REPUBLIC OF BULGARIA

EIGHTH
NATIONAL COMMUNICATION
ON CLIMATE CHANGE

UNITED NATIONS
FRAMEWORK CONVENTION ON CLIMATE CHANGE

SOFIA, 2022

1. 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
EEA	Energy Efficiency Agency
EPER	European Pollutant Emission Register
EU	European Union
EU ETS	European Union Emission Trading Scheme
ExEA	Executive Environmental Agency
FCCC	Framework Convention on Climate Change
FEC	Final Energy Consumption
FEC	Final Energy Consumption
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	Green House Gases
GVA	Gross Value Added
HPP	Hydro Power Plant
IMCCC	Inter-Ministerial Committee on Climate Change
IPPC	Integrated Pollution Prevention and Control
ISPA, PHARE, SAPHARD	European Union funds and programmes
IWG	Interministerial Working Group
JI	Joint Implementation
JISC	Joint Implementation Steering Committee
KP	Kyoto Protocol
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.

2. Executive summary

2.1. Introduction

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2.2.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.

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, Republic of North 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 2.1 Location of Bulgaria in Europe

Figure 2.2 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 1988-2020 (Source: NIMH), the average annual air temperature for the lower part of the country (for areas up to 800 m altitude) is increased on average with 0.9 °C relative to the climatic normal for the reference period 1961-1990 and ranges between 10.6 °C and 13.3 °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, 2020 (with an average annual temperature 13.0 °C) is the hottest year (followed by 1994 and 2007) in the observed period 1988-2020, but also it is the warmest ones since 1930 in Bulgaria. The average amount of precipitation in 2020 (for areas up to 800 m altitude) is 574 mm, which is slightly (about 10%) below the climatic normal for the period 1991-2020.

According to calculated data, Bulgaria's population is 6 916 548 people at the end of 2020. The population density is 62.3 per sq. km at the end of 2020.

During the period between the last two Censuses 2011-2020 the population in the country decreased by 11.5.% due to the negative natural growth rate and due to international migration (from 7 364 570 people in 2011 to 6 519 789 people in 2020 - https://infostat.nsi.bg/infostat/pages/reports/result.jsf?x_2=1962). 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. 72.9% live in urban areas and 27.1% live in rural areas.

The average age of the population for the country is 44.0 for 2020. 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 71.1 for male and 78.2 for female for the period 2018-2020. 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 (51.6 %)..

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.

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 2020 decreased with 55.7% compared to 1990. Instead energy consumption in transport sector in 2020 has inceased from 5% to 34% of the final energy consumption.

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 35 % 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.

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

Information for the annual GHG Inventory in Bulgaria for the period 1988-2020 is 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.

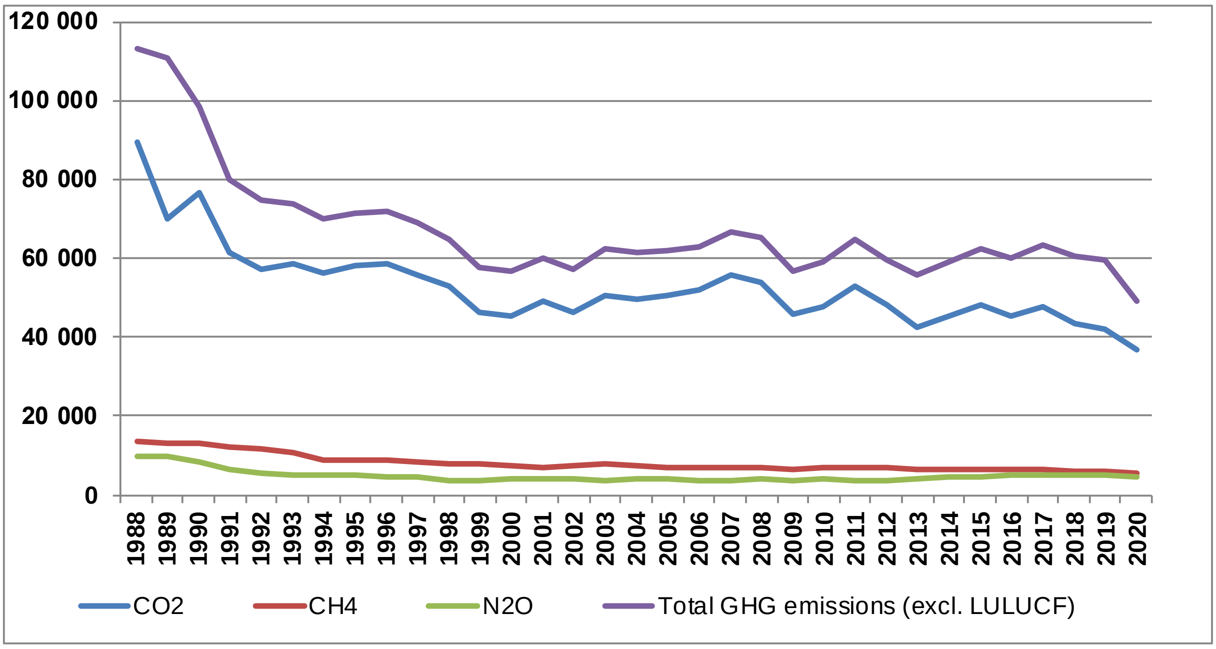
The annual inventory and reporting of greenhouse gas emissions and removals provide an information base for the planning and monitoring of climate policy. The Kyoto Protocol obliges its parties to establish a national greenhouse gas inventory system by the end of 2006. Bulgaria’s National Greenhouse 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 2022 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 (NF3) and sulphur hexafluoride (SF_6).

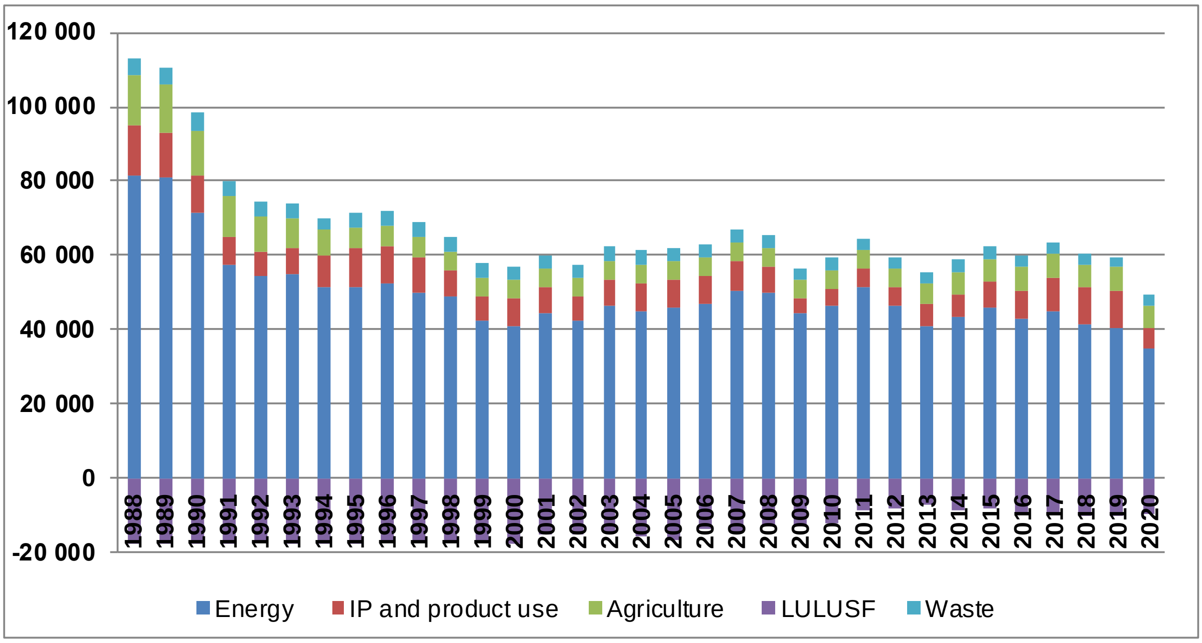
Each of these gases has a different warming effect. As an example, the gases HFCs, PFCs, NF3 and SF6 (so called F-gases) have much greater warming effect, in some cases over one hundred times, compared to methane (25), nitrous oxide (298) and carbon dioxide (1).The change in the overall emissions for the period 1988–2020 is shown in Table below.

Figure 2.3 Total greenhouse gas emissions in CO2 eq. Gg



The aggregated GHG emissions trend for the period 1988 – 2020 by sectors in Bulgaria is shown on Table below**Error! Reference source not found.**.

Figure 2.4 Aggregated GHG emissions by sector, Gg CO2 eq. for the period 1988-2020



The Energy sector, where GHG emissions come from fuel combustion, headed the list in 2020 with the biggest share – 71.29%. Sector IPPU ranked the second place with 10.78% and sectors Agriculture ranked the third place with 12.58% and Waste with 5.35%.

2.4.Policies and Measures

The Ministry of Environment and Water (MOEW) 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.

Energy Efficiency Agency within Ministr of Agency 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 Action Plan 2014-2020;
- National Action Plan for Renewable Energy 2020;
- 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.

2.5. 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.

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), Natioal Energy Strategy until 2020 and the latest available energy projection scenarios.

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

In the scenario **“with measures”** reflects all implemented and adopted policies and measures to reduce GHG emissions in the country by the end of 2020, 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 “**with additional measures**” scenario comprises planned for period after 2020 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.

Table 2.1 Aggregate GHG emissions of Bulgaria (excl. LULUCF)– Gg CO_2 eq. - scenario with measures

	2020*	**2025**	**2030**
Total emissions, WEM	49 186	50 902	50 779

Table 2.2 Aggregate GHG emissions of Bulgaria - Gg CO_2 eq. - scenario with additional measures

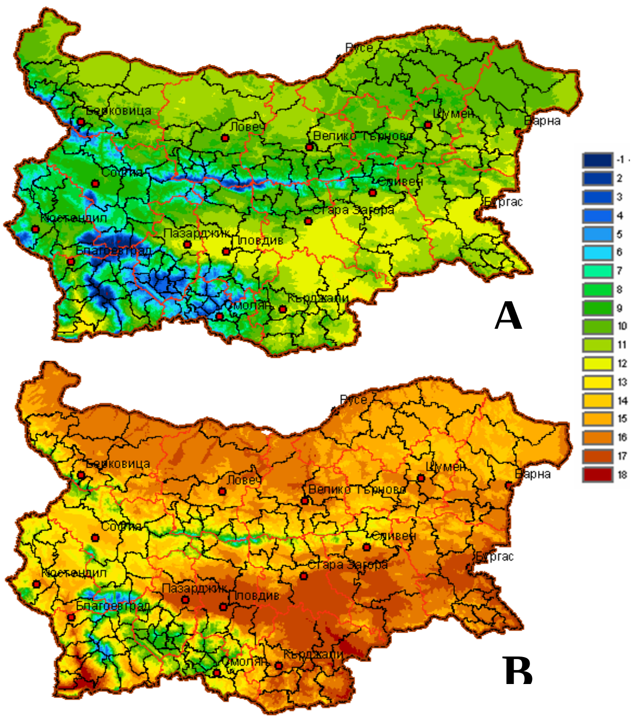
	2020*	2025	2030
Total emissions, WAM	49 186	50 323	49 508

2.6. Vulnerability Assessment, Climate Change Influence and Adaptation Measures

Bulgaria is situated in one of the regions that is particularly vulnerable to climate change (mainly through temperature increase and extreme precipitation) and to the increased frequency of climate change-related extreme events, such as droughts and floods. The risks inflicted by climate change-related events may lead to loss of human life or cause considerable damage, affecting economic growth and prosperity, both nationally and transboundary.

Consensus exists in the scientific community that climate change is likely to increase the frequency and magnitude of extreme weather events. Over the past decades, in Bulgaria, this frequency has increased significantly. The most common hydrometeorological and natural hazards are extreme precipitation and temperatures, storms, floods, wildfires, landslides, and droughts. The number of deaths and victims due to natural hazards is considerable, indicating weather and climate vulnerability. The vulnerability of Bulgaria's population and businesses to the impacts of climate change is accelerated by a relatively high degree of poverty in the most affected areas, the continuing concentration of the country's population in several industrial and urban regions, and various consequences of the transition from a state-controlled economy to a free-market economy. A growing body of evidence suggests that economic losses from climate- and weather-related disasters have also been rising.

Figure 2.5 Average Year Temperature for 1961–1990 (A); Pessimistic Climate Scenario for Average Year Temperature for 2080 (B)



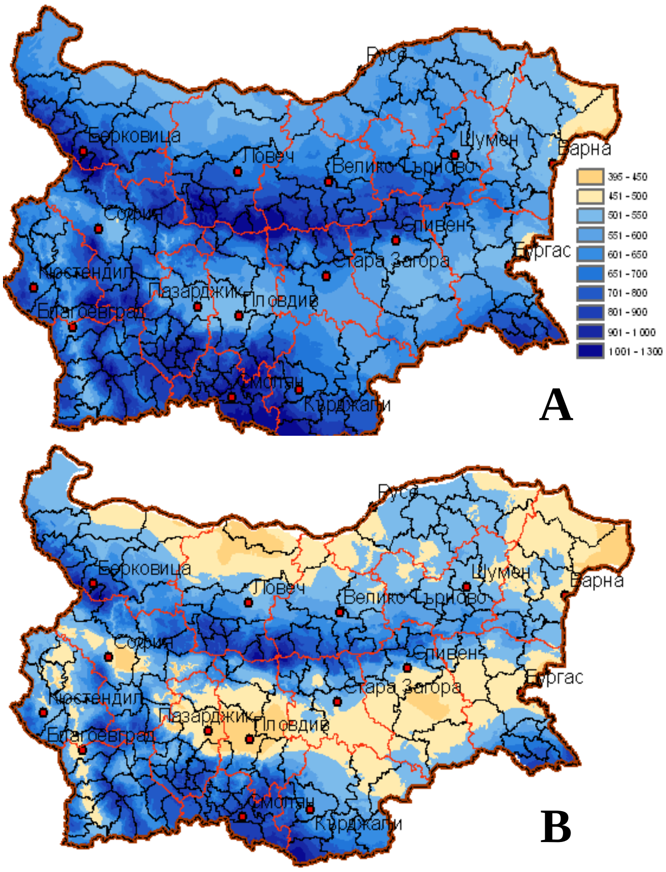
Source: NIMH.

Scientific projections indicate that global temperature will rise between 1.8°C and 4°C by 2100, with the temperature increase in Europe expected to be even higher than the estimated global average.

Research conducted by the Department of Meteorology, National Institute of Meteorology and Hydrology at the Bulgarian Academy of Sciences (NIMH-BAS), projects an increase in annual air temperature in Bulgaria of 0.7°C to 1.8°C by 2020. Even warmer temperatures are expected by 2050 and 2080, with projected increases of 1.6°C to 3.1°C and 2.9°C to 4.1°C, respectively (Figure 1.5). Generally, the temperature increase is expected to be more significant during the summer season (from July to September).

In terms of the expected changes in rainfall patterns, a reduction in precipitation is likely, leading to a significant reduction of the total water reserves in the country. In this regard, projections suggest a decrease in precipitation by approximately 10 percent by 2020, 15 percent by 2050, and up to 30 percent to 40 percent by 2080 (Figure 2.6). In most climate change scenarios, rainfall during the winter months is likely to increase by the end of the century, but significant decrease in rainfall during the summer months is expected to offset this increase.

Figure 2.6. Precipitation per Year for 1961–1990 (A); Precipitation per Year for 2080, According to the Pessimistic Scenario (B)



Source: NIMH.

According to the available climate change scenarios for Bulgaria, there is a trend toward increased frequency of extreme events and disasters, as demonstrated by frequent occurrences of heavy rainfalls, heat and cold waves, floods and droughts, hurricane winds, forest fires, and landslides.

Biodiversity, land and aquatic ecosystems, as well as water resources, agriculture, and forestry sectors are expected to be affected by the anticipated changes. These changes would furthermore affect society and its citizens as well as the economy as a whole.

Climate change impacts do not affect all people and territories equally due to different levels of exposure, existing vulnerabilities, and adaptive capacities to cope. The risk is greater for the segments of the society and businesses that are less prepared and more vulnerable.

2.7. 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.

2.8.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.

2.9.Research projects and systematic observation

T 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.

Table 2.3 Projects related to the protection of the environment, water and climate, financed by FNI in the period 2013 - 2020:

Contract	Topic:	Main organization	Head	Amount (in BGN)
DFNI E 02/16 of 12.12.2014	Effective use of waste biomass for energy and environmental purposes: potential of bioethanol as a feedstock fuel	Institute of Catalysis at BAS	Prof. Dr. Sonya Damyanova Ivanova	240000.00
DFNI E 02/19 of 12.12.2014	Influence of aerosol and gas pollution on air quality above a populated place in a mountain valley	University of Mining and Geology "St. Iv. Rilski"	Prof. Dr. Plamen Borisov Savov	100000.00
DFNI T02/2 of 12.12.2014	Development of a complex system for bioremediation of water contaminated with heavy metals and co-generation of energy based on microbial metabolism	University of Mining and Geology "St. Ivan Rilski"	Associate Professor Dr. Irena Ilieva Spasova	165000.00
DN 07/7 of 15.12.2016	Investigation of Chemical, Electrochemical and Biological Processes in Microbial Fuel Cells in Mining Wastewater Treatment	Mining and Geology University "St. Ivan Rilski" - Sofia	Assoc. Dr. Anatolii Tsankov Angelov	120000.00
DN 07/12 of 15.12.2016	Research on environmentally compatible processes for the extraction and fractionation of valuable functional substances from waste biomass	Institute of Engineering Chemistry - BAS	Prof. Dr. Eng. G. Angelov	118600.00

Contract	Topic:	Main organization	Head	Amount (in BGN)
DN 04/1 of 13.12.2016	A study of the combined effects of the natural radioactive background, UV radiation, climate change and cosmic rays on model groups of plant and animal organisms in mountain ecosystems	Institute for Nuclear Research and Nuclear Energy (INRNE) at BAS	Assoc. Dr. Hristo Angelov	120000.00
DN 04/3 of 17.12.2016	Arsenic migration in riparian zones: relation of river and groundwater dynamics to arsenic mobilization in polluted river terraces	National Institute of Geophysics, Geodesy and Geography - BAS	Associate Professor Dr. Tsvetan Kostadinov Kotsev	120000.00
DN 04/4 of 15.12.2016	Study of processes of transfer and deposition of atmospheric pollutants in Bulgaria	National Institute of Meteorology and Hydrology, BAS	Associate Professor Dr. Emilia Venkova Georgieva	119996.00
DN17/12 of 12.12.2017	Man as a physiological source of deterioration of air quality and comfort conditions in inhabited non-industrial indoor environments	Technical University Sofia	Prof. Dr. Petar Stankov	120000.00
DN17/20 of 12.12.2017	Functional composite nanomaterials derived from natural sources for environmental protection	University of Mining and Geology "St. Ivan Rilski"	Ch. Assistant Professor Gospodinka Dinkova Gicheva,	120000.00
DN17/25 of 20.12.2017	Preparation, purification and immobilization of lipase in solid-phase cultivation of Rhizopus arrhizus as a tool for the development of eco and "green" technologies	University of Food Technology, Plovdiv	Prof. Dr. Georgi Todorov Dobrev	120000.00

Contract	Topic:	Main organization	Head	Amount (in BGN)
DM17/2 of 12.12.2017	Integration of Plant-Sediment Microbial Fuel Cells in Engineered Wetlands for the Treatment of Oil-Contaminated Water	University of Mining and Geology "St. Ivan Rilski"	Assoc. prof. eng. Rosen Valeriev Ivanov	20000.00
DM17/6 of 12.12.2017	Closed cycle for environmental protection in thermal power plants by conversion of fly ash into zeolites and their application as carbon dioxide adsorbents	Technical University Sofia	Assoc. prof. eng. Denitsa Zgureva	19300.00
DN14/3 of 13.12.2017	Assessment and analysis of climate changes on regional/local scales and some of their consequences	National Institute of Geophysics, Geodesy and Geography, BAS	Member-Correspondent, Prof. D.Sc. Kostadin Ganchev Ganev	120000.00
DN14/6 of 13.12.2017	The natural environment in the Pirin Mountains under conditions of climate change	SU "St. Kliment Ohridski"	Prof. Dr. Georgi Donchev Rachev	113570.00
DN14/7 of 13.12.2017	Chemical forms and behaviour of transition metals in polluted natural waters and soils and their influence on the ecosystem vegetation - small mammals - endoparasites. Experimental study and thermodynamic modelling	Institute of General and Inorganic Chemistry, BAS	Prof. Dr. Diana Todorova Rabadzhieva	120000.00
DM14/1 of 11.12.2017	Modern trends in the regime and characteristics of the snow cover in Bulgaria	National Institute of Meteorology and Hydrology - Bulgarian Academy of Sciences (NIMH - BAS)	Assoc. prof. Dimitar Nikolov	20000.00

Contract	Topic:	Main organization	Head	Amount (in BGN)
DM14/2 of 20.12.2017	Geological and ecological risks related to the study of deep and shallow aquifers from the region of Central Northern Bulgaria	MGU "St. Ivan Rilski"	Ch. Assistant Professor Nikolay Krasimirov Hristov,	20000.00
KP-06-N24/2 of 08.12.2018	Relationship of the spatial distribution of heavy metals in soil to the morphology of polluted floodplain terraces	National Institute of Geophysics, Geodesy and Geography, BAS	Prof. Dr. Georgi Zhelezov Georgiev	120000.00
KP-06-OPR03/3 of 14.12.2018	Profiles of spatial differentiation of river water quality in basins with heterogeneous anthropogenic impact	National Institute of Geophysics, Geodesy and Geography, BAS	Assoc. Dr. Marian Stoyanov Varbanov	120000.00
KP-06-N37/5 of 06.12.2019	Sustainable resource supply chains in terms of environmental, economic and social criteria	Institute of Engineering Chemistry, BAS	Prof. Dr. Elisaveta Georgieva Kirilova	120000.00
KP-06-N37/27 of 18.12.2019	Smart textile materials with ecological and biomedical applications	Chemical Technology and Metallurgy University - Sofia	Assoc. prof. eng. Desislava Staneva Grabcheva	120000.00
KP-06-M37/3 of 06.12.2019	Utilization of RDF fuel waste to obtain innovative nanoporous carbon materials for environmental protection	Institute of Organic Chemistry with Phytochemistry Center, BAS	Assoc. prof. eng. Ivanka Georgieva Stoycheva	30000.00
KP-06-N34/9 of 19.12.2019	A study of carbon and some significant hydrocarbons in atmospheric aerosol in an urban environment	National Institute of Meteorology and Hydrology	Assoc. Dr. Elena Hristova	119790.00

Contract	Topic:	Main organization	Head	Amount (in BGN)
KP-06-M34/1 of 09.12.2019	Extraction of heavy metals from wastewater	Institute of Mineralogy and Crystallography, BAS	Assoc. prof. Lilya Tsvetanova	30000.00
KP-06-PN44/1 of 26.11.2020	Complex radioecological study of natural water resources	Institute for Nuclear Research and Nuclear Energy - BAS	Prof. Dr. Dimitar Tonev	170000.00
KP-06-M47/2 of 26.11.2020	Discovery of geometric characteristics and classification of tree species in Bulgaria for the purpose of environmental protection, part of NATURA 2000	Technical University Sofia	Assoc. prof. eng. Nikol Veselinova Hristova	30000.00
DN01/17 of 22.12.2016	Expansion of the pine beetle THAUMETOPOEA PITYOCAMPA (DENIS & SCHIFFERMULLER, 1775) (LEPIDOPTERA, THAUMETOPOEIDAE) in Bulgaria - a dangerous allergen and economically significant pest in pine ecosystems	Forestry Institute, BAS	Member-Correspondent Dr of Sc Plamen Borisov Mirchev	BGN 110,000.00
DN11/4 of 14.12.2017	The soil microbiome as an indicator of biodiversity and evolution of microbial communities under persistent heavy metal contamination	Institute of Molecular Biology, BAS	Assoc. Prof. Galina Radeva	BGN 120,000.00
DN11/13 of 18.12.2017	Biodiversity of the families Eulophidae and Pteromalidae (Hymenoptera: Chalcidoidea) in mountain habitats. Barcoding and distinguishing morphologically related species.	Institute of Biodiversity and Ecosystem Studies - BAS	Assoc. Prof. Dragan Chobanov, PhD	BGN 70,108.68

Contract	Topic:	Main organization	Head	Amount (in BGN)
DN11/14 of 18.12.2017	Phylogeographic pathways and barriers between the Balkans, the Carpathians and Asia Minor: a combined evolutionary-ecological study on a model group of insects (Insecta: Orthoptera: Barbitistini)	Institute of Molecular Biology, BAS	Assoc. Georgi Angelov Miloshev, prof.	BGN 119,992.00
DM11/2 of 15.12.2017	Influence of the ecological condition of the Varna and Burgas bays on the population-biological parameters of the mullet fish species (Mugil cephalus, Liza aurata and Liza saliens)	Institute of Oceanology - BAS	Prof. Radoslava Ivanova Bekova	BGN 20,000.00
KP-06-N21/1 of 17.12.2018	Cybertaxonomic approach in phylogenetic studies on model genera of invertebrates (Invertebrata, Arachnida, Insecta) to clarify problems of the origin, formation and conservation of the invertebrate fauna of the Balkan Peninsula	NPM-BAN	Prof. Dr. Pavel Stoev 897802524	BGN 119,904.39
KP-06-N21/2 of 18.12.2018	The Thracian mounds – hotspots of biodiversity and islands for the protection of natural flora and vegetation	IBEI - BAS	Prof. Dr. Iva Apostolova	BGN 119,660.00
KP-06-N21/7 of 18.12.2018	Study of ecological pressure in the Bulgarian Black Sea water area by means of integrated microbiological, biochemical and genetic markers in the Black Sea mussel Mytilus galloprovincialis Lam.	"Episkop Konstantin Preslavski" University of Shumen	Prof. Dr. Tsveteslava Ignatova-Ivanova	BGN 120,000.00

Contract	Topic:	Main organization	Head	Amount (in BGN)
KP-06-N21/8 of 18.12.2018	Mechanisms of recovery from drought induced water and low temperature stress: survival strategies of the resurgent plant *Haberlea rhodopensis*	IFRG, BAS	Prof. Dr. Katya Georgieva	BGN 120,000.00
KP-06-N21/11 of 18.12.2018	A study of pheromone communication in the viper (*Vipera ammodytes*) and its role in the behaviour of the species.	IBEI - BAS and IOHCF-partners	Assoc. Dr. Borislav Naumov	BGN 120,000.00
KP-06-H21/16 of 12.12.2019	The diversity of alpine plants in Bulgaria under the influence of climate change: installation of GLORIA sites for long-term monitoring and assessment of the risk of biodiversity loss (GLORIA – Bulgaria)	IBEI, BAS	Assoc. Dr. Anna Ganeva	BGN 120,000.00
KP-06-M21/1 of 12.12.2019	Extremophilic algae flora in thermo-mineral springs in South-West Bulgaria: changes in composition, conservation and assessment of new, threatened and invasive species	SU "St. Kliment Ohridski"	Assoc. Prof. Petya Draganova	BGN 20,000.00
KP-06-M21/2 of 12.12.2018	Study of faunal diversity, assessment of status and ecosystem services in different types of model ecosystems in Sarnena Sredna Gora	IBEI - BAS	Assoc. Professor Teodora Teofilova	BGN 19,993.60
KP-06-N-31/3 of 10.12.2019	Interaction between forests and avalanches in Pirin, Bulgaria	IEMPAM, BAN	Assoc. Prof. Ekaterina Pavlova	BGN 101,400.00

Contract	Topic:	Main organization	Head	Amount (in BGN)
KP-06-N-31/6 of 11.12.2019	Complex ecotoxicological study of psammophilic mussel species from sublittoral habitats of the Bulgarian Black Sea water area	Institute of Neurobiology - BAS	Assoc. Dr. Albena Aleksandrova	BGN 120,000.00
KP-06-N-31/9 of 11.12.2019	Marine benthic diatoms as a tool for assessing anthropogenic pressure along the Black Sea coast	Institute of Oceanology - BAS	Dr. Ralitsa Petrova Zidarova	BGN 120,000.00
KP-06-N-31/12 of 11.12.2019	Forest Management Scenarios for the Conservation of Plant and Fungal Diversity under Climate Change (MFORDIV)	Institute of Biodiversity and Ecosystem Studies, Bulgarian Academy of Sciences	Prof. Dr. Tsvetan Mladenov Zlatanov	BGN 120,000.00
KP-06-M-31/3 of 24.9.2019	Study of the distribution and impact of the invasive alien species *Impatiens glandulifera* Royale on the natural habitats in the gorge of the river Iskar between Plana and Lozenska mountain	Paisii Hilendarski University of Plovdiv	Assoc. Prof. Plamen Stankov Glogov	BGN 30,000.00
KP-06-M-31/4 of 26.09.2019	Assessment of the Bulgarian Fauna of Fulgoromorpha (Insecta: Hemiptera) and preparation of a regional red list of rare, endemic and endangered species,	Sofia University "St. Kliment Ohridski"	Assoc. Prof. Iliya Gyonov	BGN 30,000.00
KP-06-N-41/7 of 30.11.2020	An ecosystem approach to assess the biodiversity and population status of key fish species from the Bulgarian Black Sea coast	Institute of Oceanology "Prof. Fridtjof Nansen" - Varna, PARTNERS - Institute of Neurobiology	Assoc. Prof. Albena Aleksandrova	164,416.00 with DMA, 119,800.00 without DMA

Contract	Topic:	Main organization	Head	Amount (in BGN)
KP-06-M-41/2 of 27.11.2020	Influence of changing climatic conditions and increasing anthropogenic pressure on ichthyofauna in brackish (transitional) waters along the Bulgarian Black Sea coast	Institute of Oceanology "Prof. Fridtjof Nansen" - Varna	Assoc. Prof. Radoslava Bekova	BGN 30,000.00
KP-06-M-41/3 of 27.11.2020	Structure and function of fungal communities: adaptability of key fungal species to heavy metal-contaminated soils	Institute of Molecular Biology "Acad. Rumen Tsanev"	Dr. Michaela Alexova	BGN 30,000.00
KP-06-N23/1 of 17.12.2018	Building Radon Health Risk Assessment Models in Public Access Buildings for Long-Term Social Benefits	NCRRP	Associate Professor Kremena Ivanova	BGN 120,000.00
KP-06-OPR 03/12 of 18.12.2018	A model for sustainable management of urban soils by building buffer green areas around transport arteries in order to improve the quality of life	Paisii Hilendarski University of Plovdiv	Prof. Dr. Katya Georgieva	BGN 120,000.00
DFNI I02/15 of 12.12.2014	Information system for integrated risk assessment of natural disasters	University of National and World Economy	Prof. Dr. Dimitar Velev	222750
DFNI B02/4 of 12.12.2014	Environmentally friendly methods and means for controlling viral and bacterial diseases on vegetable crops from Solanaceae family to produce quality produce	Institute of Vegetable Crops "Maritsa" - Plovdiv	Prof. Dr. Stoyka Masheva	210000

Contract	Topic:	Main organization	Head	Amount (in BGN)
DFNI B02/8 of 12.12.2014	Biogenic volatile organic compounds, global climate change and the ability of plants to adapt to a changing environment	Institute of Plant Physiology and Genetics - BAS	Prof. Dr. Violeta Velikova	135000
DFNI E02/7 of 12.12.2014	Statistical modelling of environmental and human risk of soil contamination with heavy metals	Sofia University "St. Kliment Ohridski"	Prof. Dr. Stefan Tsakovski	184000
DFNI E02/13 of 12.12.2014	New eco-technologies for biodegradation of organic waste with production of hydrogen and methane	"Stefan Angelov" Institute of Microbiology - BAS	Assoc. Prof. Ivan Simeonov	240000
DN 06/1 of 14.12.2016	Organic molecular markers and contaminants in hydrophobic soils	Institute of Soil Science, Agrotechnology and Plant Protection "N. Pushkarov", AA	Prof. Dr. of Sc. Irena Dimitrova Atanasova	120000
DN 16/4 of 11.12.2017	An integrated approach to modelling wildfire spread	Forestry Institute - BAS	Prof. Dr. of Sc. Hristo Ivanov Tsakov	120000
DM 16/5 of 20.12.2017	Integrated analysis of the capacity of forest ecosystems from Sredna Stara Planina to reduce the influence of toxic elements: condition, dispersion, degradation and impact	Forestry Institute - BAS	Assoc. Prof. Rositsa Yaneva	20000
KP-06-N 26/11 of 18.12.2018	Role of carotenoids in the efficiency and resistance of the photosynthetic apparatus of higher plants to environmental changes	Institute of Biophysics and Biomedical Engineering - BAS	Prof. Dr. Antoaneta Vidolova Popova	120000

Contract	Topic:	Main organization	Head	Amount (in BGN)
KP-06-M 26/3 of 30.11.2018	Application of integrated biomarkers in an assessment model of aquatic ecosystems contaminated with priority organic substances	Paisii Hilendarski University of Plovdiv	Assoc. Prof. Vesela Yancheva	20000
KP-06-OPR 03/7 of 17.12.2018	Assessment of the ecosystem service "water" provided by water conservation forest areas in Bulgaria	Forestry University	Assoc. Prof. Nevena Vasileva Shuleva	120000
KP-06-OPR 03/6 of 17.12.2018	Assessment and mapping of ecosystem services in high mountain areas in Rila and Pirin for sustainable management of natural resources	Forestry Institute - BAS	Prof. Dr. Maria Hristova Glushkova	120000
KP-06 N 36/11 of 13.12.2019	"Socio-economic efficiency of using WWTP sludge in agriculture"	Institute of Agrarian Economics	Assoc. Prof. Bozhidar Ivanov	118800
KP-06 N 36/13 of 17.12.2019	Structural-functional characteristics and prospects for the use of endemic relict conifer communities in Bulgaria in the conditions of a changing climate	Institute of Biodiversity and Ecosystem Studies (IBEI) - BAS;	Prof. Dr. Tsvetomir Denchev	120000
KP-06 M 36/4 of 17.12.2019	Increasing the upper limit of the forest in Tsarichina Reserve as an example of a positive response of forest ecosystems to climate change and land use change	Forestry Institute - BAS	Chief Assist. Dimitar Dimitrov	30000

Contract	Topic:	Main organization	Head	Amount (in BGN)
KP-06 N 46/1 of 27.11.2020	Effectiveness of anti-erosion agrotechnologies to improve soil quality and hydrological regime and limit greenhouse gas emissions	Institute of Soil Science, Agrotechnology and Plant Protection "N. Pushkarov" - Sofia	Assoc. Prof. Viktor Kolchakov	118400
KP-06 M 46/1 of 27.11.2020	Biodiversity of forest ecosystems of the middle old mountain under conditions of change	Forestry Institute	Assoc. Prof. Rositsa Yaneva	30000
KP-06 M 46/3 of 27.11.2020	Effect of drought on maize and sorghum photosynthesis	Institute of Biophysics and Biomedical Engineering	Assoc. Prof. Martin Stefanov	30000

3. National circumstances relevant to greenhouse gas emissions and removals

3.1. 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, 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.

3.2. 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, Republic of North 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 km² and water volume of 211 mln m^3, and 23 dams with total area of 376 km² and water volume of 4,571 mln m^3. Bulgaria has three National Parks – Pirin, Rila and Central Balkan. They have a total area of 193,049 hectares and comprise more than one-third of all protected areas in Bulgaria. The National Parks belong to the state. They are managed and administered by Directorates, operating under the Ministry of Environment and Waters. The Bulgarian National Parks offer excellent opportunities for tourism, scientific research and education.

3.3. 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. Despite its small area, Bulgaria has unusually various climate conditions due to the combined influence of the strongly differing continental and Mediterranean climates and the diverse landscape. 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 distinctly till the late 1990s – on an annual basis, Northern Bulgaria is cooler at about 1°C and receives about 192 mm more precipitation than Southern Bulgaria. Since the beginning of the 21st century, temperatures have been rising. The northern half of the country is warming faster than the southern half, equalizing the average annual temperature on both sides of the Balkan Mountains. The growing number of torrential precipitation events in south Bulgaria leads to an increase in total precipitation in this region, which results in a relatively more evenly distributed annual precipitation in the southern and northern parts of the country. The Balkan Mountains appear the south boundary of the area in which continental air masses circulate freely. The Rhodope Mountains mark the northern border of the Mediterranean weather systems domination. 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 end of 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 sometimes 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 1988-2020 (Source: NIMH), the average annual air temperature for the lower part of the country (for areas up to 800 m altitude) is increased on average with 0.9 °C relative to the climatic normal for the reference period 1961-1990 and ranges between 10.6 °C and 13.3 °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, 2020 (with an average annual temperature 13.0 °C) is the hottest year (followed by 1994 and 2007) in the observed period 1988-2020, but also it is the warmest ones since 1930 in Bulgaria. The average amount of precipitation in 2020 (for areas up to 800 m altitude) is 574 mm, which is slightly (about 10%) below the climatic normal for the period 1991-2020.

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, 29 of the last 32 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.

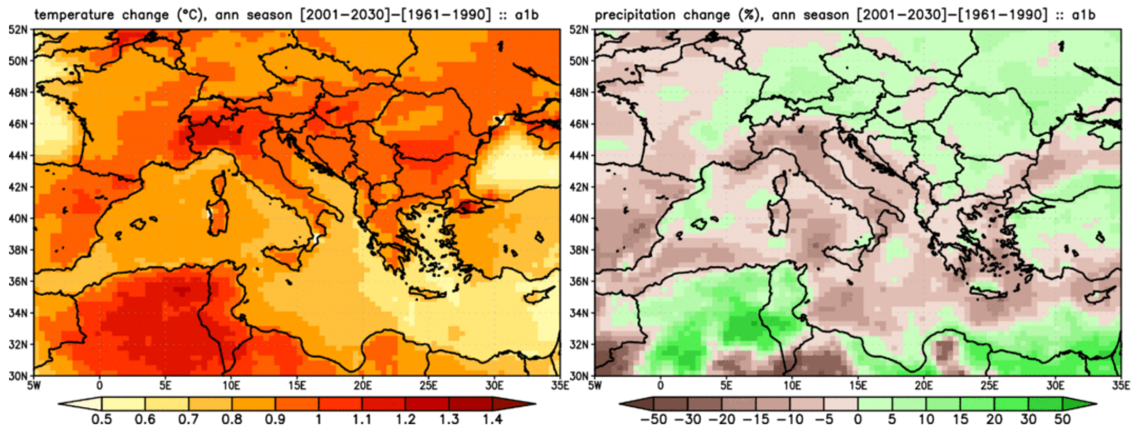
The results from the studies of water resources in Bulgaria based on current trends of air temperature and precipitation as well as on simulation models and climate scenarios show that the annual river runoff is likely to decrease during this century. The main reasons for this – the observed trends of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

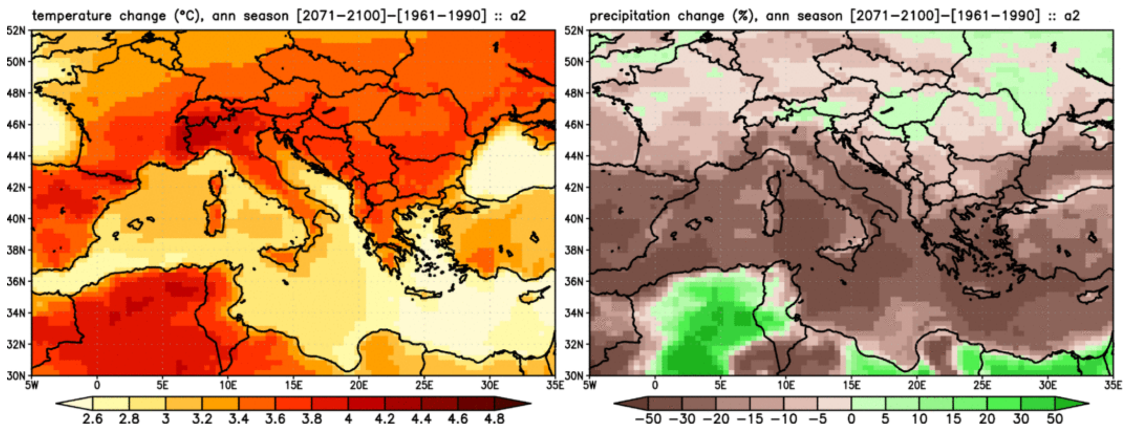
The expected global warming will be accompanied by an increase in the frequency of the hot air waves combined with increased humidity and urban air pollution. The result will probably lead to a large number of heat strokes. Besides the risk of further limitation of water resources, more forest fires, 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 2.1 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.

3.4.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, increasing average age of population, Table 3.1**.**

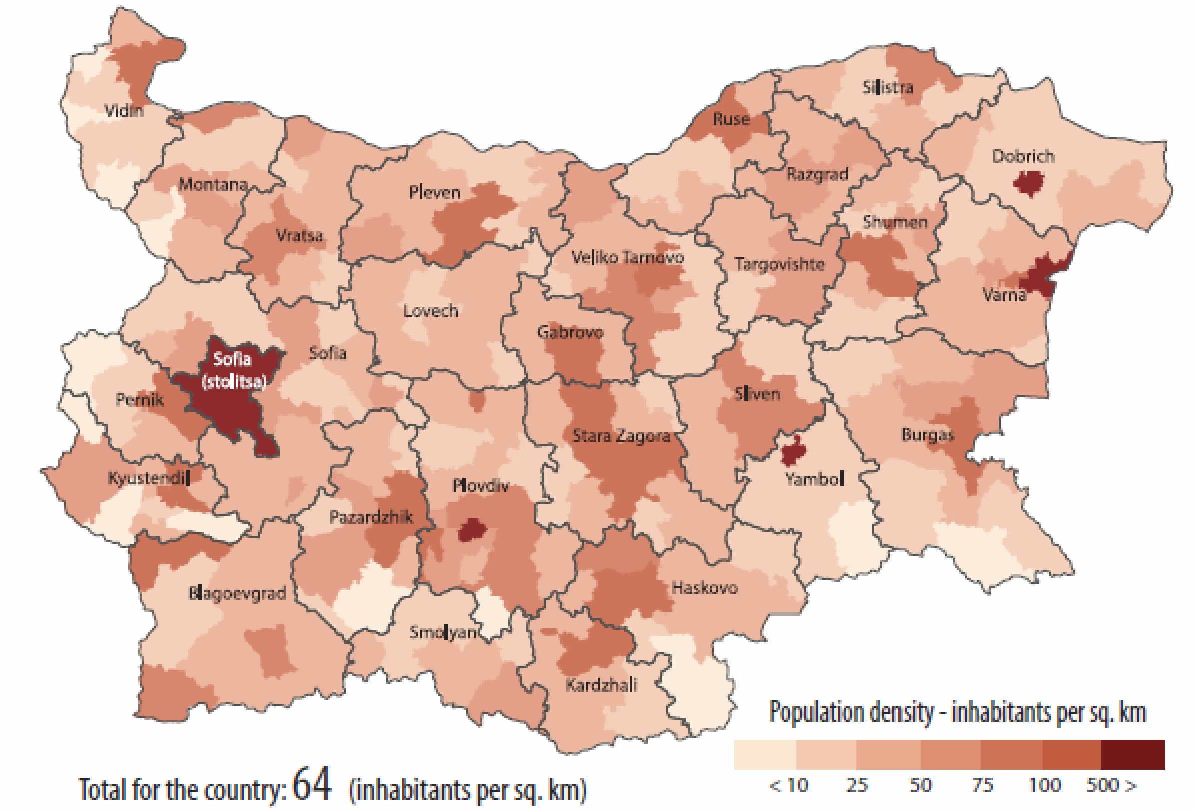
Table 3.1 Demographic parameters

Years	**Birth rate ‰**	**Natural increase ‰**	**Marriage rate,‰**	**Average age of population**	**Population annual average (mil)**
1960	17,8	9,7	8,8	32,4	7,87
1970	16,3	6,0	8,6	34,4	8,49
1980	14,5	3,4	7,9	35,8	8,86
1990	12,1	-0,4	6,9	37,5	8,72
2000	9,0	-5,1	4,4	38,9	8,41
2010	10,0	-4,6	3,2	41,9	7,5
2012	9,5	-5,5	2,9	42,8	7,28
2013	9,2	-5,2	3,0	43,0	7,24
2014	9,4	-5,7	3,4	43,2	7,2
2015	9,2	-6,2	3,9	43,3	7,15
2020	8.5	-9,5	3,2	44,0	6,92

According to calculated data, Bulgaria’s population is 6 916 548 people at the end of 2020. The population density is 62.3 per sq. km at the end of 2020.

During the period between the last two Censuses 2011-2020 the population in the country decreased by 11.5.% due to the negative natural growth rate and due to international migration (from 7 364 570 people in 2011 to 6 519 789 people in 2020 - https://infostat.nsi.bg/infostat/pages/reports/result.jsf?x_2=1962). 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. 72.9% live in urban areas and 27.1% live in rural areas.

Figure 2.2. 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 44.0 for 2020. 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 71.1 for male and 78.2 for female for the period 2018-2020. 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 (51.6 %).

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 44,0 in 2020.

3.5.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.

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 Table 2.2.

GDP growth is at moderate, balanced pace with no sudden fluctuations, typical for past periods. During the last few years of the analysis, the pace of GDP growth is bigger due to favourable economic climate in the country. The main economic indicators are given in Table 2.2.

Table 3.2 Statistical information on the main economical indicators

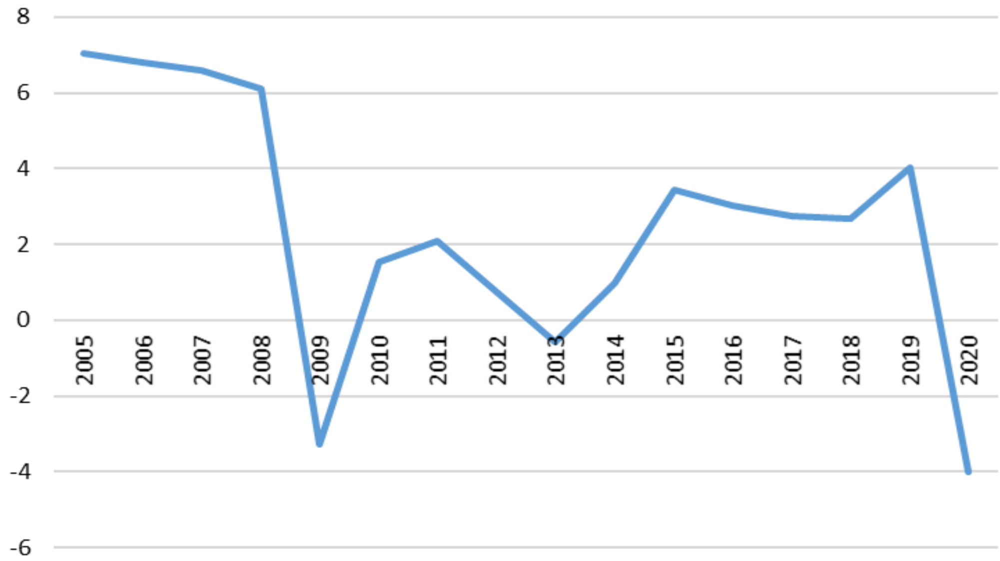
	Gross Domestic Product	**GDP, real growth**	**Real annual GDP growth**	**Export**	**Import**	**GDP per capita**	**Unemploy-ment**
	mil. Lv	**% per year**	**% per year**	**EUR million**	**EUR million**	**Lv**	**%**
2005	47 017	14,1	7,1	10 224	13 747	6 075	10,1
2006	53 608	14,0	6,8	12 876	17 561	6 963	9,0
2007	63 455	18,4	6,6	16 997	23 107	8 284	6,9
2008	72 790	14,7	6,1	19 546	26 896	9 548	5,6
2009	73 181	0,5	-3,3	15 797	18 886	9 648	6,8
2010	74 878	2,3	1,5	19 183	20 407	9 938	10,3
2011	81 124	8,3	2,1	24 390	24 328	11 040	11,3
2012	82 646	1,9	0,8	25 503	26 892	11 312	12,3
2013	82 242	-0,5	-0,6	27 156	27 396	11 320	12,9
2014	84 150	2,3	1,0	27 795	28 262	11 649	11,4
2015	89 600	6,5	3,4	29 228	28 816	12 483	9,2
2016	95 390	6,5	3,0	31 151	28 758	13 383	7,6
2017	102 741	7,7	2,8	35 193	32 927	14 520	6,2
2018	109 964	7,0	2,7	36 937	35 509	15 653	5,2
2019	120 395	9,5	4,0	39 356	37 369	17 259	4,3

2020	120 553	3,6	-4,0	27 272	29 213	17 299	5,1

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. 2.3). 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 and 4% in 2019. Due to the COVID pandemic, the GDP growth decreased dramatically reached -4% in 2020.

Figure 3.3 GDP Growth – Bulgaria

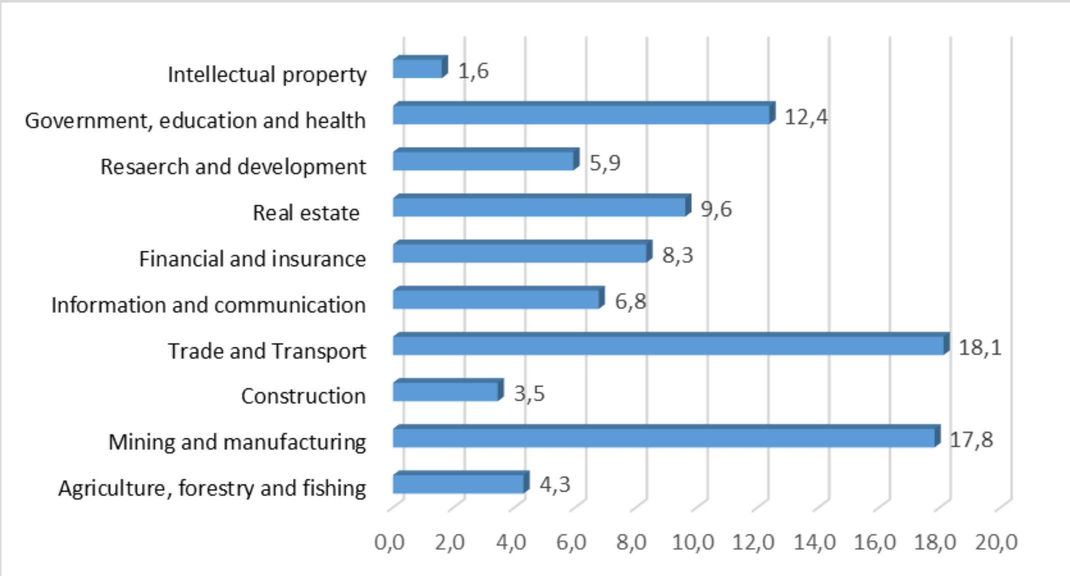


Source: National Statistical Institute

GVA in total and by economic sectors

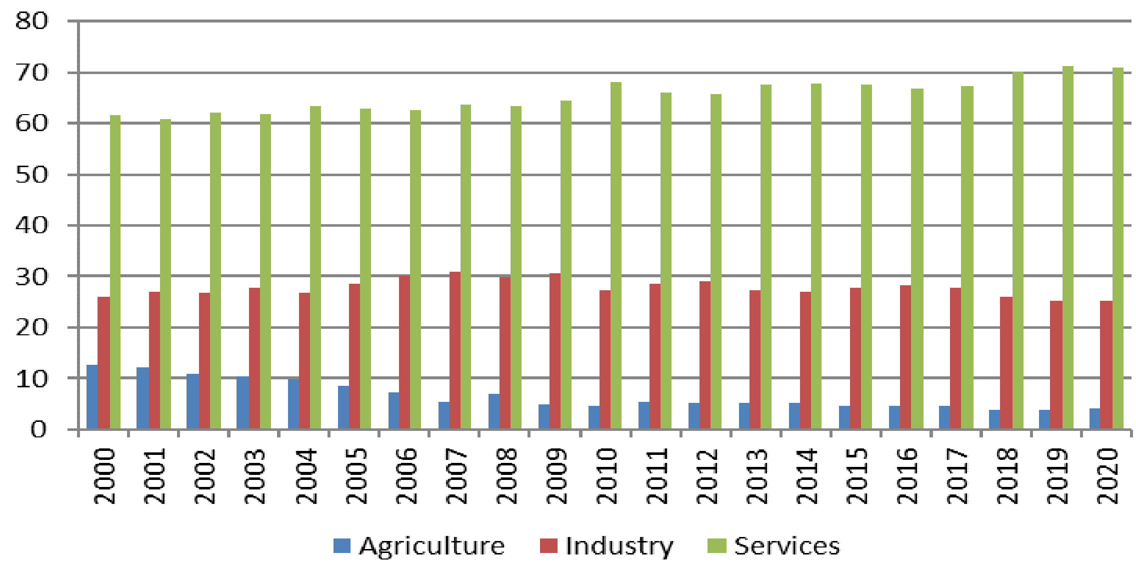
On the average, GVA is 87% of GDP, for the agricultural sector, GVA was 3% of GDP, for the industrial sector it was 22% of GDP and for the services sector it was 61% of GDP. The largest share of GVA is the services sector - 71% of the total added value. The industrial sector accounts for 25% and the agricultural sector has the lowest share of 4%.

Figure 3.4 GDP breakdown by main subsectors, 2020 (%)



Source: NSI

Figure 3.5 GDP Breakdown (2000-2020)



Source: NSI

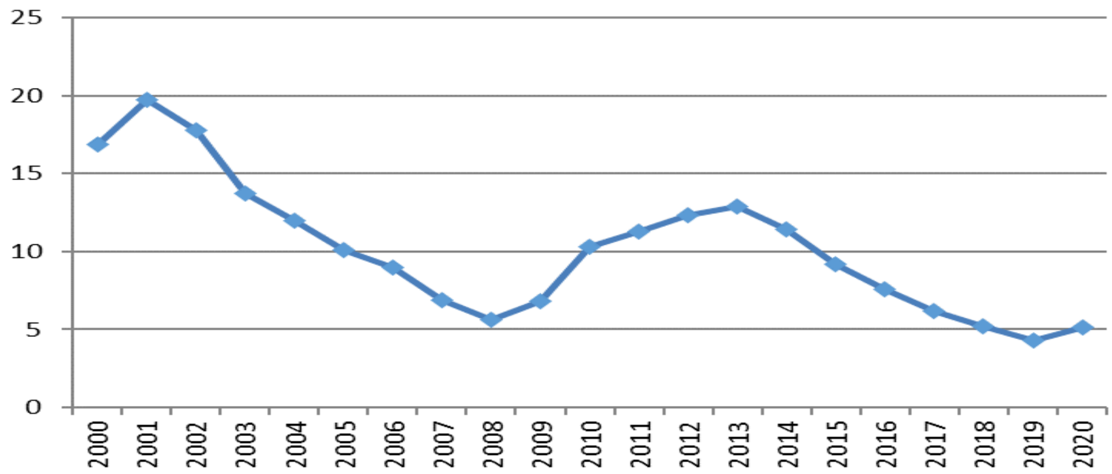
The introduction of the Currency Board lowered the inflation and became an important prerequisite for the revival of the economic activities. The inflation was reduced significantly and has come nearer the level of the industrial states.

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 until 5.1% in 2020.

Figure 2.6. 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 3.3.

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

Import significantly surpasses export and this negative trend increases.

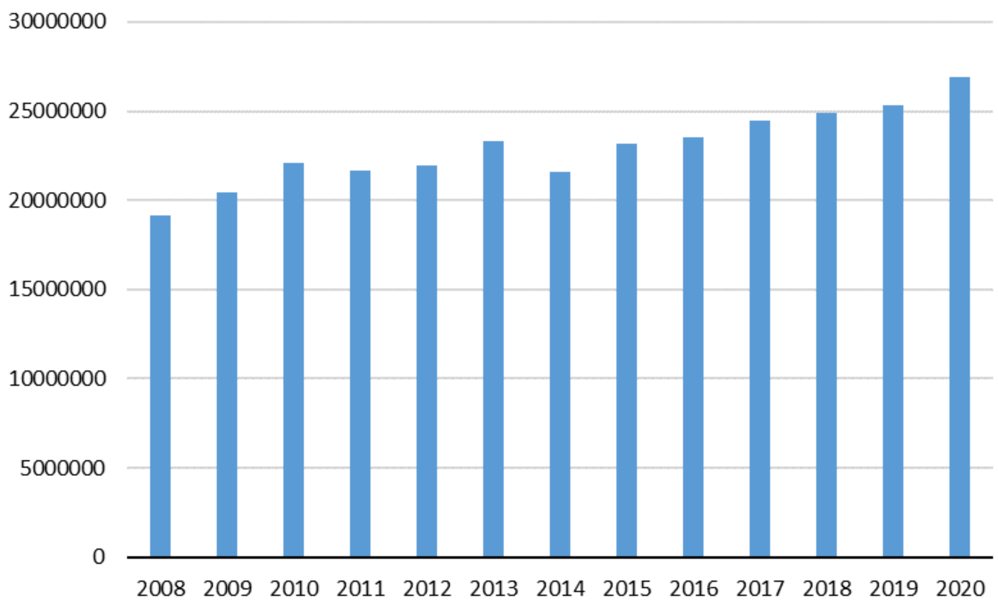
Table 3.3. Trade balance

Year	Export mil. EURO	Import mil.	Trade balance
2005	94 66,3	14 667,7	-5201,4
2006	12 011,9	18 479,3	-6467,4
2007	13 511,9	21 861,2	-8349,3
2008	15 204,0	25 094,2	-9890,2
2009	11 699,2	16 875,4	-5176,2
2010	15 561,2	19 244,8	-3683,6
2011	20 264,4	23 406,2	-3141,8
2012	20 770,2	25 459,2	-4689,0
2013	22 271	25 828,2	-3556,7
2014	22 105	26 125,8	-4020,8
2015	22 982	26 356,7	-3374,4
2016	24 126	26 181,4	-2055,4
2017	27 916	30 286	-2369,8
2018	28 648	32 148	-3499,9
2019	29 890	33 743	-3850,3
2020	28 008	30 743	-2734,3

Source: NSI

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

Figure 3.7. FOREIGN DIRECT INVESTMENTS IN NON-FINANCIAL ENTERPRISES AS OF 31.12. BY ECONOMIC ACTIVITY (€ Thousand EUR)



Source: NSI

3.6.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 3..

Table 3.4 Relative share of the private sector in GDP (%)

YEAR	Agriculture and forestry	Indutsry	Services
2000	12,6	25,8	61,6
2001	12,1	27,0	60,9
2002	11,0	26,8	62,2
2003	10,5	27,7	61,9
2004	9,9	26,8	63,3
2005	8,6	28,5	62,9
2006	7,2	30,1	62,7
2007	5,5	31,0	63,6
2008	7,0	29,7	63,3
2009	4,9	30,6	64,6
2010	4,6	27,2	68,2
2011	5,3	28,7	66,0
2012	5,1	29,2	65,7
2013	5,2	27,3	67,5
2014	5,3	27,0	67,7
2015	4,7	27,8	67,5
2016	4,7	28,4	66,9
2017	4,7	27,9	67,4
2018	3,9	25,9	70,2
2019	3,8	25,1	71,1
2020	4,0	25,1	70,8

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.

3.6.1. Land Use and National Resources

3.6.1.1.Land use

Common information on the Land Use in Bulgaria is shown on Table 3..

Table 3.5 Land use in Bulgaria – general information in ha, 2020

	2015	2020
Utilised Agricultural Area	5 011 494	5 047 252
Arable land	3 493 688	3 477 514
Permanent pastures	1 368 665	1 403 988
Forests and woodland	4 222 874	4 270 995

Source: Agrostatistical Reference Book MAF, 2020

Land for agricultural purposes in 2020 was 5 227 902 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 2020 it was 5 047 252 or 46% of the territory of the country.

The UAA increased by 0.2% 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 2020 the arable land increased by 0.5 % compared to the previous year, occupying 3 477 514 ha or 68.9% of the Utilised Agricultural Area. This growth is mainly due to the expanded area growing barley, maize, sunflower and industrial crops.

3.6.1.2.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.

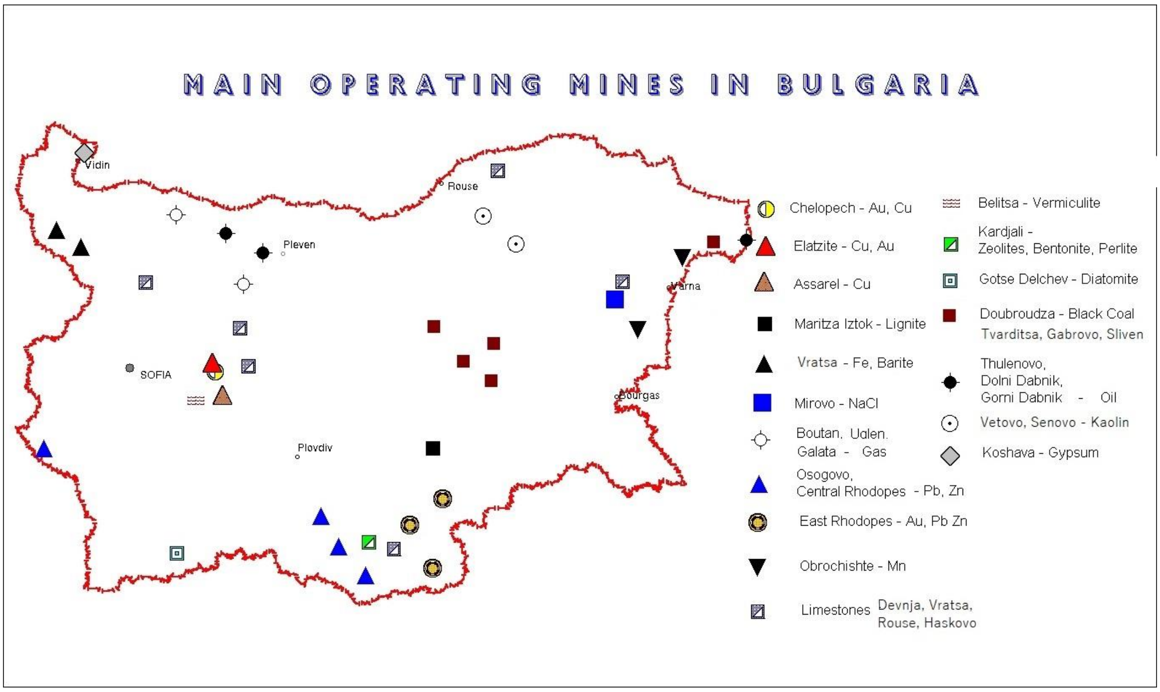
The Sakar-Stranja zone is relatively weak studied. In the most Eastern part Burgas' mines are operating. Important for the region is the Elhovo's finding of brown coal. From non-ore resources important are some marbles with pink/gray hue and some types of granites.

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.

3.6.1.3.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 3.8 and described below:

Figure 3.8. Operating mines in Bulgaria



3.6.2. 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.

3.6.3. 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 35 % 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 3. and Table 3., data for the forest areas in Bulgaria is given and also – activities for afforestation.

Table 3.6 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
Deciduous	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
Deciduous	2634	2658	2677	2703	2724
High-stemmed	850	856	861	868	878
Low-stemmed	1784	1802	1816	1835	1846
Type of forest	**2016**	**2017**	**2018**	**2019**	**2020**
Total	4231	4243	4257	4149	4270
Coniferous	1259	1254	1251	1214	1237
Deciduous	2972	2989	3006	2935	3033
High-stemmed	942	952	954	940	967
Low-stemmed	2030	2037	2052	1995	2066
of which: Wooded forest area	3865	3877	3893	3789	3603
Coniferous	1131	1125	1122	1088	1117
Deciduous	2734	2752	2770	2701	2801
High-stemmed	880	892	895	882	911
Low-stemmed	1854	1860	1875	1818	1890

Source: National Statistical Institute, Statistical Reference Book 2021

Table 3.7 Activities for afforestation, ha

Year	1990	1995	2000	2005	2010
Preparation of area	22368	10911	6056	3658	764
Afforestation	35551	14367	6313	5397	1727
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
Reforestation of artificial forest	634	558	550	322	298
Year	**2016**	**2017**	**2018**	**2019**	**2020**
Preparation of area	1763	1584	1278	1465	1613
Afforestation	1987	1745	1503	1529	1760
Reforestation of artificial forest	318	571	694	488	482

Source: National Statistical Institute, Statistical Reference Book 2021

Forest Areas in Bulgaria in 2020 - ownership distribution[1]:

Total forest area – 4 270 995 ha, of which:
Forest area – 3 952 575 ha

· State forest area – 77.6 % and non-state – 22.4 %.

o Forests managed by the EFA – 73 %

o Managed by MoEW – 4.3 % (exclusive state ownership).

o Educational and experimental forestry – 0.3 %

· Distribution of non-state forest ownership:

o Physical persons and other legal entities – 9.7 %,

o Municipal forests – 11.2 %,

o Religious communities – 1.5 %,

Forest afforested over abandoned agricultural lands - 318 420 ha

· State forest area – 12.4 % and non-state 87.6 %

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";

[1] https://eea.government.bg/bg/soer/2020/forest/gorskite-resursi-i-tehniya-prinos-kam-globalnite-tsikli-na-vaglerod-1

- „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.

3.6.4. 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 3.8.

Table 3.8 Biodiversity

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

One of the main ways for the protection of this biodiversity and landscape diversity is the protection of territories. According to the Forest Act, the National Forestry Directorate (NFD) at 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.

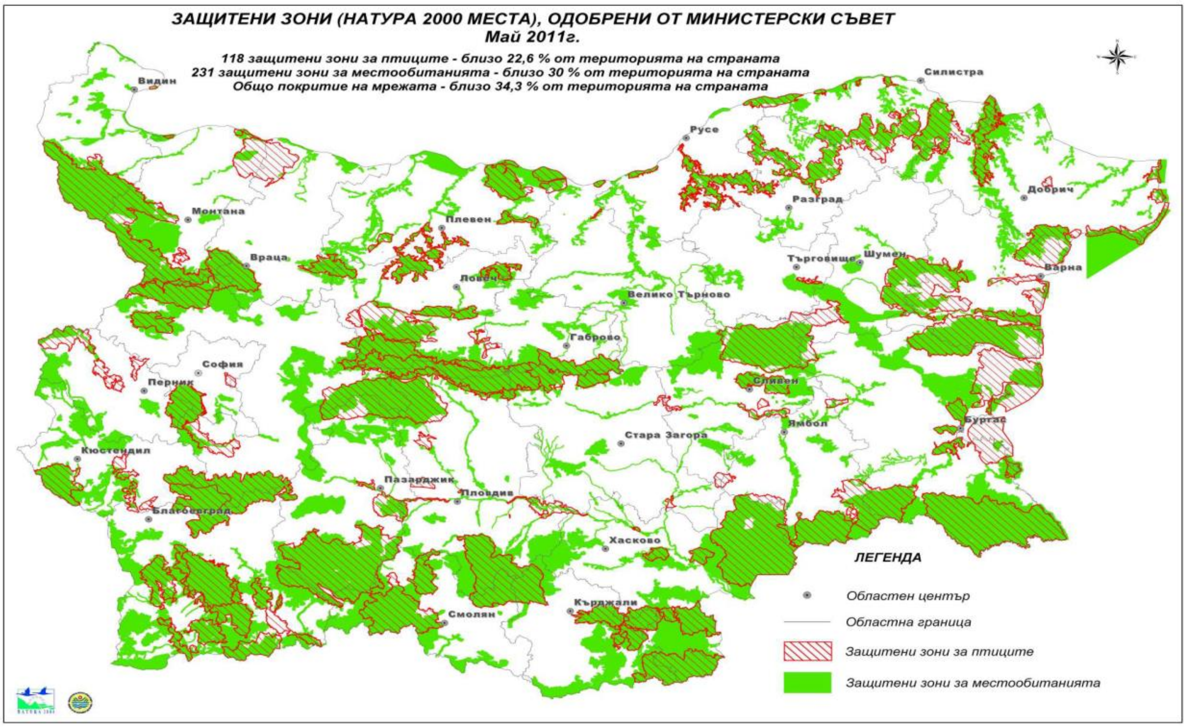
The hunting grounds encompass 140 127 ha area and are located in territories, where the genetic fund of the game and its population is being preserved and increased.

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 31.12.2020, 1,023 protected areas (PAs) were recognized with a total area of 583,582.2ha, approximately 5.3% of the country’s territory . This includes 3 national parks, 35 managed reserves, 55 reserves, 11 nature parks, 346 natural landmarks and 573 protected areas.

Figure 3.9 Protected areas in NATURA 2000 in Bulgaria



3.6.5. 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 - 2020 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 2020.
- Exemptions are granted to taxpayers with specific types of income.
- The standard rate of tax for a Bulgarian corporate tax in 2020 is 10%.
- A special tax rate is applicable for companies dealing in shipping as well as companies engaged in games of chance and gambling.

3.6.6. 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. 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 3.9 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
	2016	**2017**	**2018**	**2019**	**2020**
Industry	27,9	28,3	28,0	27,6	27,8
Transport	34,3	34,1	34,6	35,1	33,8
Households	23,7	23,8	22,9	22,3	25,0
Others	14,1	13,8	14,5	15,0	13,4
Total	100	100	100	100	100

Source: NSI

Industry is the biggest energy consumer in Bulgaria's economy, but it's share in 2020 decreased with 55.7% compared to 1990. Instead energy consumption in transport sector in 2020 has inceased from 5% to 34% of the final energy consumption.

Table 3.10 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
	2016	**2017**	**2018**	**2019**	**2020**
Industry	111	115	115	112	111
Transport	134	137	139	141	143
Households	92	94	97	93	91
Others	53	56	56	59	61
Total	398	408	408	406	398

Source: NSI

The largest relative share of input fuels for electricity production was occupied by nuclear energy – 41 %, followed by local coal – 33 %, RES – 17 %, gaseous fuels – 6 %, imported coal – 1 % and liquid fuels - 0.1%.

Table 3.3 Main energy parameters

	Primary energy production	Gross domestic energy consumption	End consumption of energy	Share of energy from RES in gross domestic energy consumption	Energy dependency
	1000 toe	**1000 toe**	**1000 toe**	**%**	**%**
2005	10 643	20 081	9 602	9,4	47,5
2010	10 453	17 916	8 699	14,1	40,5
2011	12 241	19 200	9 125	14,3	37
2012	11 689	18 398	9 103	16,1	37
2013	10 666	17 083	8 681	19	38,6
2014	11 307	17 874	8 882	18	35,4
2015	12 033	18 681	9 389	18,2	36,7
2016	11 273	18 293	9 518	18,8	38,5
2017	11 728	18 936	9 742	18,7	39,4
2018	11 957	19 003	9 758	20,6	36,3
2019	11 691	18 844	9 720	21,6	38,1
2020	10 831	17 836	9 514	23,3	37,9

Source: NSI

Public administration responsible for energy and industry includes:

- Ministry of Energy
- Ministry of Economy
- Energy Efficiency Agency (EEA)
- Ministry of Innovation and Growth
- 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 2.12 Output (Production value) of industrial enterprises, thousand BGN

	Total	Mining and quarrying	Manifacturing	Electricity, gas, steam and air-conditioning, supply	Water supply, sewerage, waste management and remediation
2011	59659708	2802188	46974358	8524327	1358835
2012	62710629	2969775	48728136	9638391	1374327
2013	62623923	2557007	49685725	9023288	1357903
2014	61978163	2432698	50933970	725631	1354564
2015	645483388	2578600	52666985	7882904	1478627
2016	65352612	2496478	53747760	7626465	1481909
2017	72979700	2851938	60892649	7681625	1553488
2018	77079450	2796522	65086068	7432370	1764490
2019	79320837	2586650	67693717	7208310	1832160
2020	73658021	3097435	61759156	7005546	2000441

Source: NSI

3.6.7. Transport

In 2020 Bulgaria had 19,9 thousand km roads. In structural terms the majority are class III roads with a 61,3 % share, followed by class II – 20,2 %, and class I – 14,5 %. Highways are 806 km with the lowest relative share – 4,0 %.

The total length of the railway network is 5 464 km, which, when related to the area of Bulgaria, makes an average density of the railway network of 36,3 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 2.13

Table 3.13 Goods carried by different transport modes 2003 – 2020, 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
2016	121 910	2 443	5	124 358
2017	134 385	2 291	9	136 685
2018	114 430	2 191	23	116 644
2019	94 279	2 376	20	96 675
2020	110 270	2 827	21	113 118

Source: NSI

Data on carried passengers is given in Table 2.14.

Table 3.14 Passengers carried by transport modes 2003-2020, 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
2016	469 054	119	2 337	244 902	716 412
2017	466 535	109	2 198	279 654	748 496
2018	443 870	114	2 470	275 131	721 585
2019	467 524	102	2 693	268 799	739 118
2020	318 768	91	591	193 008	512 458

Source: NSI

Table 2.15. Number of vehicles by type 1990-2020

	Passenger cars	LDV and HDV	Busses	Motorcycles	Mopeds
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
2016	3 143 634	496 038	21 302	99 806	74 690
2017	2 775 758	459 927	19 350	106 047	78 114
2018	2 773 401	475 045	19 232	112 387	80 813
2019	2 829 998	490 212	19 189	118 738	83 713
2020	2 866 763	499 727	19 080	124 311	85 503

Source: NIR2022

A unique feature of the Bulgarian vehicle fleet is its age structure. In 2020 about 87.4% of the vehicles were above 10 years old, whereas new vehicles (1 to 5 years) were 5.7 % of the total and 6.9% were aged between 6 and 10 years.

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.

3.6.8. 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.

- 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 (2014-2020)
- 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 77% in 1990 to 52% in 2020). 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 2020 is 2 825 kt which is in average 1.118 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 22.53 Gg in 1988 (extrapolated value) decreasing to 1.60 Gg in 2020 (decreased by 92.9%).

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 2.16 Time series of sewage sludge production and landfilling

Year	1990	2000	2005	2006	2007	2008
Sewage sludge production (Gg)	45,8	43,06	41,7	38	39,9	42,9

Sewage sludge landfilled (Gg)	21,73	20,43	23,4	16,4	20,8	17,8
Year	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Sewage sludge production (Gg)	39,4	49,8	51,4	59,3	60,3	54,94
Sewage sludge landfilled (Gg)	11,1	13,97	7,05	6,64	10,49	8,47
Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Sewage sludge production (Gg)	57,36	65,79	68,72	53,08	44,43	33,47
Sewage sludge landfilled (Gg)	8,54	6,18	6,91	3,74	1,88	1,6

Source: National Inventory Report 2022

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 2020 (Executive Environment Agency), the total quantity of the generated waste in the country are 81 945kt .

Table 3.17. Total quantity of generated wastes (2016-2020)

Type of wastes	Quantity in kt per year				
	2016	**2017**	**2018**	**2019**	**2020**
Dangerous wastes	103 928	108 304	112 825	109 654	68 081
Non-dangerous wastes	13 164	14 011	13 313	13 494	13 864

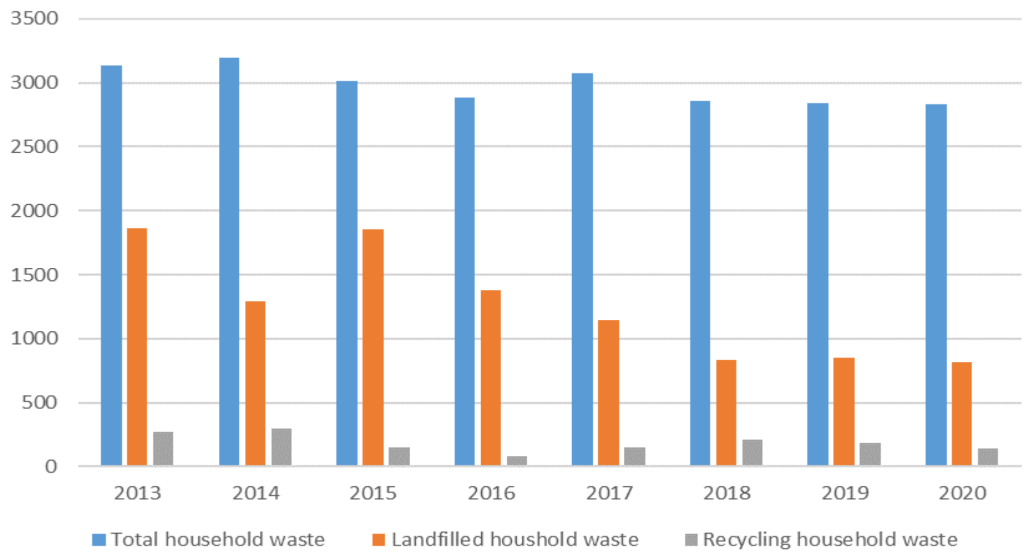
Source: National Report on the State of Environment 2022

For the period 2016 - 2020 the quantity of hazardous waste has decreased by around 34% average. Over the years, the ratio between hazardous and non-hazardous waste is preserved – respectively 11% and 89% of the total amount of waste generated in the country.

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 3.10 Share of treated waste from total generated, kt



Source: NSI

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.

Table 3.18 Household waste, thousand tons

	Measure	2013	2011	2015	2016	2017	2018	2019	2020
Generated municipal waste	*thousand tons*	3135	3193	3011	2881	3080	2862	2838	2829
Settlements served by municipal waste collection systems	*number*	4556	4578	4593	4616	4642	4698	4723	4727
Share of population, served by municipal waste collection systems	*%*	99,5	99,6	99,6	99,7	99,7	99,8	99,8	99,8
Collected municipal waste per capita of served population	*kg/year per capita*	434	442	419	406	435	407	407	408

Source: NSI

4. Greenhouse gas inventory information

4.1. Introduction

This chapter presents information about the National Inventory System and greenhouse gases emissions trends for the period 1988-2020 in Bulgaria. The source of information is the National Inventory Report 2022, 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 2022 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 CO_2-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.

4.2. 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.

4.3. Description of the National inventory arrangement

4.3.1. 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 2008-2022)**	**Prospected BGNIS**
←	Centralized inventory	→
Single institute	Single agency	→
Out-sourced inventory	In-sourced inventory	→
Private consultants	**Public/Governmental** (submission with 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.

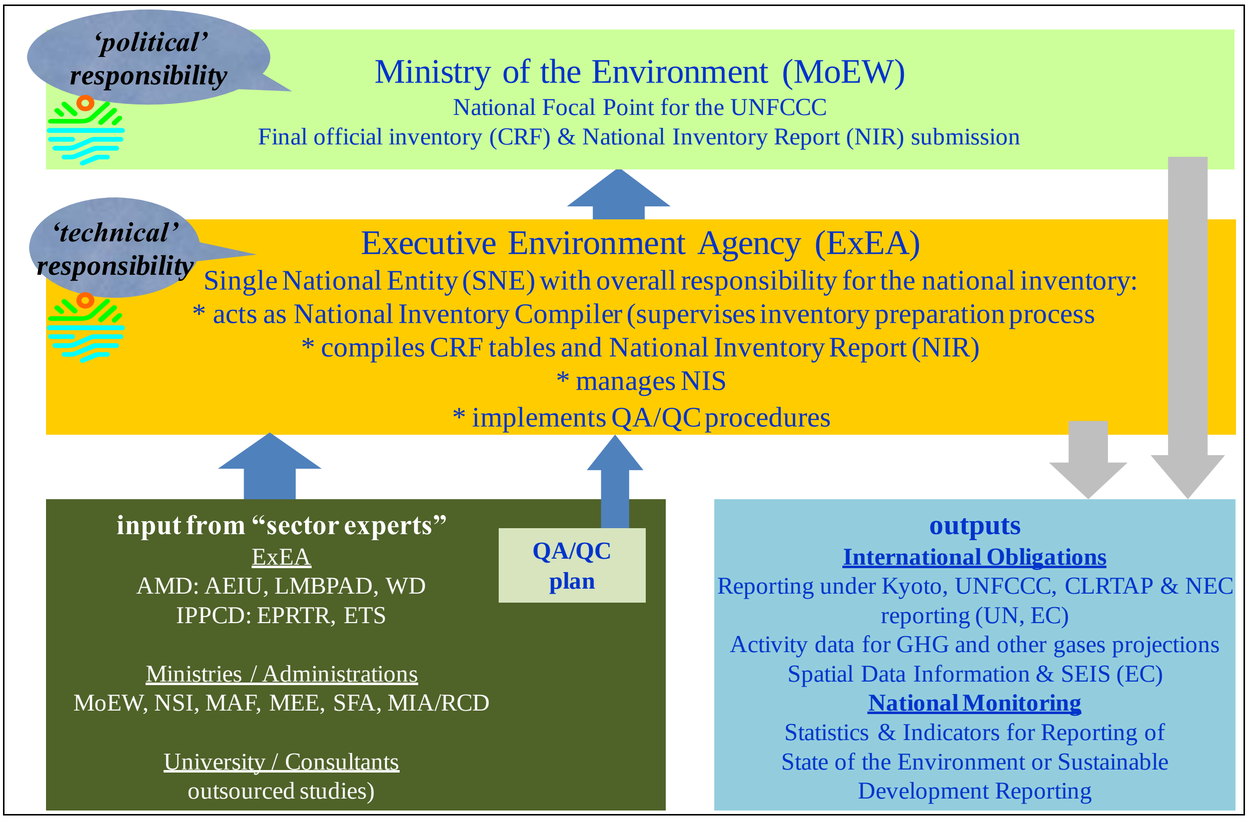
Since 2008 the Executive Environment Agency (ExEA) is responsible for the whole process of inventory planning, preparation and management.

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

By Decision № 621/25.10.2019 was approved by Council of Ministers the National Climate Change Adaptation Strategy and Action Plan for the Republic of Bulgaria.

National Climate Change Adaptation Strategy and Action Plan for the Republic of Bulgaria sets a framework for climate change adaptation (CCA) action and priority directions up to 2030, identifying and confirming the need for CCA action both at economy-wide and sectoral levels. The sectors included are agriculture, biodiversity, and ecosystems (BD&ES) services, energy, forestry, human health, transport, tourism, urban environment, and water. Disaster-risk management is also considered as a cross-sectoral topic.

The rationale for development of the Adaptation Strategy and Action Plan is that Bulgaria is situated in one of the regions that are particularly vulnerable to climate change (mainly through temperature increase and extreme precipitation) and to the increased frequency of climate change-related extreme events, such as droughts and floods. The risks inflicted by climate change-related events may lead to loss of human life or cause considerable damage, affecting economic growth and prosperity, both nationally and transboundary. Consensus exists in the scientific community that climate change is likely to increase the frequency and magnitude of extreme weather events while increases in annual air temperature and changes in rainfall patterns are expected in the coming decades in the country.

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).

4.3.2. 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).

4.4. Inventory preparation, data collection, processing and storage

4.4.1. 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

Sectors	Data Source of Activity Data	Activity Data supplier	
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

4.4.2. Inventory preparation

The inventory preparation process covers:

- Identification key source categories[2];
- Prepare estimates[3] 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[4] for each source category and for the inventory in total recalculations[5] 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[6] (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. presents the general responsibilities of all engaged institutions in functioning of Bulgarian National Inventory System.

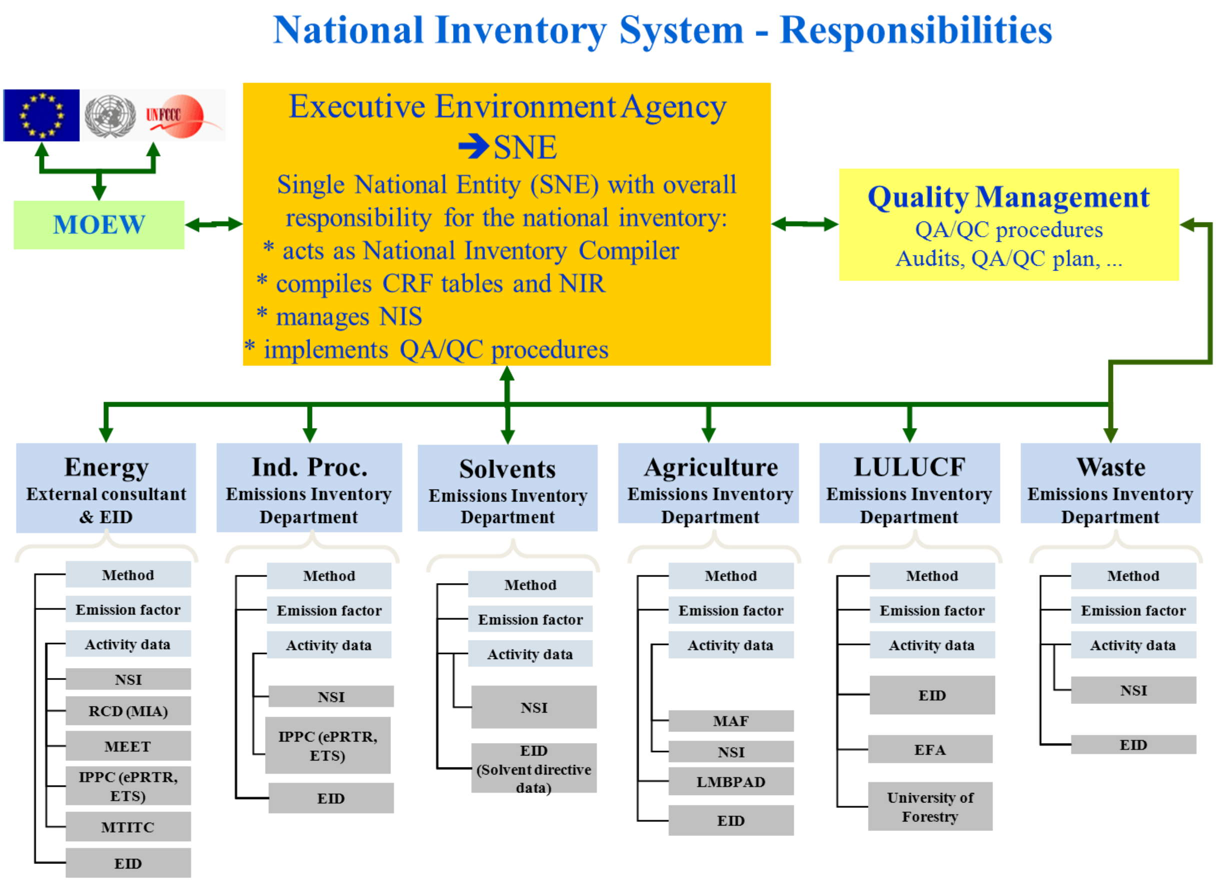
The ExEA coordinates all activities on preparation of inventory under UNFCCC.

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

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.

Figure 3.2 Bulgarian National Inventory System – Responsibilities



The following table presents the responsibilities of all engaged institutions for preparation of GHGs emission inventory for 2022 submission.

Table 3.2 Preparation of GHGs emission inventory for 2022 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	ExEA, NSI MI, MTITC	Sector expert ExEA External consultants

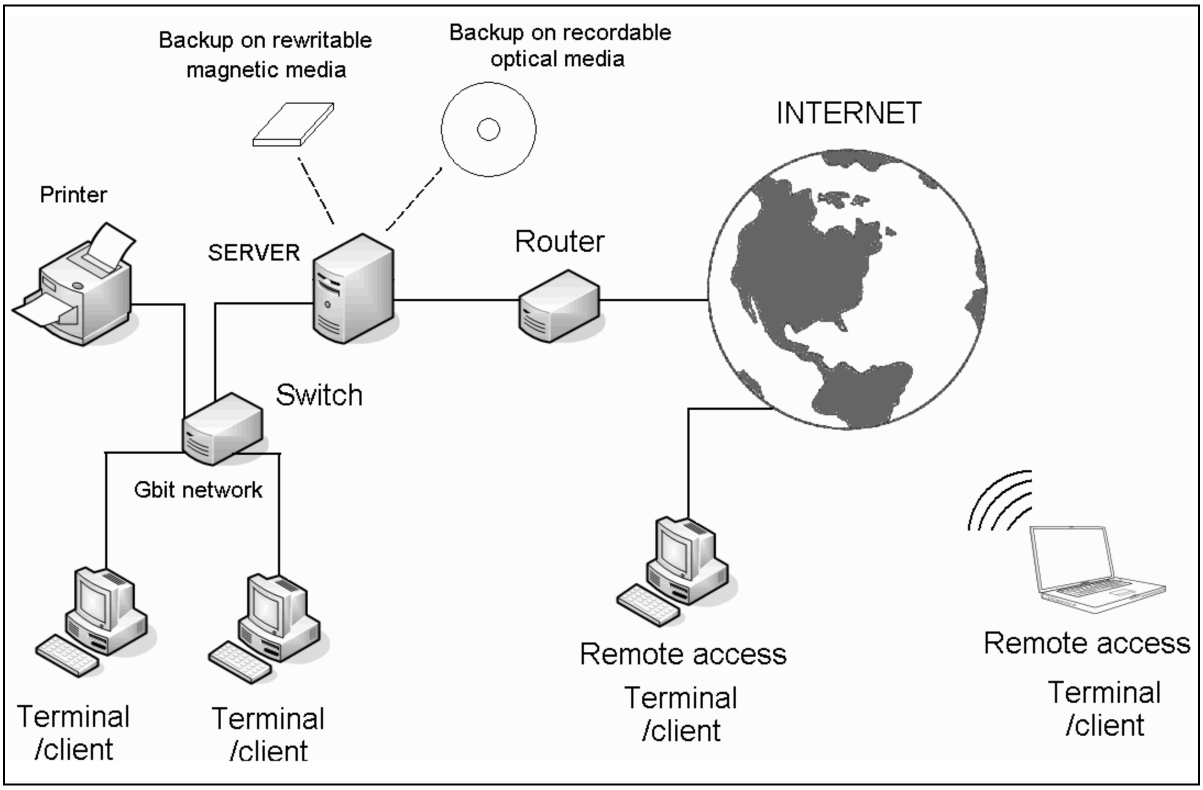
	MTITC		
Energy CRF1B	NSI ME	ExEA, NSI, ME	Sector expert ExEA External consultants
Industry processes and product use CRF2	NSI ExEA MOEW NSI ExEA	ExEA, NSI, Installations operators	Sector expert ExEA
Agriculture CRF3	MAF NSPP	ExEA, MAF	Sector expert ExEA
LULUCF CRF3	EAF MAF	ExEA, EAF	Sector expert ExEA
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.

4.4.3. 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 3.3 Documentation and data archiving in ExEA



4.4.4. 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.

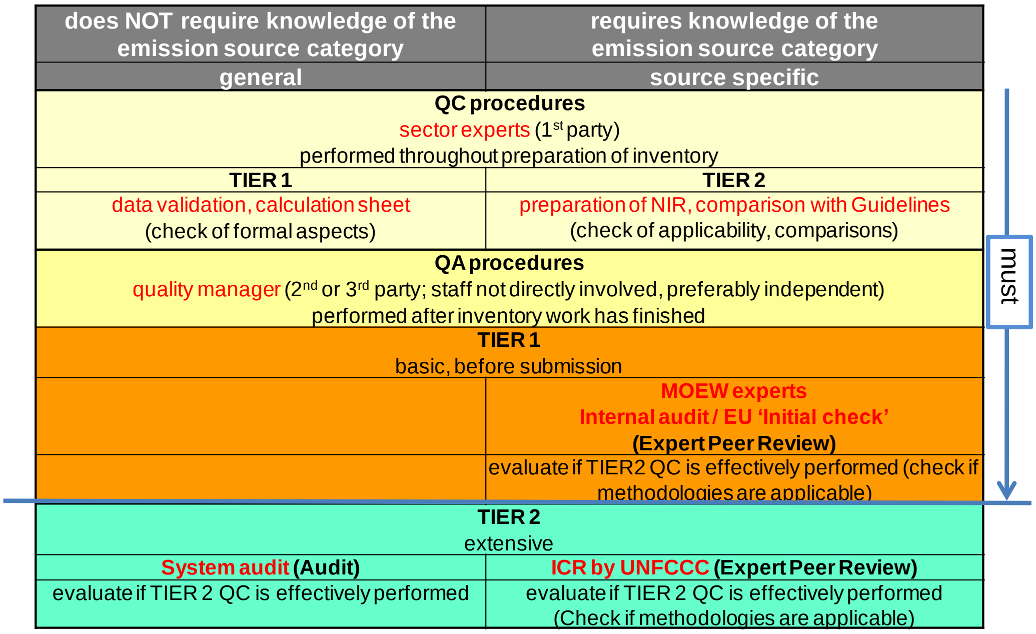
The QA/QC plan has been updated in 2014 in order to implement the new established legal, institutional and procedural arrangements within the BGNIS. The updated National QA/QC Plan was approved by the Ministry of Environment and Water in December 2014.

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 3.4 National quality assurance and quality control program



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	✓	✓
6. Personnel	✓	✓

	2006 IPCC GL	ISO 9001
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 2022 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 2022 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 2022 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.

4.5. 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 2020, submission 2022.

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
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						

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
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								
H. Other								

4.6.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
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

KEY CATEGORIES OF EMISSIONS AND REMOVALS	Gas	Criteria used for key source identification		Key category excluding	Key category including
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
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	

4.7. 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 2020 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 2020,

EM_{total} – total country emissions for 2020,

CN_i – combined uncertainty of the i-th source.

Uncertainty of the overall emissions trend for 2020 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 2020 (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 2020 (row 7, column M in Table 6.1.) are given in Table 12. The relevant data for the previous inventory for 2020 are given for comparison (NIR 2021 and NIR 2022).

Table 3.10 Uncertainty in total GHG emissions, %

Uncertainty	Uncertainty NIR 2021	Uncertainty NIR 2022
Uncertainty in total GHG emissions	17.33 %	16.18 %
Overall uncertainty into the trend in total GHG emissions	2.63	2.66

4.8.Trends in greenhouse gas emissions

This chapter describes greenhouse gas emissions (GHGs) trends over time, covering period between 1988 and 2020.

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).

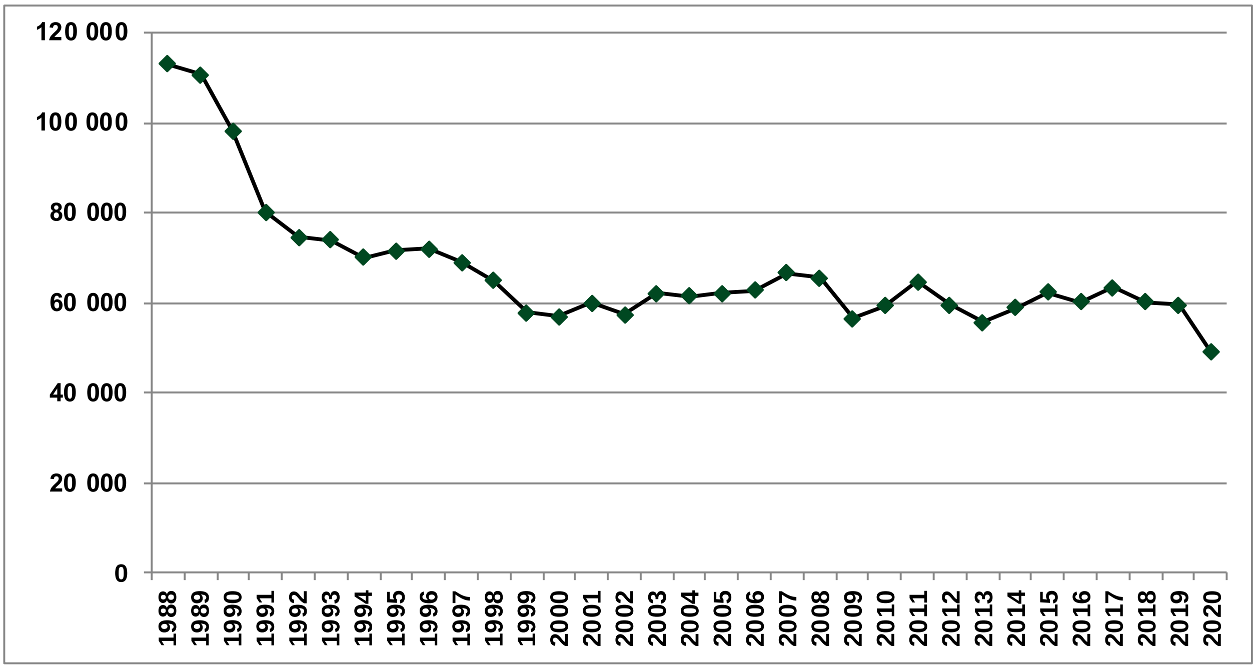
Table 3.11 Summary of emission trend per source category, Gg CO_2 eq

Source category	1988	1990	1995	2000	2005	2010	2015	2020
1. Energy	**81282,66**	**71271,25**	**51432,16**	**40933,40**	**45857,00**	**46226,88**	**45773,88**	**35063,74**
A. Fuel combustion (sectoral approach)	*78891,81*	*69041,77*	*49309,14*	*39514,04*	*44540,66*	*44625,59*	*43887,15*	*33439,94*
1. Energy industries	42179,40	36538,03	27446,71	24190,20	27098,99	31332,55	29778,92	18 249,60
2. Manufacturing industries and construction	17503,11	17762,87	13085,34	7223,91	7082,61	3158,11	2858,54	4 009,90
3. Transport	7049,67	6521,69	4325,37	5474,14	7832,16	7998,02	9307,53	9 350,97
4. Other sectors	6917,50	8132,72	4386,96	2579,06	2503,38	2112,03	1920,84	1 815,99
5. Other	5242,13	86,46	64,76	46,73	23,52	24,88	21,32	13,47
B. Fugitive emissions from fuels	*2390,85*	*2229,47*	*2123,03*	*1419,36*	*1316,33*	*1601,29*	*1886,73*	*1623,81*
1. Solid fuels	2148,45	2010,51	1835,26	1145,57	984,98	1052,26	1089,74	690,40
2. Oil and natural gas and other emissions from energy production	242,41	218,97	287,77	273,79	331,35	549,03	797,00	933,40
2. Industrial Processes	**13480,60**	**10084,04**	**10485,91**	**7230,49**	**7712,13**	**4441,53**	**7214,20**	**5300,15**
A. Mineral industry	3739,87	3277,86	2731,32	1628,45	2196,40	1811,79	2385,67	2 182,15
B. Chemical industry	5422,48	4943,27	4206,76	2764,01	2784,70	1501,86	1790,30	1 126,00
C. Metal industry	4024,37	1629,35	3360,40	2631,42	2370,52	288,66	224,06	148,93
D. Non-energy products from fuels and solvent use	229,17	169,34	103,19	96,61	105,74	100,47	85,00	83,74
F. Product uses as ODS substitutes	NO	NO	3,33	33,04	195,23	663,19	2671,74	1 704,50
G. Other product manufacture and use	64,70	64,23	80,91	76,96	59,54	75,57	57,43	54,83
H. Other	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA
3. Agriculture	**13614,07**	**12263,32**	**5753,30**	**5014,82**	**4995,28**	**5288,98**	**6074,86**	**6188,05**
A. Enteric fermentation	5071,20	4804,54	2329,68	2113,83	1869,65	1566,57	1535,49	1 492,72
B. Manure management	2031,11	1971,72	886,01	636,56	692,79	624,58	626,11	596,84
C. Rice cultivation	126,99	95,37	12,43	32,16	40,53	107,87	111,77	111,22

Source category	1988	1990	1995	2000	2005	2010	2015	2020
D. Agricultural soils	6285,21	5308,62	2486,69	2200,29	2353,65	2945,73	3738,20	3 922,38
F. Field burning of agricultural residues	37,40	37,57	23,62	15,34	20,33	26,17	32,02	31,41
H. Urea application	62,17	45,49	14,88	16,65	18,32	18,05	31,27	33,48
4. Land use, land-use change and forestry	**-17779,78**	**-17888,73**	**-17638,90**	**-17757,11**	**-16914,19**	**-12298,68**	**-8080,66**	**-9605,23**
A. Forest land	-16151,05	-16272,47	-16514,85	-15670,82	-12920,09	-10813,10	-6933,65	-8 692,41
B. Cropland	-783,52	-766,66	-611,76	-730,78	-734,03	73,05	483,95	363,15
C. Grassland	-931,19	-909,71	-1447,47	-1772,62	-3054,08	-1682,31	-1266,21	-1 176,42
D. Wetlands	118,18	105,74	89,59	139,71	192,23	264,26	287,55	232,36
E. Settlements	480,92	472,40	452,50	508,49	532,84	778,83	826,20	645,76
F. Other land	NO	NO	NO	NO	NO	NO	NO	NO
G. Harvested wood products	-583,27	-583,27	344,00	-268,48	-961,02	-957,18	-1530,65	-1 025,86
5. Waste	**4769,69**	**4738,20**	**4005,64**	**3787,05**	**3502,78**	**3363,82**	**3206,09**	**2633,68**
A. Solid waste disposal	1786,59	1874,58	2208,94	2455,74	2564,76	2644,42	2427,88	2 058,29
B. Biological treatment of solid waste	NO	NO	NO	NO	NO	NO	53,34	29,73
C. Incineration and open burning of waste	19,96	21,39	22,55	67,61	59,15	14,48	10,88	12,25
D. Waste water treatment and discharge	2963,13	2842,24	1774,15	1263,70	878,87	704,93	713,99	533,41
Total CO2 equivalent emissions without LULUCF	**113147,02**	**98356,81**	**71677,02**	**56965,77**	**62067,19**	**59321,21**	**62269,03**	**49185,62**
Total CO2 equivalent emissions with LULUCF	**95367,24**	**80468,09**	**54038,12**	**39208,65**	**45152,99**	**47022,53**	**54188,37**	**39580,40**

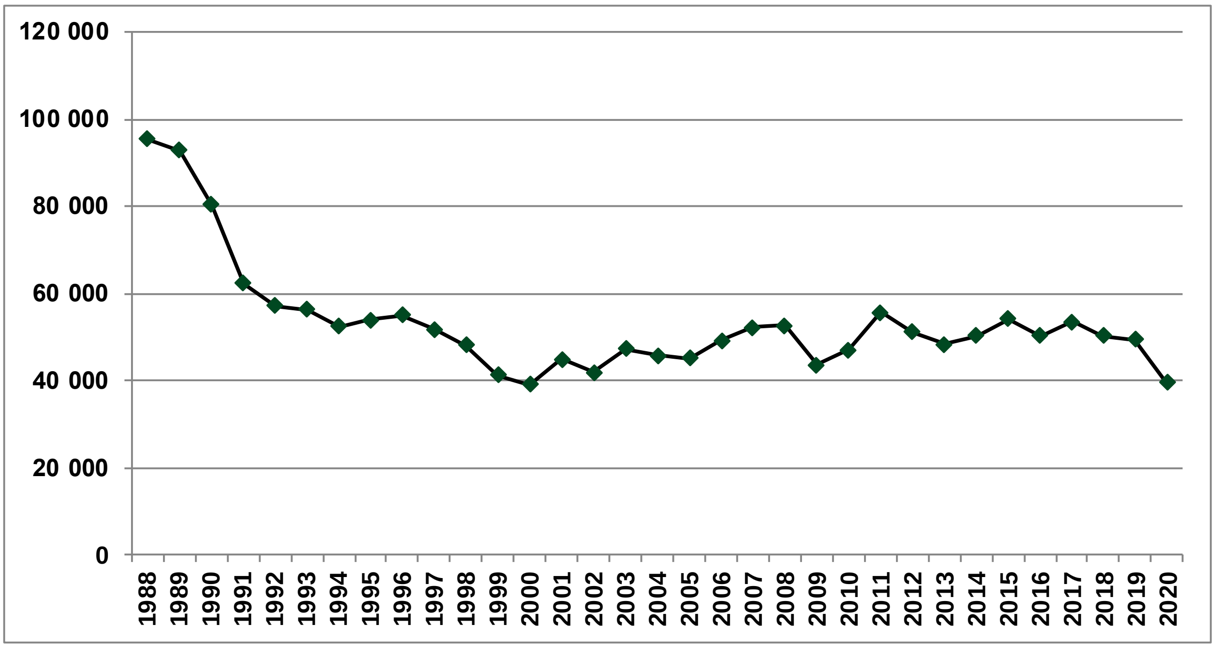
In 2020 Bulgaria's greenhouse gas emissions totalled 49 186 Gg CO_2 without reporting of sequestration from LULUCF sector. The emissions decreased by 56.53 % compared with the base year. Emissions in 2020 were 17.30 % increase in comparison with the emissions of the previous year.

Figure 3.5 Total GHG emissions (without LULUCF) for 1988 – 2020, Gg CO_2 eq.



The net emissions including reporting of sequestration from LULUCF sector were 39 580 Gg CO_2 eq. The emissions decreased by 58.50 % compared with the base year.

Figure 3.6 Total GHG emissions (with LULUCF) for 1988 – 2020, 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 1988-2020, which resulted in the reduction of population by 23.04%.

The most important greenhouse gas in Bulgaria is carbon dioxide. The share of CO_2 emissions from the total greenhouse gas emissions varies around 75.16% excluding LULUCF and 68.42% including LULUCF. In absolute terms CO_2 emissions have decreased 58.75% since 1988. Around 71.3% 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 57.72% 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 52.26% which has been occasioned mostly by the reduced nitrogen fertilisation of agricultural fields, the biggest decline was in the beginning of time series.

Figure 3.7 Total GHG emissions in Gg CO_2 eq. for 1988 – 2020

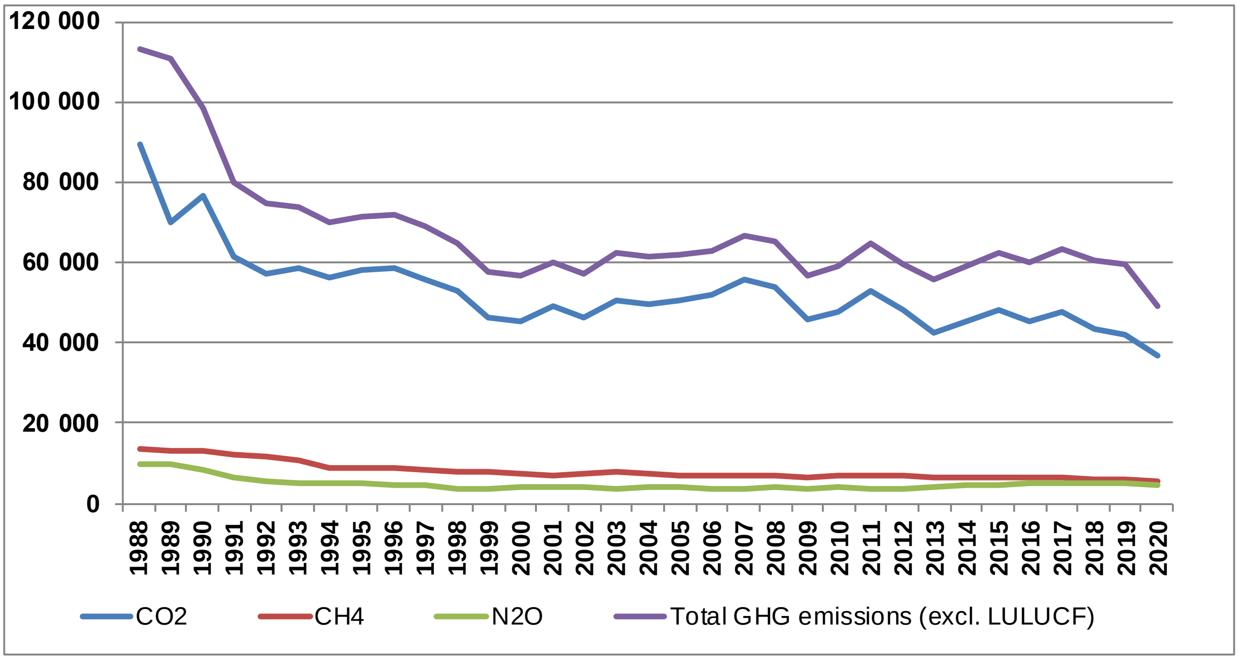
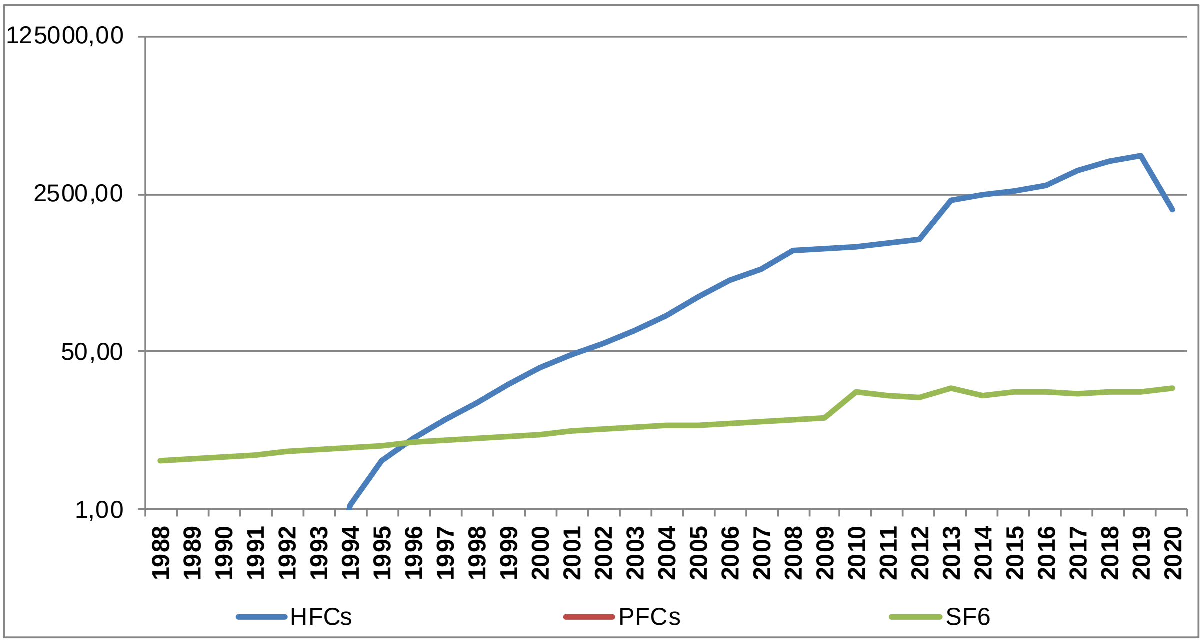


Figure 3.8 Actual emissins of HFCs, PFCs and SF6 for 1988 – 2020, Gg CO2 eq.

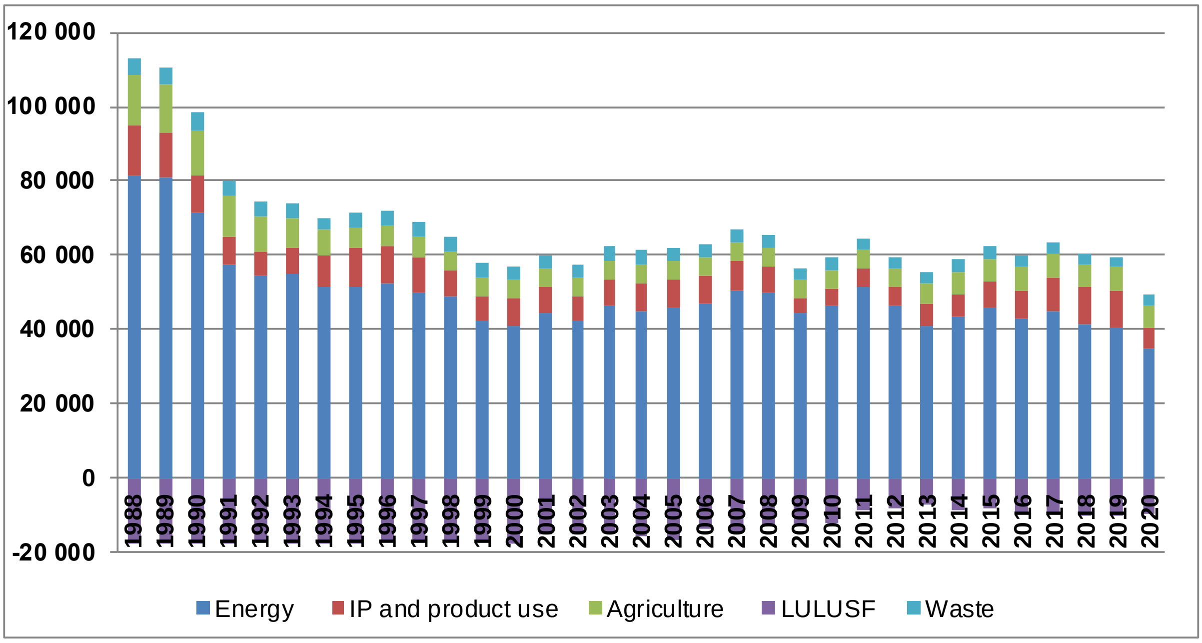


The emissions of F-gases have increased over tenfold during 1995-2020. A key driver behind the trend has been the substitution of ozone depleting substances (ODS) by F-gases in many applications. The scale of the Chart is logarithmic, so that the trend can be clear.

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 2020 with the biggest share – 71.29%. Sector IPPU ranked the second place with 10.78% and sectors Agriculture ranked the third place with 12.58% and Waste with 5.35%.

Figure 3.9 Total greenhouse gas emissions in CO_2-eq. per IPCC sector 1988-2020



4.8.1. Energy

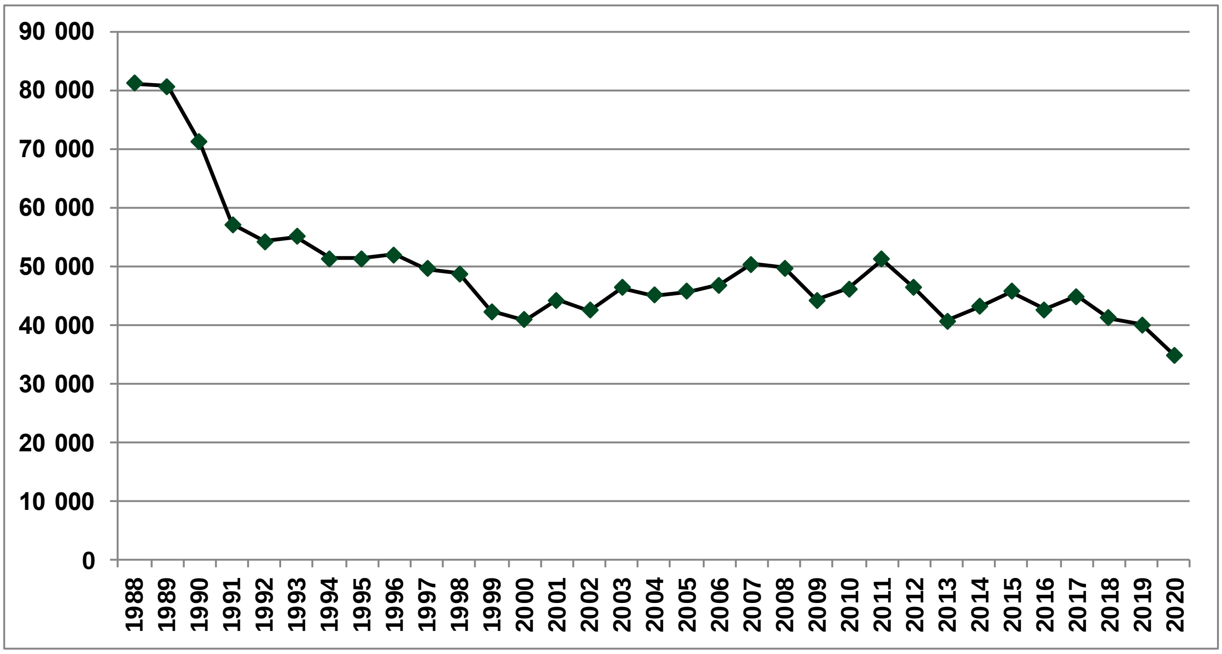
Emissions from the energy sector in 2020 decreased by 56.86% compared to the base year (35 064 Gg CO_2eq in 2020 compared to 81 283 Gg CO_2eq in 1988). Compared to previous year, the emissions in 2020 decreased with 12.81% mostly due to the decrease in electricity production from fossil fuels in the energy industries sector.

The main source of emissions in the energy sector is combustion of solid fuels, which is responsible for 49.73% of the emissions from fuel combustion in 2020, for other fossil fuels 0.74% and liquid and gaseous fuels with 49.52%.

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 2020 was defined by a substantial decrease of emissions from fuel combustion in energy industries (57.61%) and energy use in manufacturing industry and construction (77.09%) and in other sectors (commercial, residential, agriculture and forestry) (73.75%), as well as a clear increase in GHG emissions from transport (32.64%).

Figure 3.10 GHG emissions from Energy sector for 1988 – 2020, Gg CO2 eq.

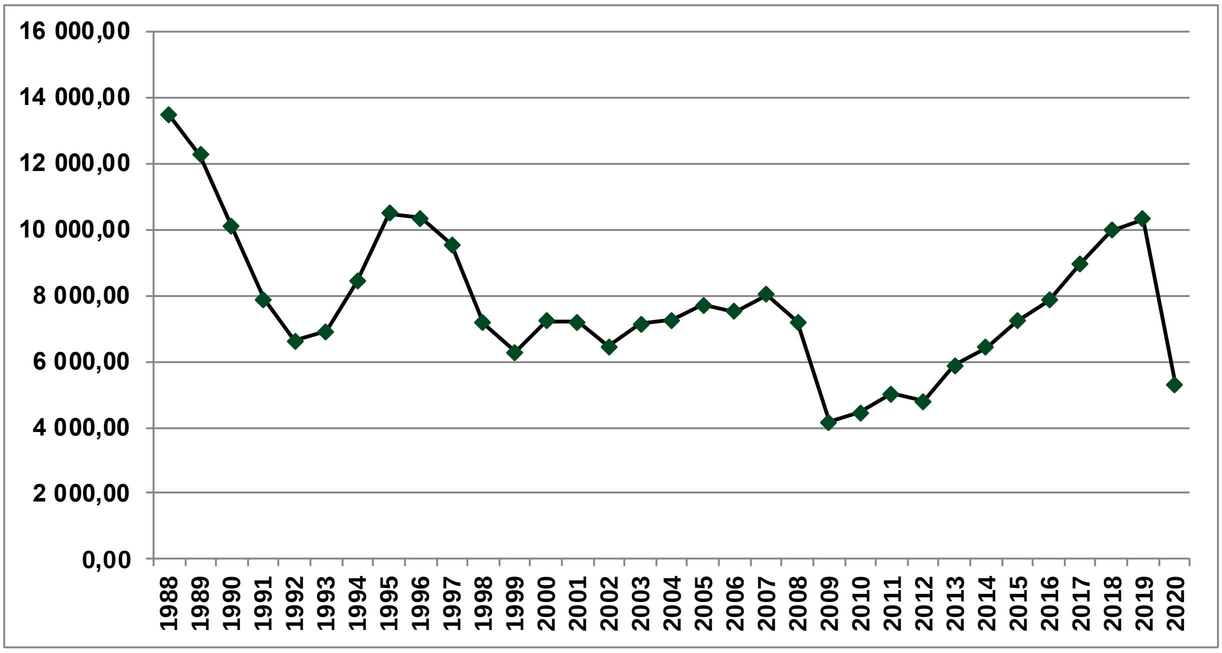


4.8.2. Industrial Processes and Product use

A steady trend towards emission reduction in this sector is observed since 1988. The emissions in 2020 decreased with 60.68% compared to the base year.

In the year 2020, 10.78% of national total greenhouse gas emissions (without LULUCF) originated from industrial processes and product use, compared to 11.91% in the base year 1988. In 2020, greenhouse gas emissions from Industrial Processes and Product use are 5 300.15 CO_2 equivalent compared to 13 480.60 Gg CO_2 in the base year.

Figure 3.11 GHG emissions from Industrial processes sector for 1988 – 2020, Gg CO2 eq.



In 2020 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 41.17%. The second category by share is Product uses as ODS substitutes (Consumption of Halocarbons) with 32.16%, followed by Chemical Industry (ammonia and nitric acid production) with 21.24% share and finally Metal Production (steel) with 2.81%.

Greenhouse gas emissions from the Industrial Processes and product use sector fluctuate during the period and reach a minimum in 2009. The reduction in 2020 for the whole sector is 60.68% while the biggest reduction (compared to the base year) can be seen in Metal Production category – 96.30%.

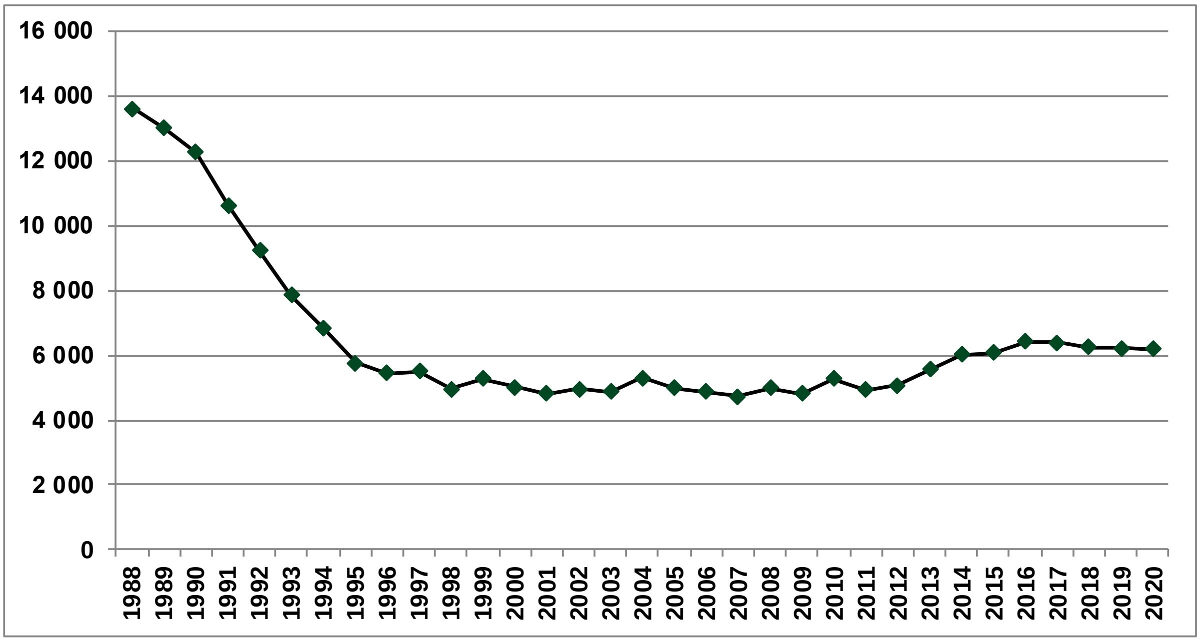
This is mainly due to economic crisis and in particular the world economic crisis in 2009. The periods around 1989/1991 and 1997/1999 represent the economic crisis time after which stabilization and increase in the production rates begins. After 1996 a process of privatization begins which leads to decrease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

4.8.3. Agriculture

The overall emission reduction in the sector has amounted to 54.55% since 1988. In the year 2020 the sector agriculture contributed 12.60% to the total of Bulgaria's greenhouse gas emissions (without LULUCF).

Figure 3.12 GHG emissions from Agriculture sector for 1988 – 2020, Gg CO2 eq.

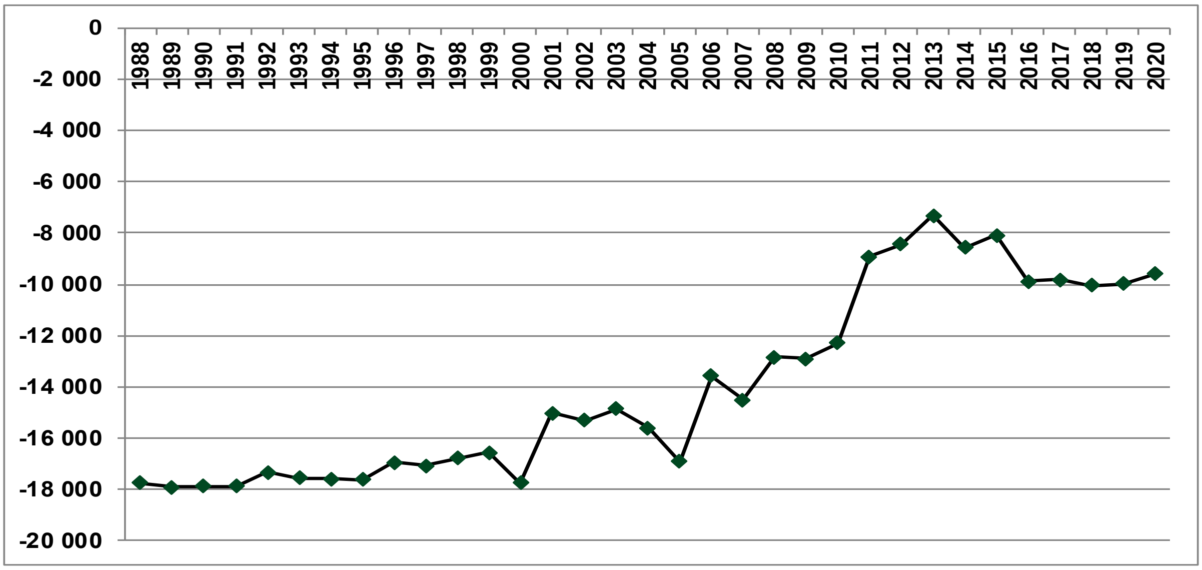


The emission reductions were mainly driven by systematic declines in the agricultural land area due to abandoning of arable lands and reduction in livestock population. Another driver for the emission reduction was the decline in the use of fertilizers.

4.8.4. 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 CO_2 emissions. The trend of net CO_2 removals (CO_2 eq) from LULUCF decreases by 45.98% 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. For the current inventoried year the share is - 19.53%.

Figure 3.13 LULUCF emissions and removals for 1988 – 2020 CO2 eq.

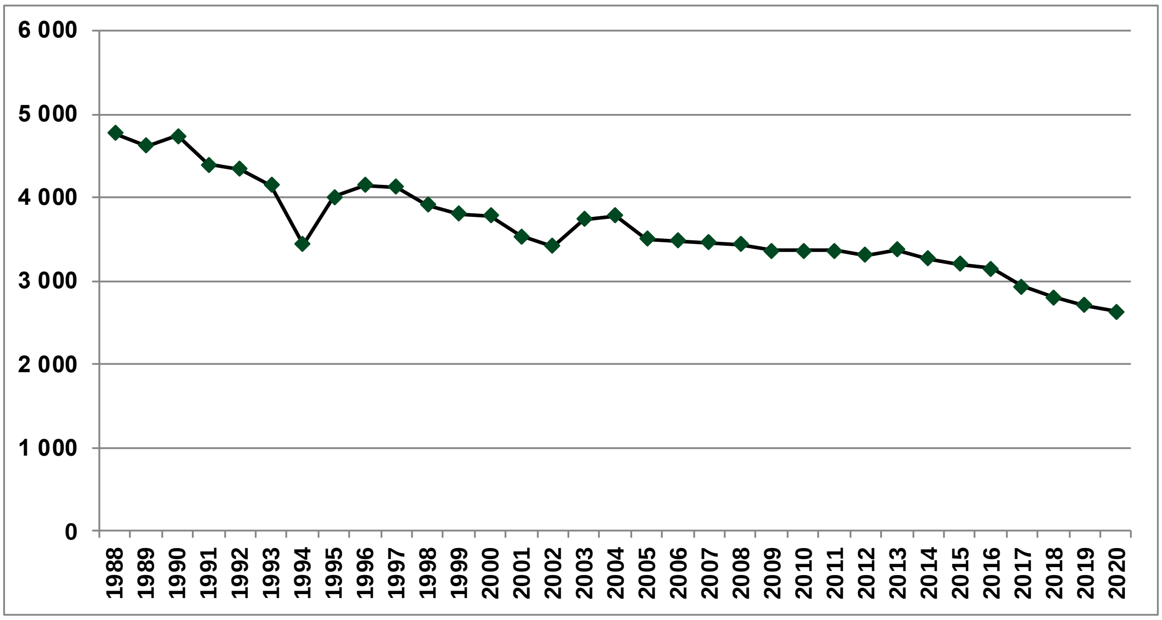


Comparing with the base year an increase in the emissions in croplands, settlements and wetlands is observed. The total emissions from croplands fluctuate during the whole time series. The emissions from Settlements increase last couple of years due to changes from other land uses to Settlements according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

4.8.5. Waste

The total sector emission reduction from the base year is 44.78%. The decline was mainly driven by a steady population decrease over the past 15 – 20 years.

Figure 3.14 GHG emissions from Waste sector for 1988 – 2020, Gg CO2 eq.



4.8.6. Indirect greenhouse gases and sulphur oxides

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

- NO_x with 72.74%

- CO with 98.28%
- SO_x with 86.82%
- NMVOC with 29.52%

4.9.Recalculations

The GHG emission recalculations for the period 1988-2019 (emission data 1988-2019) 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.

All the recalculation can be found in the NIR 2022, chapter 10 *Recalculations and Improvements*. The summary of GHG emission recalculation 2022 can be seen in Table below:

Table 3.12 Summary of GHG emission recalculations in submission 2022

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	DESCRIPTION OF METHODS	RECALCULATIONS
A. Fuel combustion (sectoral approach)		
2. Manufacturing industries and construction	Revised EF	A calculation error for the country-specific EF for RDF has been identified, which lead to recalculations in CRF category 1.A.2.g.viii Other fossil fuels for 2019.
3. Transport	Revised EF Reallocation	New COPERT v. 5.5.1 lead to recalculation of the entire time series, with significant impact on N_2O emissions. Reallocation of emissions from lubricants used in 2-stroke engines to CRF category 1.A.3.b.iv Other fossil fuels. Lubricants used in 4-stroke engines continue to be reported under 2.D.1
4. Other sectors		
5. Other		
B. Fugitive emissions from fuels		
1. Solid fuels		
2. Oil and natural gas		
C. CO2 transport and storage		
A. Mineral industry		
B. Chemical industry		
C. Metal industry		
D. Non-energy products from fuels and solvent use		In 2022 submission a recalculation provoked by recommendation from TERT was fulfilled and the lubricants used in four stroke engines only are included in this category. The emissions from two stroke engines are reported in the Energy sector
		The urea consumption has been recalculated due to the revision of the fuel consumption data and the implementation of an updated COPERT model, which corrected some errors.
E. Electronic Industry		Technical error for 2019 was corrected.
F. Product uses as ODS substitutes		Suggested from TERT in TC , according BG-2F1-2021-0004_v1.xlsx
		Suggested from TERT in TC , according BG-2F1-2021-0007_v1.xlsx
		Revision of the emission evaluation for meter dose inhalers.
G. Other product manufacture and use		
H. Other		
A. Enteric fermentation		
B. Manure management	Rvised calculation	Recalculation of NEX value in 3B Manure Management – Poultry subsector

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	DESCRIPTION OF METHODS	RECALCULATIONS
C. Rice cultivation		
D. Agricultural soils	Revised activity data	Revised activity data for area of organic soils; Revised activity data for amount of sawage sludge
F. Field burning of agricultural residues		
G. Liming		
H. Urea application		
I. Other carbon-containing fertilizers		
J. Other		
A. Forest land	Activity data on LUC to FL; biomass, dead wood	The major change in FL category is related to recalculations of LUC to Fl due to implemented geo-spatial approach in detecting the establishment of new forests. In addition, the LUC to FL before the base year have been revised based on gathered information from National Statistics Institute. The changes in area affected all calculations of emissions and removals. Due to availability of new data on growing stock for 2020, the CSC between 2016-2020 have been recalculated for biomass and dead wood.
B. Cropland		
C. Grassland	Area; Organic soils	The area changes in FL affected CL and GL category in relation with LUC matrix. This affected the emissions and removals calculations. In addition, the area of organic soils as well as the associated CO2 emissions with drained organic soils have been reported.
D. Wetlands		
E. Settlements		
F. Other land		
G. Harvested wood products	Data for 2019	Recalculations of emissions and removals for 2019 due to availability of updated information
H. Other		
A. Solid waste disposal	Revised AD and Extrapolation	• New regression model for the period 1950-2008 • Recalculation of methane recovery • Extrapolation of the amount of sludge for the period 1988-2003 • Recalculation of sewage sludge for 2017 and 2018 • Recalculation of Landfilled municipal waste for the period 2010-2019
B. Biological treatment of solid waste	Modification	The AD are provided on a dry weight basis, in order to ensure consistency between the NIR and the CRF tables
C. Incineration and open burning of waste	Revised AD	The 2021 Submission was made on basis of preliminary data for 2019.
D. Waste water treatment and discharge	Revised MCF for centralized WWTP Revised FAO data	Recalculation due to the revised MCF = 0.03 Recalculation of protein/gr/day for the period 2010-2019 Recalculation of the CH4 emissions for the period 2011-2015
E. Other		
6. Other (as specified in summary 1.A)		

4.10. 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.

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 on the basis the following modalities:

(1) Each Party retains its organization designated as its registry administrator to maintain the national registry of that Party and remains responsible for all the obligations of Parties that are to be fulfilled through registries;

(2) Kyoto transactions are forwarded to and checked by the UNFCCC Independent Transaction Log (ITL), which is responsible for verifying the accuracy and validity of those transactions;

(3) The transaction log and registries continue to reconcile their data with each other in order to ensure data consistency and facilitate the automated checks of the ITL;

(4) All registries reside on a consolidated IT platform sharing the same infrastructure technologies. The chosen architecture implements modalities to ensure that the consolidated national registries are uniquely identifiable, protected and distinguishable from each other, notably:

a) With regards to the data exchange, each national registry connects to the ITL directly and establishes a distinct and secure communication link through a consolidated communication channel (VPN tunnel);

b) The ITL remains responsible for authenticating the national registries and takes the full and final record of all transactions involving Kyoto units and other administrative processes such that those actions cannot be disputed or repudiated;

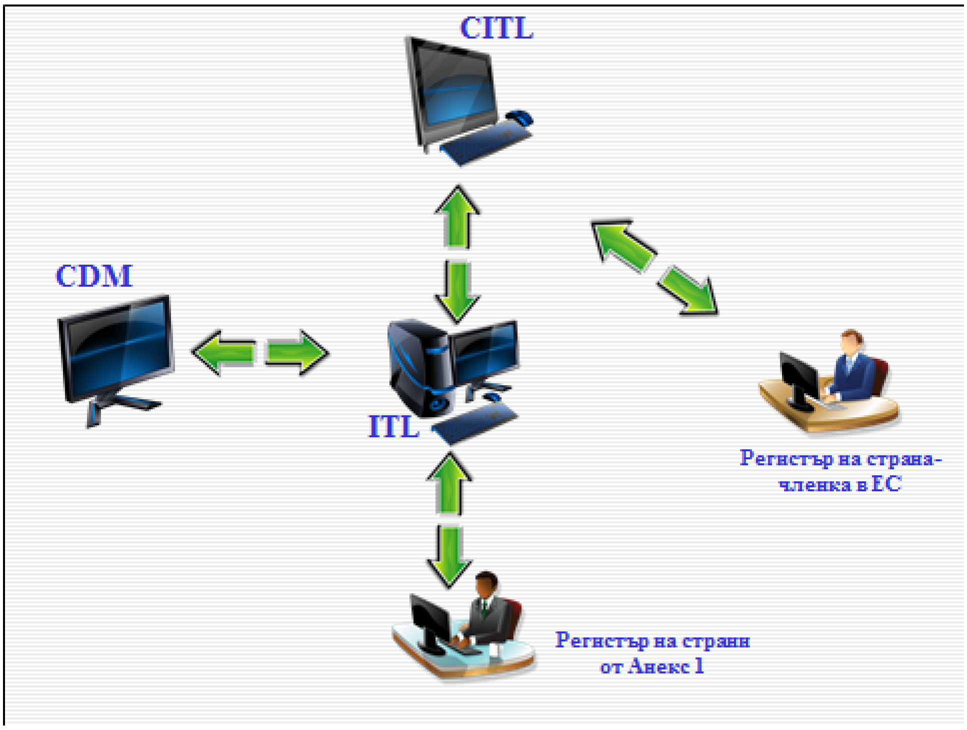
c) With regards to the data storage, the consolidated platform continues to guarantee that data is kept confidential and protected against unauthorized manipulation;

d) The data storage architecture also ensures that the data pertaining to a national registry are distinguishable and uniquely identifiable from the data pertaining to other consolidated national registries;

In addition, each consolidated national registry keeps a distinct user access entry point (URL) and a distinct set of authorization and configuration rules.

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

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



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 2020.

Reporting Item	Description
15/CMP.1 annex II.E paragraph 32.(a) Change of name or contact	A new registry administrator has been appointed since 25th August 2020: Ms. Kameliya Tsvetanova Krumova e-mail: kameliak@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	There was a change in the cooperation arrangement during the reported period as the United Kingdom of Great Britain and Northern Ireland no longer operate their registry in a consolidated manner within the Consolidated System of EU registries, CS EUR.
15/CMP.1 annex II.E paragraph 32.(c) Change to database structure or the capacity of national registry	There has been 6 new EUCR releases (versions 12.4, 13.0.2, 13.2.1, 13.3.3 , 13.5.1 and 13.5.2) after version 11.5 (the production version at the time of the last Chapter 14 submission). No changes were applied to the database, whose model is provided in Annex A. No change was required to the application backup plan or to the disaster recovery plan. No change to the capacity of the national registry occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(d) Change regarding conformance to technical standards	The changes that have been introduced with versions 12.4, 13.0.2, 13.2.1, 13.3.3, 13.5.1 and 13.5.2 compared with version 11.5 of the national registry are presented in Annex B. It is to be noted that 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 are carried out prior to the relevant major release of the version to Production (see Annex B). 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	No changes regarding security were introduced.
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 reported period.
15/CMP.1 annex II.E paragraph 32.(h) Change of Internet address	No change to the registry internet address during the reported period.
15/CMP.1 annex II.E paragraph 32.(i) Change regarding data integrity measures	No change of data integrity measures occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(j) Change regarding test results	No change during the reported period.

5. Policies and measures

5.1. 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 2008-2020 the national climate change policy and legislation were harmonized with those of the EU. 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 Investment Climate Programe 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.

5.2. 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 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 of the Environment. The ExEA administrates the National GHG Registry.

– **Energy Efficiency 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.

5.3. Domestic and regional programmes, legislative arrangements.

5.3.1. 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.).

5.3.2. 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 Action Plan 2014-2020
- National Action Plan for Renewable Energy 2020
- 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:

- **Investment Climate Programme after 2015 (before National 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 (2012-2022)**

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.

5.3.3. Legislative arrangements

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

➢ *Climate change mitigation act (SG 22/2014, last amended SG /2021)*

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 System for Environmental Monitoring (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 implementation of the EU Emissions Trading Scheme;
- 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 42/2022)**

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 99/2022)**

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 20/2022)**

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 (CAAA) 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;

- **Forestry Act (FA) (SG 19/2011, last amended SG 21/2021)**

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".

5.3.4. Domestic and Regional legislative arrangements, enforcement and administrative procedures

- ❖ *Description of any domestic and regional legislative arrangements and enforcement and administrative procedures the Party has in place to meet its commitments under the Kyoto Protocol, including the legal authority for such programmes, how they are implemented, and procedures for addressing cases of non-compliance under domestic law*

Bulgaria has established national rules for taking action against entities under the EU ETS in case of non-compliance with their emission reduction targets under the EU ETS. These rules are contained in the Climate change mitigation act (2014).

The Climate Change Mitigation Act has fully transposed Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the trading scheme for greenhouse gas emissions of the Community and Directive 2008/101/EC of the European Parliament and of the Council of 19 November 2008 amending Directive 2007/87/EC in order to include aviation activities in the greenhouse gas emission trading scheme within the Community.

Rules for monitoring and reporting of greenhouse gas emissions by operators and aircraft operators covered by the EU ETS and the introduction of administrative penal provisions supporting the observance of the rules established by the operators of stationary installations and aircraft operators are legally regulated in Chapter "Six Coercive administrative measures and administrative penalty provisions", Section I "Coercive administrative measures" and Section II "Administrative Penalty Provisions" and relevant articles in these sections.

Section I Compulsory administrative measures

Article 71. (1) The Minister of Environment and Water or officials authorised thereby in accordance with their remit shall enforce coercive administrative measures in cases of:

1. violation of the provisions of this Act, of the secondary legislation for its implementation, and of acts issued by the Minister of Environment and Water or officials authorised thereby in accordance with their remit;

2. impede the exercise of their controlling functions.

(2) In the cases referred to in Paragraph 1, with a view to preventing or terminating violations, as well as to removing the adverse effects thereof, the Minister of Environment and Water and the Executive Director of ExEA or the officials authorised thereby in accordance with their remit shall apply the following coercive administrative measures:

1. issue binding written instructions for suspending certain activities or for mandatory performance of certain actions within a given deadline;

2. request expert opinions, checks, tests of installations and facilities, parts, systems or components thereof;

3. temporarily suspend or limit the activity of operators or aircraft operators;

4. suspend the access of operators and aircraft operators to their accounts in NRGGEAT within the meaning of Article

34(3)(b) of Regulation (EU) No. 389/2013 where they have violated the obligations for accurate reporting of emissions under Article 36, Paragraphs 1 and 2 until the violation has been remedied.

(3) The coercive administrative measure shall be imposed by a reasoned order by the authority referred to in Paragraph 1; such order shall determine the type of coercive administrative measure, the method of imposing it and a suitable deadline for its imposal.

(4) The coercive administrative measure shall remain in force until the grounds for imposing it have been removed.

(5) The order under Paragraph 3 shall be delivered to the interested party pursuant to the Civil Procedure Code.

(6) The order under Paragraph 3 may be appealed by the interested parties pursuant to the Administrative Procedure Code. The appeal shall not stay the implementation of the order.

Section II Administrative Penalty Provisions

Article 72. (1) An operator who carries out activities without holding the permit required under Article 31 shall be sanctioned with a fine between BGN 5,000 and BGN 10,000 - for natural persons, respectively a pecuniary penalty between BGN 10,000 and BGN 50,000 - for sole traders or legal persons.

(2) In case of a repeated violation under Paragraph 1 the fine for natural persons shall vary between BGN 10,000 and BGN 20,000, respectively the pecuniary penalty for sole traders and legal persons - between BGN 20,000 and BGN 100,000.

Article 73. An operator who fails to fulfil its obligations under Article 34, Paragraph 2 within the deadlines set out in the ordinance referred to in Article 5, item 1 shall be sanctioned with a fine - for natural persons, respectively a pecuniary penalty - for sole traders or legal persons, amounting between BGN 1,000 and BGN 10,000.

Article 74. (1) An operator or aircraft operator who fails to comply with the monitoring and reporting requirements under Article 35 shall be sanctioned with a fine - for natural persons, respectively a pecuniary penalty - for sole traders or legal persons, amounting between BGN 1,000 and BGN 10,000.

(2) In the cases referred to in Article 36, Paragraph 5, item 3 the verifiers shall be sanctioned with a pecuniary penalty of BGN 2,000 to BGN 20,000.

(3) For a repeated violation the sanction shall be a fine, respectively a pecuniary penalty, as follows:

1. under Paragraph 1 - between BGN 2,000 and BGN 20,000;

2. under Paragraph 2 - between BGN 4,000 and BGN 40,000.

(4) In case of systemic violations under Article 36, Paragraph 5, item 3 the accreditation of verifiers shall be withdrawn pursuant to the National Accreditation of Compliance Assessment Bodies Act.

Article 75. (1) Natural persons violating the requirements for keeping the information in accordance with Article 66(1), Paragraph 1 of Regulation (EU) No. 601/2012 shall be sanctioned with a fine between BGN 1,000 and BGN 5,000, and legal persons or sole traders shall suffer a pecuniary penalty of BGN 10,000 to BGN 25,000.

(2) In case of a repeated violation under Paragraph 1 a fine shall be imposed amounting between BGN 2,000 and BGN 10,000 - for natural persons, respectively a pecuniary penalty of BGN 20,000 to BGN 50,000 - for sole traders and legal persons.

Article 76. (1) For breaching the requirements of Article 48, Paragraph 1 an operator or aircraft operator – legal person or sole trader, shall be sanctioned with a pecuniary penalty of BGN 200 for each tonne of carbon dioxide equivalent for which the operator failed to surrender allowances.

(2) (New, SG No. 41/2015) For each tonne of carbon dioxide equivalent for which the operator failed to surrender allowances issued after 1 January 2013, a pecuniary penalty shall be imposed amounting to the pecuniary penalty under Paragraph 1 multiplied by ratio of the European Index of Consumer Prices for the current year to the Euroepan Index of Consumer Prices for 2013 as published by Eurostat.

(3) (Renumbered from Paragraph (2), amended, SG No. 41/2015) Payment of the property sanction under Paragraph 1 and Paragraph 2 shall not release the operator from the obligation to surrender the insufficient amount of allowances during the next calendar year.

Article 77. (1) In the event that an aircraft operator fails to comply with the requirements of Article 35, Paragraph 1, Article 48, Paras. 1 and 5 and where other measures have failed to ensure compliance, the Minister of Environment and Water may request the European Commission to impose an operating ban on the aircraft operator concerned.

(2) The request referred to in Paragraph 1 shall include:

1. details of the enforcement action which has been taken by the competent authority;

2. a justification for the imposition of an operating ban at Community level;

3. a recommendation for the scope of an operating ban at Community level and any conditions that should be applied.

(3) The request referred to in Paragraph 1 shall also contain evidence that the aircraft operator has not complied with its obligations under Paragraph 1.

(4) In the event that the European Commission adopts a decision on the request under Paragraph 2, the competent authorities shall take the measures necessary for its implementation.

(5) The competent authorities shall inform the European Commission of any measures taken to implement the decisions under Paragraph 4.

Article 78. (1) An applicant within the meaning of Article 20 of Regulation (EU) No. 1031/2010 who provides with false or misleading information any auction platform auctioning two-day spot or five-day futures shall be sanctioned with a fine between BGN 1,000 and BGN 10,000 - for natural persons, and a pecuniary penalty of BGN 10,000 to BGN 20,000 - for legal persons.

(2) An applicant under Paragraph 1 who fails to inform immediately the auction platform under Paragraph 1 of any changes in its circumstances that could affect its application for admission to bid in auctions conducted by that auction platform or any admission to bid already granted to it shall be sanctioned with a fine between BGN 1,000 and BGN 10,000 - for natural persons, respectively a pecuniary penalty of BGN 10,000 to BGN 20,000 - for legal persons.

(3) For a repeated violation under Paras. 1 and 2 the sanction shall be a fine, respectively a pecuniary penalty of BGN 2,000 to BGN 20,000 - for natural persons, respectively a pecuniary penalty of BGN 20,000 to BGN 40,000 - for legal persons.

Article 79. Anyone who makes an unauthorised disclosure of inside information within the meaning of Article 3(29) and Article 37(a) of Regulation (EU) No. 1031/2010 to any person working for an auctioneer shall be sanctioned with a fine amounting between BGN 10,000 and BGN 100,000, and in case of a repeated violation - with a fine of BGN 20,000 to BGN 200,000.

Article 80. A person who violates or fails to fulfil its obligations under Article 59, Paragraph 3, shall be sanctioned with a fine amounting between BGN 100 and BGN 600, and in case of a repeated violation - between BGN 200 and BGN 1,200.

Article 81. (1) A supplier of liquid fuels and energy for transport who fails to fulfil its obligation under Article 64, Paragraph 1 shall be sanctioned with a fine between BGN 1,000 and BGN 10,000 - for natural persons, respectively a pecuniary penalty of BGN 2,000 to BGN 20,000 - for legal persons.

(2) A supplier of liquid fuels and energy for transport who fails to fulfil its obligation under Article 66, Paragraph 1 shall be sanctioned with a fine between BGN 1,000 and BGN 10,000 - for natural persons, respectively a pecuniary penalty of BGN 2,000 to BGN 20,000 - for legal persons.

Article 82. (1) For other violations of this Act and the secondary legislation for its implementation which do not constitute a crime, the offender, if a natural person, shall be fined between BGN 100 and BGN 6,000, and if a legal person - by a pecuniary penalty between BGN 1,000 and BGN 20,000.

(2) In case of a repeated violation under Paragraph 1 natural persons shall be fined by BGN 200 to BGN 12,000, while legal persons shall be imposed a pecuniary penalty of BGN 2,000 to BGN 40,000.

Article 83. (1) The written statements ascertaining administrative violations shall be drawn up by officials authorised by the Minister of Environment and Water in accordance with their remit.

(2) The penal decrees under Paragraph 1 shall be issued by the Minister of Environment and Water or officials authorised thereby.

(3) Violations shall be ascertained, statements shall be drawn up, and penal decrees shall be issued and appealed pursuant to the Administrative Violations and Sanctions Act.

For more information see the attached file containing full text of the Climate Change Mitigation Act.

- *Description of any national legislative arrangements and administrative procedures that seek to ensure that the implementation of activities under Article, paragraph 3, and any elected activities under Article 3, paragraph 4, also contribute to the conservation of biodiversity and sustainable use of natural resources*

One of the main ways for the protection of the 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.

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.

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.

Conservation of biodiversity and sustainable use of natural resources also are implemented in the mitigations measures under LULUCF sector and also are part of adaptation policy and measures.

In addition, one of priority area of the National trust ecofund is protection of biodiversity.

- *Assessment of the progress in achieving the target and domestic measures on non-compliance*

On the national level, the administrative procedures and institutional arrangements for enforcement in the cases of non-compliance to the policies related to climate change are set at the climate change mitigation act.

On other side, Bulgaria is obliged to transpose and implement the whole EU legislation. In cases of non-compliance, there are stick enforcement procedures to the country.

- *Description of the way in which the progress of PaMs to mitigate GHG emissions is monitored and evaluated over time.*

The reporting on the implementation of measures and activities set out in Chapter 9 of the Third NAPCC follows a monitoring and reporting mechanism. This mechanism requires the reporting on the NAPCC implementation every two years, and the drafting of regular and final reports. The first official report on the implementation of the Plan is scheduled for 2017 and the second one - for 2022. The regular and final reports on the plan are subject to review and adoption by an inter-ministerial working group set up for this purpose, with the official reports being submitted for approval to the Council of Ministers.

In relation to the monitoring and reporting of the implementation of the Third NAPCC (2013-2020), an Interministerial Working Group (IMWG) was set up by Order No RD-491/08.07.2015 of the Minister of Environment and Water on the NAPCC coordination of implementation. New Order No RD-343/25.05.2017 was issued to designate an IMWG, as there have been significant changes in the composition, positions and directorates of the experts. The IMWG includes representatives of the following institutions competent and responsible for the implementation of the measures laid down in the Plan: the Ministry of Environment and Water, the Ministry of Energy, the Ministry of Economy, the Ministry of Regional Development and Public Works, the Ministry of Transport, Information Technology and Communications, the Ministry of Agriculture, Food and Forestry, the Ministry of Education and Science, the Ministry of Interior, the State Agency for Metrological and Technical Surveillance, the Forestry Executive Agency, the Agency for Sustainable Energy Development, the Road Infrastructure Agency, the Energy and Water

Regulatory Commission, the National Statistical Institute, the National Railway Infrastructure Company.

Method of reporting on the implementation of measures by sectors:

• The implementation of the measures by 2014/2016/2018/2020 is to be reported by the responsible institutions by sectors/measures.

• By 1 February 2015/2017/2019/2021 MEW is to send letters to the responsible institutions under the Plan requesting information on the progress of implementation of the measures within their competence.

• The responsible institutions provide the required information by 31 March 2015/2017/2019/2021.

• By 30 April 2015/2017/2019/2021 MEW is to prepare a current report on the basis of the information received and to convene a meeting of the Interinstitutional Working Group where the respective report is to be approved or returned for revision.

• After adoption by the IWG the official reports in 2017 and 2021 are to be submitted to the Council of Ministers by 30 June for approval.

• In case the current reports need to be amended and/or supplemented they are processed within 15 calendar days.

• The IWG is to adopt the amendments/additions at an additional meeting or through email confirmation by the principal members of the Working group.

• The report intended for approval by the Council of Ministers should contain the following information:

- Brief information of NAPCC;

- Brief information about the procedure of reporting on the implementation of the measures;

- Brief assessment of the financial resources spent for implementation of the measures by sources;

- Brief analysis of the implementation of the measures themselves – whether there are problematic sectors where measures were not implemented or the performance is significantly below the expected level and the reasons for this, as well as whether there is overachievement of measures;

- Assessment whether changes in the process of reporting or update of the measures by sectors are needed with respect to various reports to the European Commission, new European requirements or expected new legislation;

- Brief information on the implementation of measures with indirect effect, including in the field of education and science and of administrative measures;

- Total quantity of emission reductions as a result of the implemented measures.

• The reports are prepared in a format predefined by the MEW which includes the following columns:

- Description of the measure;

- Responsible institution;

- Utilized financial resources by sources of funding;

- Indicator for implementation of the measure;

- Target value in 2014/2016/2018/2020;
- Reporting value in 2014/2016/2018/2020;
- Difference between target value and reporting value for each year.

The functions and the members of the existing Interministerial Working Group on the National Plan for Allocation of Greenhouse Gas Emission Allowances are to be extended in order to expand the existing coordination mechanism between the institutions concerned, including business organizations and NGOs, on issues related to the national climate change policy.

Main tasks of the IWG (within the context of NAPCC):

• Review of periodic reports under NAPCC within the relevant time limits and the approved format (defined by an Order of the Minister of Environment and Water);

• In case of non-performance of the interim objectives – provide recommendations for further actions/measures in order to achieve the ultimate goals of the Plan;

• Preparation of a summary report under NAPCC and submission to the IWG and then to the Council of Ministers for approval. In case of discrepancies between the planned and the reported figures this report should be accompanied by an assessment of the causes thereof and suggestions for further action;

• Assessment of the need for revision/update of the NAPCC and preparation of relevant recommendations for updating (with specific deadlines) – along with the first report in 2015;

• Opinions on various issues related to the national policy on climate change, including on draft legislation discussed in the EU working bodies, on elaborated national reports, plans, etc.

• Opinions on other issues/materials sent by the Secretariat or provided during meetings of the IWG.

5.4.Policies and measures and their effects

The information and the analysis of the provided national measures for the period until 2020 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.

5.4.1. 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.

5.4.2. 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 2020 the sector is responsible for 71% of national total GHG emissions (33 440 Gg CO_2e from sector 1A of the total 49 186 Gg CO_2e excl. LULUCF).

5.4.2.1.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	2010	2015	2016	2017	2018	2019	2020
Total emission, mln.t CO_2 eq., including:	57,0	59,3	62,3	60,1	63,3	60,3	59,5	49,2
Energy Sector (production of electric and thermal energy)	24,2	31,3	29,8	26,4	27,7	23,5	22,5	18,2
Share of the Energy Sector, %	59	68	65	62	61	57	56	52

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. 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.

5.4.2.2.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.

5.4.2.3.Measures in the Energy Sector

<u>Priority axis 1</u>: LOW-CARBON PRODUCTION OF ELECTRIC ENERGY FROM COAL-FIRED POWER PLANTS

Measures with direct impact on the reduction of GHG emissions

<u>Measure 1: Improvement of production efficiency in existing coal-fired power plants</u>

Characteristics: In 2007-2009 the average carbon intensity of electricity generation from coal-fired power plants is 1.2 t CO_2 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 CO_2 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

During the implementation period of the National Investment Plan, a large number of investment projects were included for implementation, all of which were planned for implementation in a long 5-6 year period.

Expected effect:

Total reduction by 2020 of 4 680 000 tonnes CO_2 eq. monitoring indicator:

Ton reduced CO2 per MWh

Table 4.2 Cumulative emission reduction

	2014	**2016**	**2018**	**2020**
Cummulative emission reduction ktCO_2/year	520	1 300	2 800	4 680

Source TNAPCC

Implementation:

According to this measure, the operators of coal-burning installations included in the NIP ("Brickel TPP" EAD, "Maritsa TPP 3" AD, "Bobov dol TPP" EAD, "Maritsa Iztok 2 TPP" EAD, "Toplofikatsia Pernik" AD, "Toplofikatsia Ruse" EAD, "Toplofikatsia Sliven" EAD, TPP at "Solvay Sodi" AD, and "VIDAHIM" AD) have implemented a total of 48 projects with their own financial resources.

The utilized financial resources are worth 477 million BGN, compared to the initially assigned 240 million BGN.

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

<u>Measure 1: pilot projects with clean coal technologies</u>

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 CO2, 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.

<u>Measure 2: Geologic studies for CO_2 storage sites</u>

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.

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

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.

<u>Priority axis 2:</u> REDUCTION OF THE CARBON INTENSITY OF THE ELECTRICITY GENERATION MIX

<u>Measure 1: Increase of highly efficient co-generation</u>

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

Type of policy instrument:

Economic, fiscal, regulatory

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

Expected effect:

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

Monitoring indicator:

MWh generated energy

Table 4.3 Generated Electricity, MWh

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

Evaluation of the effect:

The produced high-efficiency electric energy by year is as follows:

- for 2017 – 2 526 282 MWh, which is a 5.77% share of the net electricity produced by all power plants in the country in 2017 (43 737 555 MWh).
- for 2018 – 2 541 141 MWh, which is a 6.0% share of the net electricity produced by all power plants in the country in 2018 (42 348 983 MWh);
- for 2019 – 2 762 200 MWh, which is a 6.99% share of the net electricity produced by all power plants in the country in 2019 (39 466 296 MWh);
- for 2020 – 2 736 895 MWh, which is a 7.32% share of the net electricity produced by all power plants in the country in 2020 (37 376 037 MWh);

For the period 2017 - 2020, the total amount of electricity produced by plants with combined production of electricity and thermal energy, for which quantities certificates of origin have been issued, amounts to 10 566 518 MWh.

According to this measure, 6 investment projects for the construction of new and the modernization and rehabilitation of operating installations for the combined production of electricity and thermal energy with a total value of BGN 115 275 779 have been implemented.

The saved emissions for the entire period are 400 883 tons of CO_2 eq.

Measures with indirect impact on the reduction of GHG emissions

<u>Measure 2: Institutional support for investments in decarbonised electricity generation capacities – nuclear energy</u>

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

Evaluation of the effect:

According to the Bulletin on the state and development of the energy sector of the Republic of Bulgaria, the share of nuclear energy in the electricity mix by year is as follows:

- For 2017 - 34.4 %;
- For 2018 - 34.5 %;
- For 2019 - 37.4 %;
- For 2020 - 40.8 %

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

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

Evaluation of the effect:

The reported values for the share of electrical energy from RES in gross final energy consumption are as follows:

- 2016 - 19.15 %;

- 2017 - 19.02 %;
- 2018 - 22.36 %;
- 2019 - 23.51 %;
- 2020 - 23.59 %.

For 2016, 2018, 2019 and 2020, overachievement of the target is observed.

<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

National Eelectrical Company EAD invests in the rehabilitation and modernization of its Hydro Power Plan and Pumped Storage Hydro Power Plant in order to effectively use the available hydropower potential and ensure the balancing of the production of electricity from wind power plants. According to this measure, the investment project "Construction of the Yadenitsa Dam" is included in the National investment plan. For motivated reasons, the implementation of this project has been delayed.

<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	976 000

Evaluation of the effect:

The national target for the share of renewable energy for heating/cooling in gross final energy consumption for 2014 according to the National Action Plan for Renewable Energy is 19.8%. The performance is a 28.52% share of renewable energy for heating/cooling in gross final energy consumption in 2014 (according to Eurostat data). The target was exceeded by 8.5%.

The target value according to the Third NACCC is 256 000 MWh of generated energy by 2016, 556 000 MWh of generated energy by 2018, 976 000 MWh by 2020.

According to Eurostat data, the gross final consumption of heat energy and cooling energy from RES by year is as follows:

- In 2016, 13 983 912 MWh were produced;
- In 2018, the amount was 15 691 196 MWh and
- 16 333 172 MWh were produced in 2019.

The determined intermediate sectoral targets for the share of heat energy and cooling energy from renewable energy in the gross final consumption of heat energy and cooling energy in the country according to National Action Plan for Renewable Energy are: for 2016 21.9%, for 2017 22.0%, for 2018 22.3%, for 2019 23.0% and for 2020 23.8%.

According to Eurostat data, the share of heat energy and cooling energy from RES in the gross final consumption of heat energy and cooling energy by year is: for 2016 - 29.99%, for 2017 - 29.88%; for 2018 - 33.3%, for 2019 it is 35.51%. and for 2020 – 37.18%.

The measure is exceeded.

Measures with indirect impact on the reduction of GHG emissions

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

Characteristics: One of the barriers to the development of new district heating companies is the costly start-up investment in district heating networks. At the same time, the technological losses of existing heating networks account for about 23%. Well-targeted financial support is needed for rehabilitation of existing and construction of new heating networks in order to ensure the sustainable development of the sector and to reduce emission s of greenhouse gases associated with the consumption of thermal energy. A National Program for stabilization and development of the heating sector in the Republic of Bulgaria has been developed in accordance with the Energy Strategy of the Republic Bulgaria by 2020.

During the period 2013 - 2019, some of the heating companies in the country, included in the NIP, have implemented, with their own financial resources, investment projects or stages of projects for "Rehabilitation of existing and construction of new heat supply networks", consisting in the replacement of old and amortized heat transfer network of different diameters with a new, highly efficient one made of pre-insulated pipes.

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.

In 2014, an information platform was created to achieve interoperability of spatial data and services for use by the state administration and citizens regarding renewable energy sources.

The measure was executed successfully.

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

Measures with indirect impact on the reduction of GHG emissions

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

Instruments:

Regulatory incentives for energy network operators

Indicator of implementation

% of energy loss reduction

Expected results:

30% fewer losses in energy transportation

Implementation:
The table below presents reporting data by year in the period 2017-2020 for the technological costs of the transmission of electrical energy on the electricity distribution networks owned by "CEZ Razpredelenie Bulgaria" AD, "Elektrorazpredelenie YUG" EAD and "Elektrorazpredelenie SEVER" AD.

Table 4.5. Reporting data on the technological costs of the transmission of electric energy on the power distribution networks in the period 2017-2020.

Name of the company	2017		2018		2019		2020	
	MWh	%	MWh	%	MWh	%	MWh	%
CEZ Razpredelenie Bulgaria AD	1,106,545	**10.35**	950,829	**9.06**	820,710	**8.01**	760,251	**7.49**
“Elektrorazpredelenie YUG” EAD	817,723	**8.51**	724,191	**7.62**	650,048	**6.96**	619,238	**6.8**
"Elektrorazpredelenie SEVER" AD	632,098	**10.02**	506,402	**8.01**	438,175	**7.20**	386,884	**6.56**

It can be seen from the table that in the period from 2017 to 2020, all three electricity distribution companies reduced the technological costs of the transmission of electrical energy on the electricity distribution networks, reporting the lowest values in 2020.

5.4.3. Energy efficiency and RES – Household and Services Sector

5.4.3.1.General information on the Households and Services Sector

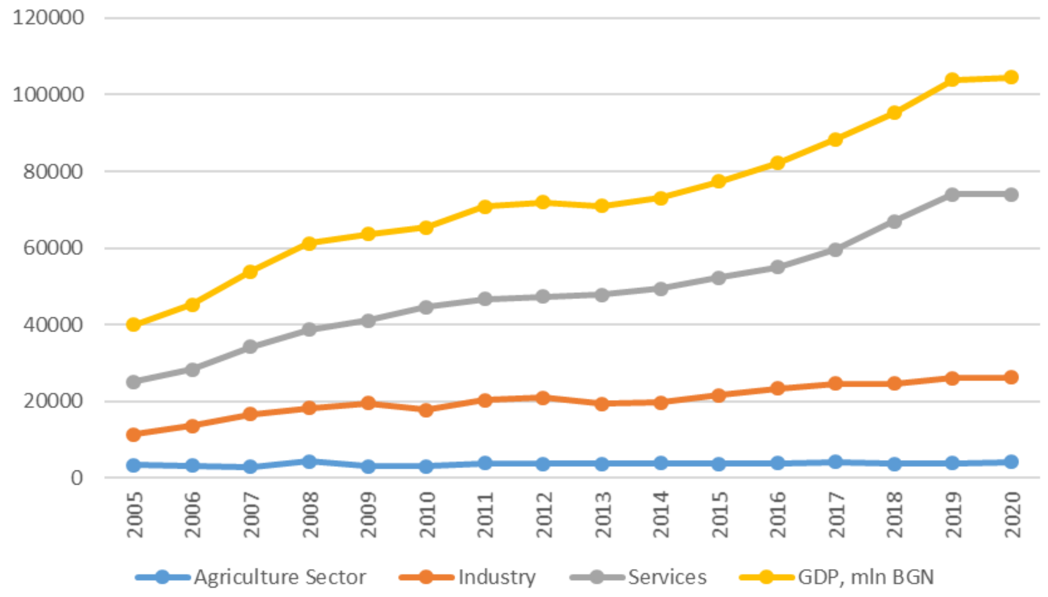
Economic environment

In the period 2005-2020 the Bulgarian economy shows a constant average annual growth rate of 61%.

Table 4.6 Trend of the GDP for the period 2000-2020

Year	GDP, mln. BGN	Agricultural sector	Industry	Services
2000	27 928	3 082	6 333	15 097
2005	39 986	3 425	11 393	25 168
2010	65 357	3 020	17 789	44 549
2015	77 389	3 638	21 524	52 226
2016	82 144	3 866	23 322	54 956
2017	88 356	4 152	24 633	59 571
2018	95 278	3 722	24 637	66 919
2019	103 952	3 902	26 108	73 941
2020	104 579	4 205	26 297	74 076

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 4.7 Structure of Gross Value Added by Economic Sector,%

Year	**GVA total**	**Agricultural sector**	**Industry**	**Services**
2000	100	12,6	25,8	61,6
2005	100	8,6	28,5	62,9
2010	100	4,6	27,2	68,2
2015	100	4,7	27,8	67,5
2016	100	4,7	28,4	66,9
2017	100	4,7	27,9	67,4
2018	100	3,9	25,9	70,2
2019	100	3,8	25,1	71,1
2020	100	4,0	25,3	70,7

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 18 444 ktoe in 2001 to 17 192 ktoe in 2020. The changes in PEC by fuel type over the same period is shown in Table 4.7.

Table 4.8 Primary energy consumption (PEC) ktoe

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Primary energy consumption	18 444	18 375	18 718	18 197	19 215	19 852	19 513	19 017	16 915	17 399
Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Primary energy consumption	18 575	17 831	16 504	17 257	17 958	17 665	18 322	18 369	18 218	17 192

Sourse: NSI

Production of primary energy by fuel type is presented in Table 4.8 And Figure 4.2 **Error! Reference source not found.**

Table 4.9 Primary energy production by fuel type 2001-2020, *1000 toe.*

	2001	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Coal	4497	4178	4927	6207	5608	4782	5106	5832	5081	5670	5056	4676	3732
Crude oil	38	31	23	22	24	28	27	26	24	124	122	C	C
Natural gas	18	384	59	351	308	234	160	85	77	66	29	32	48
Nuclear energy	5086	4855	3849	4105	4020	3668	4047	3912	4011	3941	4168	4302	4335
El. energy from RES	689	1137	1534	1471	1662	1893	1914	2117	1996	1938	2584	2549	2579
Waste	1	58	3	9	7	13	13	18	32	39	50	67	66
Total	**10 330**	**10 643**	**10 453**	**12 241**	**11 686**	**10 669**	**11 308**	**12 032**	**11 273**	**11 728**	**11 957**	**11 691**	**10 831**

Sourse: NSI

Figure 4.2 Primary energy consumption by fuel type 2001-2020. Source: NSI

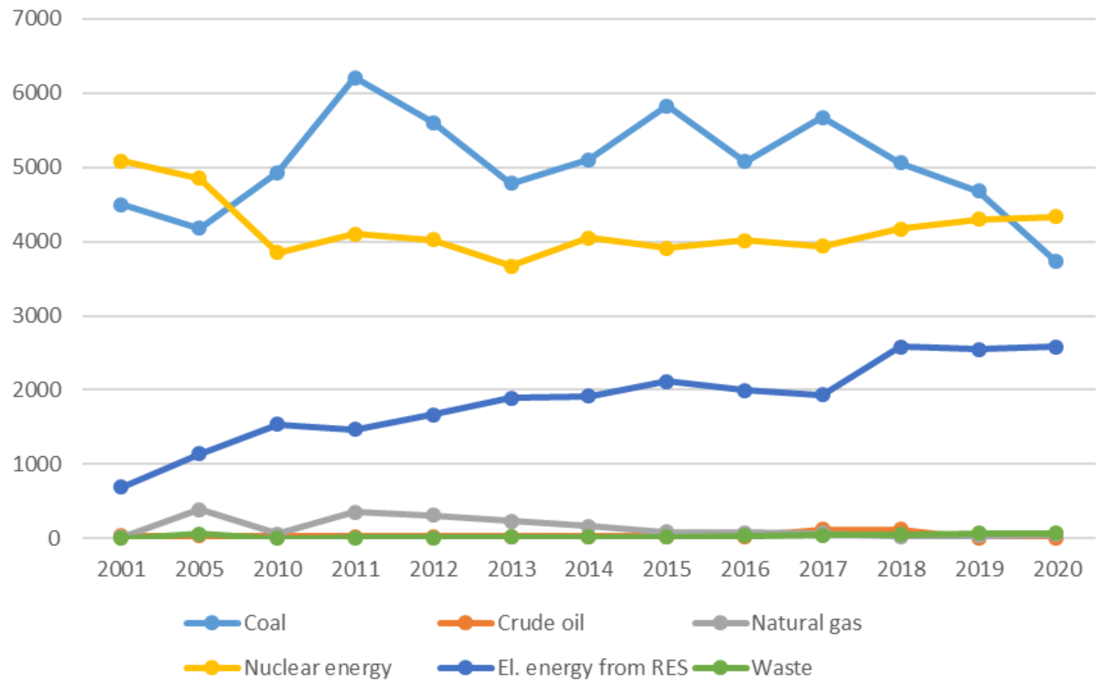


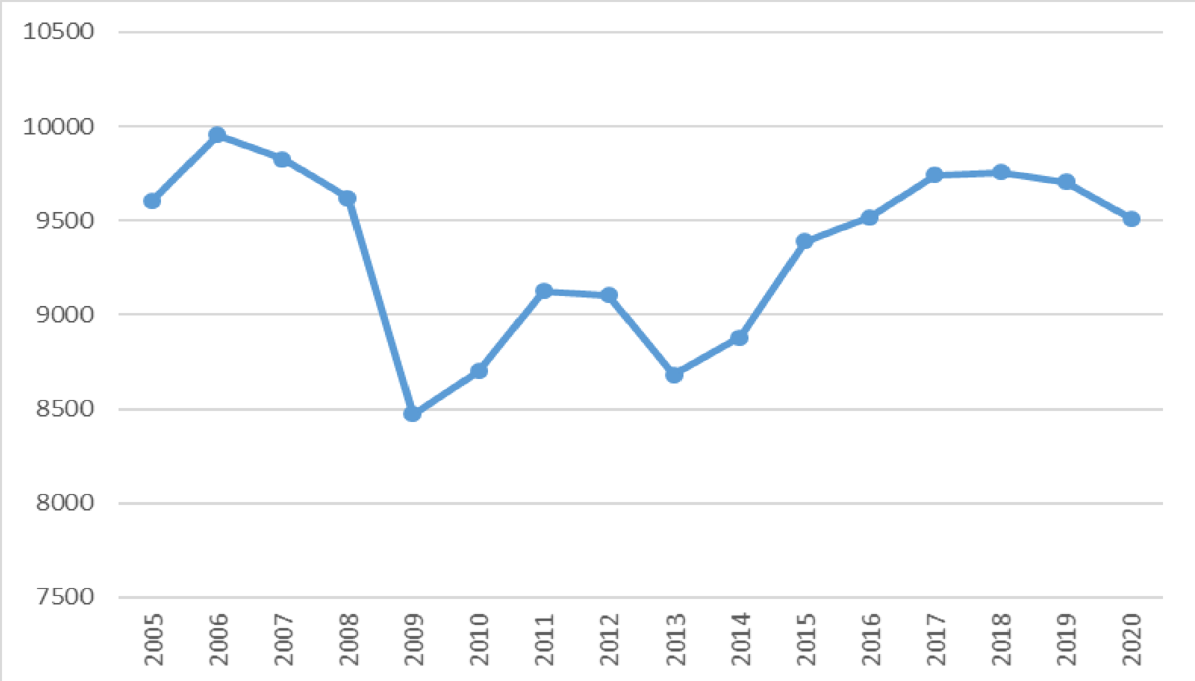
Table 4.10 Final energy consumption 2005-2020г. ktoe

Year	2005	2006	2007	2008	2009	2010	2011	2012
Final energy consumption	9 602	9 953	9 825	9 622	8 472	8 699	9 125	9 103
Year	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Final energy consumption	8 681	8 882	9 389	9 518	9 742	9 755	9 707	9 513

Source: NSI

For the period 2005 - 2020 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 Final energy consumption 2005-2020г. ktoe



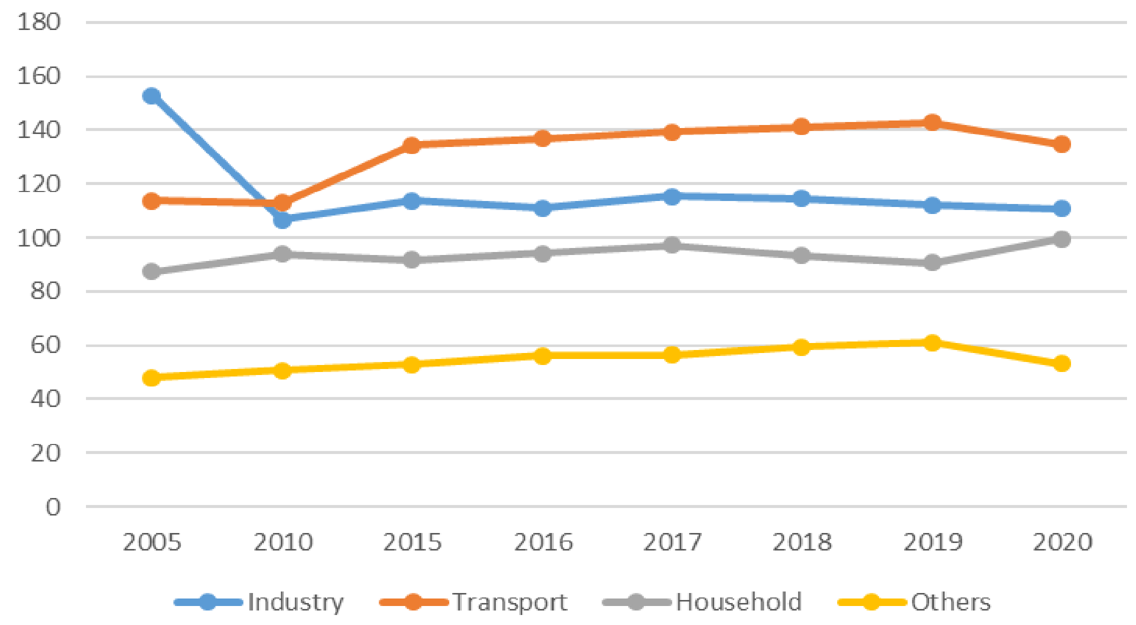
Changes in final energy consumption in Bulgaria by economic sectors over the period 2005-2020 is shown in Table 4.10.

Table 4.11 Final energy consumption by sectors, PJ

Year	Final energy consumption, PJ	Industry	Transport	Household	Others
2005	402,0	152,8	113,8	87,5	47,9
2010	364,2	106,8	112,8	93,9	50,7
2015	393,1	113,9	134,5	91,8	52,9
2016	398,5	111,2	136,8	94,3	56,2
2017	407,9	115,3	139,2	97,1	56,3
2018	408,4	114,6	141,2	93,4	59,3
2019	406,4	112,2	142,8	90,5	61,0
2020	398,3	110,8	134,6	99,7	53,1

Sourse: NSI,

Figure 4.4 Final energy consumption by sectors 2000- 2020



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 2019.

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

Energy intensity

Final energy intensity is the main indicator of energy efficiency consumption by end users and it decreases by over 47% on average per year during the period 2000-2020.

Table 4.12 Final Energy Intensity

Year	Energy intensity of the economy	
	(toe per 1000 EUR GDP (2010 = 100)	(toe per 1000 EUR GDP (2015 = 100)
2000	0,764	0,682
2001	0,77	0,687
2002	0,71	0,634
2003	0,693	0,619

2004	0,633	0,565
2005	0,626	0,559
2006	0,603	0,539
2007	0,555	0,496
2008	0,517	0,462
2009	0,471	0,421
2010	0,47	0,42
2011	0,493	0,44
2012	0,469	0,418
2013	0,438	0,391
2014	0,454	0,405
2015	0,459	0,41
2016	0,436	0,389
2017	0,439	0,392
2018	0,429	0,383
2019	0,409	0,365
2020	0,405	0,362

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**

Directive 2012/27/EU on energy efficiency is aimed at establishing a common framework to promote energy efficiency within the Union, so as to ensure achievement of the objective of saving 20 % of the Union's primary energy consumption by 2020, and setting up conditions for further energy efficiency improvements after 2020. In accordance with the provisions of this Directive, in 2014 the Republic of Bulgaria developed and presented to the European Commission a National Energy Efficiency Action Plan 2014-2020 [7][NPDEE].

In 2015 and 2016 the work on achievement of the energy efficiency targets set out in the National Action Plans for 2008-2016 continued. They have been developed in accordance with the requirements of Directive 2006/32/EC of the European Parliament and of the Council on energy end-use efficiency and energy services.

This updated version of the National Energy Efficiency Action Plan 2014-2020 has been developed in accordance with the provisions of Article 7(1),(2) and Paragraph 17(1) of the Transitional and Final Clauses of the Energy Efficiency Act and in conformity with the requirements of Article 24(2) of Directive 2012/27/EU.

The energy policy of the Republic of Bulgaria is fully aligned with that of the European Union in terms of energy security, competitiveness and sustainable development. The Energy Strategy of the Republic of Bulgaria for the period to 2020 confirms that 'energy efficiency has the highest priority in the country's energy policy'. This has served as a basis for setting ambitious energy efficiency improvement targets.

The NPDEE sets the 2020 national energy efficiency target of 716 ktoe/year of energy savings in final energy consumption (FEC) and 1 590 ktoe/year in primary energy consumption (PEC), including 169 ktoe/year in the transformation, transmission and distribution processes in the energy sector.

Annual report as required by Directive 2012/27/EU, tracks only the implementation in 2019 of the actions and measures of the NEEAP which directly impact the attainment of the national target could be find on the link: https://energy.ec.europa.eu/system/files/2020-11/ener-2020-01182-00-00-en-tra-00_0.pdf.

5.4.3.2.Measures in the Household and Services sector

[7] http://www.seea.government.bg/documents/TRA%20BG%20NEEAP%202017%20EN.pdf

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

Measures with direct impact on the reduction of GHG emissions

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 492.9ktCO_2. The indirect effect is estimated at about 1983.4ktCO_2.8 The total amount of reduced emissions will be 2476.4 ktCO_2.

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 985.9ktCO_2. 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 4952.8kt$CO_2$9.

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 resources10;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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8 The value is determined on the basis of emission factor 0.055ktCO2eq/TJ

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

10 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 resources11. Introduction and promotion of flexible financial schemes - contracts for sale of energy. Incentives in case of combined and integrated solutions to reduce energy consumption.

Implementation:

In 2018, gas distribution companies (GDC) built 160,080 m of gas distribution network (GDN) and made investments in the amount of BGN 23,376 thousand. The total number of customers in the Natural Gas sector at the end of 2018 was 107,669, of which 100,439 (93%) were household customers and 7,230 (7%) non-household customers. The total consumption of natural gas by GDC customers in 2018 was 531,136 m3 (5,607,026 MWh), of which 432,243 m3 (4,563,045 MWh) of non-household customers (81%) and 98,893 m3 (1,043,980 MWh) to household customers (19%). The quantities of natural gas have been converted from cubic meters to energy units (MWh), and for their conversion, an average arithmetic coefficient of the representative calorific value of natural gas for 2018 in the amount of 10,557 was used, which is determined monthly by the operator of the gas transmission network "Bulgartransgaz EAD. From 01.01.2019, the unit of measure for natural gas quantities is in energy units (MWh).

In 2019, the constructed network was 186,771 m, and the investments made by GDC amounted to BGN 26,548 thousand. The total number of customers at the end of 2019 was 119,745, of which 112,153 (93.7%) were residential customers and 7,592 (6.3%) were non-residential customers. The total consumption of natural gas by GDC customers in 2019 was

[11] 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.

5,436,093 MWh, of which 4,367,246 MWh by non-household customers (80%) and 1,068,846 MWh by household customers (20%).

In 2020, 154,347 m of underground water supply was built, the investments made by the GDC amounted to BGN 27,031 thousand. As of the end of 2020, the total length of the built GDN in the country was 5,262,221 m. The total number of GDC customers as of 31.12.2020 was 132,424, of which 124,652 (94.1%) were household customers and 7,772 (5.9%) non-household customers. The total consumption of natural gas by GDC customers in 2020 was 5,605,628 MWh, of which 4,314,224 MWh by non-household customers (77%) and 1,291,404 MWh by household customers (23%).

Evaluation of the effect:

The total number of natural gas customers for the period 2018-2020 increased by 23% - from 107,669 in 2018 to 132,424 in 2020. Household customers increased by 24.11%, and non-household customers by 7.50%.

The increase in the number of gasified household customers in 2020 compared to 2018 is related to the implementation of the project "Measures for energy efficiency at the end users of natural gas through the gas distribution companies in Bulgaria" DESIREE GAS, which aims to provide a special and an effective mechanism to support the gasification of Bulgarian households in accordance with the requirements of the EU Energy Efficiency Directive, promoting the most efficient technologies and supporting the transition from carbon-intensive energy sources to natural gas. The term of the project was extended until June 2020. The grant for gasification of Bulgarian households under the DESIREE GAS project is 30% of the allowable costs for building installation. 100% joining fee is additionally financed free of charge.

The regulatory mechanism applied by RCEW provides incentives for gas distribution companies to continue the development of gas distribution networks and the joining of new customers with the aim of gradually increasing the consumption of natural gas. In this regard, RCEW approves marginal prices for the sale of natural gas, which enables gas distribution companies to sell to final customers at prices lower than those approved, thus stimulating the gasification of households.

The measure was executed.

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 Energy Efficiency Directive - sanitation of communal, public and state buildings at the percentage rate required by the directive (built up area over 250m^2)

Characteristics: The measure will come into effect after adoption of the new Energy Efficiency Directive (EED) expected by the end of 2012. At this stage of negotiations within the EU legislative bodies the percentage of buildings that are to be retrofitted per year laid down in the draft directive is 3%, which is acceptable for our country according to the Bulgarian position on the proposal.

State-owned and municipal dwellings12 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	**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 m^2.

The measure is included in the National Action Plan for Energy Efficiency (NAPEE) 2014-2020. It is reported annually with the annual reports on the implementation of the NAPEE, which are approved by the Council of Ministers and sent to the EC. The annual reports are publicly available on the website: https://energy.ec.europa.eu/system/files/2020-11/ener-2020-01182-00-00-en-tra-00_0.pdf.

For the period 2014-2019, the renovated area of the buildings amounted to 28.2% of the total gross floor area, or an average of about 5.6% per year; as of 31.12. 2019 - 229 buildings meet the requirements for minimum energy performance or 28.2% of the total built-up area of the buildings within the scope of art. 5 of the Directive.

According to the requirement of Art. 5 of Directive 2012/27/EU, all Member States must ensure that at least 3% of the built-up area of the heated and/or cooled buildings owned and used by the central administration are renewed annually, starting from April 1, 2014. In the Republic of Bulgaria, with the provisions of the EEA, a more ambitious goal of 5% was adopted, which, in addition to the buildings of the central administration, also covers part of those used by the territorial administration.

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

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

Characteristics: This measure is proactive and is consistent with the announced direction and actions of the EC aiming at reducing fuel and energy consumption.

Precondition for achieving the estimated effect are the regulatory changes with the view of introducing a requirement for specific (proportional) annual reduction of the amount of energy provided on the market by distribution companies and traders in energy (end-use consumption). Market mechanisms and incentives to reduce fuel and energy consumption need to be established along with mandatory schemes and market of energy services (market of “white” certificates/ certificates of energy savings).

The measure is consistent with the new policy proposed by the EC to improve the energy efficiency in end-use consumption by saving annually fuel and energy equivalent to 1.5% of the energy provided by distribution companies and traders in energy on the market for the previous year (excluding energy in transport). The annual energy savings, respectively obligations, will be constant value (expressed in percentage) until 2020. To introduce such a scheme it is necessary to undertake appropriate legislative changes and to prepare its structure and operation. The responsible persons will be determined in the course of development of the scheme.

These can be both traders in fuel and energy or end consumers. The actual reduction of fuel and energy consumption occurs in end-use consumption and should be a result of implemented measures.

The anticipated effect is determined on the basis of projected fuel and energy consumption in the Industry and Household sectors where the consumption is expected to decrease by 1,5% on an annual basis. The decrease in final fuel and energy consumption according to the objectives will lead to reduction of emissions as follows: 40.5ktCO_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	**2016**	**2018**	**2020**
GWh	34.4	34.34	34.64

Type of instrument:

Energy Efficiency Directive.

Implementation:

Pursuant to Art. 7 of Directive 2012/27/EU, through the Energy Efficiency Act (EEA) a scheme for obligations for energy savings has been introduced. In Art. 14 of the EEA, the persons who have an obligation to fulfil individual goals for energy savings are defined. The measure is included in the NAPEE, and its implementation is reported annually.

The cumulative target for the period 2014-2020 under the obligation scheme is 4,977 GWh. The total assessment of the effect of the implementation of the measure for the same period amounts to 2,226 GWh. The realized energy savings under the obligation scheme and taking into account the implementation of the alternative measures lead to the achievement of 48% of the national cumulative target for 2020.

By 2019, 40.91 GWh new savings from the implementation of the measure; by 2018, 68.6 GWh new savings from the implementation of the measure.

As part of the national policy to reduce greenhouse gas emissions and adapt to climate change, financial support for projects to reduce greenhouse gas emissions continues under the Climate Investment Program (CIP) and the Climate Micro-Projects Program of the National Trust Ecofund. At this stage, the CIP has made the most progress, as under the program measures have been implemented to reduce energy consumption in 114 public buildings and 63 electric vehicles have been purchased for the needs of the administration. According to the CIP, the following results were achieved:

- Implemented measures to reduce energy consumption in 114 sites, including: 40 schools, 22 nurseries and kindergartens, 15 administrative buildings, 8 community centres, 6 public buildings, 6 universities, 7 health services, 4 street lights and 6 municipal hospitals/polyclinics.

- To date, 63 electric vehicles (EVs) have been purchased, including: 37 EVs, category M1 (4+1 seats) or N1; 8 Plug-in hybrid vehicles, category M1 (4+1 seats); 17 EVs, category L7e; 1 EV van M1 (6+1, 7+1 seats).

- Greenhouse gas emissions saved from supported projects with accumulation since the launch of the Climate Investment Program (CIP) in tCO2eq: 849,000

To support the implementation of the national goal for energy efficiency in the period 2013 - 2020, the following alternative measures were implemented:

- National program for energy efficiency of multi-family residential buildings (NPEEMFRB/The Program).

The NPEEMFRB was launched in 2015, which is implemented decentralized and with 100% administrative management of the process and public resource. The benefits of the Program are indisputable from the point of view of improving the energy performance and the overall condition of the housing stock, while at the same time it contributes to the protection of air purity, the reduction of greenhouse gas emissions and acts as a catalyst for a purposeful long-term housing policy.

At the moment, the financial resource for the implementation of the Program is almost exhausted.

Table 4.13 presents information on the scope of the NPEEMFRB for the entire program period, as well as the general progress in implementation as of 31.12.2020.

Table 4.13. Summary data on the implementation of the NPEEMFRB

A. General information about NPEEMFRB

Concluded financing contracts between municipality, regional governor and BDB, number	2022
Expected improved housing infrastructure (for all 2022 buildings), sq.m. Built-up area	11,538,597
Residences to be renovated (for all 2022 buildings), number	136,104
Expected energy savings from renovated residential buildings (estimated for all 2022 buildings), MWh/year	975,00
Estimated annual reduction of greenhouse gas emissions (estimated for all 2022 buildings), $1CO_2$/year	327,000

B. General information on the implementation of the program as of 31.12.2020.

Buildings with started activities, number	2010
Renovated buildings, number	1921
Buildings under construction, number	**16**
Buildings with signed contracts for engineering without started CAW, after completed surveys, number	16

C. Information on buildings put into operation as of 31.12.2020.

Renovated buildings, number	1921
Improved housing infrastructure, sq.m. Built-up area	10,855,018
Renovated homes, number	128,439
Expected energy savings from renovated residential buildings, MWh/year	922,300
Expected annual reduction of greenhouse gas emissions, $1CO_2$/year	313,000
Value of all activities on the buildings, BGN.	BGN 1,931,682,300

- Project BG161P0001-1.2.01-0001 "Energy renovation of Bulgarian homes" under the Regional Development Operational Program 2007-2013:

The project was implemented in the period from 2012 to 2015, and the beneficiary under the program is the "Housing Policy" Directorate of the MRDPW.

- Number of renovated residences - 2203;
- Estimated energy savings from the renovated residential buildings - the estimated value of the expected energy savings from the renovated residential buildings indicated in the project application form is 17,500 MWh/year. According to the information available in the MRDPW - Analysis of the implementation of the "Energy renovation of Bulgarian homes" project (2016), the reported value of the expected energy savings from the actually renovated residential buildings, after the implementation of the project, is 16,355.14 MWh/year. Energy savings are estimated given the fact that they are determined on the basis of energy audits carried out before the renovation of the buildings.

Under the Operational Program "Growing Regions" 2014-2020 (OPGR 2014-2020), 272 grant agreements (GA) worth BGN 296,843,354.52 were concluded for improving the energy efficiency of public and residential buildings. 189 projects have been implemented. According to the projects, 685 buildings have been renovated by the end of 2020, of which 484 residential buildings and 201 public buildings. The annual primary energy consumption of public buildings was reduced by 76,932,311.30 kWh/year and 6,142 households moved to a higher energy consumption class. The expected annual reduction of greenhouse gas emissions is 39 455.77 tons of CO_2 eq.

Evaluation of the effect:

The total effect of the implementation of the projects in the period of implementation of the measure is 1 765 190 tons of CO_2 eq. emissions saved.

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 2020.

Implementation:

During the reporting period, the following activities were carried out to implement the National Plan for increasing the number of buildings with close to zero net energy consumption:

In 2019, as part of the administrative measures provided for in the national nZeb plan, by order of the Minister of the Ministry of Regional Development and Public Works(, a National Expert Council (the Council) was formed to coordinate the implementation of the National Plan for buildings with near-zero energy consumption 2015 - 2020 (nZeb plan).

The expert council is widely represented and includes experts from the state administration, branch organizations and financial institutions. Ministry of Regional Development and Public Works, Ministry of Energy, Ministry of Environment and Water, Agency for Sustainable Energy Development, Technical University-Sofia, University of Architecture, Construction and Geodesy-Sofia, National Association of Municipalities in the Republic of Bulgaria, Chamber of Engineers in Investment Design in Bulgaria , Chamber of Architects in Bulgaria, Chamber of Builders in Bulgaria, Chamber of Installers in Bulgaria, Chamber of Energy Auditors, Bulgarian Association of Architects and Consulting Engineers, DZZD "Fund for Sustainable Cities", Regional Fund for Urban Development AD, “Energy Efficiency and Renewable Sources” Fund. The work of the Council is organized by thematic areas in four thematic working groups (TWG) as follows: TWG-1 "Regulation, standardization and technical standards"; TWG-2: "Scientific applied, research and analytical activities and intelligent technologies”; TWG-3: "Financial mechanisms and policies for investment mobilization"; TWG-4: "Awareness and publicity, acquisition of knowledge and skills".

In the context of the COVID-19 pandemic, the work of the council is mainly conducted online. At the time of preparation of this report, two technical opinions have been developed. The first opinion was prepared with the leading role of the Centre for Energy Efficiency EnEffect and includes: Identifying the professional and user groups that need more information on near-zero energy buildings, defining the competences and knowledge that these groups need to acquire, a sample program of information seminars to stimulate interest in buildings with near-zero energy consumption, systematized information with online links to all nZEB projects that have been implemented or are being implemented in Bulgaria with information on useful practices, trainings and educational materials implemented on projects with European and national funding on the subject, development of guidelines for a broad public campaign to promote the benefits and advantages of near-zero energy buildings at national and local level.

The second opinion was developed by the MRDPW together with the Chamber of Engineers in Investment Design and includes: analysis of the applicability of the current national definition of nZEB, study of completed buildings in Bulgaria up to the level of the zero consumption norm, analysis of errors and difficulties in engineering calculations, proposal to supplement the national definition and adapt it to the new Directive (EU) 2018/2001 to promote the use of energy from renewable sources, analysing the obstacles to the implementation of the national definition in urbanized territories, in areas with a built heating and gas transmission network. It is being discussed that the nZEB Council in partnership with the Technical University-Sofia should develop practical guidelines/instructions for designers and consultants with specific examples for calculating the share of renewable energy when using the various engineering technologies to maintain the microclimate in buildings. A rubric has been created on the website of the MRDPW to reflect the work of the Council, which is in the process of developing and publishing materials to promote nZEB (https://www.mrrb.bg/bg/ministerstvo/ekspertni-i-konsultativni-suveti/nacionalen-eksperten-suvet-za-koordinirane-izpulnenieto-na-nacionalniya-plan-za-sgradi-s-blizko-do-nulevo-potreblenie-na-energiya/).

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.

Implemenation:

The energy efficiency certification of buildings in operation and parts of buildings in operation aims to certify the current state of energy consumption in buildings, energy performance and their compliance with the scale of energy consumption classes. Certification is based on an energy efficiency survey. The BREEAM, LEED, DNGB standards are voluntary. The introduction and implementation of the standards has an indirect effect on the overall reduction of greenhouse gas emissions.

During the period 2014-2019, 4,616 public and residential buildings were certified.

<u>Measure 5: increasing awareness regarding the requirements to nearly zero energy buildings, new materials, practices and technologies</u>

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.

Implemetation:

The measure is informative and for increasing the knowledge and qualifications of the professional branch. In connection with the implementation of the measure by the end of 2020, at least 10 seminars on providing information on the nZEB.

<u>Priority axis 3</u>: INCREASING EFFICIENCY OF TRANSFORMATION OF PRIMARY ENERGY CARRIER

Measures with direct impact on the reduction of GHG emissions

<u>Measure 1: replacement of the obsolete and inefficient equipment for production of energy with new equipment</u>

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 72 383 tonnes CO_2 eq by 2020

Target value by year	**2016**	**2018**	**2020**
GWh	**261.2**	**175.1**	**176.8**

Type of instrument:

Financial and administrative

Implemenation:

The measure refers to the final consumption of fuels, their conversion into energy for heating, cooling and DHW, as well as energy consumption. The assessment of the effect was made on the basis of predicted consumption of fuels in the Home and services sector, taking into account other related measures.

The measure is also tied to the activity provided for in the Second NAPEE, in accordance with the regulations for the specific product groups adopted pursuant to Art. 15 of Directive 2009/125/EC to create a framework for determining ecodesign requirements for products related to energy consumption.

In accordance with the activity of the SAMTS, inspections were carried out according to Directive 2009/125/EC to create a framework for determining the ecodesign requirements for products related to energy consumption.

<u>In 2017, the following were checked:</u>

- 639 models of vacuum cleaners within the scope of the ecodesign requirements of Regulation No. 666/2013. For 12%, corrective actions were taken to the instructions for use. 18 vacuum cleaners have been discontinued;

- 459 models of incandescent lamps for their compliance with the ecodesign requirements of Regulation No. 244/2009 (amend. Regulation No. 2015/1428). As a result of the inspection, 94 pieces of 12 lamp models were destroyed; 787 pieces were suspended from sale in the commercial outlet; 15 AEAV were drafted; the import of 35 models of ordinary incandescent lamps has been suspended.

<u>In 2018:</u>

- 50 models of refrigerators under the EEPLIANT2 project for their compliance with the ecodesign requirements of Regulation No. 643/2009. 2 models of non-compliant refrigerators were found, for which actions were taken.

- 195 products (routers, game consoles, cable TV decoders, home theatre systems, projectors, BlueRay players, fitness equipment, robotic vacuum cleaners, laptops and video surveillance systems) within the scope of network standby requirements Regulation No.

1275/2008 (amend. Regulation 801/2013). 2 non-conforming products were discovered, for which stop distribution orders have been issued.

In 2019, the following were checked:

- 412 models of halogen lamps for their compliance with the ecodesign requirements of Regulation No. 244/2009 (amend. Regulation No. 2015/1428). 3 lamp models were stopped from sale at the dealer, 34 in total; for 8 models of lamps, orders have been issued to stop the distribution under Art. 30c of the LTRP; for 3 models of lamps, orders have been issued to stop distribution and withdraw from the market under Art. 30a, para. 2 of the LTRP.

- 29 electric motor models for compliance with the ecodesign requirements of Regulation No. 640/2009. For 2 models, an order to stop distribution was issued under Art. 30c of the LTRP, for 3 models, corrective actions have been taken regarding the information on the technical data plate.

In 2020, the following were checked:

- 29 ventilation units, according to the EEPLIANT3 project, for compliance with the requirements for ecodesign specified in Regulation (EU) No. 1253/2014. Corrective action letters have been sent to the economic operators regarding the mandatory information, the product fiche and the energy label that must be found on the websites where the products are offered. For 2 non-compliant recuperators, investigative protocols were drawn up and orders were issued to temporarily stop their distribution.

- 298 dryers, under the EEPLIANT3 project, for compliance with the ecodesign requirements of Regulation No. 932/2012. Inconsistencies were found on 3 dryers that have been purchased for testing. As a result of the tests, it was found that 1 tumble dryer does not comply with ecodesign requirements. A stop distribution and recall order has been issued.

- 267 air conditioners for compliance with the ecodesign requirements of Regulation No. 206/2012. The inspection found 15 models of air conditioners not meeting the requirements, for which the following actions were taken: 9 AEAV have been drafted; 2 trader stop orders; 3 air conditioners suspended from sale in the commercial outlet; corrective actions have been taken regarding the instructions for use for 5 air conditioners.

Evaluation of the effect

The effect of energy efficiency inspections of water boilers and air-conditioning installations in public buildings, which are mandatory under the EEA, during the period 2014 - 2019, is estimated at 134.68 GWh annual energy savings or 240 tons of CO_2 eq.

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 CO_2 eq by 2020

Target value by year	**2016**	**2018**	**2020**
Installations	200	400	400

The implementation of the measure has not yet started.

5.4.4. Industry Sector

Development of the sector in the period 2000-2020

- 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;

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.**

5.4.4.1.Measures in the Industry Sector

<u>Priority axis 1:</u> IMPROVEMENT OF ENERGY EFFICIENCY IN THE INDUSTRY

Measures with direct impact on the reduction of GHG emissions

<u>Measure 1: audits for energy efficiency and implementation of the prescribed measures</u>

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 CO_2 eq. by 2020

Target value by year	**2016**	**2018**	**2020**
t CO_2 eq	1 260 000	280 000	238 000

Instrument:

Legislative - Energy Efficiency Act

Implementation:

According to procedure BG161P0003-2.3.02 "Energy efficiency and green economy", implemented under the operational program "Development of the competitiveness of the Bulgarian economy" 2007-2013 (OPDCBE), a total of 437 enterprises were supported and funds in the amount of BGN 262,764,217.57 were certified (EUR 134,351,271.89). We would like to point out that the target group of the procedure was only SMEs and there was no requirement for an annual energy consumption of more than 3000 MWh.

During the 2014-2020 program period under the operational program "Innovations and Competitiveness" (OPIC), the only procedure for energy efficiency for large energy consumers was the procedure for selecting projects BG16RFOP002-3.002 "Increasing energy efficiency in large enterprises". The purpose of the procedure was to provide focused support to large enterprises in Bulgaria for the implementation of energy efficiency measures in order to achieve sustainable growth and competitiveness of the economy. As of 2020, 61 enterprises have been supported under the procedure and payments in the amount of BGN 107,104,387.46 have been made.

As a result of the implementation of the projects, savings in CO_2 emissions in the amount of 281 116.60 tons/year were recorded.

Evaluation of the effect

Greenhouse gas emissions (CO_2) saved from the supported projects are approximately 126 603.77 t CO_2/year as of 2016, as of 2018 there were 650 230 tons of CO_2, and by the end of the period there were another 73,13 thousand tons of CO_2 - a total of 849 963.77 tons of CO_2.

<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 CO_2 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

Implementation:

In implementation of the mentioned measure, procedure No. BG161P0003-2.3.01 "Investments in green industry" was implemented under OPDCBE.

Grant procedure BG161P0003-2.3.01 "Investments in green industry" was aimed at providing support to large enterprises in the country in the implementation of investment projects directly related to the production of products subject to recycling when they become waste, (including products that fulfil the conditions of the harmonized standard EN 13 432:2000 for the biodegradability of packaging), more efficient use of waste products and reduction of energy intensity in these enterprises, as a key factor in overcoming their negative impact on the environment and increasing "green" investments in the Bulgarian economy.

Within the framework of the procedure, 30 enterprises were supported, and 28 were successfully completed. The amount of certified funds under the procedure amounts to BGN 64,942,110.47 (EUR 33,204,883.15).

<u>Priority axis 3</u>: ESTABLISHMENT OF A TECHNOLOGY PARK AND A BUSINESS INCUBATOR

Measures with indirect impact on the reduction of GHG emissions

<u>Measure 1: establishment of a technology park and a business incubator</u>

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

Implementation:

An indicator of the implementation of the measure is the construction of a technological park. The measure was executed.

Within the framework of OPDCBE, in line with the procedure for the direct provision of grant BG161P0003-1.2.05 "Creation of a science and technology park", the activities for the construction of the first science and technology park on the territory of the country were launched.

The construction of the park is divided into two phases, as phase 1 was realized within the framework of OPDCBE 2007-2013, and phase 2 under OPIC.

During the first phase (program period 2007-2013), activities were financed for the preparation and construction of the park and its commissioning, including construction of the infrastructure of the park, delivery and installation of LTA/LIA, promotional and information campaigns, provision of services to the incubator planned for construction.

During the first phase of the project, events and specialized forums were held with over 1,900 participants, such as: industrial panel on the topic "Financing of projects and innovative products of start-up companies and SMEs in the field of energy efficiency", etc. Under phase 1 of the project, funds worth BGN 67,332,359.28 (EUR 34,427,016.71) were certified as grants.

In the second phase, it was planned to carry out the final construction of all infrastructure sites, as well as the launch of the incubation program with included services for the incubated enterprises.

As a result of the implementation of phase 2 of the project, 33 start-up innovative enterprises were supported by providing them with financial assistance through subsidized rent in the amount of 50% of the market value; 10 partnerships were established with representatives of Bulgarian technological companies, with which innovative technological solutions and new products and services were developed; numerous companies (including start-ups) use services provided by the laboratory complex of Sofia Tech Park; an interactive museum "TechnoMagic Land" was created, which has been actively operating since 2017.

As of 30.12.2020, funds in the amount of BGN 8,591,720.25 have been disbursed under the project.

5.4.5. Waste Sector

5.4.5.1.General information on the Waste sector

Waste management and in particular waste treatment is a source of greenhouse gases.

According to the National GHG inventory the Waste sector includes the following sub-sectors:

- Emissions from landfill of waste;
- Emissions from wastewater treatment;
- Emissions from waste incineration.

The sector is one of the major sources of GHGs. The main GHGs emitted into the atmosphere as a result of waste treatment are methane and nitrous oxide emitted during the process of waste disposal and wastewater treatment. Worldwide, about 5-20% of the total methane is released during the anaerobic processes of waste decomposition.

Solid Waste Disposal on Land contributes over 78%, Wastewater Handling about 20%, compost production about 1.12% and Waste Incineration about 0.5% 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 CH_4 as a result of the processes of anaerobic and aerobic degradation of their content. In the 2020 inventory, methane emissions from this source are the first - 78%.

The second major source of CH_4 in this sector is the treatment of waste water in treatment facilities (15%), 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.

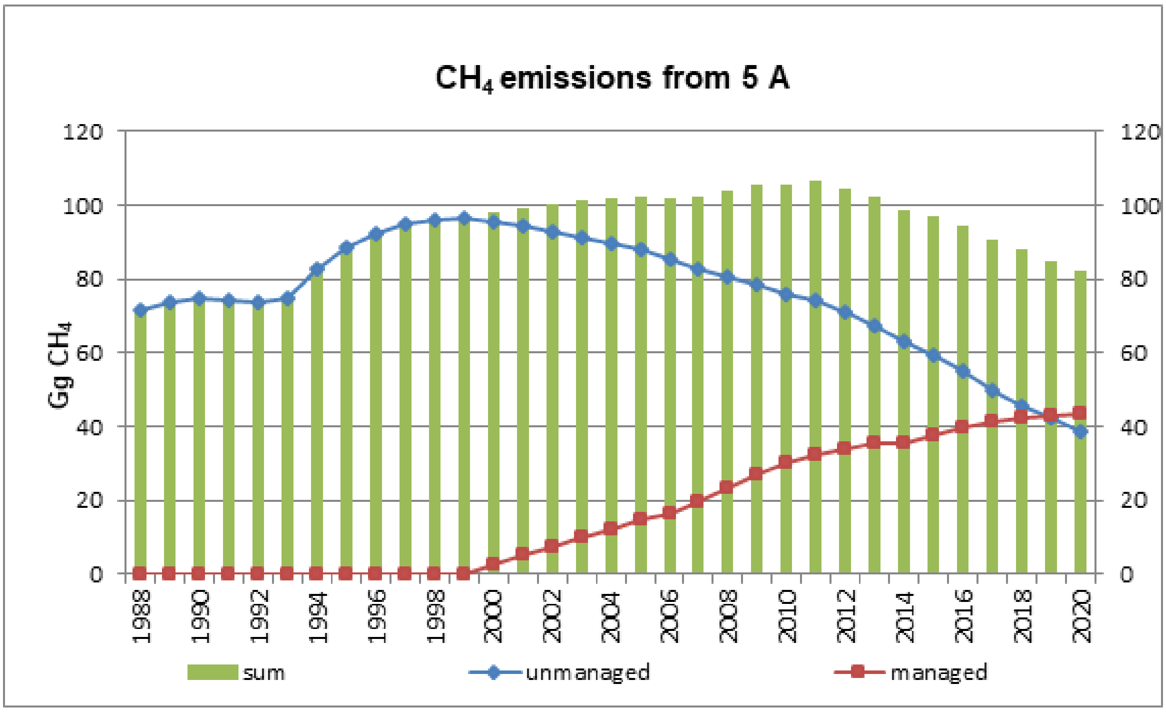
– **Waste disposal on land**

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.

The diagram below shows the emissions of methane emitted from landfilled waste in the period 1988-2020.

Figure 4.5. Methane emissions from Solid waste disposal on land (5A) in Gg/year



Source: NIR2022

The measures to reduce GHG emissions from landfilled waste include:

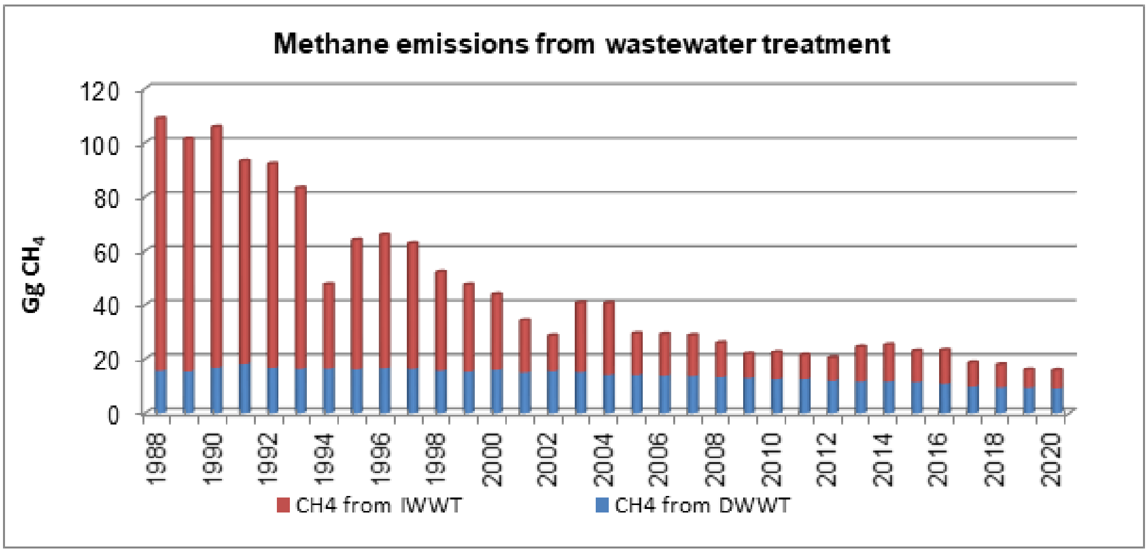
- Prevention of waste for disposal by promoting the efficient use of resources, further development of the collective systems for separate waste collection , linking the amount of the municipal waste charge to the quantities of generated waste, creation of stable conditions for marketing of materials 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 N_2O 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.

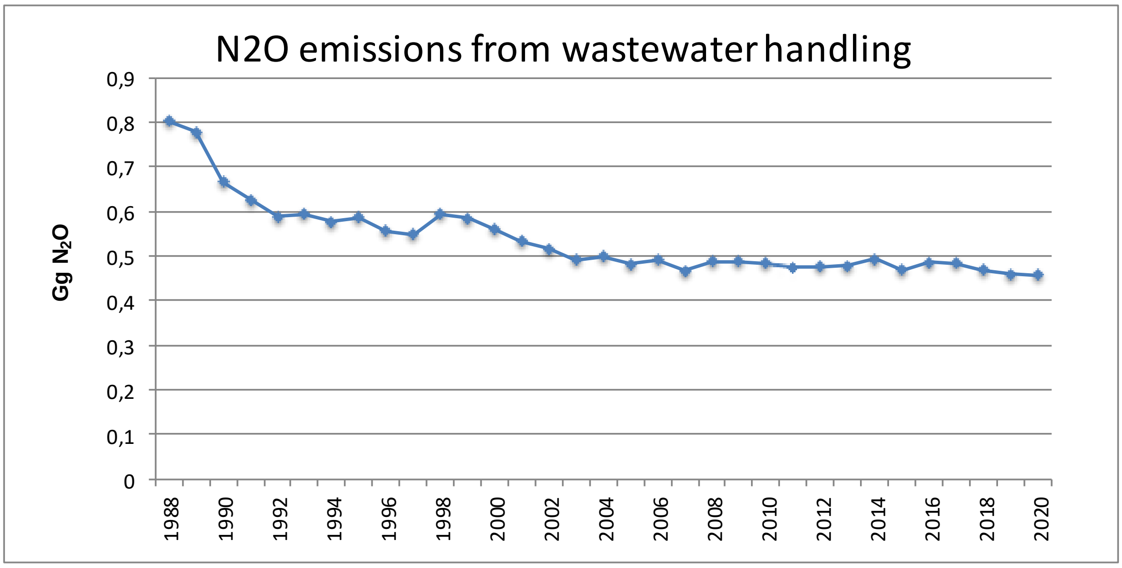
Figure 4.6. Trend in CH_4 emissions in Sector Wastewater treatment



DWWT – Domestic wastewater treatment, IWWT – industrial wastewater treatment

Source: NIR2022

Figure 4.7. Trend in N2O emissions in Wastewater handling



Source: NIR2022

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 2020 the quantity of generated industrial wastewater is less than 2019 with 6.25%.

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 2020 about 58 % of the population is connected to centralized aerobic treatment plants, 32 % is connected to the public sewerage, but without treatment (sea, river, lake) and 9 % of the country population use septic systems and latrines (detail information at: www.nsi.bg).

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.

5.4.5.2.Measures at the Waste Sector

Priority axis 1: REDUCTION AND PREVENTION OF THE QUANITTIES OF WASTE THE DISPOSAL

Measures with direct impact on the reduction of GHG emissions

Measure 1: construction of installations for mechanical and biological treatment (mbt) and installations for treatment and recovery of compost and biogas

Characteristics: The measure is incorporated into the National strategic plan for gradual reduction of biodegradable waste intended for landfilling 2010-2020. As a result of its implementation for the period 2013-2020, 5 289 000 tonnes of biodegradable waste will be diverted from landfills. An additional impact of the measure will be the substitution of phosphate fertilizers in agriculture with compost produced at waste treatment installations.

Indicator of implementation:

Number of installations built

Expected effect:

Total reduction of 5 823 763 tonnes CO_2 eq. by 2020

Target value by year	**2014**	**2016**	**2018**	**2020**
Number of installations built	12	32	42	54

Instrument:

National Programme for Waste Management Activities 2009-2013 National strategic plan for the phased reduction of the amount of biodegradable waste intended for disposal at landfills 2010-2020.

Implemenation:

According to the procedure for the direct provision of the grant "Combined procedure for the design and construction of composting installations and installations for the pre-treatment of household waste" (OPE 2014-2020), contracts were concluded with the municipalities of 16 regional waste management associations (RWMA) with a total value of grant provided of BGN 130.4 million.

According to a procedure through direct provision of the grant "Second combined procedure for the design and construction of composting installations and installations for the pre-treatment of household waste" (OPE 2014-2020), contracts were concluded with the municipalities of 3 RWMA with a total value of BGN 23.7 million provided.

According to the concluded contracts for grants under both procedures, it is planned to build a total of 24 composting plants that will serve a total of 75 municipalities.

The construction sites of the projects implemented by the following municipalities have been opened: Madan, Gotse Delchev, Troyan, Velingrad, Oryahovo, Blagoevgrad, Dospat. The project implemented by the municipality of Sandanski has ended. The CAW for the construction of the installations under the project implemented by the municipality of Zlatitsa and for the construction of 2 of the 4 installations under the project implemented by the municipality of Pazardzhik have been completed. The installation under the project with the leading municipality of Petrich has been built and put into operation (a final package of reporting documents has been presented, which is in the process of being checked).

According to the procedure through the direct provision of grant "Design and construction of anaerobic installations for separately collected biodegradable waste" (OPE 2014-2020), contracts with municipalities from 3 RWMA with a total value of provided grant of BGN 85.2 million are in the process of being implemented.

Regarding the procedure through direct provision of grant "Design and construction of composting installations for separately collected green and/or biodegradable waste" (OPE 2014-2020) with specific beneficiary municipalities from a total of 39 municipalities from 7 RWMA:

- The project proposal of the municipality of Rodopi is under evaluation.
- Contracts were signed with 15 municipalities with a total value of grant provided of BGN 49.3 million, including: Karlovo, Montana, Harmanli, Plovdiv, Berkovitsa (in partnership with the municipality of Varshets), Maritsa, Svilengrad, Chiprovtsi (in partnership with the municipality of Georgi Damyanovo), Vratsa (in partnership with the municipality of Mezdra), Valchedrum (in partnership with the municipality of Yakimovo), Lom , Hisarya, Yambol, Saedinenie (in partnership with Stamboliyski municipality) and Krichim (in partnership with Perushtitsa).
- The installation was built and put into operation according to the project implemented by the municipality of Montana (the final package of reporting documents is in the process of being checked).
- The civil engineering works for the construction of the installations under the project, carried out by the municipalities of Harmanli and Plovdiv, have been completed.

- The implementation of the project with the leading municipality of Svilengrad has ended.

The contract for grant with the municipality of Sevlievo under the procedure "Completion of the project for implementation of a decentralized model for bio-waste management in one of the waste management regions in Bulgaria, including the construction of the necessary technical infrastructure - a separate collection system and a recycling facility - has been concluded of the collected bio-waste" (OPE 2014-2020), with a specific beneficiary municipalities of Sevlievo, Dryanovo and Suhindol from RWMA and a value of grant provided of BGN 1.8 million, has ended.

The project includes two composting installations on the territory of Sevlievo and Dryanovo and the allocation of a composting site on site for the municipality of Suhindol.

In order to complete the infrastructure for pre-treatment of waste and composting of bio-waste, according to the procedures for the direct provision of grants under priority axis 2 of the OPE 2014-2020 ("*Combined procedure for the design and construction of composting plants and pre-treatment plants of household waste", "Second combined procedure for design and construction of composting installations and installations for pre-treatment of household waste", "Design and construction of composting installations for separately collected green and/or biodegradable waste", "Design and construction of anaerobic installations for separately collected biodegradable waste", "Completion of the project for implementation of a decentralized model for bio-waste management in one of the waste management regions in Bulgaria, including construction of the necessary technical infrastructure - a system for separate collection and a facility for recycling of collected bio-waste"*) contracts were signed for the construction of 43 installations for composting green waste, 3 anaerobic installations and 19 installations for preliminary treatment.

After their construction and commissioning, 61 green waste composting facilities, 45 regional pre-treatment facilities and 4 anaerobic digestion facilities will operate in the country.

When choosing operations according to the cited procedures, requirements are laid down to comply with the principle of sustainable development, in which the reduction of greenhouse gas emissions and the limitation of climate change are sought when financing projects.

In addition, the implementation of measures for the construction of anaerobic installations for biodegradable waste will contribute to the implementation of measures in the National Action Plan on Climate Change for the period 2013-2020, as well as the goal of the Europe 2020 Strategy for 20% reduction of greenhouse gas emissions.

Under OPE, the so-called demonstration projects in the field of waste management aimed at creating a zero-waste society and raising public awareness of compliance with the waste management hierarchy, **are also being implemented.** By the end of 2020, 27 contracts have been concluded under the procedure.

According to the main indicator under the priority axis "Solid waste: Additional capacity for waste recycling", as of 31.12.2020 progress of 30,366 tons/year is reported.

Given the specificity of the operations carried out under priority axes 1 and 2 of the OPE 2014-2020, aimed mainly at the construction of ecological infrastructure, the overall progress achieved in terms of physical indicators will be reported at the end of the projects, due to the need for a high degree of completion or introduction in operation of the objects. The expectations of the OPE MA are that with the mobilization of all participants in the process and adequate organization of activities, the projects will be completed within the period of eligibility of costs (31.12.2023).

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.

Implementation:

An Ordinance on packaging and packaging waste was adopted (promulgated SG No. 85/06.11.2012 amended and supplemented SG No. 60/20.07.2018 amended and supplemented with PMS 420/31.12.2020).

Orders have been issued by the Minister of the Environment and Water, which determined the members of the packaging waste recovery organizations that should / should not pay a product fee for packaging for 2016, 2017, 2018, 2019.

As of 31.12.2020 permits have been issued to 5 organizations for the recovery of packaging waste: “Ecopack Bulgaria" AD, "Bulecopack" AD, "Eco Partners Bulgaria" AD, "Ecobulpack Bulgaria" AD and "Eco Collect" AD. Covered population in separate collection systems – 6,227,311 citizens.

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.

Implementation:

Pursuant to the provision of § 13a of the Final Provisions of the Law on Amendments and Supplements (LAS) to the Law on Local Taxes and Fees (LLTF) (SG, no. 101 of 2013, amended and supplemented, SG No 105 of 2014) until March 30, 2015, the Council of Ministers, together with the National Association of Municipalities in the Republic of Bulgaria, develops a methodology for preparing the draft estimate with the necessary costs for the activities and for the types of bases that serve to determine the amount of the fee for household waste under LLTF, and submits to the National Assembly a project to amend Art. 66 and 67 of the LLTF.

In connection with the implementation of the provision of § 13a, Order No. R-7/09.01.2015 of the Prime Minister of the Republic of Bulgaria was issued, in which the composition of a new interdepartmental working group for the development of the methodology for preparing the draft estimate was determined with the necessary costs, as well as a draft of the LAS of LLTF.

A proposal has been received from the Waste Management and Soil Conservation (WMSC) Directorate of the MoEW to supplement the implementation indicator "Acceptance of methodological guidelines", so that it acquires the form of "Acceptance of methodological guidelines and change of LLTF".

According to the Third NAPCC it was planned that the measure would be implemented in the period 2013-2014, as it was expected that the methodological guidelines would be adopted in 2013 and that the differentiated charging would be applied in the municipalities from 2015. In accordance with the changes in the LLTF, the implementation of the measure started in 2015.

In the LLTF (promulgated SG, issue 117 of 1997, amended SG, issue 88 of 2017, amended SG, issue 98 of 2018) changes have been adopted, effective from January 1, 2022, according to which the tax assessment of real estate or their book value is no longer a possible basis for determining the fee for household waste, and a new way of determining the the fee for household waste on the principle of bearing the costs by the causer or owner of the waste, the so-called "polluter pays" principle.

With the adopted changes in the LLTF, it is envisaged that the procedure for preparing and the model of the draft estimate, as well as the method of calculating the amount of the fee, will be determined in an ordinance of the Council of Ministers, which should be adopted by March 31, 2021. (Transitional and final provisions of the LAS of the LLTF. SG, issue 98/2018).

In this regard, and with the aim of fulfilling the regulatory requirements, a draft Ordinance on the procedure for preparing and the model of the draft estimate for the relative costs of carrying out the activities of providing the services for which the fee for household waste is paid is being developed in the LLTF (under Art. 62 of the LLTF) and for the method of calculating the amount of the fee when applying the bases adopted in the LLTF.

The bases for determining the fee for household waste defined in the LLTF are:

- For the service of collection and transportation of household waste and for the service of treatment of household waste in facilities and installations - an individually determined amount of household waste for the property, including through bags; amount of household waste for the property, determined according to the number and capacity of the necessary containers for collecting household waste and the frequency of their transportation, as well as the number of users of the service in the property;
- For the service of maintaining the cleanliness of the territories for public use in populated areas and settlements in the municipality - number of users of the service in the property and the expanded built-up and/or unbuilt area of the real estate.

In Art. 67, para. P of the LLTF it is also regulated that when accepting on the basis of "individually determined amount of household waste for the property, including through bags with a certain capacity and carrying capacity" or "quantity of household waste for the property, determined according to the number and capacity of the necessary containers for collecting the household waste waste and the frequency of their transportation" the municipal council, when determining the amount of the fee for household waste, may accept additional differentiation according to the type of household 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.

Implementation:

Towards the end of 2020, as a result of the three completed projects along the axis, two composting installations were built on the territory of Sevlievo and Dryanovo, an on-site composting site for the Suhindol municipality; installation for composting separately collected green and biodegradable household waste - Svilengrad and accompanying infrastructure; composting plant and plant for pre-treatment of mixed household waste, located on a site within the Sandanski municipality and serving all municipalities from the Regional Waste Management Association - Sandanski, Kresna and Strumyani municipalities. By the end of 2020, the installations under the projects implemented by the municipalities of Plovdiv, Maritsa, Montana and Petrich were also built and put into operation.

The CAW for the construction of the installations under the projects implemented by the municipalities of Harmanli, Zlatitsa and for the construction of 2 of the 4 installations under the project implemented by the municipality of Pazardzhik have also been completed.

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

Implementation:

The requirement for the design and operation of waste landfills was introduced by Ordinance No. 8/2004. With the introduction of installations for capturing and burning biogas in all regional landfills for the period up to 2020, 360 million nm^3 of methane were burned.

Measure 2: capture and flaring of biogas in old municipal landfills to be closed

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 Capture and burn biogas in all new and operating regional landfills.

Implementation:

Under the procedure "Reclamation of landfills, subject of a procedure for violation of EU law in case C-145/14", 54 contracts with a total value of grant provided of BGN 120.9 million were concluded with the municipalities: Nessebar, Byala (Ruse municipality), Dolni Dabnik, Ruen, Nevestino, Pavlikeni, Kovachevtsi, Elena, Devnya, Kula, Kostenets, Suvorovo, Zemen, Dolna Mitropolia, Stara Zagora, General Toshevo, Pordim, Chirpan, Malko Tarnovo, Galabovo, Vetrino (region Varna), Kavarna, Treklyano, Simitli, Pleven, Tryavna, Belogradchik, Gulyantsi, Blagoevgrad, Polski Trambesh, Tervel, Bratsigovo, Burgas, Koprivshtitsa, Ruzhintsi, Velingrad, Pomorie, Breznik, Dimovo, Roman, Chelopech, Batak, Byala (region Varna), Bobov Dol, Pernik, Sapareva Banya, Rila, Trun, Nikopol, Kocherinovo, Pirdop, Dupnitsa, Boboshevo and Belovo.

Of the above, 14 are the completed projects of municipalities: Bobov Dol, Bratsigovo, Byala (region Ruse), General Toshevo, Kavarna, Kovachevtsi, Kostenets, Kula, Nessebar, Pavlikeni, Ruen, Ruzhintsi, Simitli and Tervel.

The remaining 40 projects are in different stages of implementation.

The technical reclamation of municipal solid waste landfills in the municipalities of Pazardzhik, V. Tarnovo, Samokov, Provadia, Radomir has been completed and was implemented with funds from EMEPA and the State Budget of the Republic of Bulgaria Law.

Measures with indirect impact on the reduction of GHG emissions

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

Characteristics: There was interest in the energy potential of the landfills and it was studied in the landfills of Sofia (Suhodol), Plovdiv (Tzalapitza), Burgas and Ruse after 1999, and before that - in Sliven and Gabrovo. Municipal landfills are to be closed and the largest of them (20 landfills) will be inspected in order to select 5 where significant amount of generated methane may be expected. Audits will be carried out to identify their energy potential with a view to its possible utilization.

At the moment, there are no commissioned studies to investigate the energy potential of the biogas generated in landfills that are about to be closed.

Measure 2: measuring the amount (flow) of biogas captured in combustion systems

Characteristics: The effect from the introduction of measurement of the amount of recovered methane gas will be reflected in the reporting of GHG emissions. The Guidelince for National Greenhouse Gas Inventories (IPCC 2006) requires measurement and documentation for the purpose of recognition of the methane recovery.

As a result, an amendment and supplement to Ordinance No. 6 on the conditions and requirements for the construction and operation of landfills and other facilities and installations for the recovery and disposal of waste was adopted (issued by the Minister of the Environment and Waters, promulgated, SG No. 80 of 13.09.2013, in force from 13.09.2013).

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

Measures with direct impact on the reduction of GHG emissions

Measure 1: introduction of anaerobic stabilization of sludge with capture and burning of biogas in new plants and plants under reconstruction in settlements with over 20 000 population equivalent

Characteristics: A cost-benefit analysis for each project should justify or discourage the recovery of methane. Practice has shown that it is technologically feasible and economically viable to produce electricity from the biogas emitted from the methane tanks of large wastewater treatment plants (more than 50 000 PE) in order to cover the main share of the energy needs of the plants. An additional effect of the stabilization of sludge at UWWTP will be achieved as a result of the possibility to use the stabilized sludge in agriculture so as to recycle the nutritional substances, to preserve the fertile soils and to limit the use of agricultural chemicals and synthetic fertilizers

Indicator of implementation:

Number of plants with anaerobic stabilization of sludge

Expected effect:

Total reduction of 1 025 589 tonnes CO_2 eq. by 2020

Target value by year	**2016**	**2018**	**2020**
Number of plants with anaerobic stabilization of sludge	8	-	20

Implementation:

Within the priority axis, 41 projects with a total grant value of BGN 2,221,132,992 have been agreed upon by the end of 2020. Of these, 31 are in the process of implementation, and 10 are completed projects.

The majority of the funded projects under the axis are aimed at achieving the objectives set in Directive 91/271/EEC on the treatment of waste water from settlements and Directive 98/83/EC on the quality of water intended for human consumption. The main result is the implementation of measures for the collection, removal and purification of waste water, also as a result of the investments in the rehabilitation of the existing infrastructure, the efficiency of the water supply networks is increased and water losses are reduced.

The performance of the main indicators on the priority axis at the end of the reporting period is as follows:

- for indicator “Water supply: Additional population served by improved water supply” 99,547 persons are reported.
- For indicator “Waste water treatment: Additional population served by improved waste water treatment” 292,542 population equivalent are reported.
- As of 31.12.2020, according to the indicator "Built/rehabilitated/reconstructed WWTPs", a total of 10 units were reported. WWTP (Radnevo, Bansko, Tervel, Vratsa, Shumen, Vidin, Asenovgrad, Aytos, Primorsko and Varna - resort “Golden Sands"). Put into operation are also the reconstructed and expanded WWTP in the city of Dobrich and the built WWTP in the town of Elhovo. With the implementation of the projects for which financing contracts have been concluded, a total of 28 WWTP are expected to be built/reconstructed/rehabilitated .
- As of 31.12.2020, the water supply networks of Bansko, Dolna Mitropolia, Trastenik, the village of Bukovlak and the village of Yasen, Elhovo, Yambol, Stage I of the WSS network of Vratsa, the newly built and reconstructed WSS networks of the municipalities of Asenovgrad and Dobrich were put into operation.

The measures on the priority axis have an impact on the fight against climate change, adaptation and resilience to disasters. This principle is applied to the projects within the framework of which it is envisaged to treat the sludge and/or capture, burn and/or utilize the biogas released in the methane-tanks of the WWTP.

Measure 1. (Measure with indirect effect) Introduction measurement of the amount (flow rate) of captured biogas in combustion systems.

In the adopted in 2014 National Strategic Plan for the management of sludge from urban waste water treatment plants on the territory of the Republic of Bulgaria, the activity "Providing financing for technologies for co-generation of biogas, electricity and heat" is set with implementation deadline 2016 - 2020.

5.4.6. Agriculture Sector

5.4.6.1.General information of the Agriculture sector

In the year 2020 the sector agriculture contributed 12.51 % to the total of Bulgaria's greenhouse gas emissions (without LULUCF). The trend of GHG emissions from 1988 to 2020 shows a decrease of 55 % for this sector due to decrease in activity data.

CH4 emissions are 31% from of the total emissions in the sector in CO2-eq in 2020. A steady trend of emissions decrease is observed after 2004 due to reduction in animal numbers.

N2O emissions from the sector are also significant. The share of N2O emissions is 68% for the year 2020. The biggest share in these emissions has the Agricultural soils category with 93.07%. N2O emissions from manure management and field burning of agricultural residues are of an order of magnitude smaller.

Since 1988 the CH4 emissions from agriculture decreased by 69% and N2O emissions by 42%.

5.4.6.2.Overview of the state of the Agriculture sector

After Bulgaria's accession to the EU there were significant structural changes in the field of agriculture involving mainly reduction of the number of farms and increase in the average size of the land used by them.

The area with agricultural designation in 2020 is 5 227 902 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 2020, it amounts to 5 047 252 ha. Compared to the previous year, UAA has increased by 0.2 %.

Arable land includes areas where applies seed rotation, temporary meadows with grain and legumes grasses, fallow lands and greenhouses. In 2020 the arable land increased by 0.5 % compared to the previous year, occupying 3 477 514 ha. The relative share of arable land compared to the utilised agricultural area of the country remained constant compared to the previous year – 69 %.

Table 4.14. Arable land, used agricultural area and area with agricultural purpose for the period 2015 – 2020, ha

	2015	2016	2017	2018	2019	2020
Wheat	1 151 225	1 215 684	1 197 768	1 237 736	1 250 478	1 203 964
Barley	191 433	168 244	138 122	115 773	112 264	131 340
Rye and triticale	24 190	30 909	30 639	29 767	28 163	25 875
Oats	13 329	15 675	19 730	16 886	13 866	11 386
Maize	524 121	468 762	461 085	478 354	641 555	642 373
Other cereals	31 479	21 304	19 600	24 641	26 352	22 757
Sunflower	851 245	887 845	934 715	859 910	789 604	888 200
Tobacco	17 443	13 930	10 506	8 668	4 849	5 440
Industrial oil seed crops	225 847	196 958	181 067	203 397	158 305	120 055
Other industrial crops	53 755	55 144	58 848	46 640	57 878	65 209
Potatoes	9 449	10 109	12 909	14 611	11 177	11 524
Peas, kidney beans, broad beans, lentils and other legumes	24 617	33 928	78 389	103 445	42 167	24 989
Fresh vegetables	37 538	46 527	33 312	35 483	35 627	25 705

	2015	2016	2017	2018	2019	2020
Annual fodder crops	6 871	14 223	17 705	18 152	13 859	8 345
Meadows planted with legumes and cereals	94 682	108 793	117 951	118 619	124 333	127 286
Fallow land	235 150	191 537	159 959	149 683	149 636	161 565
Greenhouses	1 314	1 419	1 520	1 606	1 503	1 502
ARABLE LAND:	**3 493 688**	**3 480 991**	**3 473 825**	**3 463 370**	**3 461 615**	**3 477 514**
Family gardens	15 664	15 367	15 258	14 836	14 636	14 231
Orchards	68 543	77 625	84 320	88 829	90 221	91 339
Vineyards — pure crop	54 210	52 517	53 251	53 787	53 005	51 356
Combined perennial plants	8 522	8 222	8 220	8 312	7 813	7 120
Plant nurseries	2 202	2 602	2 304	2 100	1 699	1 703
Total perennial crops:	133 477	140 966	148 094	153 029	152 738	151 518
Permanent grasslands and meadows - fruit orchards	1368665	1384088	1392352	1399041	1 408 481	1 403 988
USED AGRICULTURAL AREA:	**5 011 494**	**5 021 412**	**5 029 529**	**5 030 276**	**5 037 470**	**5 047 252**
Uncultivated area	191 258	193 228	194 873	195 918	185 455	180 651
AREA WITH AGRICULTURAL PURPOSE:	**5 202 752**	**5 214 640**	**5 224 402**	**5 226 194**	**5 222 925**	**5 227 902**

Source: MAF, department "Agrostatistics"

In 2020, the total area seeded with permanent crops was 151 518 ha — by 0.8 % less compared to 2019.

Areas with plant nurseries and vineyards - pure crop also decreased compared to the previous year.

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 2020, the uncultivated lands decline by 3 % in comparison to the previous year, or up to 180 651 ha.

Fertilization of agricultural soils is a source of emissions of the greenhouse gas nitrous oxide (N2O). Over the recent years data have shown that the amount of applied mineral fertilizers constantly grows as well as the areas (until 2011) treated with mineral fertilizers, mainly unilateral nitrogen fertilization.

Table 4.15 Used amounts of mineral fertilizers – tonnes of active substance

Year	**Nitrogen** *tonnes*	**Phosphorus** *tonnes*
2012	235 386	20798
2013	258 856	11656
2014	322 004	28144
2015	341 608	27573
2016	365913	36050
2017	351120	29562
2018	339329	33280
2019	352486	33501
2020	364335	34441

Source: Eurostat

5.4.6.3.Objectives and priorities in the Agriculture sector

To achieve the objectives in area of Climate Change for the Agriculture sector 25 measures were developed and grouped in 2 priority goals and 6 priority axis. The proposed measures are aimed at reducing emissions from the major sources in the sector. The measures are consistent with the condition of the sector and the main priorities of the CAP for the period 2014-2020. One of the main challenges facing CAP is finding a solution to the increasingly aggravated production conditions in agriculture due to climate change and the need for farmers to reduce their share of greenhouse gases, to play an active role in mitigating climate change and to provide energy from renewable sources. In this regard there is an opportunity to promote the implementation of a number of measures in the field of direct 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.

5.4.6.4.Measures in the Agriculture Sector

<u>Priority axis 1</u>: REDUCTION OF EMISSIONS FROM AGRICULTURAL LAND

Measures with direct impact on the reduction of GHG emissions

<u>Measure 1: encouraging the use of suitable crop rotation, especially with nitrogen fixing crops</u>

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 6 356 Gg CO_2 eq

Implementation:

In the RDP 2014-2020, it is not planned to apply the direction "Introduction of crop rotation for soil and water protection", which during the program period 2007-2013 was part of measure 214 "Agro-ecological payments" of the RDP.

During the program period 2014-2020, organic production is stimulated by providing financial support under Measure 11 "Organic Agriculture" of the RDP. Payments under the direction "Organic crop production" continue even after the end of the 2014-2020 RDP period.

During the period 2015-2020, a Payment Scheme for agricultural practices that are favourable to the climate and the environment (green direct payments) was implemented in the scope of direct payments financed by the European Agricultural Guarantee Fund (EAGF).

Green Direct Payments are granted for eligible areas under the Single Area Payment Scheme (SAPS) provided that the green requirements are met on the holding, as far as applicable to its type and size. Farmers with arable land, perennial crops and permanently grassed areas are entitled to a green payment.

The green requirements are threefold:

- diversification of crops - for the arable land in the farm;

- preservation of permanently grassed areas;

- maintenance of 5% of the cultivated land as ecologically targeted areas (land left fallow; landscape features; strips of permissible areas at the edges of forests; areas with tree crops with a short rotation cycle; areas with catch crops or green cover; nitrogen fixing cultures).

Within the scope of scientific research projects from the Academy of Agriculture, the effect of the inoculation of leguminous crops with symbiotic nitrogen-fixing bacteria on the yield and export of nitrogen with the produce was tracked. The positive results for the complete cycle of nitrogen in the studied agro-ecosystem and the low emissions in the atmosphere are a basis for expanding the research. In model field trials, the efficiency, adaptability and plasticity of different crops and crop rotations are analysed annually.

149 contracts between AA and beneficiaries of the RDP with the subject of agrochemical research and consulting have been executed.

Evaluation of the effect

In 2014, under the RDP 2007 - 2013, the following areas were supported:

- for the introduction of crop rotation - 645,597 hectares;
- cultivated in a biological way - 33,899 hectares.

In 2015, the RDP 2007 - 2013 supported areas:

- for the introduction of crop rotation - 648,455 hectares;
- cultivated in a biological way - 29,849 hectares.

Under the direction "Introduction of crop rotation for soil and water protection" under the 2007-2013 RDP, the following have been stated:

2017 - 78,890.40 hectares

2018 - 74,391.64 hectares

2019 - 68,298.00 hectares

According to the direction "Biological plant breeding" from the RDP 2007-2013, the following have been declared:

2016 - 20,244.23 hectares

2017 - 14,213.21 hectares

According to the direction "Biological plant breeding" from the RDP 2014-2020, the following have been declared:

2016 - 91,490.65 hectares

2017 - 90,002.05 hectares

2018 - 83,672.65 hectares

2019 - 81,420.79 hectares

2020 - 73,623.16 hectares

The area eligible for support under the Climate and Environmentally Friendly Agricultural Practices Payment Scheme (Green Direct Payments) is as follows:

Campaign 2015 – 3,648,235 hectares

Campaign 2016 – 3,685,144 hectares

Campaign 2017 – 3,753,164 hectares

Campaign 2018 – 3,796,115 hectares

Campaign 2019 – 3,808,546 hectares

By the end of 2020, the target value for improved crop rotation has been exceeded. For the period 2015 - 2020, the areas on which practices favourable to the environment and the climate (including crop diversification) are carried out are within 3.6-3.8 million hectares per year. As of 2020, the target value for the areas cultivated in a biological way has been exceeded by 61,623.15 hectares.

The measure was exceeded, as the saved emissions for the period of implementation of the measure were 2 860 200 tons of CO_2 eq.

Measure 2: management of degraded agricultural land through:

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	500	1000	2500	2500
recultivated agricultural land	500	1000	2000	2500

Implementation:

For the period 2014-2016 for the implementation of practices aimed at controlling soil erosion for a total of BGN 13.168 million paid under the 2007-2013 RDP and 2014-2020 RDP, including:

- in 2014 - BGN 0.782 million;
- in 2015 - BGN 0.978 million;
- in 2016 - BGN 11.408 million.

The following funds are authorized under the "Soil Erosion Control" direction under the RDP:

2017 - BGN 11,962,533.27

2018 - BGN 10,784,893.92

2019 - BGN 10,548,566.19

For the period 2014-2016, under the 2007-2013 RDP and 2014-2020 RDP, activities aimed at controlling soil erosion on a total of 26,790 hectares were supported, including:

2014 - 1,554 hectares;

2015 - 1,196 hectares;

2016 - 24,040 hectares.

According to the "Soil Erosion Control" direction of the RDP 2007-2013, the following are stated:

2017 - 847,12 hectares

According to the "Soil Erosion Control" direction of the RDP 2014-2020, the following are stated:

2017 - 32,563.28 hectares

2018 - 31,718.59 hectares

2019 - 30,606.06 hectares

2020 - 15,605.50 hectares

In the RDP 2014-2020, under measure 10 "Agroecology and climate", the direction "Control of soil erosion" is provided. Activities related to the achievement of agro-ecological and climate goals are included in the direction, incl. aimed at limiting soil erosion.

Payments under the "Soil Erosion Control" direction continue even after the end of the 2014-2020 RDP period.

On an area of 2000 decares, the Agricultural Academy conducts experiments to improve agrotechnical solutions for increasing soil fertility and adapting technologies to the new characteristics of natural resources (change in phenophases, increased calamity and erosional degradation, etc.), provoked by climate change.

Evaluation of the effect

As of 2020, anti-erosion activities were carried out on 13,105.5 hectares more than the target value. The measure was exceeded, as the saved emissions for the period of implementation of the measure were 339 164 tons of CO_2 eq.

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

Implementation:

The reported values represent the number of persons consulted by the National Agricultural Advisory Service (NAAS) for the entire period, who received consultations on-site in the office and/or on-site in outsourced receptions and/or on-site in agricultural holdings. This number also includes farmers who were provided with advisory packages under measure 2 of the Rural Development Programme (RDP) 2014-2020, which also contain information under the measure from the NAPCC. The reported values for the number of trained farmers from the NAAS were obtained as a result of the number of persons trained within courses of 30 and 150 study hours under Measure 111 "Professional training, information activities and dissemination of scientific knowledge" of the RDP in 2014 and those trained in short-term courses and training seminars, within the Center for Vocational Training (VTC) at the NAAS. The programs contain topics/study hours through which the farmers were trained under the specified measure.

During the period 2015-2016, according to measure 111 "Professional training, information activities and dissemination of scientific knowledge" of the RDP, the Agricultural Academy delivered 920 hours of lectures and trained 300 farmers from the Sofia, Pernik, Kyustendil and Vratsa regions.

Visual training seminars are held annually for farmers on 35 demonstration fields organized by the AA. Within more than 240 open days in the period 2014-2020, the newest varieties of plants and breeds of animals in Bulgaria were presented, including foreign, as well as varieties with good adaptive potential, resistant to diseases and enemies, drought, high and low temperatures. During the reporting period 2014-2020, 192 scientific-practical conferences, seminars, symposiums, round tables were held. At these forums, innovations in agriculture, problems caused by climate change, sustainable use of natural resources, economics and marketing were discussed, including the opportunities and challenges related to the new CAP 2021-2027. The offices of applied science and research services at the Academy carry out studies of the needs of farmers and breeders, which are promptly transformed into training seminars, consultations and advice.

In total, for the period 2014 - 2020, reporting data indicate the following:

903 trained farmers (through the Vocational Training Center (VTC) of the National Agricultural Advisory Service);

10,361 farmers consulted.

Compared to the set indicators, in total for the period 2014-2020:

4,097 farmers less than the target value were trained;

8,361 farmers more than the target value were consulted.

Measure 2: introduction of water saving and energy saving irrigation technologies

Characteristics: The irrigation of agricultural land will have an increasingly important role in the parallel impacts of the agricultural sector development on one hand, and the effects of climate change on the other hand. The efficient and rational use of water is essential for the good condition of soil and for the reduction of the need to use extra energy in irrigation.

Implementation:

With an amendment to the 2014-2020 RDP, in 2016 it was possible under Measure 4.1 "Investments in agricultural holdings" to support projects involving investment costs for water-saving technologies in agricultural holdings, as no separate budget for investments was foreseen to introduce energy-saving irrigation technologies. Such investments can be supported within the budget under Measure 4.1 “Investments in agricultural holdings”.

The reported values of the indicator represent the number of persons trained by the NAAS under measure 111 of the RDP 2007-2013 and beyond, as well as the persons who received an A2B consulting package under sub-measure 2.1.1 "Consulting services for farmers and foresters" for young farmers or consulting packages under sub-measure 2.1.2 "Consulting services for small farms" under measure 2 "Consulting services, farm management services and farm replacement services" from the 2014-2020 RDP.

A reported value for the number of farmers consulted has been added, as consultations were provided in relation to the measure during the reporting period.

The number of projects supported by the end of 2020 under sub-measure 4.1 "Investments in agricultural holdings" with investments contributing to increasing the efficiency of water consumption in agriculture and to increasing the efficiency of energy consumption in agriculture and agrofood industry.

In the period 2017 - 2019, within the framework of scientific research carried out by the AA, simulation models were developed to support the making of informed decisions in the planning and management of irrigation canals; water-saving technologies (drip irrigation and mulching) are optimized for growing several crops in greenhouse and field conditions; the needs of water based on evapotranspiration and the influence of different moisture availability on the yield and the efficiency of using water for irrigation were estimated; research and analysis of energy costs in open and closed water distribution networks of irrigation systems have been carried out. The soil moisture, water reserve and elements of the water balance in the active soil volume were parametrized for different plantings in the period 2006-2020. Two-dimensional images of the distribution of root extraction in seven soil layers were prepared.

For the reporting period:

903 trained agricultural producers from the VTC of the NAAS;

9,503 farmers consulted;

11,994 consultations.

Supported projects with investments contributing to increasing the efficiency of water consumption in agriculture - 28.

Supported projects with investments contributing to increasing the efficiency of energy consumption in agriculture and the food industry - 117.

Performance for the period 2014 - 2020:

- 703 more trained farmers compared to the target value;

- 95 supported projects in excess of the target value.

<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.

Implemenation:

In the 2014-2020 RDP, no separate budget has been determined for the implementation of investments for the construction of facilities for extensive grazing animal husbandry. Such investments can be supported within the budget under Measure 4.1 "Investments in agricultural holdings".

The measures to support consultations and trainings related to the measures of the NAPCC laid down in the 2007-2013 RDP and 2014-2020 RDP are not provided independently, but in most cases are part of a consulting package or are presented as priorities for training . For this reason, no separate budget has been provided for consulting and training of agricultural producers under NAPCC.

The 2014-2020 RDP does not include a special measure specifically regarding investment support for extensive grazing animal husbandry. Farmers can receive financial assistance for such investments within measure 4.1 "Investments in agricultural holdings" of the Program.

In the RDP 2014-2020, no separate financial assistance is provided for extensive maintenance of pastures. Such support, regardless of the way pastures are maintained, is provided under measure 10 "Agroecology and climate" and measure 11 "Organic agriculture."

The reporting values of the indicator for the number of trained livestock breeders represent the persons trained by the NAAS under measure 111 "Professional training, information activities and dissemination of scientific knowledge" from the 2007-2013 RDP and beyond, trained through the VTC of the NAAS.

The Agricultural Academy works to create new varieties of leguminous and grain forage crops with the aim of creating new seed-producing crops, enriching genetic resources, incl. with genotypes with increased nitrogen-fixing potential, improving the condition of pastures and their nutritional value. In order to reduce the carbon footprint of animal husbandry, the influence of different forages and silages on the release of carbon oxides is studied.

Evaluation of the effect

For the period 2014-2020, 903 livestock breeders were trained.

Priority axis 3: IMPROVEMENT OF THE MANAGEMENT OF MANURE

Measures with direct impact on the reduction of GHG emissions

Measure 1: improvement of the management and use of manure

Characteristics: Production, processing and management of manure is one of the most significant sources of the greenhouse gas CH4 in agriculture. All activities aimed at storage and handling of manure should take into account both the type of manure - solid or liquid - and the technologies for gathering and processing. The investment support is crucial to motivate the farmers to build such expensive facilities.

The proposed budget for the measure is based on:

The average cost of building facilities for storage of manure for one farm with 50 cows is 130 000 BGN.

1000 x 130 000 BGN = 130 000 000 BGN

For training: 300 livestock holdings x 690 BGN = 207 000 BGN

Indicator of implementation:

Number of livestock holdings with improved storage;

Number of investment projects

Expected effect:

Total reduction of 1171 tonnes 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.

Implementation:

In the RDP 2014-2020, no separate budget has been determined for the realization of investments for the construction of manure storage facilities. Such investments can be supported within the budget under Measure 4.1 "Investments in agricultural holdings"

The measures to support consultations and trainings related to the measures of the NAPCC laid down in the 2007-2013 RDP and 2014-2020 RDP are not provided independently, but in most cases are part of a consulting package or are presented as priorities for training . For this reason, no separate budget has been provided for consulting and training of agricultural producers under NAPCC.

The funds agreed in 2014 under the RDP 2007-2013 for investments in the implementation of Council Directive 91/676/EEC regarding the protection of water from nitrate pollution from agricultural sources amount to BGN 29.3 million.

The 2014-2020 RDP does not include a special measure specifically regarding investment support for the construction of manure storage facilities. Farmers can receive financial assistance for such investments within measure 4.1 "Investments in agricultural holdings" of the Program.

The number of projects supported by the end of 2020 under sub-measure 4.1 with investments contributing to the stimulation of carbon storage and absorption in the agriculture and forestry sector is indicated.

The reporting values of the indicator for trained farmers represent the number of persons trained by NAAS under measure 111 "Professional training, information activities and dissemination of scientific knowledge" from the 2007-2013 RDP and beyond, as well as the persons who received an A2B consulting package under sub-measure 2.1.1 "Consultancy services for agricultural and forestry farmers" for young farmers or consultancy packages under sub-measure 2.1.2 "Consultancy services for small farms" under measure 2 "Consultancy services, farm management services and farm replacement services" from the RDP 2014-2020.

A reporting value for the number of persons consulted has been added, since during the reporting period the NAAS provided consultations in connection with the measure.

Evaluation of the effect

In 2014, 193 project proposals were approved under the 2007-2013 RDP for investments in implementation of Council Directive 91/676/EEC regarding the protection of water from nitrate pollution from agricultural sources.

Supported under the RDP 2014-2020 projects with investments contributing to the stimulation of carbon storage and absorption in the agriculture and forestry sector - 17.

7,831 farmers were consulted on the measure.

9,031 consultations were provided for the correct implementation of the measure.

The measure was exceeded, as the saved emissions for the period of implementation of the measure were 2,260 tons of CO_2 eq.

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

Implemenation:

In the RDP 2014-2020, no separate budget has been determined for the implementation of investments for the construction of manure processing facilities. Such investments can be supported within the budget under Measure 4.1 "Investments in agricultural holdings"

The 2014-2020 RDP measures to support consultations and training related to the measures of the NAPCC are not provided independently, but in most cases are part of a consulting package or are presented as priorities for training. For this reason, no separate budget has been provided for consulting and training of agricultural producers under NAPCC.

The 2014-2020 RDP does not provide for a special measure specifically regarding investment support for the construction of manure processing facilities. Farmers can receive financial assistance for such investments within measure 4.1 "Investments in agricultural holdings" of the RDP.

The reporting values for the number of trained agricultural holdings from the NAAS were obtained as a result of the number of trained persons within courses of 30 and 150 study hours under measure 111 "Professional training, information activities and dissemination of scientific knowledge" from the RDP 2007-2013 in 2014 and those trained in short-term courses and training seminars, within the framework of the VTC of the NAAS. The programs contain topics/study hours, through which the agricultural holdings were trained under the specified measure.

Evaluation of the effect

Total for the period 2014-2020:
903 trained farmers under the measure during the reporting period, or the trained farmers are 703 more than the target value.

Measures with indirect impact on the reduction of GHG emissions

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

Characteristics: The resource centre is an independent specialized unit under research institutions or NGOs that creates, collects and disseminates the results of applied research and publications, good practices and experience with low carbon practices for processing manure adapted to Bulgarian conditions and the needs of farmers. It should specify the main topics and approaches for training farmers, as well as provide recommendations regarding the measures to be developed and promoted.

For the reporting period, the measure was not implemented.

<u>Priority axis 4:</u> OPTIMIZATION OF THE USE OF PLANT RESIDUE IN AGRICULTURE

Measures with direct impact on the reduction of GHG emissions

<u>Measure 1: technical support for farmers for tilling soil/stubble</u>

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 CO2 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

Implemenation:

A Thematic sub-programme for the development of small farms has been developed for the RDP 2014-2020. It provides support to small agricultural holdings for investments in material assets (Submeasure 4.1.2. "Investments in agricultural holdings under the Thematic sub-programme for the development of small holdings" of the RDP 2014-2020).

In the 2014-2020 RDP, no separate budget has been determined for the implementation of investments in facilities and equipment for soil/stubble processing. Small and medium-sized farms can receive financial support within the budget of the investment measures included in the Thematic sub-programme of the 2014-2020 RDP.

Under the 2014-2020 RDP, 790 farms were supported for the purchase of agricultural machinery.

Evaluation of the effect

In 2016, 130 farms were supported for the purchase of machinery;

In 2017 - 218;

In 2018 - 155;

In 2019 - 154;

In 2020 - 133.

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.

Implementation:

The 2014-2020 RDP measures to support consultations and training related to the measures of the NAPCC are not provided independently, but in most cases are part of a consulting package or are presented as priorities for training. For this reason, no separate budget has been provided for consulting and training of agricultural producers under NAPCC.

The reporting value of the indicator during the period for the number of information and training events organized by the National Agricultural Advisory Service with scientific institutes, applied science organizations and other institutions and experts to support the transfer of knowledge and technology to farmers.

During the period, the NAAS also provided consultations related to the measure.

The reported value for trained persons includes persons trained by the NAAS (under measure 111 of the RDP 2007-2013 and beyond, as well as persons who received an A2B consulting package under sub-measure 2.1.1. or consulting packages under sub-measure 2.1.2 under measure 2 of the RDP 2014-2020) on topics related to the measure.

Evaluation of the effect

Performance for the period 2014 - 2020: 6,925 farmers were consulted; 8,422 consultations were provided. 8 information materials have been prepared. The total number of information meetings is 298, with the participation of 4,964 farmers (an average of 708 participants/year).

An average of 42 information meetings/year were held, which significantly exceeds 1 campaign/year.

For the period, the total number of farmers who received consultation and information under this measure was 11,889, which is 1,389 more than what was planned for the entire period.

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 CO_2 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

In the RDP 2014-2020, no separate budget has been determined for the implementation of investments related to the improvement of rice production techniques and technology. Financial assistance for such investments can be provided within the budget of Measure 4.1 "Investments in agricultural holdings" of the Program.

In the 2014-2020 RDP, there is no special measure specifically related to rice production. To make investments, rice producers can take advantage of the financial support under measure 4.1 "Investments in agricultural holdings" of the Program.

Priority axis 6: RAISING THE AWARENESS AND IMPROVING THE KNOWLEDGE OF FARMERS AND ADMINISTRATION REGARDING THE ACTIONS AND THEIR EFFECT ON CLIMATE CHANGE

Measures with indirect impact on the reduction of GHG emissions

Measure 1. (Measure with an indirect effect) Training of farmers by sub-sectors in agriculture - animal husbandry and crop husbandry

The trainings related to the NAPCC measures are not provided independently, but in most cases are part of a consulting package, which is why a separate budget cannot be set for the training of farmers under the NAPCC.

Consultations and advice to farmers on the necessary measures and ways to overcome the consequences of climate change are also provided by the Agricultural Academy.

The reported value includes the persons trained and consulted by the NAAS (under measure 111 "Professional training, information activities and dissemination of scientific knowledge" from the RDP 2007-2013 and beyond, as well as persons who received an A2B consulting package (Consulting package for young farmers) under measure 2 "Consulting services, farm management services and farm replacement services" from the 2014-2020 RDP) on topics related to the measure.

By the end of 2016, 1,144 farmers were trained under measure 111 of the 2007-2013 RDP and 205 outside of it.

A total of 7,237 people received advice from the NAAS under various consulting packages under sub-measure 2.1.2 "Consulting services for small farms" of the 2014-2020 RDP.

According to measure 10 "Agroecology and climate" and measure 11 "Organic agriculture" at the beginning of 2020, 642 documents for completed training have been provided.

By the end of 2020, 6,586 farmers have been trained in excess of the target value.

Measure 2. (Measure with an indirect effect) Trainings of the National Agriculture Advisory Service (NAAS) at national and regional level.

The trainings related to the NAPCC measures are not provided independently, but in most cases are part of a consulting package, which is why a separate budget cannot be set for the training of NAPCC experts. By the end of the period, 45 experts were trained.

5.4.7. Land Use, Land Use Change and Forestry Sector

5.4.7.1.General information on the sector

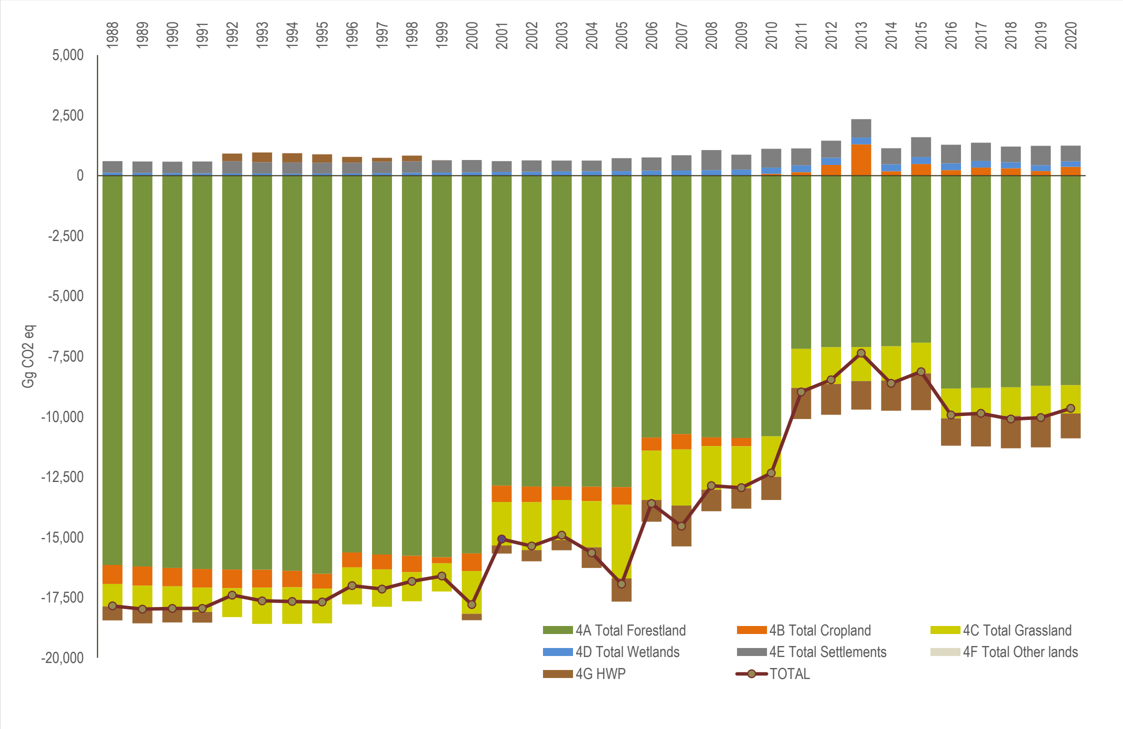
The sector of Land Use, Land Use Change and Forestry (LULUCF) is not addressed and no measures are proposed to reduce emissions or to increase the absorption of greenhouse gases in the previous two Action Plans on Climate Change (2000, 2005). Accounting for the activities in the sector is necessary in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

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 CO_2 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-CO_2 emissions in the LULUCF sector are the biomass burning, lime and urea application, as well as fertilisation.

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.

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 4.8)

Figure 4.8 LULUCF emissions and removals 1988 – 2020 CO_2eq.



The figure shows that the LULUCF sector is serving as a sink of greenhouse gases for Bulgaria. The category "Forest land" is a sink of CO2 during the whole time series. The contribution of the HWP, Cropland, Grassland and Other Land categories to the emissions/removals from LULUCF category is in both directions – as source and as a sink of emissions. All remaining categories (Settlements and Wetlands) are sources of CO2 emissions. The trend of net CO2 removals (CO2 eq) from LULUCF decreases by 45% compared to the base year. The main reason for the overall decrease of the uptakes of CO2 emissions from LULUCF is due to the drop in removals from category Forest land and the slight increase in emissions from CL, WL and SM categories. The key driver for the trend of emissions in LULUCF is the FL category. The major reason behind this dramatic decline is that in Bulgaria, since 2000, there is a constant increase in harvesting. Although the increase in the wood removals, the harvesting in these years is still below to what was planned to be harvested. In 2019 the harvesting is by 20% higher than 2010 as since 2012 it reaches the planned quantities according to FMPs. The increase in harvesting since 2011 is in response to the market demand and also to the fact that since the adoption of the new Forest Act (2011) there was an organizational change in the management of the forestry operations and in most cases the planned harvesting according to FMP is fulfilled. Although such an absolute increase in harvesting, the growing stock in Bulgaria is increasing during the years and it is expected to increase in the next 20-30 years.

Despite the decrease observed, the share of the removals from the total GHG emissions (in CO2eq) 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 – 15.7% from the total GHG emissions in CO2eq, while in the inventoried year the share is – 19.5%.

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.

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.

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, as follows:

- **Priority axis 1:** Increasing the absorption of greenhouse gases;
- **Priority axis 2:** Storage of carbon stocks in forests;
- **Priority axis 3:** Increasing the carbon sequestration potential of forests;
- **Priority axis 4:** Long-term carbon sequestration in wood products.

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 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.

5.4.7.2.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

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 CO_2 eq by 2020

Target value by year	**2014**	**2016**	**2018**	**2020**
ha utilized areas	120 ha utilized areas	130 ha utilized areas	120 ha utilized areas	120 ha utilized areas

Type of instrument:

Development of a programme for afforestation of non-wooded areas intended for afforestation in forest areas; Organization of afforestation campaigns; Publishing and distribution of explanatory leaflets.

Implementation:

The increase in forest areas has an important role in offsetting greenhouse gas emissions in other sectors. With the utilization of unforested areas for afforestation in forest territories, in the long term, the capacity of forests as an absorber of greenhouse gases will also increase.

During the period 2013 – 2020, 12,713.10 hectares of non-forested areas for afforestation in state forest territories provided for the management of state enterprises under Art. 163 of the Forests Act (FA) were afforested. (Territorial Directorate - TD)

Used funds for afforestation in the forest territories - state property, provided for management to state enterprises (SEs) under Art. 163 of the Forests Act (FA), during the period 2013 - 2019 incl.: BGN 15,338 thousand.

The forested bare areas in the state forest territories provided for the management of the SEs, according to the inventories of forest crops carried out in the period 2013-2019, were reported. (Territorial Directorate - TD)

During the period 2013-2020 incl. the state-owned enterprises under Art. 163 of the FA have spent, invested their own funds from their economic activity in the amount of BGN 107 million for afforestation activities (production of saplings, soil preparation, planting/sowing, fencing, replenishment, cultivation and inventory of crops, as well as to support natural regeneration).

Evaluation of the effect:

As a result, the saved emissions for the period are 295,375 t CO_2 eq.

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

Characteristics: The proposed measure corresponds to those with codes 223 and 226 under the Rural Development Programme. It is possible to apply under this programme with projects and to obtain appropriate funding. The needed financial resources are estimated on the basis of accepted mean values of investments. There is a potential for creating new forests outside the forested areas especially over the last two decades, when large territories of the agricultural land is not cultivated. The implementation of the measure will increase the absorption of greenhouse gases and thus contribute to climate change mitigation, to the protection of biodiversity and of the soil against erosion. To achieve the objective of the measure it is necessary, before undertaking afforestation activities, to make an inventory of the areas that are suitable for afforestation and to conduct applied scientific studies to evaluate their suitability and possibility for afforestation; appropriate recommendations for suitable species should be provided on the basis of the conditions of the places where they grow.

Indicator of implementation:

1400 ha afforested areas

Expected effect:

Total reduction of 35 112 tonnes 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.

Implementation:

With the implementation of the measure, an increase in the absorption of greenhouse gases is achieved, mitigating the effects of climate change, as well as preserving biological diversity and protecting the soil from erosion.

The afforested areas of interested parties - owners of afforested agricultural lands are reported according to the "new afforestation on agricultural lands" indicator, according to the inventories of forest crops during the period 2013-2020.

Funds used in the period 2013-2016 - BGN 12,443,850.

Forested areas for the period 2013-2020 - 1675.4 hectares

Evaluation of the effect

Forested 275.4 hectares above the target value.

The saved emissions for the reporting period are 42,019 tons of CO_2 eq.

<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 CO_2 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.

Implementation:

A proposal was made by the MRDPW to change the performance indicator "100 hectares of increased areas", so that it acquires the type "Improved park environment, landscaped areas and playgrounds (sq. m)".

For the period 2014-2016, the improved park environment, green areas and children's playgrounds with the support of the Operational Program "Regional Development" 2007-2013 amount to 4,726,757 million square meters, and the benefited from a renewed urban environment population is 4.4 million people.

According to the same measure, the instrument "General development plans" is implemented. Since 2015, based on the provision of § 123, para. 2 and para. 3 of the Transitional and Final Provisions to the Law on Amendments and Supplements to the Law on Territorial Planning (amend. SG, issue 98/2014), MRDPW financially supports the development of general development plans of municipalities (GPDM) on the territory of the Republic of Bulgaria by allocating the funds from the state budget, which are foreseen each year for the activity. There are currently 185 active agreements for financial support in the development of the GPDM, concluded between the MRDPW and the municipalities. The financial support will continue in the following 2018 and 2019. According to the information available in the MRDPW, 19 municipalities financially supported in this way have GPDM that have entered into force.

In the indicated reporting period - 2013 - 2017, 26 municipalities were financially supported in the same order by the closed Ministry of Investment Planning.

In addition, in accordance with the Law on the Organization of the Black Sea Coast, the Ministry has commissioned the development of GPD for five Black Sea municipalities, with three municipalities having effective GPDM. In 2017, two more municipalities are to be awarded the development of the GPD.

According to OPRD 2014-2020, 61 grant agreements (GA) worth BGN 380,805,596.27 were concluded for overall improvement of the quality of the urban environment -

construction and restoration of parks, green areas, playgrounds, physical elements of the urban environment, etc. By the end of 2020, 29 projects have been implemented.

2,488,571.21 square meters of undeveloped areas in urban areas were created or rehabilitated.

Measure 4: restoration and sustainable management of wetlands. protection and preservation of wetlands in forest areas, peatlands, marshlands

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

Implementation:

Within the framework of the priority axis, a total of 68 projects have been agreed by the end of 2020.with a total value of BGN 109,171,621 grant. Of these, 66 are in the process of implementation, and 2 are completed projects. Efforts in this sector are aimed at establishing a new effective management structure for the Natura 2000 network; planning and carrying out information campaigns for the Natura 2000 network; implementation of priority measures in wetlands; measures to improve the nature protection status of birds, preparation/updating of plans for restorative, maintenance and other nature protection measures for target species from the Natura 2000 network. A significant financial resource under the axis is also provided through the Community-Led Local Development (CLLD) approach to improve the conservation status of species from the Natura 2000 network in the territory of various local initiative groups (LIG).

Regarding measure 4 "Restoration and sustainable management of wetlands. Preservation and conservation of wetlands in forest territories, peatlands, swamps" from the sector "Land use, change in land use and forestry" of the Third NAPCC, it should be noted that during the reporting period, within the framework of procedure BG16M1OP002-3.015 "Implementation of priority measures in wetlands" under priority axis 3 of the OPE 2014-2020, the following 4 projects are being implemented:

- "Management of succession processes and improvement of the quality of the habitats of protected water-loving species in the wet zone in the natural reserve "Srebarna". The aim of the project is to improve the nature conservation status of species and types of natural habitats on the territory of the Ramsar site of international importance - wetland "Srebarna", falling into the Natura 2000 network and maintained reserve "Srebarna", through: restoring the water regime in Lake Srebarna, limiting the inflow of biogens and successional processes (measure 22 of the National Priority Action Framework for Natura 2000 for the period 2014-2020), construction of a "western channel", ensuring water flow in the lake, removal of silt, debris, detritus and cutting of reeds; implementation of conservation measures from the action plans of the curly-headed pelican, the great water bull and the little cormorant (measure 109 of the NPRD); monitoring the state of the ecosystem and the target species. The project is implemented by RIEW Ruse and is in the amount of BGN 8,532,373.00.

- Improvement of the water regime and management of successional processes in wetlands of international importance "Ropotamo Complex", "Poda Locality" and "Vaya Lake". The purpose of the project proposal is to improve the nature conservation status of species and types of natural habitats on the territory of protected areas BG0001001 "Ropotamo", BG0002041 "Ropotamo Complex", BG0000271 "Dairy-Poda" and BG0000273 "Burgas Lake" from the Natura 2000 network, falling into wetland areas "Ropotamo Complex", "Poda Area" and "Vaya Lake", designated as wetlands of international importance (Ramsar sites). The implementation of measures from the National Plan for the protection of the most important wetlands in Bulgaria is planned, including restoration of the water regime, limitation of the inflow of biogens and limitation of successional processes. The project is implemented by RIEW Burgas and is worth BGN 8,427,161.88. grant.

- Implementation of priority measures in the Ramsar site "Belene Islands Complex", Nature Park "Persina". The project aims to improve the conservation status of species and types of natural habitats in the Ramsar site "Belene Islands Complex", falling within the boundaries of the Persina Nature Park. The project proposal envisages mowing reeds and supporting the processes of opening water mirrors in the "Kaikusha" swamp; improving the conditions for control and management of incoming waters in the Persin Island wetland, by modernizing and automating the process of opening and closing the sluice gates, built under the project "Restoration of wetlands and reduction of pollution", financed by GEF, World Bank, executed by the MoEW; improving the conservation status of habitat 2340* - Pannonian intracontinental dunes, by limiting the spread of the invasive species Amorpha fruticosa. The project is implemented by the Persina Nature Park Directorate and is worth BGN 1,660,382.98.

- "Activities to improve the condition of Durankulak Lake and Shabla Lake wetlands". The implementation of the project proposal aims to contribute to: limiting the eutrophication processes, by reducing the amount of macrophyte vegetation of the "Durankulak Lake" and "Shabla Lake" protected areas; improvement of the condition and trends of the population of the red-breasted goose /Branta ruficollis/ and provision of optimal conditions for wintering in the "Durankulak Lake" and "Shabla Lake" protected areas; improving the state of water ecosystems on the territory of the two protected areas. The project is implemented by RIEW Varna and is in the amount of BGN 2,297,435.15. grant.

All four projects are expected to be completed in 2024.

Funds used until the end of 2016 under the LIFE+ program: BGN 777,409

Restored/preserved wetlands for the period 2013 - 2020 341.2 hectares.

The following projects were completed during the period:

- "Protection and restoration of 11 types of natural habitats near rivers and wetlands in 10 Natura 2000 sites in the Bulgarian forests" - model afforestations were made in 2 protected areas of Natura 2000 – Marten-Ryahovo and Reka Maritsa; 5 forest types were restored habitats by planting saplings of local species on an area of 80.6 hectares in 7 nature parks;
- "Restoration and conservation of alluvial forests of habitat *91E0 in protected areas under NATURA 2000 and model territories in Bulgaria";
- "Improving the nature protection status of priority natural habitat for conservation 91D0 - Swamp forests in protected area BG 0001030 "Western Rhodopes".

Projects in progress:

- "Implementation of priority measures in the Ramsar site "Belensky Islands Complex";
- "Conservation of the curly-headed pelican along the Black Sea-Mediterranean migration route";
- "Improving water management in the Persina and Kalimok swamps in Bulgaria";
- "Improving the environmental protection status of species and types of natural habitats on the territory of the Natura 2000 network, falling into the Golden Sands nature park - activities are being implemented to improve the environmental protection status of natural habitat types - 91F0 "Riverside mixed forests of Quercus robur, Ulmus laevis and Fraxinus excelsior or Fraxinus angustifolia along large rivers (Ulmenion minoris)", 3140 "Hard oligotrophic to mesotrophic waters with benthic formations of the genus Chara" and 3150 :Natural eutrophic lakes with vegetation of the Magnopotamion or Hydrocharition type";
- "Improving the nature protection status of natural habitat 6430 "Hydrophilic communities of tall grasses in the plains and in the mountain to alpine belt" subject to protection within the boundaries of the protected area BG 0000496 "Rila Monastery", in the territorial scope of the "Rila Monastery" monument.
- "Restoration and maintenance of priority natural habitats and species on the territory of Vitosha Nature Park".
- In order to improve the environmental protection status of peatland complexes (natural habitat 7140 "Transitional marshes and floating mobile peatlands"), a model for restoring the water regime of a peatland area above the village of Chuipetlovo has been prepared and implemented.

- DNP "Vrachanski Balkan" carried out a study of the macrophyte component in wetlands Natura 2000 - habitats 3150 Natural eutrophic lakes with vegetation - places with high herpetological diversity.
- "Vitosha" DNP carries out activities to protect and support the deposits of the willow (Salix pentandra L.), the only surviving deposit of which in Bulgaria is located on the territory of the park. A model has been developed for the sustainable management of peatlands in the "Vitosha" nature park, including a pilot project for restoring the water regime of a specific peatland section in the city of Konyarnika. To restore riverside habitat 91 EO Alluvial forests with Alnus glutinosa and Fraxinus excelsior, a total of 1200 container saplings of green, white and black alder and 400 container saplings of mountain ash were produced and planted along the Kurtova and Zheleznishka rivers.
- Development by BAS: Strategies for Enhancing Coastal Resilience - Toolkit: The scientists have conducted research in an area that is becoming particularly relevant with the start of funding for the RIA under the Green Deal of the EC. Future research may include ecosystem restoration for 'blue carbon' uptake and effects on coastal fortification (ecosystem services). As a result: 1) A system is developed for early warning of the consequences of sea storms; 2) Developed "green" solutions for coastal protection - underwater shafts

Evaluation of the effect

Restored/preserved wetlands for the period 2013 - 2020 – 141.2 hectares above the target value.

The emissions saved as a result of the implementation of the projects are 7,986 tons of CO_2 eq.

Measures with indirect impact on the reduction of GHG emissions

<u>Measure 1: development of a financial mechanism to support the activities for creation of new forests</u>

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).

With financing from the RDP - "Technical Assistance", a team of the Forestry University developed a "Methodology for determining the average standard prices for creating forests - afforestation and maintenance activities". The methodology is the basis of the financial mechanism for creating forests in the prepared sub-measures "8.1" and "8.3" of the RDP 2014-2020 and in the draft regulations establishing the procedure for their implementation.

<u>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</u>

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.

No activities were carried out under the measure. No such analysis has been prepared. During the period, the action is implemented by implementing effective control when changing the purpose of the forest territories, applying the existing legal framework.

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 CO_2 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.

Implementation:

3,464.8 hectares of new anti-erosion afforestation were carried out, including 2013 – 436.1 hectares; 2014 – 542.1 hectares, 2015 – 454.4 hectares, 2016 – 579.9 hectares, 2017 – 520.8 hectares, 2018 – 487.4 hectares and 2019 – 444.1 hectares.

24.5 hectares of buffer forest belts have been restored. 5.4 hectares of new forest buffer forest belts were created. In order to maintain existing ones, cultivation cuttings were carried out on 10.2 hectares and sanitary cuttings on 15.7 hectares.

In 2014, EFA approved the document "Instructions for the management of the field protection belts". With the 2015 amendment to Art. 36, para. 3 of Ordinance No. 8 for felling in forests, restrictions have been introduced related to the maintenance of field protection belts.

During the period, no special program was developed for the restoration and creation of new field protection belts.

Funds used for the period 2013-2016 for anti-erosion afforestation - BGN 15,449,440.

By the end of 2019, 24.5 hectares of buffer forest belts were restored and 5.4 hectares of new belts were created.

For the period 2013-2019 incl. anti-erosion afforestation was carried out on 3,464.8 hectares.

Evaluation of the effect

The saved emissions for the reporting period are 82 759 tons of CO_2 eq.

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.

Implementation:

In the state forest territories, a forest certification process is underway, within which the forests with high conservation value are determined and measures and activities are foreseen according to the certification standard for their determination and sustainable management.

A practical guide "Identification, management and monitoring of High Nature Value Forests (HNVF) in Bulgaria" (June 2016), prepared by WWF Danube-Carpathian Program Bulgaria, has been developed and is being implemented.

By orders from 2016 of the Minister of Agriculture and Food, approximately 109,000 hectares of state forests – 7% of the habitats in Natura 2000 areas – have been designated as forests in an old age phase.

As of 31.12.2019, forests in the old age (FOA) phase occupy an area of 109,300.3 hectares of state forest territories in NATURA 2000 in Bulgaria. This area is nearly twice as large as the area of declared reserves in the country. In the municipal forest territories, in NATURA 2000, FOA are currently declared on the territory of the municipalities of Botevgrad, Sevlievo, Kyustendil and Harmanli - a total of 579.8 hectares. There are currently no private forests designated as FOA.

In 2020, by order of the Minister of Agriculture, Food and Forestry, another 2,085 hectares of forest territories, managed by the state, were designated as old-age forests.

<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.

Implemenation:

The amendment of the Regional Development Plan of March 2020 guarantees high quality of strategic documents for regional and spatial development. Requirements for the content of the strategic documents for regional and spatial development are set out in the RDP, which also aim at their compliance with the National Strategy and Action Plan for Adaptation to Climate Change of the Republic of Bulgaria, respectively, with the Third NAPCC.

According to Art. 8, paragraph 2 of the new RDP, the new document for strategic planning of regional and spatial development at the municipal level, is the integrated municipal development plan (IMDP). In the requirements for the structure and content of IMDP, listed in Art. 13, para. 3 of the RDP, it is expressly required that the plan contains measures to limit climate change and measures to adapt to climate change and to reduce the risk of disasters.

Observance of these measures in the implementation of IMDP will indirectly contribute to the preservation and improvement of the state of urban and suburban parks.

<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.

Implementation:

2 applied science topics were developed and implemented: "Development of a methodology for determining the risk of forest fires on the territory of the country" and "Development of a scheme for deploying means for monitoring and detecting fires in the forest territories of the country with a view to building a unified system for monitoring and automatic detection of fires" .

A Program for the Protection of Forests from Fires has been developed in implementation of the 2014-2023 Strategic Plan for the Development of the Forest Sector.

In 2015, 17 automated fire monitoring and detection systems were built in the SE and DNP, 14 of which were financed under the RDP 2007-2013 and 3 under the OPE 2007-2013.

Purchased equipment and carried out ongoing maintenance of road infrastructure with a total value of BGN 14,000,000.

Projects carried out during the period:

- Information campaign "Stop forest fires - learn how" -
- TGS Bulgaria - Serbia Project CB007.1.31.189 "Increasing the capacity for risk management in large forest fires in the cross-border region - coordination, training, monitoring, innovative methods and technologies" with an approved budget of BGN 617,401.18. - the utilized financial resources are BGN 586,705.85, incl. delivery of specialized pickup trucks for extinguishing forest fires - 2 pcs.; delivery of an aerial surveillance system - 1 minibus, 2 multicopters and 1 unmanned aircraft.
- TGS Bulgaria - Turkey Project CB005.1.11.005 "Increasing the operational capacity for forest fires and improving disaster prevention" with an approved budget of 595,086.21 - the utilized financial resources are BGN 563,572, incl. delivery of specialized pick-ups for extinguishing forest fires - 3 pcs.; delivery of personal protective equipment - 36 pcs.
- TGS Bulgaria - Turkey Project CB005.1.11.006 "Intelligent strategic transnational development for response in the event of large-scale natural and man-made hazards

and disasters - IseC with an approved budget of BGN 526,544.21 - the utilized financial resources are BGN 484,225, including. delivery of an aerial surveillance system - 1 minibus, 2 multicopters and 2 unmanned aircrafts; delivery of a specialized vehicle for rapid intervention (pickup).

Priority axis 3: INCREASING THE POTENTIAL OF FORESTS TO CAPTURE CARBON

Measures with direct impact on the reduction of GHG emissions

Measure 1: increasing the density in the listed natural and artificial plantations

Characteristics: A first step can be the assignment of scientific studies followed by amendments to the regulations. Activities will commence on this basis with the view of increasing the density in the listed plantations by supporting their natural regeneration or using other methods. The information on the areas and the necessary funding is provided by EFA.

Indicator of implementation:

3500 ha plantations with density increased by at least 20 %

Expected effect:

Total reduction of 16 720 tonnes 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.

Implementation:

The measure takes into account the afforestation in forest areas managed by the SEs - in rows and the replenishment of crops, according to the inventories of forest crops in the period 2013-2020, as well as the support for natural regeneration.

The measure has been over-implemented, as according to the data of the Ministry of Agriculture and Forestry for the period 2013-2020 - areas of plantations in forest territories - state property, provided for management of forested areas with increased density - 38,552.2 ha, of which - 3,241.7 hectares - by replenishing crops and 35,310.5 hectares - by supporting natural regeneration.

Evaluation of the effect

For the period 2013-2020, the area of plantations with increased density exceeded the target value by 36,552.2 hectares

The saved emissions for the reporting period are 191 335 tons of CO_2 eq.

Measures with indirect impact on the reduction of GHG emissions

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

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

Implementation:

Regional forestry systems have been developed for the management of coppice oak forests for 4 state-owned enterprises (SEs) under Art. 163 of the Forestry Act. Guidelines for the management of coppice oak forests have been approved for the area of 3 SEs.

Corresponding regulatory and administrative changes have been made in Ordinance 8 on felling in forests, aimed at maintaining the mixed nature and age structure of forests with the preservation and tolerance of valuable and sustainable forms of local, rare and endangered tree species when carrying out plantation and regeneration felling.

Expected results: increased vitality, productivity and sustainability in the uplands, increased share of natural plantations with different age and complex structure and preserved genetic fund, biological diversity of valuable tree species.

The funds used from the EFA budget are BGN 27,000.

Completed three applied science topics:

- "Transformation of coniferous crops created in the area of broad-leaved tree species, in plantations of natural seed origin";
- "Regional silvicultural systems for the management of coppice oak forests in the territorial scope of the NCSE";

"Regional silvicultural systems for the management of coppice oak forests in the territorial scope of the NWSE, SWSE and SESE".

Measure 2: supporting the increase of the percentage of certified forests

Characteristics: The measure aims to improve forest potential to capture carbon through implementation of the criteria for certification of forests - sustainable management of forest ecosystems, preservation of forest litter and old trees, independent monitoring and control over forest management processes, minimization of opportunities for illegal logging. The information of the areas and the necessary funding is provided by the EFA.

Implementation:

By the end of 2019, the certified forest areas in Bulgaria have a certificate from the Forest stewardship council - FSC. According to the FSC annual bulletin (Facts & Figures, December 4, 2019), the area of certified forest areas as of December 2019 is 1,454,068 hectares, equal to 34% of the total forest area in the country, and the certified units are 25. The area of the certified state forest territories managed by the state enterprises under Art. 163 of the FA, is 1,438,694.9 hectares, equal to 50% of the total territory managed by them in the country, and the certified units are 25. For comparison - the total area of certified forests as of 31.12.2013 is 424,860 hectares, of which 422,930 hectares are state forest territories.

By the end of 2019, 67% of the target value set for 2020 had been achieved.

Measure 3: development of good practices for the establishment and management of intensive forest crops for biomass production and establishment of standards for residual biomass after logging

Characteristics: The plantations for accelerated production are not managed as a forest under the Forestry Act, so the environmentally sound management of such cultures requires relevant methodological guidelines in the form of guidance or "best practices". The development may be assigned pursuant to art. 4 of Ordinance № 8 of 5 August 2011 on forest logging.

Implementation:

During the reporting period, work was carried out on several tasks related to establishing the possibilities for biomass extraction from forest crops:

- "Creation of an experimental culture of perspective clonal species of poplars (Populus sp.), with the aim of performing a complex assessment of their potential for biomass production" - implemented by the Institute of Forestry at the BAS;
- "Determination of the usable potential of forest wood biomass in Eastern Bulgaria and technologies for its extraction and processing. Forest wood biomass market" - implemented by the Testing Station for Oak Forests (TSOF) in Burgas;
- "Selection and propagation of local black, white, grey poplars" - implemented by the test station for fast-growing forest tree species (TSFGFTS) Svishtov;
- Project "Testing of poplar branches from EU member states for biomass production /fast-growing species/";
- In 2020, an applied science topic was adopted by the EFA Expert Council: "Functions and tables for the above-ground woody biomass of fast-growing deciduous species at an early age", developed by a scientific team of the Forest Institute at the BAS. The development allows, by measuring average values of diameter and height for a given crop or for individual trees, and comparing the corresponding values in the tables, to obtain the weight of the absolutely dry wood mass for both harvested and standing trees. The tables have been developed by differentiating by individual branches, depending on whether seed or shoot saplings are harvested and taking into account crop density. They also allow the calculation of stem biomass and branch biomass separately. With the application of the proposed tables in practice, the interest of landowners in creating intensive crops of fast-growing tree species can be increased.

For the period 2013-2020, 5 applied science developments were carried out and 7 experimental crops were created in different parts of the country.

Measure 4: development of a part in the new strategic documents concerning the forestry sector that involves measures aimed at improving the role and the contribution of forests to carbon accumulation

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

Priority axis 4: LONG-TERM CARBON STORAGE IN WOOD PRODUCTS

Measures with indirect impact on the reduction of GHG emissions

Measure 1: extend the use of wood products as substitutes for products from non-renewable, polluting and energy-intensive materials

Characteristics: Initiatives by stakeholders in the forestry sector – state and scientific institutions, representatives of the forestry business, branch organisations and NGOs – concerning the advantages of wood products. The measure is related to training and awareness raising of citizens, including with respect to the effective use of wood products.

Implementation:

In the performance of the project: "Regional Policies for Sustainable Bioenergy" - BIO4ECO, funded by the EU's INTERREG Europe program and launched in 2016, is a campaign to increase awareness and engagement of society and business on the benefits of using wood and wood products to preserve CO_2, a presentation was prepared and published on the EFA website with an analysis of the possibilities of using biomass from forests in Bulgaria as RES and good practices in this area from several EU countries are presented. In the "Forests" sector, according to the adopted National Strategy and Action Plan for adaptation to climate change, a strategic goal "Improving the potential for sustainable use of forest resources" is foreseen, which aims to stimulate the long-term use of wood products and expand its use as a building material.

Conducted a campaign to increase awareness and engagement of society and business about the benefits arising from the increased use of wood products; a presentation published on the EFA website with an analysis of the possibilities of using forest biomass as RES and presented good international practices; held expert meetings with the World Bank team developing the National Strategy and the Action Plan for Adaptation to Climate Change, in order to discuss the possibilities for expanding the use of wood products.

<u>Measure 2. (Measure with indirect effect) Development of a section in the new strategic documents for the forestry sector, including measures aimed at improving the role and contribution of forests to increase carbon sequestration</u>

The National Strategy for the Development of the Forestry Sector in the Republic of Bulgaria NSDFSRB (2013-2020) and the Strategic Plan for the Development of the Forestry Sector in Bulgaria SPDFSB (2014-2023) have been prepared in sync with the NAPCC.

In 2020, monitoring was carried out and an evaluation of the results of the implementation of the 2013-2020 NSDFSRB was carried out.

Within the project: "Regional policies for sustainable bioenergy" - BIO4ECO, financed under the INTERREG Europe program of the EU, a National Action Plan for Energy from Forest Biomass 2018-2027 was developed and adopted, formulating 6 priorities with specific goals and activities for sustainable production and efficient use of forest biomass as a renewable energy source; reducing air pollution; strengthening the legal and political framework to ensure the sustainable development of energy from forest biomass strengthening scientific research.

Used financial resources for the period 2013-2016 - a total of BGN 132,000, including:

- Preparation of a Strategic Plan for the development of the forestry sector in the Republic of Bulgaria 2014-2023 - BGN 126,000.
- Publication of the brochure "National strategy for the development of the forestry sector in the Republic of Bulgaria 2013-2020" - BGN 6,000

The National Strategy for the Development of the Forestry Sector in the Republic of Bulgaria 2013-2020 (NSDFSRB) and the Strategic Plan for the Development of the Forestry Sector 2014-2023 (SPDFS) were developed.

Adopted "National Action Plan for Energy from Forest Biomass 2018-2027", supplementing the operational goals set in the Strategic Plan for the Development of the Forestry Sector.

5.4.8. Transport Sector

5.4.8.1.General information on the Transport sector

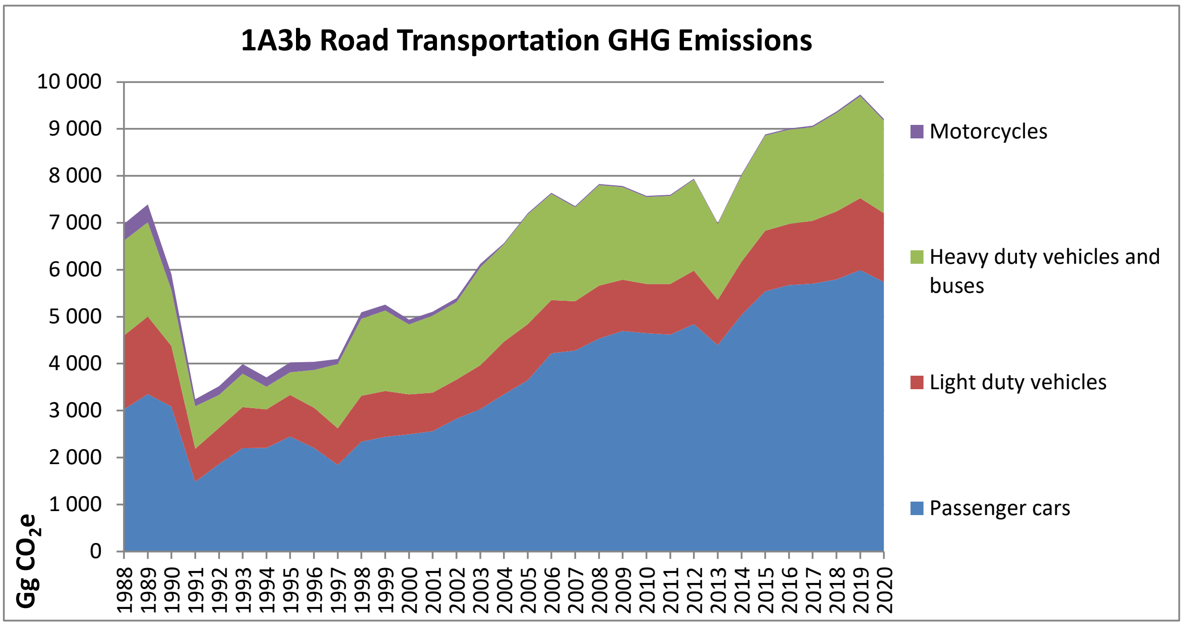
The analysis of the development of the Bulgarian transport sector over the recent years shows significant structural changes and a tendency for growing share of road transport in the overall transport activity.

Following a steep decline after 1989 as a result of the political and economic crisis, a distinct uptrend of GHG emissions can be observed ever since 2000. That change came as a result of the economic recovery, ushered in by the introduction of a currency board regime in 1997 and rigorous economic and political reforms. The main contributing gas is CO_2, followed by CH_4 and N_2O.The CO_2 emission trend is directly related to fuel consumption and therefore shows a decrease in the period 1990-2000. However, in line with the reviving economy, CO_2 emissions grew steadily until 2006. Afterwards, a period of stabilization took place until 2009 when a slight drop in emissions was observed, 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), which resulted in a decrease of emissions, but the drop was compensated after 2014. In 2015 the fuel consumption increased significantly and since then it grows steadily.

Overall, the GHG emissions from road transport increased by 32.1% compared to the base year level of 6 973Gg CO2e and reached 9 213 Gg CO_2e in 2020.

The most significant contributor to GHG emissions were passenger cars, followed by heavy-duty vehicles, light-duty vehicles and motorcycles and mopeds. As it can be observed in the following figure, in 2020 passenger cars accounted for 62.3%, light-duty vehicles were responsible for 15.9%, and heavy-duty vehicles (incl. buses) for 21.4% of road transport GHG CO_2e emissions; and the share of passenger cars was clearly increasing over the time series. The remaining 0.4% were shared among mopeds and motorcycles.

Figure 4.9: Emissions allocated to vehicle categories for the period 1988-2020



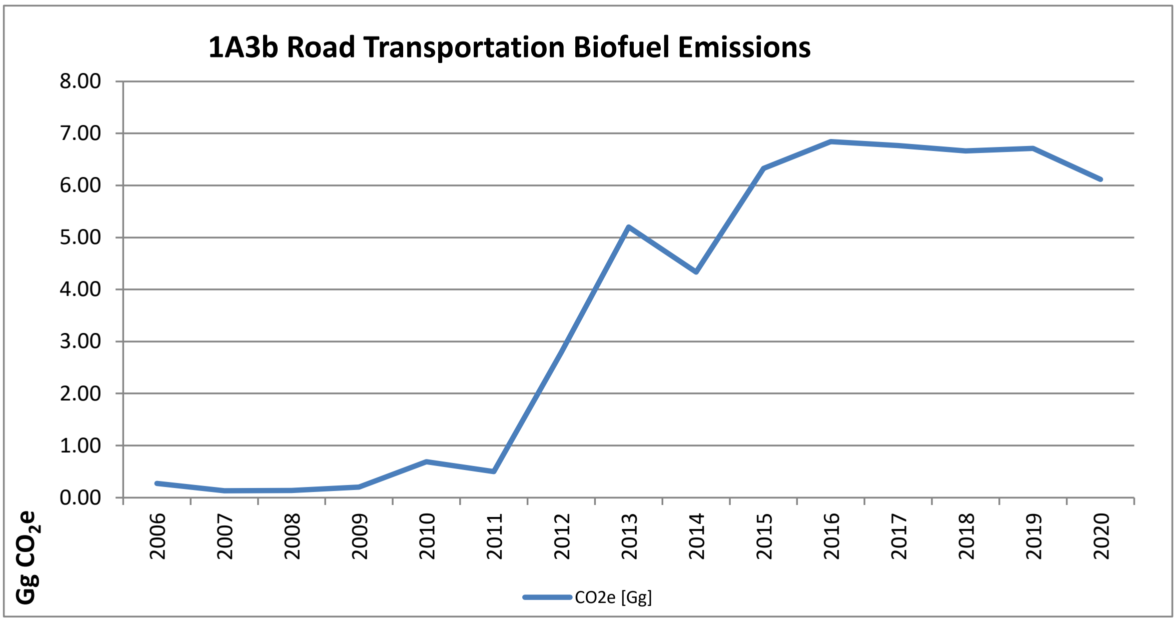
Source: NIR2022

Whereas CO_2 emissions were closely linked to fuel consumption, CH_4 and N_2O emissions were considerably impacted by engine technology and did not follow the trend in the fuel consumption. As it can be observed in the following figure, N_2O emissions and implied emission factors tend to fluctuate for the period of the inventory following the introduction to the market of various engine technologies implementing EURO emission standards and various fuel quality standards (e.g. lead and sulphur content). However, for N_2O emissions there is an upward trend mostly due to the increase of diesel vehicles share.

CH_4 emissions plummet, following Bulgarian gasoline consumption pattern, as the main source of those emissions proves to be pre-EURO gasoline passenger cars. After the crisis in the early 90s, a slight increase in the period 1992 – 1995 can be observed, followed by downward trend. Ultimately, compliance with strict Euro emission standards significantly influences CH_4 emissions and results in decreased levels of methane.

Bulgarian market transport diesel and gasoline contain a small percentage of biofuels which are reported in the Energy balances as biofuels for blending. The reporting approach subtracts the amounts of biofuels for blending from the total amounts of road diesel and gasoline. A steep upward trend can be noticed due to an increase in biodiesel consumption since 2011. For the 2020 submission biofuel consumption was revised in order to account for fossil carbon content in biodiesel resulting from methanol use.

Figure 4.10 Emissions by biofuels from Road Transport for the period 2006-2020



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[13] which shows that while other sectors can achieve greater reductions, the transport sector is expected to reduce its greenhouse gases (GHG) by at least 60% by 2050 compared to 1990 levels, however it remains a significant and growing source of GHG. The aim of the transport sector is to reduce GHG emissions by about 20% below their level in 2008 by 2030. Given the significant increase of transport emissions over the past two decades, this reduction would nevertheless lead them to a level higher by 8 % than the level in 1990.

According to Decision 406/2009/EC (Efforts Sharing Decision) Bulgaria is assigned an individual target allowing it to increase the emissions from sectors outside the ETS, such as the transport sector, with 20% by 2020 compared to their level in 2005. Although this individual commitment facilitates the national objectives in the course of time the Transport sector undoubtedly requires drastic changes in order to achieve stability. One of the biggest challenges is to reduce dependence of the transport system and the Bulgarian economy on oil.

In this regard, the main measures in the sector should be directed at achieving an optimal balance in the use of the potential of different types of transport.

5.4.8.2.Measures in the Transport sector

The main measures in the sector are divided into four priority axes as follows:

- **Priority axis 1:** Reducing emissions from transport
- **Priority axis 2:** Reduction of fuel consumption
- **Priority axis 3:** Diversification of transportation
- **Priority axis 4:** Informing and educating users

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

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

Implementation:
According to OPRD 2007-2013, 1,224.4 km of roads were rehabilitated under 85 projects worth BGN 865,831,816.55. According to OPRR 2014-2020, 36 GA worth BGN 410,481,053.36 were concluded for the rehabilitation and modernization of existing road infrastructure. By the end of 2020, 18 projects were completed, which reconstructed or modernized 328.1 km of roads.

Evaluation of the effect
The measure was executed.

<u>Measure 2: introduction of intelligent transport systems along the national and the urban road network</u>

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

Implementation:

Intelligent transport systems (ITS) cover a wide range of technical solutions designed to improve transport by improving mobility and increasing safety in road traffic. Telematics (a combination of telecommunications and informatics) uses advanced technologies to meet transportation needs.

According to priority axis 1 "Sustainable and integrated urban development" of OP "Regional development 2007 - 2013", projects were implemented for the modernization of public transport in seven large cities of Bulgaria: Sofia, Burgas, Plovdiv, Varna, Stara Zagora, Ruse and Pleven. Their main goal is to ensure accessibility and convergence through efficient and sustainable urban transport systems, including the use of intelligent transport systems, as well as improving the ecological situation in cities. 7 intelligent transport systems have been introduced.

According to OPRD 2014-2020, 6 GA for urban transport have been concluded, which include the introduction of intelligent transport systems in the cities of Sofia, Ruse, Stara

Zagora, Pernik, Kazanlak and Dupnitsa. By the end of 2020, the activities on the introduction of intelligent transport systems under 3 of the 6 projects have been completed.

Information about projects:

- Project "Integrated urban transport of Burgas" - ITS:

Indicator "Intelligent transport systems introduced" under the project "Integrated urban transport of Burgas", implemented until 2018. An integrated system for control and management of public transport was introduced, which allowed to achieve a high level of service and accuracy of the service. It includes the following elements:

- Integrated ticketing system;

- System for informing passengers in real time;

- Public transport management and control system;

- System for ensuring the priority of urban transport;

- Video surveillance system (CCTV).

The introduced systems contribute to the optimization of the city transport network by allowing passengers to use different bus lines with a unified electronic ticket. The electronic ticketing system offers opportunities for upgrading by integrating tickets used by different transport operators, introducing promotional fares and easily combining with other services in an urban environment such as bicycle rental, parking and others. The city's video surveillance system now includes more than 1,200 cameras for monitoring the urban environment, of which about 500 at transport locations, or in the buses of the urban transport of Burgas.

Another important step towards digitalization of services was the integration of mobility information in the Smart Burgas Integrated City Platform in 2019, as well as the implemented pilot project for the introduction of other mobile and web applications related to:

- Tracking of available spaces in the paid street parking zone "Blue Zone-Burgas";

- Offering additional options for paying for parking time via the Internet.

In recent years, the municipal transport scheme has been updated by introducing rapid bus lines and a rapid bus corridor. The network of bus and trolleybus lines of the urban transport scheme of the city of Burgas has a total length of 485 km. The backbone of the scheme are two fast bus lines connecting the residential quarter "Meden Rudnik" with residential quarter "Izgrev" and residential quarter "Slaveykov". The so-called “feeder” bus lines to serve the local part of the quarters more efficiently. In order to further reduce traffic jams, improve safety and transport service, the intercity bus lines have been removed from the central city and the route of the rapid bus lines. A system has been introduced to ensure the priority of public transport along the route of the fast lines in order to reduce the delays of public transport, as well as to reduce traffic jams.

A zone with a limit of up to 30 km has been introduced in the city with the scope of the central part of the city and part of the residential quarter “Vazrazhdane”.

- Modernization of urban transport in the Municipality of Vratsa - integrated transport management system (for electronic billing and real-time passenger information):

Each vehicle will be equipped with a video surveillance system. Trolleybuses and electric buses will be equipped with information boards (VMS) providing information from the outside (electronic with the possibility of information in Bulgarian and English) - one information board on the front, on the sides and on the right, showing the name of the route and the number of the line (and one at the back – showing the line number). The information board will also be equipped with a suitable voice announcement system for the stops (loudspeakers at each door).

The new vehicles will introduce an integrated transport management system (for electronic billing and real-time passenger information) and collision avoidance systems based on artificial vision. 22 intelligent systems for electric buses and trolleybuses will be delivered and installed to avoid collisions and assist drivers when moving and manoeuvring in urban environments.

- Project "Integrated urban transport of Pernik" - ITS:

The implementation of the activity envisages delivery and introduction of remotely replaceable electronic information boards (EIB) at public transport stops. With the implementation of the EIB at the public transport stops, its attractiveness for citizens increases in synergy with the other investments foreseen under the project. The time saved by the implementation of the control system is directly proportional to the number of stops that are equipped with the information boards.

The system aims to offer better awareness and care to public urban transport passengers, making it more attractive and thus increasing its usability. It ensures the transmission of information from the Central Dispatch Center to all EIBs at the stops regarding the number of arriving buses, the scheduled arrival time, the time remaining until arrival, possible delays, as well as other information useful for passengers. EIBs display this information in a way accessible to passengers.

In the Dispatch Center, a standard end interface receives the information provided by the Urban Transport Control System and transmits it to the EIB end interfaces. The GSM communication medium is used for connection between the end interfaces. It provides the connection between the panel end interfaces on the one hand and the Dispatch Center end interface on the other.

The system consists of: 70 electronic boards for 70 stops that display useful traffic and other information in real time.

Evaluation of the effect

The measure was executed.

<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 CO_2 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

Implementation:

Biofuels are fuels produced from biomass and used in transport. They diversify the energy balance and reduce dependence on mineral fuels.

The main types of biofuels are bioethanol, biodiesel, biogas, synthetic biofuels, biohydrogen, pure plant oils. In Bulgaria, the most promising are projects for the production of bioethanol and biodiesel.

In 2013 and 2014, the quantities of biofuels consumed in the Transport sector, meeting the sustainability criteria, were respectively 104 ktoe and 111 ktoe, of which for 2013: biodiesel - 105,435 t (96 ktoe) and bioethanol - 12,568 t (8 ktoe) and for 2014: biodiesel - 106,321 t (96 ktoe) and bioethanol - 22,824 t (15 ktoe).

In 2015 and 2016, the quantities of biofuels consumed in the Transport sector, meeting the sustainability criteria, were respectively 166.1 ktoe and 186.5 ktoe, of which for 2015: biodiesel – 112.5 ktoe and bioethanol – 32.2 ktoe and for 2016: biodiesel – 130.3 ktoe and bioethanol – 32.9 ktoe.

In 2017 and 2018, the quantities of biofuels consumed in the Transport sector meeting the sustainability criteria were 172.4 ktoe and 151.1 ktoe, respectively.

The reported decrease is due to the introduced limitation regarding the consumption of conventional biofuels that can be counted for the purpose in the Transport sector, as well as the registered 18 ktoe of biofuels that do not meet the sustainability criteria. In 2018, 11.25 ktoe of new generation biofuels were consumed, which corresponds to 0.33% of the final energy consumption in the transport sector (3,372.2 ktoe).

In the transport sector, 2019 and 2020 saw an increase in the consumption of biofuels in the transport sector compared to 2018, leading to a reduction in GHG emissions from the use of renewable energy in transport. The share of electric energy from renewable energy has a slight growth, which is why the reductions in GHG emissions are close to the levels of 2018.

In 2019 and 2020, the total consumption of renewable energy in the transport sector was 158.0 ktoe and 171.1 ktoe. For the considered period, between 61 - 62% is the share of used conventional biofuels in the total consumption of renewable energy. After 2018, the use of new generation biofuels is observed, with 50.8 ktoe and 55.8 ktoe consumed in 2019 and 2020, respectively. The amount of electricity used in this sector in 2019 and 2020 is 9.6 ktoe and 11.5 ktoe.

Evaluation of the effect

In the transport sector, there is a sharp increase in the share of biofuels compared to previous years, which in turn leads to a significant reduction in greenhouse gas emissions from the use of energy from renewable sources in transport.

According to the National Reports on the progress of Bulgaria in the promotion and use of energy from renewable sources, the reductions in greenhouse gas emissions from the use of energy from renewable sources in transport are:

2013 - 149,243 tons of CO_2 eq.;
2014 - 162,155 tons of CO_2 eq.;
2015 - 202,315 tons of CO_2 eq.;
2016 - 227,853 tons of CO_2 eq.;
2017 - 228,803 tons of CO_2 eq.;
2018 - 271,575 tons of CO_2 eq.;
2019 - 239,342 tons of CO_2 eq.;
2020 - 231,383 tons of CO_2 eq.;

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.

Implementation:

- According to the JESSICA initiative under the OPRD 2007-2013 and within the framework of the support through financial instruments under the OPRD 2014-2020, by the end of 2020, 4 projects were implemented - 2 completed and 2 in the process of implementation, according to which 128 charging stations for electric cars were built. A total of 199 charging stations are planned to be built.

- Ordinance No. RD-02-20-2 of 2017 on planning and design of the communication and transport system of urbanized territories (Ordinance No. RD-02-20-2 of 2017) provides an estimate until 2030 for sizing of the degree of motorization of the big cities in Bulgaria. The communication and transport system of the cities shall be planned and designed in such a way as to give priority to the development of public transport for the carriage of passengers, the use of bicycles and electric mobility in the movement of personal vehicles. In 2019, a requirement was introduced to designate parking spaces for electric vehicles in public service buildings, in residential buildings and in mixed-use residential buildings, as well as a requirement to equip such buildings with charging points for electric vehicles. According to the regulation, charging points (dispensers) for electric vehicles are provided uniformly in the urban area without restrictions in compliance with Directive 2014/94/EU. At the next stage (in 2022), Regulation No. RD-02-20-2 of 2017 is planned to be adapted to the requirements of Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 for amendment of Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency regarding the introduction into national legislation of requirements for providing infrastructure for electromobility, provided for in the amendments to Directive 2010/31/EU.

- During the period 2018 - 2020, a new Regulation No. RD-02-20-2 of 28. 09 2020 was developed and promulgated for Bulgaria on the terms and conditions for the design, construction, commissioning and control of refuelling stations for cars powered by hydrogen fuel. The technical normative act is designed for the design and construction of an infrastructure for refuelling cars with hydrogen - the ecological fuel of the future. The specific regulation is a measure for the implementation of the National policy framework for the development of the market of alternative fuels in the transport sector and for the deployment of the relevant infrastructure, adopted by Decision No. 87 of the Council of Ministers (CM) of 26.01.2017, amended by Decision No. 323 of the CM of May 11, 2018. The Ordinance was issued under the joint competence of five ministries: Ministry of Transport, Information Technologies and Communications - in its capacity as the responsible department for transposing Directive 2014/94/EU of the European Parliament and of the Council on the deployment of infrastructure for alternative fuels (Directive 2014/94/EU), Ministry of internal affairs, the Ministry of Economy, the Ministry of Environment and Water.

- Development of the first National Report in fulfilment of the provisions of Art. 10, paragraph 1 of Directive 2014/94/EU – On 6 January 2020, after agreement within the European Affairs Council, the report was submitted to the European Commission.

- A pilot scheme to promote the use of electric and hybrid electric vehicles within the Climate Investment Program - National Framework was approved by Decision No. 87/26.01.2017 of the Council of Ministers and amended by Decision No. 323/11.05.2018 of The Council of Ministers. The national framework expresses the state's vision to actively support the development of alternative fuels in transport with a view to achieving the defined national goals in the field of energy, transport and the environment. The global objective of the framework is the creation of a sufficiently favourable environment for the wider application of alternative fuels and drives in the transport sector and the achievement of conditions comparable in the field to other developed EU countries. In the long-term horizon (after 2030), the aim is the deployment of electromobility, the wider use of natural gas as a standard fuel and the exit of hydrogen technology from the research/development phase. The key principle on which the national policy framework is built is the principle of technological neutrality in the sense of avoiding public sector support to only one type of alternative fuel. It presents the current state of the infrastructure for individual types of alternative fuels used in road, water and air transport. On 6 January 2020, after agreement within the European Affairs Council, the report was presented to the European Commission. The main purpose of the regulation is to provide an opportunity to build infrastructure for refuelling cars with hydrogen fuel, thereby contributing to the development of the market for vehicles using alternative fuel.

- The scheme finances projects to promote the use of electric vehicles. Beneficiaries of these projects can be the central administration and its territorial subdivisions and municipal administrations. Currently, the funding for the projects to promote the use of electric cars is in the amount of:

- BGN 20,000 (twenty thousand) for all-electric vehicles category M1 (4+1) seats and N1;

- BGN 10,000 (ten thousand) for hybrid electric (plug-in) vehicles category M1 (4+1 seats) and N1.

- BGN 20,000 (twenty thousand) for all-electric vehicles category L7e.

- Up to 50%, but not more than BGN 3,000 (three thousand) for an additional upgrade. The additional upgrades (for cleaning, for watering, for transporting bulky objects, isothermal boxes, garbage containers, etc.) are intended for vehicles of category L7e. Various types of optional upgrades can be purchased for each L7e category all-electric vehicle purchased.

- BGN 30,000 (thirty thousand) for fully electric vehicles (vans 7+1; 6+1 seats), category M1 or N1

- BGN 40,000 (forty thousand) for all-electric vehicles category M2 and N2.

- Construction of infrastructure for charging and operation of electric vehicles - On the territory of the city of Burgas there are five municipal charging stations for electric vehicles, as well as several private ones. The main points are the municipal parking lot on "General Gurko" street No. 64, OZK Park Arena Burgas and Eldrive - Burgas Plaza, point next to the School of Motor Transport on "24-ti Primorski Polk" street, area next to the passenger seaport. A joint project of the Municipality of Burgas and the company "Eldrive" AD is underway for the phased introduction of a total of 50 electric charging stations for fast or slow charging within the whole city in the next 2 years. This aims to stimulate the use of private electric cars. For now, charging through municipal electric charging stations is free. The Municipality of Burgas increases the number of official electric vehicles every year. So far they are 9 – 2 electric cars, 3 electric vans, 4 electric scooters. The procedures for the delivery of 2 more electric vans are currently underway. A special sticker has been introduced through the Municipal Program "Transport" with which all electric cars are marked. Legislative measures have been adopted: in the Ordinance on determining the amount of local taxes and in the Ordinance on paid and free parking of motor vehicles on the territory of the Municipality of Burgas. Preferences are listed - all electric cars, mopeds and motorcycles are exempt from motor vehicle tax and park for free within the "blue and green zone" in Burgas.

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

Implementation:

The Program for the construction and reconstruction of the transport infrastructure on the territory of the Stolichna Municipality for the period 2013 - 2016, adopted by the Stolichna Municipal Council with Decision No. 108 under Protocol 35/28.02.2013, is being implemented. The Program emphasizes the development of a single sustainable transport - a communication system based on a well-developed and quality infrastructure, guaranteeing a high level of mobility, a quality urban environment and the satisfaction of citizens and businesses. The program includes major objects of the transport infrastructure to be built or rehabilitated within the period with various sources of funding.

A long-term program of the Stolichna Municipality for the development of bicycle transport has been developed and is being implemented, including the construction of bicycle routes and accompanying infrastructure and improving the attractiveness and convenience of cycling, as a real alternative to the private car for all types of travel, while at the same time better integration of cycling with other modes of transport. For the period 2014-2016, bicycle paths were designed, rehabilitated and built in different parts of Sofia.

The Metropolitan Municipality plans to introduce the "public bicycle" service mainly in the central part of the city. This service will be an electronic system for parking in designated parking lots and renting out public bicycles.

During the construction, major repairs and rehabilitation of the main city arteries, bicycle routes are laid - if possible.

According to priority axis 1 "Sustainable and integrated urban development" of OP "Regional development “2007 - 2013", projects were implemented for the modernization of public transport in seven large cities of Bulgaria: Sofia, Burgas, Plovdiv, Varna, Stara Zagora, Ruse and Pleven. With their implementation for the purchase of 64 trolleybuses and 192 buses, 19,162 tons of CO2 eq./year are saved.

According to OPRD 2014-2020, 9 contracts for urban transport were concluded, which include the purchase of new vehicles — 13 trams, 14 trolleybuses and 85 buses (24 electric buses, 15 natural gas buses and 46 diesel buses) in the cities of Sofia, Varna, Pleven, V. Tarnovo, Sliven, Gabrovo, Pernik, Kazanlak and Dupnitsa. By the end of 2020, the vehicle delivery activities for 7 of the 9 projects have been completed. 13 trams, 14 trolleybuses and 61 buses were delivered.

Evaluation of the effect

For the period 2012 - 2016, the realized saved emissions are 541 215 tons of CO_2 eq.

<u>Measure 2: developing and promoting the use of bicycles for transport</u>

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

Implementation:

Stimulation of bicycle traffic is ensured by the following legal acts, which are within the competence of the Ministry of Transport and Tourism:

Ordinance No. RD-02-20-2 of 2018 on road design (SG, No. 79 of 2018) sets technical requirements, norms and standards for the design of republican and local roads outside the boundaries of urbanized territories, called "roads" for short. Section II lists the elements of the roadway, including pedestrian and bicycle lanes. There are requirements for dynamic dimensions for pedestrian and bicycle lanes, and for a shared lane they are separated by marking strips. When designing pedestrian and bicycle paths, it is legally required to analyse the intensity of car traffic (MVs/24 h) and the peak hourly intensity of pedestrian and bicycle traffic.

Ordinance No. RD-02-20-2 of 2017 on planning and design of the communication and transport system of urbanized territories (SG, issue 7 of 2018) defined the principles, criteria, norms and rules for planning and designing the communication and transport systems (CTS) in the urbanized territories. The Ordinance stipulates that, wherever appropriate and possible, cycle routes are provided as separate cycle lanes, physically separated from vehicle traffic. Separate bicycle lanes are also designed in places where bicycle routes do not coincide with the direction of the street network, such as parks and gardens. The Ordinance requires municipalities to develop a Bicycle Transport Development Plan, which can be part of the Sustainable Urban Mobility Plan (SUMP) or be developed independently. With regard to bicycle traffic, on the basis of the same ordinance, the municipalities also develop a Program for the Development of Bicycle Transport.

The instruments for implementing the measure are:

- Design and implementation of new cycling infrastructure;
- Development of systems for the use of municipal bicycles;
- Trainings and campaigns;

For the implementation of the measure and the development and stimulation of bicycle traffic, for the reporting period, pedestrian zones, bicycle lanes and sidewalks with an area of 1 773 548 square meters were built/rehabilitated with the support of OP "Regional Development" 2007-2013.

A long-term program of the Stolichna Municipality for the development of bicycle transport has been developed and is being implemented, including the construction of bicycle routes and accompanying infrastructure and improving the attractiveness and convenience of cycling, as a real alternative to the private car for all types of travel. When choosing the routes, the aspiration is to create a complete, relatively continuous bicycle network in an urban environment, linking bicycle routes with metro stops, as well as taking into account the possibilities for combining pedestrian and bicycle traffic.

During the construction, major repairs and rehabilitation of the main city arteries, bicycle routes are laid - if possible.

Encouraging citizens to use bicycles is carried out through the implemented measures to expand the built network of bicycle lanes, linking them to public transport stops; building the automatic ordering system through subscription electronic cards or voucher cards.

In the system for shared bicycles "Velo Burgas" 30 electric bicycles have been introduced and are being used.

Evaluation of the effect

As a result of the implementation of the measure during the reporting period, 381 442 tons of CO_2 eq. were saved.

Measures with indirect impact on the reduction of GHG emissions

Measure 1: fiscal policy to stimulate economies and to limit consumption of conventional fuels

Characteristics: The indirect effect from the introduction of this measure is estimated at 406 872 tCO2 eq.

The measures is proposed in the White Paper "Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system" (COM (2011) 144 final).

Implementation:

Fiscal policy to stimulate savings and limit the consumption of conventional fuels through:

- ***tax reliefs for manufacturers and users of electric vehicles;***
- ***a more complete application of the "polluter pays" and "consumer pays" principles.***

During the period 2013-2014, a number of reliefs related to the environmental characteristics of vehicles were adopted. With the adoption of the LAS of the LLTF (State Gazette no. 102 of 2012, in force from 01.01.2013) electric cars are exempt from annual tax. With the next LAS of the LLTF (State Gazette No. 101 of 2013, in force from 01.01.2014) the preference is preserved for owners of vehicles with active catalytic converters, with additional reliefs being provided for owners whose vehicles comply with environmental categories Euro 3, Euro 4, Euro 5 and Euro 6. With the adoption of an addition in Art. 58, para. 2 of the LLTF (SG, no. 105 of 2014) from January 1, 2015, in addition to electric cars, electric motorcycles and mopeds are also exempt from annual tax, thus expanding the range of tax-exempt electric vehicles and overcoming the created inequality in the taxation of four-wheel and two-wheel electric vehicles.

The changes in the LLTF (SG, no. 97 of 2017) expand the range of tax-exempt vehicles, such as electric vehicles categories L5e, L6e and L7e, defined in Art. 4 of Regulation (EU) No. 168/2013 of the European Parliament and of the Council of January 15, 2013 on the approval and supervision of the market of two-, three- and four-wheeled vehicles, which are exempt from tax. With the change made, a reduction of harmful emissions in the atmosphere is achieved indirectly and the tax policy regarding electric vehicles is continued.

In 2018 (SG, no. 98 of 2018, effective from January 1, 2019) a new concept for determining the tax on vehicles for passenger cars and trucks with a technically permissible maximum mass of no more than 3.5 tons has been adopted, namely the tax to be determined by a formula that includes two components: property and environmental. The property component takes into account the power and the year of manufacture of the car, and the ecological component takes into account the ecological category of the car, respectively the pollution caused by the respective car.

The ecological component is related to the ecological characteristics of the car and is a correction factor that reflects the ecological category of the car, which is related to the European standards for exhaust gases (also known as Euro 1, 2. 3, 4, 5 and 6). The environmental component provides relief for owners of cars complying with environmental standards "Euro 4" and higher and aggravation for owners of cars that do not comply with an environmental category or correspond to an environmental category lower than "Euro 4".

Also, in connection with the proposed new method of taxation, it has been accepted that the relief for vehicles with an active catalytic device will not apply.

The new concept provides an opportunity for all motor vehicle owners to enjoy tax preferences in case they own motor vehicles meeting higher environmental standards.

The changes adopted in 2017 and 2018 are aimed at achieving compliance with European directives related to air cleanliness and dealing with the exceeding of the maximum permissible values for concentrations of pollutants in the ambient air.

<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).

Implementation:

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.

To reduce the number of motor vehicles (MVs) using conventional fuels in urban transport, the following projects were implemented during the reporting period:

- Project "Implementation of activities to improve the quality of atmospheric air through the purchase and delivery of buses", financed through OP "Environment" 2007 - 2013, budget of the Stolichna Municipality and funds of "Stolichen Avtotransport" EAD.

126 new gas articulated buses and specialized equipment for them were delivered under the project. The utilized financial resources under the project are BGN 66,992,306.37.

Under the Measure "Reduction of vehicles using conventional fuels in urban transport by 2020" are:

- 40 trolleybuses on greener fuel for the municipality of Pleven were purchased and put into operation. The financial resources for the project are BGN 37,347,075 and are provided by OP "Environment" 2007-2013.

- Purchased and put into operation for the municipality of Burgas:

- 28 new SOLARIS URBINO buses, 18 diesel buses
- 39 new buses SOLARIS URBINO, 12 on methane fuel
- 22 new SOLARIS trolleybuses - optimized engine, with recuperation
- 6 new Karsan minibuses, diesel
- 7 new buses SOLARIS METROPOLIS, 18 diesel.

As of 2016, 100% of the fleet serving the urban transport scheme of the municipality of Burgas has been replaced with vehicles with more environmentally friendly fuel. A general reduction of motor vehicles using conventional fuels in urban transport has been achieved (60% of the fleet serving the urban transport scheme). The funds utilized for the project are BGN 55,610,608.63 and are provided by OP "Environment" 2007-2013, municipal budget and with funds of the municipal transport company.

Measure "Introduction of a higher "Euro standard" for public transport buses". (Program for environmental protection on the territory of Plovdiv Municipality 2014 - 2020).

In 2013, Euro 0-4 buses represented 84.7% of the total fleet serving public transport in Plovdiv. In 2016, their share fell to 16.7%. The share of buses with a higher engine environmental standard (Euro 5.6 and EEV) increased from 15.3% to 83.3%. In addition to expanding the network, 50 of the newly introduced buses (Euro5,6 and EEV) have replaced 45 with Euro 0 and 5 with Euro 4. As of 31.12.2016, the total number of buses serving the transport scheme of the Municipality of Plovdiv is 300, distributed by type of fuel as follows: diesel - 258 units, gas - 38 units, natural gas - 4 units, methane - 0 units, biofuel - 0 units. The financial means are provided by the transport companies that have concluded contracts with the Municipality of Plovdiv for servicing the bus lines of the municipal transport scheme.

- Project "Introduction of an intelligent transport system in the city of Stara Zagora":

The project activities include the construction of 1 intelligent transport system and electronic information boards providing information in real time at 119 public transport stops. The time benefits for public transport users amount to an average of 1.52 million euros/year as of 2016. The project is worth BGN 5,730,895.50 including VAT and was financed by the OP "Regional Development" 2007-2013.

- Project "Development and stimulation of the use of "hybrid" and electric car transport - Stara Zagora municipality"

8 hybrid trolleybuses, 14 new low-floor trolleybuses, 55 new buses – Euro 6 were purchased under the project. It is estimated that the project will achieve a reduction in CO_2 emissions from transport - 188.25 t/year on average, as well as an increase in the share of urban transport (including people with disabilities) - 0.48%. The municipality expects an increase in public transport trips - 393,829 average trips/year. The project is worth BGN 47,715,975.75 including VAT and was financed by the Regional Development OP 2007-2013 and the Environment OP 2007-2013.

- Project "Development and stimulation of cycling - Stara Zagora municipality."

By the end of 2016, bicycle lanes with a total length of 7,924 km were built under the project. The value of the project is BGN 1,858,523.00 including VAT with the financial support of the OP "Regional Development" 2007-2013.

- Project "Rehabilitation of the trolleybus infrastructure - poles and contact network under the project "Integrated urban transport system of the city of Ruse".

The total cost of the project is: BGN 29,256,115.47, the financing of which was provided by the OP "Regional Development" 2007-2013.

- 13 trams in Sofia, 14 trolleybuses in Pleven and 7 electric buses in Kazanlak have been delivered under urban transport projects under the OPRD 2014-2020.

Priority axis 3: DIVERSIFICATION OF TRANSPORT

Measures with direct impact on the reduction of GHG emissions

Measure 1: increasing the share of public electric transport – railway, metro, trolley, tram and metro

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.

Implementation:

In connection with increasing the share of public transport, the implementation of the projects was supported with funds from the state budget, such as for the construction and extension of the metro and for the production, delivery, renovation and modernization of metro trains, for the period 2003-2012 were approved and granted additional funds from the central budget under the budget of the Stolichna Municipality, in the amount of BGN 197.2 million, and for the considered period of the Third National Action Plan on Climate Change 2013 - 2020 - BGN 110.0 million.

The state budget also plans funds for subsidies and compensation for free and reduced-price transportation for certain categories of citizens, public passenger transportation on intra-city transport and inter-city road transport.

Funds for subsidies for "BDZ-Passenger Transport" EOOD are provided through the budget of the Ministry of Transport, Information Technologies and Communications.

Every year in the state budget of the Republic of Bulgaria funds are planned for capital transfers for non-financial enterprises in the railway sector, which are provided for the maintenance, development and construction of the railway infrastructure and for the purchase of new rolling stock.

For the reporting period, the following projects related to the rehabilitation of railway infrastructure were carried out:

Table 4.16 Rehabilitation of railway infrastructure

Name of the measure	Used financial resource		Indicator of implementation of the measure	Reported value at the end of 2020.	Difference between targeted and reported value	Note
	Amount BGN	Source of funding				
Rehabilitation of the railway infrastructure in sections of the railway line Plovdiv - Burgas	Total project cost: BGN 470,652,350.23 Funds paid as of 31.12.2020 – BGN 456,195,487.71	Operational Programme Transport 2007 - 2013	Rehabilitation of railway 21 km (position 1)	21	0	Position 1: - Issued Permission for use outgoing No ST-05-566/14.04.2014 - A permit was issued for the commissioning of the "Energy" subsystem on 21.5.2019. - A permit was issued for the commissioning of the "Infrastructure" subsystem on 20.12.2019.
			Rehabilitation of railway 120 km (position 2)	120	0	Position 2: - Permit for use 6T-05-1865/13.12.2016 was issued for stages 1 to 11 (Stara Zagora station - Kermen station). - Permit for use ST-05-53/24.01.2017 was issued for stages 12 to 18 (Kermen station - Zimnitsa station). - A permit was issued for the commissioning of the "Energy" subsystem on 14.9.2018 - A permit was issued for the commissioning of the "Infrastructure" subsystem on 08.01.2019.
			Rehabilitation of railway 150 km (position 3)	150	0	Position 3: - Permit for use ST-05-129/02.03.2017 was issued. - A permit was issued for the commissioning of the "Energy" subsystem on 13.12.2018. - A permit was issued for the commissioning of the "Infrastructure" subsystem on 09.01.2019.
			Modernization of TPS Nova Zagora, TPS Stara Zagora and construction of SCADA (item 4)	2 TPS and SCADA	0	Position 4: - Permit for use No. ST – 09 – 1105/05.07.2016 was issued for stage I - TPS Nova Zagora. - Permit for use No. ST-05-1757/07.12.2016 was issued for stage III - TPS Stara Zagora. - Permit for use No. ST-05-1756/07.12.2016 was issued for stage II - Central Dispatch Center. - A permit was issued for the commissioning of the "Energy" subsystem on 14.9.2018
Rehabilitation of the railway infrastructure along the sections of	Total project cost: BGN 21,339,147.60 Funds paid as	Operational program "Transport and transport infrastructure" 2014 -	Modernization of traction substations Burgas, Karnobat and Yambol	3 TPS	0	- A use permit No.ST-05-971/09.08.2018 was issued for the Yambol railway station. - Use permit No. ST-05-450/19.04.2018 was issued for Burgas TPS. - A use permit No. ST-05-

the railway line Plovdiv - Burgas - restoration, repair and modernization of traction substations Burgas, Karnobat and Yambol	of 31.12.2020 – BGN 21,328,680.38	2020.				970/09.08.018 was issued for Karnobat TPS. - A permit was issued for the commissioning of the "Energy" subsystem on 27.03.2020.
Rehabilitation of the railway line Plovdiv - Burgas, Phase 2	Total project cost: BGN 810,018,562.65 Funds paid as of 31.12.2020 – BGN 175,070,037.52	Operational program "Transport and transport infrastructure " 2014 - 2020.	rehabilitation of 75 km of railway lines	28 km	0	Skutare-Orizovo section is completed. Permission for use No. ST-05-166/05.03.2020 was issued. Straldzha - Tserkovski section is completed. A use permit No. ST-05-653/31.05.2018 and a permit for commissioning the "Infrastructure" subsystem was issued on 23.10.2020. The following components of the project are currently being designed: - Modernization of the railway section Orizovo - Mihailovo; - The reconstruction of the shuttle development at the Zimnitsa station and the rehabilitation of the contact network at the Zimnitsa and Straldzha stations; - Design and construction of signalling and telecommunications systems on the railway line Plovdiv - Burgas; - Modernization of TPS Chirpan; - Design and construction of 2 new road overpasses at km. 127+805 and km.134+350 in the Khan Asparuh-Nova Zagora interstation; - Design and construction of 2 new road overpasses at km. 253+520 and km. 260+921 in the section Chernograd – Balgarovo; - Design and construction of 2 new road overpasses at km. 244+619 and at km. 248+202 in the Chernograd-Aytos interstation.
			construction of 36 km of railway lines	0	0	
			construction of 2 bridges	0	0	
			construction of 1 tunnel	0	0	
			rehabilitation of 87 km of existing CN	32 km	0	
			construction of 37,000 m of new CN	0	0	
			modernization of 1 TPS	0	0	
			Removal of 39 railway crossings	0	0	
			construction of 34 overpasses	0	0	
			construction of 4 underpasses	0	0	
			construction of 586,000 m of optical cable line	0	0	
			construction of 33 GSM-R base stations	0	0	
			renewal of signalling in 24 stations	0	0	
Modernization of the railway line Sofia - Plovdiv in the	Total project cost: 312261927.78 BGN Funds disbursed at the end of	Operational Programme Transport 2007 - 2013	Built railway lines	122.118 km	0	1. Permission for use No. ST-05-1144/15.07.2016 for Modernization of the railway section Stamboliyski-Plovdiv; 2. Permission for use No. ST-05-614/25.04.2016 for TPS Proslav;
			Modernized track development in stations	5	0	

Septemvri - Plovdiv section	December 2020: BGN 257,755,763.00		Repair and modernization of bridges	23	0	3. Permission for use No. ST-05-1329/04.12.2017 for signalling systems in the Septemvri - Plovdiv section and telecommunications Sofia - Plovdiv; 4. Permission for use No. ST-05-365/29.03.2017 for signalling systems in the Septemvri - Plovdiv section and telecommunications Sofia - Plovdiv; 5. Permission for use No. ST-05-609/31.05.2017 for Modernization of the Septemvri - Pazardzhik railway section; Permission for use No. ST-05-705/20.06.2017 for Modernization of the railway section Pazardzhik - Stamboliyski
Modernization of the railway section Sofia-Elin Pelin	Total project cost: BGN 132,966,320 Funds disbursed at the end of December 2020: BGN 79,465,848.18	Connecting Europe Facility; Agreement INEA/CEF/TRAN/M2014/1048809	Built railway lines	11,400 km	38,397 km	The project is in the process of implementation and is expected to be completed by 12.2022.
			Modernized track development in stations	1	2	
			Repair and modernization of bridges	4	13	
"Reconstruction and electrification of the railway line Plovdiv - Svilengrad along corridors IV and IX, phase 2: section Parvomay-Svilengrad"	Total cost of the project according to approved application form is: **BGN 663,316,861.61** The actual disbursed funds under the project are: BGN 444,932,486.68	Operational Programme Transport 2007 - 2013	➢ 70,475 m of laid single-track railway, including: rehabilitated railway with a length of 4337 m. ➢ The contact network was built - 73,666 m ➢ New reception buildings were built - 3 units. ➢ Rehabilitated reception buildings - 2 units ➢ New stops built – 5. ➢ Stations with renewed signalling - 7. ➢ Stations with renewed track development - 6. ➢ Level crossings	100% fulfilled	100% fulfilled	The project has been completed. The site has been accepted for operation with Permits for use: **For Phase 1 , 5 usage permits have been issued -** ST-05-852 dated 02.06.2014; ST-05-1217 of 19.08.2014; ST-05-725 dated 12.05.2016; ST-05-1584 dated 24.10.2016 and ST-05-1747 dated 07.12.2016. **For Phase 2, 3 usage permits have been issued** - ST-05-2308 of 12.12.2015; ST-05-726 dated 12.05.2016 and ST-05-1145 dated 15.07.2016. **For Phase 3, 3 usage permits have been issued -** ST-05-1270 dated 11.08.2016; ST-05-366 dated 29.03.2017 and ST-05-1131 dated 02.10.2017. **For Phase "Systems"** - ST-05-540 of 05.05.2017

			removed – 28. ➢ railway bridges – 28. ➢ Pedestrian overpasses – 7. ➢ Road overpasses and underpasses – 17. ➢ Drains and pipes - 127. ➢ Disinfection frame at Svilengrad station – 1. ➢ New traction substations were built - 2. Extension of an existing traction substation - 1.			

Evaluation of the effect

For the period of the report, the measure was implemented, and the emissions saved were 944 335 tons of CO_2 eq.

<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

Implementation:

The measure aims to achieve a two-sided effect, expressed on the one hand in increasing the degree of usability of more ecological modes of transport and, on the other - in creating suitable conditions for increasing the added value of transport activity, with a general reduction of transport costs per unit GDP.

For the period 2014 - 2016, the project "Construction of an intermodal terminal in the South Central Planning Region of Bulgaria - Plovdiv" was implemented. Terminal design activities have been completed. The terminal was built and on 28.10.2016 it was handed over by the contractor NC "Railway Infrastructure". The total value of the project is BGN 11,873,910.00, financed by OP "Transport" 2007-2013.

For the reporting period, the construction of an intermodal terminal (IMT) in the North Central Planning Region of Bulgaria - Ruse is also planned. Due to a change in the policies of the Ministry of Transport, Information Technologies and Communications (Managing Authority of OP "Transport and Transport Infrastructure"), at the moment the priority for construction of IMT Ruse is in the process of revision, and the funding is being reassessed. The total value of the project is BGN 4,195,300, and as of 31.12.2016, the following funds have been paid - BGN 3,914,424.60, provided by OP "Transport" 2007-2013.

Evaluation of the effect

For the period of the report, the measure was implemented, and the emissions saved were 81 374.4 tons of CO_2 eq.

Measures with indirect impact on the reduction of GHG emissions

<u>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</u>

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).

Implementation:

During the period 2014 - 2016, the following transports were carried out by means of rail transport and at a distance of 300 km:

- Transit rail transportation of car trailers from Turkey to Germany and back, resulting in 80,764,016 gross tonkm Ruse - Svilengrad and back - 521 km;
- Transit rail transportation of car trailers from Turkey to Liechtenstein and back, resulting in 9,532,962 gross tonkm Svilengrad - Dragoman and back - 387 km.

The measure was executed successfully.

<u>Measure 2: connecting the central network airports – Sofia, Varna, Burgas, Plovdiv and G. Oryahovitza with railway lines</u>

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).

Implementation:

Art. 41, para. 3 of Regulation 1315/2013 introduces an obligation for the member states to connect the airports in their territory, indicated as main in part 2 of Annex II to the Regulation, with the rail and road infrastructure of the Transeuropean transport network, by 31.12.2050 at the latest, and where possible to integrate with a high-speed rail network. The appendix defines the status of Bulgarian airports, namely: Sofia Airport is part of the main Transeuropean transport network, and the airports in Burgas, Varna, Plovdiv and Gorna Oryahovitsa are part of the wide-range Transeuropean transport network. The airports that are subject to connection with the railway network have also been determined - a total of 37 airports in the member states, which do not include the Bulgarian ones. In this sense, our country has no commitment to build a railway connection to Sofia airport, and the MTITC has no such plans in the medium term (for airports falling on the wide-range network there is no such requirement). Since 04/02/2015, Sofia Airport has been connected to the central part of the city and Sofia Central Station by a metro line and has become a modern multimodal transport centre.

The measure was executed successfully.

<u>Priority axis 4:</u> INFORMING AND TRAINING CONSUMERS

Measures with indirect impact on the reduction of GHG emissions

<u>Measure 1: sustainable transport statistics</u>

It has not yet been specified which institution will initiate this process, whether an Interdepartmental Working Group will be formed, and what types of data will be reported to the National Statistical Institute (NSI).

The Ministry of Transport, Information Technologies and Communications (MTITC) is not a statistical authority under the Statistics Act and does not provide data to NSI. EA "Maritime Administration" and General Directorate "Civil Aviation Administration", secondary allocators of budget credits to MTITC, are statistical authorities and provide specific data to NSI. In this regard, it is necessary to take into account that a methodology for the requested statistical data should be developed before the regulation included in the measure is drawn up.

<u>Measure 2: informed selection of a transport vehicle</u>

EA "Automotive Administration" at MTITC works actively to harmonize Bulgarian legislation with the legislation of the European Union in the field of road transport with the aim of reducing noise and environmental pollution as a result of harmful emissions from exhaust gases from cars, increasing the purity of the atmospheric air.

<u>Measure 3: instruction in economic driving</u>

According to the data of the responsible institution - the Ministry of Transport, Information Technologies and Communications (EA "Automotive Administration"), the number of trained drivers and driver qualification cards issued is as follows:

2013 – 34,482

2014 – 27,300

2015 – 26,893

2016 – 36,125

2017 – 43,223

2018 – 38,026

2019 – 25,462

2020 – 28,855

For the period 2013 - 2020, a total of 260 366 qualification cards were issued.

5.4.9. Education and science

5.4.9.1.Measures in the field of education and science

Objective and direction of the measures in the field of science and education

The measures in the field of science and education are consistent, on the one hand, with the needs of the relevant sectors and, on the other hand, with the National Strategy of Scientific Research by 2020 and with the Programme for Development of Education, Science and Youth Policies in Bulgaria. Those two documents contain several leading national research priorities that are focused on areas closely related to the possibilities to reduce greenhouse gas emissions - energy sources and energy saving technologies; addressing and control of harmful and hazardous municipal and industrial waste; new raw materials and other materials.

The main objective of the measures is to focus the research and development activities and the educational activity on the issue of reducing greenhouse gas emissions, the identification and the study of the natural and the anthropogenic factors in order to ensure their sustainable management on the basis of practical experience and within a more competent administrative and organizational, technological, information and financial environment.

The contribution of science and education to the achievement of the national targets for reducing greenhouse gas emissions is in two directions:

– **Establishing the condition:**

- contribution to the definition of the mechanisms and the specifics of the origin and the generation of greenhouse gases in the relevant sectors;
- contribution to the monitoring of the implementation of the plan;
- involvement in fundamental research that contributes to the identification of problems at global level.

– **Building the capacity of human resources and institutions to contribute to the reduction of the anthropogenic impact on climate change:**

- Establishment of general knowledge and understanding of the anthropogenic impact on climate change at all levels of the educational system and setting up strategies to reduce this impact (through the system of general secondary education)
- Preparation of specialists for the different sectors.

In the first two National Action Plans on Climate Change (NAPCC) education and science are included in the package of measures at national level (respectively in the first NAPCC) as well as an important tool in the policy of the Government of Bulgaria on Climate Change (in the second NAPCC). No specific measures on science and education are identified in the second action plan.

The national policy in the field of research and education is conducted by the Ministry of Education and Science (Ministry of Education), and in the field of innovation - the Ministry of Economy. 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.

– **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.

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

In the period 1988 – 2020 Bulgaria has reached significant reduction of the GHG emissions equal to 49 186 Mt, which is about 57 % 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.

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.

The overall assessment of the achieved and expected reductions in greenhouse gas emissions from the implemented measures was carried out after processing the information received by the Ministry of Environment and Water from all interested institutions and organizations.

The concept and implementation of the measures of the Third NAPCC lays down the conservation, rational and responsible use of resources as a key prerequisite not only for the improvement and protection of the environment, but also for achieving sustainable economic growth and increasing the competitiveness of the Bulgarian economy. The introduction of low-carbon, energy-efficient and waste-free technologies, as well as the utilization and recycling of a greater amount of waste, contributes not only to the overall reduction of greenhouse gas emissions, but also to the increase of productivity and resource efficiency. Opportunities are created for the discovery of new sources of growth and jobs through cost savings, market realization of innovations and better management of resources throughout their life cycle.

The presented policies and measures by sector contribute to the reduction of greenhouse gas emissions in Bulgaria. The overall effect of their implementation guarantees the achievement of the legally binding goals for our country under the "Climate and Energy" package, as well as the energy efficiency goals.

The main sources of funding for the implementation of the measures are: the structural and cohesion funds of the EU; The European Agricultural Fund for Rural Development; donor funds of international financial institutions such as the EBRD and the World Bank; The EU Emissions Trading Scheme; the National Green Investment Scheme; The National Fund for Energy Efficiency; Kozloduy fund; PUDOOS and others.

Distribution of expected and saved emissions by sector:

- **Sector "Energy"** - The expected effect of implementing the measures of the action plan is 2 638 286 tons of CO_2 eq./year of saved emissions. The emissions actually saved are estimated at 3 584 730 tons of CO_2 eq./year, taking into account that one of the measures with a direct effect is not implemented.
- **"Home and services" sector** – 605 945 t CO_2 eq./year were saved from an expected 423 617 t CO_2 eq./year.
- **Sector "Industry"** - According to the measures set in the sector and the expected effect of their implementation – 808 286 t CO_2 eq./year, 715 869 t CO_2 eq./year have been saved. In the calculations, it was also taken into account that one measure with a direct effect was not implemented.
- **"Waste" sector** - From the implemented measures in the sector, 1 124 992 t CO_2 eq./year were saved from an expected 1 702 782 t CO_2 eq./year. All measures set out in the plan are being implemented.

- **Sector "Agriculture"** - The measures laid down in the document in the sector have been exceeded and as a result the saved emissions are 457 375 t CO_2 eq./year from an expected 4 135 t CO_2 eq./year.
- **Sector "Land use, change in land use and forestry" (LUCLUF)** - in this sector, the measures set were exceeded and 88 496 t CO_2 eq./year were saved from the expected 11 537 t CO_2 eq./year.
- **"Transport" sector** - According to the measures set for implementation in the sector, it is planned to reduce emissions by 745 932 t CO_2 eq./year. The data for the sector show that the measures are implemented successfully and the emissions saved are 1 485 466 t CO_2 eq./year.

The total effect of the measures in all sectors, expressed in saved greenhouse gas emissions, amounts to 8 062 874 t CO_2 eq./year, which is 1 728 299 t CO_2 eq./year more than the expected effect of implementing the measures (6 334 575 t CO_2 eq./year).

Table 4.17 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	CO_2	Increase the efficiency of production of the power plants	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	673	702
2.	Fuel substitution – from coal to natural gas	Energy	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	1350	1553
3.	Increasing of high efficiency combined production	Energy	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	50	240	360
4.	Increasing the share of heating and cooling based on renewable energy sources	Energy	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	2012	ME, Energy Efficency Agency (EEA)	92	137	165

							field of renewable energy sources is relatively small - about 1%.					
5.	Implementation of the measures in the Programme for accelerated gasification (PAG) in Bulgaria	Household and Services	CO2	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	357	326
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	CO2	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	30	36

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	Implemented	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	220	253	304
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, Energy Efficiency Agency (EEA), State Agency for Metrological and Technical Surveillance	9	14	24
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/industrial processes	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 Ministry of Regional development and Public Works (MRPW), EEA	170	196	235
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 price. Improved waste management and reduced GHG emissions from waste sector.	Regulatory, Economic	Implemented	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.	2017	ME, MOEW	554	665	798
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	837	1005

13.	Capture and burning of biogas in all new and in the existing regional landfills	Waste Management	CH4	Enhanced CH4 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 CO2 eq. by 2020.	2013	MOEW	634	729	875
14.	Introduction of anaerobic stabilization of sludge with management capture and burning of biogas in new plants and plants under reconstruction in settlements with population equivalent over 20 thousand residents	Waste Management	CH4 N2O	A cost-benefit analysis for each project should justify or discourage the recovery of methane.	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 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.	2013	MOEW	128	147	177
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)	358	375	394

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	CO2 N2O CH4	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	42	49	51
17.	Improvement of the manure use and management	Agriculture	CH4	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 CH4 in agriculture. All activities aimed at storage and handling of manure should take into account both the type of manure - solid or liquid - and the technologies for gathering and processing. The investment support is crucial to motivate the farmers to build such expensive facilities. The proposed budget for the measure is based on: The average cost of building facilities for storage of manure for one farm with 50 cows is 130 000 BGN. 1000 x 130 000 BGN = 130 000 000 BGN For training: 300 livestock holdings x 690 BGN = 207 000 BGN	2013	MAFF	0,28	0,32	0,39
18.	Introduction of low-carbon practices for processing manure, e.g. composting, transformation of manure into biogas under anaerobic conditions	Agriculture	CH4	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 CO2 eq. per head - holdings that breed cattle: 78 kg CO2 eq. per head - holdings that breed sheep: 4 kg CO2 eq. per head - holdings that breed birds: 18.4 kg CO2 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	0,2	0,4

19.	Technical support for farmers for tilling soil/ stubbles	Agriculture	CO2	Improved management of organic soils, Other activities improving cropland management	Economic	Implemented	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	0,09	0,11	0,16
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	0,03	0,05	0,09
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	37	42	51
22.	Afforestation 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	5,3	6,0	7,2

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	0,30	0,35	0,42
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	1	1,15	1,38
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)	10,3	11,9	14,3
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	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	24	28	33

				methods.								
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	Implemented	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	92	110
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	255	459

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	214	246	259
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	108	124	149
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; MOEW; Municipal authorities	48	95	191
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 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	2014	MF; MTITC; MRDPW; National Railway Infrastructure Company, municipal governments	118	142	212

							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 CO_2 per year.					
33.	Development and construction of intermodal terminals for combined transport	Transport	CO_2	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	63	72	87

5.6.Policies and measures pursuant to Article 2 of the Kyoto Protocol

Article 2 of the Kyoto Protocol asks to specifically address:

- policies and measures to promote sustainable development;
- the steps taken to promote and/or implement decisions by ICAO and IMO to limit

or reduce associated emissions;

- how they strive to implement policies and measures in such a way as to minimise

adverse effects.

Promote sustainable development

The 17 Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development were adopted by world leaders at a UN Summit in September 2015. Countries have committed to ending all forms of poverty, fighting inequalities and tackling climate change, while ensuring that no one is left behind. Many of the goals set, are related to climate issues. Bulgaria has supported the implementation of the 17 Goals since their adoption.

The First Voluntary National Review of the Republic of Bulgaria of the implementation of the 2030 United Nations Agenda for Sustainable Development “Transforming our World” (2030 Agenda) coincides with the celebration of the 75th anniversary of the United Nations (UN), the 65th anniversary of Bulgaria's accession to the UN and the fifth anniversary of the historic decision of the international community to adopt 17 global Sustainable Development Goals, which are comprehensive, large-scale, integral and are oriented toward peace and sustainable development, well-being of people, protection of the planet and the establishment of a multilateral partnership to achieve them.

Bulgaria considers the 2030 Agenda and its 17 global Sustainable Development Goals a long-term commitment of the country. “In preparing the National Development Programme BULGARIA 2030 special attention has been paid to the 2030 UN Agenda for Sustainable Development “Transforming our World” and to the 17 Global Sustainable Development Goals included therein. The Agenda and the Goals are regarded as a framework for the national development policies, while the National Development Programme BULGARIA 2030 itself – as the Government's response for their implementation.”

Bulgaria shares the main message of the 2030 Agenda for “leaving no one behind” and strongly advocates the link between the implementation of the UN Sustainable Development Goals and the protection of human rights. On such a basis, with particular attention to the poor and with a high sensitivity to gender equality and the rights of the child, the country is working to fulfill the principle of “leaving no one behind”. This principle is at the heart of the most important strategic documents aimed at the inclusion of persons with disabilities, vulnerable citizens, Roma, young people, people from high mountain areas, the elderly, disadvantaged children, etc

The National Development Programme BULGARIA 2030 adopted by Protocol No. 67 of the Council of Ministers of 2 December 2020 is a strategic framework document of the highest order in the hierarchy of national programming documents.

The document is based on the vision, goals and priorities of the National Development Programme BULGARIA 2030 approved by Decision No. 33 of the Council of Ministers of 20 January 2020. Three strategic goals have been determined – accelerated economic development, demographic upswing and reduction of inequalities, the implementation of which is envisaged through targeted policies and interventions, grouped into five interconnected and integrated development axes and 13 identified national priorities. The National Development Programme BULGARIA 2030 consists of detailed strategies for the priorities, an indicative financial framework, a preliminary impact assessment, as well as a mechanism for monitoring the implementation of the strategic document.

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.

In accordance with Article 2.2 of the Kyoto Protocol, Bulgaria is committed to achieving a limitation or reduction of GHG emissions not controlled by the Montreal Protocol from aviation and marine bunker fuels, working through the International Civil Aviation Organisation (ICAO) and the International Maritime Organization (IMO) respectively.

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.

As a Member state, Bulgaria follows and implements a common EU policy regarding marintime.

In 2013, the Commission set out a strategy (https://ec.europa.eu/clima/sites/clima/files/transport/shipping/docs/com_2013_479_en.pdf) for available translations of the preceding for progressively integrating maritime emissions into the EU's policy for reducing its domestic greenhouse gas emissions.

The strategy consists of 3 consecutive steps:

- Monitoring, reporting and verification of CO_2 emissions from large ships using EU ports;
- Greenhouse gas reduction targets for the maritime transport sector;
- Further measures, including market-based measures, in the medium to long term.

First step: monitor and report emissions

Large ships over 5 000 gross tonnes loading /unloading cargo/ passengers from 1 January 2018 at EU maritime ports are to monitor and later report their related CO2 emissions and other relevant information in accordance with their monitoring plan.

Monitoring, reporting and verification of information shall be done in conformity with Regulation 2015/757 (as amended by Delegated Regulation 2016/2071). Three other legal acts are also relevant: Delegated Regulation 2016/20172 regarding verification and accreditation activities, Implementing Regulations 2016/1927 on templates and Implementing Regulation 2016/1928 further defining cargo carried for some ship categories (https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32016R1928&from=BG).

Main obligations can be summarized are as follows:

- By 30 August 2017, MRV companies shall submit to an accredited MRV shipping verifier a monitoring plans using a template corresponding to the model in Annex I of Implementing Regulation (EU) 2016/1927 (for more information see also our FAQs document). Electronic templates will also be developed under THETIS MRV (the dedicated European Union information system currently under development by the European Maritime Safety Agency);
- From 1st January 2018, MRV companies shall monitor for each of their ship CO2 emisssions, fuel consumption and other parameters, such as distance travelled, time at sea and cargo carried on a per voyage basis, so as to gather annual data into a Emissions report submitted to an accredited MRV shipping verifier;
- From 2019, by 30 April of each year MRV companies shall submit to the Commission through THETIS MRV (a dedicated European Union information system currently under development by the European Maritime Safety Agency) a satisfactorily verified Emissions report for each of the ships having performed EEA related maritime transport in the previous reporting period (calendar year);
- From 2019, by 30 June of each year MRV companies shall ensure that, all their ships having performed activities in the precedent reporting period and visiting EEA ports, carry on board a document of compliance issued by THETIS MRV. This obligation might be subject to inspections by Member States' authorities.

ICAO

Regarding aviation emissions Bulgaria, as part of EU, taking action to reduce aviation emissions in Europe and working with the international community to develop measures with global reach.

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.

Therefore, as a member to ICAO, Bulgaria is fully committed to and involved in addressing the challenges caused by climate change and is promoting resource-efficient, competitive and sustainable aviation.

EU ETS

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.

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

The formulation of climate policy in Bulgaria follows EU policy. EU policy has taken into account the minimization of the adverse effects of emissions reduction policies and measures, according to Articles 3.14 of the Kyoto Protocol.

Impacts on third countries are mostly indirect and can frequently neither be directly attributed to a specific EU policy, nor directly measured by the EU in developing countries. Therefore, the reported information covers potential adverse social, environmental and economic impacts that result from complex assessments of indirect influences and that are based on accessible data sources in developing countries.

The most important continuous activity in this respect is the EU's wide-ranging impact assessment system accompanying all new policy initiatives. This approach ensures that potential adverse social, environmental and economic impacts on various stake-holders and third Parties are identified and minimized within the legislative process. In general, impact assessments are required for all legislative proposals, but also other important Commission initiatives which are likely to have far-reaching impacts. Consulting different stakeholders is an obligation for every impact assessment.

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.

5.8.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) 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.
14) National Programme for Waste Management Activities 2009-2013;
15) National Action Plans on Energy Efficiency for 2008-2016.

6. Projections and total effect of policies and measures

6.1.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), Natioal Energy Strategy until 2020 and the latest available energy projection scenarios.

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 2020, 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 2020 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 2013-2020, for the "with measures" and "with additional measures" scenarios.

These projections were compiled on the basis of 2022 inventory submission for the year 2020 using 2006 IPCC Guidelines and Global Warming Potential (GWP) from Forth Assessment Report (4 AR).

6.2. Sectoral projections

6.2.1. Energy

The projections for greenhouse gas emissions for the energy sector are based on an analysis of the country's energy balance change until 2030 based on existing measures planned by the Bulgarian government and provided as main assumptions and drivers. This analysis follows the modelling approach (BEST software for long-term assessment and energy planning). The projections take account of all existing measures to reduce greenhouse gas emissions and the existing measures for achieving the RES targets and EE.

Table 6.1 Emission projections for sector Energy - scenario with measures, Gg CO_2 eq

	Historical emissions							*WEM Projections*		
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2017**	**2020***	**2025**	**2030**
Total	71 271	51 432	40 933	45 857	462 27	45 774	45 014	35 064	35 357	34 654

*inventory data

The main drivers for this decrease are the change undergoing in the energy system namely primary energy production decreases over the analysed period, by almost 8.5 TWh. This occurs in large part due to a sustained decrease in solids-based energy production from 2020 to 2030, which is the main emitter of GHGs in the energy sector, while there is a sustained increase in biomass, as biomass blending in power plants is increasingly being used. Wind, hydro and geothermal remain constant, whereas natural gas share increases from 1.06% in 2020 to 2.34% in 2030. Solar also sees an increase from 1.18% in 2020 to 3.95% in 2030. In 2030, nuclear energy is also expected to continue to play an important role in energy production.

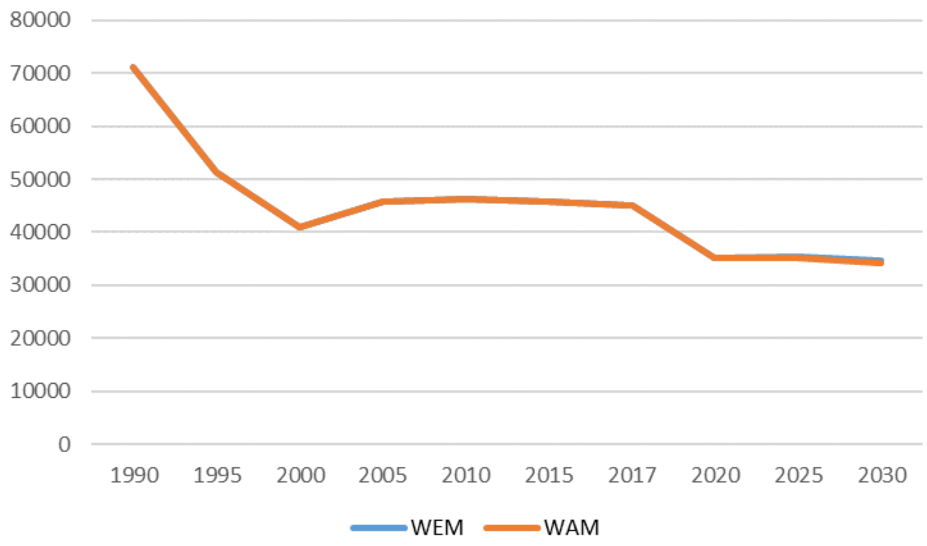
Table 5.2 Emission projections for sector Energy - scenario with additional measures, Gg CO_2 eq.

	Historical emissions							*WAM Projections*		
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2017**	**2020***	***2025***	***2030***
Total	71271	51432	40933	45857	46227	45774	45014	35064	*35243*	*34 130*

*inventory data

The projections take account of all existing measures and additional measures to reduce greenhouse gas emissions. Bulgaria undertakes significant measures in restructuring the energy system of the country – introduction of additional to the existing measures for stimulating RES towards an overall target of approximately 27% in the final energy consumption. In addition, following the implementation of energy efficiency measures and policies, a decrease in final energy consumption is expected within all sectors, which will subsequently lead to further reductions of GHG emissions.

Figure 6.1 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.

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

Energy Industries subsector comprises the following activities

- generation and transmission of electricity, including cogeneration;
- generation and transmission of heat for public use;
- transmission of natural gas (maintaining the pressure of the compressor stations).

The energy industries sector consists of large-scale electricity and heat production facilities. This is the sector responsible for the largest amount of greenhouse gas emissions. This sector is projected to continue to emit the largest share of emissions.

– **Scenario with measures – WM**

Table 6.3 Energy industries– scenario with measures, Gg CO_2 eq.

	Historical emissions							*WEM Projections*		
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2017**	**2020***	***2025***	***2030***
Total	36538	27447	24190	27099	31333	29779	27661	18250	*18231*	*18067*

*inventory data

It is difficult to project 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.

– **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.

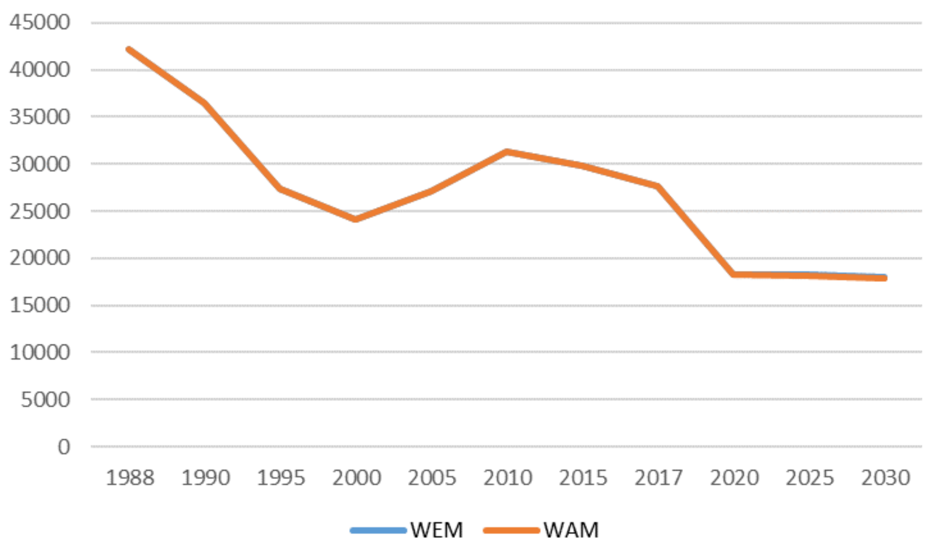
In this scenario, the projections are that the sector will continue to emit the largest share of emissions. The projected emission trends in the Energy Industries sub-sector are given in the table below:

Table 6.4 Aggregate GHG emissions from the Energy Industries Sector, Gg CO_2 eq. – scenario with additional measures

	Historical emissions							*WAM Projections*		
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2017**	**2020***	***2025***	***2030***
Total	36538	27447	24190	27099	31333	29779	27661	18250	*18213*	*17885*

*inventory data

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



Over the years to 2030, final energy consumption from various sectors of the industry will maintain relatively constant levels, but a significant decline in the use of solid and liquid fuels, including diesel, is expected for electricity generation in the manufacturing industries and construction subsector, while increasing the renewable energy production for own usage.

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.

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.

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.

6.2.2. 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.

The projections for this subsector are based on the expectations and projections for economic development, the share of individual subsectors, the forecasts for fuel use, as well as the overall forecasts for the use of some of the main energy sources.

- **Scenario with measures – WM**

Table 6.5 Aggregate GHG emissions from the Industry Sector (fuel emissions), Gg CO_2 eq. – scenario with measures

	Historical emissions							*WEM Projections*		
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2017**	**2020***	***2025***	***2030***
Total	17763	13085	7224	7083	3158	2859	3600	4274	*4146*	*3980*

*inventory data

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.

A slight decrease of greenhouse gas emissions from the Manufacturing Industries and Construction subsector is expected in 2025, which can be explained with the expected development of the subsector in a positive direction. Subsequently, by 2030, greenhouse gas emissions from the Manufacturing Industries and Construction subsector register a further decline as a result of the existing policies and measures driving energy efficiency and renewable energy incentives in the industry.

– **Scenario with additional measures – WAM**

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

Table 6.6 Aggregate GHG emissions from the Industry Sector (fuel emissions), Gg CO_2 eq. – scenario with additional measures

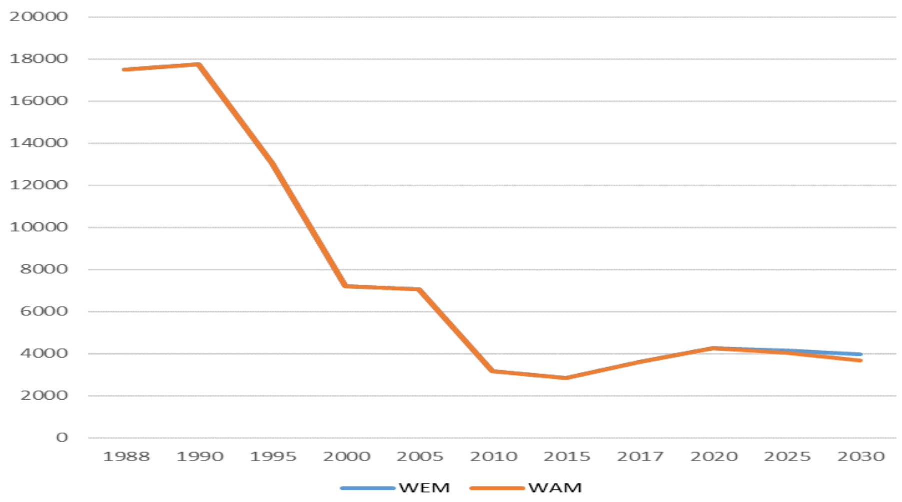
	Historical emissions							*WAM Projections*		
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2017**	**2020***	***2025***	***2030***
Total	17763	13085	7224	7083	3158	2859	3600	4274	*4061*	*3695*

*inventory data

It is expected the registered greenhouse gas emissions expected to fall by 2030 by more than 14% or 2 times more than when applying only to existing measures. This would be a result from the implementation of existing policies and measures and by the introduction of a number of additional measures, discussed in detail in the sections on energy efficiency which is seen by the overall decrease in the energy intensity of the industrial sectors and the stimulation of RES in the industry. The implementation of these measures will contribute to the achievement of national targets for the reduction of greenhouse gases.

Consumption of energy from different sectors of the industry over the period considered until 2030 will maintain relatively constant levels, with no significant peaks and downturns expected to be recorded in given production. The scenario under consideration again features a significant decline in the use of solid and liquid fuels in the production of electricity in the sub-sector of the industry - about 1.1 times higher than the expected decrease in the implementation of existing measures alone.

Figure 6.3 GHG emissions, Manufacturing Industries and Construction (fuel emissions), under the two scenarios



6.2.3. Transport Sector

The projections for the development of the Transport has been prepared in accordance with the projections for the use of fuels in the sector.

Estimates of CO_2 emissions from the Transport subsector are calculated on the basis of projections for energy consumption in the transport sector. The transport sector is divided into four sub-sectors: road traffic, air traffic, rail traffic and shipping.

Between 1988 and 1991, fuel consumption in the transport sector decreased by 48% as a result of the economic downturn. Since 1991, fuel consumption has been steadily increasing mainly due to road transport. Although there has been a decline in 2013, the use of road transport fuels has started to increase again since 2014.

– **Scenario with measures - WM**

Table 6.7 Aggregate GHG emissions from the Transport Sector, Gg CO_2 eq. – scenario with measures

	Historical emissions							*WEM Projections*		
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2017**	**2020***	***2025***	***2030***
Total	6522	4325	5474	7832	7998	9308	9543	9351	*9370*	*9033*

*inventory data

Concerning greenhouse gas emissions projection from the Transport sector, it can be concluded that by 2030 a slight decrease is expected compared to 2020, as the additional measures are barely overcoming the effects of the increase of economic activity.

Private road transport is expected to increase throughout the entire period, remaining the main part of this sector.

In terms of renewable energy used in transport sector, a diversification of the sources is expected, by the introduction of advanced biofuel (352 GWh in 2030) and hydrogen (34 GWh in 2030). Furthermore, the electricity share within the renewable energy, is forecasted to almost double in 2030 compared to 2020 level.

– **Scenario with additional measures – WAM**

The scenario with additional measures reflects all adopted policies and measures to reduce GHG emissions in the country 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 6.8 Aggregate GHG emissions from Transport Subsector, Gg CO_2 eq. – Scenario with additional measures

	Historical emissions							*WAM Projections*		
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2017**	**2020***	***2025***	***2030***
Total	6522	4325	5474	7832	7998	9308	9543	9351	*9359*	*8977*

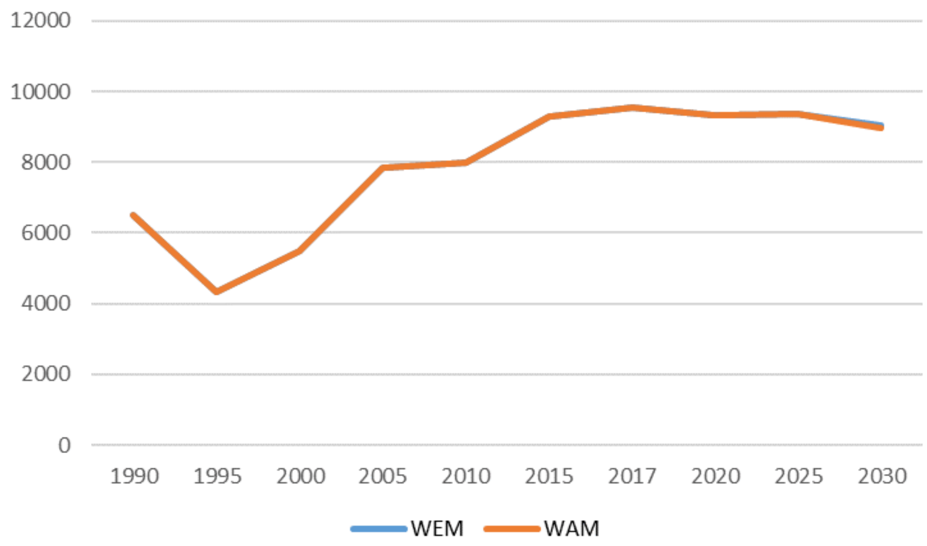
*inventory data

With regard to the greenhouse gas emissions from the Transport sub-sector, in the scenario under consideration with respect to the implementation of additional measures, it can be concluded that by 2030 there is a slight decrease, compared to the 2020.

The overall increase of final energy demand within transport segment is driven by the aviation segment, which is expected to increase by approximately 35% compared to 2020 level. On the other hand, private road transport is expected to decrease between 2020 – 2030 while a slight growth of rail activity is projected.

In terms of renewable energy used in transport sector, a diversification of the sources is expected, by the introduction of advanced biofuels (1,095 GWh in 2030) and hydrogen (32 GWh in 2030). These developments in the energy sector, including the forecasted increase in the share of public electric transport and electric and hybrid vehicles, as well and charging infrastructure in urban areas in the transport sector lead to the recorded decrease in GHG emissions.

Figure 6.4 GHG emissions, Transport Sector under the two scenarios



6.2.4. 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.

Scenario with measures – WM

Table 5.9. Aggregate GHG emissions from Industrial Processes and Product Use sector, Gg CO2 eq. – Scenario with measures

	Historical emissions							*WEM Projections*		
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2017**	**2020***	***2025***	***2030***
Total	10084	10486	7230	7712	4442	7214	8987	5300	*6380*	*6806*

*inventory data

The projections for the development of the IPPU sector reflects the expectations of recovery and smooth growth after the registered downturn as a result of the economic crisis. The change in the structure of the industry is a result of the predicted change in the structure of the subsectors.

Scenario with additional measures – WAM

Table 5.10. Aggregate GHG emissions from Industrial Processes and Product Use, Gg CO2 eq. – Scenario with additional measures sector

	Historical emissions							*WAM Projections*		
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2017**	**2020***	***2025***	***2030***
Total	10084	10486	7230	7712	4442	7214	8987	5300	*6196*	*6602*

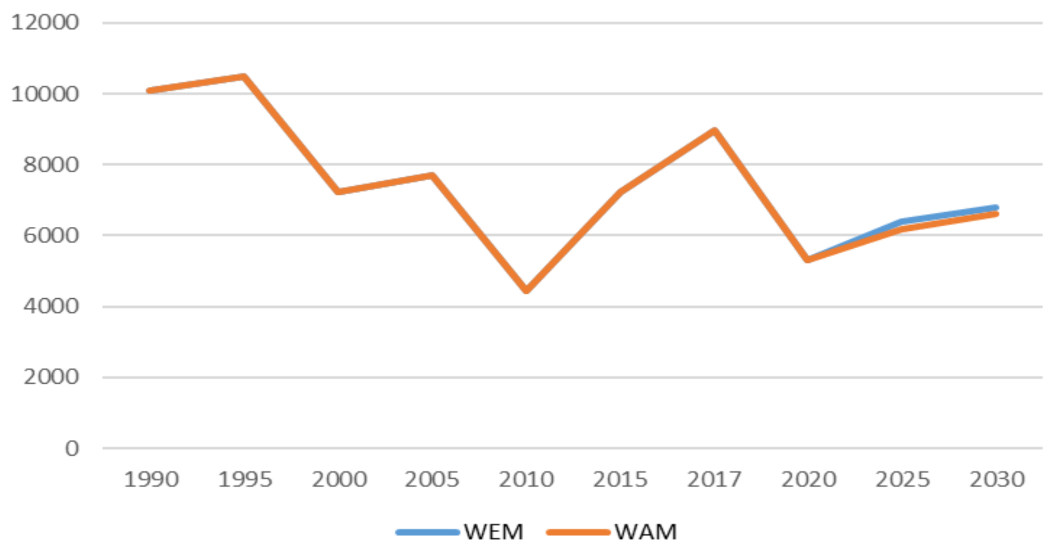
*inventory data

In WAM scenario, given the expected economic growth, an increase in greenhouse gas emissions from the Industrial Processes sector is expected compared to 2020.

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

Comparison between the two scenarios

Figure 5.5. GHG emissions from IPPU sub-sector under the two scenarios



6.2.5. 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.

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.

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 2014-2020. 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 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.

The projected emissions from the sector imply the implementation of programs for reducing the amount of biodegradable waste for landfill, as well as the capture and burning of methane at the landfill. Best practices can ensure that only about 50% of the gas generated is captured and burned.

Scenario with measures – WM

Table 5.11 GHG emissions from Waste sector, Gg CO_2 eq. – scenario with measures

	Historical emissions							*WEM Projections*		
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2017**	**2020***	***2025***	***2030***
Total	4738	4006	3787	3503	3364	3206	2938	2634	*2290*	*1947*

*inventory data

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

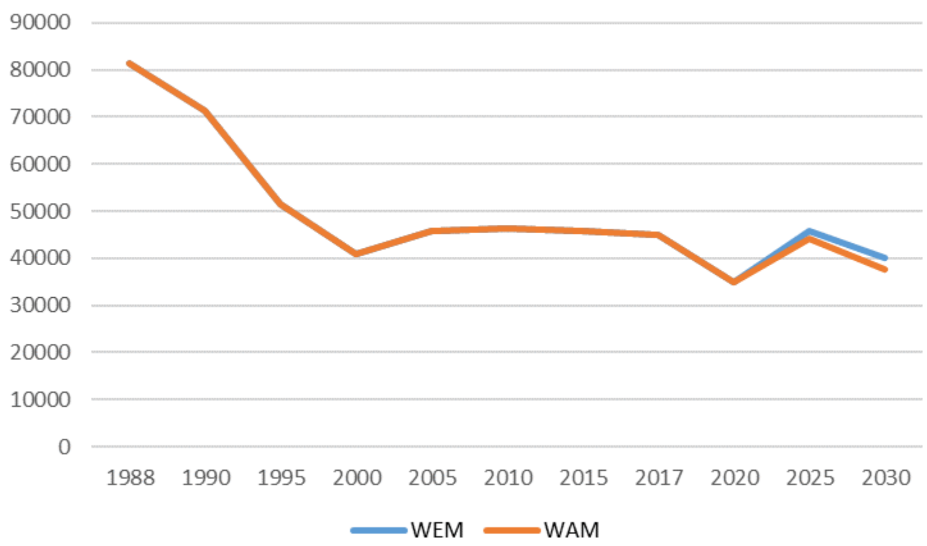
	Historical emissions							*WAM Projections*		
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2017**	**2020**	***2025***	***2030***
Total	4738	4006	3787	3503	3364	3206	2938	2634	*2061*	*1489*

*inventory data

The projected emissions in the Waste sector following the implementation of the existing measures. Continuation and upgrade of the measures from the Third national climate action plan is envisaged here. GHG emissions in the sector are expected to decline by just over 43% by 2030 compared to 2020, and the levels in the scenario that considers only existing measures remain. The additional measures envisaged have an impact on the reduction of greenhouse gas emissions by 2025, speeding up the process, but do not affect the result of reducing GHG emissions. This is also due to the implementation of the National Waste management program in which specific measures for decline of waste disposal on landfills and intensified waste separation and recycling, as well as utilization as per the waste hierarchy are envisaged. An improved waste management and biodegradable waste collection and utilization is essential also for the realization of both scenarios in particular for the WAM scenario, which relies heavily on biomass and renewable (biodegradable) waste utilization in the energy sector.

Comparison between the two scenarios

Figure 6.6 Aggregated GHG emissions, Waste Sector under the two scenarios, Gg CO_2 eq.



6.2.6. 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.

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

	Historical emissions							*WEM Projections*		
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2017**	**2020***	***2025***	***2030***
Total	12263	5753	5015	4995	5289	6075	6394	6188	*6875*	*7372*

*inventory data

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.

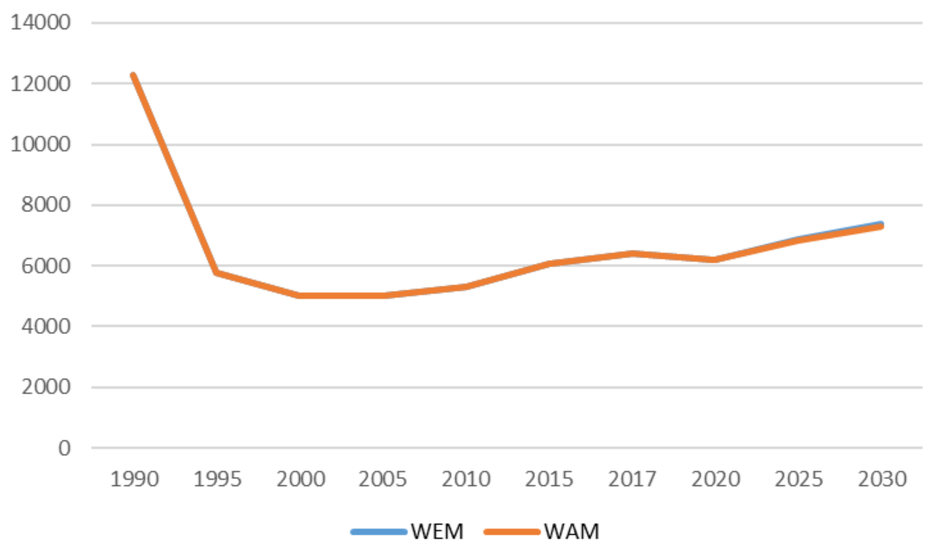
Table 6.14 Aggregate GHG emissions from the Agriculture Sector Gg CO_2 eq. – scenario with additional measures

	Historical emissions							*WAM Projections*		
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2017**	**2020***	***2025***	***2030***
Total	12263	5753	5015	4995	5289	6075	6394	6188	*6823*	*7287*

*inventory data

Comparison between the two scenarios

Figure 6.6 GHG emissions, Agriculture Sector under the two scenarios



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

Activity data estimates are made by 2030, taking into account the objectives set out in the following strategic document:

- Third National Action Plan on Climate Change (2013-2020 г.)
- National Strategy for the Development of the Forestry Sector in the Republic of Bulgaria for the period 2013-2020.
- Strategic Plan for Development of the Forestry Sector 2014-2023.
- EU agricultural policy 2014-2020
- National Reporting Plan for Forests, containing the reference level for forests of Bulgaria for 2021-2025.

The main category that contributes to the GHG removal is the Forest sector. All other categories (Arable land, Urban areas, Water areas) are sources of CO_2 emissions. The main reason for the overall steady results for the removals is due to the reduction of the absorption from the Forest category and the slight increase in the emissions from the Arable land, Urban areas, Water areas.

The main reason for the decline in the absorption by the Forest category is the observed decline in the rate of forest growth and the average age of forests.

The increased use of biomass is expected not to disrupt the land use and hence the LULUCF sector, as the land envisaged for energy crops is not expected to increase significantly. It is assumed that for biomass production Bulgaria would be utilizing the untapped potential of biomass the biodegradable fraction of products, waste and residues from biological origin from agriculture, including vegetal and animal substances, from forestry and related industries, including fisheries and aquaculture, as well as the biodegradable fraction of waste, including industrial and municipal waste of biological origin, compliant with the sustainability criteria set in article 29 of DIRECTIVE (EU) 2018/2001 of 11 December 2018 on the promotion of the use of energy from renewable sources (RED Directive).

The land necessary for production of conventional biofuels will increase slightly over the period until 2030. The additional land required for the production of advanced biofuels are considered insignificant. No additional land is assumed to be required for the production of biomass.

According to the forecasts though, Bulgaria fulfils its obligation not to reduce the GHG removal capacity below the reference level until 2030.

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

	Historical emissions							*WEM Projections*		
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2017**	**2020***	***2025***	***2030***
Total	-17889	-17639	-17757	-16914	-12299	-8081	-9811	-9605	*-9659*	*-9713*

*inventory data

– **Scenario with additional measures – WAM**

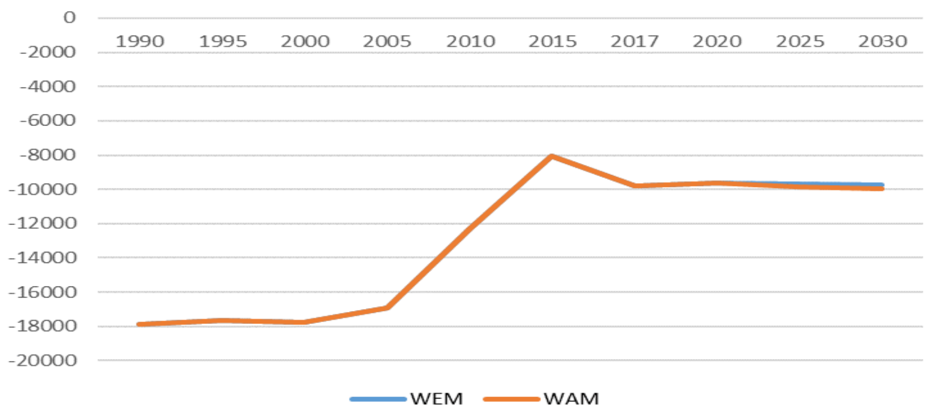
The scenario with additional measures reflects all adopted policies and measures to reduce GHG emissions in the country in this sector and includes the impact of policies and measures presented in this report.

Table 6.16 Aggregate GHG emissions from the Land Use, Land Use Change and Forestry Sector – scenario with additional measures

	Historical emissions							*WAM Projections*		
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2017**	**2020***	***2025***	***2030***
Total	-17889	-17639	-17757	-16914	-12299	-8081	-9811	-9605	*-9873*	*-9981*

*inventory data

Figure 6.7 Reduction of CO_2, from the Land Use, Land Use Change and Forestry Sector under the two scenarios



6.3. 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 2020.

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

Table 6.17 Aggregate GHG emissions of Bulgaria (excl. LULUCF)– Gg CO_2 eq. - scenario with measures

	2020*	2025	2030
Total emissions, WEM	49 186	50 902	50 779

*inventory data

The scenario with additional measures reflects all adopted policies and measures to reduce GHG emissions in the country after 2020 and includes the impact of policies and measures presented in this Plan that have a quantitative assessment at this stage.

Table 6.18 Aggregate GHG emissions of Bulgaria - Gg CO_2 eq. - scenario with additional measures

	2020*	2025	2030
Total emissions, WAM	49 186	50 323	49 508

*inventory data

Comparison between the two scenarios is presented in the following Table 5.18

Table 6.19 Comparison between GHG emissions, aggregated for Bulgaria under the two scenarios

	2020	2025	2030
Aggregate emissions in Gg CO_2 eq. ΔWAM-WEM	0	579	1271
Δ WAM - WEM, %	0	1,2	2.6

6.4. 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 CO_2 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.

Bulgaria does not plan to use the market-based mechanisms to meet its Kyoto Protocol target.

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 5.19.

Table 6.20 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)

The National Trust EcoFund (NTEF) was established in October 1995. The Fund manages assets from the state budget, including under the Debt-for-Environment and the Debt-for-Nature swaps.

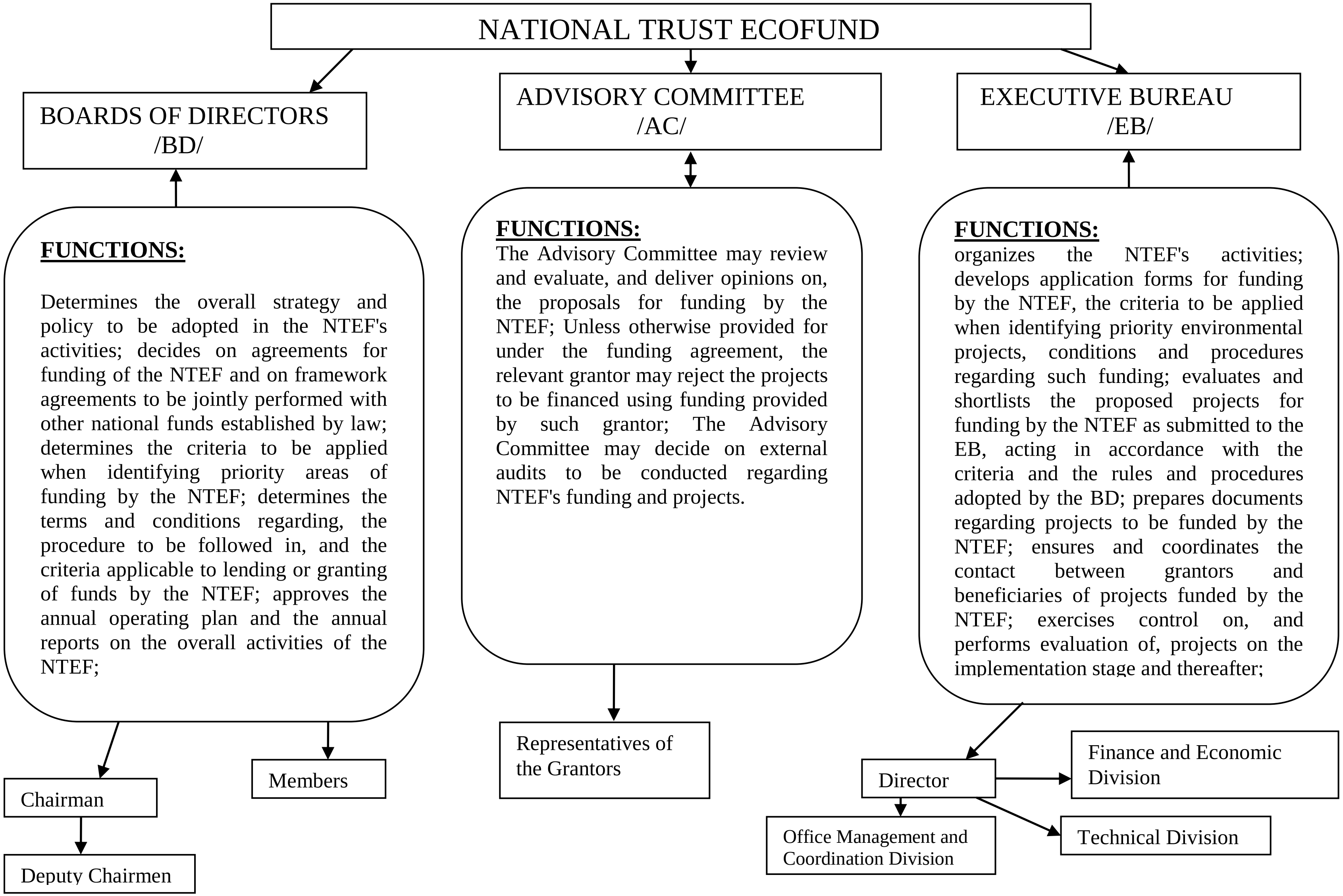
Funds are also generated via the Assigned Amount Units (AAUs) international trade deal(s), the sale of greenhouse gas emissions quotas for aviation activities, as well as funds, provided by other environmental protection agreements between the Republic of Bulgaria and international or local financing sources.

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 6.8 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 5.20 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 6.21 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

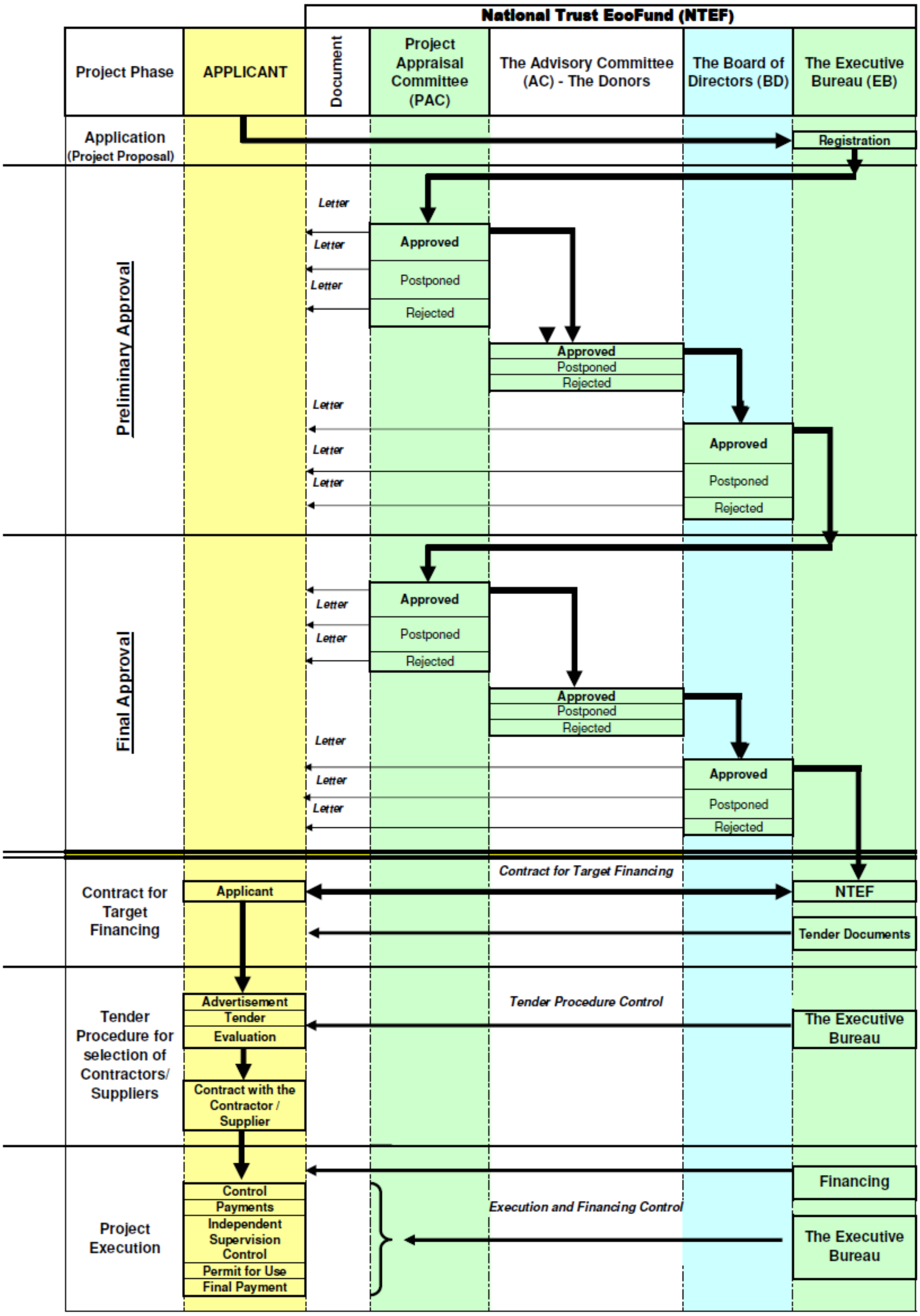
TOTAL	15 430	4 336 320	69 979

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 6.9 Schematic diagram showing the application handling procedure by NTEF



6.5. Methodology used for the presented GHG emission projections

The GHG projections for energy sector had been prepared by (B)EST stands for (Bulgaria) Energy System Tool: the (B)EST tool has been developed by E3Modelling and adapted to Bulgarian circumstances. It is designed as a one-shot country-specific model for single-country projections, aiming at addressing energy system planning, power generation investment, energy price forecasting (including removal of energy subsidies) and climate change mitigation policies including energy efficiency policies. The model incorporates energy related CO_2 emissions, environmentally oriented policy instruments and emission abatement technologies. The model is designed for medium-term and long-term projections and produces analytical quantitative results in the form of detailed energy balances up to 2050/2070. The model is a simulator of:

- Energy demand by sector and by energy product driven by the development of activity, income and energy prices

- Energy supply by energy carrier driven by energy demand and costs

- Energy prices resulting from explicit market equilibrium, and

- Investment in demand and supply sectors, driven by costs, technology progress and the dynamic turnover of the energy capital in the various sectors.

The demographic projections of population and labour force were provided by the Bulgarian Ministry of Labour.

The macro-economic projections (GDP) as well as sectoral value added in the split required by the (B)EST model was provided by the Bulgarian Ministry of Finance.

The modelling requires the transformation of sectoral value added into physical output indicators: this transformation was undertaken by E3Modelling using past data from the Eurostat PPROD database and extrapolated to the future. The assumption follows (in line with previous assumptions e.g. of the Reference scenario 2016 of the European Commission) the concept that within the EU there will be an increasing shift towards products with higher value added, implying that the physical quantities will not increase in parallel with increasing value added, but there will be a relative decoupling of physical quantities from growth in value added.

EUROSTAT and the National Statistics Institute of Bulgaria information was used for energy balances and other energy relevant information.

Table 5.22: Macroeconomic indicators

	2020	2025	2030
Macroeconomic drivers			
Population (in Million)	7,0	6,8	6,6
GDP (in Billion €)	54,0	62,3	71,1
GDP per capita (in €/capita)	7773,3	9193,3	10755,0
International Fuel prices (in €/MWh)			
Hard Coal	8,0	9,0	9,6
Crude Oil	36,9	45,2	51,6
Natural Gas	22,9	25,7	27,2
Key Policy variables			
Carbon price ETS sectors (in €/tnCO2)	24	28,8	31,2

Sectoral Value Added (in M€)			
Iron & Steel	333,3	388,6	437,5
Non Ferrous	825,4	926,2	993,7
Chemicals	406,3	429,5	441,9
Building Materials	432,6	483,5	528,5
Paper & Pulp	430,4	492,6	551,1
Food,Drink,Tobacco	1120,6	1199,9	1248,1
Engineering	1584,4	1870,8	2128,3
Textiles	665,7	636,2	602,9
Other Industries	2959,2	3312,5	3608,4
Services	32446,1	37694,0	43218,1
Agriculture	2131,3	2193,3	2345,6

WEM scenario

This scenario represents a with Existing Measures scenario (WEM): only currently implemented policies at national and European level are included. The majority of policies currently implemented at Bulgarian level have a very short time horizon, implying that their effects are very short lived.

The main policies influencing this scenario are the EU ETS (effecting power generation and industry), the CO_2 standards for cars, vans and trucks (affecting the transport system) as well endogenous market trends (changing of equipment of appliances with more efficient ones).

WAM scenario

The WAM scenario implemented the national and European policy measures which implementation are presented in the chapter 4 Policy and Measures.

The main reference list for national and European policy considred in the model are:

Policy/Measure	Description	Modelling Driver	Observed Impacts	WEM	WAM
EU ETS Directive	Directive 2003/87/EC as amended by Directive 2004/101/EC (international credits), Directive 2008/101/EC (aviation), Directive 2009/29/EC (revision for 2020 climate and energy package)	EU-ETS prices were implemented in the WEM and WAM scenario	The model assumes perfect foresight in the supply side and in the energy intensive industries implying that the investment decisions are influenced by the entire price trajectory of the projection period. The electricity price is significantly impacted by the increasing ETS prices, due to the high carbon intensity of the power generation.	✓	✓

Renewable Energy Directive	Directive 2018/2001/EU	The costs related to investments induced through the RES-value are fully reflected in the model and recovered through electricity prices, heat steam prices or other.	The values of the RES-values (for RES-E, RES h&C and RES-T) are increased		✓
GHG Effort Sharing Decision	Decision 406/2009/EC	No specific driver required	In both scenarios Bulgaria is assumed to overachieve its emission reduction objective in the Effort Sharing (non-ETS) sectors.	✓	✓
Directive on the geological storage of CO_2	Directive 2009/31/EC	The Regulations and Directives for geological storage of CO_2 are taken into account through the cost of CO_2 storage.	No CCS developments would be economically viable under the scenario conditions. No known investments in CCS are assumed in the modelling	✓	✓
Industrial Emissions Directive	Directive 2010/75/EU	The number of operation hours for facilities not compliant with the directive are assumed to be enforced.	Any newly commissioned plants are assumed to be compliant with relevant emission standards.	✓	✓
F-gas Regulation	Regulation (EU) No 517/2014	The regulation limits the total amount of the most important F-gases, bans the use of F-gases in many new types of equipment where less harmful alternatives are widely available, prevents emissions of F-gases from existing equipment.	A number of technologies related to HFCs are considered already in both scenarios for the non-CO_2 emission projection as their costs are assumed to be below 0 in the MACC curve.	✓	✓

Energy efficiency and Stationary demand

The WEM scenario is characterised by slow decoupling of energy from GDP/value added growth in industry as well as services and residential: this can be understood e.g. by the divergence of physical production from value added. The WEM scenario further derives efficiency from the renewal of appliances/equipment at the end of their lifetime.

For the WAM scenario was assumed policies in the stationary demand side sectors inciting energy efficiency, represented as efficiency values which complemented by reducing perceived costs of more efficient appliances for equipment enhancing the effects of the eco-design and eco-labelling directives, which act as disincentives also for coal and liquid based heating options. The efficiency options in industry with the assumed ETS prices are limited, as significant market efficiency occurs anyhow in the scenario.

The scenario requires significant incentives for renewables in the demand side: this is observed through an increase in biomass consumption in households.

EU level policies

Policy/Measure	Description	Modelling Driver	Observed Impacts	WEM	WAM
Ecodesign Framework Directive	Directive 2005/32/EC: All regulations	The model parameters are implemented in order to mirror technology performance required by the regulations.	When substituting new equipment/appliances in the model the choice of appliances for the decision maker is limited by the eco-design regulation: only allowed appliances are available to users.	✓	✓
Energy Labelling Directive and delegated Regulations	Directive 2010/30/EU: all delegated regulations and supporting acts	This policy aims at improve consumer information through education and targeting labelling of appliances.	A higher uptake of more efficient equipment appliances compared to a scenario where no such measures would be in place. This effect is strengthened in the WAM scenario in order to achieve the obligation under the EED.	✓	✓✓
Energy Performance of Buildings Directive	Directive 2018/844/EU	New buildings are assumed to be in compliance with the EPBD.	Slight efficiency improvements compared to a scenario with no implementation of EPBD	✓	✓
Energy Efficiency Directive	Directive 2018/2002/EU	The EED is a broad policy with many facets. It is assumed that intelligent metering is gradually introduced in the electricity system.	Due to difficult policies in this sector only small effects are implemented	✓	✓

National level policies

Policy/Measure	Sector	Description	Modelling Driver	Observed Impacts	WEM	WAM
DESIRE	Residential	Policy measure providing incentives for the shift to natural gas:	Reduction of costs to shift towards natural gas. Increased perceived cost for shift to fossil solids and liquids.	Shift towards gas heating with gas (in WEM). In WAM the effect is balanced by the requirement for additional energy efficiency to achieve the required reductions	✓	✓
EED: Art. 7	*All demand*	*Policy package implementing article 7: while the policy is EU wide it remains clear that the implementing measures will have to be implemented at national level*	*Energy efficiency values, shifting towards more efficient technologies and fuels (e.g. shift away from solids and liquids)*	*See above*		✓

Mobile demand

Based on the assumptions transport activity increases significantly in particular for road freight transport, as well as for private transport.

In the WEM scenario CO_2 standards for cars and trucks are implemented for new vehicles, however given the high average age of vehicles in Bulgaria and the high share of second-hand vehicles in the Bulgarian market the uptake of new car vintages is relatively slow.

In the WAM scenario the additional measures of are implemented: environmental zones in urban where over 70% of the population lives are assumed to provide disincentives for older vehicles and therefore a reduction of the second-hand share in new vehicles is implied. Further the request for modal shifts has been implemented: this has been implemented by improving the perception of public transport. The effects of these measures are assumed to be moderate in this scenario.

EU level policies

Policy/Measure	Description	Modelling Driver	Observed Impacts	WEM	WAM
Regulation on CO2 from cars and vans	Regulation (EU) 2019/631	Average new stock of cars needs to comply with the CO_2 regulation on vehicles.	Uptake of less polluting vehicles, slight shift from large to smaller vehicles. Also, hybrids and electric vehicles penetrate to achieve the targets	✓	✓
Regulation EURO 5 and 6	Regulation (EC) No 715/2007	(B)EST pollutant extension: reducing emission factors over time	Emission factors reduce over time because of the policy. Further changes between scenarios are observed based on the changed fuel mix	✓	✓
Regulation Euro VI for heavy duty vehicles	Regulation (EC) No 595/2009	(B)EST pollutant extension: reducing emission factors over time	Emission factors reduce over time because of the policy. Further changes between scenarios are observed based on the changed fuel mix	✓	✓

National policies

Policy/Measure	Description	Modelling Driver	Observed Impacts	WEM	WAM
Policy package incentivising modal shift	Пolicies and measures will be put in place to incentivise modal shift towards rail and public transport in urban as well as interurban environments, including: (1)Low emission areas in urban centres, (2) Updating of the public transport system (new buses), (3) Additional rail options	The prices of circulation in urban areas is increased. Further the perceived costs of public transportation are increased so as to make it more appealing to actors to choose public road and rail over private road transportation	Model shifts toward rail and public transport increasing the activity of these transport modes in the WAM scenario		✓

Power generation and energy markets

As mentioned in the assumptions decommissioning was undertaken based on the information provided by the Bulgarian ministries. No additional decommissioning based on economic grounds happens in the models.

Expansion of international interconnectors is considered exogenous. As discussed with the Ministry of Energy electricity exports are considered stable throughout the projection period. The grid expansions required due to the additional RES capacity are included in the model and are paid for in the grid tariffs.

Small scale RES are assumed to be accounted for the in supply system of the model in the current version.

The changes in power generation are driven by the following elements:

- Commissioning/Decommissioning plan;
- ETS price development;
- In the longer term decreasing of techno-economic parameters of RES (PV and wind) and increasing ETS prices make RES competitive\

EU level policies

Policy/Measure	Description	Modelling Driver	Observed Impacts	WEM	WAM
Completion of the internal energy market (including provisions of the 3rd package).	Directive 2009/73/EC: market liberalisation	Due to market liberalisation the electricity prices will be aligned to market prices and over the projection period are assumed to become fully market based. The profit margin is assumed to change from negative in the tariff-based system to zero beyond 2030.	Electricity prices increase over the projection period: this is a combined effect of the changes in the power generation structure, the ETS prices in the carbon intensive power generation sector, and the market liberalisation and the transformation of the system towards a fully market-based tariff system.	✓	✓
Energy Taxation Directive	Directive 2003/96/EC	Alignment of taxation where necessary in the exogenous input on files	The taxation is in line the Energy taxation directive	✓	✓
Nuclear Safety Directive	Nuclear Safety Directive	These elements are included in the costs for fuels and nuclear installations		✓	✓
Nuclear Waste Management Directive	Nuclear Waste Management Directive			✓	✓
Basic safety standards Directive	Basic safety standards Directive			✓	✓

National policies

Policy/Measure	Description	Modelling Driver	Observed Impacts	WEM	WAM
No new lignite investments	Lignite investments no assumed to take place	Lignite investments are not permitted in the modelling of the supply side of the model		✓	✓
RES directive	Achievement of the RES targets	The RES-E value mimics policies in the supply side to increase the share of RES in the power generation system, in particular these would include: legislative facilitations, easier site availability or grid access, or even direct financial incentives			✓

Non-CO_2 Methodology

For the projections of IPPU, Agriculture, LULUCF and Waste sectors, the MACC curve is derived from the country specific MACC curve of EPA2019.

The projection estimates follow the methods used in the latest GHG Inventory in accordance with the IPCC 2006 Guidelines. In order to calculate the emission projections, parameters on in the National Inventory of Greenhouse Gases Emissions were used.

For the projection of the WEM and WAM the negatively priced technologies of the MACC curve for Bulgaria used are assumed to be implemented from 2025 onwards. The differences between the projections are driven also by the changes in the energy system.

6.6.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 CO2 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.

6.6.1. 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 CO2 eq. which means that the average cost of saved emissions is respectively 51 BGN/tonne and 62 BGN/tonne. This means that these measures have the lowest cost per tonne of saved emissions in the energy sector . In addition, the main sources of funding will be private investments, European programmes and revenues under art. 10c of Directive 2003/87/EC, which will significantly limit the use of public funds.

Another important tool for reducing emissions is the use of high efficiency cogeneration, where the investment is estimated at approximately 790 mln. BGN for the period 2013-2020 and will lead to emissions reduction of 1.6 mln. tonnes CO2eq. The estimated average price of a tonne saved emissions is 494 BGN, which significantly exceeds the results of the previous two measures.

Immediate effect from an increased share of electricity from renewable sources is the reduction of greenhouse gas emissions as this production does not generate any emissions. Bulgaria has a significant potential of renewable energy sources and the encouragement of investments therein directly contributes to diversification of the energy mix and to slowing down the process of exhaustion of local energy resources. An important aspect here is the decentralized production of energy and the consumption of energy from renewable sources by households. The specific measure to be implemented is to increase the share of energy for heating and cooling from renewable sources which will contribute to reducing greenhouse gas emissions by 488000 tonnes by 2020.

The most prominent of the indirect measures is the one aimed at increasing the share of electricity from renewable sources in the electricity mix and that is related and contributes to the implementation of the national target with regard to the share of renewable energy in the gross final energy consumption by 2020. The investments required for this measure are estimated at 4183 mln. BGN.

6.6.2. 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 CO2eq. 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 CO2. 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.

6.6.3. Industry

The measures in the Industry Sector are aimed at improving the energy efficiency and at optimal utilization of resources. The main source of funding is the programme “Competitiveness” and its eventual extension in the next programming period. The planned investments amount to 361.6 mln. BGN, of which 261.6 mln. BGN have a direct effect and the remaining 100 mln. BGN have an indirect effect. The investments are relatively small in volume with respect to the total investments in the economy. The estimated savings in CO_2 emissions from the measures with direct impact amount to 5.6 mln. tonnes, i.e. the investment per reduced tonne of emissions is slightly more than 46 BGN which makes the measures relatively efficient.

The direct measures involve, on one hand, the technology used in the industry thus creating preconditions for increase in production competitiveness by reducing the energy intensity in the sector and the final energy consumption.

Other measures are aimed at the utilization of alternative fuels such as biodegradable waste, thus increasing resource efficiency, decreasing the dependence on imported fuels and meeting the requirements related to the prohibition of landfilling of biodegradable waste. The measure is consistent also with the estimates in the macroeconomic scenario 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.

6.6.4. 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.

6.6.5. 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.

6.6.6. 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.

6.6.7. 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.

6.7. 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.

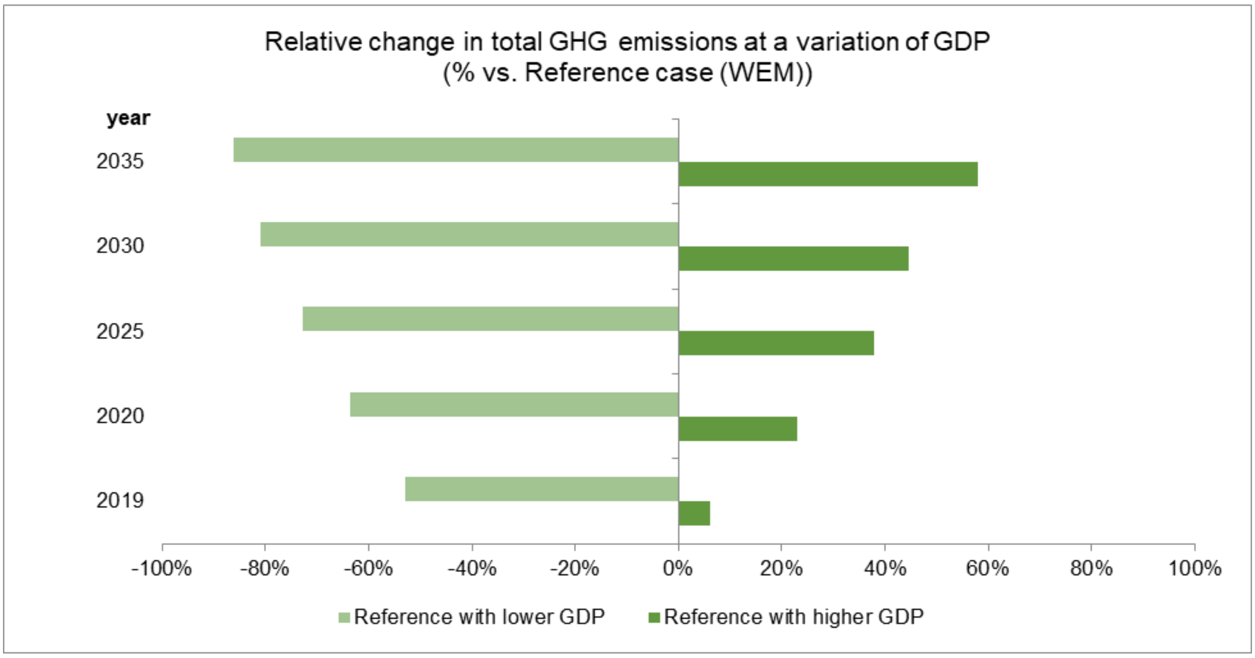
6.8. Specific assumptions related to the with measures scenario for GHG emissions

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.

Figure 5.10. Relative change in total GHG emissions at a variation of GDP (% vs. Reference case (WEM))



7. Vulnerability assessment, climate change impacts and adaptation measures

7.1.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.

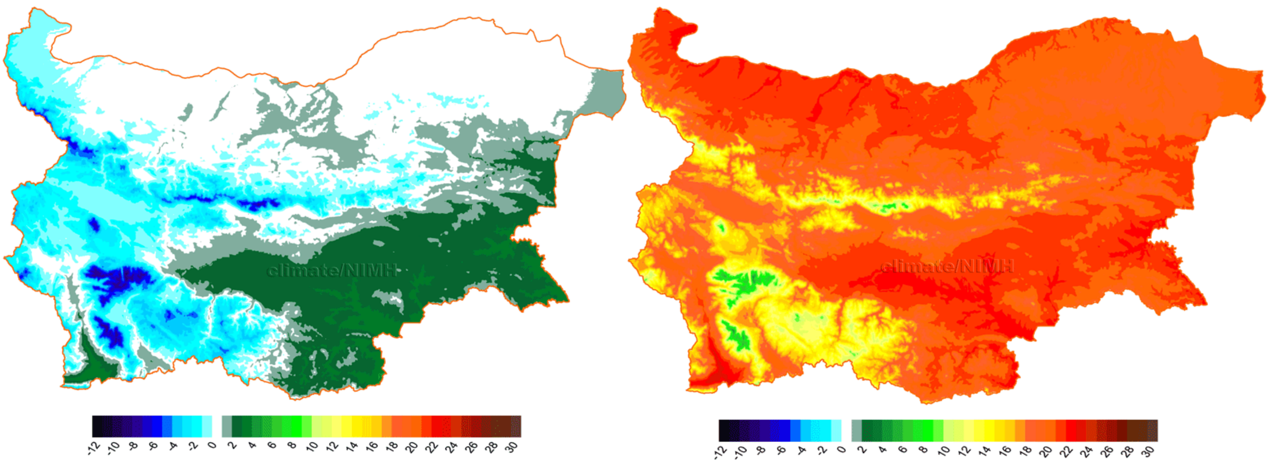
Clear expressed seasonality in the intra-annual course of insolation (relevant to the intra-annual alteration of sunshine duration) determines the levels of heat balance and thence the affiliation of the country to the regions of the continent with warmer climate. Because of the distance from the ocean, 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



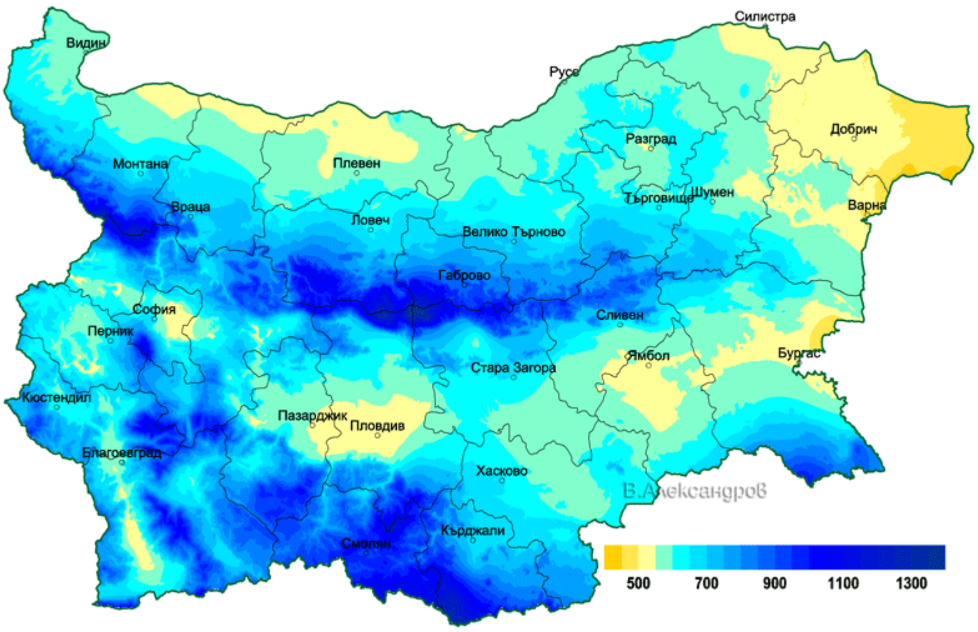
During the summer, thermal conditions are dominated by the transformed Atlantic air masses with Azorean origin in the circumstances of intense solar radiation. The temperatures to the north and south of the Balkan Mountains are almost equal. The average temperature for July is 21-24°C in the Danube Plain, 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 6.2 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 6.3 Anomalies of annual temperature in areas up to 800 m altitude for the period 1988-2016 relative to the period 1961-1990

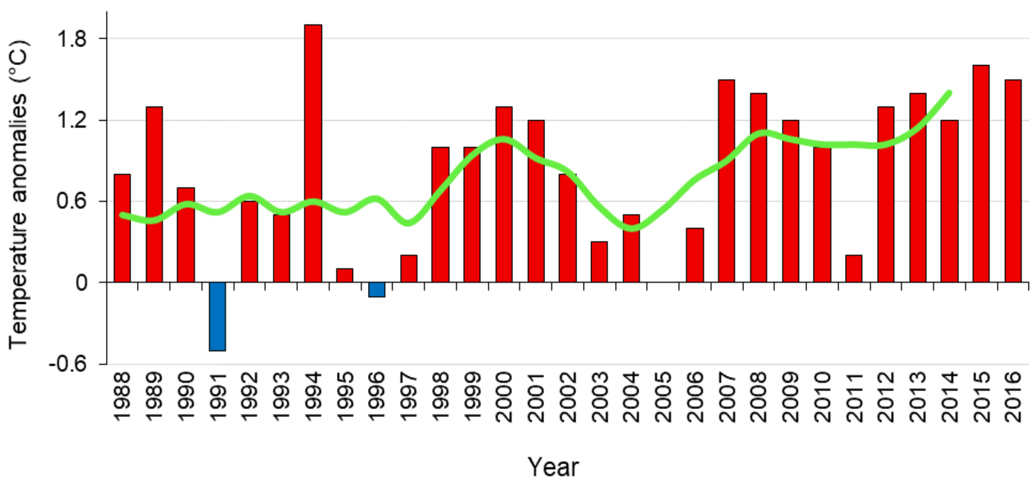
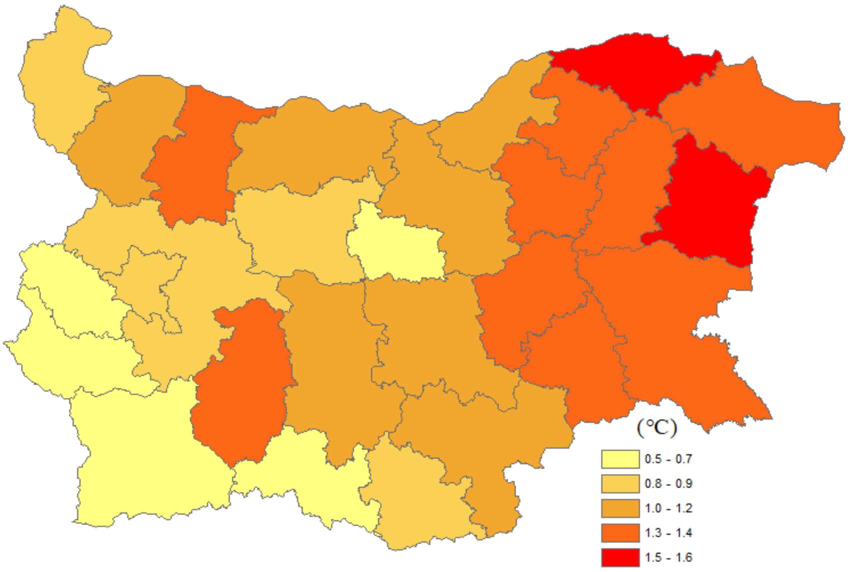


Figure 6.4 Deviations of annual average air temperature (°C) in areas up to 800 m altitude for 2020 relative to the climatic normal for the period 1961-1990 (averaging by districts)



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

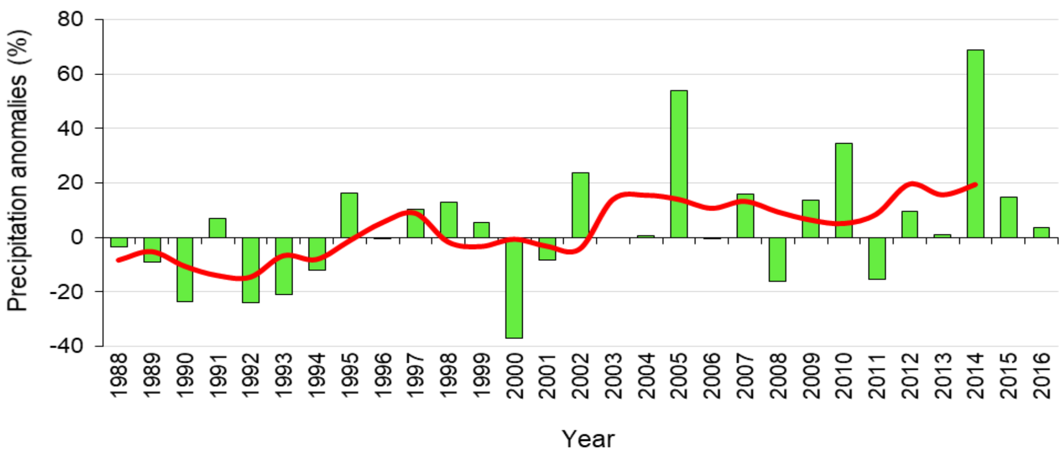
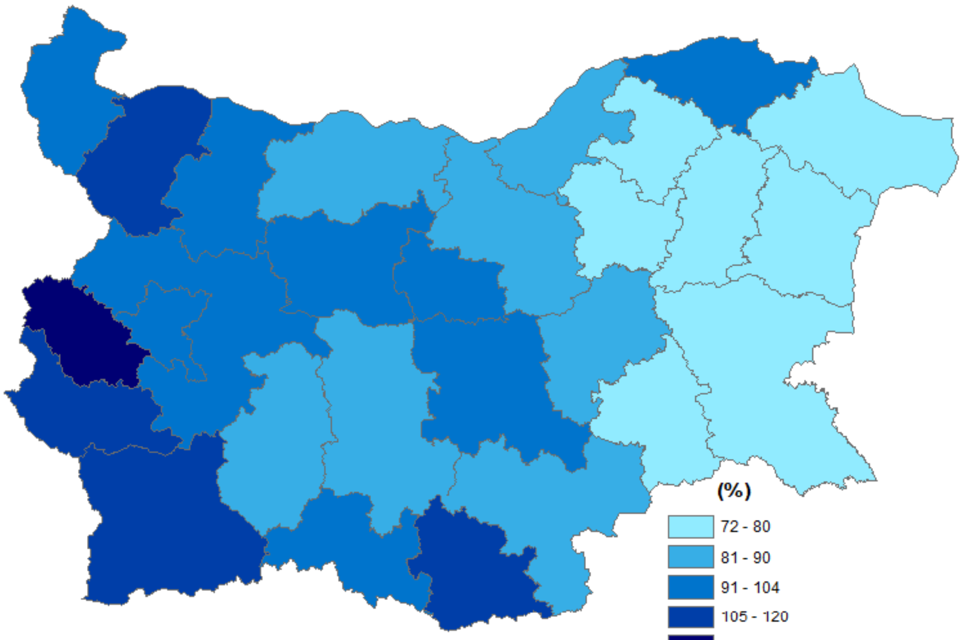
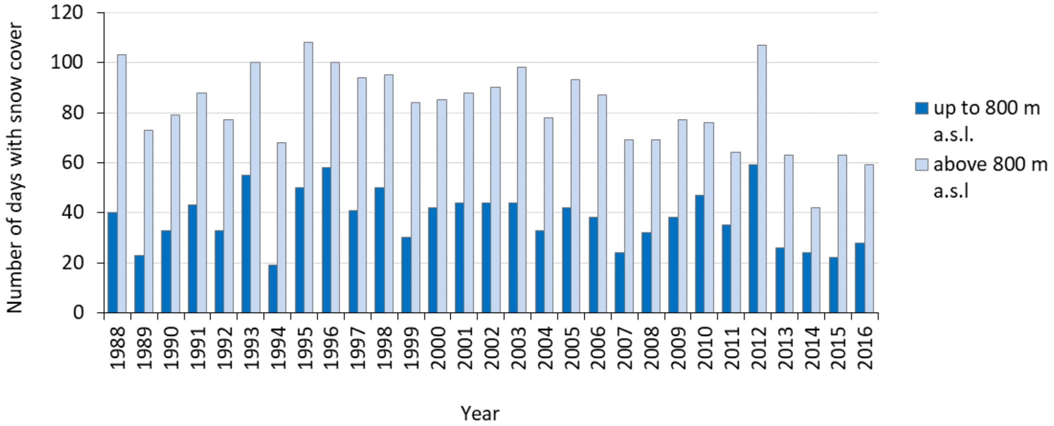


Figure 6.6 Deviations of annual precipitation (%) in areas up to 800 m altitude for 2020 relative to the climatic normal for the period 1961-1990 (averaging by districts)



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

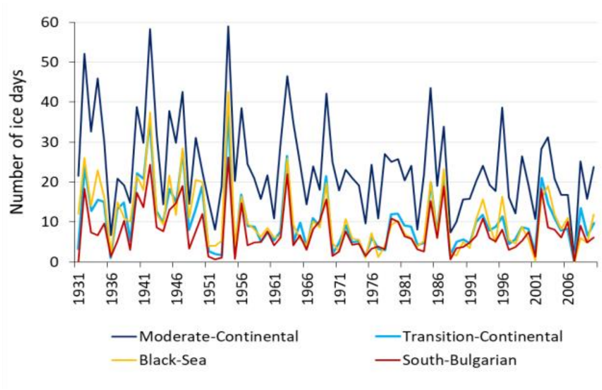


Fig. 6.8a. Number of ice days (daily $T_{max} < 0°C$) during the cold season (November-March)

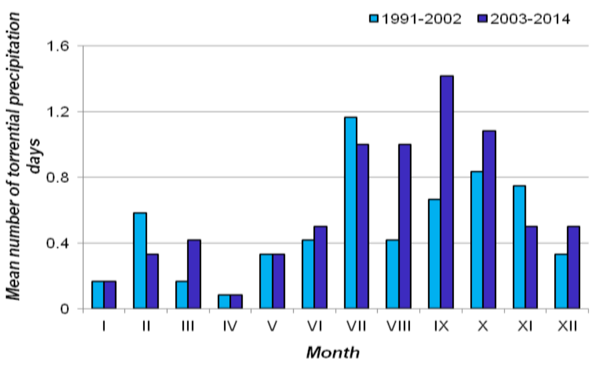


Fig. 6.8b. Intra-annual distribution of torrential precipitation days

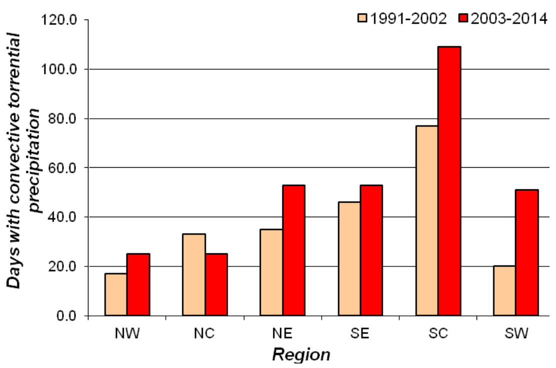


Fig. 6.8c. Distribution of days with convective heavy rainfall by regions

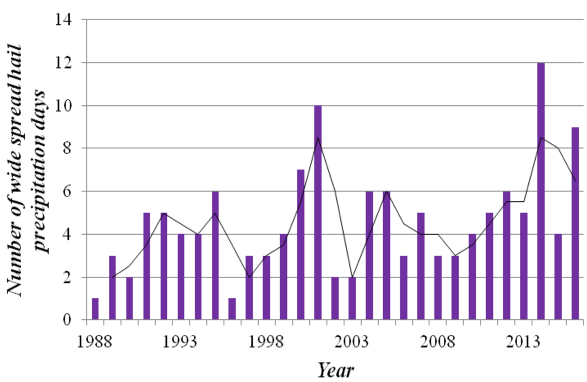


Fig. 6.8d. Number of wide-spread hail precipitation days

7.2. Expected Impacts of Climate Change for Eastern Europe including Bulgaria

Bulgaria is situated in one of the regions that is particularly vulnerable to climate change (mainly through temperature increase and extreme precipitation) and to the increased frequency of climate change-related extreme events, such as droughts and floods. The risks inflicted by climate change-related events may lead to loss of human life or cause considerable damage, affecting economic growth and prosperity, both nationally and transboundary.

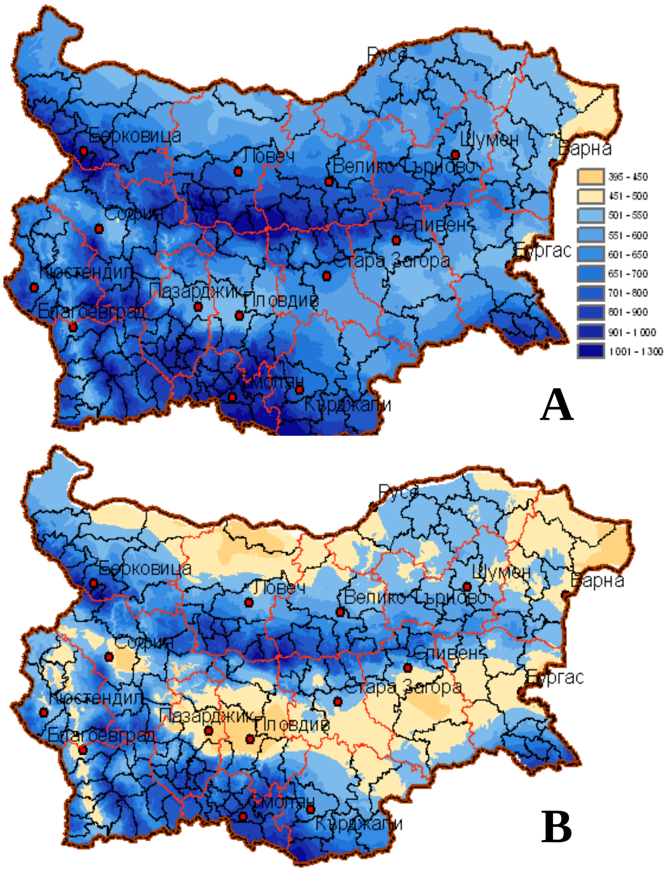
Consensus exists in the scientific community that climate change is likely to increase the frequency and magnitude of extreme weather events. Over the past decades, in Bulgaria, this frequency has increased significantly. The most common hydrometeorological and natural hazards are extreme precipitation and temperatures, storms, floods, wildfires, landslides, and droughts. The number of deaths and victims due to natural hazards is considerable, indicating weather and climate vulnerability. The vulnerability of Bulgaria's population and businesses to the impacts of climate change is accelerated by a relatively high degree of poverty in the most affected areas, the continuing concentration of the country's population in several industrial and urban regions, and various consequences of the transition from a state-controlled economy to a free-market economy. A growing body of evidence suggests that economic losses from climate- and weather-related disasters have also been rising.

Scientific projections indicate that global temperature will rise between 1.8°C and 4°C by 2100, with the temperature increase in Europe expected to be even higher than the estimated global average.

Research conducted by the Department of Meteorology, National Institute of Meteorology and Hydrology at the Bulgarian Academy of Sciences (NIMH-BAS), projects an increase in annual air temperature in Bulgaria of 0.7°C to 1.8°C by 2020. Even warmer temperatures are expected by 2050 and 2080, with projected increases of 1.6°C to 3.1°C and 2.9°C to 4.1°C, respectively (***Figure 6.9***). Generally, the temperature increase is expected to be more significant during the summer season (from July to September).

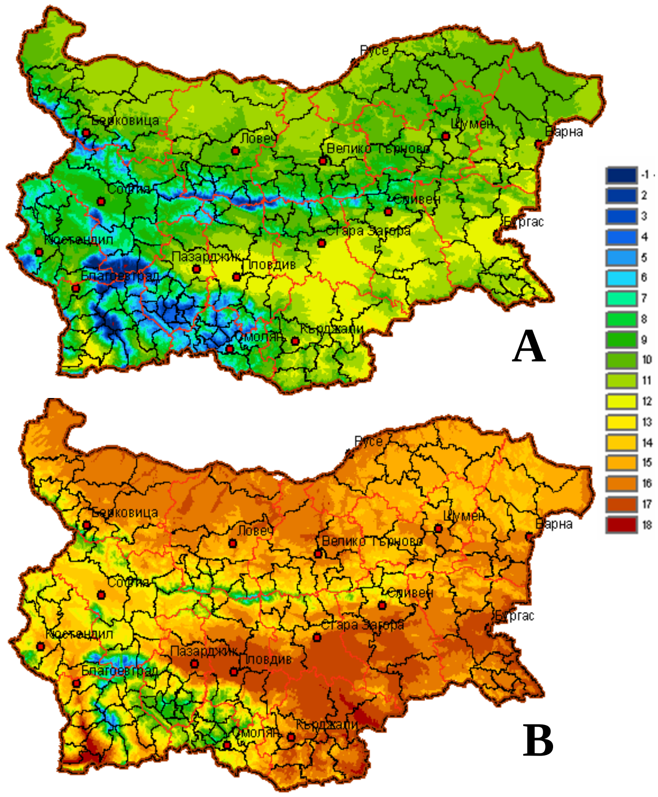
In terms of the expected changes in rainfall patterns, a reduction in precipitation is likely, leading to a significant reduction of the total water reserves in the country. In this regard, projections suggest a decrease in precipitation by approximately 10 percent by 2020, 15 percent by 2050, and up to 30 percent to 40 percent by 2080 (Figure 6.10). In most climate change scenarios, rainfall during the winter months is likely to increase by the end of the century, but significant decrease in rainfall during the summer months is expected to offset this increase.

Figure 7.9. Precipitation per Year for 1961–1990 (A); Precipitation per Year for 2080, According to the Pessimistic Scenario (B)



Source: NIMH.

Figure 7.10. Average Year Temperature for 1961–1990 (A); Pessimistic Climate Scenario for Average Year Temperature for 2080 (B)



Source: NIMH.

According to the available climate change scenarios for Bulgaria, there is a trend toward increased frequency of extreme events and disasters, as demonstrated by frequent occurrences of heavy rainfalls, heat and cold waves, floods and droughts, hurricane winds, forest fires, and landslides.

Biodiversity, land and aquatic ecosystems, as well as water resources, agriculture, and forestry sectors are expected to be affected by the anticipated changes. These changes would furthermore affect society and its citizens as well as the economy as a whole.

Climate change impacts do not affect all people and territories equally due to different levels of exposure, existing vulnerabilities, and adaptive capacities to cope. The risk is greater for the segments of the society and businesses that are less prepared and more vulnerable.

7.2.1. Climate Scenarios for 2050

The Working Group on Coupled Modelling (WGCM) established the Coupled Model Intercomparison Project (CMIP) as a standard experimental protocol for studying the output of coupled atmosphere-ocean general circulation models (CAOGCMs). The sequence of CMIP phases has underpinned and enabled the parallel sequence of Intergovernmental Panel on Climate Change (IPCC) Assessment Reports. The fifth phase of the CMIP (CMIP5) experiment uses new emission scenarios called representative concentration pathways (RCP) to assess the interactions between the human activities on the one hand and the environment on the other hand and their evolution. Unlike the previous CMIP scenarios, the RCPs are mitigation scenarios that assume policy actions will be taken to achieve certain emission targets. Four RCPs have been formulated: RCP2.6, RCP4.5, RCP6.0 and RCP8.5. They are based on a range of projections of future population growth, technological development, and societal responses. The labels for the RCPs provide a rough estimate of the radiative forcing in the year 2100 (in W/m^2 relative to pre-industrial conditions). RCP2.6 represents mitigation scenarios that aim to limit the increase of global mean temperature to < 2 °C. Different than other RCPs and earlier CMIP3 scenarios, RCP2.6 has a peak in greenhouse gases (GHG) concentration around 2050 and then declines at a moderate rate. Under RCP4.5, GHG emissions will also peak around the early 2050s and then stabilize, causing a CO_2 equivalent of about 650 parts per million and a temperature increase of approximately 1.8–2.0 °C in 2100, compared to the control period of 1986–2005. RCP8.5, on the other hand, predicts a continuous rise of GHG emissions until 2100, causing a CO_2 equivalent larger than 1370 ppm and a global average temperature increase close to 4 °C.

There are various methods to characterize the mean climate state and extreme events, but the computation and analysis of climate indices (CIs) based on daily temperature and precipitation data is probably the most widely used non-parametric approach. The Expert Team on Climate Change Detection and Indices (ETCCDI) collection consists of statistically robust indices, covering a wide range of climate conditions (details at http://etccdi.pacificclimate.org/list_27_indices.shtml). Alongside the annual means of the daily minimum, mean and maximum temperature, the present analysis is focused on four temperature-based and three precipitation-based indices on a yearly basis: absolute maximum temperature (TXx), absolute minimum temperature (TNn), the maximum number of consecutive frost days (CFD), maximum number of consecutive summer days (CSU), precipitation sum (RR), number of heavy precipitation days (RR10mm) and maximum number of consecutive dry days (CDD). The definitions of these indicators could be find in the pointed above web-site.

The annual means of the daily minimum, mean and maximum temperature (noted traditionally as TN, TG and TX) and annual precipitation sum (RR) provide important information on the current state of the climate, as well as on the long-term climate variability and change.

The bias-corrected climate datasets, provided through the InterSectoral Impact Model Intercomparison Project (ISIMIP 1) Fast Track simulation round, have been used to generate the considered climate indicators for historical and future periods (https://www.isimip.org/protocol/). For each simulation round, a set of gridded bias-corrected climate variables has been produced to be used as input data for running impact models. These datasets contain 10-day-resolution, bias-corrected climate data from five CMIP5 global circulation models, according to Table 1, covering the period 1950-2099 (historical run-up to 2005), downscaled to a 0.5°×0.5° grid.

Climate indicators have been pre-calculated for all combinations among the five global circulation models and the four RCPs. In addition, as a proxy for historical observations, the Watch Forcing Data (WFD) methodology applied to ERA-40 and ERA-Interim is used to generate observational historical climate indicators. This dataset is available at the same spatial resolution of ISIMIP climate datasets, covers the time range of 1979 to 2013, and its 30-year long part 1981-2010 is used herein as a reference for the current climate.

Table 6.1. Availability of ISIMIP Fast Track CAOGCMs

CMIP5 Model Acronym	Institution	Spat. Resolution (Lon×Lat~Lev.)
GFDL-ESM2M	Geophysical Fluid Dynamics Laboratory, USA	144×90L24
HadGEM2-ES	Met Office Hadley Centre, UK	192×145L40

IPSL-CM5A-LR	Institut Pierre-Simon Laplace, France	96×96L39
MIROC-ESM-CHEM	AORI, NIES, JAMSTEC, Japan	128×64L80(T42)
NorESM1-M	Norwegian Climate Centre, Norway	144×96L26

The analysis is focused on the multi-model statistics – multi-model mean, multi-model 25th, 50th, and 75th percentile.

The spatial patterns of the multiyear means of the CMIP5 projections of TN, TG and TX, as well as the spatial patterns for the reference period, are shown on Figure 2. The ensemble median of the listed in Table 1 models for all four scenarios is compared to the median for the reference period.

Figure 6.11. The multi-model median of the multiyear means of TN (first row), TG (second row) and TX (third row) for the reference period (1981-2010) in the first column and 2070-2099 for RCP2.6, RCP4.5, RCP6.0 and RCP8.5 in the second, third, fourth and fifth column correspondingly. The absolute changes for RCP2.6, RCP4.5, RCP6.0 and RCP8.5 relative to the reference period are shown in the sixth, seventh, eighth and ninth column correspondingly. The units are °C.

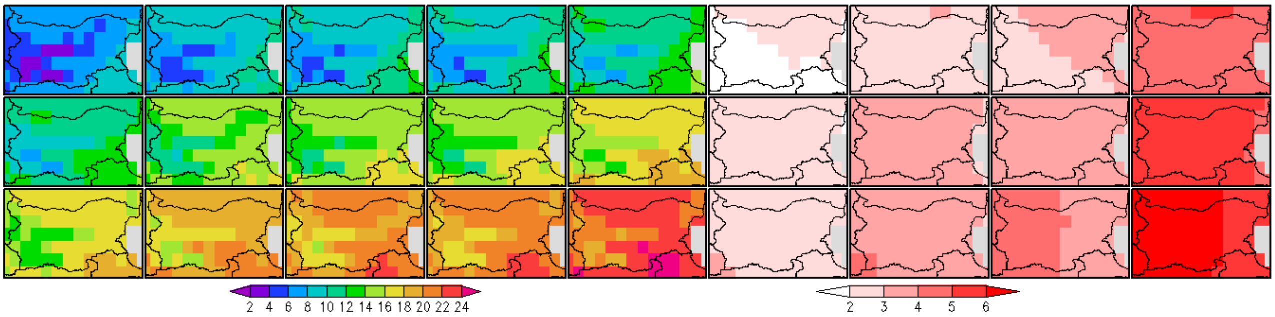
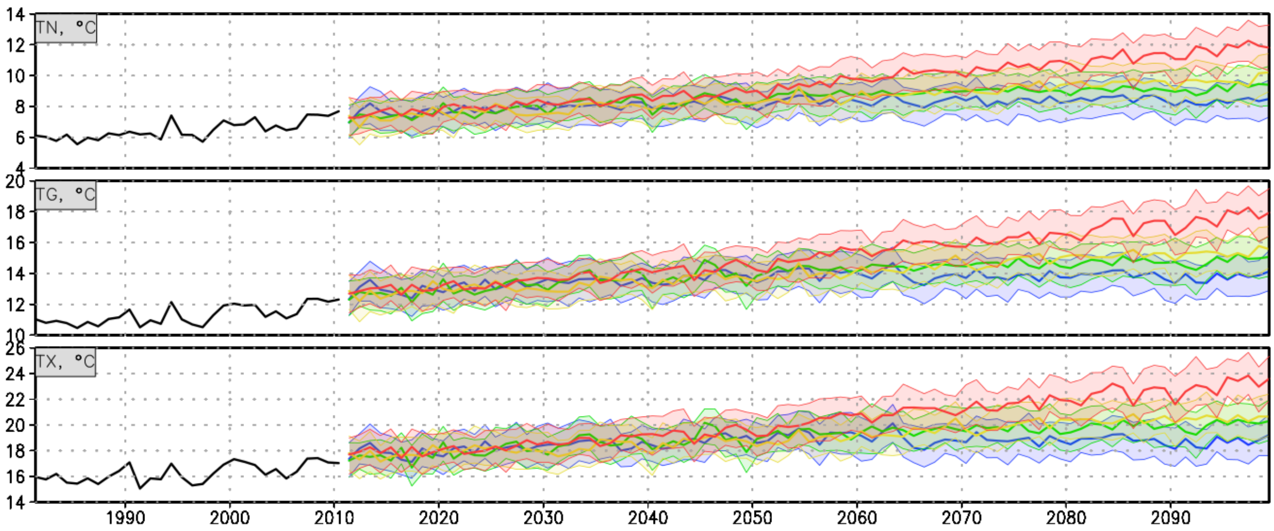


Figure 6.11 shows a gradual increase of the projected changes from RCP2.6 to RCP8.5, i.e., proportional to the radiative forcing. The changes are similar in magnitude for all parameters for fixed scenario RCP2.6-RCP6.0 and do not have a clear spatial structure. All changes are statistically significant at the 5% level.

Figure 6.12. Area-weighted regional averages of TN, TG and TX for the reference period (solid black line) and future period, simulated by the CMIP5 ensemble, for RCP2.6 (blue), RCP4.5 (green), RCP6.0 (yellow) and RCP8.5 (red). Solid lines indicate the ensemble median and the shading; the thin lines indicate the interquartile ensemble spread (between 25th and 75th percentile).



The area-weighted regional averages (i.e., over the whole territory of Bulgaria) of TN, TG and TX show a relatively smooth but steady increase of the temperatures with the apparent difference between scenarios in the second half of the century (Figure 3).

The spatial patterns of the multiyear means of the projected extreme temperatures TNn and TXx and indices CFD and CSU, with their counterparts for the reference period, are shown in Figure 6.13 and Figure 6.14.

Figure 6.13. The multi-model median of the multiyear means of TNn (first row) and TXx (second row) for the reference period (1981-2010) in the first column and 2070-2099 for RCP2.6, RCP4.5, RCP6.0 and RCP8.5 in the second, third, fourth and fifth column correspondingly. The absolute changes of the RCP2.6, RCP4.5, RCP6.0 and RCP8.5 relative to the reference period are shown in the sixth, seventh, eighth and ninth column correspondingly. Stippling indicates grid points with changes that are **not significant** at the 5% significance level. The units are °C.

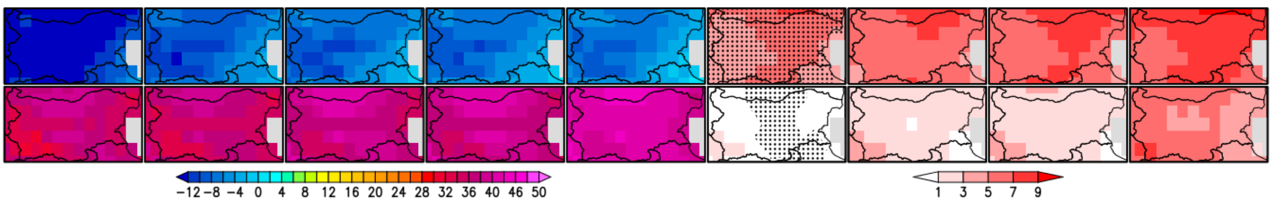


Figure 6.14. Same as Fig. 4 but for the CFD (first row) and CSU (second row). The units are days.

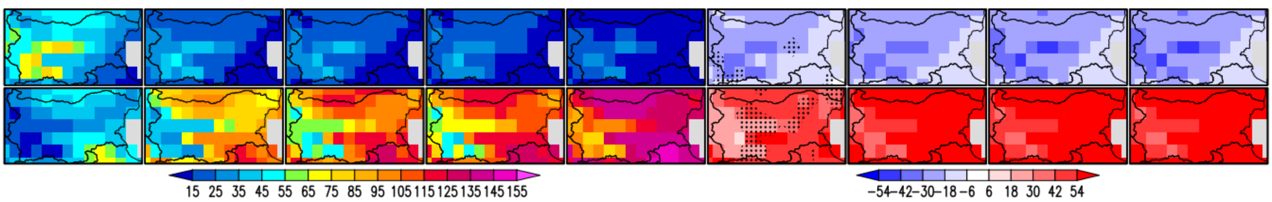


Figure 6.13 and Figure 6.14. confirm the commented above overall picture – a steady decrease of the "cold" extremes and, vice versa, an increase of the "warm" extremes, in general proportion to the radiative forcing. Despite the relatively coarse spatial resolution, the differences between the values of both indices (CFD and CSU) over the mountains and the flat regions are obvious.

Table 6.2 summarizes the results for the considered temperature-based indicators for the near (2021-2050) and far future (2070-2099) periods for the “realistic” (RCP4.5) and “pessimistic” scenario RCP8.5.

Table 6.2 Sign and magnitude of generalized projected changes of the considered temperature-based indicators for the near future (2021-2050) and far future (2070-2099) periods

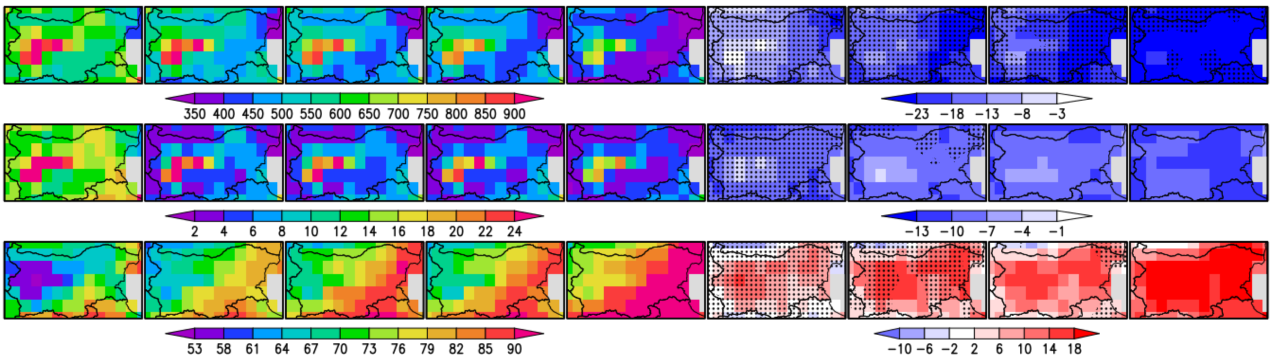
	2021-2050		2070-2099	
Scenario / Index	RCP4.5	RCP8.5	RCP4.5	RCP8.5
TN	+, 1–2ºC	+, 1–2ºC	+, 2–3ºC	+, 4–5ºC
TG	+, 1–2ºC	+, 1–3ºC	+, 3–4ºC	+, 5–6ºC
TX	+, 1–2ºC	+, 1–3ºC	+, 3–4ºC	+, > 6ºC
TNn	+, 2–3ºC	+, 3–4ºC	+, 3–5ºC	+, 7–9ºC
TXx	+, < 2ºC	+, 2–3ºC	+, 1–3ºC	+, 5–7ºC
CFD	-, 7–14 days	-, 7–14 days	-, 18–30 days	-, 18–30 days
CSU	+, 14–21 days	+, > 21 days	+, 42–54 days	+, > 54 days

It is worth mentioning that the role of the radiative forcing up to the middle of the century is practically negligible compared to the internal climate variability.

As in many other places of the world, in contrast to the projected changes in the temperature-based indices, where there is a general agreement on the sign of change independent of the region considered, changes in the precipitation indices are less consistent in this regard.

The spatial patterns of the multiyear means of the CMIP5 projections of the RR, RR10mm and CDD, as well as the spatial patterns for the reference period, are shown on Figure 6.15.

Figure 6.15. Relative instead of absolute changes of the RR are considered. The units of the RR are mm and of the RR10mm and CDD as well as their changes – days. The relative changes of the RR are expressed in %. Stippling indicates grid points with changes that are **not significant** at the 5% significance level.



First and foremost, Figure 6.15 demonstrates the complex nature of the expected precipitation changes. Although the total precipitation amount (the first row on Figure 6.15) shows a clear reduction tendency, especially over the southeastern part of the domain, there is no big difference, both in magnitude and spatial distributions, in the relative changes in the scenarios RCP2.6-RCP6.0. Second, which is most important, these changes are not statistically significant at the 5% level for all scenarios except RCP8.5. Similar is the overall picture with the days with heavy rain (i.e., RR10mm) distribution: general reduction, approximately up to a week over the bigger part of the domain, but without substantial difference from scenario to scenario. The trend is not statistically significant practically only for RCP2.6. The spatial patterns of the CDD, both in the present and projected future climate, are also complex. Most apparent is the well-expressed gradient from southeast to northwest. The contrary tendencies in the future, an increase of the CDD in the southeast and a decrease in the northwest will strengthen this contrast. It is worth emphasizing that the projected changes under RCP2.6 and RCP4.5 are not significant over the bigger part of the domain, which also indicates the complexity of the phenomena. Table 3 summarizes the results for the considered precipitation-based indicators for the near (2021-2050) and far future (2070-2099) periods.

Table 6.3 Sign and magnitude of generalized projected changes of the considered precipitation-based indicators for the near future (2021-2050) and far future (2070-2099) periods

	2021-2050		2070-2099	
Scenario / Index	RCP4.5	RCP8.5	RCP4.5	RCP8.5
RR	-, 5–8%	-, 5–8%	-, 10–15%	-, > 20%
RR10mm	-, 1–2 days	-, 2–3 days	-, 2–5 days	-, 4–8 days
CDD	+, 4–6 days	+, 6–7 days	+, 10–15 days	+, >15 days

CONCLUSIONS

- The most general and important conclusion is the distinct warming, expressed in the spatial patterns and time evolution of all considered temperature-based indicators. Their change is consistent with the tendencies of the annual means of the daily mean and extreme temperatures. The warming dominates practically over the whole domain and is statistically significant over its essential part in most cases.

- The revealed patterns of climate change intensify gradually with the increasing radiative forcing in the considered scenarios, which generally agrees with the outcome of the prevailing number of the recent studies.

- We detect “warming asymmetry” (i.e., a faster increase of cold-related indicators than warm-related ones), especially clearly for TNn and TXx.

- Concerning the precipitation-based indices, the results confirm the complexity of the expected precipitation-related changes and their inherent ambiguity. The latter is clearly evidenced by the lower level of statistical significance for the scenarios RCP2.6-RCP6.0 compared with temperature changes. It is worth emphasizing that the projected precipitation reduction over the SE part of Bulgaria and increase of the CDD could amplify the negative impact of the expected hotter climate.

7.2.2. 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 7. 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 7.). 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 7.16 Trend analysis for tropical nights

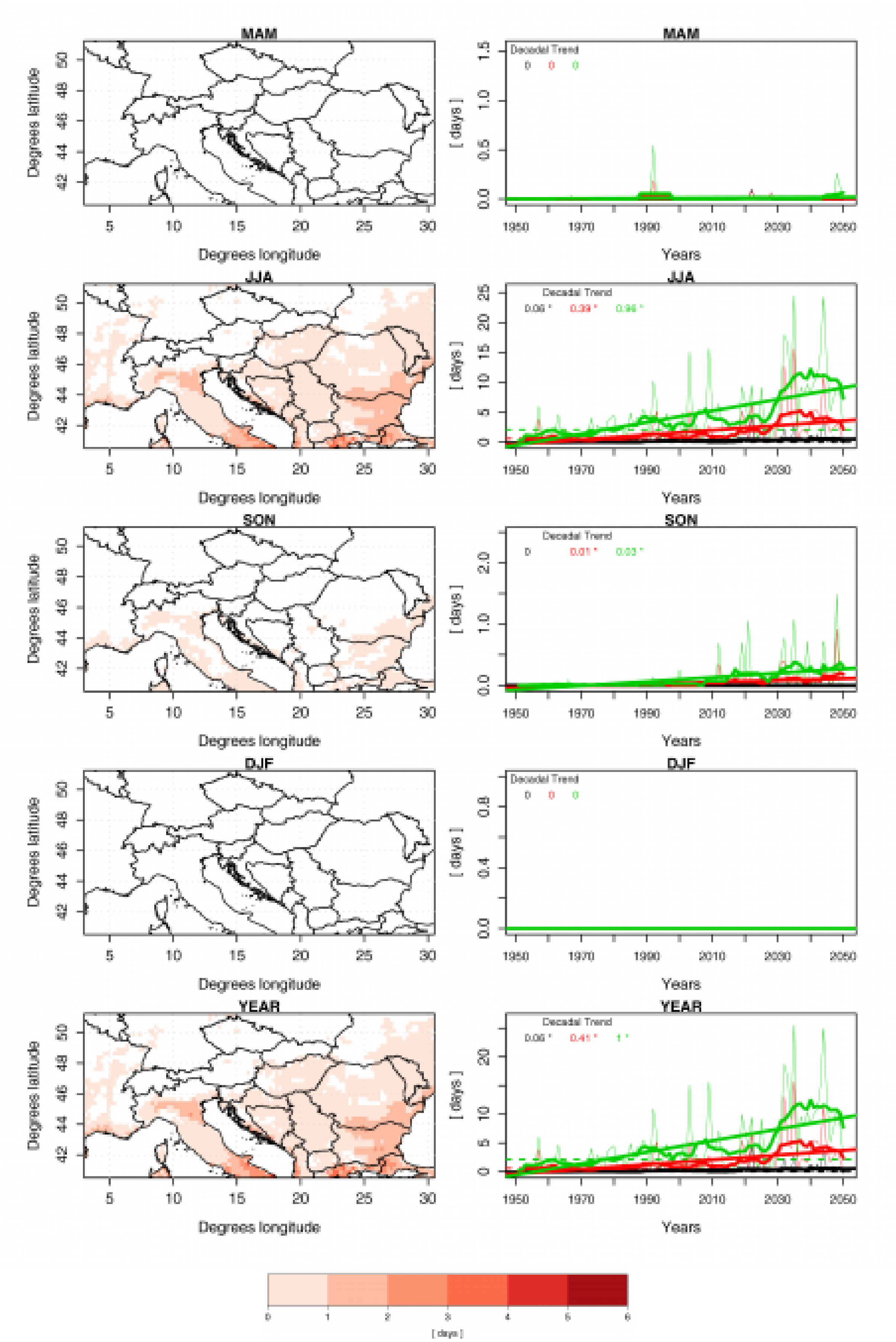


Figure 7.17 Trend analyses for the greatest 5-day rainfall

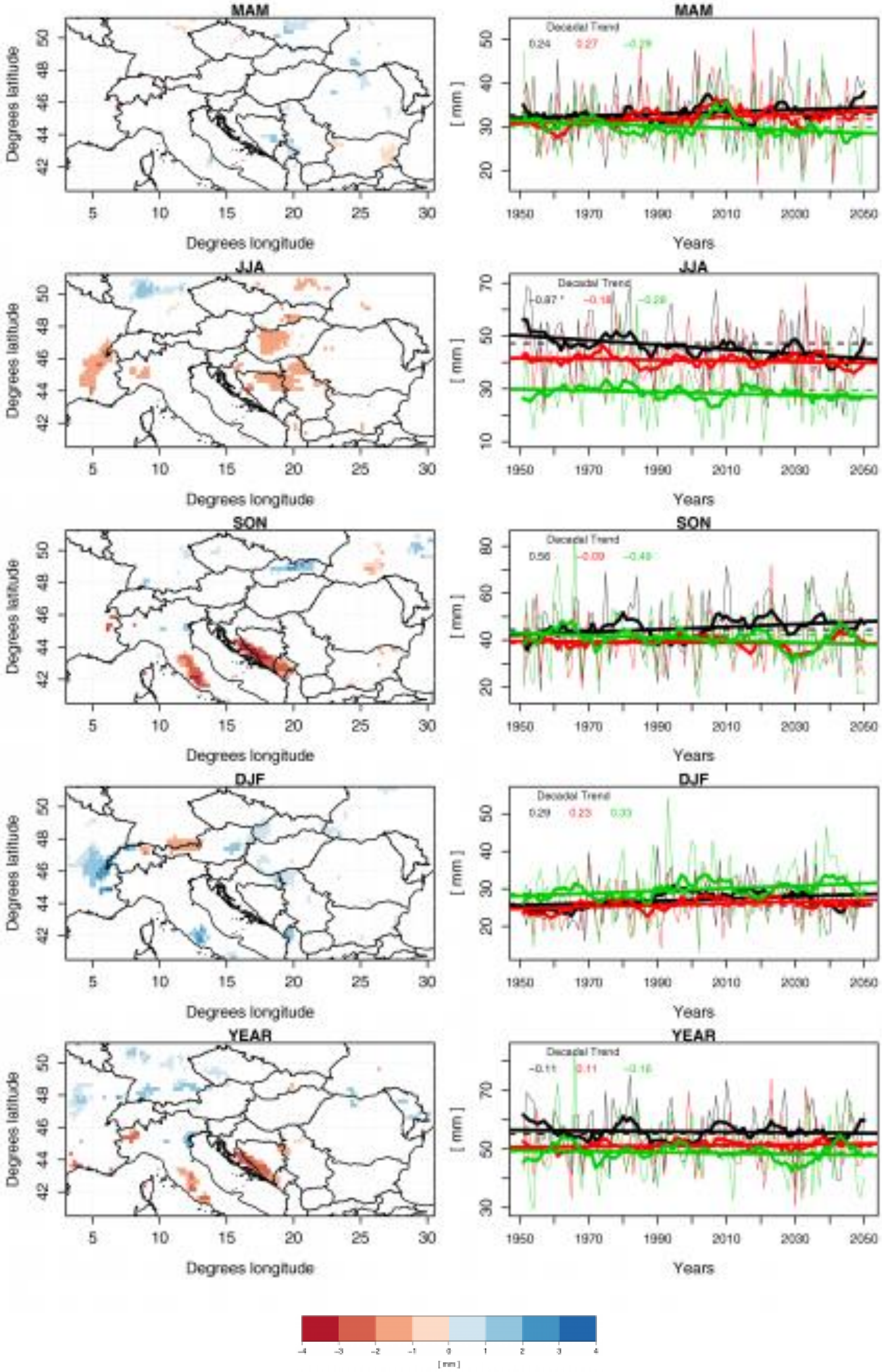
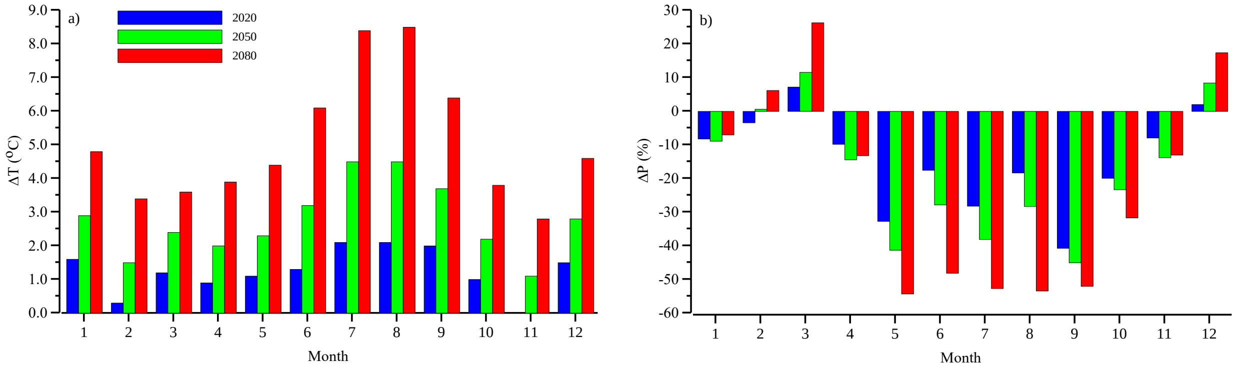
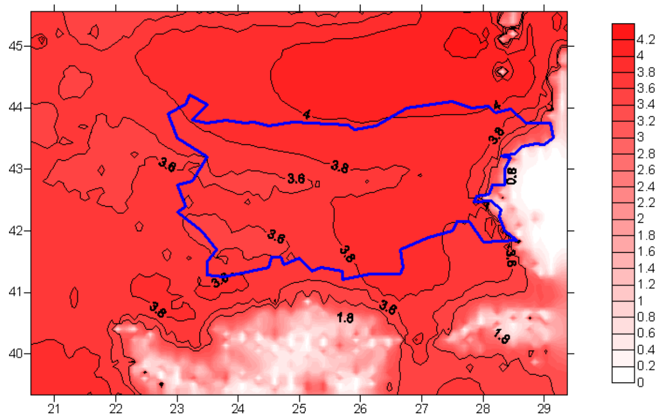


Figure 7.18 Monthly HaDCM3 climate change scenarios values of air temperature (a) and precipitation (b) in Novachene (north Bulgaria) for the 2020, 2050 and 2080.

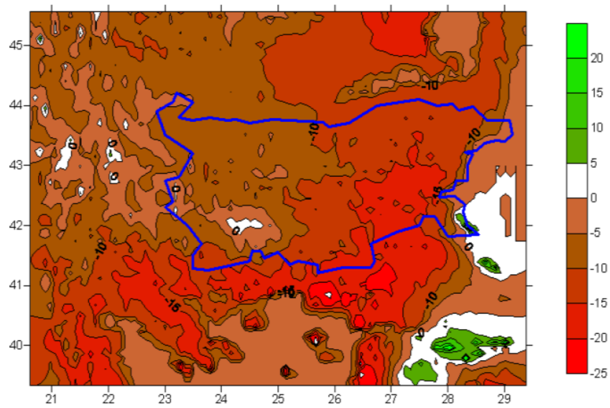


Under the umbrella of the CECILIA project climate change scenarios for Bulgaria were also simulated by applying the ALADIN regional model.

Figure 7.19 Climate change scenarios in Bulgaria for the end of the 21st century

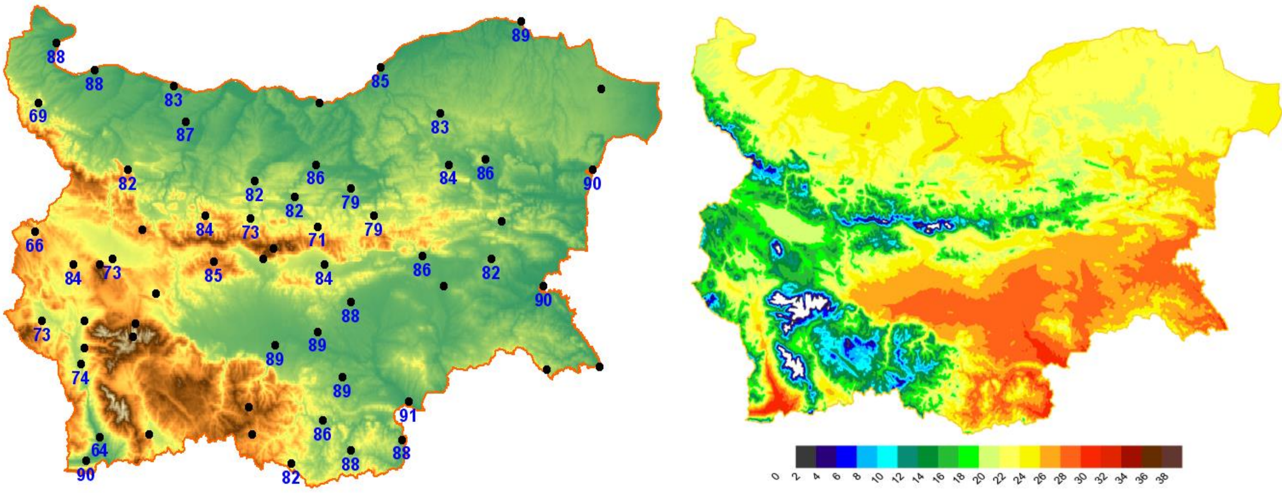


Annual temperature changes (in ºC) at the end of the 21st century, relative to 1961-1990



Annual precipitation changes (in %) at the end of the 21st century, relative to 1961-1990

Figure 7.20 Summer days (Tmax>25ºC), 1961-1990 (left). 2021-2050 (right)



7.3. Climate Risks and Vulnerabilities in Economic Sectors

This section summarizes key climate risks and vulnerabilities in nine economic sectors of Bulgaria based on the conclusions from nine sector assessment reports in the National Adaptation strategy, which also draw on the National Climate Change Risk and Vulnerability Assessment for the Sectors of the Bulgarian Economy (MoEW 2014). The potential opportunities from climate change are also outlined where these have been identified in sector assessment reports.

For all sectors, there are considerable uncertainties in assessing the nature and scale of climate change vulnerabilities. This is due to the complexity of taking into account multiple factors including future environmental, economic, and social changes. A major source of uncertainty relates to the degree to which future emissions of greenhouse gases (GHGs) will change radiative forcing over the coming century. GHG emissions are driven by complex factors such as population growth, economic growth, and energy policy.

7.3.1. Agriculture

Agriculture plays a key yet disproportionate role in the socioeconomic fabric of rural Bulgaria. The agricultural sector generated 4.4 percent of the country's total gross value added (GVA) and provided employment to 5.8 percent of the labor force (second highest rate in EU-28) in 2015[14]. More generally, the country remains predominantly rural, and while the rural space is richly endowed with natural resources, it is marked by lower incomes, limited job opportunities, an aging farm population, higher rates of poverty (the majority of the rural population is at risk of poverty or social exclusion), and an ensuing urban-rural divide in social and living standards.

Climate change will be a significant factor in the future development of Bulgarian agriculture; the first negative impacts are already a reality. The frequency and intensity of adverse climatic events have increased during the last decades—three distinct periods of droughts have been experienced and more frequent floods caused by prolonged and intense rainfalls are being regularly encountered, yet difficult to predict. Temperature increases from 2°C to 5°C and significant changes in precipitation patterns are projected by the end of this century. Climate change scenarios for Bulgaria indicate an increased frequency of climatic adverse events, such as longer droughts, heat waves, heavy rainfalls, and floods.

[14] NSI Eurostat

The agriculture sector is highly vulnerable to the impacts of climate change, as a provider of adequate food, pillar for economic growth, deliverer of ecosystem services, and provider of livelihoods for the rural population. However, the risk of the impacts of climate change is not equally distributed with regional differences in the likelihood of negative impacts from droughts and floods, as well as differences in the vulnerability, resilience, and adaptive capacity of rural dwellers to climate change. These differences are further accentuated by the pronounced dual farm structures and uneven land distribution that characterize the agriculture sector in Bulgaria. This engenders substantial differences in resilience and adaptive capacity between (a) large-scale commercial farms, which are economically highly vulnerable to the impact of drought and floods on crop yields and farm profits but are better resourced to invest in adaptation measures; and (b) smallholders practicing (semi-)subsistence farming who are also socially and economically vulnerable to adverse climate events, but tend to have more intrinsic resilience due to their more diversified production, stronger social relations, and off-farm income diversification.

Extreme weather events and gradual climate changes may have a strong impact on yields and quality of output. Specific climate change risks and vulnerabilities in the agricultural sector in Bulgaria are as follows:

- **Changes in length of growing season.** A longer growing season would allow better distribution of individual species and improve opportunities for growing new, more thermophilic species or secondary crops.
- **Agro-phenology.** In Bulgaria, earlier flowering of trees, a longer season for vines, and changes in the other natural crop cycles are expected, thus affecting final yields. In the case of cereals, further contractions of inter-phase periods from flowering to ripening are expected. A shorter reproductive period would also mean less time for grain filling, which would have a negative impact on yields.
- **Crop yields.** Yields depend on a number of factors including the length of the growing season and other crop productivity factors. Changes in yield volumes for major crops (winter wheat, corn, and sunflower) are forecasted due to projected temperature rises and reduced rainfall**.** Rising concentration of carbon dioxide (CO_2) in the future might also create conditions to improve the yields of some crops.
- **Increased risk of spread of pests, diseases, and weeds.** Changes in temperature, moisture, and concentration of atmospheric gases could not only stimulate growth and the generation of plants, fungi, and insects, but also change interactions between pests and their natural enemies and hosts. Pests and diseases often lead to harvest losses and an increased use of pesticides and veterinary drugs. A longer growing season would also affect the spread of a number of weeds, diseases, and pests.
- **Adverse effects on livestock production.** Livestock will be adversely affected by greater heat stress from increases in air temperature and humidity which affects animal production health and well-being. Changes in temperature and precipitation may affect livestock breeding in terms of reproduction, metabolism, and health. Changes in temperature and precipitation may also result in the spread of pathogens, and parasites may influence the distribution of diseases with concomitant decrease in animal productivity and increase in mortality. Climate change may also affect the availability and quality of fodder and grazing resources.
- **Increased risk of soil aridity, erosion, desertification, and salinization.** More frequent and intense droughts will likely increase soil aridity, which combined with hot winds will increase the risk of wind erosion and soil degradation. These factors increase the risk of

triggering desertification, marginalization, and abandonment of agricultural land in the areas where soils are lighter and more vulnerable to erosion.

- **Risk of water shortage.** A combination of factors may lead to water shortages in some regions of the country, leading to increased irrigation requirements. Higher temperatures and lower relative humidity will increase water needs due to evapotranspiration in agricultural plantations, although increased CO_2 levels in the atmosphere will result in higher water-use efficiency due to reduced transpiration and an increased rate of photosynthesis. Reduced precipitation levels may cause a reduction in water reserves and lower accumulation of water in irrigation reservoirs. Increased droughts and growing water need of industrial and urban water users may lead to increased competition with agriculture for water resources.
- **Adverse impacts on fisheries and aquaculture.** Droughts may lead to reduced water levels that pose a serious threat to fish farming systems and may also decrease the smaller mountain river and stream water levels, and may leading to loss of species. Higher temperatures also lead to changes in the spawning period of species. For open-basin rivers, this might cause migration to deeper, colder waters. Increased water level may affect dikes and river embankments and may lead to the destruction of valuable spawning, nursery, or feeding habitats.

It is evident that a combination of the above climate change risks and vulnerabilities in the agricultural sector will have an impact on aggregate and individual households' production levels and living standards. Droughts and floods are one of the most important manifestations of climate change in agriculture and cause significant variability of yields. With the farming sector contributing significantly to the Bulgarian economy and growing agricultural vulnerability to adverse climatic events, it is expected that the livelihoods of many Bulgarians will be increasingly affected.

7.3.2. Biodiversity and ecosystem services

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 European species, including 25 percent of those in the Red Book of Europe. NATURA 2000 sites, which occupy 34.4 percent of the territory, and protected areas with a range of 584,569.19 ha or 5.3 percent of the country's area, are dedicated for their conservation.

Projections for gradual climate changes and extreme climate events are expected to have effects at all levels of BD&ES. Manifestations of climate change are expected to have different impacts on different types of ecosystems and affect biodiversity and ecosystem services in a range of ways including in an abrupt and even catastrophic manner. On the other hand, the projected annual increase in average temperatures may help adaptation by extending the vegetation periods and allowing for the migration of species in natural ecosystems or the controlled introduction of species for agriculture, green infrastructure, or other adaptation purposes.

The main vulnerabilities to climate change at the different levels of BD&ES in Bulgaria are summarized as follows:

- **Loss of genetic diversity.** Genetic diversity is subject to threats posed directly by climate change on vulnerable/endangered species (including endemic species with a limited range and opportunities for migration) that may be lost forever. There are also indirect climate change induced effects due to competition for resources between biodiversity and human activities that cause an increase of other pressures (such as water extraction, overexploitation of rare species by vulnerable population groups, land-use change, and fragmentation by infrastructure).

- **Disruption of species lifecycles and phenological phases.** Climate change can affect the life cycles and breeding periods of species, within ecosystems, to affect populations and processes in the ecosystem (food chains and competition for resources), including by invasion of invasive species which compete with native species and replace them from traditional niches, therefore, changing the ecosystem's integrity. Invasive species may also bring opportunities for climate change adaptation (CCA) if used as an indicator in an early warning mechanism or if they are commercially important and contribute to providing ecosystem services.
- **Deterioration of habitats.** The possible consequence of climate change is the deterioration of habitats in the categories of critically endangered, endangered, vulnerable, and nearly threatened as included in the Red Data Book of the Republic of Bulgaria, Habitats (BAS 2011). In particular, high-altitude habitats are vulnerable to these changes.
- **Impacts on the provision of ecosystems services.** A key risk is the regime shifts in the long term that may occur in the provision of ecosystem services. Regime shifts could be in both directions:
    - Positive impacts: increased length of the growing period could lead to increasing productivity of terrestrial ecosystems, including crop yield and timber harvesting. Increasing temperature could also change the water condition of water bodies, resulting in changes in fish composition and structures. Disturbances in ecosystems caused by extreme events may also lead to the emergence of new species composition conductive to improved provision of ecosystem services.
    - Negative impacts: periods of drought could change the composition of producers in the terrestrial ecosystems causing changes in their functioning and resulting in reduced provision of ecosystem services. Increasing floods, fires, windthrows, and bark beetle outbreaks in forests will cause tree mortality and replacement by more adaptive species, changing the ecosystem integrity and potentially reducing the provision of ecosystem services both in the short – to mid-term (until the systems adapt and productivity is restored) or permanently (if the new equilibrium state involves reduced production of ecosystem services). The most vulnerable ecosystems are the southern border forestry area as well as the other lowland areas of the country. The inland wetlands ecosystems, heathland and shrub ecosystems (especially in the alpine zone in mountains), and coastal zone ecosystems are also the most sensitive to climate change.

Gradual climate changes and extreme weather events are, therefore, likely to affect all levels of biodiversity: genetic, species and ecosystems. However, the vulnerability and adaptive capacity assessment of BD&ES services to climate change is very complex and includes large levels of uncertainty within scientific information, system understanding, and expert knowledge. Furthermore, the climate change impacts on ecosystem integrity characteristics are insufficiently studied due to a lack of data time series with suitable quality and the complexity of interactions in the system.

7.3.3. Energy

The energy sector in Bulgaria is highly important in terms of its economic contribution, with the industry and energy sectors accounting for around 20 percent of gross domestic product (GDP). Energy generation is heavily dependent on local coal production, which contributes over half of the primary energy supply, followed by nuclear energy at 34 percent. However, Bulgaria is also highly dependent on imported energy resources (natural gas, crude oil, and nuclear fuel). In the medium term, thermal power, both from Thermal Power Plants (TPP) and Nuclear Power Plants (NPP), is expected to be the main contributor to electricity generation in Bulgaria and despite rapid growth rates of renewable energy, it is expected to account for around 80 percent of electricity generation in Bulgaria in 2024.

The energy sector will be among the sectors in Bulgaria that will be affected by climate change. Bulgaria is already exposed to a variety of natural hazards, including floods, droughts, forest fires, earthquakes, and landslides. Increased temperatures, reduced precipitation, changes in river flows and ecosystems and extreme events have caused some damage and disruption to the energy sector. In recent years, extreme weather events have caused some damage and disruption to the energy sector, which has knock-on consequences for other sectors. However, these events have not significantly affected energy infrastructure to date and have mostly led to damages in the electricity grid and temporary power cuts. An increase in the frequency and intensity of such weather events is likely to pose challenges to the sector in the future.

Energy infrastructure is vulnerable to a range of climate stressors, including temperature, precipitation, sea-level rise, and extreme events. Specifically, climate change is expected to change the intensity, frequency, and distribution of extreme heat, precipitation, and storms, exacerbating the vulnerability of energy infrastructure. Climate change risks and vulnerabilities for each of the elements of the energy system in Bulgaria are identified in the energy sector assessment report as follows:

Primary energy supply

- Coal production
  - **Damage to infrastructure and equipment.** Heavy precipitation may present risks to operations and damage infrastructure and equipment that result in interruption to production. Mine site conditions can be affected through increased risk of flooding, subsidence, landslides, soil erosion, and changing groundwater levels.
  - **Reduced coal quality.** Precipitation increases, and flooding may lead to reduced coal quality through higher moisture content of opencast mining.
  - **Increased risk of heat stress for outdoor workers.** With predicted increasing frequency and intensity of heat waves, weather-related heat exposure is presenting a growing challenge to occupational health and safety.
- Extraction and supply of natural gas:

- In recent years climate change, has increase the fire risk, especially in periods with high temperatures and summer droughts in croplands, semi-mountainous and mountainous regions, which increases the external risks to the gas transmission system. There is a risk of a possible interruption of natural gas supplies indefinitely, with an expected impact on neighboring countries, especially if the transmission infrastructure to third countries is affected.
- Floods can also cause significant disturbances in the gas and gas distribution infrastructure and their components: pipelines, compressor stations, gas distribution stations.

Electricity generation

- Nuclear and thermal power plants
  - **Reduced efficiency of power plants.** Power plants will experience some reduction in output as higher air and water temperatures affect the efficiency of their cooling systems. An increase in ambient temperature results in a decrease in the difference

between ambient and combustion temperature, reducing the efficiency of gensets, boilers, and turbines.

- **Availability of water for cooling.** Due to increased drought risk and greater competition for water resources, some power plants may face reduced ability to abstract and discharge cooling water.
- **Damage to infrastructure.** Warming temperatures may create favorable conditions for some invasive species that can damage energy infrastructure. Rozov Kladenets and Ovcharitsa lakes (the cooling lakes of the three largest TPPs in Bulgaria) offer highly suitable conditions for eutrophication and development of invasive species, and climate change may aggravate these problems.

➢ Renewable energy

- **Uncertainty of power generation.** Hydropower generation is likely to suffer from reduced precipitation, particularly in the summer season. River flow will change because of changes in precipitation patterns and the reduced snow and ice cover in mountainous regions.
- **Decreased efficiency of solar and wind power generation.** In general, solar power generation can be vulnerable to increased cloud cover associated with increased rainfall. For wind power systems, changes in wind patterns and intensity due to climate change could affect the productivity of existing wind farms. In addition, extreme stormy conditions can damage wind turbines and potentially cause shut down.

➢ Supply/demand balance

- **Shift in energy demand.** Climate change may change energy requirements for residential and industrial cooling and heating, the timing and magnitude of peak demand, and adjustments in energy consumption for transportation, construction, and agricultural activities.

➢ Electricity transmission and distribution

- **Damage to infrastructure and disruptions.** This includes (a) likelihood of more damage and disruptions to transmission lines from extreme precipitation, floods, and winter storms; (b) increasing threats to functioning of infrastructure in mountainous areas by an increased frequency and intensity of natural hazards (such as landslides, rock falls, or floods) mostly linked to increasing ambient temperature; (c) effects on efficiency of electricity transmission from increased frequency of heat waves; and (d) higher likelihood of power lines hanging below the minimum distance from the ground required by law, caused by warmer temperatures.

➢ Heating production and distribution

- **Reduced need for heating.** Increasing temperatures due to climate change may gradually reduce the need for heating.

In conclusion, changes in climate and weather extremes will affect the energy sector both positively and negatively, though negative impacts prevail. This means that climate change is a substantial energy security concern not only due to direct impacts on infrastructure and distribution but also because of consequent impacts on other sectors and issues including food security and health. However, it should also be noted that a conclusion of the Climate Change Vulnerability and Risk Analysis and Assessment of Bulgaria's Economic Sectors (MoEW 2014) is that the energy sector is 'extremely resilient' to expected impacts in the period until 2035. The high resilience of the energy infrastructure to climate change is because it is relatively well-planned and maintained.

7.3.4. Forestry

Forested areas in Bulgaria occupy about one-third of the country territory, amounting to 4.230 million ha, of which 3.864 million ha are forests. The standing wood volume of forests in Bulgaria has almost tripled from the 1960s and now amounts to about 680 million m3. Bulgarian forests have outstanding biodiversity with the vascular flora alone consisting of 4,102 species. In economic terms, the annual contribution by forestry, logging, and furniture production is approximately €500 million (EUROSTAT and European Sector Monitor of Wood Processing and Furniture Industry). About 43,000 people are employed in the forestry sector and in some rural areas, it is the main driver of economic output.

Climate change projections for increases in temperature, warmer winters, and more summer droughts along with greater number and magnitude of extreme climate events, such as heat waves and cold spells, severe storms, wet snow, and ice accumulation, will reduce forest health and tree growth, increase attacks from insects and fungi, including invasive species and cause serious losses due to fires and storm-related damages. There is already evidence of impacts on the forestry sector in Bulgaria from these types of climate events. In future these could contribute to very high economic losses, degradation of the ability of forests to sequester carbon and affect the quality of life in Bulgaria by reducing the delivery of valued ecosystem services.

According to one study, wood growth could be reduced by 3.5 million m3 per year (Kostov and Raffailova 2009). This is equivalent to 42 percent of the annual harvest and would have a devastating effect on the primary production of forest products and the rural economy. Impact of a similar scale could be expected on the forests' ability to protect drinking water supplies, attenuate extreme rainfall and flooding, stabilize vulnerable soils and slopes, facilitate a growing recreation and tourism sector, capture carbon, and support a rich resource of natural biodiversity.

Climate change is a potential driver of significant changes in the forests of Bulgaria and while their interactions and combined effects are complex, the main vulnerabilities include the following:

- **Species-specific physiological responses** to modified temperature and precipitation regime and inability to respond to changing climatic conditions. Some species may lack the adaptability to cope with new climate conditions and thus, become locally or globally extinct or suffer serious growth and health problems.
- **Uncertainties for the interaction between species.** Related to species-specific responses are the uncertainties for the interaction between species such as competition for resources, which is one of the main drivers of forest dynamics and composition in conditions of modified climate. There is high probability that some species may lose their growth advantage compared to other species which in turn may seriously modify forest composition and, in the long-term, productivity and other related ecosystem services served by the specific forests.
- **Large areas with coniferous plantations at too low elevations** and related to this, the potential for growth decline and various health problems. This vulnerability is an effect of the large-scale afforestation in the 20th century. While the plantations often served their primary goal to help in the control of erosion processes, in the last decades, there were numerous mortality waves, which were attributed to the combined negative effects of drought, aging, and lack of possibilities for regular thinning.

- **Increased probabilities of large fires and other disturbances** such as windthrows, damages from wet snow and ice, attacks from insects. This is potentially the most important factor for forests given the fact that natural disturbances often lead to dramatic changes in forest structure and environment. While in natural conditions, such temporal dynamics in forest composition and structure are often a part of the overall forest dynamics, new climatic conditions may lead to completely different species compositions and, therefore, ecosystems over a relatively short time period. In addition to the general environmental impact, natural disturbances often cause huge losses due to loss of wood, high cost of recovery measures, or the need to sell salvaged wood at very low prices.
- **Improved conditions for invasive species** with high potential for considerable damages to forests. Future climate changes may provide better opportunity for these species to migrate and increase their distribution and thus, hinder local species. This is potentially a very high risk for habitats which are rare and in marginal locations.
- **High prevalence of firewood as a timber product** that contributes little economic value to the economic sustainability of the sector and its ability to self-fund resilience actions and sequester carbon.

Bulgarian forest ecosystems are very important for the country and well-being of the society. They are highly diverse and productive. However, despite the serious efforts already undertaken to prepare for CCA, there are several groups of vulnerabilities of the forestry sector that are priorities for action, as listed earlier.

7.3.5. Human health

Human health can be influenced by a great number of weather-related manifestations linked to climate change. Climate change in Bulgaria is manifested by an increase in the average annual air and water temperatures, an increase in heatwaves and cold spells, a change in the annual rainfall, an increase in heavy rainfalls, increases in extreme weather events (windstorms, cyclones, floods, and droughts), and changes in intensity of ultraviolet (UV) radiation. All these changes affect health in a complex and individual way, depending on various socioeconomic, health, personal, and other factors.

In general, the health effects can be differentiated as primary and secondary. Primary effects directly affect human health, for example, through heat waves and cold spells, UV radiation, and floods. Secondary effects indirectly affect human health through other climate-influenced factors such as pollen, vector-borne diseases, fires, contaminated food, water, and air, and compromised crops. The primary and secondary health effects of climate change can be differentiated into the following groups: heat-related morbidity and mortality, extreme weather-related morbidity and mortality, cardiovascular diseases, including strokes, asthma, respiratory allergies and airway diseases, cancer, vector-borne and zoonotic diseases, foodborne diseases and nutrition factors, waterborne diseases, mental health and stress-related disorders, and neurological diseases and disorders.

Key future vulnerabilities for Bulgaria outlined in the sector assessment report are as follows:

- **Temperature- and humidity-related health effects.** These include expected increases in number of deaths from cardiovascular diseases and strokes in the big cities in summer due to heatwaves and the urban heat island effect; vector-borne morbidity; and Campylobacteriosis infections; respiratory diseases due to the higher impact of CO_2, dust, and PM in the warmer air; and allergic diseases due to earlier flowering and increased concentration of pollen, spores, and other allergens in the air (based on the study by Mihaylova 2014).

- **Emergency weather-related health effects.** These include expected increases in mortality due to extreme weather events and fires, with that increase being higher among vulnerable groups, waterborne and foodborne morbidity due to damaged infrastructure, and post-traumatic stress disorder (PTSD) (based on the study by Mihaylova 2014).
- **Change in precipitation-related health effects.** These include expected increases in incidence of Cryptosporidiosis and Campylobacteriosis due to a combination of more frequent precipitation and higher annual average temperatures, and diarrheal infections caused by non-cholera vibrio due to more abundant precipitation and higher levels of humidity, as well as of the higher water temperature of the Black Sea.

It is stressed, however, that assessing health outcomes in relation to climate change is a complex task that must accommodate the multiple types of uncertainty including those related to GHG emissions scenarios, data limitation, and models of the relationships between climate and health. Thus, it is necessary to deepen the knowledge and assessment of the manifestations of climate change in Bulgaria, and the mechanisms of their impact on human health.

It is further noted that climate-related health impacts disproportionately affect the more vulnerable groups of the population, in particular, children and adults, people with chronic illnesses, people with a low socioeconomic status, those living in poverty and those with harmful personal habits (use of alcohol, drugs, and tobacco). Indicators of the most vulnerable groups over recent decades show that the country is in a less favorable position than many other EU countries.

Health vulnerability to climate change may also be exacerbated as a consequence of some features of the health sector including infrastructure and structure, and the understanding and competencies of health personnel on the impact of climate change on human health. Therefore, the severity of healthy impacts resulting from the risks outlined earlier will depend on the capacity of the public health sector to address these conditions and prepare for them, as well as on factors such as individuals' behavior, age, gender and socioeconomic status, and location.

7.3.6. Tourism

International tourism in Bulgaria generates an estimated US$2.4 billion, and the tourism sector employs 11.1 percent of the national workforce (in 2015)15. The major market for tourism is the EU, and the main tourism product is coastal summer tourism in the Dobrich, Burgas and Varna regions of the Black Sea. An estimated 95 percent of all revenues from international tourism originate from seaside resorts, where arrivals peak in July and August. Winter tourism is less relevant for the national economy and caters mostly to domestic tourism.

Weather and climate have considerable importance for tourism. Climate is a key factor defining a destination's attractiveness, also influencing the timing of holidays, as well as tourist activity choices and expenditures. On holidays, weather conditions in the destination determine trip satisfaction. Adverse weather experiences, including heat waves, cold spells, heavy rainfall, storms, or changes in natural tourism assets, such as lack of snow, can all have negative repercussions for tourist perceptions of a destination and willingness to return.

Due to its spatially concentrated, weather-dependent, and highly seasonal character, tourism in Bulgaria is vulnerable to climate change. Extreme events that have been observed in the past are expected to become more frequent under scenarios of climate change, including heat waves, intense rainfall events, coastal flooding, and storms. Winter tourism is already suffering from higher temperatures and in the short- to medium-term future, ski areas are likely to become increasingly economically unviable; in the long-term future, summer temperatures are expected

[15] World Travel and Tourism Council

to exceed biophysically acceptable threshold levels, while sea-level rise and flooding will cause the loss of coastal areas. Climate change may also become indirectly relevant for tourism, in particular, through increased resource scarcity (in particular, fresh water) and a growing energy demand, for example, for air-conditioning.

Climate change thus poses various short- and longer-term threats to tourism in Bulgaria, even though warmer temperatures earlier and later in the year may make the country more attractive in the shoulder season (between high and low season). The main risks related to expected climate change and extreme weather events faced by the Bulgarian tourism sector can be summarized as follows:

- **Lower number of tourists.** A combination of climate change-related trends, including higher temperatures, more frequent heat waves, and increased precipitation and humidity may cause lower number of tourists.
- **Shorter winter season.** Winter season can be expected to continue to shrink due to shorter snow cover period as well as other factors such as higher risks of avalanches.
- **Shorter average stay.** This may result from a combination of factors including higher temperatures, more frequent heat waves, and increased precipitation and humidity.
- **Health problems with tourists.** This particularly refers to the summer season when there will be more risk of heat and sun strokes, high blood pressure issues, and so on.
- **Poorer conditions for outdoor recreation.** This is related to higher precipitation and humidity as well as extreme weather events.
- **Damage of tourist infrastructure and superstructure.** This is particularly resulting from extreme weather events including increasing winds and storms, floods, avalanches, and landslides.
- **Poorer access to tourist destinations.** This is particularly resulting from extreme weather events including floods, avalanches, and landslides.
- **Water shortages.** Tourism contributes to high water demand in water scarce areas, which will further aggravate the problem. Higher temperatures and increased drought frequency will contribute to increasing water needs in tourist areas and may impact the tourism experience and deter visitors.

The opportunities can be seen in the following:

- **Longer summer and shoulder seasons.** In particular, prolonged summer season for seaside tourism and shoulder seasons for all tourism types may result from higher temperatures.
- **Development of new tourism products.** Among these are various types of cultural tourism (historic, archaeological, special route tourism); wine and culinary tourism; and special events (for example, festivals).
- **Attracting new perspective tourism markets.** For example, this may include developing the market segment of elderly and retired people visiting outside the peak tourist seasons and developing new destinations.
- **Less need for heating energy in winter and shoulder seasons.** This is linked to higher temperature trends but needs to be balanced with need for higher energy for cooling systems in summer.

It should also be noted that the vulnerability of tourism to climate change has considerable uncertainties. For instance, there is inadequate understanding of how travelers react to extreme events such as heat waves, storms, or heavy rainfall events, and longer-term changes in average temperatures, and how these climate factors may impact choices of tourism activities, or cause demand shifts to different destinations or changes in the timing of holidays.

7.3.7. Transport

The main transport modes, in terms of infrastructure and services, in Bulgaria are road and railway, followed by water and air transport. Road transport is by far the most important mode of passenger transport with cars and buses having a total share of 96 percent in 2015, followed by railway transport, which has a share of only 3.6 percent (in terms of number of passenger trips).

The most significant past impacts on the infrastructure from weather-related events in Bulgaria have come from floods and landslides. The most vulnerable infrastructure is the national road network, including the municipal transport infrastructure (streets and roads), and public transport services. Although no comprehensive data exist for all transport subsectors, it is estimated that annual average costs for damaged transport infrastructure, due to climate-related catastrophic events, are in the range of BGN 115–135 million. This does not include social costs, such as loss of human life, or impacts on the wider economy caused by these damages.

In the medium to long term, the most important risks for the Bulgarian transport system expected as a result of anticipated climate change are concluded to be the following in the sector assessment report:

- **Floods.** The frequency and impact of floods are expected to increase under all climate change scenarios. Floods cause heavy damage to road and railway infrastructure by deteriorating the subbase layers of the road or railway structures. Water may undermine the subbase leading to catastrophic failure of the engineering structures.
- **Landslides.** Precipitation is a major factor in the development of landslides and although the total annual volumes of precipitation are projected to decrease, landslides will continue to be a serious problem due to expected higher frequency of extreme precipitations. Landslides cause heavy damage to road and railway infrastructure and river banks. These may be the reason for long-lasting disruption of operation and restricted accessibility to specific population and/or economic areas.
- **Blizzards and snowfall.** In the long term, the annual volumes of snowfall are projected to decrease, but in the short-term and midterm perspective, blizzards and intense snowfall will continue to be a major source of disruptions to the services of all modes of transport. The northern and northeastern regions are particularly prone to winter traffic disruptions due to high speed winds and snowfall.
- **Extreme heat.** Extreme heat affects roads' asphalt concrete pavements by softening their binding component—bitumen. This decreases the bearing capacity of the pavement and combined with the traffic load, leads to its deformation and to formation of ruts, which increases road accident risks. Furthermore, the combination of high heat and sunlight is the reason for surface cracks and reduces road pavement life. Regarding the railway infrastructure, extreme heat may cause rail buckling, which at its turn, leads to the need of reduction of the maximum admissible operational speed or even disruption of operation and reduces the life of the rails. Extreme heat combined with more expected droughts will further harm the Danube River navigability, which already faces serious deficiencies.

Climate change related events are expected to negatively impact all transport sector stakeholders including:

- **Infrastructure managers** due to deterioration, damage, and even temporary closures of infrastructure sections and/or nodes;
- **Transport operators** due to higher operation costs and possible disruption of operations;
- **Transport users** due to delays, longer transit times, and discomfort during the trip; and
- **End consumers/society** due to higher costs for the transport infrastructure and operations. This also includes potential losses of business, contracts, and customers due to supply chain disruptions.

It should be noted, however, that the National Climate Change Risk and Vulnerability Assessment for the Sectors of the Bulgarian Economy (MoEW 2014) evaluates the transport sector as extremely resilient for the period up to 2035. This is due firstly, to the expected moderate climate change to 2035 and secondly, to the transport system being designed and constructed with consideration of the local climate conditions. Nevertheless, the adaptive capacity of the sector is assessed as insufficient.

7.3.8. Urban environment

In 2017, the urban population in Bulgaria was 5,181,755 or 73.5 percent of the total with about 45.6 percent of the urban population concentrated in six big cities. Despite projections for overall population decline, the urban population is expected to reach 81 percent of total population by 2050. This urban concentration creates pressure on land, infrastructure, and services and exposes more people to disaster risks due to greater concentration of vulnerable groups.

The analysis of past and present weather events shows that the Bulgarian cities have experienced temperature average annual temperature increase and increased number of days with intensive precipitation, often accompanied by wind storms or hail and associated with a growing number of floods which have caused considerable damage over the recent years. Among extreme weather events, floods and landslides have caused the highest financial damages during the period 2010–2015.

Method for assessing future risks. Considering the complexity of urban environment and the variety of urban settings in the current analysis, cities are systematized into three groups according to their population— big, medium, and small—and into four groups, according to their location—coastal (on Danube River and Black Sea coast), plain areas, mountainous, and semi-mountainous areas. The vulnerability of the urban environment is also considered according to their development pattern, zoning, and specific land use.

There are a wide range of likely interlinked impacts in urban areas from future climate events. These include damage to buildings and urban infrastructures, health effects, endangered key services including food supply and electricity, reduced mobility and accessibility and water stress, as well as increased financial pressures on municipalities for maintenance of infrastructure and on emergency aid facilities and staff. Overall, climate change will have a larger-scale impact in big cities. More vulnerable to extreme weather events will be their central urban areas with higher density, intensive traffic, reduced green and open spaces, and old infrastructure with limited capacity. Extreme weather events will also affect more significantly vulnerable groups including those living below the poverty line, in poor standard housing, the homeless, the elderly, and the sick.

The main findings of the analysis and assessment of climate change risks and vulnerability given in the sector assessment report are as follows:

Extreme temperatures

- **Higher temperatures leading to the formation of heat islands,** which will occur more often and will last longer, will have the greatest impact on big cities with increased density and intensity of construction.
- **Extremely low temperatures and cold waves** are not expected to occur frequently but can last for several consecutive days and affect life in both big and small mountain cities. When combined with abundant snowfall, they can endanger vital services, including food supply.

Intense precipitation

- **Flooding will increase in frequency** and affect all settlements and cause damages in both big cities and small towns. The most vulnerable will be those housing areas located near watercourses and the neighborhoods of large cities, built illegally on their periphery in flood-prone zones.
- **Hailstorms**, which are often combined with intensive precipitations, will also cause floods in cities and damage buildings, cars, public transport, and infrastructure.
- **Prolonged precipitation**, combined with a rise in groundwater levels or wastewater seepage and some additional human factors, will trigger **landslides**, especially those in the most sensitive areas of the Black Sea and Danube cities. Additional aggravating factors in this respect include abrasion and erosion.
- **Landslides** can also be provoked by earthquakes, typical of the country. Although earthquakes are not related to climate change, their large impact on the urban environment and people's lives should be considered in the adaptation process.

Water resource scarcity

- **High temperatures combined with droughts will increase water stress** in settlements where there is water scarcity and obsolete networks that lose large amounts of water.

The above conclusions demonstrate that the urban environment in Bulgaria is vulnerable and at considerable risk from future climate change. These risks are exacerbated by the obsolete and often inadequate infrastructure in big and small settlements alike and the large proportion of aging population, predominantly with low-income and below the poverty line. This vulnerability is increased by a poor level of awareness of the problems, their causes, and possible prevention and management, among both decision makers and the general public.

7.3.9. Water

The water sector as defined here includes both managed water systems (water supply and sanitation, hydro-melioration,16 hydropower, and industrial use) and natural water systems. Bulgaria's total long-term annual renewable water resources amount to 21.3 km3, of which 20.4 km3 is accounted for as surface water and 0.9 km3 as net groundwater resources. The area covered by surface freshwater bodies accounts proximately 2,000 km2, which is less than 2 percent of the country's territory. While Bulgaria has relatively significant freshwater resources compared to other European countries, water resources are unevenly distributed throughout the country and by season.

Climate change is expected to have a significant effect on the hydrology of rivers. For some river basin management regions, total annual discharge rates are projected to drop by approximately 10 percent over a period of 30 years in comparison to the reference period 1976–2005. Significant shifts are expected in the seasonal distribution of rivers' runoff. While in winter and spring there will be an increase, summer and autumn river discharge rates are

[16] Hydro-melioration includes irrigation of agricultural crops, drainage of agricultural land, and flood protection of agricultural land.

expected to decline. Groundwater availability is not expected to change significantly. Past and present weather events and trends including serious droughts and floods since 2000 have already impacted the water sector with physical evidence of the impairment of water sector infrastructure due to floods (2004 to 2008) given in the sector assessment report.

The conclusions of the Water Sector Assessment Report for climate change risk and vulnerabilities are as follows:

- **Flood and drought hazards** are identified as most relevant to the water sector. Higher flood risks concern the entire country, while higher droughts risk concern regions with projected water scarcity. Based on projections that climate change will not affect groundwater availability and projected decline of Bulgaria's population and slow growth of industrial and agricultural activities, there is a lower scarcity risk in regions which use groundwater. High scarcity risk is likely in regions supplied with surface water and having high tourism activities, which are projected to increase.
- **The Black Sea region appears to be the most vulnerable to scarcity risk** because it uses surface water and is the most visited by tourists. Poor condition of the infrastructure in this region adds another dimension toward increasing the risk.
- **Key vulnerabilities to these climate hazards** (and their effect on water scarcity) are:
    - **State and preparedness of the infrastructure -** Overwhelmed, aging, poorly maintained infrastructure, and therefore, highly vulnerable and most probably inadequate to cope with climate change.
    - **Preparedness of the human factor, operator, or user -** Population and operators of infrastructure lack historical experience and good practices with floods and droughts, and therefore, are highly vulnerable.
    - **Hydropower production systems** – vulnerable to operation during droughts
    - **Water services** (water supply, sanitation, melioration) - vulnerable during droughts
- **Major risks to managed systems** are therefore
    - Risks to infrastructure and services: damage, improper operation, and low-level or insufficient services
    - Risks to hydroelectric-generation from low or high river flows

Major risks to natural systems are to impaired biodiversity resulting from both floods and droughts.

7.4. 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 approved by Council of Ministers (Decision № 621/25.10.2019) the National Climate Change Adaptation Strategy and Action Plan for the Republic of Bulgaria.

To achieve an adequate level of adaptation to climate change, the Bulgarian Government apply a number of leading and overarching guiding principles in the implementation of this adaptation strategy. These principles are straightforward and provided clear direction and benefits to the country. They are inspired by and highly coincide with those included in the

EC's 'Guidelines on developing adaptation strategies' and also based on the IPCC Technical Guidelines for Assessing Climate Change Impacts and Adaptations.

The EU Climate Change Adaptation Strategy rightfully sets out that "adjustments in natural and human systems in response to actual or expected climate change impacts, which moderate, harm, or exploit beneficial opportunities," are at the roots of climate change adaptation (Adger et al. 2007). It further shows that "adaptation affects all levels of decision making, all regions as well as most sectors, so that it needs to be structured as a cross-sectoral, multilevel, and inter-regional activity bringing together actors with different knowledge, interests, and values" (Grothmann 2011; Lebel, Grothmann, and Siebenhüner 2010).

Principles (based on Adger and Vincent 2005; Brown et al. 2011; Prutsch et al. 2010; UKCIP 2005) that have internationally been recognized as key factors for good adaptation and that the Government of Bulgaria (GoB) herewith makes her own, are the following:

(a) Any adaptation action undertaken should be **sustainable.** Responses to adaptation should not go against climate change mitigation efforts and should not block the carrying out of adaptation elsewhere. **Article 7** of the Paris Agreement states that the goal of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, has a view to contribute to sustainable development. Thus, there is a clear linkage between climate change adaptation and Sustainable Development Goals (as outlined in Section 4.3).

(b) Carry out adaptation in **partnership.** All stakeholders like from public institutions, civil society, and private sector, at all levels, should be identified and engaged. It should be ensured that they are well-informed and encouraged to work on adaptation.

(c) **Evidence-based** adaptation is the preferred approach. Latest research, data, and practical experience should be applied in support of robust decision making. Closing of data gaps is a priority.

(d) Apply a **balanced approach**. Social, natural, and economic development are influenced by a variety of stresses, of which climate change is one aspect. Thus, adaptation must take a holistic approach managing both, climate and non-climate risks.

(e) Address risks associated with past and current **climate variability** and **weather extremes.** This forms the starting point for anticipatory action addressing longer-term climate change related risks and opportunities. Coordination and **close synergies with DRM** should be secured.

(f) Adaptive action should be **prioritized**. Giving more attention to most affected sectors, to situations with long-term lifetimes or implications, to significant investment needs or high value stakes, or in case of critical national infrastructure, are examples.

(g) Adaptation must be **tailored** to the scale required by the climate change challenge. Solutions need to be adjusted to individual situations, also addressing responsibilities and financing.

(h) Adaptation should be **flexible**. A level of uncertainty over future climate will always remain. Adaptation options should be considered in certain fields (for example, horizontal and soft options with relatively low costs, and/or vertical options in sectors with long-term planning horizons). This creates decisions that can be adjusted easily.

(i) Adaptation needs to be **transparent.** The effects of various adaptation options, both in the near and long term, should be communicated in full, providing as much detail as possible which, among others, include the level of risk to be accepted, as well as to agree on solutions that are fair and balanced.

(j) Continuously review the **effectiveness, efficiency, equity, and legitimacy** of adaptation decisions. This will allow for their gradual improvement in line with the evolution of evidence and knowledge on climate change impacts.

In the National Strategy, for each sector, a range of adaptation options have been identified in the Sector Assessment Reports. The options can be identified for 'horizontal' (covering the whole sector) and 'vertical' (addressing specific subsectors) levels and further grouped according to the type of option. It should be noted that horizontal options can support vertical options by enabling specific subsector actions.

7.4.1. Agriculture

Adaptation actions need to be undertaken at both the national and farm levels, with the engagement of regional/local administration and communities. The responsibility of developing sectoral climate change policies and drafting guidelines and other regulatory documents should be undertaken by the MAFF in collaboration with all other relevant ministries, government organizations, and main stakeholders. At the same time, the policy should be consistent with EU and international policies and commitments. Local authorities, business companies, and society as a whole, should also have a role to play. For example, some adaptation actions (such as introducing innovations in the farms, growing new plants adaptive to climate change) would require the direct participation of agricultural holders and farmers

Adaptation options have been identified and grouped into horizontal and vertical levels. Vertical adaptation options are grouped into agricultural productivity (crops); livestock production; and natural resources (soil erosion and desertification, water shortage and irrigation, fisheries and aquaculture). Horizontal adaptation options are grouped into building adaptive capacity; improving awareness; strengthening research, technology development, and innovation; risk management; and legal framework. Table 6.3 summaries these with examples.

Table 6.4. Summary of agricultural adaptation options

Vertical Options		
Sustainable management of agricultural practices for adaptation to climate change	Agricultural productivity (crops)	Adjust timing of farm operations; grow thermophilic crops; and develop suitable irrigation systems.
	Livestock production	Develop systems and mechanisms for storing water on farms; diversify livestock farming; and save existing pastures for grazing.
	Natural resources management (soil, water, fisheries, and aquaculture)	Increase the use of perennial crops; improve water management practices; and maintain and improve existing aquaculture habitats.

Horizontal Options		
Promote adaptive capacity and awareness in agricultural sector	Building adaptive capacity	Develop climate change training; and develop knowledge dissemination actions.
	Improving awareness	Engage in wider dissemination of CCA knowledge to reach local farmers; and establish a formal platform for aquaculture.
Promote research and innovation for climate change adaptation	Research, technology development, and innovation	Develop research on new crop varieties; and develop farm-level resource management innovations.
Strengthen policy and legal framework for adaptation in the agricultural sector	Risk management	Develop insurance and risk management programs
	Legal framework	Update and amend the legislation affecting fisheries and aquaculture

7.4.2. Biodiversity and ecosystem services

The approach to identifying adaptation options uses an ecosystems-based approach to CCA. The grouping of adaptation options is based on the target groups and types of measures. The first two groups are mainly related to the national-level coordination and national and local action. The last three groups are options for operationalizing ecosystems-based adaptation at the local level and summarize the key themes identified during informal consultations with stakeholders.

It is noted that legal and methodological gaps for BD&ES contribute to a higher level of uncertainty than other sectors. To reduce this uncertainty and the related societal risks, it is important to implement adaptation options from all five groups of action outlined in Table 6.5 to take into account their mutual links.

Table 6.5. Summary of biodiversity and ecosystems services adaptation options

Enhance ecosystem governance	Strategic planning and implementation legislation	Develop and adopt the new Biodiversity Strategy and Action Plan and a new Green Infrastructure Strategy with regard to CCA
	Adjusting sectoral legislation to climate legislation	Revise the CCMA and sectoral strategies/ legislation to include provisions of CCA Strategy
	Linking emissions statistics to new environmental accounts	Create carbon environmental accounts
	Education for ecosystem thinking	Create specialized education courses for administrations responsible for implementing CCA and biodiversity legislation
Enhance knowledge management and stakeholder communication for adaptation	Open and reuse data	Ecosystem data interoperability between authorities and other actors
	Communication and understanding of ecosystem processes and climate change as pressure	Communication and tools for informed prioritization of research and practical action
	Use of local biodiversity knowledge	Targeted collection of folk customs and traditional knowledge
	Use of citizen science	Promote ecosystem thinking among volunteers
Create space for BD&ES	Reclaim space from grey infrastructure	Regional/local ‘red lines’ to prevent loss of ecosystem services vital for CCA
	Create refugia, reduce fragmentation	

Increase climate change resilience by reducing pressures not related to climate change	Reduce pollution and disturbance	Estimate carrying capacity for vital ecosystems and production capacity for their services
	Reduce overexploitation	
Sustainable use of regulating and cultural ecosystem services for adaptation	Optimal use of existing ecosystem services	Use genetic resources for resilience
	Ecosystem services for CCA as new opportunity for business and society	Ecosystem restoration—a long-term business opportunity

7.4.3. Energy

A set of adaptation options is proposed that can help increase the climate resilience of Bulgaria's energy sector. The measures that are the focus of the report are those specifically addressing near- and long-term climate risks of high magnitude, as presented in Chapter 1. Given that the energy sector in Bulgaria is facing climate-related challenges, and as there are uncertainties over future climate change, these measures have been selected because they will help improve the resilience of the sector today, as well as in the future. These are summarized in Table 6.6.

Table 6.6. Summary of energy sector adaptation options

Strategic Objective	Type of Option	Examples
Build institutional capacity, knowledge, and use of data for adaptation	Institutional capacity and knowledge networks	Provide training to the MEn, regulator, and wider energy sector decision makers/ operators on CCA
	Translate monitoring, forecasting, and weather data for the energy sector	Meetings with the NIMH to define needs for climate services and centralized agreement for provision of climate services
Mainstream climate change considerations into energy sector policies, plans, and financial mechanisms	Mainstream climate change considerations within energy sector policies and plans	Undertake an inventory of strategies, policies, plans, standards, and so on, to identify where climate resilience should be incorporated
	Financial mechanisms to build resilience	Review existing mechanisms for financial protection in other countries and evaluate potential for implementation
Incorporate climate resilience into design and engineering	Climate resilience in power plants and mines	Ensure climate resilience is integrated into water resources management affecting the operation of large hydro power plants
	Climate resilience in transmission and distribution (T&D) infrastructure	Develop maps showing climate risk zones for climatic parameters relevant to T&D infrastructure
Increase resilience of energy supply	Diversify supply to increase overall energy system resilience	Continue to develop regional electricity trading and interconnections
	Energy efficiency in buildings and industry systems	Advance efforts to motivate end users to implement energy saving measures

7.4.4. Forestry

The adaptation options included here will help safeguard the sector so that its many services will continue to be delivered for society. These include options to enhance knowledge base and awareness, enhance and protect the forest resources for climate change adaptation, and improve potential for sustainable use of forest resource. Many of the options are envisaged in the 'Strategic Plan for the Development of the Forestry Sector in the Republic of Bulgaria 2014–2023' and the further development of these adaptation options should be in coordination with the delivery of this plan. A summary of forestry adaptation option is given in Table 6.7.

Table 6.7. Summary of forestry sector adaptation options

Strategic Objective	Type of Option	Examples
Enhance knowledge base and awareness for climate change adaptation	Research, education, and extension	Create a National Forestry Extension Service and a system for dissemination of results
	Research to support adaptation	Model potential performance of important tree species under different climate change scenarios and timescales
Enhance and protect the forest resources	Resilience in regenerating, expanding, and strengthening the forest resource	Enhance Bulgaria's forest nursery capacity and system for seed collection and storage
	Maintenance of biodiversity, genetic diversity, and forest resilience	Measures to limit potential of invasive species to enter forest ecosystems
	Management of forest resources	Build national system for rapid fire detection and response to this and other natural calamities
Improving potential for sustainable use of forest resource	Improving the potential for long-term use of higher-valued wood products	Review and expand current building standards to improve the position of wood as a material
	Improving potential for sustainable and more environmentally friendly use of wood biomass for production of energy	Establish a program to promote the installation of modern energy and heat production systems for households, businesses, and small communities

7.4.5. Human health

Planned adaptation to the health impacts of climate change comprises a broad range of public health interventions. Successful planned adaptation depends on an awareness of and information about the problem, on the existence of effective response strategies, and on the availability of the resources, information, and incentives to implement them. The main challenges in developing adaptation strategies for human health are to account for the diversity of health impairments, regional conditions, and adaptation actors, and for the large uncertainty about future changes in most climate-sensitive health risks. Adaptation options outlined in Table 6.8 include those for enhancing governance, building the knowledge base and awareness, and adapting the external environment to reduce health impacts of climate change.

Table 6.8. Summary of human health adaptation options

Strategic Objective	Type of Option	Examples
Enhance governance for adaptation	Policy, legal, and institutional framework	Development of National Strategy and Action Plan on health and climate change
	Administrative, infrastructure, communication, financial, and technical capacity	Establishment of inter-disciplinary climate change and human health (CCHH) WG to provide communication, coordination, initiation, control, updating, and so on.
	Professional capacity	Thematic workshops, lectures, and training on the health effects from climate change for all professionals and stakeholders
Build knowledge base and awareness for adaptation	Public education and awareness on adaptation	Multimedia campaign on CCHH
	Monitoring, data collecting, and early warning	Build national monitoring and early warning system for CCHH
	Research and knowledge base	Assessing health vulnerability at the national and local level

Strategic Objective	Type of Option	Examples
Adapt external environment to reduce health impacts of climate change	Adapting built and natural environment to reduce health impact of climate change	Development of concept and guidelines for adjustment of public built environment to climate change.
	Socioeconomic capacity	Development register of groups vulnerable to climate change at the national and local level and special program for work with these groups

7.4.6. Tourism

Adaptation options proposed for tourism are based on the assessment of risk and vulnerability and the policy context. These are summarized in Table 6.8. and cover options for mainstreaming CCA into policy development and the legal framework related to the tourism sector, enhancing awareness and knowledge base for climate change adaptation in the sector, building adaptive capacity, and developing of specific adaptation actions for existing and new tourism.

Table 6.9. Summary of tourism sector adaptation options

Strategic Objective	Type of Option	Examples
Mainstream climate change adaptation into policy development and legal framework for tourism sector	Development of a Sectoral Climate Change Policy	Development of NAS and Action Plan for CCA in the tourism sector
	Comprehensive legal framework	Develop insurance and risk management programs
Enhance awareness and knowledge base for climate change adaptation in tourist sector	Awareness-raising measures on climate change and its impacts on the sector	Develop a national database (online portal) containing CCA specific information
	Strengthening the sector knowledge base	Develop research projects and programs for climate change impacts on tourism development
Build adaptive capacity in tourism sector	Regional and sub sectoral assessment of adaptive capacity	Conduct adaptive capacity assessments in nine tourist regions
	Capacity building	Develop climate change training
Development of specific adaptation actions for the tourism sector	Adapting existing tourism sectors	Develop and implement adaptation measures for summer and winter tourism
	Developing new tourism and management solutions	Develop new tourism types/products and/or destinations

7.4.7. Transport

There are several areas where adaptation options with relevance to transport infrastructure can be identified, as shown in Table 6.9. These include those related to building institutional capacity and the knowledge base regarding CCA to support the formulation and implementation of policies. They also focus on mainstream CCA considerations into the planning and decision-making processes. This includes through project preparation, operation and maintenance (including in relation to extreme weather-related events) and updating design norms to account of climate change.

Table 6.10. Summary of transport sector adaptation options

Strategic Objective	Type of Option	Examples
Build institutional capacity and knowledge base of the transport sector	Building institutional capacity	Training needs assessment and implementation of training programs
	Building knowledge base	Introduce and/or improve CCA relevant data collection practice and perform dedicated studies

Strategic Objective	Type of Option	Examples
Mainstream climate change adaptation considerations into key planning and decision-making processes	Reviewing and enhancing project preparation procedures	Development of guidelines for considering CCA issues in the project management cycle
	Reviewing and improving operation and maintenance	Develop and implement program for strengthening road network resilience to extreme weather events
	Reviewing and updating design norms	Update of guidelines for design of roads' culverts and bridges

7.4.8. Urban environment

The range of adaptation options for the urban environment sector reflects the scope and complexity of climate change impacts in this context. These are focused on strengthening the policy and legal framework to mainstream adaptation to climate change, building adaptive capacity, developing financial, social, and risk management policies, and enhancing knowledge management, research, education, and stakeholder communication (as shown in Table 6.11). Identified adaptation options include those directly or indirectly targeted toward DRM. The interdependence of these adaptation options means that their effectiveness depends on their appropriate combination.

Table 6.11. Summary of urban environment adaptation options

Strategic Objective	Type of Option	Examples
Strengthen policy and legal framework to mainstream adaptation to climate change	Mainstream CCA in regional and urban development	Incorporate CCA into the new National Housing Strategy
	Revising and amending legislative documents to transpose CCA issues after a Regulatory Impact Assessment	Mainstream CCA requirements in all legislative documents related to regional and spatial/urban planning
	Technology/construction - implementing new Eurocodes and technical norms in planning, design, construction technologies, and building materials	Promote green, smart, and innovative cities, buildings and technologies planning, design, and certification
Build adaptive capacity	Developing sustainable institutions capable of providing CCA policy at all administrative levels	Organize horizontal coordination between MRDPW, MoEW, MEn, MAFF, MF, and MI
	Institutional, administrative, and expert capacity	Build emergency and DRM units' capacity, provide sufficient and modern equipment, and financial support
Develop financial, social and risk management policies for adaptation to climate-change	Financial, social, and insurance policies	Revise existing financial instruments and design new ones for CCA and DRM, including for energy efficiency and construction renovation of buildings
Enhance knowledge management, research, education and stakeholder communication for adaptation	Information—securing institutionally regulated exchange of information and data according to INSPIRE Directive obligations	Create common standards for the type, structure, scope, and format of metadata and data, harmonized with EU at the city level
	Research—provide common long-term vision and objectives in urban environment CCA research	Identify priority scientific topics, linked with the city, open and green spaces, buildings, infrastructure, construction materials and human health, and their risk resilience assessment
	Education— 'Train the trainers'	Establish joint multidisciplinary courses at different

Strategic Objective	Type of Option	Examples
	on CCA	educational levels
	Partnership—work in partnership and communicate knowledge	Organize a social network for support of vulnerable groups

7.4.9. Water

The suggested adaptation options are grouped according to three strategic objectives. These refer to enhancing adaptive governance, strengthening the knowledge base and awareness for adaptation, and enhancing adaptive management of water system infrastructure (including design, construction, and operation). Such options also link to water-related DRM in particular for floods and droughts. Types of adaptation options with examples are given in Table 6.12.

Table 6.12. Summary of water sector adaptation options

Strategic Objective	Type of Option	Examples
Enhance adaptive governance	Adaptation of legal framework to make it instrumental for addressing climate change impacts	Clarify roles and responsibilities for CCA
Strengthen knowledge base and awareness for adaptation	Use of research and education institutions	Provide research support to RBDs through framework agreements
	Awareness, education, and training	CCA training of public administration and water operators
	Monitoring and flexibility	Extend and upgrade CCA related monitoring networks of precipitation, water resources, and water use
Enhance adaptive management of water system infrastructure	Adapting design and construction	Revise and update design and construction norms
	Adapting operations	Develop methodology and assess adaptive capacity of significant water infrastructure

7.5. Expected Results

7.5.1. Agriculture

Adaptation actions in the agriculture sector can be viewed as either offering short-term or long-term benefits. Actions that offer short-term benefits are those that improve resilience to extreme events or those that improve the enabling environment and governance framework to facilitate more effective adaptation in the future. Actions offering longer-term benefits are linked to agricultural assets, which frequently have long life spans and include amendments to existing or planned assets to ensure climate resilience (for instance, improved water management and renovating the irrigation infrastructure, leading to efficient use of irrigation water and conservation of soil moisture).

Results can also be viewed in terms of the wider socioeconomic or environmental benefits that actions offer. For instance, developing better and improved early warning systems would contribute to farmers being able to foresee the costs for protecting agricultural products as well as to respond in an efficient manner to unfavorable climatic events, thus reducing the loss of crops and livestock due to droughts, floods, or other weather extreme events. Saving costs will help to stabilize the income and revenues for farmers.

7.5.2. Biodiversity and ecosystem services

The adaptation options identified in this strategy are seen as having cost-effective socioeconomic benefits. These are derived from the structural and functional links between the conservation and restoration of BD&ES services and the yield of ecosystem services that can be used for CCA. The feedback loop between anthropogenic pressures and benefits of the ecosystems services is key to adaptive management. Increases in pollution, fragmentation, extended changes in land use, and climate change decrease the provision of ecosystems' services and hence, also human well-being and economic development. In contrast, reduction of pressures, combined with ecosystem conservation or restoration, can support adaptation and provide for economic growth and social benefits accessible to the local communities at lower cost.

Key specific expected results in the short term are the adoption of the Biodiversity Strategy and Green Infrastructure Strategy, and provisions for implementation of ecosystem-based adaptation in line with these strategies included in relevant legislation. Other short term expected results include those related to activities for operationalizing ecosystem data interoperability between authorities and other actors, encouraging participative science, maximizing the use of citizen science and education for ecosystem thinking.

7.5.3. Energy

As is the case for other sectors, adaptation measures and actions in the energy sector that offer short-term benefits are those which improve resilience to extreme events and those that improve the enabling environment and governance framework to facilitate more effective adaptation (for example, mainstreaming climate change within sector policies and plans and building institutional capacity and knowledge networks). Actions with longer-term benefits are linked to energy assets, especially those of long duration and include upgrading of existing or planned assets to ensure climate resilience (for example, T&D infrastructure). In a broad sense, improved energy sector resilience has potentially significant short- to long-term benefits, and this underlines the existing need to respond to risks associated with climate change.

There are also potential associated socioeconomic or environmental benefits from energy sector CCA actions. For instance, the identified measures to improve energy efficiency in buildings has the potential to offer multiple co-benefits, namely climate change mitigation objectives, improved comfort for residents and workers, which if targeted at vulnerable groups (for example, rural and urban poor) could address social inequality. In addition, the action to review the use of water for cooling processes by TPPs and NPPs has the potential to offer environmental co-benefits through reduced abstraction of freshwater.

7.5.4. Forestry

Adaptation of Bulgarian forests to climate change and its potential consequences, reducing the overall vulnerability of the forestry sector, and increasing its economic viability and resilience is seen as crucial for the quality of life of the Bulgarian population. Successfully adapting the forest sector to climate change will have the added benefit of increasing its mitigation effect as more carbon will be sequestered from the atmosphere and the economic importance of the sector will grow.

A number of specific benefits from CCA actions are identified for the forestry sector. These include the benefits provided by applied research to support an informed response to climate change threats in forestry, the increase of forest resilience and capabilities to handle new conditions provided by the maintenance of biodiversity and genetic diversity, and the improvement in the long-term potential for sustainable use of wood biomass.

7.5.5. Human health

Health sector adaptation to climate change may have a wide range of favorable consequences. The overall benefits for a healthier and more economically active population will be facilitated by a number of contributing adaptation measures. These include creating awareness of CCHH issues, enhancing coordination and cooperation among different government agencies and NGOs concerned with CCA and human health, and strengthening health education and training on the impacts of climatic change on the environment and human health. These measures will all build capacity of health actors to address climate change-related health impacts.

7.5.6. Tourism

Overall long-term results of the proposed CCA measures for the tourist sector will be the economic benefits of exploiting the opportunities provided by a changing climate (such as developing new types of tourism and new destinations). The measures to build adaptive capacity will also increase resilience to climate change impacts in the sector. Adaptation practices should bring benefits to all tourism stakeholders both on the supply- and demand-side, as well as for the local communities and for the Bulgarian economy as a whole. The sector assessment report also identifies the potential for mitigation benefits from more sustainable resource use in the sector.

In the short term, key specific expected results are the development of a NAS and Action Plan for CCA in the tourism sector and better governance and coordination of adaptation actions; higher awareness, higher knowledge base and higher capacity; and the development of assessment tools for adaptive capacity and thus more adequate reaction to climate change in the sector. A further expected result from capacity building actions is better coordination, information, and communication between the responsible governmental and public institutions.

7.5.7. Transport

The results of the implementation of adaptation options, including the associated benefits, are difficult to evaluate with accuracy for the transport sector as they are expected to occur over a long period and depend on many external factors. However, the overall results from these activities are expected to be improved resilience to climate change for the transport infrastructure across all subsectors. This is contributed to by measures to build the institutional capacity and knowledge base of the transport sector, including through increasing CCA expertise availability across all key stakeholders, establishing and improving relevant data bases per transport sector, and improving knowledge as a basis for planning and implementing appropriate CCA measures. Mainstreaming climate change adaptation considerations into key planning and decision-making processes is also key to achieving resilience in transport infrastructure.

7.5.8. Urban environment

The benefits from the identified adaptation options include the expected synergistic and cumulative effect of their simultaneous or sequential implementation. Mainstreaming CCA into regional and urban development policies, including housing and construction, will increase the effectiveness of regional policies and will ensure land protection in spatial and urban planning and development.

Improving information provision, accelerating the implementation of the Access to Spatial Data Act, and exchanging information will facilitate the development of scientific research, will make the decision-making process for urban development and environmental protection more transparent and reliable, and will increase the capacity of scientific institutions and different experts.

The development of urban research will provide new arguments for protecting public interests and improve the living and recreation environment. Research on innovative building technologies, construction, and materials will help designers and builders to create intelligent buildings and facilities, which are better resistant to climate change and extreme events.

Institutional development, improved horizontal and vertical coordination, and integration, cooperation between national, regional, and local levels authorities will enhance the quality and effectiveness of their work, while linking sectoral policies with spatial planning. This will also contribute to the successful implementation of an integrated and more comprehensive approach to urban renewal and development.

7.5.9. Water

For adaptation options supporting the strategic objective to enhance adaptive governance, expected results are identified as improved coordination among institutions, effective and efficient implementation of RBMPs, and the adoption of more water-efficient and less water polluting technologies and practices.

Under the strategic objective to strengthen the knowledge base and awareness for adaptation, the key expected results are the availability of the latest research achievements and reliable water monitoring data, enhanced quality of plans and programs developed by RBDs, raised public awareness, and increased preparedness of stakeholders. Overall, the adaptation actions will contribute to improved decision making under uncertainty.

For the strategic objective to enhance adaptive management of water system infrastructure, the expected results are the adaptive design and construction of managed water systems, identification of significant water infrastructure which needs reinforcement, and adequately and safely operated water systems.

8. Financial resources and transfer of technology

8.1. Provision of new and additional financial resources

This is not applicable for Bulgaria.

8.2. Assistance to developing country Parties that are particularly vulnerable to climate change

This is not applicable for Bulgaria.

8.3. Provision of financial resources, including financial resources under Article 11 of the Kyoto Protocol

This is not applicable for Bulgaria.

8.4. 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"[17],
- **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

[17] https://ope.moew.government.bg/en/pages/programirane-2014-2020/18

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 and during 2022, the final report containing information on the 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 reports are published on the website of the Ministry of Environment and Water of Bulgaria.

The first and final official reports on the implementation of the Third NAPCC is elaborated within the above-mentioned Interministerial Working Group and approved by the Council of the Ministers.

9. Research projects and systematic observation

9.1.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.

9.2.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.

Major international and with a national scope projects:

- Educational project "Climate box - scientists, teachers and students together for climate, atmosphere and waters";

- The scientific supervisors of doctoral students from IICAV-BAS have taken part in various scientific forums (conferences, seminars, workshops, scientific networks, expert bodies, scientific unions, associations, societies, etc.) related to the issues of climate change - see Measure 3;

- The scientific supervisors of doctoral students from NIGGG-BAN have taken part in various scientific forums (conferences, seminars, workshops, scientific networks, expert bodies, scientific unions, associations, societies, etc.) related to climate change issues - see Measure 3;

- The scientific supervisors of doctoral students from ICIT-BAN have taken part in various scientific forums (conferences, seminars, workshops, scientific networks, expert bodies, scientific unions, associations, societies, etc.) related to climate change issues.
- Project "Water balance and water resources of the country";
- Project "Local climate classification of the city of Sofia based on geospatial information about the urban landscape" ;
- "Climate" section of "Assessment of climatic conditions on the territory of the municipality of Veliko Tarnovo" as part of "Update of the program for reducing emissions and reaching the established norms for fine dust particles in the atmospheric air in the municipality of Veliko Tarnovo";
- Project "Study of changes in atmospheric air quality for the last 8 - 10 years in large cities in Bulgaria";
- "Climate" section of the "Sustainable Energy and Climate Plan of the Stolichna Municipality for 2021-2030";
- Project "Vertical Structure of the Atmosphere in the Black Sea Coastal Zone Using Remote Sensing Measurements and Mesometric Modeling";
- Project "Investigation of the influence of the characteristics of the air environment on the quality of life and human health";
- Project “Development of an innovative VEGA wind generator - product innovation” ;
- Project "Systematic analysis of geomagnetic observatory data to detect phenomena and correlations with various environmental parameters (climatic, geological, geophysical) ;
- Project "A Concept for Integrating the Ecosystem Approach in Spatial Urban Planning Policies and Tools";
- Project "Assessment of wind-solar renewable energy resources in representative regions of Bulgaria";
- Project "Satellite information downscaled to urban air quality in Bulgaria - "SIDUAQ"
- Project "Application of Remote sensing and GIS for Assessment of Ecological Sustainability and Functioning of Selected Agro-ecosystems in Changing Environmental Conditions"
- Project: “Developing Support For Monitoring And Reporting Of GHG Emissions And Removals From Land Use, Land Use Change And Forestry (LULUCF)”
- Project: "Copernicus" program/National database "KORINE land cover 2018 NNP EPLUS – Low-carbon energy for transport and household
- Processes, quality of the marine environment, ecosystem functions and services in the coastal zone and the Bulgarian Black Sea Economic Zone. (RP.I.4.)
- Epilithic diatoms from the Southern Gulf of Livingstone Island (Antarctica): opportunities for bioindication with colonization of new substrates in conditions of climate change.

- IICAV, in cooperation with a specialized company financed under a European project, installed (free of charge for the beneficiaries) 3 meteorological stations in Primorsko and Varna, the readings of which are already actively used by local institutions.

- According to the ICAMOS project "Information complex for aerospace environmental monitoring", financed under OP "Development of the competitiveness of the Bulgarian economy", procedure BG161PO003-1.2.04 "Development of applied research in research organizations in Bulgaria", the laboratory base of ICIT-BAS was improved.

- Project "Extreme phenomena and wind profile in a coastal area"

- Project "Natural and anthropogenic factors of climate change - analysis of global and local periodic components and long-term projections"

- Project "Influence of climate, atmosphere and waters on the environment, the parameters of the orientation of the Earth, the gravitational field and the movements of the observation stations"

- Project "Assessment and analysis of climate changes on regional/local scales and some of their consequences"

- Project "Joint Study of Atmospheric Dynamics and Three-Dimensional Structure of Atmospheric Pollution Fields"

- Project "Bioclimatic Characteristics at Regional and Local/Urban Scales"

- Project No. D01-230/06.12.2018 DSD-4 (RPI.1) DSD-4/25.02.2019 Work package I.1, Regional/local characteristics of the country's climate

- Project "Bioclimatic parameterization of Bulgaria"

- Project "Influence of aerosol and gas pollution on air quality above a populated place in a mountain valley"

- NNP EPLUS – Low-carbon energy for transport and household

- MASRI project - Infrastructure for sustainable development in the field of marine research, also tied to the participation of Bulgaria in the EURO-ARGO European infrastructure

- Project “National Science Program”, RP.I.4. Processes, quality of the marine environment, ecosystem functions and services in the coastal zone and the Bulgarian economic zone of the Black Sea, RP I.4.2-1: Assessment of multi-year changes in the hydrophysical factors of the marine environment and their impact on individual components of the ecosystem

- CMEMS BS-MFC-2 Project, Copernicus Marine Environmental Monitoring System - Black Sea Monitoring and Forecasting Center - Phase 2

- CMEMS-INSTAC Project Copernicus Marine Environmental Monitoring System - Provision of in situ products - Phase 2

- Project “Organization of an online training seminar for Copernicus Maritime Services dedicated to the Black Sea”, Lot 1

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”.

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.

Table 9.1 Projects related to the protection of the environment, water and climate, financed by FNI in the period 2013 - 2020:

Contract	**Topic:**	**Main organization**	**Head**	**Amount (in BGN)**
DFNI E 02/16 of 12.12.2014	Effective use of waste biomass for energy and environmental purposes: potential of bioethanol as a feedstock fuel	Institute of Catalysis at BAS	Prof. Dr. Sonya Damyanova Ivanova	240000.00
DFNI E 02/19 of 12.12.2014	Influence of aerosol and gas pollution on air quality above a populated place in a mountain valley	University of Mining and Geology "St. Iv. Rilski"	Prof. Dr. Plamen Borisov Savov	100000.00
DFNI T02/2 of 12.12.2014	Development of a complex system for bioremediation of water contaminated with heavy metals and co-generation of energy based on microbial metabolism	University of Mining and Geology "St. Ivan Rilski"	Associate Professor Dr. Irena Ilieva Spasova	165000.00

Contract	Topic:	Main organization	Head	Amount (in BGN)
DN 07/7 of 15.12.2016	Investigation of Chemical, Electrochemical and Biological Processes in Microbial Fuel Cells in Mining Wastewater Treatment	Mining and Geology University "St. Ivan Rilski" - Sofia	Assoc. Dr. Anatolii Tsankov Angelov	120000.00
DN 07/12 of 15.12.2016	Research on environmentally compatible processes for the extraction and fractionation of valuable functional substances from waste biomass	Institute of Engineering Chemistry - BAS	Prof. Dr. Eng. G. Angelov	118600.00
DN 04/1 of 13.12.2016	A study of the combined effects of the natural radioactive background, UV radiation, climate change and cosmic rays on model groups of plant and animal organisms in mountain ecosystems	Institute for Nuclear Research and Nuclear Energy (INRNE) at BAS	Assoc. Dr. Hristo Angelov	120000.00
DN 04/3 of 17.12.2016	Arsenic migration in riparian zones: relation of river and groundwater dynamics to arsenic mobilization in polluted river terraces	National Institute of Geophysics, Geodesy and Geography - BAS	Associate Professor Dr. Tsvetan Kostadinov Kotsev	120000.00
DN 04/4 of 15.12.2016	Study of processes of transfer and deposition of atmospheric pollutants in Bulgaria	National Institute of Meteorology and Hydrology, BAS	Associate Professor Dr. Emilia Venkova Georgieva	119996.00
DN17/12 of 12.12.2017	Man as a physiological source of deterioration of air quality and comfort conditions in inhabited non-industrial indoor environments	Technical University Sofia	Prof. Dr. Petar Stankov	120000.00

Contract	Topic:	Main organization	Head	Amount (in BGN)
DN17/20 of 12.12.2017	Functional composite nanomaterials derived from natural sources for environmental protection	University of Mining and Geology "St. Ivan Rilski"	Ch. Assistant Professor Gospodinka Dinkova Gicheva,	120000.00
DN17/25 of 20.12.2017	Preparation, purification and immobilization of lipase in solid-phase cultivation of Rhizopus arrhizus as a tool for the development of eco and "green" technologies	University of Food Technology, Plovdiv	Prof. Dr. Georgi Todorov Dobrev	120000.00
DM17/2 of 12.12.2017	Integration of Plant-Sediment Microbial Fuel Cells in Engineered Wetlands for the Treatment of Oil-Contaminated Water	University of Mining and Geology "St. Ivan Rilski"	Assoc. prof. eng. Rosen Valeriev Ivanov	20000.00
DM17/6 of 12.12.2017	Closed cycle for environmental protection in thermal power plants by conversion of fly ash into zeolites and their application as carbon dioxide adsorbents	Technical University Sofia	Assoc. prof. eng. Denitsa Zgureva	19300.00
DN14/3 of 13.12.2017	Assessment and analysis of climate changes on regional/local scales and some of their consequences	National Institute of Geophysics, Geodesy and Geography, BAS	Member-Correspondent, Prof. D.Sc. Kostadin Ganchev Ganev	120000.00
DN14/6 of 13.12.2017	The natural environment in the Pirin Mountains under conditions of climate change	SU "St. Kliment Ohridski"	Prof. Dr. Georgi Donchev Rachev	113570.00
DN14/7 of 13.12.2017	Chemical forms and behaviour of transition metals in polluted natural waters and soils and their influence on the ecosystem vegetation - small mammals - endoparasites. Experimental study and thermodynamic modelling	Institute of General and Inorganic Chemistry, BAS	Prof. Dr. Diana Todorova Rabadzhieva	120000.00

Contract	Topic:	Main organization	Head	Amount (in BGN)
DM14/1 of 11.12.2017	Modern trends in the regime and characteristics of the snow cover in Bulgaria	National Institute of Meteorology and Hydrology - Bulgarian Academy of Sciences (NIMH - BAS)	Assoc. prof. Dimitar Nikolov	20000.00
DM14/2 of 20.12.2017	Geological and ecological risks related to the study of deep and shallow aquifers from the region of Central Northern Bulgaria	MGU "St. Ivan Rilski"	Ch. Assistant Professor Nikolay Krasimirov Hristov,	20000.00
KP-06-N24/2 of 08.12.2018	Relationship of the spatial distribution of heavy metals in soil to the morphology of polluted floodplain terraces	National Institute of Geophysics, Geodesy and Geography, BAS	Prof. Dr. Georgi Zhelezov Georgiev	120000.00
KP-06-OPR03/3 of 14.12.2018	Profiles of spatial differentiation of river water quality in basins with heterogeneous anthropogenic impact	National Institute of Geophysics, Geodesy and Geography, BAS	Assoc. Dr. Marian Stoyanov Varbanov	120000.00
KP-06-N37/5 of 06.12.2019	Sustainable resource supply chains in terms of environmental, economic and social criteria	Institute of Engineering Chemistry, BAS	Prof. Dr. Elisaveta Georgieva Kirilova	120000.00
KP-06-N37/27 of 18.12.2019	Smart textile materials with ecological and biomedical applications	Chemical Technology and Metallurgy University - Sofia	Assoc. prof. eng. Desislava Staneva Grabcheva	120000.00
KP-06-M37/3 of 06.12.2019	Utilization of RDF fuel waste to obtain innovative nanoporous carbon materials for environmental protection	Institute of Organic Chemistry with Phytochemistry Center, BAS	Assoc. prof. eng. Ivanka Georgieva Stoycheva	30000.00

Contract	Topic:	Main organization	Head	Amount (in BGN)
KP-06-N34/9 of 19.12.2019	A study of carbon and some significant hydrocarbons in atmospheric aerosol in an urban environment	National Institute of Meteorology and Hydrology	Assoc. Dr. Elena Hristova	119790.00
KP-06-M34/1 of 09.12.2019	Extraction of heavy metals from wastewater	Institute of Mineralogy and Crystallography, BAS	Assoc. prof. Lilya Tsvetanova	30000.00
KP-06-PN44/1 of 26.11.2020	Complex radioecological study of natural water resources	Institute for Nuclear Research and Nuclear Energy - BAS	Prof. Dr. Dimitar Tonev	170000.00
KP-06-M47/2 of 26.11.2020	Discovery of geometric characteristics and classification of tree species in Bulgaria for the purpose of environmental protection, part of NATURA 2000	Technical University Sofia	Assoc. prof. eng. Nikol Veselinova Hristova	30000.00
DN01/17 of 22.12.2016	Expansion of the pine beetle THAUMETOPOEA PITYOCAMPA (DENIS & SCHIFFERMULLER, 1775) (LEPIDOPTERA, THAUMETOPOEIDAE) in Bulgaria - a dangerous allergen and economically significant pest in pine ecosystems	Forestry Institute, BAS	Member-Correspondent Dr of Sc Plamen Borisov Mirchev	BGN 110,000.00
DN11/4 of 14.12.2017	The soil microbiome as an indicator of biodiversity and evolution of microbial communities under persistent heavy metal contamination	Institute of Molecular Biology, BAS	Assoc. Prof. Galina Radeva	BGN 120,000.00
DN11/13 of 18.12.2017	Biodiversity of the families Eulophidae and Pteromalidae (Hymenoptera: Chalcidoidea) in mountain habitats. Barcoding and distinguishing morphologically related species.	Institute of Biodiversity and Ecosystem Studies - BAS	Assoc. Prof. Dragan Chobanov, PhD	BGN 70,108.68

Contract	Topic:	Main organization	Head	Amount (in BGN)
DN11/14 of 18.12.2017	Phylogeographic pathways and barriers between the Balkans, the Carpathians and Asia Minor: a combined evolutionary-ecological study on a model group of insects (Insecta: Orthoptera: Barbitistini)	Institute of Molecular Biology, BAS	Assoc. Georgi Angelov Miloshev, prof.	BGN 119,992.00
DM11/2 of 15.12.2017	Influence of the ecological condition of the Varna and Burgas bays on the population-biological parameters of the mullet fish species (Mugil cephalus, Liza aurata and Liza saliens)	Institute of Oceanology - BAS	Prof. Radoslava Ivanova Bekova	BGN 20,000.00
KP-06-N21/1 of 17.12.2018	Cybertaxonomic approach in phylogenetic studies on model genera of invertebrates (Invertebrata, Arachnida, Insecta) to clarify problems of the origin, formation and conservation of the invertebrate fauna of the Balkan Peninsula	NPM-BAN	Prof. Dr. Pavel Stoev 897802524	BGN 119,904.39
KP-06-N21/2 of 18.12.2018	The Thracian mounds – hotspots of biodiversity and islands for the protection of natural flora and vegetation	IBEI - BAS	Prof. Dr. Iva Apostolova	BGN 119,660.00
KP-06-N21/7 of 18.12.2018	Study of ecological pressure in the Bulgarian Black Sea water area by means of integrated microbiological, biochemical and genetic markers in the Black Sea mussel Mytilus galloprovincialis Lam.	"Episkop Konstantin Preslavski" University of Shumen	Prof. Dr. Tsveteslava Ignatova-Ivanova	BGN 120,000.00

Contract	Topic:	Main organization	Head	Amount (in BGN)
KP-06-N21/8 of 18.12.2018	Mechanisms of recovery from drought induced water and low temperature stress: survival strategies of the resurgent plant *Haberlea rhodopensis*	IFRG, BAS	Prof. Dr. Katya Georgieva	BGN 120,000.00
KP-06-N21/11 of 18.12.2018	A study of pheromone communication in the viper (*Vipera ammodytes*) and its role in the behaviour of the species.	IBEI - BAS and IOHCF-partners	Assoc. Dr. Borislav Naumov	BGN 120,000.00
KP-06-H21/16 of 12.12.2019	The diversity of alpine plants in Bulgaria under the influence of climate change: installation of GLORIA sites for long-term monitoring and assessment of the risk of biodiversity loss (GLORIA – Bulgaria)	IBEI, BAS	Assoc. Dr. Anna Ganeva	BGN 120,000.00
KP-06-M21/1 of 12.12.2019	Extremophilic algae flora in thermo-mineral springs in South-West Bulgaria: changes in composition, conservation and assessment of new, threatened and invasive species	SU "St. Kliment Ohridski"	Assoc. Prof. Petya Draganova	BGN 20,000.00
KP-06-M21/2 of 12.12.2018	Study of faunal diversity, assessment of status and ecosystem services in different types of model ecosystems in Sarnena Sredna Gora	IBEI - BAS	Assoc. Professor Teodora Teofilova	BGN 19,993.60
KP-06-N-31/3 of 10.12.2019	Interaction between forests and avalanches in Pirin, Bulgaria	IEMPAM, BAN	Assoc. Prof. Ekaterina Pavlova	BGN 101,400.00

Contract	Topic:	Main organization	Head	Amount (in BGN)
KP-06-N-31/6 of 11.12.2019	Complex ecotoxicological study of psammophilic mussel species from sublittoral habitats of the Bulgarian Black Sea water area	Institute of Neurobiology - BAS	Assoc. Dr. Albena Aleksandrova	BGN 120,000.00
KP-06-N-31/9 of 11.12.2019	Marine benthic diatoms as a tool for assessing anthropogenic pressure along the Black Sea coast	Institute of Oceanology - BAS	Dr. Ralitsa Petrova Zidarova	BGN 120,000.00
KP-06-N-31/12 of 11.12.2019	Forest Management Scenarios for the Conservation of Plant and Fungal Diversity under Climate Change (MFORDIV)	Institute of Biodiversity and Ecosystem Studies, Bulgarian Academy of Sciences	Prof. Dr. Tsvetan Mladenov Zlatanov	BGN 120,000.00
KP-06-M-31/3 of 24.9.2019	Study of the distribution and impact of the invasive alien species *Impatiens glandulifera* Royale on the natural habitats in the gorge of the river Iskar between Plana and Lozenska mountain	Paisii Hilendarski University of Plovdiv	Assoc. Prof. Plamen Stankov Glogov	BGN 30,000.00
KP-06-M-31/4 of 26.09.2019	Assessment of the Bulgarian Fauna of Fulgoromorpha (Insecta: Hemiptera) and preparation of a regional red list of rare, endemic and endangered species,	Sofia University "St. Kliment Ohridski"	Assoc. Prof. Iliya Gyonov	BGN 30,000.00
KP-06-N-41/7 of 30.11.2020	An ecosystem approach to assess the biodiversity and population status of key fish species from the Bulgarian Black Sea coast	Institute of Oceanology "Prof. Fridtjof Nansen" - Varna, PARTNERS - Institute of Neurobiology	Assoc. Prof. Albena Aleksandrova	164,416.00 with DMA, 119,800.00 without DMA

Contract	Topic:	Main organization	Head	Amount (in BGN)
KP-06-M-41/2 of 27.11.2020	Influence of changing climatic conditions and increasing anthropogenic pressure on ichthyofauna in brackish (transitional) waters along the Bulgarian Black Sea coast	Institute of Oceanology "Prof. Fridtjof Nansen" - Varna	Assoc. Prof. Radoslava Bekova	BGN 30,000.00
KP-06-M-41/3 of 27.11.2020	Structure and function of fungal communities: adaptability of key fungal species to heavy metal-contaminated soils	Institute of Molecular Biology "Acad. Rumen Tsanev"	Dr. Michaela Alexova	BGN 30,000.00
KP-06-N23/1 of 17.12.2018	Building Radon Health Risk Assessment Models in Public Access Buildings for Long-Term Social Benefits	NCRRP	Associate Professor Kremena Ivanova	BGN 120,000.00
KP-06-OPR 03/12 of 18.12.2018	A model for sustainable management of urban soils by building buffer green areas around transport arteries in order to improve the quality of life	Paisii Hilendarski University of Plovdiv	Prof. Dr. Katya Georgieva	BGN 120,000.00
DFNI I02/15 of 12.12.2014	Information system for integrated risk assessment of natural disasters	University of National and World Economy	Prof. Dr. Dimitar Velev	222750
DFNI B02/4 of 12.12.2014	Environmentally friendly methods and means for controlling viral and bacterial diseases on vegetable crops from Solanaceae family to produce quality produce	Institute of Vegetable Crops "Maritsa" - Plovdiv	Prof. Dr. Stoyka Masheva	210000

Contract	Topic:	Main organization	Head	Amount (in BGN)
DFNI B02/8 of 12.12.2014	Biogenic volatile organic compounds, global climate change and the ability of plants to adapt to a changing environment	Institute of Plant Physiology and Genetics - BAS	Prof. Dr. Violeta Velikova	135000
DFNI E02/7 of 12.12.2014	Statistical modelling of environmental and human risk of soil contamination with heavy metals	Sofia University "St. Kliment Ohridski"	Prof. Dr. Stefan Tsakovski	184000
DFNI E02/13 of 12.12.2014	New eco-technologies for biodegradation of organic waste with production of hydrogen and methane	"Stefan Angelov" Institute of Microbiology - BAS	Assoc. Prof. Ivan Simeonov	240000
DN 06/1 of 14.12.2016	Organic molecular markers and contaminants in hydrophobic soils	Institute of Soil Science, Agrotechnology and Plant Protection "N. Pushkarov", AA	Prof. Dr. of Sc. Irena Dimitrova Atanasova	120000
DN 16/4 of 11.12.2017	An integrated approach to modelling wildfire spread	Forestry Institute - BAS	Prof. Dr. of Sc. Hristo Ivanov Tsakov	120000
DM 16/5 of 20.12.2017	Integrated analysis of the capacity of forest ecosystems from Sredna Stara Planina to reduce the influence of toxic elements: condition, dispersion, degradation and impact	Forestry Institute - BAS	Assoc. Prof. Rositsa Yaneva	20000
KP-06-N 26/11 of 18.12.2018	Role of carotenoids in the efficiency and resistance of the photosynthetic apparatus of higher plants to environmental changes	Institute of Biophysics and Biomedical Engineering - BAS	Prof. Dr. Antoaneta Vidolova Popova	120000
KP-06-M 26/3 of 30.11.2018	Application of integrated biomarkers in an assessment model of aquatic ecosystems contaminated with priority organic substances	Paisii Hilendarski University of Plovdiv	Assoc. Prof. Vesela Yancheva	20000

Contract	Topic:	Main organization	Head	Amount (in BGN)
KP-06-OPR 03/7 of 17.12.2018	Assessment of the ecosystem service "water" provided by water conservation forest areas in Bulgaria	Forestry University	Assoc. Prof. Nevena Vasileva Shuleva	120000
KP-06-OPR 03/6 of 17.12.2018	Assessment and mapping of ecosystem services in high mountain areas in Rila and Pirin for sustainable management of natural resources	Forestry Institute - BAS	Prof. Dr. Maria Hristova Glushkova	120000
KP-06 N 36/11 of 13.12.2019	"Socio-economic efficiency of using WWTP sludge in agriculture"	Institute of Agrarian Economics	Assoc. Prof. Bozhidar Ivanov	118800
KP-06 N 36/13 of 17.12.2019	Structural-functional characteristics and prospects for the use of endemic relict conifer communities in Bulgaria in the conditions of a changing climate	Institute of Biodiversity and Ecosystem Studies (IBEI) - BAS;	Prof. Dr. Tsvetomir Denchev	120000
KP-06 M 36/4 of 17.12.2019	Increasing the upper limit of the forest in Tsarichina Reserve as an example of a positive response of forest ecosystems to climate change and land use change	Forestry Institute - BAS	Chief Assist. Dimitar Dimitrov	30000
KP-06 N 46/1 of 27.11.2020	Effectiveness of anti-erosion agrotechnologies to improve soil quality and hydrological regime and limit greenhouse gas emissions	Institute of Soil Science, Agrotechnology and Plant Protection "N. Pushkarov" - Sofia	Assoc. Prof. Viktor Kolchakov	118400
KP-06 M 46/1 of 27.11.2020	Biodiversity of forest ecosystems of the middle old mountain under conditions of change	Forestry Institute	Assoc. Prof. Rositsa Yaneva	30000

Contract	Topic:	Main organization	Head	Amount (in BGN)
KP-06 M 46/3 of 27.11.2020	Effect of drought on maize and sorghum photosynthesis	Institute of Biophysics and Biomedical Engineering	Assoc. Prof. Martin Stefanov	30000

9.3.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 9.2 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 9.2 RBCN stations in Bulgaria

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

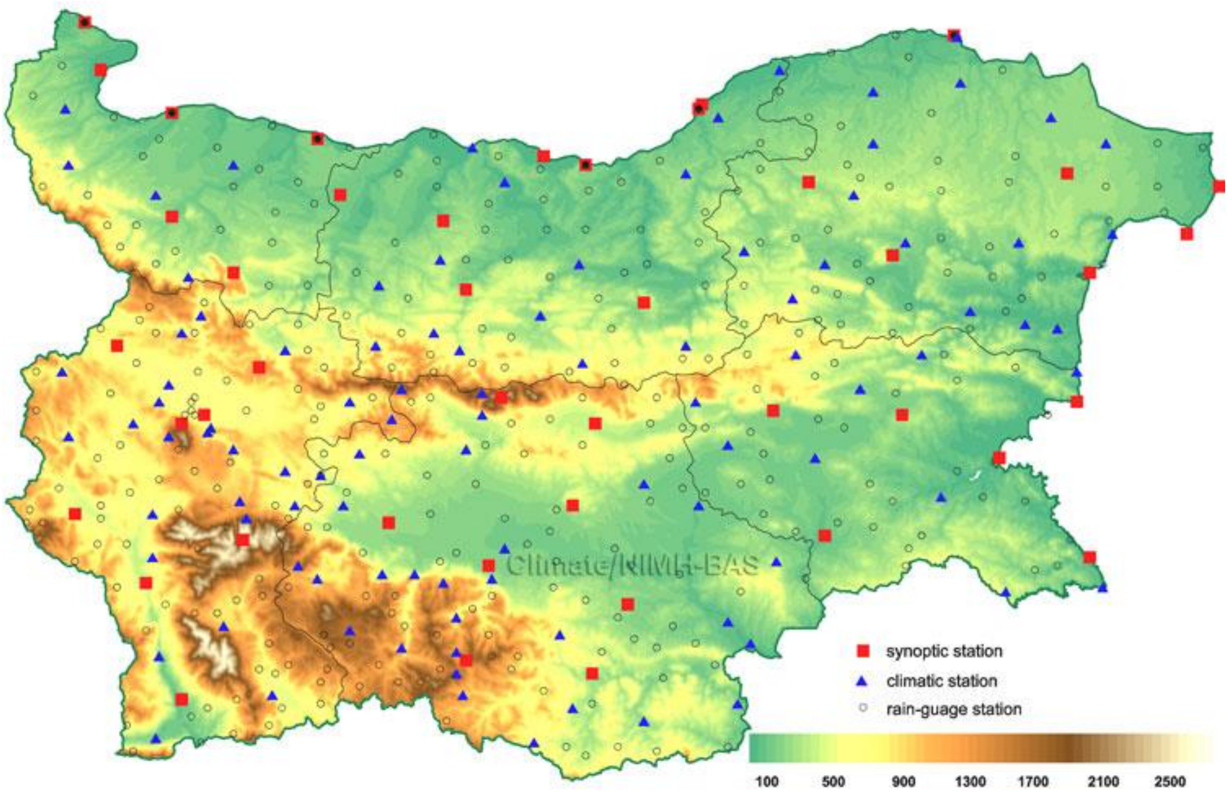
Table 9.3 Participation in the global atmospheric observing systems

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

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

In addition to the above information, the National Institute of Meteorology and Hydrology in Sofia, Bulgaria has about 40 synoptic and more than 90 climatic stations across the country, Figure 9.1.

Figure 9.1 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).

Additional informaction

Support to related capacity-building activities in developing countries:

The status of Republic of Bulgaria under the UNFCCC is as a country with economy in transition. As such Bulgaria provides financial assistance on a voluntary basis. In addition as the country is not developed one and is not included in Annex II of the Convention it could provide support to related capacity-building activities in developing countries if it has the possibility to do so.

Socio-economic analysis, including analysis of both the impacts of climate change and response options

The National Adaptation Strategy was built on the National Climate Change Risk and Vulnerability Assessment of the Bulgarian Economic Sectors (MoEW 2014) and draws extensively on the information, analyses, and recommendations of the nine sector assessment reports, the Disaster Risk Management Assessment report, and the report on the 'Macroeconomic Implications of Climate Change'.

The analysis Macroeconomic Implications of Climate Change evaluates the social and economic implications of climate change impacts and adaptation actions in Bulgaria and highlights the costs of inaction and the benefits of climate action within an economy-wide framework. The analysis estimates overall economic activity (that is, gross domestic product [GDP]), economic welfare, sectoral output, and employment levels, all with and without climate adaptation to provide elements in answer to the following questions: what are the most vulnerable sectors to climate change, how effective is adaptation to its most significant impacts, and what are the broader socioeconomic benefits from climate change adaptation?

In addition the Action Plan includes operational objectives and specific actions for each of the sectors.

The Strategy with all the appendixes could be found at the following link: https://www.moew.government.bg/en/climate/international-negotiations-and-adaptation/adaptation/

Research and development on mitigation and adaptation technologies

Regarding the research and development on mitigation and adaptation technologies could be find in the final report for implementation of the Third national action plan on climate change (2013-2020).

The Final Official Report on the Implementation of the Third National Action Plan on Climate Change (2013-2020) could be found at: https://www.moew.government.bg/en/national-action-plans-on-climate-change-and-reports/.

10. Education, training and public awareness

10.1. 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.

10.2. 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 10.1

Table 10.1 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 10.1 and some positive results are in place.

10.3. 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.

Affirmation of the topic of climate change and the reduction of greenhouse gas emissions in the educational process is priority. The topic of climate change (or the reduction of the greenhouse effect) is related to the formation of knowledge, skills and attitudes in key competence.

Skills to support sustainable development and a healthy lifestyle, laid down in Art. 77, para. 1 of the Preschool and School Education Act.

It is present in separate lesson units or their elements of general education subjects of every level of education such as geography and economics, man and nature, biology and health education, chemistry and environmental protection, physics and astronomy, philosophy.

In the second stage of the high school level of education, students deepen their knowledge, skills and attitudes related to the climate, its change and protection in the general educational preparation in the subject of civic education, as well as in the profiling preparation in the subjects: geography and economics (module "Natural Resource Potential. Sustainable Development"), Biology and Health Education, Chemistry and Environmental Protection, Physics and Astronomy, Philosophy.

Higher education:

THRACIAN UNIVERSITY STARA ZAGORA:

Developed programs and educational modules (or their separate units and elements) introduced in the bachelor's, master's, qualification and doctoral programs, affecting the sectoral aspects of greenhouse pollution and ways to reduce it from 2013 until now. The following study programs have been developed at Thracian University:

Educational Degree "Bachelor":

- Environmental construction and territorial planning
- Environmental aspects of agricultural and transport equipment
- Economy of the environment

Educational Degree "Master":

- Wind and solar energy;
- Technology for growing energy crops;
- Regenerative systems in agricultural production;
- Solar thermal systems;
- Physic and chemical methods of analysis
- Energy efficiency of agricultural buildings
- Technology for the processing of plant oils and biofuels
- Technical and technological systems for biogas production

- Ecological urban planning
- Energy biotechnologies
- Energy management
- Energy efficiency of buildings (with project)
- Energy efficiency of industrial systems (with project)
- Bioeconomy and eco-entrepreneurship

Diploma theses related to RES:

- Topic "Assessment of the possibilities for functional integration of recuperators and renewable energy sources in a common storage system".
- Topic "Effect of overcooling of fresh milk on the performance characteristics of a milk tank.
- Topic "Influence of frequency parameters on the time components of pulsation systems in milking machines for cows".
- Topic "Project for renovation and reconstruction of a sheep farm into a meat-cattle farm".
- Topic "Study of the possibilities of obtaining photovoltaic electricity from solar installations on the roof of a livestock building type K200".
- Topic: "Development and research of a wind engine for driving a reciprocating water pump".
- Topic: "Energy analysis of a combined hot water extraction system in a cow farm in the village of Momino selo".
- Topic: "Effect of milk receiver volume on some energy performance parameters of refrigerated tanks".
- Topic: "Air conditioning of a mushroom house for the production of cultivated mushroom".
- Topic: "Designing a solar hot water system for the filter of a pig farm in the village of Khan Asparuhovo".
- Topic: "Investigation of the energy efficiency of sow buildings with straw panel enclosing walls".
- Topic: "Energy analysis of biomass of different composition for biogas production".
- Topic: "Possibilities for reducing heat energy consumption in the production of wood pellets"
- Topic "Influence of biomass composition on the energy efficiency of a biogas plant with a trigenerative mode of operation".

"ANGEL KANCHEV" UNIVERSITY OF RUSE:

In accordance with the requirements of Measure 1, the "Angel Kanchev" University of Ruse has developed, approved and periodically updates curricula in a number of disciplines related to the protection of environmental components, both for bachelor's and master's courses, as well as for doctoral programs.

Areas of work are related to highly efficient conversion and use of energy (energy saving) and increasing energy efficiency (of buildings, systems and facilities); development of technologies for optimal utilization of alternative and/or renewable energy sources; management of waste flows and utilization of the biodegradable fraction in their composition; development of hybrid, electric and hydrogen-powered vehicles, traffic optimization, etc. problems caused by the growth of greenhouse gas emissions.

2 dissertations were defended with the following topics:

- "Investigating the effect of using exhaust gas impacting technologies to reduce harmful emissions from stationary diesel engines"
- "Analysis of the environmental characteristics of the means of transport in operation"

2 diploma theses were developed and successfully defended on the following topics:

- “Modeling and application of hydrogen fuel cells”;
- “Development of a graphical interface for modelling hybrid powered vehicles”.

UNIVERSITY OF MINING AND GEOLOGY "ST. IVAN RILSKI”:

An educational thematic module has been developed to the existing study programs for bachelors, masters and doctoral students with thematic units - Energy-saving, Low-carbon and Innovative technologies in the field of waste management.

TECHNICAL UNIVERSITY GABROVO:

Developed study plans and curricula of "Bachelor" and "Master" specialities from the qualification degree, related to the following topics:

- Educational Degree "Bachelor" - number of study plans - 6; number of study programs – 21. Disciplines such as: Ecological energy technologies; Technologies and equipment for air purification; Renewable energy sources, etc.
- Educational Degree "Master" - number of study plans - 1; number of study programs – 6. Disciplines: Energy efficiency; Energy resources.
- Developed specialized disciplines in doctoral programs: number of disciplines – 7: Renewable energy sources; Technical and economic evaluation of electrical engineering projects; Energy efficiency of lighting systems; Technical and economic evaluation of electrical engineering projects; Energy efficiency of electric drives; Energy efficiency of buildings; Model study of buildings
- Number of doctoral programs – 4: Power supply and electrical equipment, Lighting equipment and light sources, Electromechanics, Industrial heat engineering. Developed and defended theses related to the topic: 157

UNIVERSITY OF ARCHITECTURE, CONSTRUCTION AND GEODESY:

The subject matter of the individual lecture modules is in accordance with the objectives of the Third NAPCC, the priority axis and the interdisciplinary nature of the problem.

In 2017, the speciality "Engineering Ecology" was created in the bachelor's and master's degrees of study at the Faculty of Hydrotechnical Engineering with included topics and lecture modules on climate change, renewable energy sources, small-scale energy production, energy-efficient design, construction and spatial planning, economic aspects of climate change.

In 2017, the Master's Program "Energy Efficiency in Construction" was established.

Extracurricular activities:

- UACG participates as a partner in the European project "Innovative training schemes for retrofitting to nZEB-levels - Fit to nZEB", (agreement 754059), financed under the "Horizon-2020" program of the EC from June 2017 to June 2019, dedicated to training pupils, students, specialists and teachers in the ways of energy efficient renovation of buildings up to the nZEB level;
- Trainings were held with a lecturer from the UACG for professionals from the "Construction" sector and representatives of municipal administrations;
- An Energy Efficiency Laboratory was established on the 1st floor of the UACG, in cooperation with EnEffect, in 2017 under the Train-to-nZEB European project (contract 649810), financed under the Horizon-2020 program of the EC. It hosts numerous courses on energy efficiency projects;
- Participation of professors - experts from UACG in the National Expert Council for coordinating the implementation of a national plan for buildings with close to zero energy consumption;
- Annual participation of AF students in the international student competition Multi Comfort 2020/2021, which is aimed at the sustainable development of the urban environment and increasing the energy efficiency of residential buildings.

UNIVERSITY OF FOOD TECHNOLOGIES - PLOVDIV:

In the Faculty of Engineering, curricula have been developed according to study plans for majors in educational degrees "Bachelor" and "Master", in which climate changes and reducing emissions of carbon dioxide released into the environment are affected. The Department of Electrical Engineering and Electronics offers a Master's course in "Electrical Efficiency", which includes curricula for the disciplines "TPP and co-generation systems", "Energy efficiency of electrical, electronic and thermal equipment", "Electricity from renewable energy sources", "Energy efficiency of power electronic devices", "Alternative energy sources and technologies".

In the "Industrial Heat Engineering" department, diploma projects are developed on topics related to the survey of buildings and industrial enterprises with the aim of determining the saved carbon dioxide emissions with a view to environmental protection, as well as the use of RES in the design of heating and cooling of a given building or enterprise.

TECHNICAL UNIVERSITY VARNA:

Creation and updating of curricula and programs in specialities related to energy efficiency and climate change, by including specialized disciplines:

- Educational Degree "Bachelor": "Engineering ecology", "Renewable energy sources", "Heat engineering and investment design", "Electricity supply and electrical equipment", "Electroenergetics", "Ship machines and mechanisms", "Electric equipment of the ship" and others.
- Educational Degree "Master": "Engineering ecology", "Renewable energy sources", "Heat engineering and investment design", "Production of electric energy from renewable energy sources", "Energy management" "Electricity supply and electric equipment of industry", "Electricity supply and electric equipment of water transport", "Electric energy systems", "Ship engines and mechanisms", etc.

TECHNICAL UNIVERSITY SOFIA:

New and updated curricula of majors:

- Educational Degree "Bachelor": "Renewable energy technologies and fluid engineering", "Energy conversion technologies and energy efficiency in buildings and industrial sites", "Automotive electronics"
- Educational Degree "Master": "Systems for energy efficient management", "Electricity from renewable energy sources", "Technologies for utilization of renewable energy sources", "Engineering ecology", "Electricity from renewable energy sources".

The Bachelor's degree "Heat Power Engineering and Nuclear Energy" and the Master's degree "Nuclear Energy" are included in the list of priority and protected specialities in the context of emission-free production of electricity and thermal energy from NPPs, according to the Paris Agreement and the convention signed in 2016.

AGRICULTURAL ACADEMY:

The Agricultural Academy (AA) develops doctoral dissertations, most of which are on topics related to the global problem of mitigating the impact of climate change on the quality and productivity of ecosystems, which includes research on their adaptive potential, genetic-selection research, increasing shares of green and biotechnology in agriculture, etc. At the same time, emphasis is also placed on the reverse process - the impact of agriculture on the climate and control of greenhouse gas emissions by creating various new technologies and improving elements of the production process.

The following topics have been developed:

- Study of innovative methods for utilization of emissions from greenhouse and other harmful gases from animal husbandry;
- Investigation of the effectiveness of nitrogen fertilizers with controlled release of the active substance in soil differences representative of the country;
- Variation of reused reserves of biomass and nitrogen in wheat types and genotypes;
- Information base for modelling components of soil water balance and assessment of agro-ecological risks;
- Research and analysis of cold resistance in some crosses of durum wheat (Triticum durum Desf.);
- Thermal properties and thermal regime of some soils in Bulgaria;
- Assessment of the risk of drought in agriculture and remedial regimes to mitigate its consequences;
- Water-production dependencies at different levels of water supply through drip irrigation of raspberries;
- Research on the parameters of watering during rain;
- Agrochemical and microbiological aspects of family composting;
- Evaluation of the ameliorative impacts on the water and heat regime of soybean and wheat crops;
- Application of nitrogen-fixing and other soil microorganisms when growing chickpeas;
- Assessment of tolerance to salinity in species of the Cucurbitaceae family;
- Studying the influence of different tillage systems, when growing cereals on sloping terrains, on the export of soil, organic matter and greenhouse gases;

• Contamination of soils and plants in Bulgaria with man-made gamma emitters after the Chernobyl NPP accident and their migration into the soil-plant system;

• Study of living mulch and the effect of pre-planting preparation in plum orchards on sloping terrain.

Educational project of Bulgarian Academy of Sciences:

- Educational project "Climate box - scientists, teachers and students together for climate, atmosphere and waters"
- My Green City Academy
- Educational project "Innovative laboratory for studying natural disasters and environmental catastrophes from space"
- Improving transnational legislation in the field of marine litter" - MELTEMI
- Raising public awareness and reducing marine litter to protect the Black Sea ecosystem" – LitOUTer
- Guidance by scientists of IICAV-BAS in the development of the following doctoral theses in the field of climate, its changes and the relevant influencing factors (incl. greenhouse gases and pollution/purification of the atmosphere), for obtaining the scientific degree "Doctor":
- "Global and regional climate variability - driving factors" (doctoral student from NIGGG-BAS)
- ”Acidity of precipitation in Bulgaria - spatial distribution, assessment of its impact on the natural environment, economy and human health and relationship with meteorological conditions and air pollution" (PhD student from NIMH)
- "Atmospheric boundary layer in an urban environment according to data from aerial tests and systems for remote sensing of the atmosphere"; (PhD student from NIMH)
- "Meso-meteorological modelling of the atmospheric boundary layer (ABL) and comparison with experimental data over different bedding surfaces" (PhD student from NIMH)
- "Functional dependence of plant productivity on specific climatic factors" (PhD student from NIGGG-BAS)
- Guide by scientists of NIGGG-BAS of doctoral dissertations in the field of climate, its changes and relevant influencing factors (incl. greenhouse gases and pollution/purification of the atmosphere), for obtaining the scientific degree "Doctor":
- “Global and regional climate variability - driving factors" (NIGGG-BAS)
- Guidance by scientists of ICIT-BAS in the development of the following doctoral theses in the field of climate, its changes and the relevant influencing factors (incl. greenhouse gases and pollution/purification of the atmosphere), for obtaining the scientific degree "Doctor":
- In 2020, 1 scientist from IICAV carried out 3 lecture hours for postgraduate training in the field of specific meteorological conditions and air pollution in port areas, as part of the European project ECOPORTIL.
- In 2020, 1 scientist from NIGGG-BAS conducted 6 lecture hours for training related to the impact of climate change on ecosystems and the provision of ecosystem services, as part of a BA lecture course in Landscape Science and Environmental Protection at the University of Veliko Tarnovo

Guidance by scientists of IO-BAS in the development of the following doctoral theses in the field of climate, its changes and the relevant influencing factors, for obtaining the scientific degree "Doctor": "The role of scientific foundations and application of the ecosystem approach for sustainable management of fisheries in the Black Sea" (PhD student from IO-BAS).

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

Increasing the knowledge and qualification of the teaching staff on issues related to climate change is esencial for Bulgarian Academy of Sciences:

- Educational project "Climate box - scientists, teachers and students together for climate, atmosphere and waters";
- The scientific supervisors of doctoral students from IICAV-BAS have taken part in various scientific forums (conferences, seminars, workshops, scientific networks, expert bodies, scientific unions, associations, societies, etc.) related to the issues of climate change;
- The scientific supervisors of doctoral students from NIGGG-BAN have taken part in various scientific forums (conferences, seminars, workshops, scientific networks, expert bodies, scientific unions, associations, societies, etc.) related to climate change issues;
- The scientific supervisors of doctoral students from ICIT-BAN have taken part in various scientific forums (conferences, seminars, workshops, scientific networks, expert bodies, scientific unions, associations, societies, etc.) related to climate change issues.

Universities:

During the reporting period of the 8th National Communication the project "Energy efficiency and better quality of milk in Bulgarian dairy farms" was developed **at the Thracian University Stara Zagora**.

The same was implemented through the financial support of Norway grants, Innovation Norway (the Government of Norway through the Norwegian Financial Mechanism 2009-2014) within the framework of Program Area BG 10 - "Innovations in the green industry".

On the Bulgarian side, the leading responsible institution is the "Bioselena" Foundation for Organic Agriculture, and its partners are the non-governmental organization Norges vel - Norway and Thracian University - Stara Zagora, Faculty of Agriculture. A contract KNRIN-2013/104377 was concluded between the institutions with a term of execution - 01.01.2014 - 01.01.2016. The utilized financial resources are slightly over 220,000 Euro.

In fulfilment of the objectives of the project, 2 systems for extracting heat from renewable energy sources were designed and developed:

- Integrated 2-module hybrid installation including:

Solar thermal boilers (solar collectors);

Boiler for burning wood pellets.

- Integrated 3-module hybrid installation including:

Module for extracting the heat from the milk;

Solar thermal boilers (solar collectors)

Boiler for burning wood pellets.

The systems have been implemented in three pilot farms:

Cow farm "Georgi Matanski", Momino village - 85 cows;

Cow farm "Ivan Danchev" village Dobrodan - 110 cows;

Buffalo farm "Yotkovi", town Tsar Kaloyan - 74 buffaloes.

Technological effect of the project:

Production of heat from RES with parameters covering full washing of milking equipment and milk cooling equipment. Promotion of RES among farmers, milk processors, students and specialists working in the field of agricultural production, animal husbandry and processing industry.

Social effect of the project:

Provision of sufficient domestic hot water for the staff and suitable ergonomic conditions, both during work and during breaks in the work shift; Provision of heating of the domestic premises to the farm; Acquisition of general technical knowledge and skills related to the exploitation of RES.

Training seminars and conferences related to the project:

First national training seminar on the project "Energy efficiency and better quality of milk in Bulgarian dairy farms" under the patronage of the Deputy Minister of Agriculture and Food Tsvetan Dimitrov - 142 participants, of which 82 were students (with received certificates).

Second national training seminar "Application of RES in animal husbandry", with the participation of partners from Norway - 112 participants, of which 93 students (with received certificates).

Agra, 2016 - Conference on "Innovations in Agriculture" - 207 participants, of which 46 students (with received certificates).

Bata Agro, 2016 - Presentation of project results with the participation of 5 students of "Agrarian Engineering" - 84 participants, of which 39 students (with received certificates).

The **University of Ruse** "Angel Kanchev" is included in the National Scientific Program "Low Carbon Energy for Transport and Life" (EPLUS).

The current program emphasizes a key moment in the updated European strategy – accelerated development and commercialization of technologies for storage and regeneration of energy from RES and capture and utilization of CO2. It is in synergy with the work programs of the Joint Undertakings in Horizon 2020 such as "Fuel Cells and Hydrogen", as well as with the leading thematic direction "Secure, clean and efficient energy".

In 2020, the university participated in the organization and hosted several seminars and conferences related to the topic of climate change and reducing greenhouse gas emissions, such as: Scientific conference "Electric vehicles", organized on the initiative of the University of Ruse "Angel Kanchev" with the support of the industrial cluster of the same name and aimed at exchanging experience and good practices of scientists and specialists from practice in areas such as: electric cars, designs and features; rechargeable batteries; charging stations; use of renewable energy sources; ecology and efficiency of the use of electric vehicles.

Gabrovo Technical University participates in the following specializations and experience exchange meetings:

- number of realized mobilities under the ERASMUS+ program - 3
- number of business and work meetings – 3

Participation in competitions for academic positions:

- number of contests -2

Development of research and educational projects:

- number of international projects - 4
- number of national projects – 7
- number of projects financed specifically from the state budget - 20
- number of projects with external companies – 4.

The lecturers from the "Industrial Heat Engineering" department at the **University of Food Technology Plovdiv** regularly participated in the period 2014-2020 at conferences on climate change and energy efficiency: TE-RE-RD Romania and "Ecology, self-esteem, environment", TU-Sofia, Sozopol). In 2020, lecturers from the Department of "Engineering Ecology" and the Department of "Industrial Business and Entrepreneurship" took part in the international scientific conference ENVIRORISKs 2020, Sofia.

At **the Technical University Varna**, specializations abroad under the Erasmus+ program and exchange of knowledge and experience with other universities in the field of environmental impact and energy efficiency, as well as courses in energy efficiency for the certification of auditors, have been carried out.

Sofia Technical University participates in BG05M2OP001-2.009-0033-C01 - Stimulation of modern scientific research by creating a scientific and innovative environment for the promotion of young researchers of a new generation at Technical University Sofia and National Railway Infrastructure Company in the field of engineering technical sciences and technological development.

The University of Chemical Technology and Metallurgy participates in numerous projects - national, under European programs and jointly with private companies, related to the management of atmospheric air quality, the reduction of harmful emissions, the reduction of the spread of pollutants emitted by industrial enterprises, etc.

For the period 2013 - 2019, members of the academic staff of the "Engineering Ecology" department at the university took part in a large number of national and international scientific forums. They have also participated in a number of university scientific conferences, in the preparation of textbooks and teaching aids and have numerous scientific publications related to climate change.

Agricultural Academy:

The academic supervisors and advisers of the PhD students from the AA have increased their qualifications through specializations under the Erasmus+ program - 40 scientists in the period 2013-2020.

The scientific supervisors and consultants of the doctoral students from the AA organized and participated in various scientific events related to the exchange of knowledge about climate change (conferences, seminars, round tables, scientific networks, expert commissions, scientific unions, associations, etc.) - 120 scientists

10.5. 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.

10.6. Pablic participation

The Ministry of Environment and Water and the Climate Change Policy Directorate seek to maintain a policy of transparency and public awareness on combating climate change, how to adapt to and mitigate the effects of climate change

During the reporting period, the information on climate change policy was periodically updated on the MoEW website, as detailed in the "Climate" section. Up-to-date information on the development of the Ministry's new website has also been prepared. Climate change policy is presented at a number of forums, meetings with non-governmental organizations and businesses, conferences, seminars and trainings through participation and presentation of presentations to familiarize stakeholders with relevant and up-to-date aspects of policy development in this area.

A number of opinions have been prepared and information has been submitted in connection with a request for access to public information, as well as responses to complaints or inquiries made by citizens.

The Eighth National Communication was prepared by Ministry of Environment and Water in cooperation with the other relevant institutions, National Institute of Meteorology and Hydrology and Bulgarian Academy of Science and on the basis of current information, documents and legislation. All of information which is presented is public and accessible on the websites of the Ministry of Environment and Water in the section “Public Consultation”.

The “Public Consultation” section aims to promote cooperation between citizens, business and non-governmental organizations and experts in state institutions in policy formulation and law-making. The portal is the main place for access to a variety of information about the planned changes in the policies of the Ministry of Environment and Water.

ANNEX I –Biennial report

FIFTH BIENNIAL REPORT

OF THE REPUBLIC OF BULGARIA

Accompanying the document: Eighth National Communication the Republic of Bulgaria under the United Nations Framework Convention on Climate Change

CONTENTS

1. Introduction

The fifth Biennial Report of Bulgaria (BR5) 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 Eighth National Communication under the UNFCCC (NC8).

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 reported in the Bulgaria’s Eighth 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);
- Progress in achievement of quantified economy-wide emission reduction targets and relevant information (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 2022, chapter 1, submitted to the UNFCCC on 15 April 2022. The greenhouse gas data presented in this chapter are consistent with the 2022 GHG inventory submission of Bulgaria to the United Nations Framework Convention on Climate Change (UNFCCC) Secretariat submitted on 15 April 2022 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 2020 Bulgaria's greenhouse gas emissions totalled 49 186 Gg CO2 without reporting of sequestration from LULUCF sector. The emissions decreased by 56.53 % compared with the base year. Emissions in 2020 were 17.30 % increase in comparison with the emissions of the previous year.

The net emissions including reporting of sequestration from LULUCF sector were 39 580 Gg CO_2 eq. The emissions decreased by 58.50 % 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 1988-2020, which resulted in the reduction of population by 23.04%.

The most important greenhouse gas in Bulgaria is carbon dioxide. The share of CO_2 emissions from the total greenhouse gas emissions varies around 75.16% excluding LULUCF and 68.42% including LULUCF. In absolute terms CO_2 emissions have decreased 58.75% since 1988. Around 71.3% 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 57.72% 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 52.26% 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 1995-2020. A key driver behind the trend has been the substitution of ozone depleting substances (ODS) by F-gases in many applications. The scale of the Chart is logarithmic, so that the trend can be clear.

More detailed information about the trends of the greenhouse gas emissions are described in the chapter 3.1 of the Bulgaria’s Eighth 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 2022.

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 Eighth National Communication.

There were no significant changes of the inventory system since the Forth Biennial Report of Bulgaria (BR4), 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 committed to achieving a joint quantified economy-wide greenhouse gas emission reduction target of 20 per cent below the 1990 level by 2020 ("the Cancun pledge"). It is therefore a joint pledge with no separate targets for Member States under the Convention. The UK remains part of the joint EU 2020 target together with the 27 EU Member States.

The EU has jointly committed to its UNFCCC target and implemented it internally through EU legislation in the 2020 EU Climate and Energy Package. In this package, the EU introduced a clear approach to achieving the 20% reduction in total GHG emissions from 1990 levels, by dividing the effort between the sectors covered by the EU Emissions Trading System (EU ETS) and the sectors under the Effort Sharing Decision (ESD). Binding national targets were set for Member States under the Effort Sharing Decision. The achievement of EU internal compliance under the 2020 Climate and Energy Package including the national targets under the ESD is not subject to the UNFCCC assessment of the EU's joint commitment under the Convention.

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 2020 calculated applying global warming potential values from the fourth IPCC assessment report is 26 543 226 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 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-BR5.

4. Progress in achievement of quantified economy-wide emission reduction targets and relevant information

The EU has substantially overachieved its reduction target under the Convention, which means that also its Member States and the United Kingdom have fulfilled their emission reduction obligations. As stated in the 2022 EU GHG inventory submission to the UNFCCC, the total GHG emissions, excluding LULUCF and including international aviation, decreased by 34% in the EU-27 + UK compared to the base year 1990 or 1.94 billion tons of CO2e (carbon dioxide equivalent).

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.

Total GHG emissions excluding emissions and removals from LULUCF decreased by 50 % between 1990 amd 2020, whereas total GHG emissions including net emissions and removals from LULUCF decrease by 51 % over the same period. The emission trends 1990 – 2020 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 Eighth 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 BR5 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 Eighth 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. 19/05.03.2021). 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 Final 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 8,062,874 tCO_2 eq.

More information on sectoral policy and measures is descripted in the Bulgaria's Eighth 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), Natioal Energy Strategy until 2020 and other relevant documents.

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

- with measures - WEM
- with additional measures - WAM

Total GHG emissions (without LULUCF) in the scenario "with measures" are expected to decrease with 48% in 2025 and 2030 compared to 1990. The scenario "with additional measures" shows a decrease with 49% in 2025 , and 50% in 2030 complared to 1990.

Table 5.1. Aggregate GHG emissions of Bulgaria (excl. LULUCF)– Gg CO_2 eq. - scenario with measures and scenario with additional measures

	1990	2020*	2025	2030	Δ (2025 - 1990), %	Δ (2030 - 1990), %
WEM scenario Aggregate emissions in Gg CO_2 eq.	**98 357**	**49 186**	**50 902**	**50 779**	**-48**	**-48**
WAM scenario Aggregate emissions in Gg CO_2 eq.	**98 357**	**49 186**	**50 323**	**49 508**	**-49**	**-50**

**inventory data*

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 Eighth 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 Republic of North Macedonia.

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 – Republic of North 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 Republic of North Macedonia 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 Republic of North Macedonia regarding to Bulgarian contribution to the short-term financing 2011-2012: sharing Bulgarian experience of monitoring, reporting and verification of greenhouse gas in the Republic of North 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 Republic of North 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 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.

In 2020, Bulgaria's Ministry of Foreign Affairs gives a grant contribution of 50 000 euros, to the Green Climate Fund. Same year an contribution of 84 170 euro is made to the Trust Fund of the Republic of Bulgaria to UNESCO.

7. Other reporting matters

No other reporting matters supplied in this submission

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REPUBLIC OF BULGARIA
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