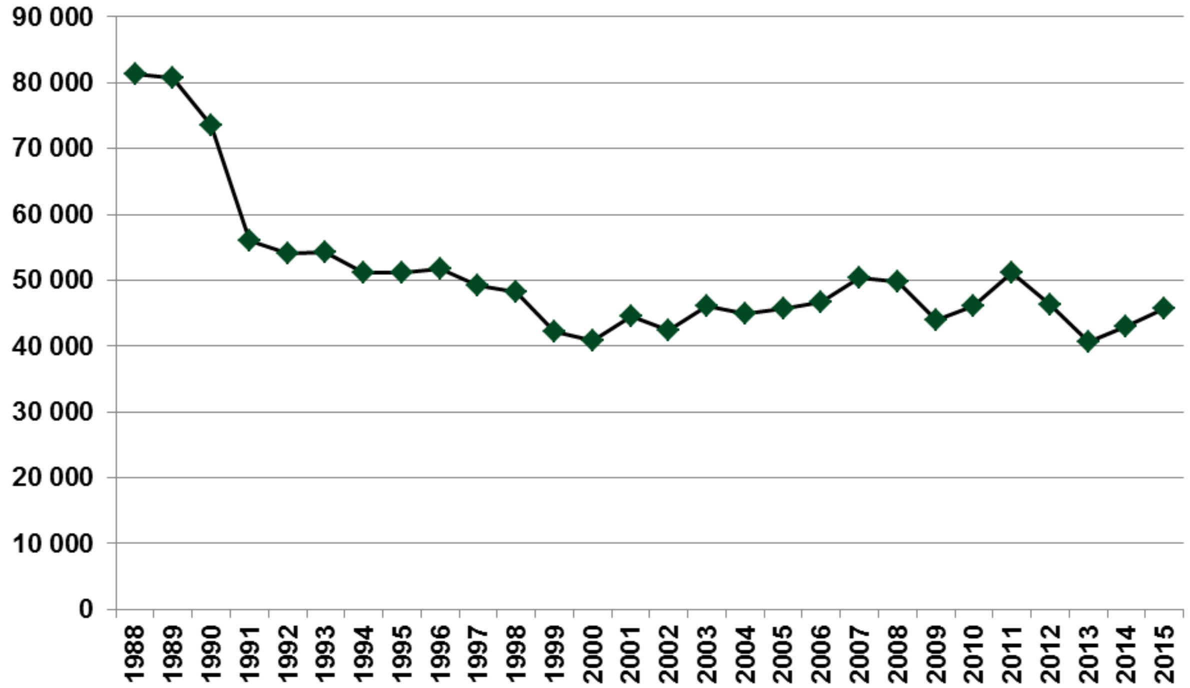
Emissions from the energy sector in 2015 decreased by 43.84% compared to the base year (45 646.28Gg CO_2e in 2015 compared to 81 593 Gg CO_2e in 1988). Compared to previous year, the emissions in 2015 increased with 6.1% mostly due to the increase of electricity production from fossil fuels in the energy industries sector and increase of fossil fuel use in the transport sector.

Main source of emissions in the energy sector is fuel combustion of solid fuels, which is responsible for 61.7% of the emissions from fuel combustion in 2015, followed by liquid fuels with 26.4% and gaseous fuels with 11.1%.

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 2015 was defined by a substantial decrease of emissions from fuel combustion in energy industries (61.5%) and energy use in manufacturing industry and construction (83.6%) and in other sectors (73.1%), as well as a clear increase in GHG emissions from transport (32%).

Figure 3.9 GHG emissions from Energy sector for 1988 – 2015, Gg CO2 eq.

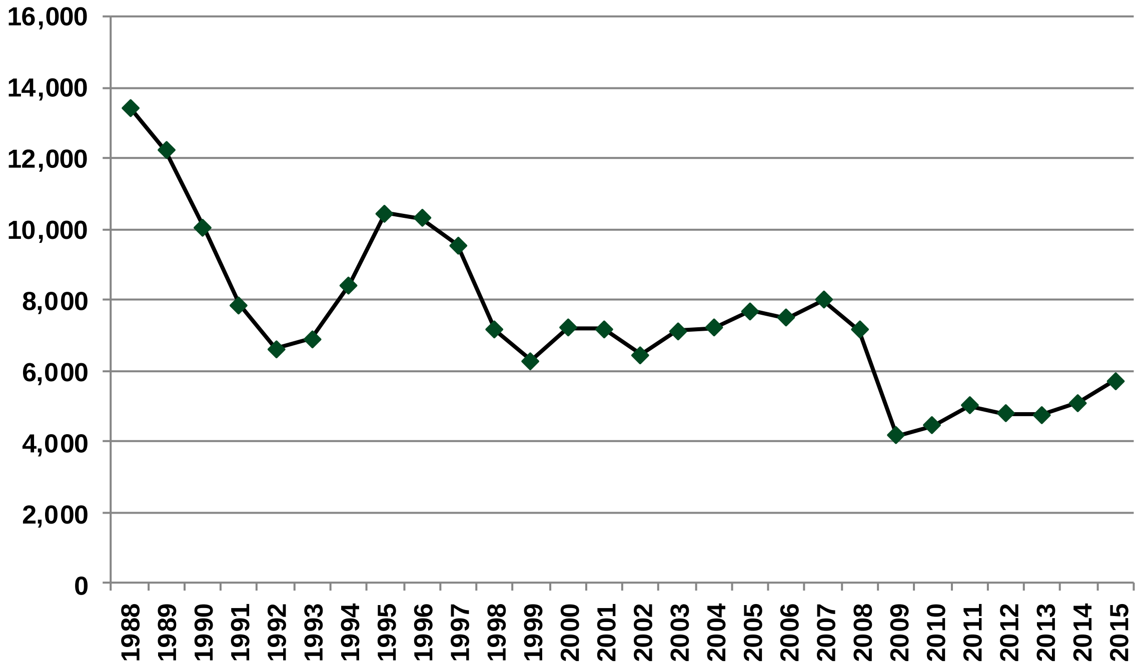


3.8.8. Industrial Processes and Product use

A steady trend towards emission reduction in this sector is observed since 1988. The emissions in 2015 decreased with 57.6% compared to the base year.

In the year 2015, 9.3% of national total greenhouse gas emissions (without LULUCF) originated from industrial processes and product use, compared to 11.5% in the base year 1988. In 2015, greenhouse gas emissions from Industrial Processes and Product use are 5699.26 CO_2 equivalent compared to 13 438.62Gg CO_2 in the base year.

Figure 3.10 GHG emissions from Industrial processes sector for 1988 – 2015, Gg CO2 eq.



In 2015 the most important emitting category is Mineral products (mainly production of clinker and quick lime), which share in the total Industrial processes and product use emissions is 41.86%. The second category by share is Chemical Industry (ammonia and nitric acid production) with 31.41%, followed by Product uses as ODS substitutes with 20.2% share and finally Metal Production (steel) with 3.93%.

Greenhouse gas emissions from the Industrial Processes and product use sector fluctuate during the period and reach a minimum in 2009. The reduction in 2015 for the whole sector is 57.6% while the biggest reduction (compared to the base year) can be seen in Metal Production category – 94.4%.

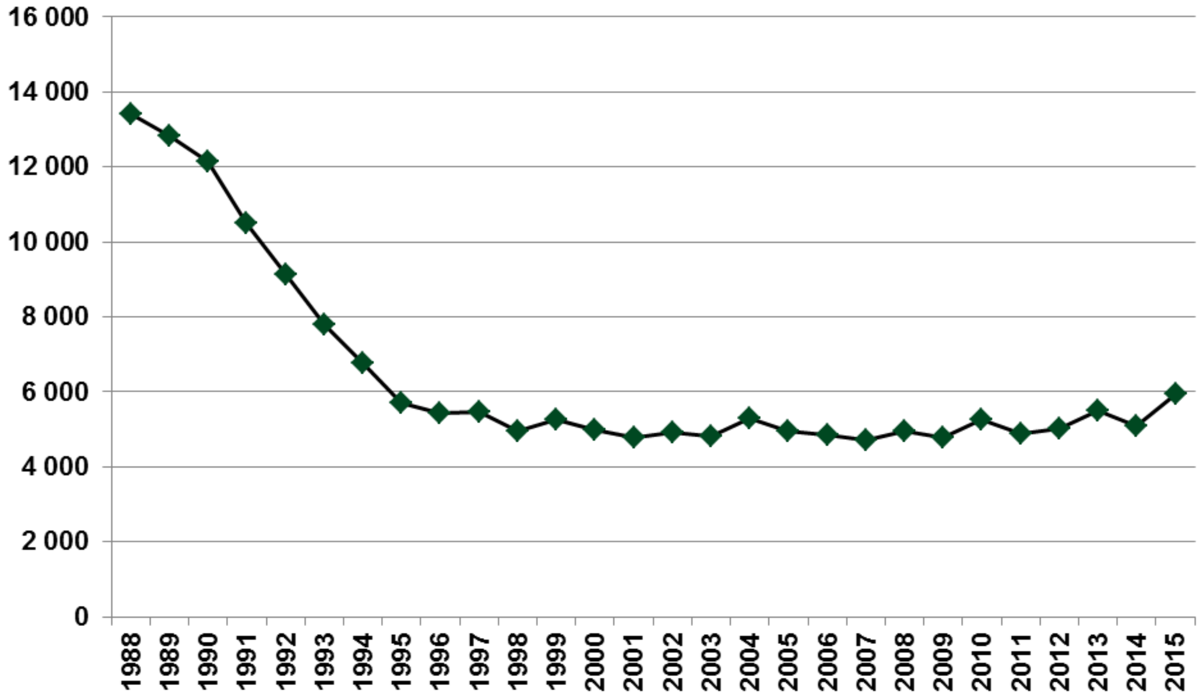
This is mainly due to economic crisis and in particular the world economic crisis in 2009. The periods around 1989/1991 and 1997/1999 represent the economic crisis time after which stabilization and increase in the production rates begins. After 1996 a process of privatization begins which leads to decrease 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.

The general reduction in the emissions in the later years of the time period is influenced also by the starting introduction of better technologies on plant level.

3.8.9. Agriculture

The overall emission reduction in the sector has amounted to 55.73% since 1988. In the year 2015 the sector agriculture contributed 9.7% to the total of Bulgaria's greenhouse gas emissions (without LULUCF).

Figure 3.11 GHG emissions from Agriculture sector for 1988 – 2015, Gg CO2 eq.

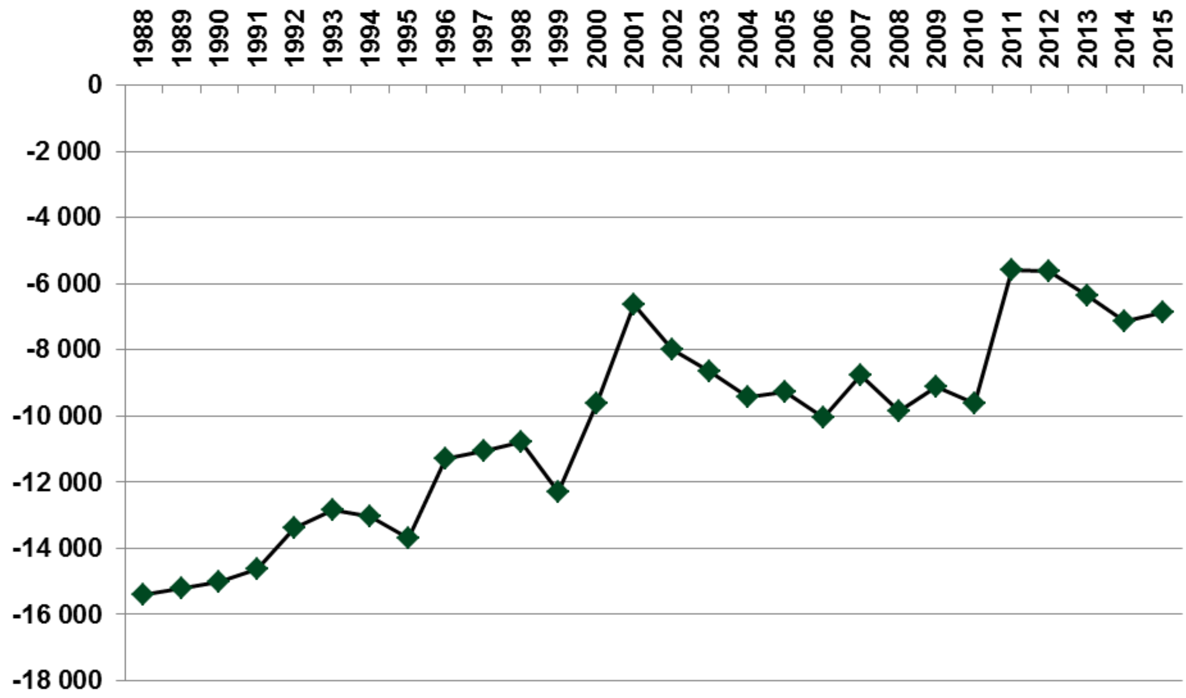


The emission reductions were mainly driven by systematic declines in the agricultural land area due to abandoning of arable lands and reduction in livestock population. Another driver for the emission reduction was the decline in the use of fertilizers.

3.8.10. Land-Use Change and Forestry

The LULUCF sector is serving as a sink of greenhouse gases for Bulgaria. The two categories – "Forest land" and "Grassland" are removals of CO_2. All other categories are sources of CO2 emissions. The trend of net CO_2 removals (CO_2 eq) from LULUCF decreases by 55.43% compared to the base year. The main reason for the overall decrease of the uptakes of CO_2 emissions from LULUCF is due to the fall in removals from category Forest land and the slight increase in emissions from CL, WL and SM categories. The key driver for the fall in removals from FL is the observed decline in the rate of forest growth as the average age of the forest stands increases steadily over the reporting period. In spite of the decrease observed, the share of the removals from the total GHG emissions (in CO_2eq) 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 -15.21% from the total GHG emissions in CO_2-eq, while in the inventoried year the share is -12.54%.

Figure 3.12 LULUCF emissions and removals for 1988 – 2015 CO2 eq.

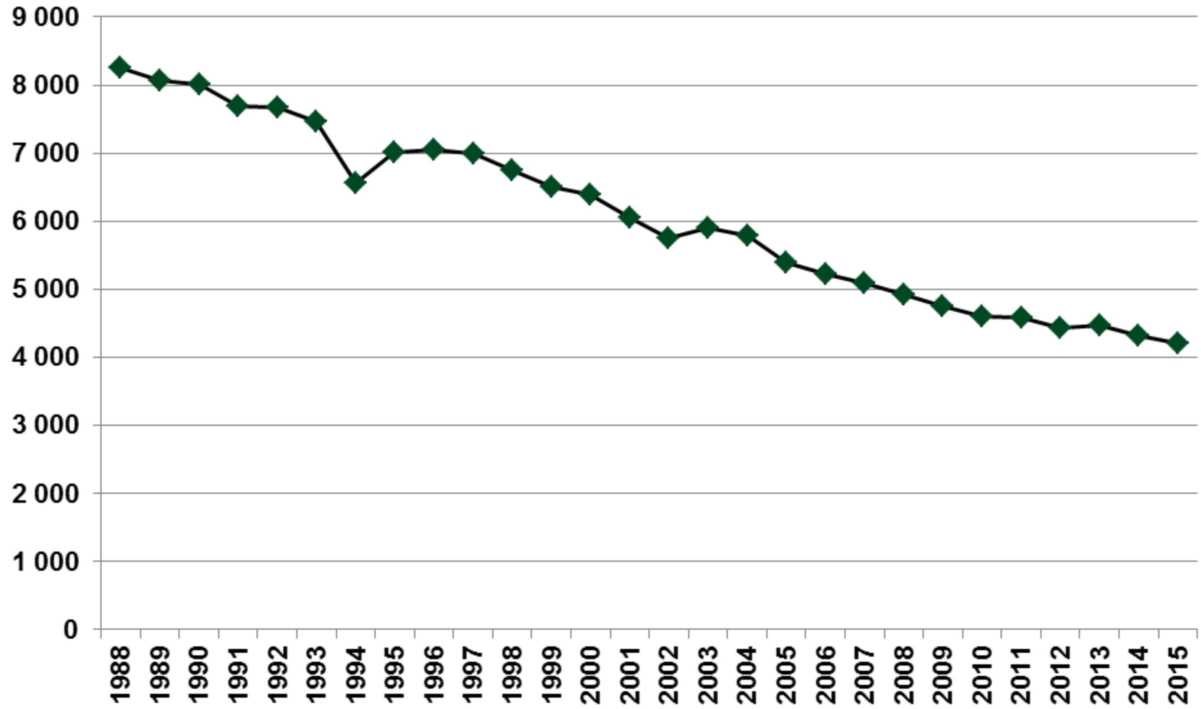


Comparing with the base year an increase in the emissions in croplands, settlements and wetlands is observed. The total emissions from croplands fluctuate during the whole time series. The emissions from Settlements increase last couple of years due to changes from other land uses to Settlements according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

3.8.11. Waste

The total sector emission reduction from the base year is 49.16 %. The decline was mainly driven by a steady population decline over the past 10 years.

Figure 3.13 GHG emissions from Waste sector for 1988 – 2015, Gg CO2 eq.



3.8.12. Indirect greenhouse gases and sulphur oxides

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

- NO_x with 51.5%
- CO with 86.2%
- SO_x with 25.1%
- NMVOC with 56.3%

3.9.Recalculations

The GHG emission recalculations for the period 1988-2014 (emission data 1988-2014) 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.

Recalculation difference between Submission 2016 and submission 2017 is 2 % for 1988 year and 0,11 % for 2014 year.

3.10. 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.

Publicly accessible information

Section E of the annex to decision 15/CMP.1 outlines provisions for the national registry to support, via a user-interface, non-confidential information being made available to the public. Bulgaria has made this information available on the Executive Environment Agency's website:

http://eea.government.bg/

The actual internet address of the Bulgarian registry in the Union registry is:

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

The following information has been made accessible to the public in line with the requirements. This information is non-confidential. Bulgaria considers all information to be confidential that is determined to be confidential according to article 110 of the Commission Regulation (EU) No 389/2013. Accounts' holding's publicly accessible information:

http://eea.government.bg/bg/r-r/r-te/registry/main3

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

http://eea.government.bg/bg/r-r/r-te/registry/main7

http://eea.government.bg/bg/r-r/r-te/registry/main8

http://eea.government.bg/bg/r-r/r-te/registry/main9

http://eea.government.bg/bg/r-r/r-te/registry/main10

Joint implementation (JI) projects' publicly accessible information:

http://eea.government.bg/bg/r-r/r-te/registry/main3

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/bg/guvkavi-pazarni-mehanizmi/

Information according to paragraph 45 - 48 of the annex to decision 13/CMP.1:

(a) Account name: the holder of the account;

(b) Account type: the type of account (holding, cancellation or retirement);

(c) Commitment period: the commitment period with which a cancellation or retirement account is associated;

(d) Representative identifier: the representative of the account holder, using the Party identifier (the two-letter country code defined by ISO 3166) and a number unique to that representative within the Party's registry;

(e) Representative names nominated by the account holder and authorized to work with the account.

The Information includes the following Article 6 project information, for each project identifier if the Party has issued ERUs for a project:

(a) Project name: a unique name for the project;

(b) Project location: the Party and town or region in which the project is located;

(c) Years of ERU issuance: the years in which ERUs have been issued as a result of the Article 6 project;

(d) Reports: downloadable electronic versions of all publicly available documentation relating to the project, including proposals, monitoring, verification and issuance of ERUs, where relevant, subject to the confidentiality provisions in decision 9/CMP.1.

The information includes the following holding and transaction information relevant to the national registry, by serial number, for each calendar year:

(a) The total quantity of ERUs, CERs, AAUs and RMUs in each account at the beginning of the year (displayed in the year X+5, according to the Commission Regulation (EU) No 389/2013 the information is confidential until the year X+5);

(b) The total quantity of AAUs issued on the basis of the assigned amount pursuant to Article 3, paragraphs 7 and 8 (displayed in the year X+1);

(c) The total quantity of ERUs issued on the basis of Article 6 projects (displayed in the year X+1);

(d) The total quantity of ERUs, CERs, AAUs and RMUs acquired from other registries and the identity of the transferring accounts and registries (displayed in the year X+5, according to Commission Regulation (EU) No 389/2013 the information is confidential until the year X+5);

(e) The total quantity of RMUs issued on the basis of each activity under Article 3, paragraphs 3 and 4 (displayed in the year X+1)

(f) The total quantity of ERUs, CERs, AAUs and RMUs transferred to other registries and the identity of the acquiring accounts and registries (displayed in the year X+5, according to Commission regulation (EU) No 389/2013 the information is confidential until the year X+5)

(g) The total quantity of ERUs, CERs, AAUs and RMUs cancelled on the basis of activities under Article 3, paragraphs 3 and 4 (displayed in the year X+1)

(h) The total quantity of ERUs, CERs, AAUs and RMUs cancelled following determination by the Compliance Committee that the Party is not in compliance with its commitment under Article 3, paragraph 1 (displayed in the year X+1)

(i) The total quantity of other ERUs, CERs, AAUs and RMUs cancelled (displayed in the year X+1)

(j) The total quantity of ERUs, CERs, AAUs and RMUs retired (displayed in the year X+1)

(k) The total quantity of ERUs, CERs, and AAUs carried over from the previous commitment period (displayed in the year X+1)

(l) The Information does not include current holdings of ERUs, CERs, AAUs and RMUs in each account because this is confidential according to Commission Regulation (EU) No 389/2013.

Information on changes in National registry

The following changes to the national registry of Bulgaria have therefore occurred in 2016.

Reporting Item	Description
15/CMP.1 annex II.E paragraph 32.(a) Change of name or contact	From 19th September 2016 Mrs. Zornica Ruseva is not a registry administrator. A new registry administrator has been appointed since 30th January 2017: Ms. Polya Hristova e-mail: p.hristova@eea.government.bg Tel.:+359 2 9406416 Fax: +359 2 9559015 Executive Environment Agency Address: 136 Tzar Boris III Blvd., P.O. Box 251 1618 Sofia Bulgaria
15/CMP.1 annex II.E paragraph 32.(b) Change regarding cooperation arrangement	No change of cooperation arrangement occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(c) Change to database structure or the capacity of national registry	New tables were added to the CSEUR database for the implementation of the CP2 SEF functionality. Versions of the CSEUR released after 6.7.3 (the production version at the time of the last Chapter 14 submission) introduced other minor changes in the structure of the database. These changes were limited and only affected EU ETS functionality. No change was required to the database and application backup plan or to the disaster recovery plan. The database model, including the new tables, is provided in Annex A. No change to the capacity of the national registry occurred during the reported period.

Reporting Item	Description
15/CMP.1 annex II.E paragraph 32.(d) Change regarding conformance to technical standards	Changes introduced since version 6.7.3 of the national registry are listed in Annex B. Each release of the registry is subject to both regression testing and tests related to new functionality. These tests also include thorough testing against the DES and were successfully carried out prior to the relevant major release of the version to Production (see Annex B). Annex H testing was completed in January 2017 and the test report will provided at a later date. No other change in the registry's conformance to the technical standards occurred for the reported period.
15/CMP.1 annex II.E paragraph 32.(e) Change to discrepancies procedures	No change of discrepancies procedures occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(f) Change regarding security	The mandatory use of hard tokens for authentication and signature was introduced for registry administrators.
15/CMP.1 annex II.E paragraph 32.(g) Change to list of publicly available information	No change to the list of publicly available information occurred during the reporting period.
15/CMP.1 annex II.E paragraph 32.(h) Change of Internet address	No change of the registry internet address occurred during the reporting period.
15/CMP.1 annex II.E paragraph 32.(i) Change regarding data integrity measures	No change of data integrity measures occurred during the reporting period.
15/CMP.1 annex II.E paragraph 32.(j) Change regarding test results	Changes introduced since version 6.7.3 of the national registry are listed in Annex B. Both regression testing and tests on the new functionality were successfully carried out prior to release of the version to Production. The site acceptance test was carried out by quality assurance consultants on behalf of and assisted by the European Commission; the report is attached as Annex B. Annex H testing was carried out in January 2017 and the test report will be provided at a later date.

4. Policies and measures

4.1. Climate policy framework

After Bulgaria joined the European Union (EU) on 1 January 2007 the context of climate policy in the country changed considerably because apart from the international commitments under the UN Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol (KP) it is now aligned with the existing and newly adopted European legislation in this area. Over the period 2008-2012 the national climate change policy and legislation were harmonized with those of the EU and the National Action Plan on Climate Change (NAPCC) has not been updated during that process. The following steps were undertaken to comply with the commitments taken as a result of Bulgaria's full membership in the EU:

• the provisions of Directive 2003/87/EC establishing a Community greenhouse gas emission allowance trading scheme were introduced;

• steps were undertaken to introduce the newly adopted EU climate related legislation (the legislative package "Climate and Energy"), and the legislation for inclusion of aviation in the Community Emissions Trading Scheme (Directive 2008/101/EC);

• the National System for Greenhouse Gas Inventory was reviewed and revised in 2010 in order to improve reporting according to the UNFCCC guidelines and the requirements of the European legislation;

• a functioning Green Investment Scheme was set up to fund projects leading to reduction of greenhouse gas emissions.

After the adoption of the Bali Action Plan in 2007 the policy on climate change shifted considerably on global scale following the dynamics of international negotiations to reach a new global climate agreement that will cover all major (including the so called "emerging") economies, and an agreement on climate policy management after the first commitment period under the Kyoto Protocol (after 2012). Bulgaria participates as a full member of EU within the framework of international negotiations since 2007, i.e. according to the common, coordinated position of the Union in these negotiations.

4.2. 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, Ministry of Energy , Ministry of Transport, Information Technology and Communications (MTITC), The Energy Efficiency Agency (EEA), The Ministry of Agriculture Food and Forestry (MAFF), 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.

- **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 Ministry of Environment and Water conducts the overall state policy on climate change mitigation, assisted by the National Expert Committee on Climate Change and Coordinating Committee on Climate change as an advisory bodies. For the purpose of application and implementation of the country's commitments under international, European and national legislation on climate change, Directiorate Policy on Climate Change is structured within the Ministry.

- National expert Committee on Climate Change

The implementation of the state policy on climate change and the coordination of the institutions involved in its implementation is also carried out by the National Expert Council on Climate Change with the Minister of Environment and Water, established by Order RD-790 of 14.10.2014. The detailed rules for the coordination and interaction with the institutions, the functions and the organization of work are detailed in the approved Council's Rules of Procedure.

- Coordinating Committee on Climate change

By Order № RD-230 of 04.26.2016 was formed Coordinating Council on Climate Change in order to assist the Minister of Environment and Water in developing a National strategy for adaptation to climate change and other issues related to the implementation of the national climate policy, incl. and coordinating interactions with institutions involved in policy development and implementation.

- **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 and National Report on the State and Protection of the Environment. The ExEA administrates the National GHG Registry.

- **Sustainable Energy Development Agency within Ministry of energy**

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.

4.3. Domestic and regional programmes, legislative arrangements.

4.3.1. 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.).

4.3.2. 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;
- Third National Climate Change Action Plan (2013 – 2020).

- National Programme for Promotion of the Biofuels Use in the Transport Sector 2008-2020;
- Integrated Transport Strategy for the period until 2030
- Strategic Plan for Development of the Forestry Sector in the Republic of Bulgaria 2014-2023
- National Strategy for the Development of the Forestry Sector in the Republic of Bulgaria for the period 2013-2020
- Energy strategy of the Republic of Bulgaria until 2020
- National waste prevention programme (NWPP) 2014 - 2020
- National Waste Management Plan (NWMP) 2014 – 2020
- National Regional Development Strategy

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

– **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.

In order to exploit the possibilities for financing projects to reduce greenhouse gas emissions through the National Green Investment Scheme is a decision of the Council of Ministers № 546/12 September 2013 for addition to the agreement with Austria for the purchase of AAUs in Scheme green investments. It is accepted and a decision of the Council of Ministers № 547/12 September 2013 in connection with the implementation of projects under the Green Investment Scheme.

The funds from the sale of AAUs of the Republic of Austria have implemented projects for energy efficiency of the 77 public facilities state and municipal property in Bulgaria. Public projects to improve energy efficiency in municipal buildings, kindergartens and primary schools. Realized are energy efficiency projects at 13 public sites throughout the country.

In 2015 was started the Investment Climate Programme, which is a kind of continuation of the National Green Investment Scheme. The new programme is implemented by Trust Eco-Fund and it is financed by the revenues from so called "early auctions" of greenhouse gas emissions allowances from installations paid into the budget of the Ministry of Environment and Water by 31st December 2012. The funds are designated to be used for financing of the projects aiming at improving of energy efficiency of state and municipal public buildings, as well as for promoting the use of electric and hybrid vehicles by public institutions (since 2016).

– **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.

- **Integrated Transport Strategy for the period until 2030**

The Integrated Transport Strategy for the period until 2030 was adopted by the Council of Ministers of the Republic of Bulgaria with Decision No 336/23 June 2017. The strategic document is in compliance with the requirements of the Ex-Ante Conditionality’s 7.1, 7.2 and 7.3 (Transport) of the European Structural and Investment Funds.

The Strategy is in accordance with the Partnership Agreement of the Republic of Bulgaria.

The Integrated Transport Strategy for the period until 2030 was adopted by the Council of Ministers of the Republic of Bulgaria on 21 June 2017.

The strategic objectives of the transport policy for the period until 2030 are:

- Increasing the effectiveness and competitiveness of the transport sector
- Improvement of the transport connectivity and access (internal and external)
- Limiting the negative effects of the transport sector development.

The strategic priorities of the transport sector are as follows:

- Effective maintenance, modernization and development of transport infrastructure
- Improvement of the management of the transport system

Development of intermodal transport

- Improvement of the conditions for implementation of the principles for liberalization of the transport market
- Reduction of the consumption of fuel and increasing the energy efficiency of transport
- Improvement of the connectivity of the Bulgarian transport system with the Single European transport space
- Ensuring quality and easily accessible transport in all regions of the country
- Limiting the negative effects of transport on environment and people's health
- Increasing security and safety of the transport system.

As a part of the Strategy a National Transport Model is prepared. The model covers freight and passenger traffic as well as all modes of transport. On the basis of the model different scenarios for the transport sector development are elaborated.

For the purposes of the investment programming some projects are identified and their realization will contribute to the sustainable development of the transport sector in medium and long-term period.

- **National Strategy for the Development of the Forestry Sector in the Republic of Bulgaria for the period 2013-2020**

The Strategy is main document that defines the strategic framework of the state policy for achieving long-term and sustainable management of vital and productive multifunctional forests and growing competitiveness of the forestry sector as a basis for a better standard of living, especially in mountain and rural areas. A prerequisite for the sustainable development of the forest territories is the three levels of forest planning - national, regional and local, as defined in the Forestry Act, reflected respectively in the National Strategy for the Development of the Forestry Sector, the Strategic Plan for the Development of the Forestry Sector, territories and forestry plans and programs.

- **Strategic Plan for Development of the Forestry Sector in the Republic of Bulgaria 2014-2023**

This plan is developed with the financial support of the European Social Fund under Operational Program Administrative Capacity's project "Strategic Planning in the Bulgarian Forests – a Guarantor for Effective Management and Sustainable Development". These strategic documents can be found on the website of the Executive Forest Agency (EFA): http://iag.bg/docs/lang/1/cat/5/index.

The implementation of the Operational objectives with the corresponding budget, timeline, expected results, performance indicators, responsible institutions and stakeholders is regulated in specific sub-activities in SDPFS as follows:

Operational objective 1 from SDPFS "Increasing of the forest area, tree growing stock and the stock of carbon in forest areas"

Operational objective 2 from SDPFS "Improving the management and use of forests"

Operational objective 3 from SDPFS "Increasing the effectiveness of preventing and combating forest fires and illegal activities in the forests"

Operational objective 4 from SDPFS "Increasing the resilience and adaptability of forest ecosystems to climate change"

The above mentioned operational objectives and activities are expected to have a direct and sometimes indirect positive effect on both the adaptation of forest ecosystems to climate change, as well as on the reduction of the negative impact of climate change, including by increasing the absorption of greenhouse gases from the atmosphere.

The aforementioned "Programme of Measures for the Adaptation of Forests in the Republic of Bulgaria and Mitigation of the Negative Impact of Climate Change on them" is approved in 2011 by the Minister of Agriculture and Food under the proposal of the Executive Director of EFA. In the Program are identified and designated concrete measures (the Program is published on the EFA website at http://www.iag.bg/docs/lang/1/cat/5/index).

As regards the management of pastures, grasslands and meadows from the State and Municipal Land Funds (SLF and MLF), given that these are lands with special status, whose main purpose is their use for livestock grazing and mowing, to this moment is prepared an Amending Act of the Ownership and Use of Agricultural Land Act, introducing a simplified regime for the use of these lands as intended. The draft legislative act provides for rental and lease of pastures, grasslands and meadows of SLF and MLF to be done without a tender procedure, as they will be allocated only to the owners or users of holdings with grazing livestock registered in the System for animal identification and registration of holdings under Bulgarian Food Safety Agency, according to the number and type of registered animals at market price determined by an independent appraiser in accordance with the conditions for maintaining the land in good agricultural and environmental condition. Pastures, grasslands and meadows of SLF and MLF remaining free after allocation of their registered owners of grazing animals will be auctioned, and to persons who undertake responsibility to maintain them in good agricultural and environmental condition. Rental contracts and leases concluded in this way can be terminated before the expiry of their term, if there is non-compliance with the conditions for maintaining the land in good agricultural and environmental condition defined pursuant to Art.42 of the Farmers Support Act. It should be noted that the purpose of sustainable and strict management of the landed estates of the SLF, which fall within the ecological network of special areas of conservation, called "Natura 2000", representing a way of permanent usage - "pastures", "pastures, grasslands", "pastures with shrubs", "meadows" or "fields" - private state property, for which Ministry of Environment and Water has issued orders to comply with specific restrictions and the exact borders. They are brought to the attention of MAF for their reflection in the sketches of the landed estates. They are available for use in strict compliance with the restrictions, which are monitored in the checks.

On pastures of municipal land, the existing provisions of the Ownership and Use of Agricultural Land Act is stipulated that the decision of the municipal council, annually lays down rules for the use of grasslands and pastures that contain:

- Operational perspective plan for grazing;
- Parts of grasslands and pastures, mainly for mowing;
- Measures for the protection, maintenance and improvement of grasslands and pastures, such as cleaning of bushes and other unwanted vegetation, anti-erosion activities, fertilization, temporary fencing;
- Parts of grasslands and pastures for artificial pasture for planting with appropriate grass mixtures;
- Mode of use, prohibitions and restrictions depending on the specific features of the landscape, soil, climate and other natural conditions.

According to the provision of Art.25 of the Ownership and Use of Agricultural Land Act is determined that the ownership of the municipalities on pastures and grasslands is public and only exceptionally allowed to be declared as private municipal property, in case of the change of use of grasslands and pastures under the Municipal Property Act, in cases defined in Paragraph 3 (points from 1 to 5) of the above-mentioned article, as follows:

- for construction of technical infrastructure under the Spatial Planning Act;
- for investment projects received a certificate for investment class A or class B or priority investment project under the Investment Promotion Act when it stated in the certification of the project;
- for creating of new or expand existing construction boundaries of urbanized areas (settlements and settlement formations), as well as creating or expanding the boundaries of individual regulated landed estates outside them;
- for investment projects related to socio-economic development of the municipality;
- other cases determined by law.

In the above-listed cases, the municipal council adopts a decision expressing prior consent to change the use of pastures and grasslands, subject to the terms and conditions regulated by special laws (Protection of Agricultural Land Act) and regulations to maintain a reserve of permanent grasslands, and provided that there is no shortage of land for the needs of livestock.

As regards to the arable lands, pursuant to Art. 7 of the Ownership and Use of Agricultural Land Act, is regulated that the eroded, polluted, salty, acid and waterlogged agricultural lands are recovered and improved on the basis of a set of activities or technologies that operate on the basis of pre-designed, coordinated and approved technologies and projects approved by the Expert Council.

Mines, quarries and other areas with disturbed soil profile, ash ponds, tailings, landfills and other waste depots, old riverbeds, routes of abandoned canals, roads, railways and construction sites after dismantling of engineering equipment, finishes and superstructure are subject to reclamation, which is based on pre-established, coherent and approved the project, which is an integral part of the project for construction of the site. The procedure for using humus after its withdrawal, reclamation, land improvement and the adoption of reclaimed areas is defined in Regulation № 26 for land reclamation, improvement of low-productive lands, withdrawing and utilization of the humus layer.

One of the main strategic documents containing measures for the Land Use, Land-Use Change and Forestry sector, is the Third National Action Plan on Climate Change (NAPCC) (http://www.moew.government.bg/?show=top&cid=570)

- **National Waste Management Plan (NWMP) 2014 – 2020**

The National Waste Management Plan (NWMP) plays a key role in achieving a resource efficient and sustainable waste management, as the analysis of the current situation shows that in Bulgaria there is significant potential to improve waste prevention and its management, better use of resources, development of new markets and new jobs, as at the same time reduce the harmful effects of waste on the environment

NWMP is based on the following principles:

- Prevention "- waste should be reduced and avoided where it is possible.
- "Extended producer responsibility" and "polluter pays" - those who produce or contribute to waste generation or pollute the environment or current waste holders must cover the full costs for waste treatment and should manage them in a way that ensures high level of protection of the environment and human healthcare.
- “Precaution” - potential waste problems should be foreseen and avoided at the earliest possible stage.
- “Self-sufficiency and proximity” – waste should be disposed as near as possible to the place of their generation as waste generated in the EU should be treated within the union.
- „Public participation“ – relevant stakeholders and authorities as the general public have the opportunity to participate in the development of waste management plans and waste prevention programs and have access to them after their development.

- **National waste prevention programme (NWPP) 2014 - 2020**

Bulgaria has developed a National waste prevention programme (NWPP) in accordance with the requirements of the WFD and Article 50 of the Waste Management Act for the first time. NWPP is an integral part of NWMP and identifies measures for implementation of the highest level in the waste management hierarchy. The fourth NWMP is the transition from waste management to the efficient use of waste as resources and sustainable development by prevention of their generation, as far as possible. Successful implementation of the plan will lead to the prevention and reduction of the harmful effects of waste on the environment and human health and reduce the use of primary natural resources. The plan supports the central and local authorities to concentrate limited financial resources from national and EU sources on priority projects in the field of waste management.

- **Waste Management Programmes (WMP)**

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.

– **National Regional Development Strategy**

National Regional Development Strategy (NRDS) for the period 2012 – 2022 is developed in accordance with the legislative regulations of the Regional Development Act. NRDS is the main document that defines the strategic framework of the government policy for achieving balanced and sustainable development of the regions in the country and for overcoming the intra-regional and inter-regional differences/ disparities in the context of pan-European cohesion policy, and achieving smart, sustainable and inclusive growth.

NRDS plays an important role for achieving compliance and mutual complement between the objectives and the priorities of the regional development policy and the sectoral policies and strategies that promote balanced development of the regions.

The designated in the NRDS period, from 2012 to 2022, is a period, in which major changes are supposed to take place in global and in European scale, it is a period of the emergence of new tests and challenges to the European Community and the European countries in coherence with the overcoming the effects of the debt financial crisis and the on-going successful implementation of the cohesion policy and preservation of national and regional identity in the development process. The biggest challenges, facing Europe and the European countries, are: the globalization, the negative demographic trends, the climate changes and the energy dependence. The European policy in this period will be adjusted so as to help the regions to be prepared to face these challenges and trials and each of the regions to find individual solutions to cope with the difficulties it is faced. In response to the requirements of the strategy "Europe 2020", "National Development Programme: BULGARIA 2020" is developed as a long-term framework document, defining the vision and the overall objectives of the development policies for a period of 10 years for all sectors of the government, including their territorial manifestations.

4.3.13. **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:

- *Climate change mitigation act (SG 22/2014, last amended SG 85/2017)*

In pursuance of its international commitments and in order to synchronise Bulgarian legislation with the European law, the Climate Change Mitigation Act outlines the overall policy to be followed in order to mitigate climate change and its impacts and fulfil international obligations within the UNFCCC and Kyoto Protocol, as well as the EU legal framework.

The Act integrates the already existing climate change mitigation related articles of the Environmental Protection Act, namely provisions on:

- the National Environmental Monitoring System (including the National GHG Inventory System), directed by the Minister of Environment and Water through the Executive Environment Agency, originally established by the EPA and related regulation
- the Greenhouse Gas Emissions Allowances Trading Scheme, for which the Minister of Environment and Water (acting jointly with other ministers) elaborates a National Allocation Plan every five years
- the National Trust Eco Fund, established in 1995 after signing a swap deal ‘Debt for Nature’ with Switzerland and assigned in 2010 with responsibility for managing the funds received by Bulgaria within the Green Investment Scheme and other programmes
- The Act further regulates instruments available under the Kyoto Protocol (Joint Implementation, CDM), administration of the national GHG trading register, and reduction of GHG emissions from fuels used for transport and energy and the voluntary emissions reduction scheme.
- The Act also reaffirms the National Action Plan on Climate Change as the “instrument which determines the framework of state policy in the field of climate change for each separate period of action under the policies of the European Union and international treaties to which Bulgaria is a party”. The most recent (Third) National Action Plan (replacing the second one published in 2004) was adopted in 2012. It provides for transition to a low carbon and resource efficient economy and includes measures to achieve the target of over 18.5% GHG emissions reduction by 2020 compared to the 2005 levels and 20% share of renewables in energy production by 2020.
- The Act further establishes the National Expert Council on Climate Change as an advisory body to the Minister of Environment and Water. The Council includes representatives of the relevant Ministries, the State Agency for National Security, the Executive Environment Agency, Bulgarian Academy of Sciences, the National Association of Municipalities and non-profit organisations, whose activity is directly related to climate change mitigation”.
- The Act also mandates the Minister of Environment and Water and other competent ministers to draft, after consultation with the National Council of Experts on Climate Change, a national strategy on climate change adaptation. The adaptation strategy is to be prepared for not less than 20 years, with the exception of the first strategy to be drawn up for the period up to 2030 inclusive, and should be adopted by the Council of Ministers.

The Act sets the target of minimum 6% reduction of the lifecycle GHG emissions of liquid fuels and energy for transport per unit of energy by 31 December 2020 compared to the 2010 fuel standards. It provides for every supplier of liquid fuels and energy to the transport sector to submit to the MOEW by 31 March each year a verified report on the GHG intensity of products delivered the previous year.

- **Environmental Protection Act (EPA) (SG 91/2002, last amended SG 96/2017)**

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 55/2017;
- Ordinance on the conditions and the procedure for carrying out environmental assessment of plans and programmes – SG57/2004, last amended by SG 12/2016.

– **Energy Act (EA) SG 107/2003, last amended SG 58/2017)**

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 Energy and Water Regulatory Commission (EWRC) – 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.

- **Energy from Renewable Sources Act (ERSA) (SG 35/2011, last amended SG 58/2017)**

The Energy from renewable sources 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 Energy from renewable sources (NAPERS); 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 Energy from renewable sources 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.

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

Bylaws issued on the basis of ERSA 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 42/2015;
- 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 42/2015.

- **Energy Efficiency Act (EEA) (SG 35/2015, last amended SG 105/2016)**

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 (as of 12 March 2013 the threshold is reduced to 500 m^2) and owners of industrial systems with annual energy consumption over 3000 MWh.

The operated buildings with a total floor area over 500 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 SG19/2016;
- 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 42/2015;
- Ordinance № 7 of 2004 on energy efficiency, heat and energy savings in buildings – SG 5/2005, last amended SG 31/2015;
- 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 35/2013;
- 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 - has been repealed.;
- 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 - has been repealed;
- 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-16-301) – SG 27/2014
- 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 101/2013;
- Ordinance on indicators for energy consumption and energy performance of buildings (№ RD-16-1058) – SG 10/2016;

- Statutes of the Sustainable Energy Development Agency - SG 88/2011.The EEA transposes the requirements of Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/86/EEC and Directive 2010/31/EU of the European Parliament and the Council of 19 May 2010 on the energy performance of buildings (OJ, L 153/13 of 18 June 2010).

- **Clean Ambient Air Act (CAAA) (SG 45/1996, last amended SG 85/2017)**

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.

In June 2014 a new EU Regulation (№ 517/2014) on fluorinated greenhouse gases, repealing Regulation № 842/2006, came into force and applies from 1 January 2015. New F-gas Regulation 517/2014/EU, which repeals 2006/842/EC, is currently included in amendment of Clean Ambient Air Act (2015).

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 88/2014;

- 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 61/2017;
- Ordinance establishing measures for implementing Regulation (EC) № 842/2006 on certain fluorinated greenhouse gases - SG 3/2009, last amended SG 7/2011 - has been repealed.

- **Forestry Act (FA) (SG 19/2011, last amended SG 58/2017)**

The Forestry Act and the related regulations, which are the main normative basis governing the public relations related to the conservation, management and use of the forest territories in the Republic of Bulgaria. The objectives of the Act are geared towards ensuring multifunctional and sustainable management of forest ecosystems and include:

• Conservation and increase of forest area;

• maintenance and improvement of forests;

• ensuring and maintaining the ecosystem, social and economic functions of forest areas;

• ensuring and increasing the production of timber and non-timber forest products through environmentally friendly forest management;

• maintaining the biological and landscape diversity and improving the status of the populations of the wild flora, fauna and fauna species;

• providing recreational opportunities for the population and improving the conditions for recreation;

• striking a balance between the interests of the community and forest owners;

• Assisting and encouraging landowners in forest areas;

• Implementation of international and European commitments for the conservation of forest habitats.

- **Local Government and Local Administration Act (LGLAA) (SG 77/1991, last amended SG 9/2017)**

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 96/2017)**

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 96/2017)**

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 58/2017)***

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 105/2016)**

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 - has been repealed.;
- Ordinance № 4 of 16 April 2013 on the conditions and requirements for construction and operation of waste incineration and co-incineration plants – SG 36/2013
- 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 - has been repealed.
- Ordinance № 6 on the conditions and requirements for construction and operation of landfills and other facilities and installations for waste recovery and disposal – SG 80/2013, last amended SG 13/2017;
- Ordinance on packaging and packaging waste – SG 19/2004, last amended SG 29/2011 - has been repealed.;
- Ordinance on packaging and packaging waste – SG 85/2012, last amended SG 30/2016
- 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 100/2013.

- **Statistics Act (SA) (SG 57/1999, last amended SG 15/2013)**

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, **last amended SG 14/2015**)

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 of the Council of 23 April 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 into the Bulgarian legislation.

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".

4.4.Policies and measures and their effects

The information and the analysis of the provided national measures for the period until 2016 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.

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

- Regulation in 2014 have been approved to further clarify the EU ETS process:Regulation on the order and methods of administration of the National registry for trading with greenhouse gas emissions was approved by DCM 266/29.08.2014
- 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 was approved by DCM 265/29.08.2014
- Regulation on the conditions, order and way of preparation of reports and for verification of the reports of the installation and aircraft operators;

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. – has been replaced.

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 – has been replaced.

- 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; - has been replaced.
- 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 – has been replaced.

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.

4.4.15. Energy sector

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.

Emissions from the energy sector are the main source of GHGs in Bulgaria: in 2015 the sector is responsible for 74.2% of national total GHG emissions (45 646 Gg CO2e from sector 1A of the total 61 483 Gg CO2e excl. LULUCF).

4.4.15.1. 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	2010	2012	2014	2015
Total emission, mln.t CO_2 eq., including:	59,4	63,7	60,3	60,5	57,5	61,5
Energy Sector (production of electric and thermal energy)	24,1	27,1	31,6	31,6	29,0	30,3
Share of the Energy Sector, %	40,5	42,5	52,4	52,2	50,4	49,2

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.

4.4.15.2. Priority axes for development of the sector

The priority axes result from the current energy policy according the Energy Strategy of Bulgaria 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.

4.4.15.3. 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

	2014	2016	2018	2020
Cummulative emission reduction k tCO2/year	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 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 CO_2 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 CO2 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

<u>Measure 4: Increasing the capacity for generation of pumped-storage hydroelectricity</u>

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

<u>Priority axis 3</u>: MODERNIZED DEVELOPMENT OF THE DISTRICT HEATING SYSTEM

Measures with direct impact on the reduction of GHG emissions

<u>Measure 1:Increasing the share of heating and cooling based on renewable energy sources</u>

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 CO_2 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

Measure 1:Rehabilitation of existing and building of new low-carbon district heating networks

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.

Priority axis 4: 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

<u>Measure 1:Energy efficiency in the transportation of energy and introduction of “smart” energy storage networks and facilities</u>

Instruments:

Regulatory incentives for energy network operators

Indicator of implementation

% of energy loss reduction

Expected results:

30% fewer losses in energy transportation

4.4.16. Energy efficiency and RES – Household and Services Sector

4.4.16.1. General information on the Households and Services Sector

Economic environment

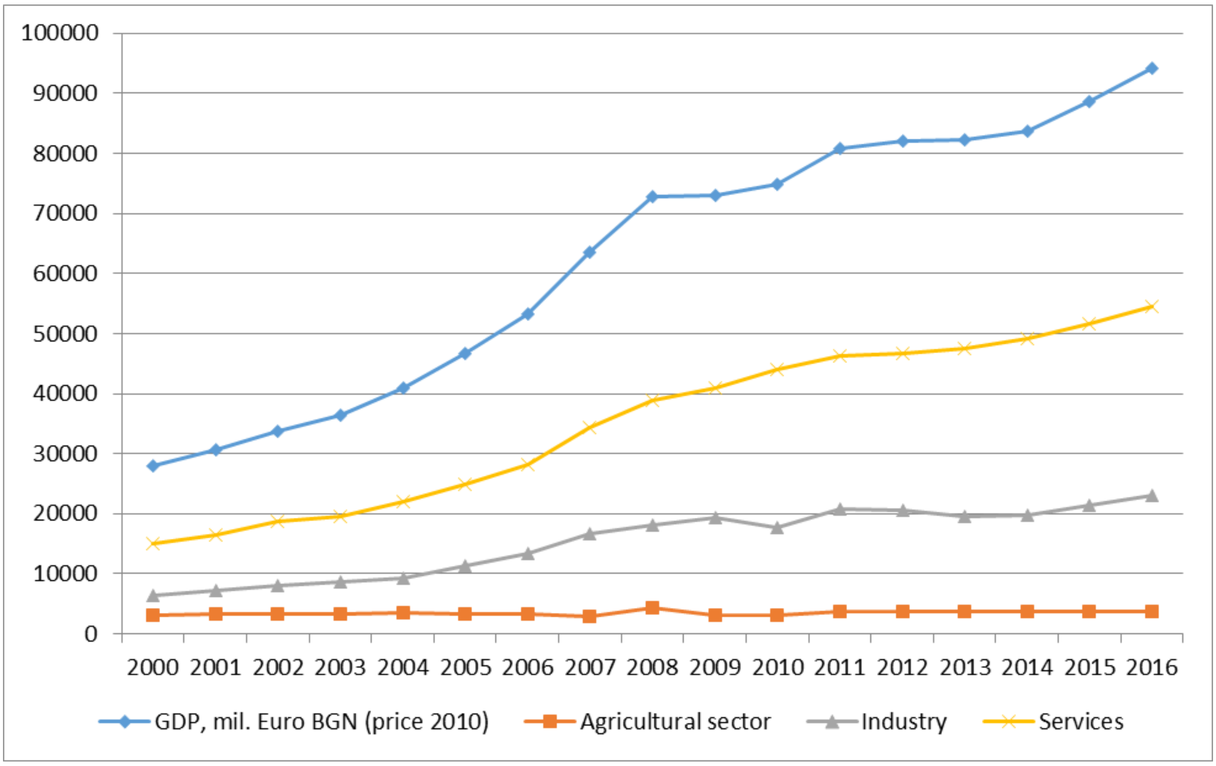
In the period 2000-2015 the Bulgarian economy shows a constant average annual growth rate of 67%, with GDP rising from € 14,3 bln. in 2000 to € 44,3 bln. in 2015 at constant prices of 2010.

Table 4.5 Trend of the GDP for the period 2000-2016

Year	GDP, mil. Euro BGN (price 2010)	Agricultural sector	Industry	Services
2000	27928	3082	6333	15097
2001	30751	3277	7310	16466
2002	33806	3300	8073	18704
2003	36357	3311	8757	19596
2004	40886	3457	9369	22117
2005	46651	3399	11278	24984
2006	53219	3255	13426	28179
2007	63464	2949	16590	34315
2008	72756	4276	18131	38787

2009	72986	3093	19257	41009
2010	74771	3110	17802	44110
2011	80759	3711	20686	46228
2012	82040	3741	20510	46738
2013	82166	3776	19519	47476
2014	83634	3819	19705	49086
2015	88571	3664	21335	51547
2016	94130	3817	22993	54408

Figure 4.1 Basic indicators of economic development (mln. BGN)



Source: NSI

The next table present the structure in % of GVA by economic sectors.

Table 4.6 Structure of Gross Value Added by Economic Sector,%

Year	GVA total	Agricultural sector	Industry	Services
2000	100	12,6	25,8	61,6
2001	100	12,1	27,0	60,9
2002	100	11,0	26,8	62,2
2003	100	10,4	27,7	61,9
2004	100	9,9	26,8	63,3
2005	100	8,6	28,4	63,0
2006	100	7,3	29,9	62,8
2007	100	5,5	30,8	63,7
2008	100	7,0	29,6	63,4
2009	100	4,9	30,4	64,7
2010	100	4,8	27,4	67,8
2011	100	5,2	29,3	65,5
2012	100	5,3	28,9	65,8
2013	100	5,3	27,6	67,1
2014	100	5,3	27,1	67,6
2015	100	4,8	27,9	67,3
2016	100	4,7	28,3	67,0

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 4.7.

Table 4.7 Primary energy consumption (PEC) ktoe

Year	Primary energy consumption, ktoe
2001	18666
2002	18601

2003	18864
2004	18261
2005	19273
2006	19945
2007	19349
2008	18913
2009	16865
2010	17367
2011	18604
2012	17839
2013	16492
2014	17243
2015	17931

Sourse: NSI

Production of primary energy by fuel type is presented in **Error! Reference source not found.** and **Error! Reference source not found.**

Table 4.8. Primary energy production by fuel type 2001-2015, *1000 toe.*

	2001	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Coal	4497	4177	4307	4773	4814	4560	4927	6206	5606	4781	5105	5381
Crude oil	34	30	28	26	25	24	23	22	24	28	27	26
Natural gas	18	384	375	236	155	14	59	351	308	234	159	84
Nuclear energy	5277	4851	5162	3728	3977	3878	3849	4105	4020	3666	4046	3911
El. energy from RES	532	1097	1139	975	995	1077	1326	1232	1360	1509	1573	1657
Total	**10507**	**10539**	**11011**	**9738**	**9966**	**9553**	**10184**	**11916**	**11318**	**10218**	**10910**	**11509**

Sourse: NSI, MEE

Figure 4.2 Primary energy consumption by fuel type 2001-2015. Source: NSI, *MEE*

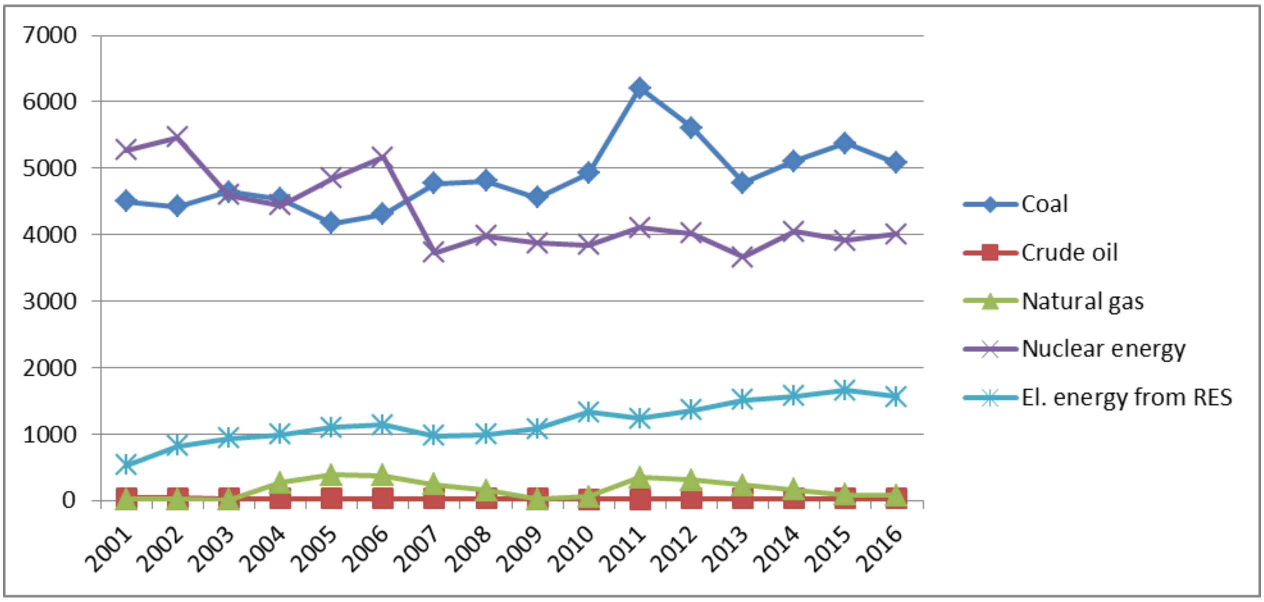


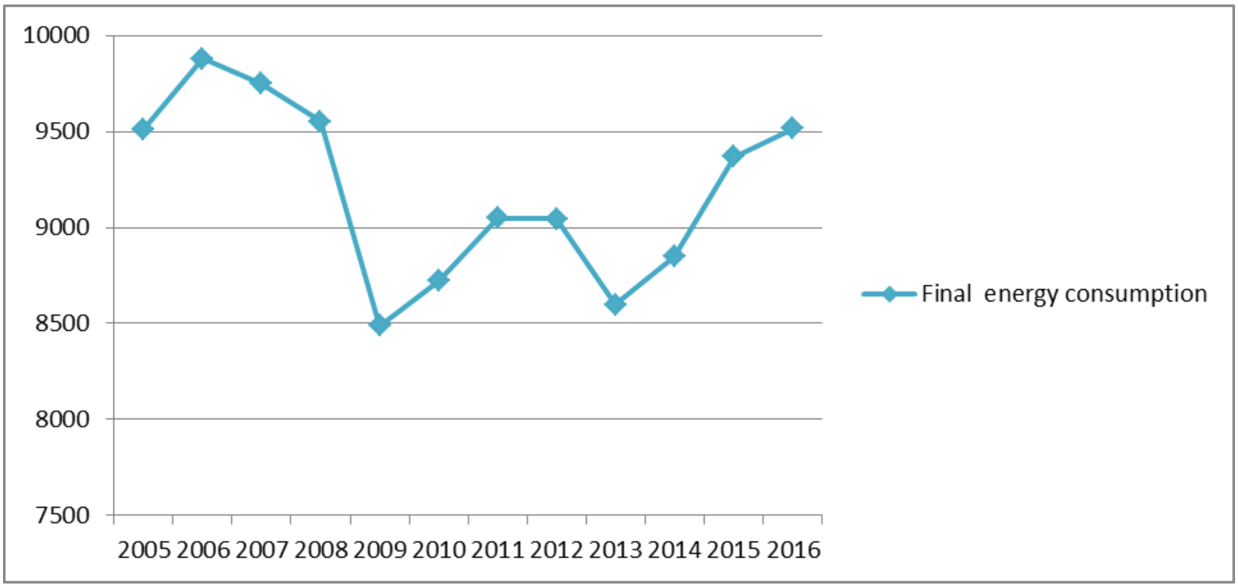
Table 4.9 Final energy consumption 2005-2015г. ktoe

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Final energy consumption	9512	9880	9748	9552	8487	8720	9050	9044	8597	8847	9367

Source: NSI, MEE

For the period 2005 - 2016 the final energy consumption declined in the period of economic crisis, after that period a constant value maintained about 9,500 mtoe

Figure 4.3 Finalenergy consumption 2001-2012г. ktoe



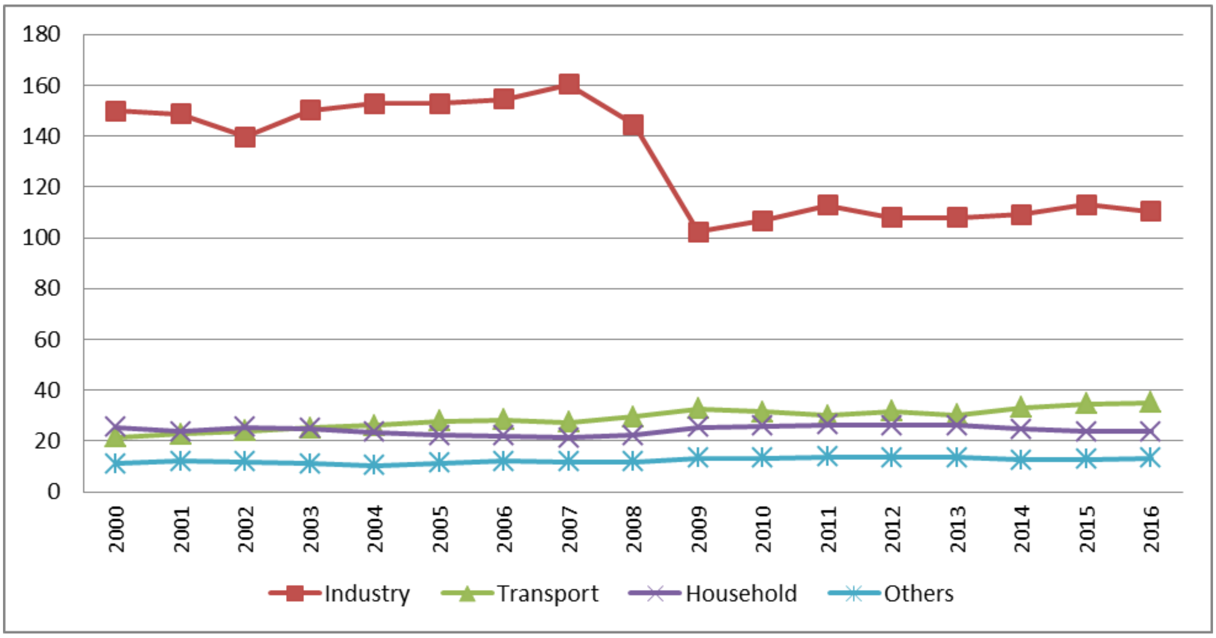
Changes in final energy consumption in Bulgaria by economic sectors over the period 2001-2016 is shown in **Error! Reference source not found.**.

Table 4.10 Final energy consumption by sectors, PJ

Year	Final energy consumption, PJ	Industry	Transport	Household	Others
1997	426,635	228,097	15,8489	21,9136	8,77331
1998	411,814	187,569	20,1403	25,0915	9,22123
1999	373,295	153,195	22,7568	25,2019	11,0027
2000	358,558	149,846	21,4736	25,5605	11,1747
2001	358,976	148,757	22,7199	23,7112	12,1297
2002	360,107	139,672	23,8926	25,497	11,8242
2003	387,153	150,055	25,0784	24,9162	11,2469
2004	383,092	152,734	26,1858	23,4536	10,4918
2005	398,248	152,86	27,7754	22,3612	11,4802
2006	413,656	154,451	28,3502	22,0951	12,2166
2007	408,129	160,396	27,4723	21,2659	11,9614
2008	399,923	144,486	29,6482	22,2466	11,9765
2009	355,334	102,284	32,6617	25,3211	13,232
2010	365,089	106,722	31,3991	25,9404	13,4289
2011	378,905	112,751	30,0773	26,4199	13,7459
2012	378,654	107,852	31,7448	26,2826	13,4896
2013	359,939	107,852	30,2896	26,2533	13,4931
2014	370,406	109,192	33,1977	24,6863	12,6371
2015	392,178	113,085	34,7497	23,6255	12,7896

Sourse: NSI,

Figure 4.4 Final energy consumption by sectors 2001- 2016



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 slow increased until 2008 and was maintained at the same levels until 2012.

The trend in the energy consumption for the “Households” sector is similar.

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

Despite the slight increase, the consumption in sector “Household” has a relative share in the final energy consumption – around 200 %.

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 2004-2015.

Table 4.11 Final Energy Intensity

Year	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Toe per 1000 euro GDP (2010 = 100)	0,633	0,625	0,604	0,546	0,509	0,462	0,465	0,490	0,470	0.431	0.446	0.449

In the last two years the end-use energy intensity small increased from 0.446 toe/1000 EURO in 20141 to 0.449toe/1000 EURO in 2015.

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 by more than 23%.

BENCHMARK INDICATORS	2005	BASELINE SCENARIO 2020	TARGET SCENARIO 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[6]. 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).

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

SNAPEE[7] 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 CO2[8] (by 2020).

Table 4.12 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

4.4.16.2. Measures in the Household and Services sector

Priority axis 1: PROACTIVE NATIONAL POLICY TO STIMULATE THE EFFICIENT USE OF ENERGY RESOURCES AND THE COST EFFECTIVE DEVELOPMENT OF RES

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

[8] 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.

Measures with direct impact on the reduction of GHG emissions

Measure 1: implementation of the measures in the programme for accelerated gasification (pag) of republic of Bulgaria

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 1983.4ktCO2.9 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 4952.8ktCO210.

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 resources11;introduction and promotion of flexible financial plans – contracts for sale of energy; incentives for combined and integrated solutions to reduce the energy consumption.

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9 The value is determined on the basis of emission factor 0.055ktCO2eq/TJ

10 Determined on the basis of eliminated emissions from electric energy.

11 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 .

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 CO_2 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 CO_2 eq by 2020

Target value by year	**2014**	**2016**	**2018**	**2020**
GWh	144.3	144.3	216.5	216.5

Type of instrument:

Introduction of institutional and fiscal incentives. Creating a competitive environment for the used energy resources[12]. 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

[12] 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.

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 dwellings13 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:

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.

<u>Measure 2: introduction of mandatory energy efficiency scheme (reduction of fuel and energy consumption in the final energy consumption)</u>

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).

[13] According to the definitions and the methodology of NSI.

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: 40.5ktCO_2eq. (by 2016); 41.4 ktCO_2eq. (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 CO_2 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

<u>Measure 3: developing a national plan to increase the number of nearly zero energy buildings</u>

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 CO2 eq by 2020

Target value by year	**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

Measure 1: development and phased implementation of national programme "1000 sunny roofs"

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	**2016**	**2018**	**2020**
Installations	200	400	400

4.4.17. **Industry Sector**

Development of the sector in the period 2000-2016

- Reduction of the energy intensity of industry over 2 times (a key indicator of energy efficiency);
- 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 is 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.**

4.4.17.1. 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	**2016**	**2018**	**2020**
t CO2 eq	1 260 000	280 000	238 000

Instrument:

Legislative - Energy Efficiency Act

<u>Priority axis 2</u>: USE OF ALTERNATIVE FUELS

<u>Measure 1: use of biomass in the combustion units of installations</u>

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

4.4.18. Waste Sector

4.4.18.1. 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.

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.

GHG emissions in the Waste sector are generated as a result of the collection, storage and treatment of solid household and public waste and after treatment of household and industrial wastewater.

Solid waste can be handled by landfilling, recycling, incineration with the aim of destroying or obtaining energy. In this sector, GHG emissions are determined only by solid waste disposal processes.

The deposited solid waste is released by CH4 as a result of the processes of anaerobic and aerobic degradation of their content. In the 2015 inventory, methane emissions from this source are the first - 75%.

The second major source of CH4 in this sector is the treatment of waste water in treatment facilities (20%), treating separately the treatment of industrial waste water and the treatment of household and public wastewater.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.

– **Waste disposal on land**

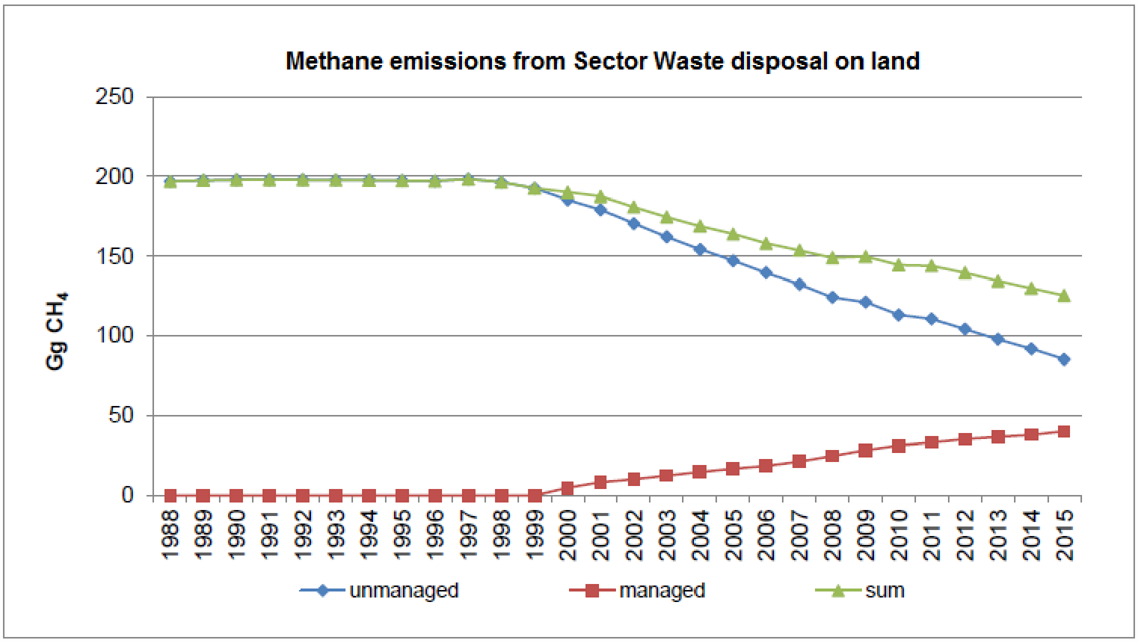
The emissions of methane emitted during the anaerobic degradation processes due to methanogenic bacteria in landfilled waste are estimated in this sub-sector.

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 1988-2015.

Figure 4.6. Emissions CH_4 in Gg/year



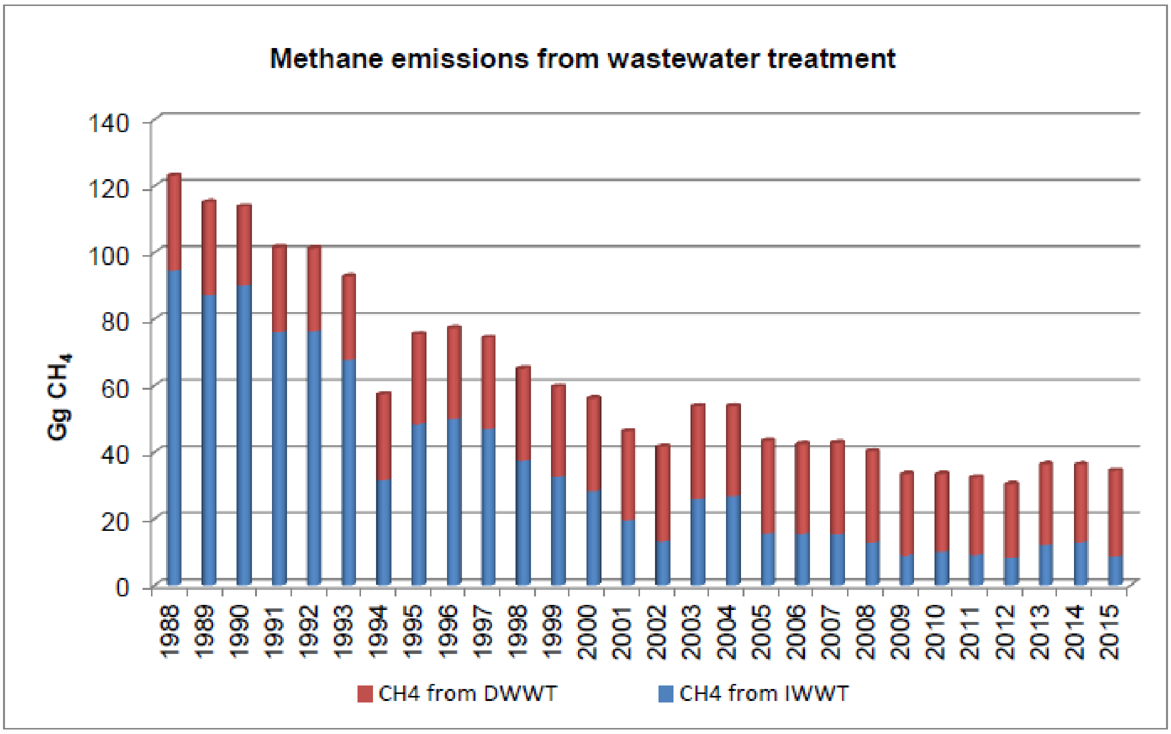
The measures to reduce GHG emissions from landfilled waste include:

- 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.

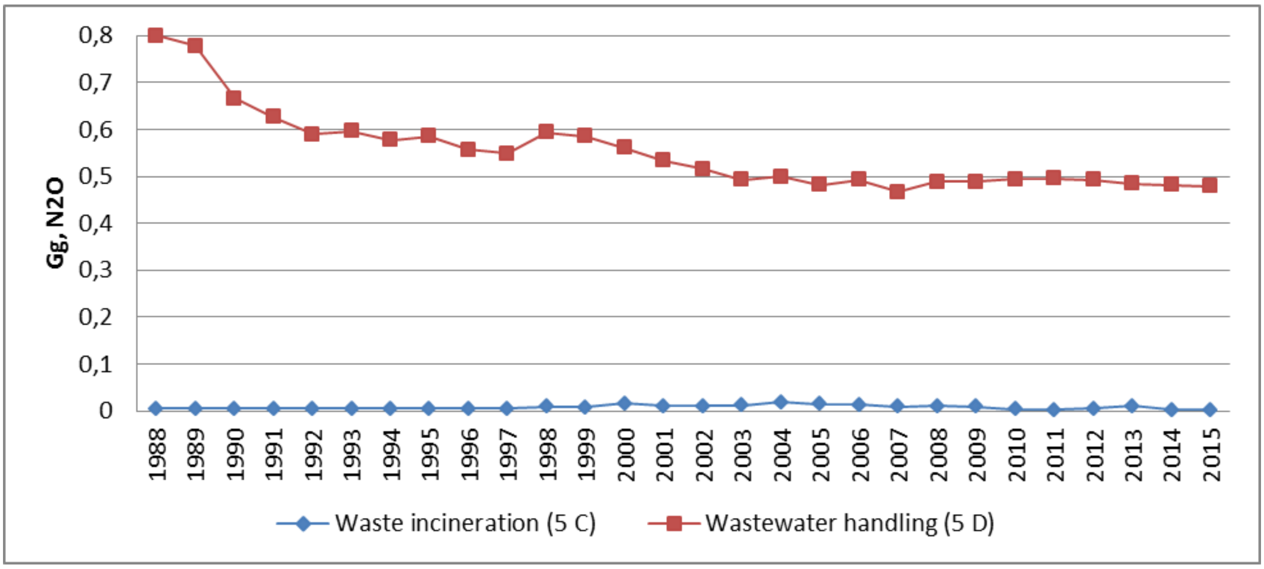
Figure 4.7. Trend in CH4 emissions in Sector Wastewater treatment



DWWT – Domestic wastewater treatment, IWWT – industrial wastewater treatment

Source: NIR

Figure 4.8. Trend in N2O emissions in Sectors Waste incineration and Wastewater handling



After the crisis in 1989 in the country and changes in economy in that period a decline in total generated wastewater from industry is observed (1990-1994). This trend is characteristic for paper and pulp production, production of food and beverage, organic chemicals, textile and textile products and affect the emissions in that period.

In 2002 again a decline in total generated wastewater could be observed from industry: food and beverage, paper and pulp production, organic chemicals and textile. This is connected with the next stage of the economy restructuring in the country – privatization of enterprises (part of them are sold, closed or changed their functions).

During 2003-2004 a significant growth of generated industrial wastewater is observed, formed by discharged wastewater from preceiding years (discharge of several big tailing ponds of mining companies in the country) with permission of the Ministry of Environment and waters which gives rise of the emissions from industrial wastewater treatment.

In 2015 the quantity of generated industrial wastewater is less in comparison with 2014 – 146 283 thou.m3 versus 111 355 thou.m3 for 2015. The sharp decline is characteristic for paper and pulp industry – from 29 360 thou.m3 in 2014 to 15 675 thou.m3 in 2015. Slight decrease is also observed in generated wastewater from production of fertilizers, textile and other industries. This tendency leads to significant decrease in CH4 emissions from industrial wastewater treatment in comparison with previous (2014) year. According to NSI data, domestic wastewater has been treated in centralized aerobic treatment plants, septic systems, latrines and discharged into water bodies (sea, river, lakes). In 2015 about 62.3 % of the population is connected to centralized aerobic treatment plants, 13.2 % is connected to the public sewerage, but without treatment (sea, river, lake) and 24.5 % of the country population use septic systems and latrines (detail information at: www.nsi.bg).

In Bulgaria, 73% of the population is classified as urban income group and 27 % - as rural income group (NSI data).

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 .

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.

4.4.18.2. 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 CO2 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

Measure 1: further development of collective systems for separate collection of waste from the population

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

Measure 2: introduction of differentiated charges for the generated waste

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.

Measure 3: introduction of separate collection of “green” waste in municipalities

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

Priority axis 2: CAPTURE AND FLARING OF BIOGAS FROM LANDFILLED WASTE

Measures with direct impact on the reduction of GHG emissions

Measure 1: capture and flaring of biogas in all new and existing reginoal landfills

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

<u>Measure 1: evaluation of the energy potential of the biogas from landfills that are planned to be closed</u>

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.

<u>Measure 2: measuring the amount (flow) of biogas captured in combustion systems</u>

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.

<u>Priority axis 3</u>: CAPTURE OF BIOGAS FROM URBAN WASTEWATER TREATMENT PLANTS (UWWTP) AND ITS BURNING

Measures with direct impact on the reduction of GHG emissions

<u>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</u>

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

4.4.19. **Agriculture Sector**

4.4.19.1. General information of the Agriculture sector

In the year 2015 the sector agriculture contributed 10% to the total of Bulgaria's greenhouse gas emissions (without LULUCF). The trend of GHG emissions from 1988 to 2015 shows a decrease of 56% for this sector due to decrease in activity data.

CH_4 emissions are 30% from of the total emissions in the sector in CO_2-eq in 2015. A steady trend of emissions decrease is observed after 2004 due to reduction in animal numbers.

N_2O emissions from the sector are also significant. The biggest share belongs to the agricultural soils emissions. The share of N2O emissions is 69% for the year 2015. The biggest share in these emissions has the Agricultural soils category with 88%. N2O emissions from manure management and field burning of agricultural residues are of an order of magnitude smaller.

Since 1988 the CH_4 emissions from agriculture decreased by 70% and N_2O emissions by 45%.

4.4.19.2. 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.

The area with agricultural designation in 2015 is 5 202 752 ha, which represents approximately 47% of the territory of the country.

Utilised Agricultural Area (UAA) is composed of arable land, perennial crops, plant nurseries, permanent grasslands and family gardens. In 2015, it amounts to 5 011 494 ha, which is nearly 45% of the territory of the country. Compared to the previous year, UAA has decreased by 0.7%.

Arable land includes areas where applies seed rotation, temporary meadows with grain and legumes grasses, fallow lands and greenhouses. In 2015 the arable land increased by 0.7% compared to the previous year, occupying 3 493 688 ha. The relative share of arable land compared to the utilised agricultural area of the country remained constant compared to the previous year - 69.7%.

Table 4.15. Arable land, used agricultural area and area with agricultural purpose for the period 2011– 2015, ha

	2011	**2012**	**2013**	**2014**	**2015**
Wheat	1 152 999	1 194 141	1 328 062	1 305 733	1 151 225
Barley	174 010	176 556	182 457	218 612	191 433
Rye and triticale	17 841	24 303	31 506	37 020	24 190
Oats	17 163	16 814	20 835	21 732	13 329
Maize	430 914	525 412	518 471	480 929	524 121
Other cereals	12 006	16 046	22 938	19 768	31 479
Sunflower	795 319	854 738	928 781	877 538	851 245
Tobacco	21 710	24 857	19 265	19 072	17 443
Industrial oil seed crops	233 934	144 457	123 544	208 212	225 847
Other industrial crops	54 458	40 989	29 795	47 676	53 755
Potatoes	16 852	17 465	10 634	10 224	9 449

Peas, kidney beans, broad beans, lentils and other legumes	8 076	9 395	8 263	4 877	24 617
Fresh vegetables	27 227	24 778	26 846	29 394	37 538
Annual fodder crops	3 804	11 035	4 685	7 206	6 871
Meadows planted with legumes and cereals	84 804	83 489	83 237	87 715	94 682
Fallow land	174 110	128 097	121 289	92 268	235 150
Greenhouses	2 010	2 113	1 509	1 412	1 314
ARABLE LAND:	3 227 237	3 294 685	3 462 117	3 469 388	3 493 688
Family gardens	22 517	22 226	16 757	17 072	15 664
Orchards	69 478	69 494	66 824	66 057	68 543
Vineyards — pure crop	78 468	77 341	60 474	53 521	54 210
Combined perennial plants	8 629	8 529	5 998	4 791	8 522
Plant nurseries	3 311	3 715	1 892	2 002	2 202
Total perennial crops:	159 886	159 079	135 188	126 371	133 477
Permanent grasslands and meadows - fruit orchards	1 678 308	1 646 993	1 381 049	1 363 984	1 368 665
USED AGRICULTURAL AREA:	5 087 948	5 122 983	4 995 111	4 976 815	5 011 494
Uncultivated area	398 624	358 239	263 698	216 125	191 258
AREA WITH AGRICULTURAL PURPOSE:	5 486 572	5 481 222	5 258 809	5 192 940	5 202 752
Fresh vegetables	27 227	24 778	26 846	29 394	37 538

Source: MAF, department “Agrostatistics”

In 2015, the total area seeded with permanent crops was 133 477 ha — by 5.6% more compared to 2014, as the largest contribution to this increase have areas with mixed perennials and orchards.

Areas with plant nurseries and vineyards - pure crop also increased compared to the previous year, while only family gardens decreased. Uncultivated lands include both abandoned perennial crops and arable land not used for agricultural production for more than two years, but their operational recovery is possible with minimal resources.

In 2015, the uncultivated lands decline by 11.5% in comparison to the previous year, or up to 191 258 ha.

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 4.6 Used amounts of mineral fertilizers – tonnes of active substance

Year	**Total NPK**	**N**	**P_20_5**	**K_20**
	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	235 386	47 633	23848
2013	305 276	258 856	26 695	19 725
2014	418 758	322 004	64 459	32 295

2015	460 120	341 608	63 152	34 112

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.

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.

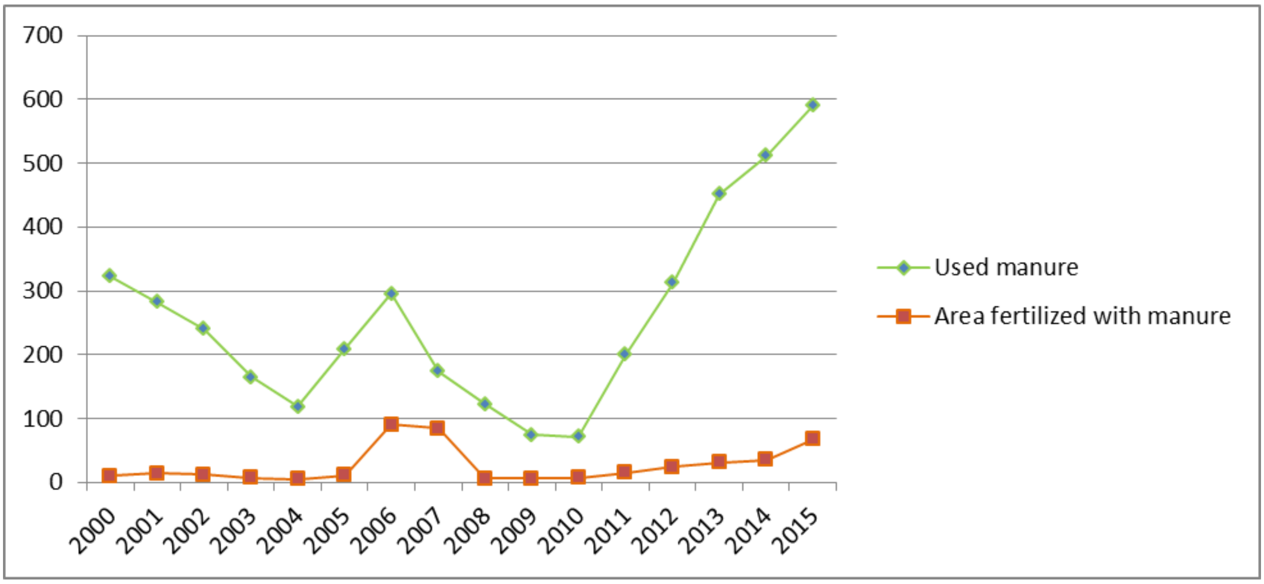
Table 4.7 Used manure

Year	**Used manure**	**Average for the period**	**Area fertilized with manure**
	(thousand tonnes)		***(thousand ha)***
2000	323.0	2000-2004:	10.40
2001	282.0		13.90
2002	240.5	252.62 thousand tonnes	11.90
2003	164.4		6.90
2004	118.2	2005-2009:	5.08
2005	209.4		10.60
2006	296.0	175.32 thousand tonnes	90.50
2007	173.9		84.70
2008	122.9	2010 -2015	5.60
2009	74.4	356.38 thousand tonnes	6.18
2010	71.3		6.96
2011	200.118		15.06
2012	312.698		23.73

2013	451.654		30.76
2014	511.945		34.77
2015	590.532		67.10

Source: Agrarian reports

Figure 4.5 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)[14].

4.4.19.3. 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

[14] MAF, Annual Report on the Implementation of RDP (2007-2013) in the Republic of Bulgaria for the period 01.01.2010 – 31.12.2010.

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 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.

4.4.19.4. 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 CO_2 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 CO_2 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

<u>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.)</u>

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

<u>Measure 2: introduction of water saving and energy saving irrigation technologies</u>

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.

<u>Priority axis 2:</u> REDUCTION OF METHANE EMISSIONS FROM THE BIOLOGICAL FERMENTATION IN ANIMAL HUSBANDRY

Measures with indirect impact on the reduction of GHG emissions

<u>Measure 1: encouragement of the extensive grassland husbandry</u>

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 CH_4 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 CO_2 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	**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

Measure 1: establishment of a resource centre for low-carbon practices in processing manure

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	**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	**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.

4.4.20. **Land Use, Land Use Change and Forestry Sector**

4.4.20.1. General information on the sector

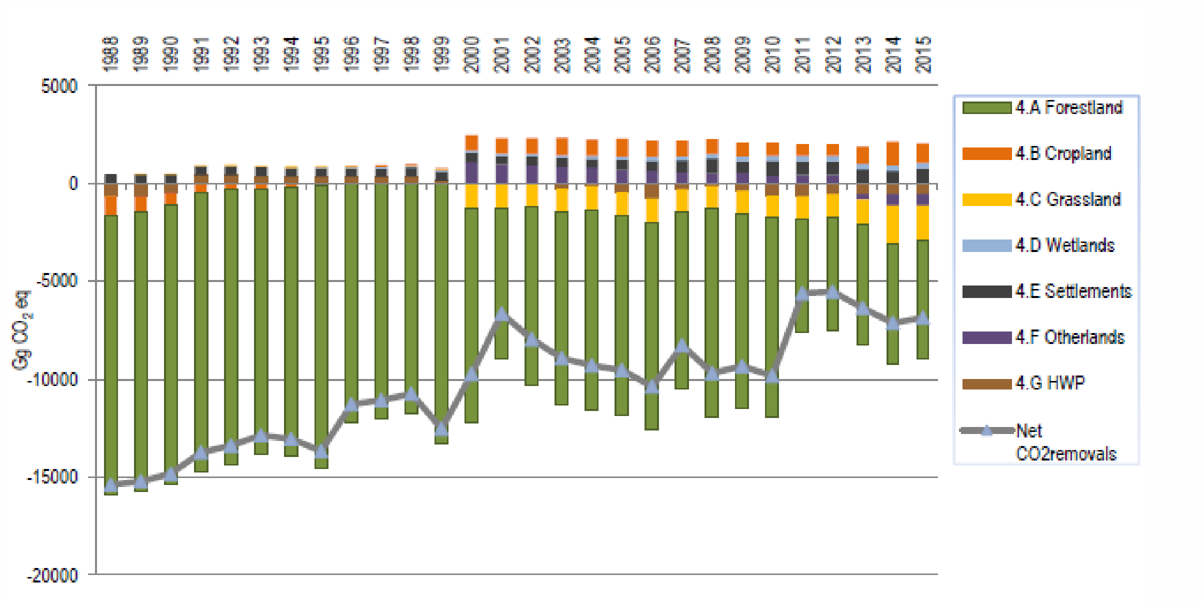
The sector of Land Use, Land Use Change and Forestry (LULUCF) is not addressed and no measures are proposed to reduce emissions or to increase the absorption of greenhouse gases in the previous two Action Plans on Climate Change (2000, 2005). Accounting for the activities in the sector is necessary in order to make a comprehensive analysis of the carbon balance in the country.

Land Use, Land-Use Change and Forestry (LULUCF) sector includes emissions and greenhouse gas removals from different land-use types, changes in the land-use and forestry. The greenhouse gas inventory of LULUCF sector comprises emissions and removals of CO2 due to overall carbon gains or losses in the relevant carbon pools of the predefined six land-use categories. These pools are above-ground biomass, below-ground biomass, dead organic matter (litter and dead wood) and soils. Sources of the non-CO2 emissions in the LULUCF sector are the biomass burning, lime and urea application, as well as fertilisation.

Since reporting year 2015 the methodology used to calculate emissions and removals in LULUCF follows that of the 2006 IPCC Guidelines. The predefined land-use categories are Forest land (FL), Cropland (CL), Grassland (GL), Wetland (WL), Settlements (S), Other land (OL). In accordance with the 2006 IPCC Guidelines emissions and removals should be reported into two sub-categories – land remaining in the same category and land converted to another land-use category. All the land-use changes were traced down and reported for a transition period of 20 years (as require in IPCC 2006) after which they are reported in the respective categories.

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 4.6 LULUCF emissions and removals 1988 – 2015 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.[15].

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 measures aimed at

[15] Green Paper on Forest Protection and Information in the *EU*.

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.

4.4.20.2. Measures in the Land Use, Land Use Change and Forestry Sector

Priority axis 1: INCREASING GREENHOUSE GAS SEQUESTRATION

Measures with direct impact on the reduction of GHG emissions

Measures with direct impact on the reduction of GHG emissions

Measure 1: utilization of „non-wooded areas intended for afforestation " in forest areas

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 CO2 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.

Measure 2: afforestation of abandoned agricultural land, barren and deforested areas, eroded and threatened by erosion land outside forest areas

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 CO_2 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

<u>Measure 1: supporting preservation and maintenance of forests of high conservation value and extensive approach for their use</u>

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.

<u>Measure 2: preservation and improvement of the condition of urban and suburban parks</u>

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.

<u>Measure 3: prevention of forest fires through introduction of early warning systems</u>

Characteristics: The data of the required funding to implement such prevention programme is estimated by EFA.

<u>Priority axis 3</u>: INCREASING THE POTENTIAL OF FORESTS TO CAPTURE CARBON

Measures with direct impact on the reduction of GHG emissions

<u>Measure 1: increasing the density in the listed natural and artificial plantations</u>

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 CO_2 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

<u>Measure 1: introduction of appropriate systems to manage forest plantations under changing weather conditions aimed to create highly productive and sustainable mixed forests</u>

Characteristics: The scientific task may be assigned in connection with article 4 of Ordinance № 8 of 5 August 2011 on forest logging.

<u>Measure 2: supporting the increase of the percentage of certified forests</u>

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.

<u>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</u>

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.

<u>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</u>

Characteristics: The strategic documents are prepared pursuant to art. 9 of the Forestry Act as an essential element of forestry planning.

<u>**Priority axis 4**</u>: 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.

4.4.21. **Transport Sector**

4.4.21.1. 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.

Following a steep decline in 1989 as a result of the political and economic crisis, a distinct uptrend of GHG emissions could be noticed since 2000 to present. The change was a result of the economic recovery, preceded by the introduction of a currency board regime in 1997 and rigorous economic and political reforms. The main contributing gas is CO2, followed by CH4 and N2O.The CO2 emission trend is directly related to the fuel consumption and therefore shows a decrease in the period 1990-2000. However, with the reviving economy CO2 emissions grew constantly to 2006. Afterwards, a period of stabilization began and continued to 2009 when there was a slight drop in the emissions mainly related to the economic crisis and the consequent decline in transportation. For 2013 there was again a drop in the fuel consumption (mostly for diesel fuel and gasoline), which resulted in decrease of the emissions, but the drop was compensated in 2014 and 2015, reaching the highest ever consumption.

Overall, the GHG emissions from road transport increased by 28.7% compared to base year level of 6 923.6 Gg CO2e and reached 8 913.9 Gg CO2e in 2015.

The most significant contributor to GHG emissions are passenger cars, followed by heavy-duty vehicles, light-duty vehicles and motorcycles and mopeds. As it can be noticed from the following figure, in 2015, passenger cars account for 65.1%, light-duty vehicles are responsible for 13.7%, and heavy duty vehicles (incl. buses) account for 20.9% of total GHG CO2e emissions, with the share of passenger cars increasing over the time series. The remaining 0.3% were shared among 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[16] 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

16 Communication from the Commission "A Roadmap for moving to a competitive low carbon economy in 2050", (COM (2011)112).

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.

4.4.21.2. 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

Measure 1: developing and promoting the use of “hybrid” and electric vehicles

Characteristics: The indirect effect from the introduction of the measures is estimated at 135 624 tCO_2 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 CO_2 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 CO_2 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 tCO_2 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 CO_2 eq by 2020

Target value by year	**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

4.4.22. Education and science

4.4.22.1. 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. 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 MES 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 MES 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.

4.5. Status of implementation and quantitative evaluation of the sectoral policies

In the period 1988 – 2015 Bulgaria has reached significant reduction of the GHG emissions equal to 61.483 Mt, which is about 47 % 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 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 Table 1.18 Summary of policies and measures with direct effect on the reduction of greenhouse gas emissions.

Table 4.19 Summary of policies and measures with direct effect on the reduction of greenhouse gas emissions

№	Name of mitigation action	Sector(s) affected	GHG (s) affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq)		
										2020	2025	2030
1.	Improvement of production efficiency in existing coal-fired power plants	Energy Energy supply Cross-cutting	CO_2	Efficiency improvement in the energy and transformation sector Framework policy	Economic Regulatory	Implemented	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.	2013	Ministry of Energy (ME)	466	585	585
2.	Fuel substitution – from coal to natural gas	Energy Energy supply	CO2	Switch to less carbon-intensive fuels	Regulatory Economic	Implemented	The European Emission Trading Scheme and the competition on the electricity market encourage the transition to lowcarbon 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 CO2 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.	2013	ME	2700	2700	2700
3.	Increasing of high efficiency combined production	Energy Energy supply	CO2	Efficiency improvement in the energy and transformation sector	Economic Regulatory	Implemented	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.	2013	ME	200	200	200
4.	Increasing the share of heating and cooling based on renewable energy sources	Energy Energy supply	CO2	Increase in renewable energy Reduction of greenhouse gas emissions	Regulatory Economic	Implemented	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%.	2012	ME, Sustainable Energy Development Agency (SEDA)	61	66	70

5.	Implementation of the measures in the Programme for accelerated gasification (PAG) in Bulgaria	Household and Services	CO_2	Reduction of end-use energy intensity of households Energy consumption	Economic Fiscal	Implemented	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.	2013	ME, MOEW, Energy and water regulatory commission	370	310	310
6.	Renovation of communal, public and state buildings at the percentage rate required by the Directive 2012/27/EU (with total area over 250m2)	Household and Services	CO_2	Improving the energy efficiency in municipal dwellings	Regulatory Economic	Planned	Measure implemented in connection with requirements of Directive 27/2012 / EU - 3 % of the total floor area of heated and/or cooled buildings on central government is renovated each year to meet at least the minimum energy performance. State-owned and municipal dwellings 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). 3% annual sanitation are 4562 buildings are to be retrofitted by 2020. The thematic objective 4 "Support for the transition to a low carbon economy" of the financial regulations for the period 2014 - 2020 of OP Regional Development is to support energy efficiency measures in buildings. Measures are implemented in both public and residential buildings and their cost is estimated at about 950 mln.BGN. In the operational program are pledged more measures to be applied horizontally to the public health, social, cultural, educational and sports infrastructures, along with the envisaged construction and repair activities.	2015	ME	25	26	26

7.	Introduction of mandatory energy efficiency scheme (reduction of the consumption of fuel and energy in the energy end-use consumption)	Household and Services	CO2	This measure is proactive and is consistent with the announced direction and actions of the EC aiming at reducing fuel and energy consumption.	Regulatory	Adopted	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 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).	2014	ME	18	18	18
8.	Replacement of the obsolete and inefficient equipment for production of energy with new equipment	Household and Services	CO2	Efficiency improvement of appliances	Regulatory Economic	Implemented	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.	2013	ME, SEDA, State Agency for Metrological and Technical Surveillance	9	9	9
9.	Development and staged implementation of national programme “1000 sunny roofs”	Household and Services	CO2	Efficiency improvements of buildings Increase in renewable energy	Regulatory	Planned	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.	2015	ME, SEDA, Municipal administration (Local)	17	14	14

10.	Audits for energy efficiency and implementation of the prescribed measures	Industry	CO_2, HFCs, PFCs	Efficiency improvement in industrial end-use sectors Reduction of emissions of fluorinated gases	Regulatory Economic	Implemented	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	2008	ME, Ministry of Economy (MEE), Ministry of Regional development and Public Works (MRPW), SEDA	119	119	119
11.	Use of biomass in the combustion units of installations	Industry, Energy supply, Waste Management	CO_2, CH_4, N_2O	The aim is to decrease the use of fossil fuel use and increase share of the alternative fuel and wastes. Reduction of heat pric	Regulatory, Economic	Planned	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.	2015	ME, MEE, MOEW	554	554	554
12.	Construction of installations for mechanical and biological treatment (MBT) and installations for treatment and recovery of compost and biogas	Waste Management	CH_4	Gradual reduction of biodegradable waste intended for landfilling 2010-2020.	Economic	Implemented	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.	2013	MOEW, Municipalities	728	728	728
13.	Capture and burning of biogas in all new and in the existing regional landfills	Waste Management	CH_4	Enhanced CH_4 collection and use Improved landfill management	Regulatory Education	Implemented	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. The combined effect of the two measures is expected to be 5 070 122 total reduction in tonnes CO_2 eq. by 2020.	2013	MOEW	634	634	634
14.	Introduction of anaerobic stabilization of sludge with	Waste Management	CH_4 N_2O	A cost-benefit analysis for each project should justify or discourage	Regulatory, Economic	Implemented	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	2013	MOEW	128	128	128

	management capture and burning of biogas in new plants and plants under reconstruction in settlements with population equivalent over 20 thousand residents			the recovery of methane.			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.					
15.	Encouraging the use of suitable crop rotation, especially with crops fixing atmospheric nitrogen	Agriculture	CH4	Other activities improving cropland management Improved management of organic soils	Economic	Implemented	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	2013	Ministry of agriculture, food and forestry (MAFF)	1	1	1

16.	Management of degraded agricultural land using: Biological reclamation with grass species typical of the region. Management of degraded agricultural land using: Implementation of erosion control measures and soil treatment methods	Agriculture	CO_2 N_2O CH_4	Activities improving grazing land or grassland management Improved management of organic soils	Economic	Implemented	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, salinisation, 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	2013	MAFF, MOEW	2,5	2,5	2,5
17.	Improvement of the manure use and management	Agriculture	CH_4	Improved animal waste management systems	Economic Research Education	Implemented	Production, processing and management of manure is one of the most significant sources of the greenhouse gas CH_4 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	2013	MAFF	0,146	0,146	0,146
18.	Introduction of low-carbon practices for processing manure, e.g. composting, transformation of manure into biogas under anaerobic conditions	Agriculture	CH_4	Improved animal waste management systems	Economic, Education, Regulatory	Adopted	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 The proposed budget for the measure is based on: For training: 200 livestock holdings x 690 BGN = 138 000 BGN For model farms – 1 000 000 BGN	2014	MAFF	0,1	0,1	0,1

19.	Technical support for farmers for tilling soil/ stubbles	Agriculture	CO2	Improved management of organic soils, Other activities improving cropland management	Economic	Adopted	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 CO2 eq. per tonne production. The proposed budget for the measure is based on: 5000 holdings x 45 000 BGN = 225 000 000 BGN	2014	MAFF	0,094	0,094	0,09 4
20.	Financial support for improving the equipment and the technology of production	Agriculture	CH4	Other agriculture	Economic Fiscal Research	Planned	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.	2014	MAFF	0,003	0,003	0,00 3
21.	Utilization of "non-wooded areas intended for afforestation " in forest areas	LULUCF	CO2	Afforestation and reforestation Restoration of degraded lands	Economic Regulatory Planning	Implemented	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.	2013	MAF	1,7	1,6	1,6
22.	Afforestatio n of abandoned agricultural land, barren and deforested areas, eroded and threatened by erosion land outside forest areas	LULUCF	CO2	Afforestation and reforestation Restoration of degraded lands	Economic Regulatory Planning	Implemented	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.	2013	MAFF, MRDPW and municipalities	4,8	4,7	4,7

23.	Increase of areas for urban and suburban parks and green zones	LULUCF	CO2	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.	Economic Regulatory	Implemented	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.	2013	MRDPW, Municipalities	0,3	0,3	0,3
24.	Restoration and sustainable management of wetlands. Protection and preservation of wetlands in forest areas, peatlands, marshlands	LULUCF	CO2 CH4	Prevention of drainage or rewetting of wetlands Conservation of carbon in existing forests Enhanced forest management	Economic, Regulatory	Implemented	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	2013	MOEW	0,5	0,7	0,7
25.	Restoration and maintenance of protective forest belts and new anti-erosion afforestation	LULUCF	CO2	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.	Regulatory, Economic	Implemented	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.	2013	MAFF, Executive Forests Agency (EFA)	0,8	1,2	1,5
26.	Increasing the density in the listed natural and artificial plantations	LULUCF	CO2	Increasing the density in the listed plantations by supporting their natural regeneration or using other methods.	Research Planning Regulatory	Implemented	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.	2013	EFA/MAFF	1,0	2,5	4,0

27.	Rehabilitation and modernization of the existing road infrastructure to ensure optimum speed and optimum driving modes of automobile engines	Transport	CO2	Improved transport infrastructure	Economic	Adopted	For implementation of the measure have been realized: Projects funded under the Operational Programme Transport - building lots of highways Trakia, Hemus, Maritsa - 15 sites with total length 318 km. Projects funded under the Operational Programme Regional Development - 22 sites: newly constructed or rehabilitated road infrastructure (roads II and type III) with a total length of 349.5 km.	2014	MF, Ministry of Transport, Information Technology and Communications (MTITC), MRDPW, Road Infrastructure Agency	80	60	70
28.	Introduction of intelligent transport systems along the national and the urban road network	Transport	CO2	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.	Fiscal, Regulatory, Economic	Implemented	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.	2014	MTITC	170	170	170
29.	Increasing the share of biofuels	Transport	CO2	The most promising projects in Bulgaria are the projects for production of ethanol and biodiesel.	Regulatory	Implemented	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.	2012	ME, SEDA, MOEW	101	101	101
30.	Reducing the share of trips by private motor vehicles	Transport	CO2	Improving the urban public transport and non-motorized transport development	Economic, Planning, Regulatory	Implemented	Reducing the share of trips by private motor vehicles by improving the urban public transport and non-motorized transport development. Project-oriented approach – specific implementation	2012	MRDPW	75	75	75

31.	Development and promotion of cycling	Transport	CO2	Promotion of cycling	Education, Information, Economic	Implemented	Project-oriented approach – specific implementation 1. Design and construction of new cycling infrastructure 2. Developing systems for use of municipal bicycles Trainings and campaigns	2013	MF; MRDPW; MEW; Municipal authorities	120	130	130
32.	Increasing the share of public electrical transport - railways, trolley, tram, metro	Transport	CO2	Modal shift to public transport or non-motorized transport	Economic Planning Voluntary/negotiated agreement	Implemented	– Increasing the share of public electrical transport. – 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. Creasing the share of public electrical transport. – 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. 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.	2014	MF; MTITC; MRDPW; National Railway Infrastructure Company, municipal governments	127	127	127
33.	Development and construction of intermodal terminals for combined transport	Transport	CO2	Improved transport infrastructure	Economic	Implemented	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.	2014	MF; MTITC; National Railway Infrastructure Company	58	58	58

4.6.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.

In April 2015, an EU regulation was adopted on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport. The regulation take effect 1 January 2018 and will apply to all ships above 5,000 gross tonnes in respect to their CO2 emissions during their voyages to and from ports in the EU. Bulgaria is in the process of implementing this regulation. In the IMO, a similar mandatory data collection system for fuel consumption, as well as other additional specified data, was adopted in October 2016. This regulation is expected to enter into force on 1 March 2018 and applies to all ships in the world above 5,000 gross tonnes. These ships account for approximately 85 % of CO2 emissions from international shipping.

The mandatory data collection system is intended to be the IMO's first step in a three-step approach to decrease greenhouse gas emissions from shipping. The second step will be to analyse the data collected, which will provide the basis for the third step: further measures to enhance energy efficiency and address greenhouse gas emissions from international shipping.

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 CO_2 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.

In September 2016 ICAO decided to implement a global measure, the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). Sweden is among the nations that have voluntarily participated in the scheme from its outset.

The EU ETS regulation was amended with an exemption in 2014 so that up until 31 December 2016 the scheme only covered intra-EU/EEA flights. Following the ICAO Assembly in 2016, the EU Commission is revisiting the EU ETS regulation due to the decision on the global market-based measure.

4.7. Information on minimization of adverse effects (including adverse effects of climate change) on developing countries in the implementation of policies and measures

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 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.

4.8. 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 – The measure was implemented
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
6) Transports cargo dispatching system - The measure is implemented
7) Modernization of Railway transport - The measure is implemented
8) Improvement of Manure use and management - Some projects was implemented. Campaigns, workshops and training sessions for good practices have taken place.
9) Improvement of the operation of NPP-Kozloduy – The measure is implemented
10) Construction of hydro cascade Gorna Arda and Sredna Vucha - The projects are implemented under Memorandum of understanding regarding bilateral cooperation for the realization of Joint Implementation.
11) Construction of small and micro HPP in different country regions - A number of applications for the construction of small and micro HPP has built

12) Upgrading of cogeneration plants and district heating boilers by natural gas turbines - 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

13) 13) Gas supply to households Households and public buildings - Several gas supply networks are constructed. A number of schools are under gasification. Due to the high price of gas the residential sector is with low rates.

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, Third National Action Plan on Climate Change for the period 2013-2020 (NAPCC 2013-2020) and Natioal Energy Strategy until 2020.

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 2015, 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.

The "**with additional measures**" scenario comprises planned for period after 2015 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 2017 inventory submission for the year 2015 using 2006 IPCC Guidelines and Global Warming Potential (GWP) from Forth Assessment Report (4 AR).

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.

The GHG emissions projections for the energy industry sector are based on analysis of the country energy balance. This analysis is based on modelling with the use of the Long-term

Assessment and Energy Planning software. The main scenario developed takes into account all existing measures for decreasing the greenhouse gas emissions. This projection is thus equivalent to the WEM scenario for the projection of the Bulgarian National Projection Report. The WAM scenario is based on the WEM scenario and the projections for the effects of the additional measures.

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

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 as it 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 “Maritsa East 2”, TPP “Contour Global 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.

The energy industry sector consists of the facilities for power and heat generation on large scale. This is the sector that is responsible for the largest quantity of GHG emissions. Emissions from the energy sector are the main source of GHGs in Bulgaria: in 2015 the sector is responsible for 81.4% of national total GHG emissions (44461 Gg CO_2e from sector 1A of the total 54 608 Gg CO_2e excl. LULUCF). It is projected that this \ sector will continue to emit the biggest part of the emissions.

The power plants with the highest power generation are the NPP Kozloduy, the lignite and coal fired thermal power plants, and the district heating and power generation plants in the biggest cities. The number of newly commissioned renewable power plants has decreased significantly due to decrease in the feed-in tariffs for wind and solar PV power plants. The installed capacity of all the RES power plants has reached 25% of the total installed capacity in the country. By the end of 2015 the RES installed capacities are as follows:

- Hydro – 2474 MW

- Wind – 698 MW

- Solar – 1024 MW

- Biomass – 41 MW

In the renewable energy sources category the biomass, hydro, solar photovoltaic, wind and geothermal power plants are included.

As displayed in the above sections, on the basis of many forecasts, it is assumed that GDP will continuously increase in the projection period. This will lead to increase in the power consumption. In the model developed it is assumed that the electricity consumption increases by 20% by 2025 as a consequence of the increased economic activity and GDP. Another assumption of the energy balance forecast is that after 2025 the increase of electricity consumption due to increased activity will be contravened by increased energy efficiency.

The forecast electricity balance is displayed in the table 5.1.:

Table 5.1 Electricity balance - forecast

Year	2020	2025	2030
Gross Electricity Consumption	34169	35083	33956
Electricity Export	4872	2825	5321
Losses in Distribution Networks	4100	4210	4075
Losses in Transmission Networks	1079	1053	1084
Losses in Pumping (HAPP)	1573	1767	1999
Electricity to Transmission Networks	45793	44938	46435
Power Plant Own Needs	4794	4550	4599
Generation Necessary	50587	49488	51034

The energy balance forecast envisages that the country will continue to be net exporter of electricity. Electricity generation will be more than the consumption within the boundaries of the electricity system. The net quantity of electricity will gradually decrease until 2025 as it is highly unlikely that new generation capacities be commissioned. After 2025 until the end of the projection period the electricity exports are expected to be 5 000 – 6 000 MWh a year.

Below is the forecast for the power generation capacities until 2030 (table 5.2). It is based on a forecast for the generation capacities by the TSO and on the Energy Balance Forecast until 2050.

Table 5.2. Power generation capacities - forecast

Name of Power Plant	2015	2020	2025	2030
NPP Kozloduy	**2200**	**2200**	**2200**	**2200**
TPP Maritsa iztok 1	670	670	670	670
TPP Maritsa iztok 2	1563	1563	1563	1563
TPP Maritsa iztok 3	908	908	908	908
TPP Maritsa 3	120	120	0	0
TPP Ruse	0	0	0	0
TPP Varna	0	0	0	0
TPP Bobov dol	420	420	0	0
TPP Brikel	200	200	200	200
Total TPP	**3881**	**3881**	**3341**	**3341**
District TPP	**1073**	**1138**	**1138**	**1138**
New Cogen	60	230	295	295
Industrial TPP	625	625	625	625
HPP Existing	1751	1751	1751	1751
HPP new	0	100	166	166
HAPP	931	931	931	931
WPP	800	1116	1337	1628
SPP	1320	2000	2300	2700
BPP	270	270	270	270
Total Power Capacity	**13842**	**15173**	**15285**	**15976**

TPP "Contour Global Maritsa East 3" – units 4 and 3 have been rehabilitated and electric filters in order to capture 99.98% of the dust particles were installed. No changes in the installed capacities are envisaged in the projection period and the plant will continue operating.

TPP Maritsa East 2 modernization of units 5 and 6 took place. New desulfurization facilities have been installed for these units. In the end of the projection period it is envisaged that the oldest units will start being decommissioned and this has been included in the projections.

The operational units 5 and 6 of the NPP Kozloduy are undergoing modernization and increase in capacity and the total nominal capacity of units 5 and 6 will be increased from 2000 to 2200 MW. The developed forecast does not envisage increase of the generation capacity by addition of new units in the existing NPP Kozloduy or by addition of a new nuclear power plant.

TPP Maritsa 3 is owned by NEK and is projected to be decommissioned by 2023, which is the end of the projected lifetime.

TPP Ruse and TPP Varna have already discontinued operation because the inability to meet the ecological standards. It is not envisaged that those plants are modernized and restarted.

TPP Bobov dol and TPP Brikel will both be gradually stopped and decommissioned by the end of the projection period.

In the TSO forecast for the projection period it is envisaged that the priority connection of RES power plants will continue. According to the forecast for the development of the Bulgarian electricity system by 2035, RES power plants will be connected to electricity with priority. By the end 2050, the TSO expects the installed capacity for power generation from RES to be 6900 MW or about 40% of the total generation capacity of the electricity system. The TSO forecast has been used limited to the extent of the emission projection period for the current report, namely 2030.

In the sector of HPPs, it is envisaged that the existing power plants will continue operation. A new cascade HPP with generation capacity of 160 MW is planned to be commissioned in the period 2020 – 2025. A small increase in the generated electricity is expected in the sector of the district heating and power plants, driven by increased technological heat demand.

Centralized heat generation

This subsector includes the district heating plants and the thermal power plants that are close to cities, where waste heat from electricity production can be utilized.

In the forecast from the model, it is expected that in the projection period the heat generation will increase by 70% by 2030 – from 5400 GWh to 8715 GWh. Despite the increase in the absolute quantity of heat produced, the ecological effects are expected to be strongly reduced by the switch from coal to natural gas and biomass in some of the plants that have not yet performed that.

Table 5.3 Heat production - forecast

Year	2015	2020	2025	2030
Heat production from:				
Coal	2200	2200	2200	2200
Biomass	10	45	85	120
Natural gas	4030	5230	5500	5980
Liquid fuels	60	70	70	70
Nuclear	345	345	345	345

Total	6645	7890	8200	8715

On table 5.**Error! Reference source not found.**4 and 5.5 are presented projection for total GHG emissions expressed in Gg CO2 eq for Energy sector until 2030 under both scenario. The applied until 2015 measures are accounted, as well as the emission from fuels combustion in transport, households, services and agriculture and forestry.

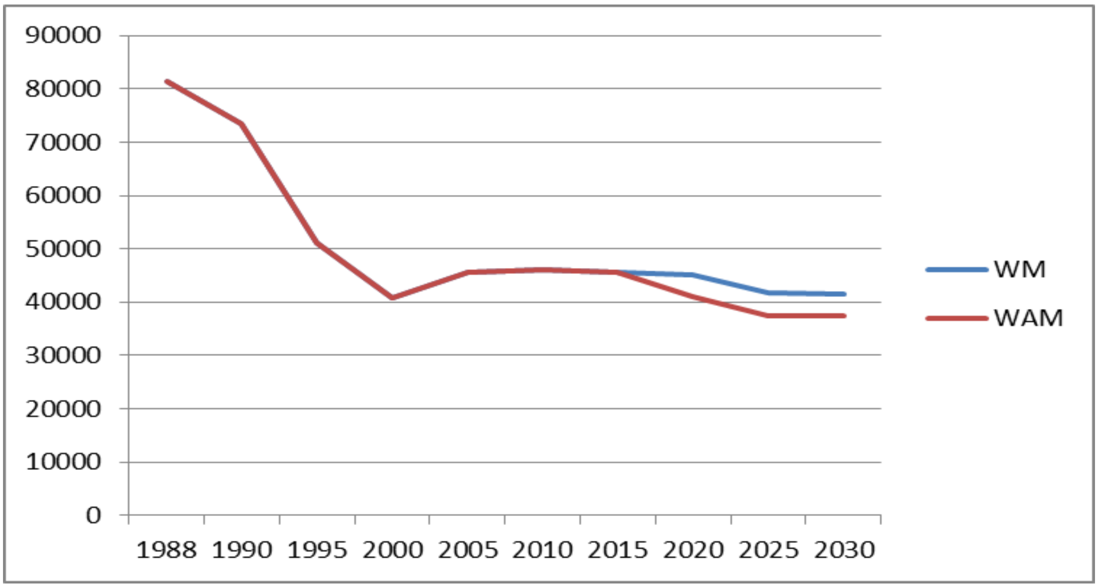
Table 5.4 Emission projections for sector Energy - scenario with measures, Gg CO_2 eq

	Historical emissions							WM Projectionss		
	1988	1990	1995	2000	2005	2010	2015	2020	2025	2030
Total	81275	73471.	51217	40777	45659	46009	45646	45203	41697	41453
CO2	77858	70253.	48470	38763	43961	44249	43828	43536	40131	39875
CH4	2888	2707	2376	1665	1374	1460	1505	1466	1382	1395
N2O	523	511	370	348	322	299	312	200	183	182

Table 5.5 Emission projections for sector Energy - scenario with additional measures, Gg CO2 eq.

	Historical emissions							*WAM Projections*		
	1988	1990	1995	2000	2005	2010	2015	2020	2025	2030
Total	81275.3	73471.98	51217.79	40777.25	45659.28	46009.32	45646.28	40 937	37431	37 398

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 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. 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 5.1 Energy industries– scenario with measures, Gg CO_2 eq.

	Historical emissions							*WM Projections*		
	1988	1990	1995	2000	2005	2010	2015	2020	2025	2030
Total	42 179,4	38676,85	27259,83	24076,86	27148,08	31638,28	30316,87	31460,09	27787,11	26937,76
CO_2	42024,36	38530,05	27151,09	23978,43	27034,13	31505,88	30190,07	31324,01	27664,14	26814,50
CH_4	18,84	13,54	8,38	6,77	7,524	9,00	8,87	8,98	9,01	8,91
N_2O	136,19	133,26	100,35	91,65	106,42	123,39	117,92	127,103	113,96	114,34

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 2015. From a methodological point of view this scenario contain the measures outlined in the country's Energy Strategy and in the the Third National Action Plan on Climate Change 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.

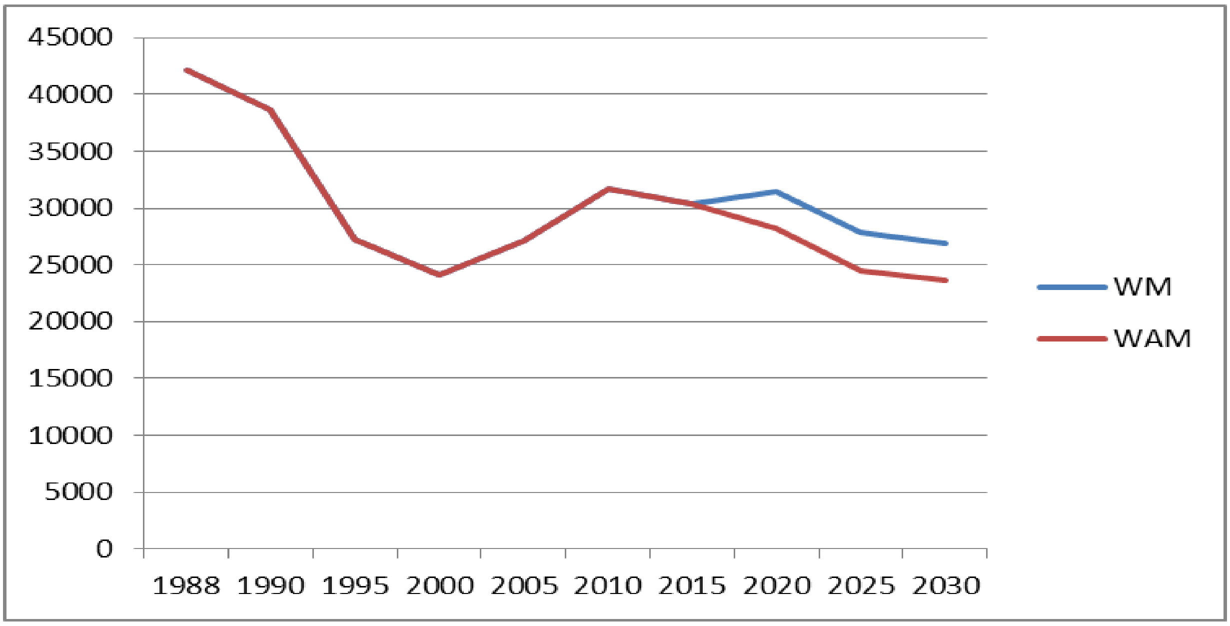
- **Scenario with additional measures – WAM**

The scenario with additional measures reflects all adopted or planned policies and measures for reduction of GHG emissions in the country after 2015 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 5.2 Aggregate GHG emissions from the Energy Industries Sector, Gg CO2 eq. – scenario with additional measures

	Historical emissions							*WAM Projections*		
	1988	1990	1995	2000	2005	2010	2015	2020	2025	2030
Total	42 179,**4**	38676,85	27259,83	24076,86	27148,08	31638,28	30316,87	28157	24477	23627

Figure 5.2. Emission projections for sector Energy Industries – WEM and WAM scenarios, Gg CO_2 eq



The proposed scenario with additional measures contains measures along several priority axes or directions and the following directions refer to this sector:

- Measures leading to reduction of the carbon intensity of the electricity generation mix by additional production of decarbonised electricity);
- Measures leading to reduction of the carbon intensity of the supplied electricity by decreasing network losses and development of decentralized energy production;
- Measures undertaken by energy companies with effect redirected to other sectors – to energy consumers.

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 CO2 per year.

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.

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 19-20% 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 5.7 shows changes of GHG emissions similarly to those in the scenario WM but one step further towards reduction.

Figure 5.2 shows a comparison between projections of the aggregate emissions from the Energy Industry 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.

5.2.2. 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 5.8 Aggregate GHG emissions from the Industry Sector (fuel emissions), Gg CO_2 eq. – scenario with measures

	Historical emissions							*WM Projections*		
	1988	1990	1995	2000	2005	2010	2015	2020	2025	2030
Total	17503,42	17768,46	13084,57	7228,39	7088,83	3156,71	2862,07	3159,783	3209,295	3259,514
CO_2	17367,73	17669,53	13027,03	7199,99	7051,60	3126,93	2822,86	3146,35	3193,55	3241,45
CH_4	31,738307	20,883295	15,719258	8,8568847	10,561379	8,7586714	12,216423	13,4304	15,7467	18,063
N_2O	103,95	78,05	41,82	19,54	26,67	21,02	26,99	22,946	20,35	19,052

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 5.8).

– **Scenario with additional measures – WAM**

The scenario with additional measures reflects all adopted policies and measures to reduce GHG emissions in the country after 2015 and includes the impact of policies and the measures presented in this Plan that have a quantitative assessment at this stage.

Table 5.9 Aggregate GHG emissions from the Industry Sector (fuel emissions), Gg CO2 eq. – scenario with additional measures

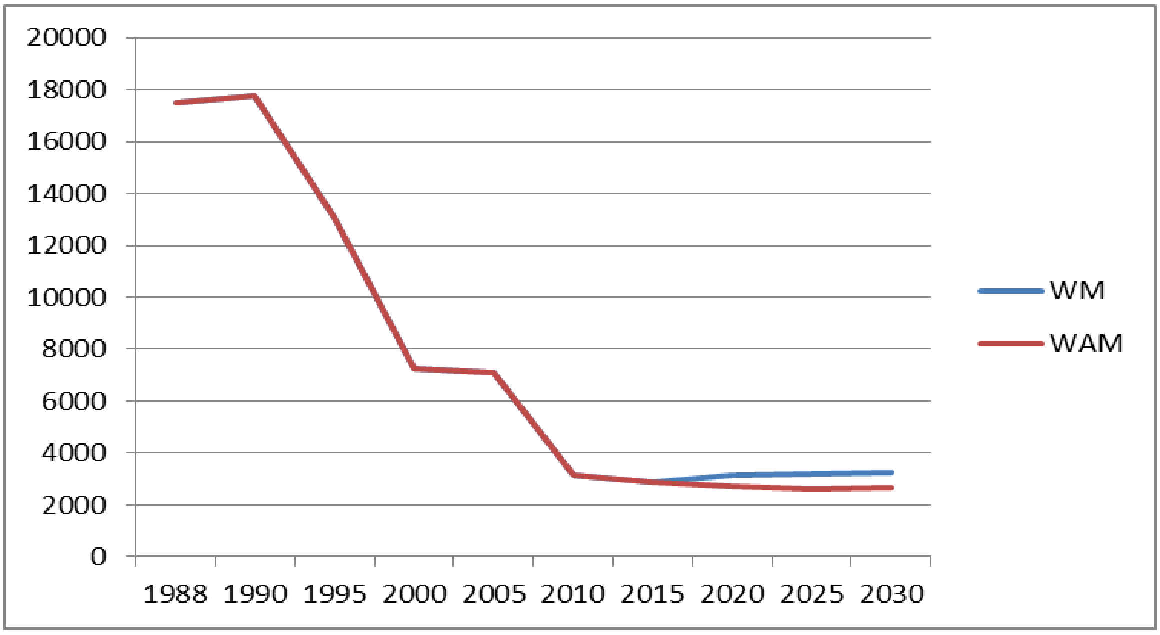
	Historical emissions							*WAM Projections*		
	1988	1990	1995	2000	2005	2010	2015	2020	2025	2030
Total	17503,42	17768,46	13084,57	7228,39	7088,83	3156,71	2862,07	2712	2609	2647

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.

Table 5.9 **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. for the period 2015-2030.

Figure 5.2 GHG emissions, Manufacturing Industries and Construction (fuel emissions), under the two scenarios



5.2.3. Transport Sector

The development of this sector has always been a priority due to its special position as part of the country's infrastructure.

The forecast for the development of the Transport sector has been prepared in accordance with the given forecast for the use of fuels in the sector. In the scenario it is assumed that the goal to be met is the 10% share of biofuels by 2020. By the end of the projection period, the target set is 15% share.

The forecast reflects the tendency for decrease in the share of liquid fuels (oil products) as opposed to an increase in the usage of electricity and natural gas.

This can also be observed in the structure of the fuels used.

Table 5.10 Use of fuels in sector Transport - forecast

Year	2015	2020	2025	2030
Coal	0.0%	0.0%	0.0%	0.0%
Fuels from Coal	0.0%	0.0%	0.0%	0.0%
Natural gas	2.6%	3.0%	6.0%	11.0%
Oil Products	92.2%	82.8%	73.5%	64.3%
Renewables	3.2%	10.0%	11.3%	14.8%
Renewable (Heat)	0.0%	0.0%	0.0%	0.0%
Heat	0.0%	0.0%	0.0%	0.0%
Electricity	2.1%	4.2%	9.2%	9.9%
Fuels for final energy consumption	**100.0%**	**100.0%**	**100.0%**	**100.0%**

The projections on carbon dioxide emissions from the transport sector are calculated on the basis of projections on energy use in the transport sector. The calculation of emissions of other greenhouse gases is based on the change in transport activity, number of vehicles in different vehicle types and emissions factors. The transport sector has been divided into four sub-sectors: road traffic, air traffic, rail traffic and shipping.

The projections for road transport are based on assessments on transport demand and on the development of the vehicle fleet. The demand for transport with passenger cars is expected to be mainly influenced by demography, fuel prices and in-come in households.

The development of the vehicle fleet is based on the assumptions on the allocations of fuels and existing instruments and historical trends. The projections for aviation, navigation and railways are based on assumptions on transport demand.

The present measures are oriented towards the following main areas:

- reduction of transport emissions;
- reduction of consumption;
- diversification of transport;
- information and training of consumers.

– **Scenario with measures - WM**

Table 5.11 Aggregate GHG emissions from the Transport Sector, Gg CO_2 eq. – scenario with measures

	Historical emissions							***WM Projections***		
	1988	1990	1995	2000	2005	2010	2015	2020	2025	2030
Total	7134,34	6572,96	4421,40	5514,73	7831,03	7973,33	9362,20	8354	7772	7335
CO_2	6999,72	6396,14	4246,64	5356,79	7723,49	7873,36	9251,33	8255	7680	7248
CH_4	71,05	69,80	50,12	35,56	31,54	27,72	27,33	24.4	22.69	21.41

N_2O	63,56	107,01	124,63	122,37	76,00	72,25	83,53	74.53	69.34	65.44

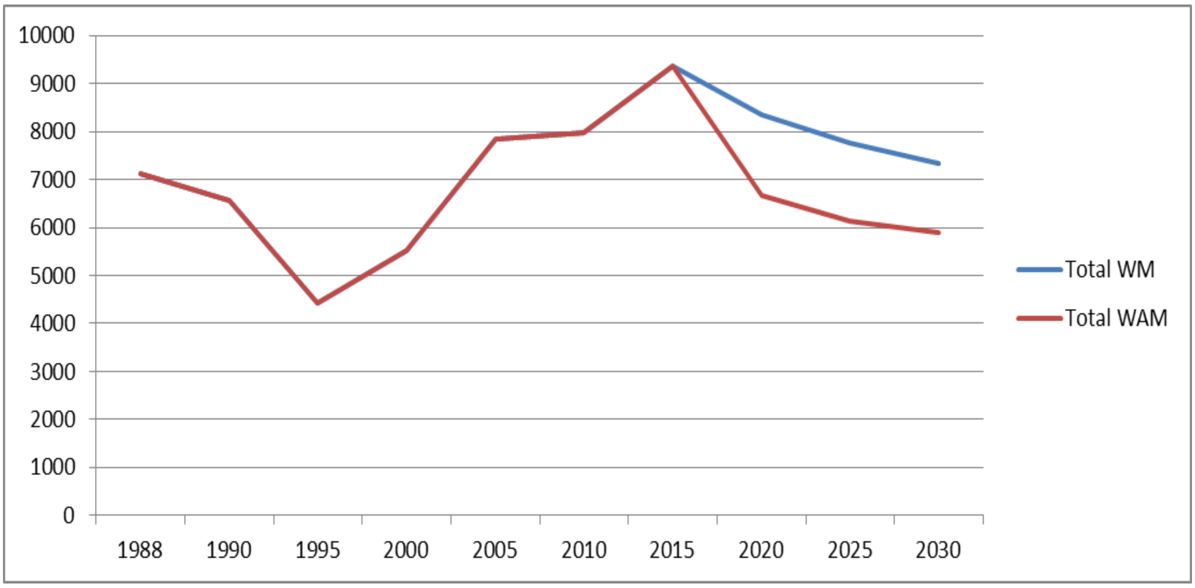
– **Scenario with additional measures – WAM**

The scenario with additional measures reflects all adopted policies and measures to reduce GHG emissions in the country after 2015 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 5.12 Aggregate GHG emissions from Transport Subsector, Gg CO_2 eq. – Scenario with additional measures

	Historical emissions							*WAM Projections*		
	1988	1990	1995	2000	2005	2010	2015	2020	2025	2030
Total	7134,34	6572,96	4421.4	5514,73	7831,03	7973,33	9362,20	6664	6125	5893

Figure 5.3 GHG emissions, Transport Sector under the two scenarios



5.2.4. **Households and Services Sector**

The forecast is based on the separate forecasts for the usage of fuels in the Services and the Residential subsectors. The forecasts for the two are added together to create the overall expectations for this Energy subsector.

Services

It is expected that the sector will grow faster than the economy and a rate of growth of 3.5-4.0% is expected by 2020. Further in the projection (until 2030), the growth rate converges to the growth rate of the overall economy. The structure of fuels used in the subsector is given below:

Table 5.13. Usege of fuels in sub sector Services - forecast

Year	2015	2020	2025	2030
Coal	0.4%	0.3%	0.2%	0.1%
Fuels from Coal	0.0%	0.0%	0.0%	0.0%
Natural gas	8.6%	10.0%	16.1%	18.6%
Oil Products	4.6%	5.0%	4.0%	3.0%
Renewables	1.4%	2.0%	4.3%	5.1%
Renewable (Heat)	6.1%	12.0%	14.0%	15.0%
Heat	10.9%	9.0%	9.0%	9.0%
Electricity	68.0%	61.7%	52.4%	49.2%
Fuels for final energy consumption	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Residential (Household)

The forecast for the energy supply of the households is based on expectations for the following factors:

- Number of households
- Average number of people in the households
- Income of the population
- Prices of the energy sources and the energy supply

The expectation is that the number of households will increase in the projection period due to the decrease of the average number of people in a household and despite the decrease of the population. This is foreseen to be the major reason for the increase of the energy consumption for the Residential sector. The main reason for the increase of the energy consumption of the households is the increasing income of the population. This results into increase of the saturation of the households with home appliances. The increase of the energy prices affects negatively the consumption of energy but it is a major stimulus for the implementation of energy efficiency measures.

The analysis of the household energy consumption shows a higher dependency on the energy prices than on the income of population. When the increase of the energy prices is faster than the increase of the income, then the amount of energy consumed decreases. While the rates of increase of the energy prices and the income are on par, the energy consumption of the households increases.

The forecast of the final energy consumption of the Residential sector has been prepared by taking into account the number of the households and the average household consumption. The specific energy consumption of the Bulgarian households at present (0.30 toe/year) is approximately two times smaller than the average household energy consumption in the European Union (0.61 toe/year). In the model, it is assumed that there will be gradual increase toward the average for the European Union. This parameter has been set to 0.39 toe/year in 2020 and 0.47 toe/year in the end of the projection period.

In terms of the energy sources to supply the household with energy, the following is assumed:

- Currently only a little more than 2% of the households in the country are gasified.
- The Energy Strategy of Bulgaria until 2020 envisages that this share reaches 30% by 2020, which however seems implausible and this suggested increase is not accounted for in the forecasts of Bulgartransgaz. That is why a share of 8% has been used in the model for the projection by 2020.
- It is expected that the given goal of 30% will be reached by 2030 and after that the share will converge more slowly to the average for the European Union (namely 40%). By 2035 the share of gasified households is set to 35%.

- The electricity used for space heating in the households is expected to decrease rapidly in the projection period with the main substitutes being the heat from renewable sources as well as natural gas.
- The rest of the fuels do not have significant shares in the fuel structure and are not expected to have big changes in absolute terms.

The structure of fuels used in the subsector is given below:

Table 5.14. Usage of fuels in sub sector Household

Year	2013	2015	2020	2025	2030
Coal	8.3%	7.6%	6.0%	3.0%	2.0%
Fuels from Coal	1.1%	1.1%	1.0%	1.0%	1.0%
Natural gas	2.2%	4.4%	10.0%	20.0%	30.0%
Oil Products	1.0%	1.0%	1.0%	1.0%	1.0%
Renewables	31.4%	28.1%	20.0%	19.0%	18.0%
Renewable (Heat)	0.3%	2.2%	7.0%	9.0%	12.0%
Heat	15.6%	15.9%	16.6%	16.0%	16.0%
Electricity	40.1%	39.6%	38.4%	31.0%	20.0%
Fuels for final energy consumption	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

– **Scenario with measures - WM**

Table 5.3 Aggregate GHG emissions from the Households and Services Sector Gg CO_2 eq. – scenario with measures

	Historical emissions							***WM Projections***		
	1988	1990	1995	2000	2005	2010	2015	2020	2025	2030
Total	6917.50	8102.97	4291.85	2567.09	2512.47	2112.03	1858	1726	2207	2843

5.2.5. Industrial Processes and Product Use

In the past, the main industry sectors of Bulgaria were metallurgy, machine manufacture and chemicals. 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.

The Industrial Processes and Product Use (IPPU) sector’s share as accounted in the 2017 national inventory report is about 9,3**% from the total emissions in 2015.** In 2015 the most important emitting category is Mineral Industries (mainly clinker production) which share in the total Industrial processes emissions is 41,9 **%.** The second category by share is Chemical Industry (ammonia and nitric acid production) with 31,4**%,** followed by Consumption of Halocarbons and SF6 with 20,2**%** share and finally Metal Production (steel) with 3,9%**.**

The emissions reduction during the whole time period from 1988 to 2015 is due to mainly economic reasons. The general reduction in the emissions in the later years of the time period is influenced also by the starting **introduction of better technologies on plant level**.

According to the IPCC 2006, GHG emissions in IPPU result from non-energy industrial activities.

GHG emissions in non-energy sectors were calculated using models based on spreadsheets, considering the activity data and production structure of sub-sectors. The emission factors used are either specific for the sector (determined by analysing data from previous years) according to the IPCC guidelines. Emissions projections are based on following consideration:

- ✓ activity level of the sector, which is a source of GHG emissions;
- ✓ activity level of sub-sector, which is a source of GHG emissions;
- ✓ product or material used for whose manufacture or from whose use GHG emissions result;
- ✓ share of the product/quantity of material used in the activity data of the sub-sector;
- ✓ growth or decrease factor of the activity data at the activity sub-sector level;
- ✓ implied emission factor for the greenhouse gas for the product or material used.

In addition to official statistics, data and other information from industry organizations and companies have been used to obtain better detailed knowledge on the industries and emissions concerned.

Mineral products and chemical industry are the main sources of CO_2 emissions in IPPU sector. Data from cement and lime producing companies is included in the projections.

In the Mineral Industry sector with the largest part of the emissions (about 46,3% in 2015) originates from cement production. Other sources of CO_2 emissions come from lime production, soda ash use, glass production, bricks production.

GHG emissions under chemical industry branch originated by ammonia, nitric acid, Carbide production, Calcium carbide production, Soda Ash and Methanol production but activity data are confidential..

The third largest source of greenhouse gases under IPPU sector is consumption of HFC-s as substitutes for ozone depleting substances. The consumption of HFCs in Bulgaria depends on industry for domestic productive consumption manufacturing) – filling of newly manufactured products, refilling of equipment – or in pre-charged equipment.

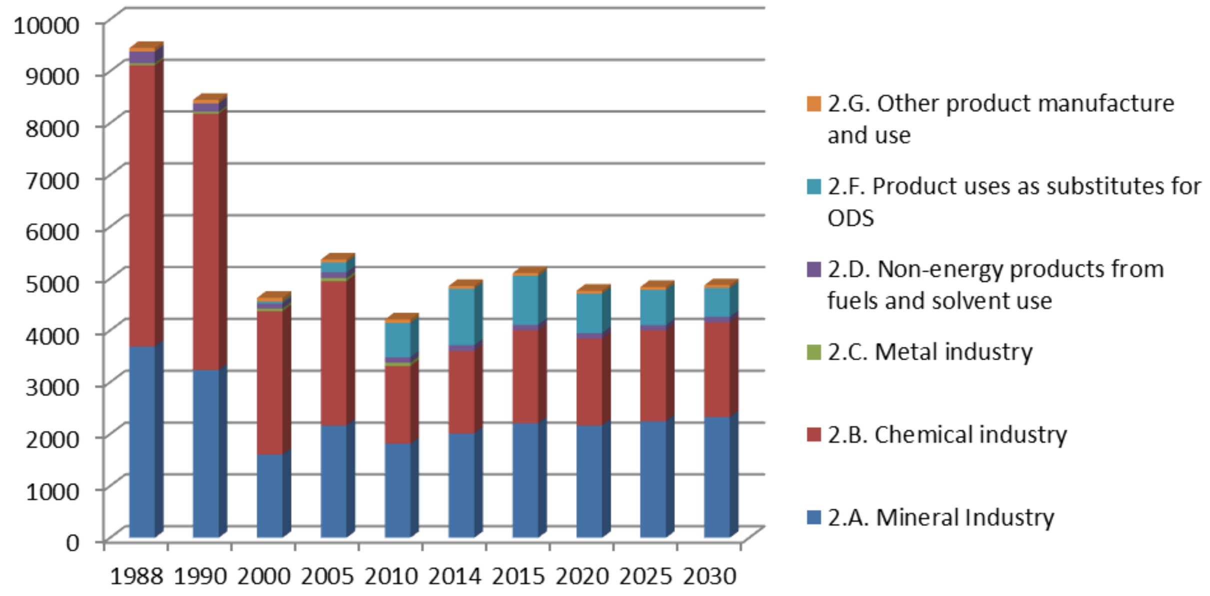
Smaller quantities of GHG-s originate from the sectors: Non-energy products from fuels (CO_2) and Solvent use (NMVOC-s) and other product manufacture and use (SF_6 and N_2O)

Since there are no additional measures planned in the IPPU sector, then the WAM scenario emissions are equal to WEM scenario emissions.

Table 5.16. GHG emissions from Industrial Processes and Product Use sector, Gg CO2 eq.

	Historical emissions							***Projections***		
	1988	1990	1995	2000	2005	2010	2015	2020	2025	2030
Total	13438,6	10046,9	10453,7	7210,1	7683,0	4438,5	5699,3	4829,5	4784,4	4900,8
CO2	11419,3	8324,0	9014,0	6314,6	6540,4	3477,2	4388,6	4226,1	4410,2	4594,2
CH4	52,1	39,9	49,0	37,6	35,1	0,0	0,0	0,0	0,0	0,0
N2O	1963,9	1679,3	1382,5	818,4	904,2	285,6	140,1	141,1	146,8	152,5
F-gas	3,3	3,7	8,2	39,5	203,3	675,7	1170,6	462,4	227,5	154,1

Figure 5.5. Projected GHG emissions from IPPU sub-sector



As a starting point for activity data projections, we used the most recent activity data for the subsector for Bulgaria presented in the 2016 national inventory submissions at the same level of detail. The emission factors have been elaborated based on the national GHG inventory data and a reasonable average value of last 5 year's emission factors and keep these factors constant.

Emissions from IPPU sector are influenced by changes in industrial production and national (European) policy for emission reduction.

5.2.6. Waste Sector

GHG emissions emitted from the Waste Sector are CO_2, CH_4 and N_2O. CO_2 is emitted from the Waste Incineration category. The main share of CH_4 from the Waste sector comes from Solid Waste Disposal on Land. N_2O is emitted from Wastewater treatment and discharge, Biological Treatment and 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.

In absolute terms the GHG emissions from the Waste sector has decreased by 49,16% in 2015 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.

In the Waste projection estimates Bulgaria follows the methods used in its latest GHG Inventory in accordance with the IPCC 2006 Guidelines. In order to calculate the emission projections, basic parameters on which base emissions from the waste sector are estimated in the National Inventory of Greenhouse Gases Emissions were used as a starting point. The projections are based on existing policies and measures for reduction of waste generation and estimates of future quantities of landfilled waste.

Projections in the subcategory Solid Waste Disposal on Land are based on the 2006 IPCC Guidelines. Calculating the amount of municipal waste, human population projection from NSI and the annual real GDP growth rate. Projections in the subcategory Waste Incineration and Open Burning are based on past trend and are forecasted using historical data. For the projections in the Wastewater Treatment and Discharge subcategory, projections on population and historical data are used.

The WEM scenario takes into account the current status of waste management in conformity with the effective legislation and the estimates development of waste management according to effective National Waste management plan 2009-2014. The governmental programmes have set targets and have already achieved tangible reduction of waste generation. The planned measures for reduction of GHG emissions in the sector are related, mostly to the management of solid municipal waste.

The analysis of the GHG inventories over the past few years indicates that the landfills for solid municipal waste are the largest source of methane (CH_4) among all other sources of CH_4 that are reported in the national inventory. 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 50 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.

The projected emissions from the sector in the scenario with measures suggest implementation of programs for reduction of the amount of biodegradable waste for landfilling, as well as capture and flaring of the landfill methane. The best practices can ensure capture and flaring of only about 50% of the generated gas.

Electricity can be generated from landfills where methane is captured and the amount of the generated methane is sufficient. It is seen as a supplementary measure to the scenario with measures.

It is technologically feasible and economically viable to produce thermal and electric energy from the biogas emitted during the stabilization of sludge in methane tanks of the large wastewater treatment plants (for more than 50 000 PE) in order to cover the main share of the installations' energy needs. Currently, this is performed only in 4 WWTP in the country.

Scenario with measures – WM

Table 5.17 GHG emissions from Waste sector, Gg CO_2 eq. – scenario with measures

	Histrorical emissions							***Projections***		
	1988	1990	1995	2000	2005	2010	2015	2020	2025	2030
Total	8259	8007,54	7015	6391	5384	4608	4199	3989	3833,	3684
CO2	18,51	19,83	20,91	62,58	54,83	13,45	10,10	26,45	25,67	24,89
CH4	8000	7787,70	6818	6156	5181	4447	4023	3811	3660	3516
N2O	240	200	176,	172	148	146	165	151	147,	143

With projection with measures, the total reduction of GHG emissions in Waste sector is expected to be 55 % by 2030 compared to 1988.
Reduction of CH_4 emissions is expected to be around 56% by 2030 compared to 1988 under the WEM scenario and N_2O emissions respectively - 40 %.

Scenario with additional measures – WAM

The scenario with additional measures reflects all adopted policies and measures to reduce GHG emissions in the country in this sector and includes the impact of policies and measures presented in this report that have a quantitative assessment at this stage.

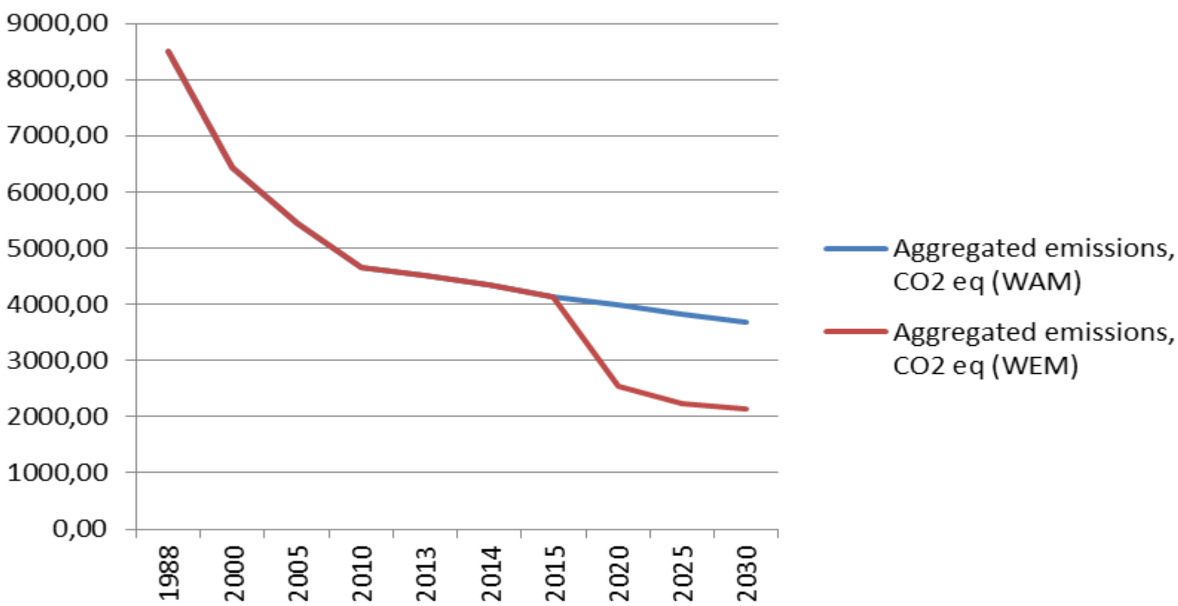
Table 5.4 Aggregate GHG emissions from the Waste Sector, Gg CO_2 eq. – scenario with additional measures

	Historical emissions							*Projections*		
	1988	1990	1995	2000	2005	2010	2015	2020	2025	2030
Aggregated emissions	8 259	8 007	7 015	6 391	5 384	4 608	4 199	2 554	2 224	2 137

The total reduction of GHG emissions in Waste sector under the WAM scenario is projected to be 75 % by 2030 compared to 1988.

Comparison between the two scenarios

Figure 5.4 GHG emissions, Waste Sector under the two scenarios



5.2.7. Agriculture Sector

The reduction of emissions in this sector is a direct consequence of the overall decline of farming since 1988. The reduction of emissions from stock-breeding follows the decrease in the number of livestock.

An important element of the governmental policy is the utilization of EU funds targeted to support rural organizations in order to increase their role in achieving market protection in the purchase of agricultural products. The technological restructuring and the new investment policy of the Ministry of Agriculture, Food and Forestry will ensure the food supply and a positive trade balance. This will increase the competitiveness of the Bulgarian agricultural producer. Special attention will be focused on the preservation of soil fertility through the introduction of anti-corrosion activities, new methods of soil cultivation and discontinuation of the practice of burning crop residues in the fields.

GHG emissions from the Agriculture sector for 2015 are mainly due to several sources as follows:

- Agricultural soils (60.5%);

Emissions from agricultural soils include the following main categories that produced N2O emissions:

- Direct emissions – these emissions are 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.

- Emissions from pasture animals – emissions from the excretion on pasture range and paddock.

- Indirect emissions – these emissions are result from ammonia and nitrous oxides release in the ambient air after nitrogen fertilization; Emissions from drawing of water.

- Enteric fermentation (25.7%);

Emissions from enteric fermentation are result from fermentation in ruminant animals' digestive system (e.g., cattle, sheep, and goats). Non – ruminant livestock (horses, mules and asses) and monogastric livestock (swine) produce lower methane emissions. The amount of methane that is released depends on age, weight of the animal, and the quality and quantity of the feed consumed. All domestic animals are bred in Bulgaria.

- Manure management (10.3%);

The category manure management produced methane and nitrous oxide emissions during the storage and treatment of manure, and from manure deposited on pasture (CH4), and treatment of manure before it is applied to land (N2O). In accordance with the IPCC guidelines, the term "manure" is used collectively to include both dung and urine produced by livestock.

- Rice cultivation (1.9 %)

Rice cultivation is a traditional Bulgarian agricultural activity. During the structural reforms, rice crop areas decreased from 14 100 ha in 1988 to 1 417 ha in 1999. There has been a restoration of rice crop areas after 1999, reaching 11 043 ha in 2014.

In Bulgaria rice is produced under the continuously flooded water regime with season length of 103 days and one harvest per year.

- Agricultural residue burning (0.5 %);

Despite field burning is prohibited by the Bulgarian law, this "tradition" continues and is emission source not only of main GHGs but also of GHGs-precursors.

- Urea fertilisation (1.13%).

Scenario with measures – WM

According to the Third National Action Plan on Climate Change (NAPCC) for 2013-2020, Bulgaria provisions grow of 8% for the first period of the projections 2015 - 2020 for the sector of agriculture, due to governmental policy for utilization of EU funds targeting to support rural organizations.

Livestock numbers are one of the most important parameters in accurately determining emissions and projections from enteric fermentation and manure management. For N_2O emissions from Managed Soils, the needed parameters for estimating the emissions and projections are nitrogen input from application of synthetic fertilizers, nitrogen input from application of manure, nitrogen fixed by N-fixing crops and nitrogen in crop residues returned to soils.

Table 5.19 Aggregate GHG emissions from the Agriculture Sector, Gg CO_2 eq. – scenario with measures

	Histrorical emissions							***Projections***		
	1988	1990	1995	2000	2005	2010	2015	2020	2025	2030
Total	13408	12127	5716	4987	4963	5245	5937	5065	5266	5454
CO2	72,90	53,34	17,45	19,52	21,49	18,05	67,27	67,27	67,27	67,27
CH4	5928	5644	2648	2299	2073	1830	1784	1635	1737	1842
N2O	7407	6429	3049	2668	2868	3396	4085	3362	3461	3544

Scenario with additional measures – WAM

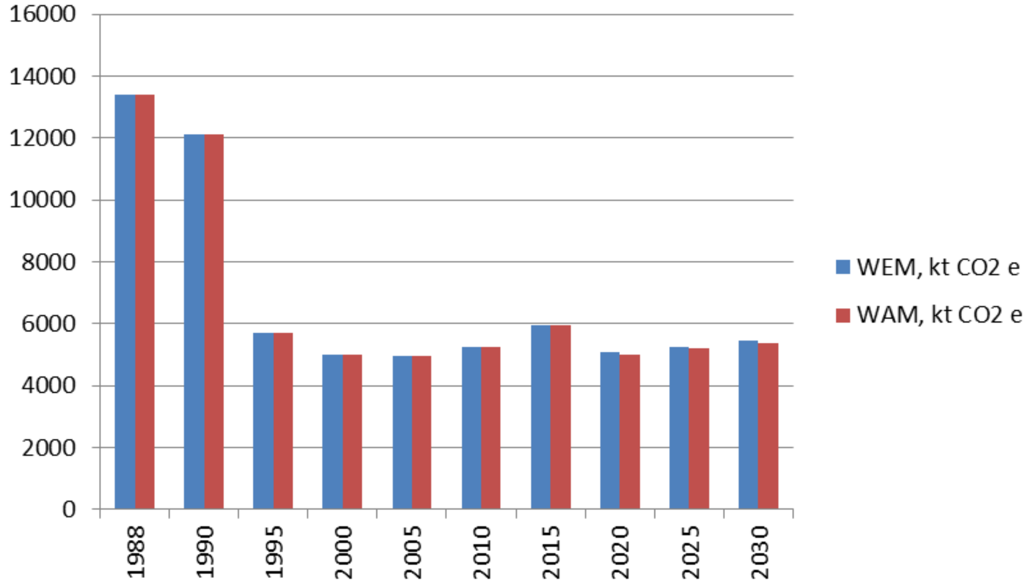
The scenario with additional measures reflects all adopted policies and measures to reduce the GHG emissions in the country in this sector and includes the impact of policies and measures presented in this report that have a quantitative assessment at this stage.

Table 5.20 Aggregate GHG emissions from the Agriculture Sector Gg CO_2 eq. – scenario with additional measures

	Histrorical emissions							***Projections***		
	1988	1990	1995	2000	2005	2010	2015	2020	2025	2030
Aggregated emissions	13408	12127	5716	4987	4963	5245	5937	5005	5205	5391

Comparison between the two scenarios

Figure 5.5 GHG emissions, Agriculture Sector under the two scenarios



5.2.8. Land Use, Land Use Change and Forestry (LULUCF)

The LULUCF emission/removal projections, Bulgaria follows methods which represent a statistical treatment of historical data. The level of stratification is the same as that used in the national inventory. In its estimates Bulgaria has used the average historic annual rate or the use of trend value/trend function. The projections of activity data have been made up to 2030 taking into account the objectives set out in the following strategic document:

- Third National Action Plan on Climate Change (2013 – 2020)
- National Strategy for Development of the Forestry Sector in the Republic of Bulgaria for the period 2013-2020 (NSDFSRB).
- Strategic Development Plan for the Forestry Sector (SDPFS) 2014-2023
- EU agricultural policy for 2014-2020

In the LULUCF projection estimates Bulgaria follows the methods used in its GHG Inventory report. Concerning Forest land category Bulgaria has applied stock change method in estimating changes in biomass pool. The values of conversions parameter – D, BEF, R are considered to be the same as used in the GHG Inventory preparation. The driver in the estimate is the growing stock of Bulgarian forest. For the projections estimation Bulgaria has used excel-based projection model. The emission factors used in estimation of changes in soil and dead organic matter pools are the same as in the GHG Inventory report.

Scenario with measures – WM

The estimates of LULUCF projections of emissions/removals with WEM (with existing measures) scenario reflects all adopted policies and measures set out in strategic documents for development of Forestry and Agricultural sector.

Table 5.5 Aggregate GHG emissions from the Land Use, Land Use Change and Forestry Sector – scenario with measures

	Historical emissions							***Projections***		
	1988	1990	1995	2000	2005	2010	2015	2020	2025	2030

Total	-15388	-15023	-13685	-9610	-9260	-9607	-6874	-11209	-11737	-12265
CO2	-15456	-15094	-13754	-9900	-9334	-9703	-6967	-11304	-11832	-12360
CH4	1,1	2,4	1,3	134,7	3,4	15,2	12,8	14,4	14,4	14,4
N2O	67,5	68,4	67,7	156,0	71,1	80,6	80,3	81,1	81,2	81,2

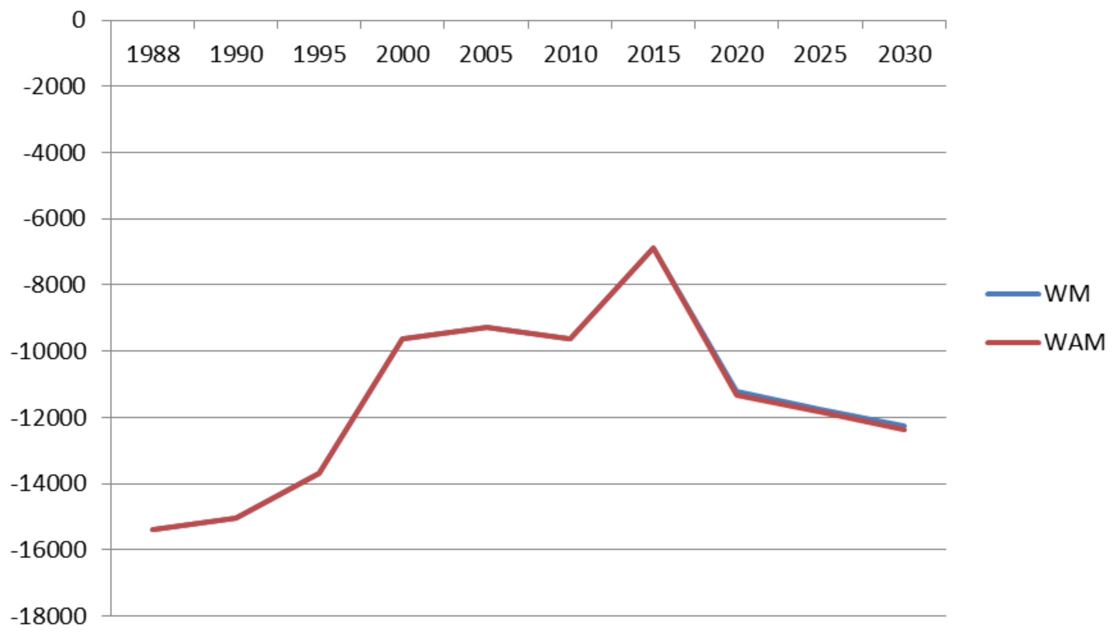
– **Scenario with additional measures – WAM**

The scenario with additional measures reflects all adopted policies and measures to reduce GHG emissions in the country in this sector and includes the impact of policies and measures presented in this report.

Table 5.23 Aggregate GHG emissions from the Land Use, Land Use Change and Forestry Sector – scenario with additional measures

	Historical emissions							***Projections***		
	1988	1990	1995	2000	2005	2010	2015	2020	2025	2030
Aggregate emissions	-15388	-15023	-13685	-9610	-9260	-9607	-6874	-10104	-5887	-6019

Figure 5.6 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 2015.

The scenario with additional measures reflects all adopted policies and measures to reduce GHG emissions in the country after 2015 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 of Bulgaria (excl. LULUCF)– Gg CO_2 eq. - scenario with measures

	2015	2020	2025	2030
Total emissions, WM	61 482,75	59 086,83	55 580,88	55 492,74

The scenario with additional measures reflects all adopted policies and measures to reduce GHG emissions in the country after 2015 and includes the impact of policies and measures presented in this Plan that have a quantitative assessment at this stage.

Table 5.25 Aggregate GHG emissions of Bulgaria - Gg CO_2 eq. - scenario with additional measures

	2015	2020	2025	2030
Total emissions, WAM	61 482,75	53 325,5	49 650,4	49 826,8

Comparison between the two scenarios is presented in the following Table 5.26

Table 5.26 Comparison between GHG emissions, aggregated for Bulgaria under the two scenarios

	2015	2020	2025	2030
Aggregate emissions in Gg CO2 eq. ΔWAM-WEM	0	2889,9	2717,4	2571,1
Δ WAM - WEM, %	0	5,0	5.0	4.8

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 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) were regulated by Directive 2003/87/EC. It functioned at Member State level on the basis of National Allocation Plans (NAPs) developed by each country and approved by decisions of the European Commission.

Pursuant to Directive 2008/101/EC, the scope of the ETS is enlarged to cover also aviation activities as of 1 January 2012.

Bulgaria was included de jure in the EU 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 a decision of the Commission from April 2010. At the time of the approval of the NAP, the Emission Trading Scheme in Bulgaria covered 132 installations. The total amount of allowances for allocation was determined at just under 206 million (205,892,286) and included the allowances for installations covered by the scheme, as well as those reserved for new entrants and projects under the Joint Implementation mechanisms of the Kyoto Protocol.

Directive 2009/29/EC on ETS provides for the reduction of greenhouse gas emissions from sources covered by the scheme by 21 % compared to their 2005 levels. The new elements can be summarized as follows:

- inclusion of new sectors and gases;
- harmonized approach – a common cap on emissions, instead of 27 national limits;
- reserve for new entrants set at EU level (5% of the total allocation);
- a single registry;
- gradual increase of traded allowances at the expense of free allocation;
- harmonized rules for free allocation based on ambitious indicators;
- 100% auctioning of allowances for electricity generation.

In Phase III of the scheme, the default means of allocating allowances is auctioning. During the current trading period (2013-2020), approximately the half of emission allowances are allocated for free and half are auctioned. The power sector is included in the EU ETS, and according to the rules in Phase III of the scheme, which commenced in 2013, no free allowances should be given to the power sector. Under the derogation (Article 10(c) of the revised EU-ETS Directive) free of charge allocation is allowed to existing power plants for a transitional period (a decreasing number free of charge allowances, which by 2020 is 0). This is conditional upon the country and Bulgaria must ensure that at least the equivalent value of the free allowances is invested in modernising their electricity generation through investments set out in a national plan included in their applications. All other installations receive free allocations according to fixed EU benchmarks and risk for carbon dioxide leakage.

Regarding emissions from the aviation sector, since the beginning of 2012, emissions from all flights from, to and within the European Economic Area (EEA) (i.e. the 28 EU Member States, plus Iceland, Liechtenstein and Norway) are included in the EU ETS. The legislation, adopted in 2008, applies to EU and non-EU aircraft operators. As the industrial installations covered by the EU ETS, aircraft operators receive tradable allowances covering a certain level of CO2 emissions from their flights per year.

In April 2013 the EU decided to temporarily suspend enforcement of the EU ETS requirements for flights in 2012 to and from non-European countries. For the period 2013-2016 the legislation has also been amended so that only emissions from flights within the EEA fall under the EU ETS.

Exemptions for aircraft operators with low emissions have also been introduced. The EU took this initiative to allow time for the International Civil Aviation Organization (ICAO) Assembly to reach a global agreement to tackle aviation emissions.

In October the ICAO Assembly agreed to develop by 2016 a 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.

28 JI projects have been approved in Bulgaria and 21 of them have already achieved and verified emission reductions. The implementation of those projects lead to greenhouse gases emission reduction around 10 million tons carbon dioxide equivalent until 2012.

The results are presented in Table 5.27.

Table 5.27 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
- Paris Agreement to the UNFCCC, enforced in 2016

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. Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC
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

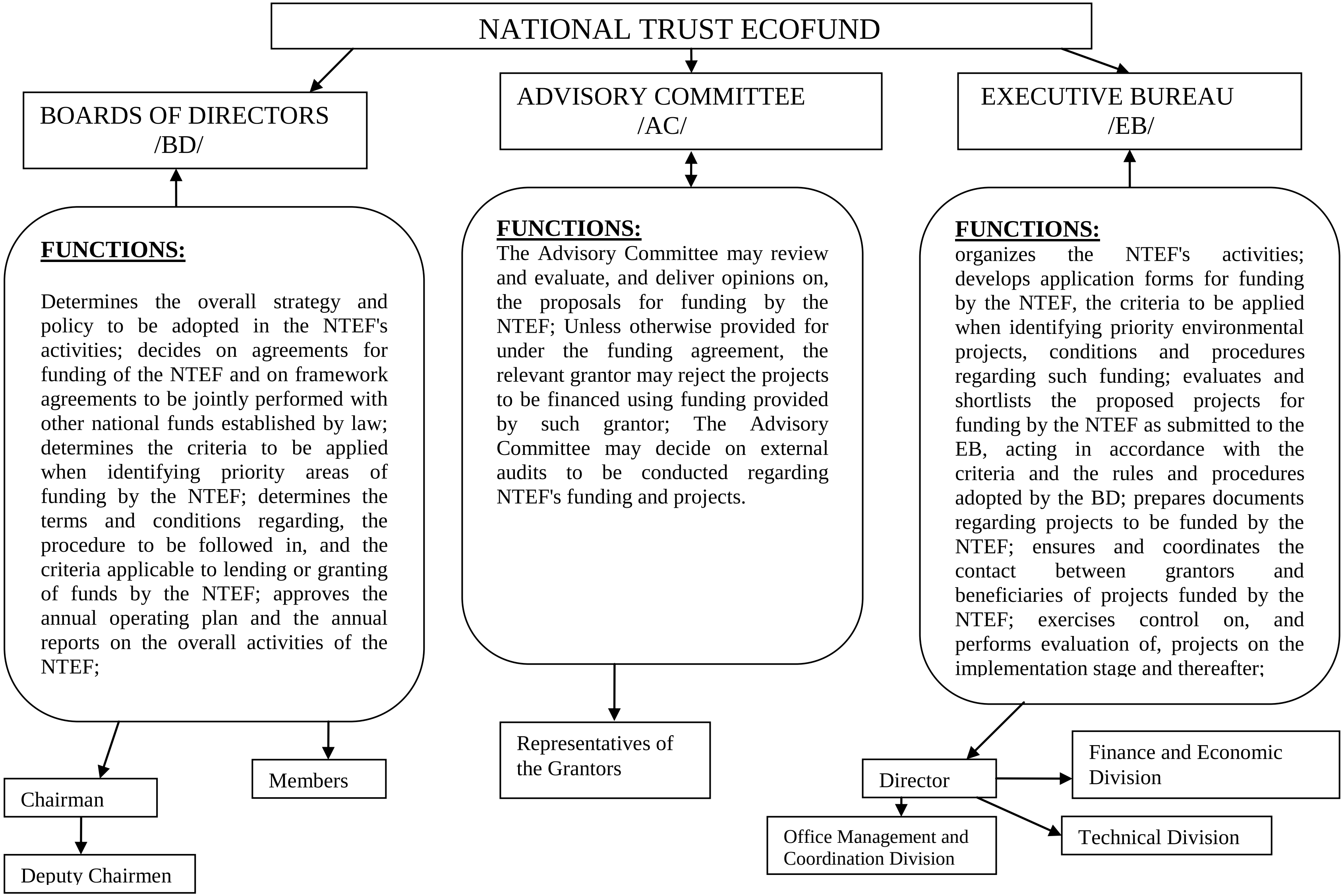
National legislation:

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. 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
9. Ratification act of the Paris Agreement (published in State Gazette, No 86/01.11.2016)

In June 2010 an Amendment to the Environmental Protection Act (EPA) was approved by the Council of Ministers and the National Assembly. The 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 5.7 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 NGIS in Bulgaria. Procedure for the process of assessment and approval of applications and projects are shown on Figure 5.10.

Table 5.28 Environmental, financial and social results from the NGIS

	Reduced GHG emissions (t CO_2/year)	Achived savings of financial resources	Number of people affected
AAUPA I	7 017	1 813 827	23 612
AAUPA II	8 413	2 522 493	46 367

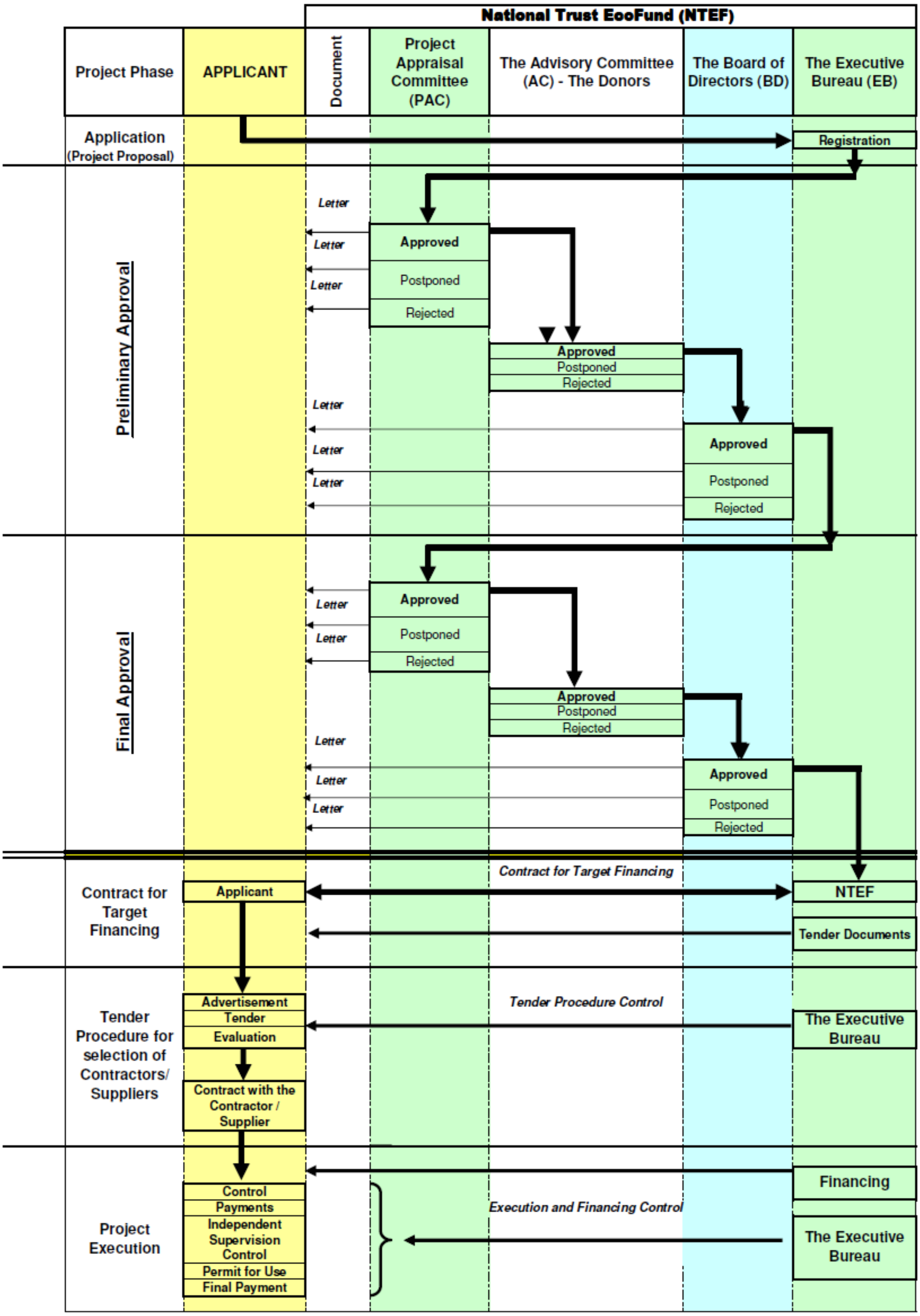
TOTAL	15 430	4 336 320	69 979

The successfully completed projects in the NGIS program stimulate a decrease of energy consumption in the public buildings. This, on the other hand, translates into reduction of greenhouse gas emissions – a total of 443 844 t/CO_2 eq. for the entire program.

In 2015 was started the Investment Climate Programme, which is a kind of continuation of the National Green Investment Scheme. The new programme is implemented by Trust Eco-Fund and it is financed by the revenues from so called "early auctions" of greenhouse gas emissions allowances from installations paid into the budget of the Ministry of Environment and Water by 31st December 2012. The funds are designated to be used for financing of the projects aiming at improving of energy efficiency of state and municipal public buildings, as well as for promoting the use of electric and hybrid vehicles by public institutions (since 2016).

In addition in 2015 at COP 21 in Paris Bulgaria announced its grant contribution of 100 000 Euros to the Green Climate Fund through the Ministry of Foreign Affairs of Republic of Bulgaria, That was a voluntary contribution to the GCF

Figure 5.8 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 2015 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 5.29: Basic macroeconomic indicators (2010 prices)

Basic indicators	**2010**	**2011**	**2012**	**2015**	**2020**	**2025**	**2030**
GDP (billion euro)	38.2	38.9	39.0	41.3	**42.6**	**45.3**	**47.8**
GVA (billion euro)	33.2	33.9	33.6	35.3	**36.7**	**39.1**	**41.2**
Population (million)	7.50	7.32	7.28	7.15	6.94	6.72	6.49
Employment (15+, million)	3.60	3.52	3.43	3.44	3.60	3.65	3.7
Employment rate (15+, %)	47.9	46.6	46.6	49.1	52.8	51.8	51.6
GDP per capita (euro)	5169	5619	5741	6309	6750	6 823	8 089
GVA per employee (euro)	10607	11341	11488	11976	12 450	13 304	16 124

Source: NSI, MF projections, own calculations

9Table 5.6: Basic macroeconomic indicators - growth

Growth (average annual, %)	**2011**	**2012**	**2015**	**2010 2015**	**2015 2020**	**2020 2025**	**2025 2030**	**2010 -2030**
GDP	2.80	2.90	3.6	3.28	4.32	3.44	2.75	3.45
GVA	0.96	2.82	3,0	2.75	4.54	4.02	3.32	3.66
GDP per capita	4.76	3.12	3.5	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	-0,7	-0.99	-0.65	-0.69	-0.69	-0.75
Employment	0.09	0.47	0.4	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 2015-2020 is projected at 4.3%. 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 5.31 GDP on the demand side – real growth (%)

	2011	2012	2015	2010 2015	2015 2020	2020 2025	2025 2030	2010 2030
GDP	2.80	2.90	3.6	3.28	4.32	3.44	2.75	3.45
Consumption	1.28	1.90	2,59	2.36	4.11	2.70	3.61	3.19
Consumption of households	0.64	1.87	1.5	2.38	3.99	2.46	3.77	3.15
Domestic investments	-5.00	4.70	4,41	3.89	6.70	2.19	1.43	3.53
Export	11.72	5.36	4,2	6.80	4.75	4.00	1.63	4.28
Import	6.22	4.89	4,1	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 5.32: GDP on the production side – real growth (%)

	2011	2012	2015	2010 2015	2015 2020	2020 2025	2025 2030	2010 2030
GVA	0.96	2.82	3,0	2.75	4.54	4.02	3.32	3.66
Agriculture	-1.82	2.26	-1.4	-0.01	1.76	1.17	0.49	0.85
Industry	4.07	2.35	3.1	3.03	4.35	4.03	3.33	3.68
Mining industry	9.74	3.70	2.0	3.64	3.45	3.44	3.10	3.41
Processing industry	6.83	2.69	2.9	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	2.8	4.02	3.95	3.93	3.34	3.81
Water supply; sewerage services, waste management and recovery	9.82	9.33	4.4	7.54	6.15	6.53	5.01	6.30
Construction	-10.38	-0.50	1.43	-1.18	3.99	3.44	2.75	2.23
Services	-0.35	3.11	1.2	2.83	4.77	4.11	3.42	3.78
Trade; repair of motor vehicles and motor cycles	1.31	2.55	1.2	3.03	4.51	3.68	3.55	3.69
Transport, storage and posts	1.66	3.12	1.3	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 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 CO_2 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 CO_2eq. 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 CO2 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 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 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, 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 CO2 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 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 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.

GHG emissions projections depend on a number of economic and energy assumptions and are subject to significant uncertainty, especially in the longer term. In general, GDP growth has a direct and significant impact on GHG emissions. The energy intensity is correlated with population and GDP rates.

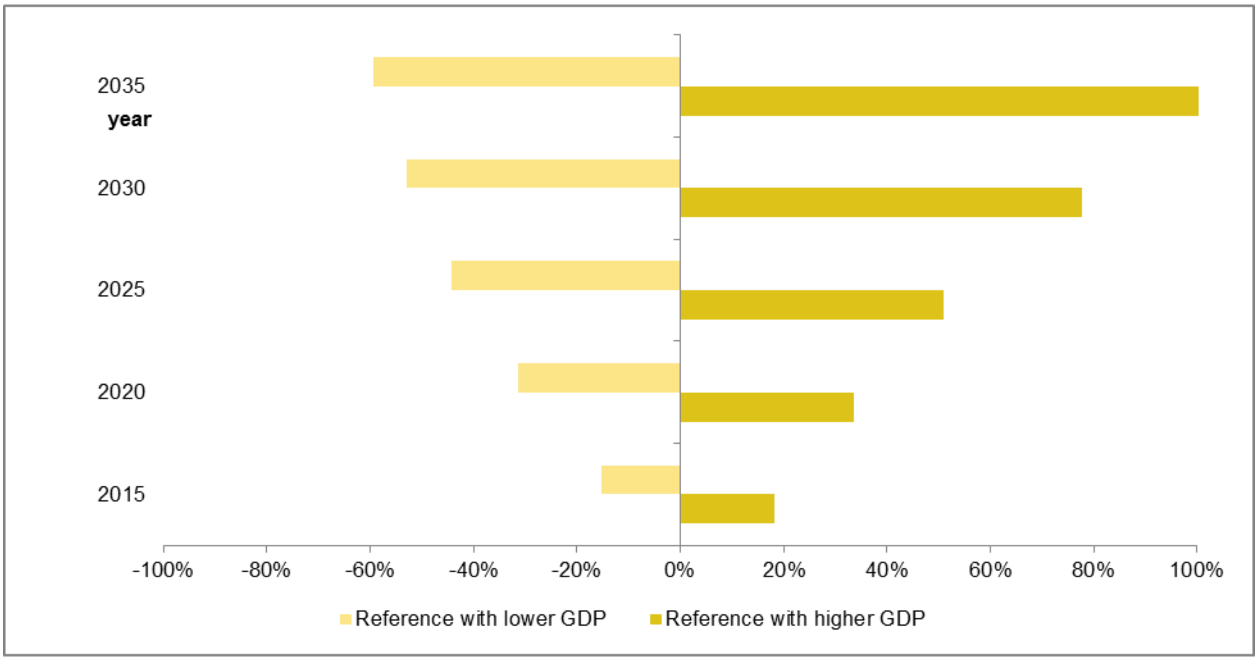
Table 5.33. GHG emissions at a different scenario

Scenario	**base year**	**2015**	**2020**	**2025**	**2030**
	GHG emissions (Mt CO_2-eq)				
Reference	57	59	59	56	56
Reference with higher GDP	57	70	79	85	100
Reference with	57	50	41	31	26

lower GDP					

These scenarios suggest that the expected emission range in 2030 could be from 26 Mt in the lowest emissions scenario to 118 Mt in the highest emissions scenario. This 96 Mt range will continue to change over time with further government actions, economic conditions and developments in energy demand.

Figure 5.11. Relative change in total GHG emissions at a variation of GDP (% vs. Reference case (WEM))



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% lowlands (0–200 m), 41% hills (200–600 m), 25% highlands (600–1,600 m), and 3% mountains (>1,600 m). Bulgaria has unusually various climate conditions due to the influence of the strongly different continental and Mediterranean climates and diverse landscape. The climate has four distinct seasons and varies with altitude and location. According to the accepted in the National Institute of Meteorology and Hydrology at the Bulgarian Academy of Sciences climate classification, the territory of Bulgaria is divided into two climatic areas (European-Continental and Continental-Mediterranean), four climatic subareas (Moderate-Continental, Transition-Continental, South-Bulgarian and Black-Sea), and twenty-five climatic regions, which include the corresponding coastal and mountainous zones.

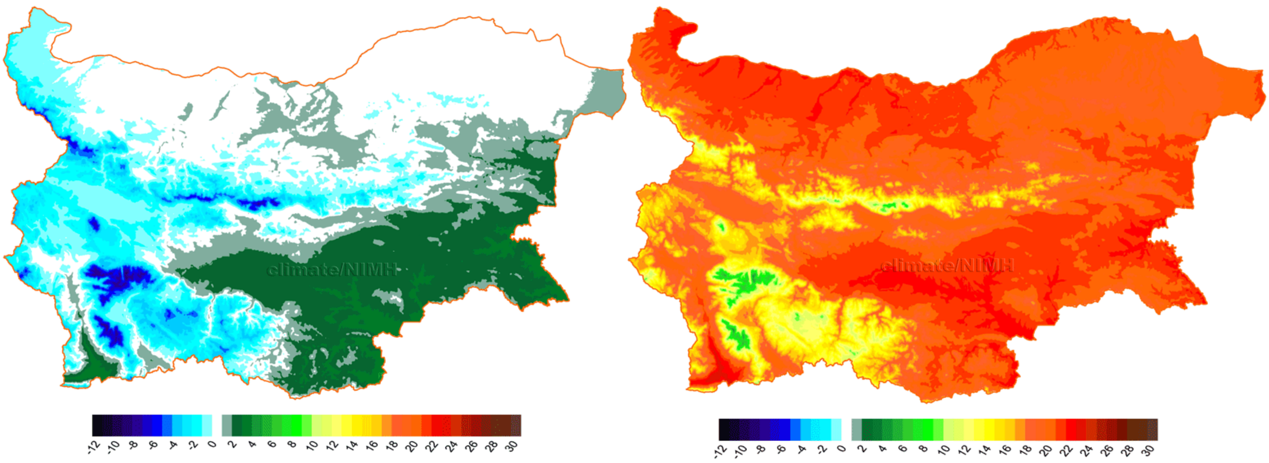
Clear expressed seasonality in the intra-annual course of insolation (relevant to the intra-annual alteration of sunshine duration) determines the levels of heat balance and thence the affiliation of the country to the regions of the continent with warmer climate. Because of the distance from the ocean, the Atlantic air masses appear chilled during the cold half year and overheated in the warm half year. Comparatively large and compact area of the Balkan Peninsula advantages the formation of local continental air masses, which during the summer become almost like tropical air, and during the winter – like cold continental air. The short distance to Mediterranean Sea enhances the climate differences between Northern and Southern Bulgaria. The immediate proximity to the Black Sea reinforces some characteristics of atmospheric circulation, mainly in the cold half year, and results in formation of specific sea climate in coastal area (20-40 km). High mountains serve as barriers for the air masses transfer, which predetermines the distribution of precipitation. The Mediterranean cyclones are most frequently observed from November to May/June; they have significant influence over the weather and climate in Southern Bulgaria. The Atlantic cyclones rarely reach the central areas of the Balkan Peninsula but they have influence over the weather and climate in Northern Bulgaria; their frequency is highest from February until June (with a maximum in May). The north-western anticyclones appear most frequently from the middle of spring until the middle of summer and usually cause cold spells in late spring and early summer. The western anticyclones cause warm spells in the winter and cold spells in the summer. The south-western anticyclones usually bring tropical air masses and the highest temperatures and droughty spells in the period July-September. The arctic anticyclones (moving from north/north-east towards southern continental areas) bring prolonged snowfalls and snowstorms in February and March. The process of formation of local anticyclones in the ridges of north-eastern ones causes the lowest temperatures in Bulgaria.

The sunshine duration reaches the highest average annual value in the southern border part of Struma Valley – 2800 hours. Along the Black Sea coast, in the Thracian Lowland, and Mesta Valley, the annual value of sunshine duration is 2200-2300 hours; in the Danube Plain – 2100 hours. Due to the higher cloudiness and naturally narrowed horizon in the mountains, the sunshine duration decreases to 1900 hours per year. For the non-mountainous parts of Bulgaria, the average annual values of the total solar radiation vary from 4000 MJ/m^2 to 4700 MJ/m^2 (up to 5000 MJ/m^2 in the southern parts of the country). In December as well as in January, the total solar radiation is 3-4% of its annual values. In the summer months (June, July and August) the total solar radiation is about 40-45% of the annual values.

During the winter, the average temperature in January is negative in the Danube Plain (from -2.3°C to about -1°C) and in the higher valleys of the West Central Bulgaria (below minus 2°C), and positive in the Thracian Lowland (0-1.5°C) as well as in the southern parts of Black Sea region (above 3°C). In the mountains, the temperature in January drops with altitude with 0.3-0.4°C per 100 m. Spatial distribution of average seasonal air temperature in the winter is shown on Figure 1 – left panel.

In the spring, spells of warm and cold weather succeed each other because of the exchange of air masses from different origin. Foehn winds are often observed in Northern Bulgaria. Thermal differences between northern and southern parts of the country almost disappear except the southernmost parts. The average temperature in April is 10-13°C (greater than 13°C in the southern regions and lower than 10°C in the valleys). In the mountains, the temperature decreases with the elevation with 0.6-0.7°C per 100 m. Conditions for the onset of spring frost appear during the cold snaps, when the minimum temperatures even in the lowlands fall below 0°C.

Figure 6.1. Air temperature (°C) in the winter (left) and summer (right) during the current climate 1961-1990



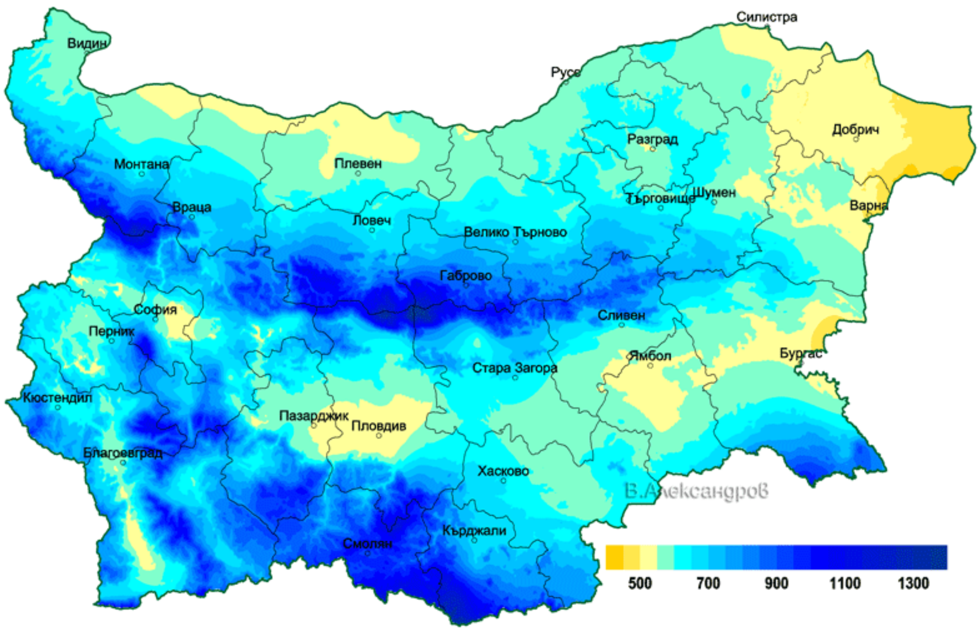
During the summer, thermal conditions are dominated by the transformed Atlantic air masses with Azorean origin in the circumstances of intense solar radiation. The temperatures to the north and south of the Balkan Mountains are almost equal. The average temperature for July is 21-24°C in the Danube Plain, and 22-24°C in the Thracian Lowland. The average monthly temperature is around or lower than 20°C in the high valleys of the West Central Bulgaria, 22°C in the Black Sea region and above 23°C in the southern regions (24-25°C along the Struma Valley). A marked decrease in the temperature with altitude is observed in the mountains (0.7°C/100 m). Spatial distribution of average seasonal air temperature in the summer is shown on Figure 6.1 – right panel.

In the autumn, the transfer of cold air masses from north-west and north-east is registered more frequently. The barrier effect of the Balkan Mountains and southern mountains (Rila-Rhodope region) causes some differences in the climate between northern and southern parts of the country. The values of average monthly temperature in October are lowest in the Danube Plain (11-12°C) as well as in the high valleys of West Central Bulgaria (lower than 11°C). The autumn is warmer in the Thracian Lowland (above 12°C), on the Black Sea coast and in the southernmost regions (13-14°C). In the higher parts of the country the differences are not so obvious in comparison with the spring and summer and the temperature decreases with 0.5°C per 100 m.

Absolute maximum temperatures in the non-mountainous parts of Bulgaria are higher than 40°C (35°C for the Black Sea coast); the set up temperature record is 45.2°C in Sadovo, registered in 1916. Absolute minimum temperatures range from -20°C to -30°C in the lowlands and from -15°C to -20°C in the coastal zone. The lowest air temperatures aren't measured in the mountains but in the plains. The set up record for absolute minimum air temperature is -38.3°C (Tran, 1947).

Average annual values of precipitation alter from 450-550 mm (mainly in some parts of Danube Plain, Thracian Lowland and Black Sea region) to 900-1200 mm in the mountainous regions (Figure 6.2). In the mountains, the annual amount of precipitation increases linearly with altitude up to 2000 m.

Figure 6.1 Annual precipitation amount (mm) during the current climate 1961-1990



During the winter, in the Moderate-Continental climatic subarea, the precipitation amount is smallest – 18-20% of the annual sum (100-110 mm in the lowland parts and 190-200 mm in the highest parts of the mountains). In the Continental-Mediterranean climatic area, the winter precipitation amount is highest: 150-300 mm. In the spring, the rainfall in the Moderate-Continental subarea increases to 25-27% of the annual amount. More frequently are observed rains of convective type. In the regions with Continental-Mediterranean climate, the precipitation decreases to 23-25% of the annual amount. In the Moderate-Continental climatic subarea, the precipitation maximum is during the summer – from 28-33% to 35% of the annual totals. The highest are the values in June (60-120 mm). In the regions with Continental-Mediterranean climate the summer rainfall is smallest: 100-160 mm or 20% of the annual amount but this value increases with the elevation. The end of the summer is a droughty period in the country, which persists sometimes until the mid-September. In October and November prolonged heavy rainfalls are observed, more frequently in Southern Bulgaria. In the regions with Continental-Mediterranean climate seasonal precipitation represents 26% of the annual amount; in the regions with temperate continental climate this value is smaller than the precipitation amounts in the spring and summer. The maximum 24-hour rainfall can reach more than 200-250 mm.

The snow cover in Bulgaria is characterized by marked variability in time and space. In the lower parts of the country, it forms and disappears several times per season (the average depth is about 10-15 cm per season). Rarely, the snow cover depth could reach 30-40 cm in the coastal region, above 60-70 cm in Dobrudzha and above 100-110 cm in the Danube Plain. In the mountainous areas the maximum of snow accumulation shifts with altitude from the end of January until the beginning of March. In the hilly parts (500-800 m) the accumulation of snow begins in December; for the high parts (1000-1500 m) – even in November. The average snow cover depth in the lower parts of the mountains is 25-30 cm in January and February. The maximum values can reach to 200 cm and more in the highest parts in March and April, when the maximum accumulation is observed.

The prevailing winds are north-west/west and north-east (in some southern parts of the country). Several regions could be outlined with relation to the average annual wind speed. The first one includes lowland parts, where the average wind speed does not exceed 2 m/s (with maximum in February/March and minimum in September/October). The second region comprises the north-eastern parts of the country and the unsheltered low mountainous regions (up to 1000 m), where the average annual wind speed is 2-4 m/s (with maximum in February-March and minimum in August-September). The third region consists of unsheltered and deforested mountainous regions over 1000 m, where the wind speed exceeds vastly 4 m/s, with an annual maximum in February and minimum in August. Among the local winds, the most characteristic are the breeze (3-5 m/s), mountain-valley winds (3-6 m/s), katabatic winds (Sliven's wind with velocity more than 15 m/s) and foehn winds (10-20 m/s).

Since the middle of 1980s, the tendency of the average annual air temperature in Bulgaria is towards warmer climate (Figure 6.3). In fact, the annual temperature anomalies are positive from 1997 to now. Moreover, they are equal or exceed 1°C for the all years after 2007 (except 2011). Since the beginning of 21st century, 2015 appears as the warmest year (1.6°C above the climactic normal in the areas up to 800 m altitude); in Northern Bulgaria – 1.8°C above the normal (Figure 4). Warmest months are November, July and January, with deviations from the monthly normal +3.2°C, +2.7°C and +2.6°C, correspondingly.

Figure 6.2 Anomalies of annual temperature in areas up to 800 m altitude for the period 1988-2016 relative to the period 1961-1990

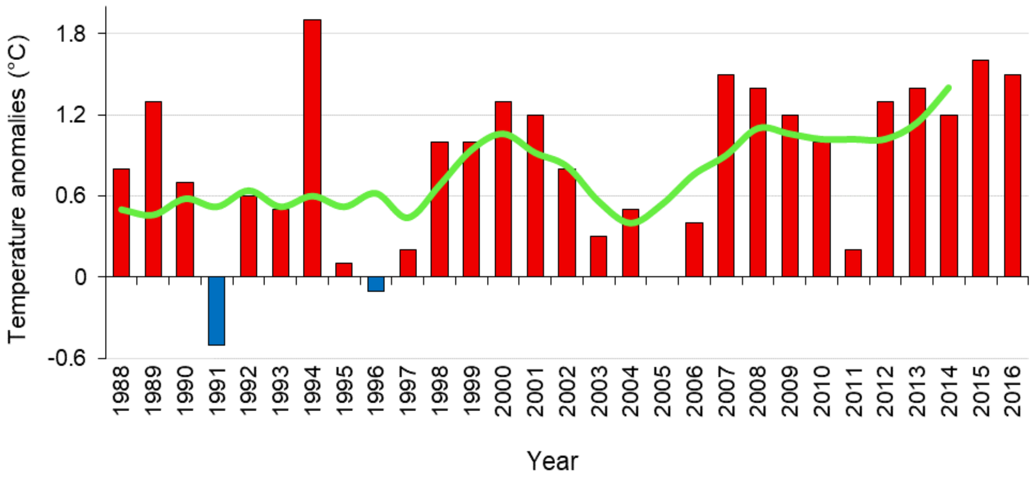
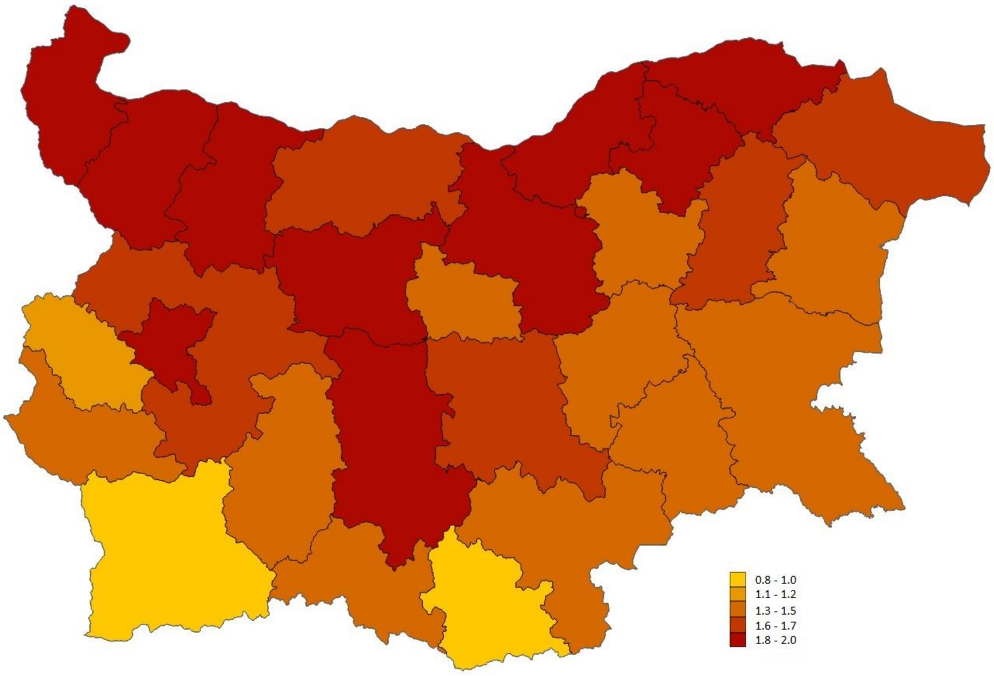


Figure 6.4 Deviations of annual average air temperature (°C) in areas up to 800 m altitude for 2015 relative to the climatic normal for the period 1961-1990 (averaging by districts)



Climate in Bulgaria became not only warmer but also drier at the end of the 20th century. During the last decade however, precipitation totals have increased (Figure 6.5) but heavy rainfall events caused severe floods damaging various socioeconomic sectors. 2014 is the rainiest year in the whole period 1988-2016 (Figure 6.6). The average annual precipitation amount is 1013 mm for the areas up to 800 m altitude that is more than the previous reached maximum of 924 mm in 2005. Most rainy months are September (902% of the monthly normal in Asenovgrad), October (487% in Avren, Varna district) and December (370% in Silistra). In 2014, in the period April-October, have been measured extreme 24-hour rainfall amounts. The largest value of 245 mm (Burgas district) ranks 2014 among the seven years in the period 1988-2014 with extreme 24-hour precipitation above 220 mm.

Figure 6.5 Anomalies of annual precipitation in areas up to 800 m altitude for the period 1988-2016 relative to the period 1961-1990

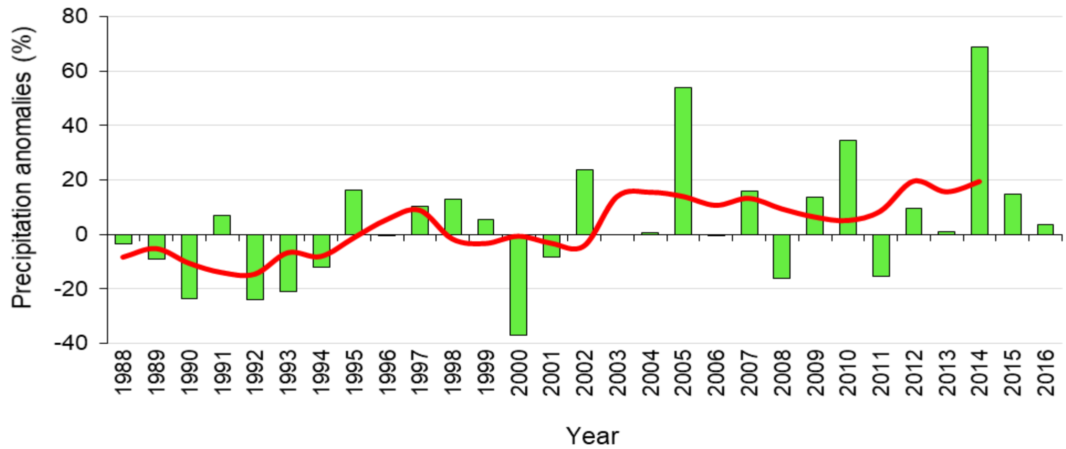
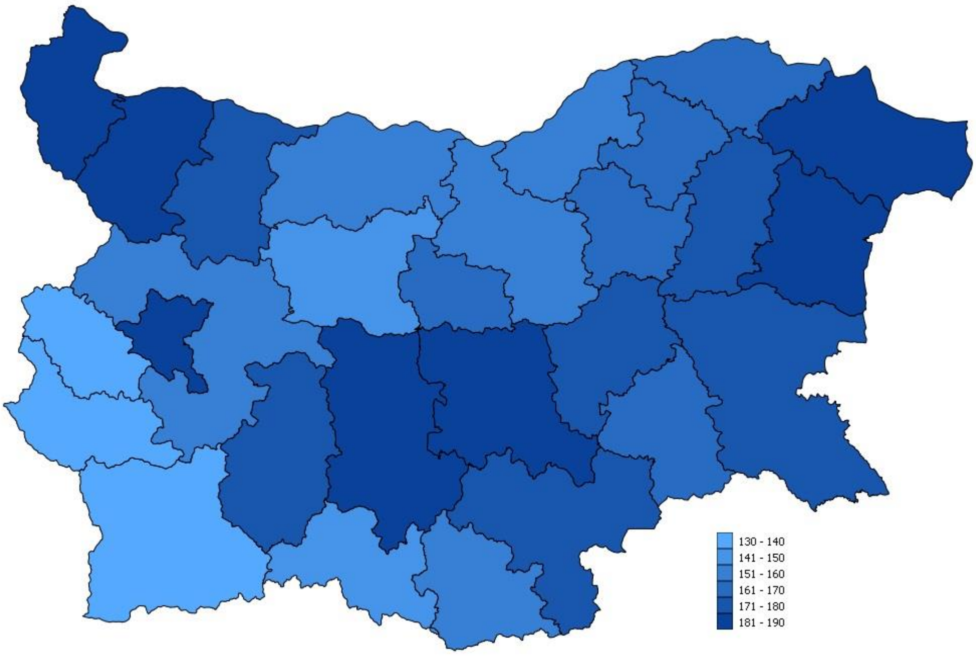
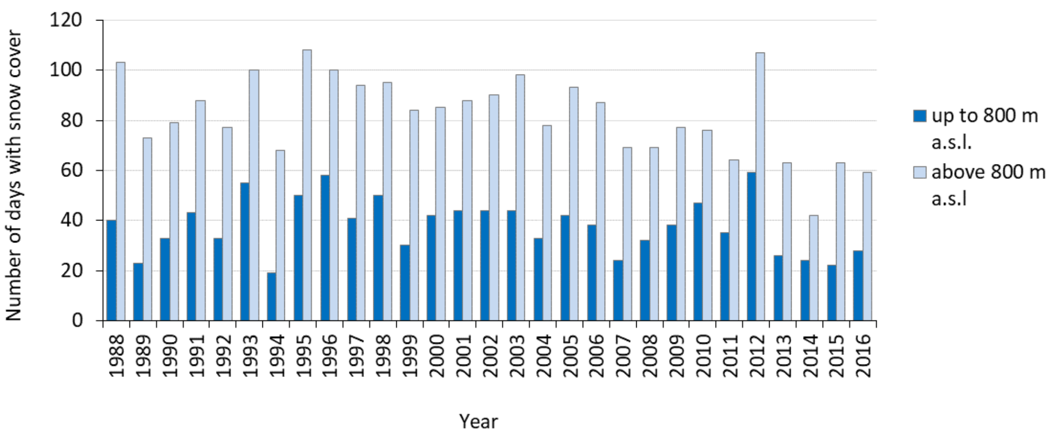


Figure 6.6 Deviations of annual precipitation (%) in areas up to 800 m altitude for 2014 relative to the climatic normal for the period 1961-1990 (averaging by districts)



During the period 1988-2016 the decreasing trend of the average maximum snow cover depth in the upland areas (800-1800 m altitude) is retained, as in 2014 was reached the lowest value of this indicator – 24 cm. Excluding 2012, the snow cover persistence decreased considerably in the last years (Figure 6.7).

Figure 6.7 Snow cover persistence in the period 1988-2016



Weather and climate extremes have enlarged during the last decades, as is shown on Figure 8. In line with the tendency of global warming, one of the basic indicators of winter severity – number of ice days – has diminished with over 25% in all climatic subareas in the period 1971-2010, compared to the period 1931-1970 (Fig. 6.8a). Since the middle of 1990s, recurrent disastrous situations, mainly related to the development of powerful convective storms, brought to economic losses and human casualties. Especially, in 2014 dangerous weather phenomena of convective origin such as intense heavy rains, thunderstorms, and heavy hails (often accompanied by strong wind gusts) caused human victims and serious damage to agricultural production, infrastructure, and buildings in many areas of the country.

During the period 1991-2014 the intra-annual distribution of number of days with convective precipitation ≥ 60 mm/24h, registered at least in 4 districts shows the increasing trend (Fig. 6.8b). Shift of the maximum in the distribution of heavy rain days connected with thunderstorms during the periods 1991-2002 and 2003-2014 is observed. While during the first period the greatest number of heavy rain days is observed in July, in the second period such type of precipitation more frequently occurred in September and October, where their increase is about 30-100%. Furthermore, increasing in frequency of the heavy rain episodes in all months from June to October (except July) as well as in the cold season months December and March is observed in the period 2003-2014.

During the period 1991-2014, the annual number of days with convective precipitation ≥ 60 mm/24h has shown a positive tendency in almost all regions of the country. The increasing in the number of convective heavy rain days is statistically significant for North East (NE), South Central (SC) and South West (SW) Bulgaria (Fig. 6.8c).

In the period 1988-2016, about 75 % of all hail events occur during the period April-July (with maximum in May and June), more frequent in western and central south parts of the country, nearby to the mountains because of the preferable orographic conditions for development of convective processes. The largest number of days with hail precipitation is registered in 2014, followed by 2005. In comparison with the period 1961-1990, the number of days with wide-spread hail precipitation (observed in at least 4 districts) also has increased, reaching maximum value in 2014 (Fig. 6.8d).

Figure 6.8 Weather and climate extremes

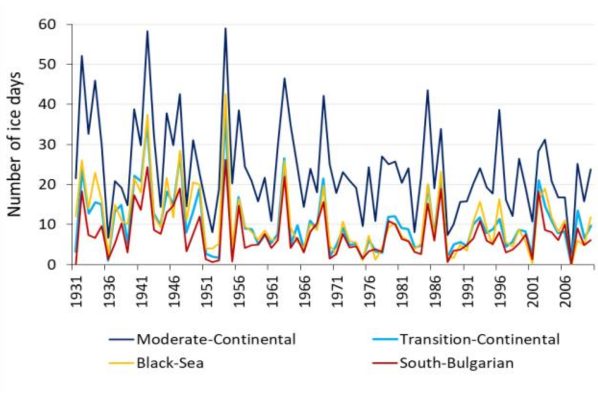


Fig. 6.8a. Number of ice days (daily $T_{max} < 0°C$) during the cold season (November-March)

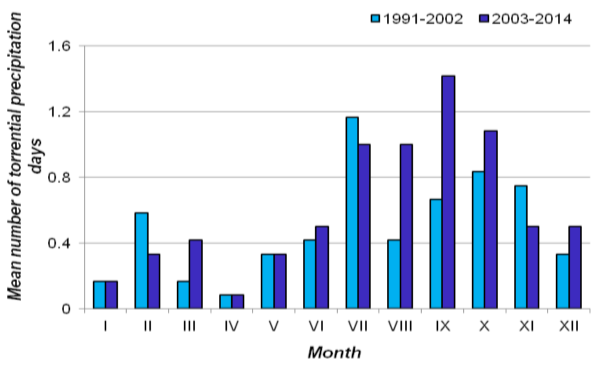


Fig. 6.8b. Intra-annual distribution of torrential precipitation days

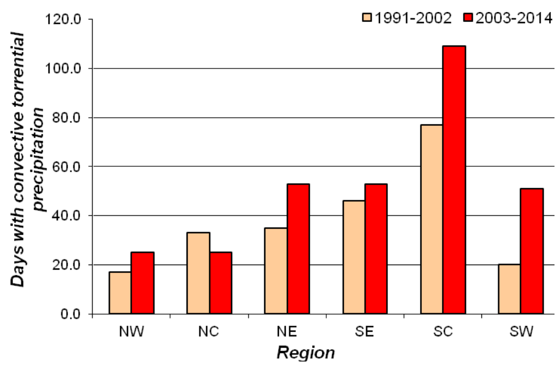


Fig. 6.8c. Distribution of days with convective heavy rainfall by regions

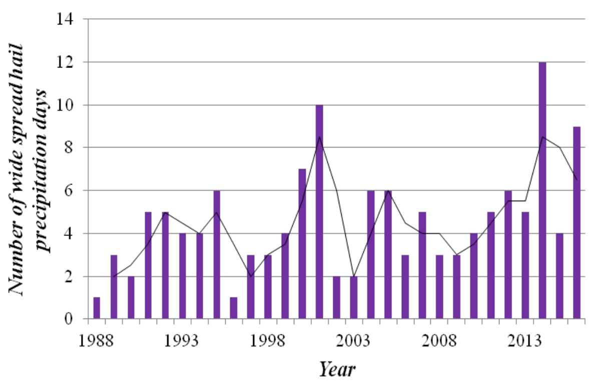


Fig. 6.8d. Number of wide-spread hail precipitation days

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 6.9 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 6.9 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).

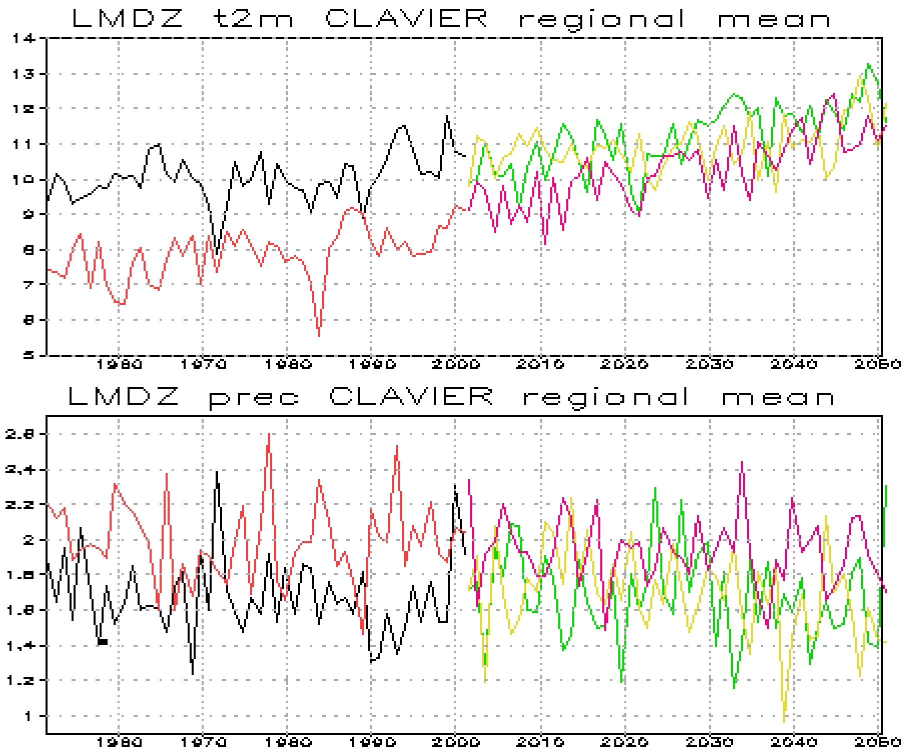


Figure 6.10 gives the geographic distribution of annual-mean changes in surface air temperature and precipitation for the A1B scenario. ECHAM and IPSL can be compared against each other. For surface air temperature, the warming in IPSL is much more important in IPSL with maxima in the Northeast of the 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 6.10 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

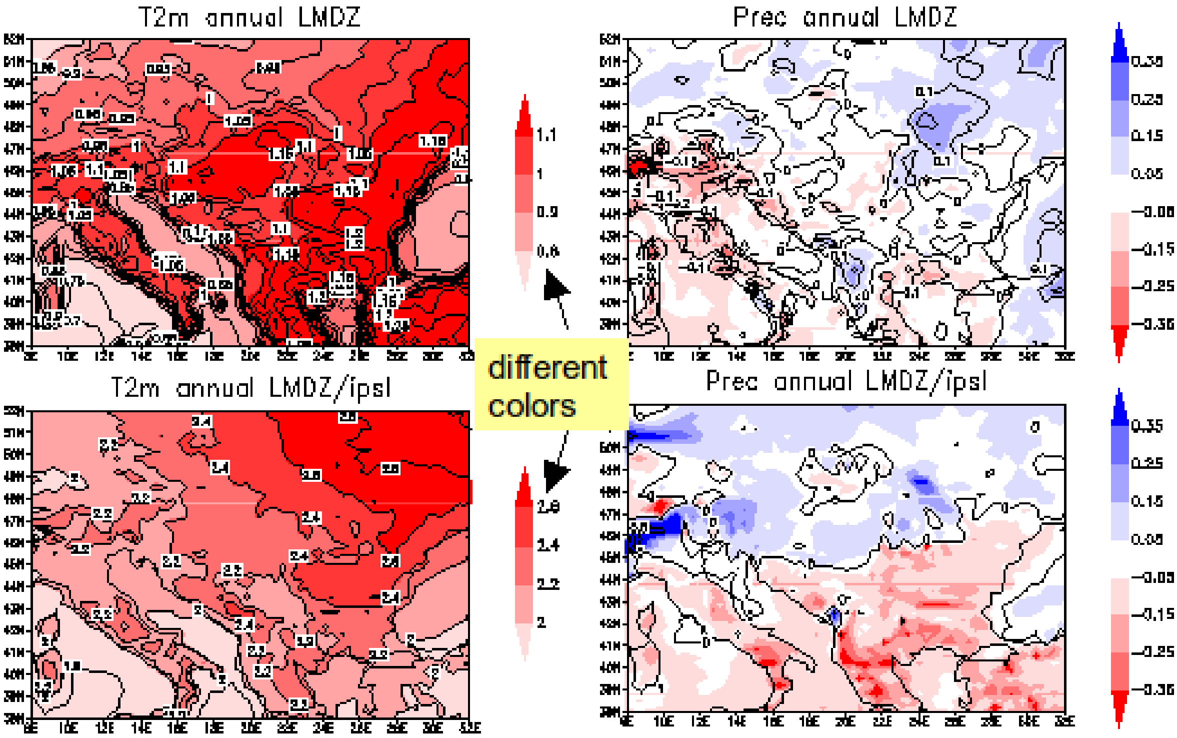


Table 6.1 Spatial average of surface air temperature in Bulgaria for the two A1B scenarios (from respectively MPI and IPSL) and the B1 scenario from MPI global climate model:

	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 6.1 gives the results on precipitation.

Table 6.1 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., Figure 6.3). The analysis is based on the empirical-statistical error corrected data from the STAT-CLIMATE-ECA-REMO57_a1b scenario.

Table 6.2 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 6.4 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 6.3). 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 6.11 Trend analysis for tropical nights

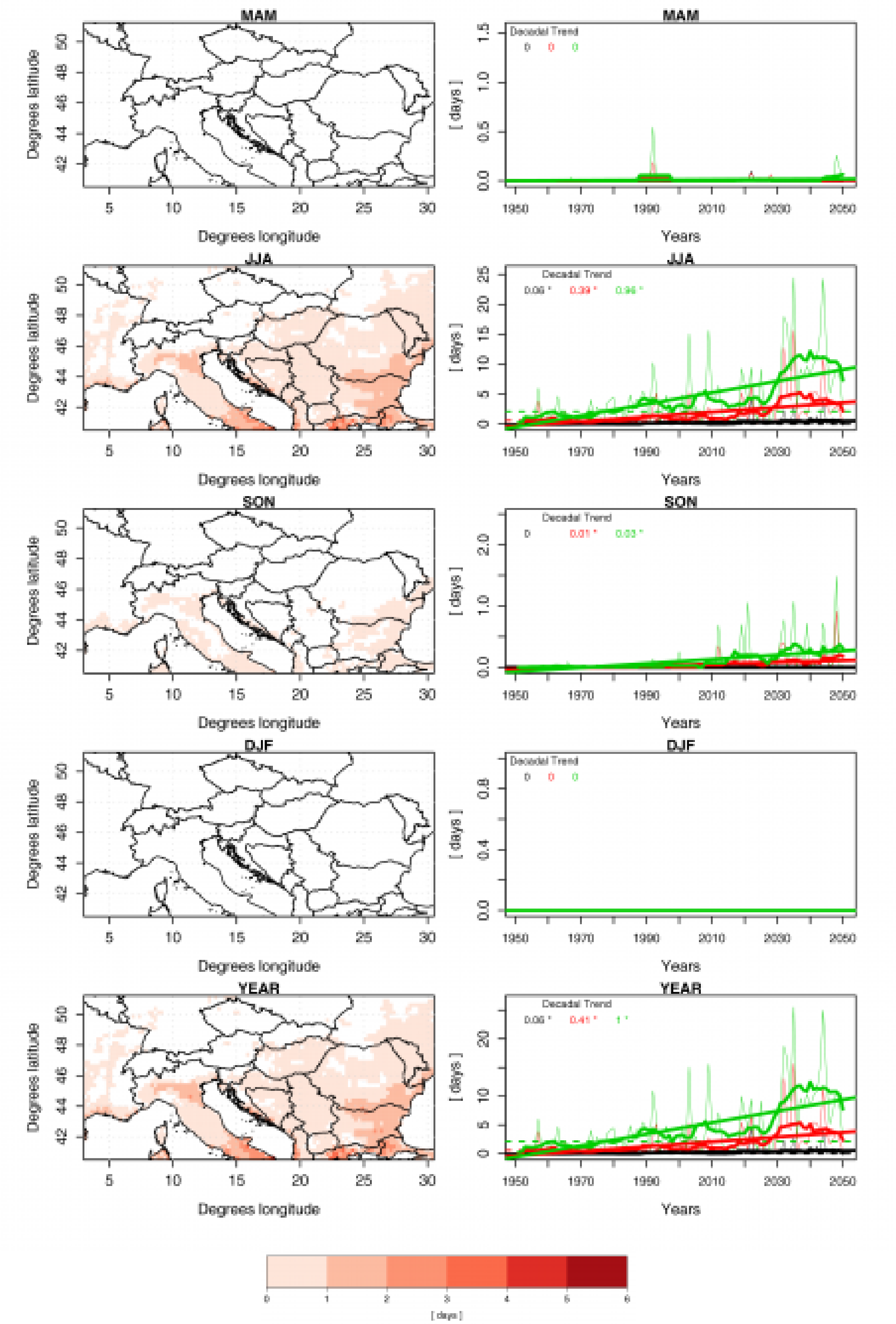


Figure 6.3 Trend analyses for the greatest 5-day rainfall

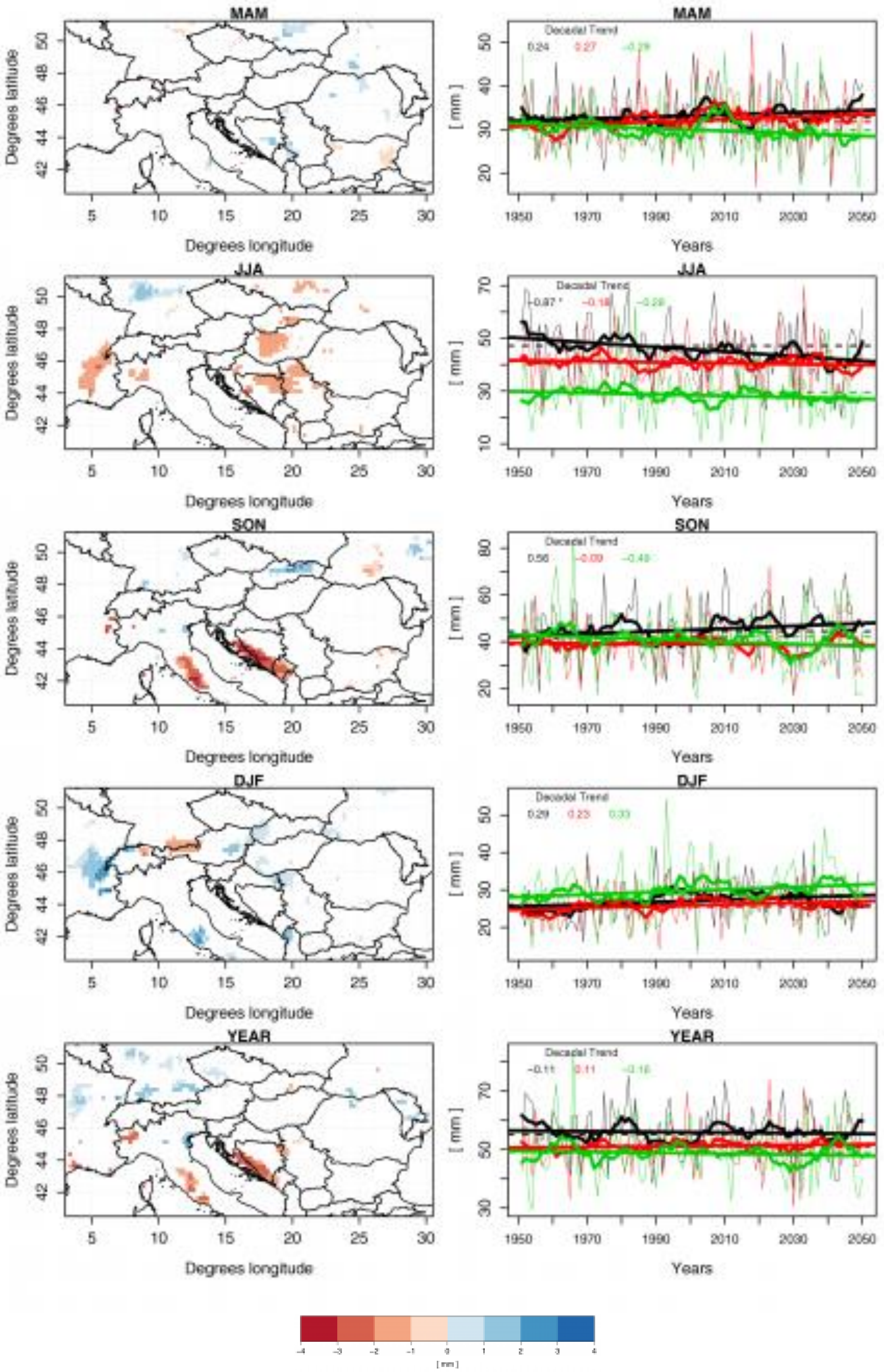
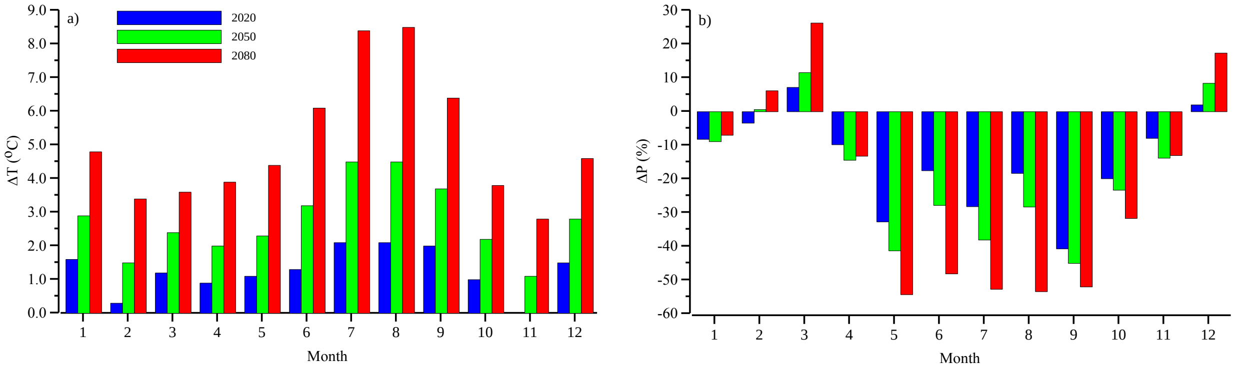
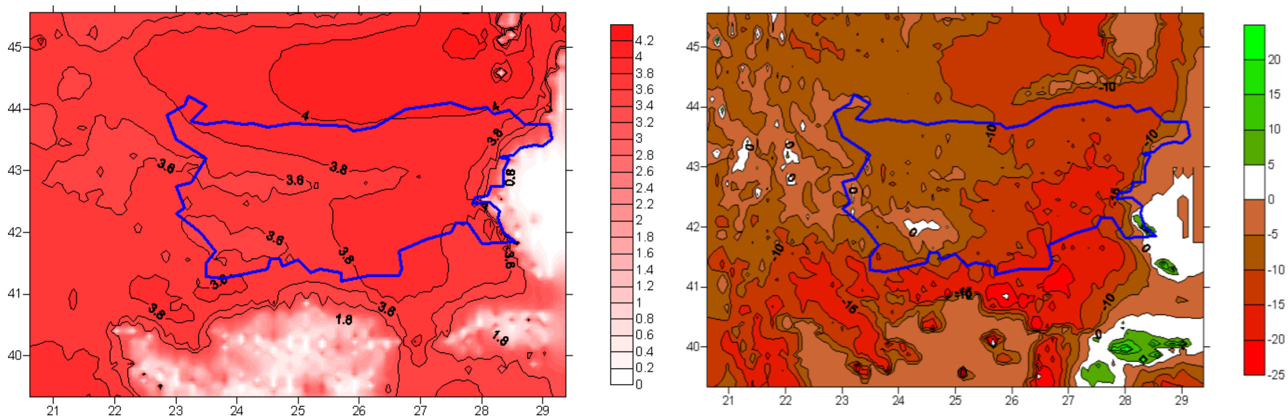


Figure 6.4 Monthly HaDCM3 climate change scenarios values of air temperature (a) and precipitation (b) in Novachene (north Bulgaria) for the 2020, 2050 and 2080.



Under the umbrella of the CECILIA project climate change scenarios for Bulgaria were also simulated by applying the ALADIN regional model (Figure 6.5 and Figure 6.14)

Figure 6.5 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

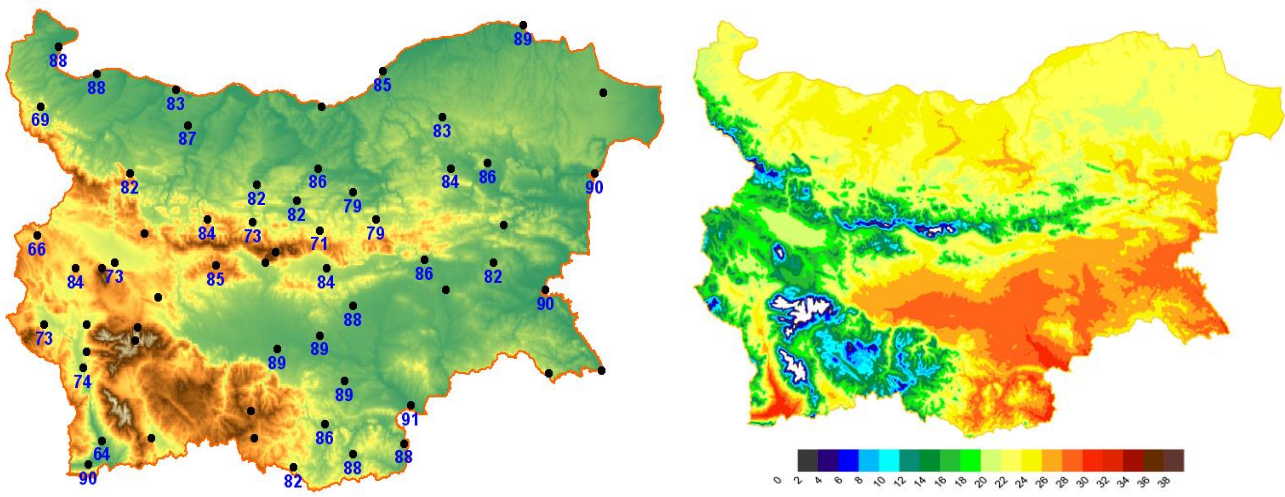


Figure 6.6 Summer days (Tmax>25ºC), 1961-1990 (left). 2021-2050 (right)

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.

<u>A Case Study (North East Region)</u>

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 6.3).

Table 6.3 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 6.4)

Table 6.4 Forest cover and non-forestry areas

Year	ha	Including (ha):					
	Total forest area not designated for wood production	Cropland	Meadows	Glades	Nursery-gardens	Roads	Rocks
1988	285834	3301	1881	85241	2654	25630	167127
1989	283182	4125	1804	86434	2637	30215	157967
1990	281714	4077	1848	87762	2634	31706	153687
1991	281118	4082	1885	87420	2703	32554	152474
1992	280735	3948	1881	88449	2667	33172	150618
1993	282627	4416	1942	89479	2555	33803	150432
1994	269097	4821	1902	86158	2298	32011	141907
1995	291157	4991	1957	97418	2406	36186	148199
1996	295057	5518	2086	101325	4096	36954	145078
1997	297485	4916	1993	103437	2263	37557	147319
1998	301068	4820	2119	106120	2300	39091	146618
1999	275952	5800	2004	98300	2494	35420	131934
2000	295832	4659	4001	104203	2344	37610	143015
2001	298233	6041	2809	105682	2499	38215	142987
2002	302027	4515	4105	108649	2898	39564	142296
2003	298846	4589	3236	109518	2551	38812	140140
2004	303056	4294	4620	110883	2292	40273	140694
2005	302792	4178	4389	109328	2146	42201	140550
2006	301429	4155	4645	108803	2037	42657	139132
2007	310889	4239	3934	110508	2027	43442	146739
2008	314203	4782	4138	112961	2034	43421	146867
2009	307808	4759	4026	110969	1685	43323	143046
2010	306090	4513	3805	111162	1710	42665	142235
2011	305028	4592	2541	111064	1717	42492	142622
2012	300014	4713	2641	109253	1669	42486	139252
2013	299872	5200	2512	108696	1602	41609	140253
2014	299583	4257	2263	110430	1580	42756	138297
2015	300151	4736	1800	114427	1580	42206	135402

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

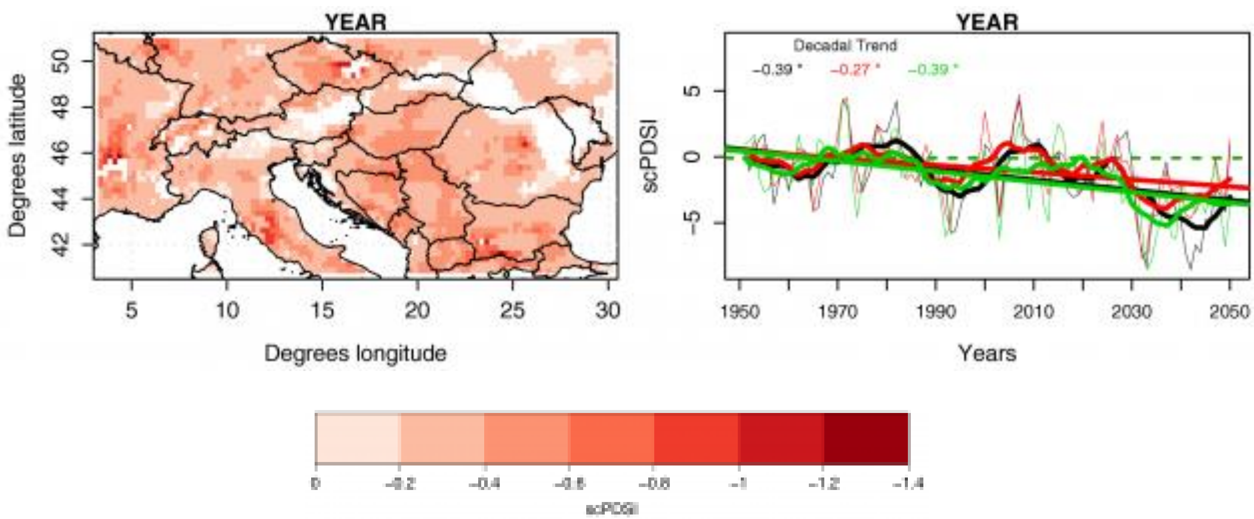
The Palmer Drought Severity Index (PDSI) was invented in 1965 by Wayne Palmer and belongs to the group of the agro-meteorological drought indices. The index is based on the calculation of a climatic soil water balance and requires long term temperature, precipitation data on a monthly time scale and 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 6.5 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 6.7 Seasonal and yearly time series



The times series on Figure 6.7 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 6.8). 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 6.9).

Figure 6.8 HadCM3 B2 changes (in days) in sunflower growing duration in the Balkan Peninsula for 2071-2080, relative to current climate; RoIMPEL model

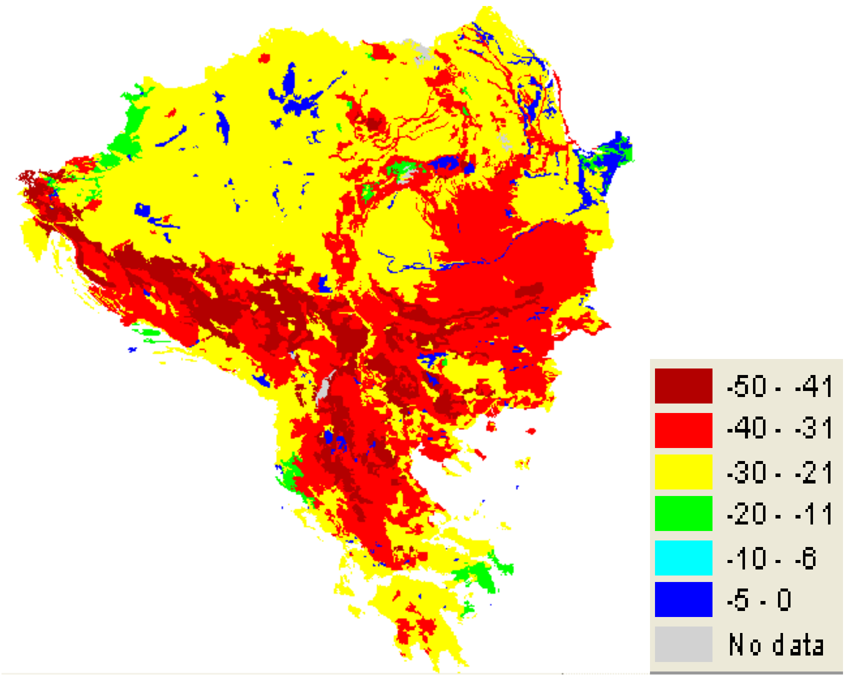
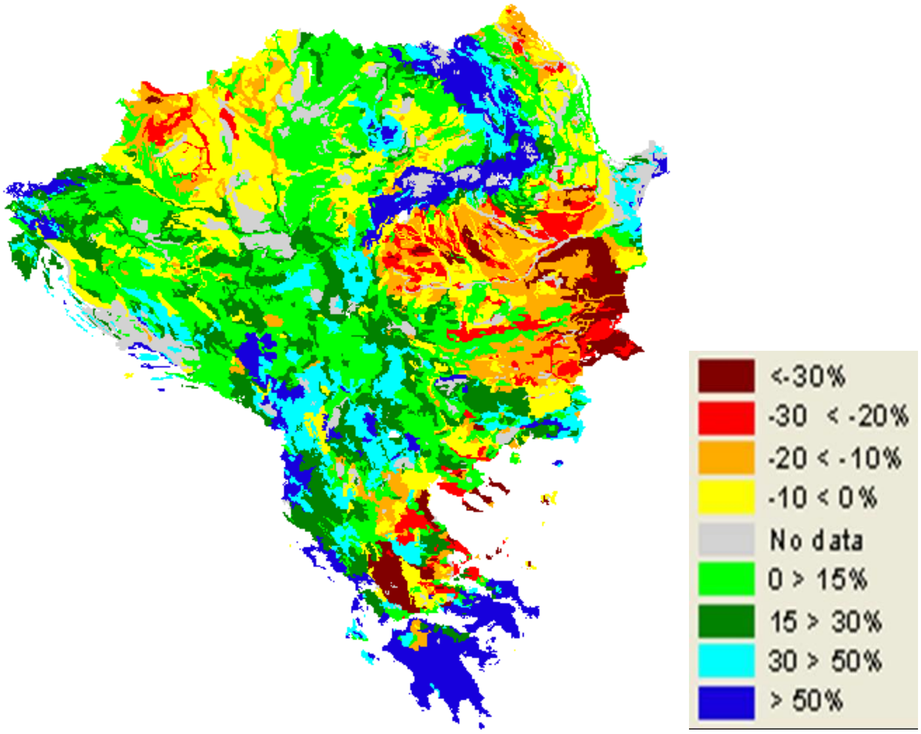


Figure 6.9 HadCM3 A2 changes (in %) in sunflower yield in the Balkan Peninsula for 2071-2080, relative to current climate; RoIMPEL model



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.

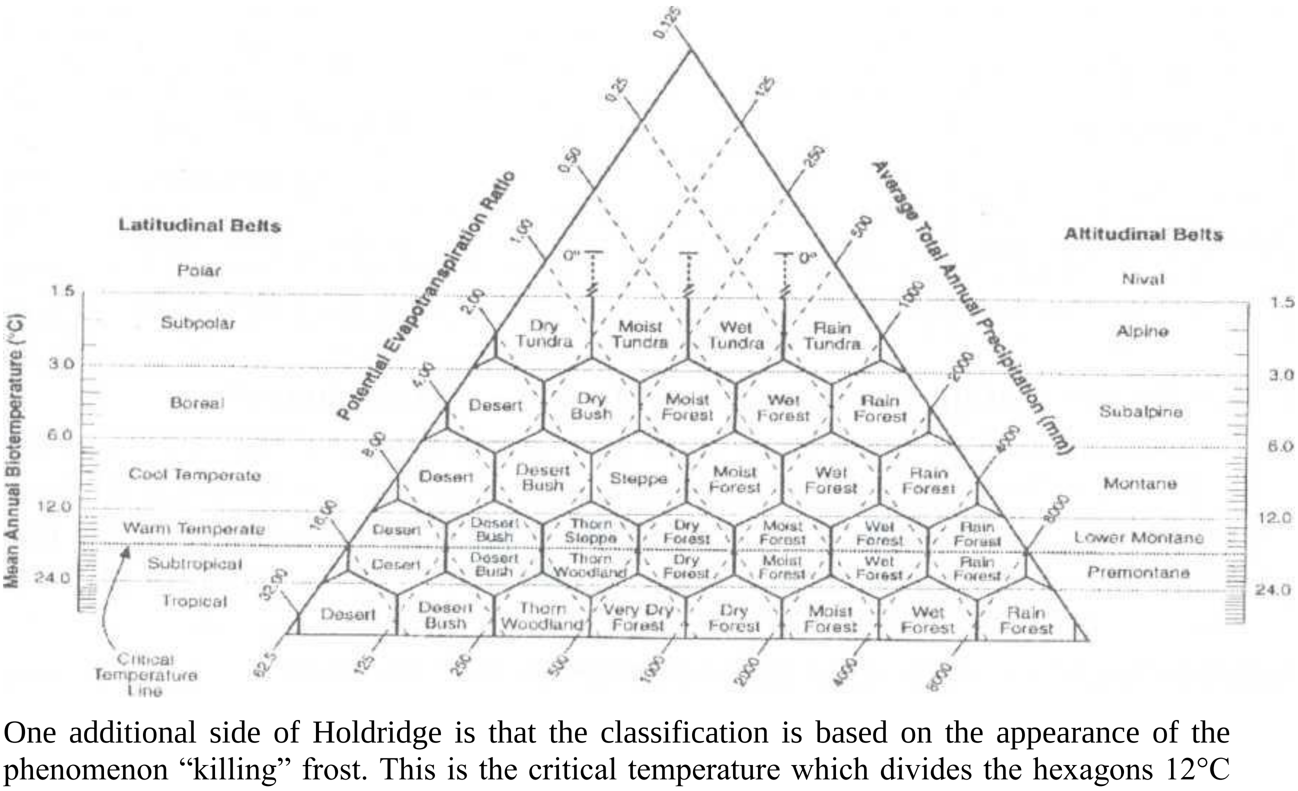
Analysis on the condition of the forest vegetation from the last decade in Bulgaria shows that the coniferous forest vegetation which was widely introduced during the last decades below 800 m a.s.l., i.e. out of its natural habitats, forms very unstable forest ecosystems. The main reason is the discrepancy 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

The Ministry of Environment and Water of Bulgaria is the central body coordinating the adaptation policy-making process.

In order to decrease country's the vulnerability to the effects of climate change and to improve the capacity of the natural, social and economic systems to adapt to the inevitable impacts of climate change, the Ministry of Environment and Water of Bulgaria has started preparation of National Climate Change Adaptation Strategy.

Taking into account that developing such a strategic document is subject to a substantial expertise and significant data collection, it was adopted a stepwise approach.

Phase I. As a first step was prepared a Framework document "National climate change risk and vulnerability assessment for the sectors of the Bulgarian economy". The document was finalized in early June 2014.

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, forestry, 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 Framework document is serving as a basis for further development of a National Adaptation Strategy. Therefore all the collected and evaluated information gives grounds for development of specific measures which should present the overall appearance of the strategic actions that reduce country's vulnerability to the effects of climate change.

Phase II. Preparation and adoption of a National Adaptation Strategy and Action Plan

The Ministry of Environment and Water of Bulgaria signed with the International Bank for Reconstruction and Development an Agreement for Reimbursable Advisory Services on the development of a National Climate Change Adaptation Strategy and Action Plan. The objectives of the Agreement are to support the Ministry of Environment and Water in: accessing options to address climate risks across the economy; formulating a Climate Change National Adaptation Strategy and Action Plan for the Republic of Bulgaria, which shall cover the period up to 2030; and strengthening capacity for implementation and cross-sector coordination on climate change adaptation.

The development of the Strategy is funded by the Operational Programme "Good Governance" (OPGG), Priority Axis 2 "Effective and professional governance in partnership with the civil society and the business". On 10 April 2017 was signed a Grant Contract between the Ministry of Environment and Water of Bulgaria and the Managing Authority of the OPGG for implementation of a project "National Climate Change Adaptation Strategy and Action Plan"

The project consists of developing a comprehensive National Climate Change Adaptation Strategy and Action Plan, which cover the period to 2030. The strategy serves as a reference document, setting a framework for adaptation action and priority directions, identifying and confirming the need for climate action both at economy-wide and sectoral level. The National Adaptation Strategy:

- provides analysis of the current situation in the sectors: agriculture, forestry, ecosystems and biodiversity, water, transport, energy, construction and infrastructure, human health, urban environment, and tourism;
- set goals and priorities for improving adaptation capacity, presented by sectors;
- defines specific measures to achieve the goals laid down in the Strategy.

The Action Plan will summarize the adaptation measures for all sectors identified in the Strategy in order to attain the strategic goals by focusing on implementation of priority adaptation measures, including consideration of implementation, responsible institutions, resources, terms ,time bound targets and monitoring indicators.

The National Climate Change Adaptation Strategy will be finalized and adopted during the second half of 2018.

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.

Another very important part to be integrated in the National Adaptation Strategy is insurance. The Ministry of Environment and Water already has developed an analytical document "Financial disaster risk management and insurance options for climate change adaptation in Bulgaria". The document was prepared with the financial and technical support of the World Bank and its purpose is to analyze the role and importance of the insurance business for the prevention of risks that occur as a result of climate change and for the development of adaptation measures.

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 6.6)

Table 6.6 Potential of the forestry areas for establishing new forests and plantations.

Year	ha	Including (ha):	
	Total non-forested area, subject for forestation	Burnt out and clearing areas	Barren areas
1988	132693	34343	98350
1989	132245	33888	98357
1990	132553	35154	97399
1991	132413	36556	95857
1992	131373	35109	96264
1993	139305	44252	95053
1994	121610	30358	91252
1995	121391	28803	92588
1996	121478	30883	90595
1997	121066	30729	90337
1998	120190	33052	87138
1999	123647	39435	84212
2000	138671	54710	83961
2001	138472	52436	86036
2002	126418	44238	82180
2003	117419	39139	78280
2004	108549	30720	77829
2005	96121	21752	74369
2006	95230	20865	74365
2007	93081	21469	71612
2008	78898	17336	61562
2009	73959	14307	59652
2010	70758	13114	57644
2011	68308	11560	56748
2012	68060	10083	57977
2013	69123	10631	58492
2014	66527	10553	55974
2015	65065	8929	56136

Table 6.7 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 6.7 Economic impacts of distribution of the forest area (by forest types) for the period 1990-2015.

Year	Total forest fund	ha								
		Afforested area without mountain pine (Pinus mugo)	Mountain pine (Pinus mugo)	Coniferous		Deciduous		Unfrosted area subject to forestation	Non-wood production designated forest area	Forest pastures
				Total	Forested	Total	Forested			
1988	3855891	3308917	21646	1325872	1187258	2530019	2121659	132693	285834	106801
1989	3858380	3313201	20939	1322531	1185534	2535849	2127667	132245	283182	108813
1990	3871447	3327092	20940	1330126	1192012	2541321	2135080	132553	281714	109148
1991	3873543	3330598	20940	1327665	1189614	2545878	2140984	132413	281118	108474
1992	3872938	3329478	21269	1323072	1184235	2549866	2145243	131373	280735	110083
1993	3897404	3345166	21311	1317841	1175427	2579563	2169739	139305	282627	108765
1994	3675786	3154110	21982	1244738	1105798	2431048	2048312	121610	269097	108987
1995	3876272	3334256	22620	1304293	1154299	2571979	2179957	121391	291157	106848
1996	3878405	3332378	22555	1293269	1144218	2585136	2188160	121478	295057	106937
1997	3878794	3330474	22627	1280960	1132019	2597834	2198455	121066	297485	107142
1998	3899655	3348615	22654	1280162	1126820	2619493	2221795	120190	301068	107128
1999	3794797	3296275	709	1188794	1072645	2606003	2223630	123647	275952	98214
2000	3914355	3375117	23190	1282319	1114647	2632036	2260470	138671	295832	81545
2001	3980032	3440802	23770	1296790	1123782	2683242	2317020	138472	298233	78755
2002	4003755	3488863	23760	1291264	1121951	2712491	2366912	126418	302027	62687
2003	4015236	3526284	21169	1288758	1126540	2726478	2399744	117419	298846	51515
2004	4063555	3624692	23310	1288331	1127336	2775224	2497356	108549	303056	3945
2005	4076464	3651243	23073	1278514	1124271	2797950	2526972	96121	302792	3231
2006	4089762	3668795	23073	1271344	1119526	2818418	2549269	95230	301429	1235
2007	4108494	3680384	23631	1277494	1114813	2831000	2565571	93081	310889	509
2008	4114552	3697811	23640	1279809	1118666	2834743	2579145	78898	314203	0
2009	4130896	3725494	23635	1281216	1122828	2849680	2602666	73959	307808	0
2010	4138147	3737542	23757	1278901	1122024	2859246	2615518	70758	306090	0
2011	4148114	3750825	23953	1270727	1117274	2877387	2633551	68308	305028	0
2012	4163415	3771385	23953	1266721	1113789	2896694	2657596	68060	300014	0
2013	4180121	3787173	23953	1263514	1109961	2916607	2677212	69123	299872	0
2014	4202015	3811933	23953	1261348	1108602	2940667	2703331	66527	299583	0
2015	4222874	3833640	24018	1260480	1109684	2962394	2723956	65065	300151	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 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 2014-2020",
- **Other EU Funds, Programs and Initiatives**
- **International:** Within the framework of the Joint Implementation (JI) mechanism under the Kyoto Protocol, Green investment scheme, Investment Climate Programme, 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.

Funds are also generated via the Assigned Amount Units (AAUs) international trade deal(s), the sale of greenhouse gas emissions quotas for aviation activities, as well as funds, provided by other environmental protection agreements between the Republic of Bulgaria and international or local financing sources.

"Operational Programme Environment 2007-2013" and „Operational Programme Environment 2014-2020' **(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;

ESPON 2020 Cooperation Programme - The revised version of the ESPON 2020 Cooperation Programme was adopted on the 26 May 2016 by the European Commission

The ESPON 2020 Programme aims at promoting and fostering a European territorial dimension in development and cooperation by providing evidence, knowledge transfer and policy learning to public authorities and other policy actors at all levels.

ESPON 2020 shall continue the consolidation of a European Territorial Observatory Network and grow the provision and policy use of pan-European, comparable, systematic and reliable territorial evidence.

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. In addition there is a new programme period INTERACT III 2014-2020 Interregional Cooperation Programme.

IPA Cross-Border Programs:

BULGARIA – SERBIA 2007 – 2013 (CCI Number: 2007CB16IPO006) and there is a new programme period BULGARIA – SERBIA 2014 – 2020 (CCI Number: 2014TC16I5CB007);

BULGARIA - THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA (CCI Number: 2007CB16IPO007) and there is a new programme period BULGARIA - THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA 2014 – 2020 (CCI Number: 2014TC16I5CB006);

BULGARIA – TURKEY (CCI Number: 2007CB16IPO008 and there is a new programme period BULGARIA – TURKEY 2014-2020 (CCI Number: 2014TC16I5CB005);

Cross-Border Cooperation Programme ROMANIA – BULGARIA 2007-2013 and there is a new programme period 2014-2020;

European Territorial Cooperation Programme GREECE-BULGARIA 2007-2013 and there is a new programme period 2014-2020;

Joint Operational Programme Black Sea Basin 2007-2013 and there is a new programme period 2014-2020.

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.

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.

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.

In June 2012 Bulgaria has adopted a **Third National Action Plan on Climate Change**. The main strategic objective of this document 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 plan provides specific measures for reduction of greenhouse gas emissions across all sectors of the Bulgarian economy and these measures are consistent with both the national policy on climate change and the potential of the national economy to reduce emissions. Successful implementation of the envisaged measures will lead to a reduction of the greenhouse gas emissions by 2020 by over 18,5% compared to their 2005 levels.

The Third NAPCC provides specific measures for reduction of greenhouse gas emissions in the following sectors - Energy Sector, Household and Services Sector, Industry Sector, Waste Sector, Agricultural Sector, Land Use, Land Use Change and Forestry, Transport Sector, Education and Science.

According to the mechanism of monitoring and reporting within the Third NAPCC, the review of measures' implementation status is envisaged to be done every two years. In that relation, during 2015, the first report containing information on the current status of implementation of the measures in all sectors covered by Third NAPCC (2013-2020) was prepared by the Interministerial Working Group established by Order No. RD-491 from 8th July 2015 of the minister of environment and water. The full report is published on the website of the Ministry of Environment and Water of Bulgaria.

The first official report on the implementation of the Third NAPCC is elaborated within the above-mentioned Interministerial Working Group and approved by the Council of the Ministers until the end of 2017.

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 international and with a national scope projects:

- Standardized automated large-scale monitoring of atypical pheno- logy of the European horseradish pine-tree species, as a result of climate change in two remote areas (France and Bulgaria), 2017 - 2019
- Climate-Smart Forestry in Mountain Regions (CLIMO) [Memorandum of understanding (MoU)], 2016-2020

- Construction of a structure in the meteorological database of NIMH-BAS for introducing information about dangerous meteorological phenomena, 2016-2018
- Climate assessment of heavy rainfall, strong wind, hailstorms and thunderstorms, ice conditions for 28 administrative districts on the territory of Bulgaria, 2016
- Freshwater ecosystem services mapping and assessment in Bulgaria, 2015 - 2017
- Mapping and Assessment of Ecosystem Services in the Wetlands of Bulgaria, 2015-2017
- Implementation of modern methods and technologies for assessment of groundwater nutrition in connection with future climate change in Bulgaria, with emphasis on the unsaturated zone, 2015 – 2016
- CMEMS-INSTAC – Copernicus Marine Environment Monitoring Service In Situ Thematic Assembly Centre, 2015 -
- East and South European Network for Invasive Alien Species – A tool to support the management of alien species in Bulgaria, 2015 - 2017
- Biogenic volatile organic compounds, global climate change, and plant adaptation potential to changing environment, 2014 - 2017
- Joint study of anthropogenic air pollution in the Burgas - Kirklareli cross-border area as a step towards future assessments on its impact on the population and the environment, 2014 - 2015
- Land-use and management impacts on carbon sequestration in mountain ecosystems", 2013 – 2016
- Characteristics of intense rains in Bulgaria - applied research, 2013 - 2016
- Specialized indices for climatic extremes on the territory of Bulgaria, 2013 - 2016
- Climate assessments for Bulgaria using the regional climatic model RegCM, 2013 - 2015
- Potential threats to environmental and economic sustainability in the Danube and Black Sea region: Danube River as invasive alien species corridor, 2012 - 2020
- Green Infrastructure approach: linking environment with social aspects in studying and managing urban forests [Memorandum of understanding (MoU): 2012-1-11901], 2012 - 2017
- COCONET (Towards COast to COast NETworks of marine protected areas (from the shore to the high and deep sea), coupled with sea-based wind energy potential, 2012 - 2016
- Policy-oriented marine Environmental Research in the Southern EUropean Seas, 2012 - 2015
- COST Action ES1102 - VALUE - Validating and Integrating Downscaling Methods for Climate Change Research, 2012 - 2015
- MSFD Guiding Improvements in the Black Sea Integrated Monitoring System, 2012 - 2014
- Improvement of integrated water management and flood risk prevention. Climate changes studies for the SEE regions (ref.: CC-WaterS etc.) – 2012 – 2014
- Effects of Climate Change on Air Pollution Impacts and Response Strategies for European Ecosystems (ECLAIRE contract 282910), 2011 – 2015
- CREAM- Coordinating research in support to application of EAF (Ecosystem Approach to Fisheries) and management advice in the Mediterranean and Black Seas", 2011 - 2014
- Strenghtening the regional capacity to support the sustainable management of the Black Sea Fisheries (SRCSSMBSF), 2011 - 2013
- Improved mountainous forest management for sustainable provisioning of ecosystem services under climate change (MFORES)". The project was co-financed by the program BG03 "Biodiversity and ecosystem services" of the Financial Mechanism of the European Economic Area, 2009 – 2014.

- EnviroGRID Building Capacity for a Black Sea Catchment Observation and Assessment System supporting Sustainable Development, 2009 – 2013
- Knowledge-based Sustainable Management for Europe's Seas, 2009 - 2013
- FUTUREforest - Woodlands for Climate Change, 2008-2011
- 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	

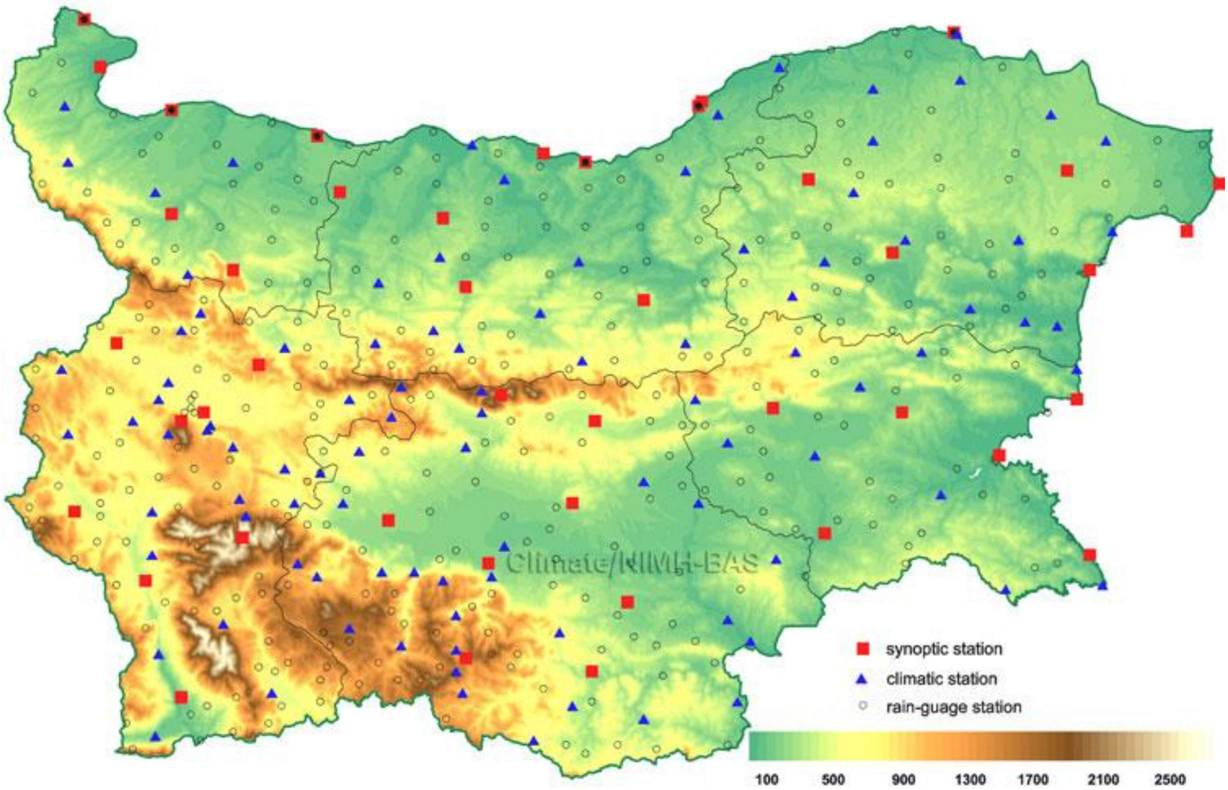
Table 8.3 Participation in the global atmospheric observing systems

	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;

<u>Marine Physics:</u>

- 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 sensational or campaign character, there are no fundamental and in-depth analysis	Tasks: Development and adoption of national program or plan for education, training and information on public Creation of informal group of journalists and experts to prepare and present information on climate change Journalists trained on the	Direct assets: A huge amount of information exists in Internet on climate change A company on environmental protection management activities exists There are environmental NGOs with experience in education and public

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

research on this subject Ignoring the gravity of the problem by the parties concerned Lack of good opportunities for employment and professional growth	information campaigns) Improved interconnection of business and science for popularizing and financing the research on the subject	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

THIRD BIENNIAL REPORT

OF THE REPUBLIC OF BULGARIA

Accompanying the document:Seventh National Communication the Republic of Bulgaria under the United Nations Framework Convention on Climate Change

CONTENTS

1. Introduction

The third Biennial Report of Bulgaria (BR3) was prepared under Decision 2/CP.17 of the Conference of the Parties to the UNFCCC and was submitted as an Annex to Bulgaria's Seventh National Communication under the UNFCCC (NC7).

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's Seventh National Communication in its corresponding chapters.

As defined in the UNFCCC biennial reporting guidelines for developed-country Parties and referring Annex I to UNFCCC decision 2/CP.17, the information is structured as follows:

- Information on GHG emissions and trends, and the GHG inventory including information on national inventory system (section 2);
- Quantified economy-wide emission reduction target (section 3);
- Policies and measures (section 4);
- Projections (section 5);
- Provisions of financial, technological and capacity-building support to developing country Parties (section 6).

Tabular information as defined in the common tabular format (CTF) for the UNFCCC biennial reporting guidelines for developed country Parties (UNFCCC decision 19/CP.18) were submitted separately in the CTF Tables attached to this submission. For the CTF submission to the UNFCCC, the electronic reporting facility (CTF application) provided by the UNFCCC Secretariat has been used as required by UNFCCC decision 19/CP.18.

2. Information on greenhouse gas emissions and trends

The legal basis for the compilation of the GHG inventory and the GHG inventory methodology as well as data availability is described in the National Inventory Report of Bulgaria 2017, chapter 1, submitted to the UNFCCC on 12 April 2017. The greenhouse gas data presented in this chapter are consistent with the 2017 GHG inventory submission of Bulgaria to the United Nations Framework Convention on Climate Change (UNFCCC) Secretariat submitted on 11 April 2017 in the CRF Tables.

Summary tables of GHG emissions of Bulgaria for emission trends by gas and by sector in the common tabular format are presented in the CRF Tables 1(a) and 1(b) in the CTF Tables attached to this submission. These data and the complete submissions of Bulgaria under the Regulation (EU) No. 525/2013 of the European Parliament and of the Council.

2.1. Summary information on GHG emissions and trends

In 2015 Bulgaria's greenhouse gas emissions totalled 61 483 Gg CO_2 without reporting of sequestration from LULUCF sector. The emissions decreased by 47.17 % compared with the base year. Emissions in 2015 were 6.9 % increase in comparison with the emissions of the previous year.

The net emissions including reporting of sequestration from LULUCF sector were 54 608 Gg CO_2 eq. The emissions decreased by 45.93 % compared with the base year.

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 1988-2015, which resulted in the reduction of population by 20%.

The most important greenhouse gas in Bulgaria is carbon dioxide. The share of CO_2 emissions from the total greenhouse gas emissions varies around 78.5% excluding LULUCF and 75.7% including LULUCF. In absolute terms CO_2 emissions have decreased 46% since 1988. Around 74.2% 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 56.6% 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 53.6% which has been occasioned mostly by the reduced nitrogen fertilisation of agricultural fields, the biggest decline was in the beginning of time series.

The emissions of F-gases have increased over tenfold during 1995-2015. A key driver behind the trend has been the substitution of ozone depleting substances (ODS) by F-gases in many applications.

More detailed information about the trends of the greenhouse gas emissions are described in the chapter 3.1 of the Bulgaria's Seventh National Communication. Summary tables of greenhouse gas emissions of Bulgaria for emission trends by gas and by sector in the common tabular format are presented in the CTF Table 1.

More detailed information on inventory data and inventory arrangements can be found in the Bulgarian National Inventory Report 2017.

2.2. National Inventory Arrangements

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.

Since 2008 the Executive Environment Agency (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.

Further information on the institutional arrangement of the Bulgarian National Inventory System is provided in chapter 3.3.2 of the Seventh National Communication.

There were no significant changes of the inventory system since the Second Biennial Report of Bulgaria (BR2), except the Order № 296/04.12.2015 by the Executive Director of ExEA (Sector experts/QC experts) which reflect relevant staffing changes of the inventory team.

More detailed information on inventory data and inventory arrangements can be found in the Bulgarian National Inventory Reports.

3. Quantified economy-wide emission reduction target

Under the UNFCCC, the EU and its Member States have taken a joint emission reduction target to reduce its GHG emissions by at least 20% compared to 1990 by 2020, with a conditional offer to move to a 30% reduction, provided that other developed countries commit themselves to comparable emission reductions and developing countries contribute adequately according to their responsibilities and respective capabilities. This is documented in the UNFCCC revised notes on the “Compilation of economy-wide emission reduction targets to be implemented by Parties included in Annex I to the Convention”[17].

No individual quantified economy-wide reduction target is set for Bulgaria as this 20 % reduction target will be fulfilled jointly by the EU and its Member States.

The EU quantified economy-wide emission reduction target is implemented through the EU Climate and Energy Package. The package underpins the EU implementation of the target under the Convention. The package introduced a clear approach to achieving the 20 % reduction of total GHG emissions from 1990 levels, which is equivalent to a 14 % reduction compared to 2005 levels. This 14 % reduction objective is divided between the European Union Emission Trading Scheme (EU ETS) and the Effort Sharing Decision (ESD) sectors. These two sub-targets are:

- a 21 % reduction target compared to 2005 for emissions covered by the ETS (including domestic and international aviation);
- a 10 % reduction target compared to 2005 for ESD sectors, shared between the 28 Member States (MS) through individual national GHG targets.

Emission reduction targets under the Effort Sharing Decision

The Effort Sharing Decision No 406/2009/EC, on the effort of Member States to reduce their GHG emissions to meet the Community’s GHG emission reduction commitments up to 2020 was adopted on 23 April 2009. The ESD sets binding annual greenhouse gas emission targets for each Member State for the period 2013-2020. By 2020, the national targets will collectively deliver a reduction of around 10 % in total EU emissions from the sectors not included in the EU ETS compared with 2005 levels.

The targets are distributed according to the principle of ‘solidarity’ in a ‘fair and equitable’ way allowing for further, accelerated growth in less wealthy countries where economic development still needs to catch up with other Member States. That means that Member States with a low Gross Domestic Product (GDP) per capita will be allowed to emit more than they did in 2005 although these ‘positive’ limits should still require a reduction effort. Thus, under the ESD, Bulgaria has a reduction target of not exceeding 20 % by 2020 compared with 2005 for emissions from sectors not covered by the EU ETS. Bulgaria’s Annual Emission Allocation (AEA) for the year 2015 calculated applying global warming potential values from the fourth IPCC assessment report is 29 132 652 AEA. More detailed information on Bulgaria’ Annual Emissions Allocations for the period from 2013 to 2020 is provided in Commission Decision of 26 March 2013 on determining Member States’ annual emission allocations for the period from 2013 to 2020 pursuant to Decision No 406/2009/EC of the European Parliament and of the Council.

In 2017, the annual emissions allocation of the EU Member States were further adjusted (by the Commission Decision (EU) 2017/1471 of 10 August 2017 amending Decision 2013/162/EU to revise Member States' annual emission allocations for the period from 2017 to 2020) to take

[17] FCCC/SB/2011/INF.1/Rev.1 of 7 June 2011. and FCCC/SBSTA/2014/INF.6

into account changes introduced by the implementation of the 2006 IPCC guidelines for national greenhouse gas inventories on the emissions levels in the inventory as these guidelines were applied in inventory reporting after the annual emission allocations under the ESD were agreed upon.

The Member States' targets under the ESD are translated into an annual emission budget for each Member State. The budget, the so-called Annual Emission Allocation (AEA), corresponds to the absolute amount of emissions allowed to that Member State. The Annual Emission Allocation units, corresponds to one ton of CO_2 each, can be traded between Member States.

Emission reduction targets under the European Union Emission Trading Scheme

The EU ETS is a market based mechanism setting a cap on the total amount of greenhouse gases that can be emitted by operators (factories and other installation in the system) in the EU. As a result, total emissions cannot exceed this cap. In addition, the cap decreases gradually every year.

A joint quantified economy-wide emission reduction target of 20 % for the years 2013-2020 is calculated providing that in 2020 emissions from sectors covered by the EU ETS will be 21 % lower than in 2005.

The EU-wide cap imposed on the EU ETS is determined for all EU Member States and the three non-EU countries (Iceland, Norway and Liechtenstein) without reflecting a specific share for each Member State. Allowances allocated in the EU ETS from 2013 to 2020 decrease by 1.74 % annually, starting from the average level of allowances issued by Member States for the second trading period (2008–2012).

This system imposes a lot of additional burden on companies and forces them to monitor, manage and cut the emission. This is a market-based system, so the idea is that the European GHG emission is managed by market-based mechanisms, not by administrative actions.

The allocation of allowances takes place through auctions and free allocation. The share of allowances auctioned on behalf of each Member State in each year is public and can be obtained from the relevant auction platforms.

Nonetheless, free allocation is provided on the basis of EU-wide rules to installation operators within a certain limit. For each of the nearly 12 000 installations in the EU ETS, the allocation has been calculated based on the common rules. A breakdown of the amounts per Member State is not available.

For more detailed explanation how the EU climate and energy package, EU target under the UNFCCC and KP are set up and related, please also refer to the EU-BR3.

4. Progress in achievement of quantified economy-wide emission reduction targets and relevant information

Bulgaria's emission reduction target for the years 2013-2020 is part of the joint target of the European Union. The historical trend in the national total emissions without the LULUCF sector is the key indicator for progress in the achievement of the target. The EU joint target under the Convention refers to greenhouse gas emissions of the EU-28 and the emissions are calculated as the sum of the emission of the Member States.

Total GHG emissions excluding emissions and removals from LULUCF decreased by 40.9 % between 1990 amd 2015, whereas total GHG emissions including net emissions and removals from LULUCF decrease by 38.4 % over the same period. The emission trends 1990 – 2015 are reported in CTF Table 1.

In the following sections, progress in achievement of quantified economy-wide emission reduction targets is described through mitigation actions (policies and measures) planned, adopted and implemented for achieving the targets and commitments under Convention and EU's Climate and Energy Package 2020. For further information on relevant mitigation policies and measures please see chapter 4 of the Bulgaria's Seventh National Communication. Information on the effects of the mitigation actions and progress in achievement of the target under the Convention, where available and relevant, has been included also in CTF Tables 3 and 4.

Emissions/removals in the LULUCF sector are not included in the EU target under the Convention.

In the BR3 brief overview of the most significant climate related policies and measures is reported. The development of GHG emissions is reported in CTF Table 4.

4.1. Cross-sectoral

- **EU level**

EU Emissions Trading System (EU ETS)

The EU ETS is a Community market mechanism established in 2005 in order to encourage investments in low carbon production. It is based on the 'cap and trade' principle. It limits emissions from nearly 11,000 heavy energy-using installations (power stations & industrial plants) and slightly over 500 aircraft operators operating between EEA countries, and covers around 45 % of the EU's greenhouse gas emissions.

There are three trading periods (2005-2007, 2008-2012 and 2013-2020) were regulated by Directive 2003/87/EC. In the first and second trading period, allowances were allocated free-of-charge. In the third trading period 2013-2020, allowances are being allocated on the basis of harmonized rules and a growing share of allowances is sold at auctions.

On 15 July 2015, the Commission presented a legislative proposal on the revision of the EU ETS for Phase 4 in line with the 2030 Climate and Energy policy Framework.

More information on EU ETS is descripted in the Bulgaria's Seventh National Communication in chapter 4.

Effort Sharing Decision (ESD)

The EU Effort Sharing Decision (2013-2020) covers emissions from the non-ETS sectors such as buildings, transport and agriculture. It sets national emission targets for 2020, expressed as percentage changes from 2005 levels. By 2020, these national targets will collectively deliver a reduction of around 10 % in total EU emissions from the sectors covered compared with 2005 levels.

Under the ESD, Bulgaria has a reduction target of not exceeding 20 % by 2020 compared with 2005 for emissions from sectors not covered by the EU ETS.

In accordance with Article 14 of the Decision, the European Commission prepared an evaluation of the implementation of the Effort Sharing Decision up to 2015. The evaluation concluded that the commitments under the Decision have contributed to stimulating new national policies and measures promoting effective reductions of greenhouse gas emissions. It also found that the Decision has resulted in Member States becoming more active in considering new measures to reduce emissions in those sectors within the Decision's scope, as well as in improved coordination between national, regional and local governments.

The results of the evaluation were used by the Commission when preparing two legislative proposals setting out how EU Member States should implement their commitment to reduce its non-ETS emissions by 30 % by 2030 compared to 2005. The proposals were tabled on 20 July 2016.

First, for sectors outside the ETS and Land Use, Land Use Change and Forestry (LULUCF),

each Member State would be subject to a binding annual greenhouse gas emission limits for the period 2021–2030. Member States agreed to share the relevant efforts on the basis of fairness, solidarity, cost-effectiveness and environmental integrity. The proposal thus recognises Member States' varying capacities to take action by differentiating 2030 targets primarily based on 2013 GDP per capita. The proposed 2030 targets range from 0 % to -40 % compared to 2005 levels.

Secondly, Member States would be required to balance greenhouse gas emissions and removals from land use, land use change and forestry under the 'no debit rule'. It is proposed that greenhouse gas emissions from land use would have to be entirely compensated by an equivalent removal of CO_2 from the atmosphere through action in this sector or alternatively in the effort sharing sectors.

- **National level**

CLIMATE CHANGE MITIGATION ACT (CCMA)

The administrative framework of the EU ETS is defined by the Climate Change Mitigation Act (CCMA) (S.G. 22/2014, last amended S.G. 58/18.07.2017). It governs the public relations relevant to the implementation of the European greenhouse gas emission trading scheme and regulates the activities related to the allocation of greenhouse gas emission allowances and the issuance and modification of greenhouse gas emission permits. The act also regulates: the relations involving plans for monitoring and reporting of greenhouse gas emissions; the operation of the national registry for greenhouse gas emission allowances and the activities 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 for the aviation sector.

Subject to regulation by CCMA is the implementation of joint implementation projects and voluntary schemes, the reduction of greenhouse gas emissions from 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 in order to meet the Community's greenhouse gas emission reduction commitments up to 2020.

CCMA consolidates the numerous provisions relating to its subject that are currently found in various regulatory acts. It settles the connections between national legislation and EU standards in the field of the regulated matter. It also provides the mechanisms needed to fulfil the obligations of Bulgaria under the Kyoto Protocol.

THIRD NATIONAL CLIMATE CHANGE ACTION PLAN (2013 – 2020)

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 fulfil 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 against 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 the transport.

The 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 caps for the sectors under the ETS. For the non-ETS sectors Bulgaria has an individual commitment allowing an increase in 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 for energy efficiency improvement 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 aim to lead to an improvement of the energy efficiency by approximately 25% or saving more than 5 million 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 for achieving 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.

4.2. Sectoral policy and measures

The government approved the First official report of the Third National Action Plan on Climate Change. The paper summarizes the progress made on the measures aimed at introducing low-carbon, energy-efficient and non-waste technologies, the recycling and recovery of more waste contributing not only to the overall reduction of greenhouse gas emissions but also to increasing productivity and resource efficiency .

The Plan implements measures for the conservation and rational use of resources as a key prerequisite not only for the protection of the environment but also for achieving sustainable economic growth and increasing the competitiveness of the Bulgarian economy.

Implementation of measures creates opportunities for new sources of growth and jobs through cost savings, market innovation and better resource management. The overall effect of the implementation of sectoral policies and measures ensures the achievement of the legally binding targets for our country in international and national terms, with an annual reduction in greenhouse gas emissions of 10 060 537 tCO2 eq.

More information on sectoral policy and measures is descripted in the Bulgaria's Seventh National Communication in chapter 4.

5. 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, Third National Action Plan on Climate Change for the period 2013-2020 (NAPCC 2013-2020) and Natioal Energy Strategy until 2020.

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

- with measures - WEM
- with additional measures - WAM

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Total GHG emissions (without LULUCF) in the scenario "with measures" are expected to decrease with 42% in 2020 compared to 1990 and 46% in 2030. The scenario "with additional measures" shows a sharper decrease with 48% in 2020 , and 51% in 2030 complared to 1990.

Table 5.1. Aggregate GHG emissions of Bulgaria (excl. LULUCF)– Gg CO2 eq. - scenario with measures and scenario with additional measures

	1990	2015	2020	2030	Δ (2020 - 1990), %	Δ (2030 - 1990), %
WEM scenario Aggregate emissions in Gg CO2 eq.	**102 072**	**60 189**	**59 086**	**55 492**	**-42**	**-46**
WAM scenario Aggregate emissions in Gg CO2 eq.	**102 072**	**61 430**	**53 325**	**49 650**	**-48**	**-51**

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 Seventh National Communication.

6. Provision of financial, technological and capacity-building support to developing country Parties

Despite the fact that Bulgaria is an Annex I Party to the Convention, as a country with economy in transition status under the Convention, it has no commitments to provide financial resources and technology transfer to developing country Parties. Nevertheless, in its first biennial report, Bulgaria did report information on provision of financial support to developing country Parties, in particular in the Former Yugoslav Republic of Macedonia (FYROM).

Republic of Bulgaria's Roadmap for participation in the international development assistance delineates the country's closely situated States that are identifying as the most appropriate beneficiaries for financial, technological and capacity-building support with regards to Bulgarian geographic priorities for projects sponsorship – Former Yugoslav Republic of Macedonia, Armenia, Moldova, Kosovo, Serbia and Georgia.

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 (UNDP) with the goal of identifying a project which fulfills the aims of EU Fast Start Finance initiative.

As a part of the EU Fast Start Finance initiative, the country provided support in 2011 and 2012 to a project on capacity-building in the FYROM on monitoring, reporting and verification systems for GHG inventories and emissions trading. In 2012 Bulgaria provided financial support in the amount of 20 000 euros in the FYORM regarding to Bulgarian contribution to the short-term financing 2011-2012: sharing Bulgarian experience of monitoring, reporting and verification of greenhouse gas in the former Yugoslav Republic of Macedonia for participation in the European Union Emission Trading Scheme of greenhouse gases.

This is achieved through direct interaction between the Ministers of Environment in the two countries as the main aim of the project is to support the implementation process of the EU Directives 2003/87/EC and 2009/29/EC in FYROM 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 and emissions trading.

As Bulgaria significantly overachieved the emissions reduction target, Bulgaria concluded two Assigned Amount Units (AAUs) Purchase Agreements (in October 2011 and April 2012). The proceeds from the sale of AAUs are being spent through the National Green Investment Scheme, supporting projects on energy efficiency. Around 100 projects for financing the improvement of public buildings, including educational institutions, kindergartens, cultural institutions, medical centers and administrative buildings have been implemented. All measures result in a significant decrease of emissions.

In 2015 was started the Investment Climate Programme, which is a kind of continuation of the National Green Investment Scheme. The new programme is implemented by Trust Eco-Fund and it is financed by the revenues from so called "early auctions" of greenhouse gas emissions allowances from installations paid into the budget of the Ministry of Environment and Water by 31st December 2012. The funds are designated to be used for financing of the projects aiming at improving of energy efficiency of state and municipal public buildings, as well as for promoting the use of electric and hybrid vehicles by public institutions (since 2016).

In addition in 2015 at COP 21 in Paris Bulgaria announced its grant contribution of 100 000 Euros to the Green Climate Fund through the Ministry of Foreign Affairs of Republic of Bulgaria, That was a voluntary contribution to the GCF..

7. Other reporting matters

No other reporting matters supplied in this submission

FOR FURTHER INFORMATION PLEASE CONTACT:

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